

ANNUAL ENVIRONMENTAL REPORT 2011

For Kilbarry Landfill and Civic Amenity Site

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Kilbarry Landfill Site

Annual Environmental Report

1.0 Introduction

Kilbarry Landfill site is located (National Grid Reference 2598E 1103N) on the outskirts of Waterford City on the Dunhill Road, approximately 300m of the N25.

The site occupies an area of 20.1 hectares. Land use in the vicinity of the site is a mixture of open flat farmland with wetland to the south-east. The area to the north and west of the site is a mixture of residential and commercial properties.

The landfilling of waste at the site has resulted in the formation of a mound of waste above ground level. The waste body has a maximum height of 20mOD in the centre of the site. The remainder of the site has a maximum height of 17.5mOD on top of the waste body and a base level of 2m to 3mOD on the edge of the site.

The site was in operation for approximately 40 years. The landfilling of waste has occurred on a former area of wetland known as Kilbarry Bog. A series of drains or channels are found on the entire western, southern and eastern perimeter of the landfill.

The waste license for the site was issued on the 19th of October 2001. Condition 2.4 of the Waste License (18-1) requires the preparation of an Annual Environmental Report within thirteen months from the date of grant of the license, and within one month of the end of each year thereafter.

This report has been prepared in accordance with Schedule C of Waste License 18-1 and the EPA “Draft Guidance on Environmental Management Systems and reporting to the Agency”. This report covers the reporting period 1st January 2011 to 31st December 2011.

1.1 Management and Staffing Structure of the Facility

The site is operated by Waterford City Council (Environmental Services and Planning, Waterford City Council, Menapia Building, The Mall, Waterford).

The site is under the overall control of Ms. Colette Byrne, Director of Services, Environmental Services and Planning. Mr. Richard Walsh, Senior Executive Officer, is responsible for the overall operation of the site. Mr. Vincent O’Shea, Civil Technician, is responsible for reporting to the E.P.A. and compliancy with the licence. Pauric McGarrigle, Executive Engineer, is responsible for the day to day supervision and management of the Civic Amenity Site and is assisted by the Facility Supervisor, Mr. James Flavin. Details of the additional site staff are provided in Table 1.

Table 1: Operational Staff (Currently on Site)

Employee	Duties and Responsibilities
Mr. James Flavin	Collection of charges. Maintenance of on site records. Implementation of waste acceptance procedures. Site inspections. Monthly monitoring of gas boreholes. Any other duties as required by site manager.
Mr. Ferdy Ozturk	Daily litter patrols. Maintenance of metals recovery compound. Any other duties as required by the site manager/supervisor.

The Facility Supervisor maintains regular contact with the Executive Engineer. Table 2 shows the current management structure of Kilbarry Landfill.

Table 2: Management Structure for Kilbarry Landfill

Position	Employee Contact Details
Director of Services Ms. Colette Byrne	Waterford City Council, Environmental Services and Planning, Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849763
Senior Executive Officer Mr. Richard Walsh	Waterford City Council, Environmental Services and Planning, Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849763
Executive Engineer (C.A.S.) Mr. Pauric McGarrigle	Waterford City Council, Environmental Services and Planning, Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849763
Civil Technician (Landfill/E.P.A.) Mr. Vincent O'Shea	Waterford City Council, Environmental Services and Planning, Menapia Building, The Mall, Waterford. Tel: 051 849534 Fax: 051 849763

Any changes to this structure will be submitted to the EPA by the Civil Technician. It shall be the responsibility of the Civic Amenity Site Manager to organise staff in the absence of the named persons from the facility.

2.0 SITE DESCRIPTION

2.1 Waste Management Activities at the Facility

The waste categories and quantities that may be accepted for disposal and recovery, as outlined in Table A.1 of the Waste License, are shown below in Table 3.

Table 3: Waste Categories & Quantities for Disposal and Recovery

Waste Type	Maximum Tonnes Per Annum
Household	17,000
Commercial	12,500
Industrial Non Hazardous	28,500
Treated Sewage Sludges	2,500
Treated Industrial Non Hazardous Sludges	7,500
Construction & Demolition Waste	2,000
Wastes for Recycling & Recovery at the Civic Waste Facility	3,000
Waste for Recycling & Recovery at the Metal Recovery Area	2,000
Total	75,000

As of the 19th January 2003 commercial waste hauliers were stopped from disposing of waste at Kilbarry Landfill. As of 26th August 2005 Kilbarry Landfill ceased accepting domestic waste for landfill disposal and all landfilling activities ceased. From August 2005 to July 2009 all domestic waste collected by Waterford City Council was being deposited at Veolia's waste facility in Six Cross Roads Business Park before being brought to Powerstown Landfill in Carlow. Since July 2009 all domestic waste collected by Waterford City Council is deposited at Veolia's waste facility in Six Cross Roads Business Park before being hauled to Homestown Landfill in Wexford.

The landfill is currently closed to the public and remediation has taken place between 2005 and 2009 which included the installation of the final cap over the area of the waste body and installation of a gas abstraction system consisting of 82no. wells and a 500m³ permanent, enclosed gas flarestack. A surface water management system was installed in 2010. It is proposed that the site become a public amenity in the form of a park and an entrance and carpark were constructed in the North East area of the site during 2010. Landscaping for the park began in 2011.

A Civic Amenity Site is located adjacent to the old landfill entrance. The following range of goods are accepted for recycling or disposal:

- W.E.E.E.
- Scrap Metal
- Timber
- Cardboard
- Car and Household Batteries
- Engine Oil
- Cooking Oil
- Glass Bottles
- Aluminium Cans
- Clothes and Textiles

- Fluorescent Tubes
- Energy Saving Light Bulbs
- Aerosols
- Paint Tins

The opening hours at the C.A.S. are 11am to 4pm Monday to Friday and 10am to 2pm on Saturdays.

2.2 Waste Quantities and Composition

The categories and quantities for the C.A.S. in 2011 are presented in Table 4 below:

Table 4: Breakdown of Waste Categories & Quantities for Civic Amenity Site

EWC Code	Description	Total Quantity 1/1/11 to 31/12/11 (tonnes)
13 02 --	Waste Engine, Gear & Lubricating Oils	2.46
14 06 --	Aerosols	1.64
16 06 01	Lead Batteries	0.66
16 06 04	Alkaline Batteries	0.97
20 01 01	Cardboard	23.62
20 01 02	Glass	1,089.65
20 01 11	Textiles	(Estimated)150.00
20 01 21	Flourescent Tubes	0.48
20 01 25	Edible Oil & Fat	0.45
20 01 27	Paint Tins	6.99
20 01 36	W.E.E.E.	288.98
20 01 38	Wood	(Estimated)6.00
20 01 40	Metals	41.39
20 02 01	Biodegradable Waste	825.86
20 03 01	Mixed Municipal Waste	309.98

The specific categories of W.E.E.E. materials collected at the Civic Amenity Site are now reported by WEEE Ireland and ERP.

2.3 Methods of Waste Deposition

Currently all waste for landfilling weighed at Kilbarry is transported to Greenstar's local depot for haulage to Homestown Landfill in Wexford.

2.4 Site Capacity

The site was in operation in the region of 40 years. The total volume of waste deposited to date is estimated to be 1,094,513m³.

The last area of landfilling was located in a lined cell constructed in 2002/2003 located at the northern end of the landfill. The site closed on 26th August 2005.

3.0 SITE DEVELOPMENT WORKS

3.1 Development Schedule

The following section describes works undertaken during 2011. A description of the existing situation for each component is provided below together with the details of the proposed works and a timescale for completion of the future work.

3.2 Report on Development Works Undertaken During Year

The following works have been completed at Kilbarry Landfill during the period January 2011 to December 2011:

3.2.1 Landscaping

A landscape architect, Mitchell and Associates, was awarded the design contract in early 2010 and the design and contract documents were drawn up and agreed with WCC. The design of the landscaping at Kilbarry incorporates signage, information boards and pathways as well as specification of planting etc. The tendering process began in September 2010 with a prequalification stage. In November 2010 a letter of intent to award the contract to Grangemore Landscapes was sent out and this contract was signed in early 2011 and works began in March 2011. The schedule of works throughout the year:

- **March:**
Gorse removal from slopes, spraying of areas with herbicide

- **April:**
Construction of four surface water drainage ponds. All ponds had their bases consolidated followed by a layer of topsoil. Slopes of ponds were graded and planting of base topsoil layer with wetland planting followed.

- **May:**
Construction of peripheral paths and capping level path. Excavation to formation level, laying of geotextile and placement of 200mm of compacted 804.
Construction of Gabion supported peripheral path in south east of park.
Placement of Topsoil to peripheral path verges.

- **June:**
Construction of peripheral paths and capping level path. Excavation to formation level, laying of geotextile and placement of 200mm of compacted 804.
Ripping and stone removal capping layer.

- **July:**
Construction of peripheral paths and capping level path. Excavation to formation level, laying of geotextile and placement of 200mm of compacted 804.
Ripping and stone removal capping layer. Construction of Stone Bands and Dry stone walls.

- **August:**
Construction of dry stone walls in various locations, shaping and construction of stone bands. Landscaping of amenity grass lands and stone removal.

- September:
Construction of dry stone walls in various locations, shaping and construction of stone bands. Landscaping of amenity grass lands and stone removal.
- October:
Construction of stepped access to capping layer in North and South of park. Landscaping of amenity grass lands and stone removal. Landscaping to main entrance area and Gabion construction at entrance.
- November:
Construction of arrivals plaza and access ramp. Planting of woodlands, shrub and individual large trees. Installation of park seating and fitness stations.
- December:
Construction of arrivals plaza and access ramp. Planting of woodlands, shrub and individual large trees. Laying of peripheral and capping level tar path. Gabion construction at main entrance.

Works still to be completed in 2012:

- Completion of planting works
- Landscaping to required standard in all peripheral areas and the main plateau
- Completion of works to entrance and carpark area
- Removal of all debris and rubbish from entire park
- Signage contract to be carried out within and outside of park
- Snag items to be completed
- Installation of cctv at main entrance

Drawing 4 shows a plan of the landscaped park at Kilbarry.

3.3 Restoration & Aftercare Schedule

The following is the phasing of the remediation works to date:

Table 5: Phasing of the remediation works

Component	Commencement	Completion
Completion of liner and final capping	October 2005	June 2008
Completion of gas abstraction system	November 2006	April 2008
Installation 3 new leachate wells	January 2008	April 2008
Installation of Permanent Flare	October 2009	October 2009
Entrance, carpark and bridge Works	June 2010	November 2010
Surface Water Management	September 2010	January 2011
Landscaping	March 2011	April 2012

3.4 Environmental Liability and Risk Assessment

An Environmental Liability Risk Assessment (ELRA) was performed by Golders Associates early in 2009 on behalf of Waterford City Council for the Kilbarry site. This is included in the Appendices.

4.0 EMISSIONS

4.1 Management of Emissions

Waterford City Council is committed to ensuring that any emissions at Kilbarry Landfill will not result in the contravention of any relevant standard, including any standard for an environmental medium or any relevant emission limit value, prescribed under any other enactment.

The council is committed that activities at Kilbarry Landfill and C.A.S. are carried on in accordance with such conditions as may be attached to the license and will not cause environmental pollution.

The council will also use the best available technology not entailing excessive costs to prevent or eliminate or, where that is not practicable, to limit, abate or reduce an emission from the activity concerned.

The potential emissions from the site include leachate, groundwater, surface water, air and noise.

Drawing 5 shows the positions of all monitoring points at the facility.

4.2 Leachate

A total of six boreholes were originally installed at the landfill, LM1 – LM6. However over time landfilling operations damaged a number of the boreholes. The damaged boreholes were replaced and an extra two were also installed. However a further two, LM2 and LM3 were damaged at some point prior to the commencement of final capping. During the capping works LM7 and LM8 were buried due to their low levels. For all of the year there was only one operational leachate monitoring borehole, LM1. LM4, LM5 and LM6 are now accessible again by jeep but remain under the final capping ground level, surrounded by manhole rings for protection. LM5 and LM6's manhole rings are full of water. A proposal is to be submitted to the EPA to abandon monitoring from these points as they are located in areas that will be wildflower meadows when the park is constructed. Future leachate monitoring will be proposed to be directly from the leachate storage lagoon in the form of grab samples.

Monitoring of the composition of leachate is undertaken on a quarterly basis, with analysis of a wider range of parameters on an annual basis. In addition leachate levels are also taken on a weekly basis.

4.2.1 Interpretation of Results

Monitoring point LM1 is located on the north-western edge of the landfill. The results indicate that the composition of leachate at LM1 is of a very low strength. Ammonia levels vary from 0.16mg/l N in the third quarter to 0.03mg/l N in the fourth quarter and the pH is stable with a range of 6.8 – 7.1.

Monitoring at LM1 indicates that this borehole is more likely to be a contaminated groundwater. Historically leachate results have been of a lower strength than the values typically quoted in the literature and this has been attributed to the high proportion of construction and demolition waste landfilled at the site.

4.3 Groundwater

There are currently seven boreholes operational around the perimeter of the site, GW2, GW4, GW5, GW6, GW15, GW16 and GW17. There were a further two boreholes, GW1 and GW18 located off-site. These boreholes are now gone due to works in the areas. GW7 and GW9 are currently inaccessible for groundwater sampling due to final capping levels but are situated inside the waste body and would yield leachate samples rather than true groundwater. GW5 and GW17 are also situated within the waste body. GW3, GW10, GW11, GW12 and GW14 were irreparably damaged. Monitoring occurs on a quarterly basis. It will be proposed to the EPA that monitoring of groundwater is scaled back given that landfilling activities have ceased and a simpler monitoring regime be applied. It will be proposed to use 1 or 2 upgradient monitoring locations as control points and a further 3 down gradient points as monitors of any improvements or otherwise in groundwaters.

Monitoring location GW2 is located on the north of the landfill site. Results show that the borehole is not polluted. Ammonia at the last monitoring event was 0.3mg/l N which is elevated in comparison to previous results. This borehole would be considered down gradient of the landfill.

GW4 is located on the eastern boundary along the Tramore Road. Results show that it is grossly polluted with ammonia levels reaching a high of 61mg/l N at quarter 3. However Ammonia levels dropped to 36mg/l N in quarter 4.

Monitoring point GW5 is located towards the south-eastern corner of the site and is within the boundary of the waste body. Results show a grossly polluted borehole with Ammonia levels at 500 and 650mg/l N throughout the year. It would be better considered as leachate given the position of the borehole. During the landscaping of the nature park this borehole was temporarily put out of use and there are no results for quarters 3 and 4. It will be reinstated for 2012.

Monitoring point GW6 is located on the southern tip of the landfill and is upgradient of the landfill. Results have become stable showing no pollution and Conductivity levels within a normal range. Ammonia levels fluctuated between 1.7 and 0.09mg/l N during 2011, this could be due to tidal conditions in the area.

Monitoring station GW15 is located along the southern boundary of the site. It has normal levels of Conductivity throughout the year. Ammonia levels remain in the 1 to 2mg/l N range and whilst elevated they are an improvement on previous monitoring results. This borehole was put out of use after quarter 1 due to landscaping works but will be reinstated for 2012.

Monitoring station GW16 is located along the eastern boundary of the site. Levels have stabilised at this point showing with Ammonias in and around 20mg/l N throughout the year. Conductivity levels remain elevated.

Monitoring borehole GW17 is located along the north-eastern boundary of the landfill. Ammonia levels fluctuated from 360 to 430mg/l N in quarter 4. The borehole remains grossly polluted but it is located within the waste body and results are more indicative of a leachate than true groundwater.

4.3.1 Interpretation of Results

Results show that GW4, GW5, GW16 and GW17 are polluted. However GW5 and GW17 are better considered as leachate from within the waste body. GW6 and GW15 are to the south and south west respectively and show elevated levels of ammonia. GW4 has again shown improvement on previous years' results.

4.4 Surface Water

The landfill is surrounded on its western, southern and eastern sides by a perimeter drain, which receives several flows from the west and south as well as water from the landfill itself. This drain flows from the western side of the landfill around its southern end before flowing northward along the eastern side of the landfill and entering the Lisduggan Stream. The Lisduggan stream flows along the northern edges of the site before exiting along the eastern perimeter and joining up with St. Johns River. The waste license requires the monitoring of surface water quality at nine locations around the landfill, S1-S9.

There is also a tidal influence at the site, which results in water flowing from the Lisduggan stream into the perimeter drain.

Monitoring point S1 showed Ammonia in 2011 at a high of 0.26mg/l N, there is no evidence of widespread pollution at his point.

Monitoring point S2 is located on the western boundary of the site. This sampling station is no longer available as it has been diverted through a pipe.

Ammonia at monitoring station S3 fluctuated from 1 to 0.29 mg/l N. The results would indicate a little pollution at this point. S3 is located on the south west boundary of the site and the results are very similar to GW15 which is in the same area.

Results at S4 show fluctuating but decreasing Ammonia levels and slightly elevated Chloride. The last monitoring event shows Ammonia at 1.7mg/l N which indicates slight pollution but in quarter 3 levels dropped to 0.05 mg/l N indicating a tentative improvement in quality at his point. S4 is located along the southern boundary of the landfill.

S5 is located along the south-eastern boundary of the landfill. Results from this station in 2009 were more or less stable showing slightly elevated Ammonia levels but otherwise clean waters. Samples could not be obtained in 2011 due to over growth in this area of the bog. As part of the park landscaping access paths to all monitoring points have been installed and this sampling point should be operational again in 2012.

S6 is also located along the south-eastern boundary. Ammonia in quarter 1 was at 0.97mg/l N. There is slight contamination at this point but B.O.D. does not indicate an overly bad quality. The sampling point was inaccessible during quarters 2-4 but with access paths installed it should be operational again in 2012.

Results from station S7 remain stable with good Dissolved Oxygen and B.O.D. levels. Ammonias are elevated at a high of 4.2mg/l N in quarter 2 and Chlorides stayed in the 30 mg/l Cl range throughout the year dropping to 22 mg/l Cl at the last monitoring event indicating some contaminant but in general water quality is good.

Monitoring station S8 is much the same as S7 with favourable Dissolved Oxygen levels and B.O.D. There is little pollution here and results indicate a reasonable quality of water. Ammonia reached a high of 0.8mg/l N in quarter 1.

Ammonia levels at station S9 reached a high of 1mg/l N in quarter 1 and then remained lower than guideline trigger levels for the rest of the year. There is no indication of contamination here and Dissolved Oxygen levels and B.O.D. also show good quality at this point.

4.4.1 Interpretation of Results

Results from monitoring stations S1 and S9 remain stable and indicate clean waters. S6 and S7 have decreased in quality slightly due to raised Ammonia levels but all other results indicate relatively clean waters. S3, S4, S5 and S8 all have slightly elevated Ammonias but the readings are more or less stable and B.O.D. at these points indicate good quality water. S5, S6 and S7 were inaccessible for part of 2011 but will be operational again for 2012.

4.5 Air Emissions

These include the following:

- Dust
- Odours
- Aerosols and airborne particulates (PM10)
- Landfill Gas

4.5.1 Dust Emissions

The main sources of dust on the landfill site are due to vehicle movement and control is effected by a mobile sprayer. Dust monitoring is required at seven locations in the vicinity of the site (D1, D2, B1, B2, S2, B6, and GW5). Dust monitoring is required three times per annum.

There were no dust limit breaches in 2011. All monitoring was carried out by Dixon.Brosnan.

4.5.1.1 Interpretation of Results

All results were well below the 350mg/m²/day limit for dust deposition except one occurrence at sample point S2 during the first monitoring event between May and June. This can be attributed to landscaping works in the vicinity at that time but even so it did not breach the limit. It is clear from the results that dust is not an issue at the site since closure and completion of final capping and gas abstraction works. An application for a licence review is being drafted and part of this will propose to scale back dust monitoring at the site in both frequency and locations. It is most likely that future dust monitoring will focus on the Civic Amenity Site.

4.5.2 Odours

Odour monitoring is required at a total of seven locations around the outskirts of the facility. Odour Ireland carried out all odour monitoring.

According to schedule F.3 of the waste license, Waterford City Council is required to monitor odour emissions from seven monitoring locations. Four of the locations are stipulated in the license as NSL2 to NSL5. The other three locations have not been given exact grid co-ordinates but, according to schedule F.3, the chosen locations should be as follows:

Location 1: at the nearest noise sensitive location (NSL) on the western boundary between NSL3 and NSL5,

Location 2: at the nearest NSL in a residential area to the north east of the facility boundary and

Location 3: at the nearest NSL in a residential area to the south east of the facility boundary.

These locations have been given the identification numbers NSL6 – NSL8.

Odour monitoring was carried out on 30th June and 24th November.

4.5.2.1 Interpretation of Results

Odour monitoring carried out at Kilbarry show results with a maximum value of 66 ou/m³ (odour units per cubic metre). There was no distinct odour from any of the samples.

The chemical analysis shows that the hydrogen sulphide and total volatile organic compounds (TVOCs) were indicative of ambient background. Minimum numbers of organic acids and mercaptans were detected also.

Hydrogen sulphide and the mercaptan concentrations are all below limits that would be needed to cause a nuisance. The organic acids were also only present in low concentrations. Levels are indicative of traffic based emissions with the highest TVOCs being recorded at NSL6 which is offsite and located in an adjacent housing estate.

As can be seen from these results odour is not a major problem at the site and this would be attributed to the fact that the site is closed and no longer operational. A formal review of the waste licence is being prepared and a request to scale back the odour monitoring will be included. Odour monitoring costs are by far the highest of all monitoring undertaken and it can be consistently seen since monitoring began that there is currently no issue with odour on site.

4.5.3 Aerosols

Aerosols are defined as fine particulate material water droplets and microbial emissions from activities carried out at the landfill. On site sources include re-suspension of fine material by wheel action of vehicles and fugitive emissions from tipping and distribution of waste. Since the closure of the site aerosols are no longer an issue.

4.6 Landfill Gas

It is estimated that 1,094,513m³ tonnes of waste has been landfilled over the lifetime of the site. Assuming that each tonne of waste will have a typical yield of 200m³ of gas, it is estimated that the facility will produce in the order of 220Mm³ of gas in its lifetime. In October 2009 a 500m³ permanent, enclosed flarestack was connected to the completed gas abstraction system and ignited. The flare is connected to 82no. gas wells bored into the main waste body. There are 20 wells at the southern tip of the site all connected to Manifold 1, which are controlled at that manifold rather than individually due to low levels of methane. The manifold valve connected to the main header pipe is closed down 95% or more to allow what little gas building up in these southern wells to be drawn off without too much oxygen getting in also.

The waste license requires the monitoring of the composition of the gas within the landfill site. However with the gas abstraction system now fully operational this monitoring is redundant and flare monitoring or field balancing data can be used instead.

Perimeter gas monitoring locations include LM1, GW2, GW4, GW5, GW6, GW7, GW9, GW12, GW15, GW17, GW19, GW22, GW23, GW24, GW25, GW26, GW27 and GW28.

Boreholes GW22 to GW28 were installed to provide extra monitoring of any possible migratory gas between the landfill and the nearest residential houses in Lacken Wood Estate and are outside the main waste body as are LM1, GW2, GW4, GW6, GW12, GW15 and GW19. Boreholes GW5, GW7, GW9 and GW17 are all within the waste body. Works adjacent to the landfill on a new industrial site made temporary monitoring points GW19, GW20 and GW21 obsolete. These points had been located outside the landfill boundary but the installation of GW22 – GW28 replaced them.

4.6.1 Interpretation of Results

The results from the field balancing indicate that there is limited production occurring in the southern part of the site. The different ages of the waste at the site means that there is likely to be some variability in the production of landfill gas in different parts of the site.

Results from the monitoring at perimeter boreholes show that there is no gas migration and the continued operation of the gas abstraction system should maintain this.

4.6.2 Landfill Gas Flare Monitoring

As per Table F.2.2 of Schedule F of waste licence 18-1 landfill gas flare monitoring is required on an annual basis for particulates, organics, hydrogen chloride and hydrogen fluoride and every six months for volumetric flow, SO₂ and NO_x. Results from both these monitoring events show emission values for all parameters to be within the limits prescribed by the licence.

4.7 Noise

Noise monitoring is required on an annual basis. There are 14 noise monitoring locations in the vicinity of the site (B1, B2, B3, B4, B5, B6, B7, NSL2, NSL3, NSL4, NSL5, NSL6, NSL7 and NSL8). Dixon Brosnan performed the annual noise monitoring survey for the site in July 2011.

4.7.1 Interpretation of Results

Schedule G.1 of the site waste licence specifies that daytime noise levels should not exceed 55 dB at any of the monitoring stations as a result of site activities. LAeq levels recorded over 30 minutes did not exceed this limit at any of the onsite or offsite stations. Noise emissions from the landfill site were inaudible at most offsite stations. Audible emissions generally consisted of vehicles using the site entrance, audible only at two stations near the entrance.

Noise levels on the site are not considered to represent a nuisance to nearby residents. The operating hours of the Civic Amenity Site are strictly adhered to and no operations take place outside these hours. In the event of complaints about noise levels, noise impact statements will be made to investigate further techniques for keeping noise levels to a minimum.

4.8 Ecology Survey

According to condition 9.20 of the waste license an annual ecological survey must be undertaken at Kilbarry Bog. White Young Green carried out the survey in 2011. The report is included in the appendices.

4.09 Leachate Volumes

The leachate management system at the site is composed of 13 no. leachate abstraction boreholes, a perimeter leachate collection trench 1.2m depth and 1m wide and 5 no. leachate collection sumps.

The water balance method has previously been used to predict likely annual leachate generation rates. This method is based on the use of a mathematical equation which provides a conservative estimate which caters for worst case scenarios.

The equation is as follows; $L_0 = [(ER.a) + LW + IR] - [aW]$

Where

L_0 : Free Leachate Produced

ER: Effective Rainfall (net precipitation after loss by evaporation).

a: Area of Cell(s)

LW: Liquid Waste

IR: Infiltration from restored areas

aW: Absorptive capacity of waste

a_A : Active area

a_R : Restored Area

a_L : Lagoon area

W_A : Waste in active area

W_R : Waste in restored area

The absorptive capacity of the waste is generally assumed to be 0.102m³ per tonne.

Subsequent to the installation of capping the leachate production rate is calculated using the 14% and 35% as lower and upper bound levels for infiltration through the capping. The calculations are carried out on an upper and lower bound basis to provide a realistic range in which the actual leachate production will lie. It is estimated that a maximum of 35% will be allowed to enter the landfill subsequent to temporary capping. This may be reduced to 14% depending on the effectiveness of the capping. The infiltration on an uncapped cell is assumed to be 100% of the effective rainfall on the site.

However since the closure of the site a permanent geomembrane cap consisting of a 7mm geocomposite gas collection layer, a 1mm HDPE liner and another 7mm geocomposite water collection layer all covered with a minimum of 1m subsoil has been installed over 100% of the landfill area. Leachate calculations shown in Tables 6 and 7 are carried out using 2% and 10% lower and upper bound levels as per EPA guidelines in Landfill Site Design Manual (2000) for **geosynthetic clay liners**. There are no values given for geomembrane liners and the calculated values for clay liners are at odds with the volumes of leachate being held and discharged at Kilbarry.

Table 6: 2% Effective Rainfall Calculation

Month	Rainfall (mm)	Evaporation (mm)	Effective Rainfall (mm)	Leachate Generation (m3)
January	68.7	13.9	54.8	134
February	110.6	19.5	91.1	222
March	30.5	47.6	0	0
April	26.1	76.1	0	0
May	41.1	105.7	0	0
June	94.6	106.2	0	0
July	65	106.2	0	0
Aug	31.4	92.1	0	0
September	59	<59	0	0
October				
November				
December	83.1	18	65.1	159
Total				515m3

Table 7: 10% Effective Rainfall Calculation

Month	Rainfall (mm)	Evaporation (mm)	Effective Rainfall (mm)	Leachate Generation (m3)
January	68.7	13.9	54.8	670
February	110.6	19.5	91.1	1110
March	30.5	47.6	0	0
April	26.1	76.1	0	0
May	41.1	105.7	0	0
June	94.6	106.2	0	0
July	65	106.2	0	0
Aug	31.4	92.1	0	0
September	59	<59	0	0
October				
November				
December	83.1	18	65.1	795
Total				2575m3

The average volume of leachate generated at the site is estimated to be between 515m³ to 2575m³ based on a permanently capped area of 122,000m³. However this does not tally with what is actually occurring onsite. It has been found since the closure and restoration that little leachate is pumping to the lagoon at the north of the site and this would be assumed to be due to a drop in leachate production following the successful installation of permanent capping. In 2011 approximately 60m³ of leachate was pumped to the lagoon.

The leachate lagoon has a capacity of 3,670m³ (2,670m³ with a freeboard of 0.5m). The leachate is discharged to the sewer by gravity feed and a valve allows a percentage of outflow into the sump. A monitoring system has been installed on the outfall of the leachate lagoon in accordance with the waste licence. The system monitors flow, pH and dissolved methane concentration.

4.10 Emissions to Groundwater

The bedrock beneath the landfill site is situated in the Campile Formation. These rocks are considered to generally form Regionally Important Aquifers with fissure flow (Rf).

To the north and north west of the site the bedrock is predominantly mudstone and shale. To the south and east the rocks are of a predominately acid volcanic unit. In addition a dolerite body has been mapped separating these units and lying immediately south and south east of the landfill site.

Depth to bedrock to the north and east of the site is between 12-14m. To the south and west the general indications are of shallow rock with one anomalous data point indicated 15m depth to bedrock. An outcrop is observed to the southern end of the site, which comprises of grey/green felsite. An outcrop to the north west of the site is described as clayey shaly ash or tuff.

Due to the nature of the bedrock fissure flow will be the dominant type of groundwater flow. The groundwater levels in the area are generally close to the surface. Groundwater flow directions are from the ground to the south and east toward the stream to the west.

The results of in-situe permeability testing carried out in 1998 indicate generally low permeabilities in the bedrock with values between 10 e-6 and 10 e-8.

Due to the low permeability of the bedrock beneath the landfill site it is considered that the preferential migration of leachate from the landfill site is likely to be occurring along the southern and western sides where depth to bedrock is shallower.

The results of groundwater monitoring to date indicate a degree of contamination due to landfill activities. Monitoring of the groundwater surrounding the site showed elevated levels of ammonia and electrical conductivity indicating that leachate is entering the groundwater system. The volumes of leachate entering the groundwater system can be seen to be reduced given the effect of final capping on the leachate volume calculations. There should be little to no new leachate generation and the continued operation of the leachate extraction system from the perimeter and waste body should further minimise leachate contamination to groundwater.

5.0 ENERGY CONSUMPTION/GENERATION

5.1 Resource and Energy Consumption Summary

Contractors are employed to supply and operate the site machinery, therefore there is no available information regarding the quantities of fuel on site at any given time. There is no fuel stored onsite.

There was approximately 5m³ of water used from the mains supply to the site throughout 2011.

In 2011 approximately €16,000 was spent on electrical supply to the site.

6.0 ENVIRONMENTAL INCIDENTS AND COMPLAINTS

6.1 Non-Conformances/Incidents and Complaints

There were no incidents reported in 2011
There were no complaints made in 2011.

6.2 Review of Nuisance Controls

It is the responsibility of the facility manager to ensure that the control measures are implemented to prevent the spread of litter. Since the closure of the landfill a number of management practices implemented on site in order to control the spread of litter have become redundant. These include litter fencing, the application of daily cover and the spreading and compaction of waste in thin layers. Regular monitoring and site inspections are carried out to ensure site tidiness is maintained since the closure of the landfill.

The main area of concern in relation to litter at present is the Civic Amenity Site to the North of the landfill. Contractors transporting materials for recycling offsite shall be required to ensure that when transporting and discharging these loads that litter is kept to an absolute minimum. All vehicles are required to be totally sealed or covered with a net or tarpaulin to ensure that materials are not blown from the vehicles.

Routine litter patrols are carried out on a daily basis to ensure that any loose litter is collected, this shall include the area surrounding the landfill, all fences and the approach road to the site. The effectiveness of the litter control techniques are monitored on a weekly basis.

6.2.1 Birds

Since the closure of the landfill birds are no longer a nuisance on the site

6.2.2 Vermin

A contract is in place with Rentokil Ireland. A programme of baiting can be employed as required to control rat infestations with preventative baiting at regular intervals to ensure that large populations do not become established. Since closure of the landfill vermin has not been a significant issue on site

6.2.3 Flying Insects

The facility manager monitors the situation. Since closure of the landfill however there has been no issue and the materials collected at the Civic Amenity Site do not pose an issue.

6.2.4 Fires

The burning of waste or other material is not permitted at the facility. Hot or burning loads of waste arriving at the facility are rejected. In the event that a fire breaks out on the site it is treated as an emergency and dealt with immediately. The Emergency Response Procedures, containing steps for dealing with fires, is included in the appendices.

6.2.5 Odour Control

Odour problems were kept to a minimum by implementing adequate compaction, speedy disposal and burial of malodorous wastes, effective and frequent use of cover material. These provisions are no longer needed due to closure of the landfill. A gas abstraction system began flaring in January 2008. A leachate management system is installed and had 3 additional wells installed in April 2008. Odour monitoring is carried out at bi-quarterly intervals. There were no odour complaints in 2011 and based on the monitoring results odour presents no significant issue at the site.

6.2.6 Dust Control

Dust control measures will be employed during the construction/installation of specified engineering works particularly the installation of the final capping and the gas abstraction system. It is proposed that a mobile sprayer or bowser shall be employed to control fugitive dust emissions from the movement of vehicles during dry and windy weather. This is to be achieved through the spraying with water of site roads and any other areas used by vehicles. Speed restrictions shall also apply to construction vehicles within the landfill.

6.3 Programme for Public Information

Communications Programme

The purpose of the Communications Programme is to ensure that members of the public can obtain information concerning the environmental performance of the facility at all reasonable times.

Council Directive 90/313/EEC on the Freedom of Access to Information on the Environment recognises the significance of the public's access to information relating to the environment. To ensure that members of the public can obtain information concerning the environmental performance of Kilbarry Landfill the communications programme described below shall be implemented at the facility.

The purpose of this programme is to allow any local community groups, key interest groups, local residents and members of the local community access to information on matters relating to the environmental performance of Kilbarry Landfill. This in turn will address any local community concerns and allow the public the opportunity to provide feedback on the facility. The Facility Manager will be responsible for the implementation of this programme, which shall form a normal part of the routine operation and management of the facility.

Programme:

1. All requests concerning the environmental performance of the facility should be made in writing to:

Mr. Vincent O'Shea,
Facility Manager,
Kilbarry Landfill,
Environmental Services,
Floor 4 Menapia Building,
The Mall,
Waterford City.

2. The Facility Manager shall copy all requests to:

Ms. Colette Byrne,
Director of Services,
Waterford City Council,
Environmental Services,
Menapia Building,
The Mall,
Waterford.

3. Each request should indicate the name, address and contact telephone number of the concerned party, an outline of the information required and the manner in which they require the information i.e. copy of record, computed disk, etc.
4. If requested, a suitable member of staff will provide a clear, unbiased explanation of the information provided.
5. The Director of Services or other authorised, nominated representative in Waterford City Council or any other nominated person will deal with replies to requests made by the media for information relating to the environmental performance of the landfill.

Record keeping

All records of requests for information regarding the environmental performance of the landfill and all minutes of meetings with concerned parties and details of site visits/ open-days shall be maintained and kept secure from loss, damage or deterioration. All of the aforementioned files shall be stored at the site office at Kilbarry Landfill and the Offices of Waterford City Council, Planning & Environment Department, 6/7 Lombard Street, Waterford.

The Facility Manager shall keep a register of all requests for information from the public on site.

7.0 OBJECTIVES AND TARGETS

7.1 Schedule of Environmental Objectives and Targets for the Forthcoming Year

The objectives and targets have been based on the conditions set by Waste License 18-1. The purpose of this section is to establish a summary of objectives and targets for the prevention of pollution and for the continual improvement of the site.

Table 10: Schedule of Objectives and Targets

2012 Schedule of Objectives and Targets				
Prepared by: Vincent O'Shea, Facility Manager			Date: January 12	
Approved by: Ms. Colette Byrne, Director of Services, Waterford City Council				
	Target	Plan	Responsible Party	Timescale (for completion)
Objective 1 To establish site infrastructure as required by Licence Conditions	Repair all defects in the existing site gates and fences.	Regular inspections are carried out of gates and fencing.	Facility Manager	Within three working days of defect.
	Install active collection and flaring system for landfill gas.	Active gas collection system and permanent flare installed.	Facility Manager/ Consultant Contractor	Completed.
	Investigate utilisation of landfill gas	Utilisation not feasible.	Facility Manager/ Consultant	Completed.
	Surface Water Management	Install system as proposed	Facility Manager Consultant Contractor	Completed.
	Landscaping	Suitable tree and shrub planting required on the perimeter of the facility and for final capping/restoration.	Horticulturist	April 2012
	Permanent Enclosed Flarestack	Install flare and connect to gas abstraction system	Facility Manager Contractor	Completed

2012 Schedule of Objectives and Targets

Prepared by: Vincent O'Shea, Facility Manager

Date: January 2012

Approved by: Ms. Colette Byrne, Director of Services, Waterford City Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 2 Management & Operation of the Facility Objective 3 To Prevent Environmental Nuisance & Emissions	Develop written waste acceptance procedures and ensure all staff are familiar with same.	To minimise nuisance and ensure only permitted material accepted for recycling.	Facility Manager & Compactor Operator	Reviewed annually
	Implement Litter Control Measures	To maintain litter control measures	Facility Manager Site Staff	Ongoing
	Dust Control	To maintain dust control measures.	Facility Manager Site Staff	Ongoing
	Vermin Control:	Contract with Rentokil Ireland.	Facility Manager	In Place
	Continue existing gas monitoring program.	Continue with existing monitoring programme	Facility Manager	On Going
	Continue existing leachate monitoring program.	Monitor changes in the composition of the leachate with time.	Facility Manager	On Going
	Monitor dust control measures during construction works at the facility.	Dust control measures to be implemented on site during all construction works at the facility.	Facility Manager	On Going
Objective 4 Promotion of Waste Recycling	Make public aware of recycling initiatives, techniques and current methods aswell as materials accepted at Kilbarry	Promotion through local newspapers, radio, school talks and information leaflets.	Environmental officer Facility Manager	Ongoing

2012 Schedule of Objectives and Targets

Prepared by: Vincent O'Shea, Facility Manager

Date: January 2012

Approved by: Ms. Colette Byrne, Director of Services, Waterford City Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 5 To improve the Environmental Performance	Establish an Environmental Management System	To monitor the facility's environmental performance.	Facility Manager	Reviewed Annually
	Prepare the Annual Environmental Report	Summarise the results of environmental monitoring programme and assess facility's progress towards achieving its objectives and targets.	Facility Manager Consultant	January 2012
	Reduce non-compliance	Carry out site inspections.	Facility Manager Site Supervisor	Ongoing
	Improve environmental monitoring programme	Continue and expand groundwater, surface-water, leachate & landfill gas monitoring to ensure complete compliance with license.	Facility Supervisor Facility Manager	Ongoing.
	Reduce risk of gas migration	Install active gas abstraction system and flare. Also gas utilisation system to be assessed.	Facility Manager Consultant Contractor	Gas abstraction system completed. Utilisation unfeasible.

2012 Schedule of Objectives and Targets

Prepared by: Vincent O'Shea, Facility Manager

Date: January 2012

Approved by: Ms. Colette Byrne, Director of Services, Waterford City Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 5 To improve the Environmental Performance (Continued)	Reduce visual impact	Landscaping of site into a public amenity park.	Horticulturist	April 2012
	Control dust emissions	Monitoring	Contractor	Quarterly
		Spray roads during dry weather	Facility Manager	Ongoing
		Operate and maintain wheelwash	Facility Manager	Ongoing
		Enforce speed limits	Facility Manager	Ongoing
	Litter control	Daily litter inspections	Facility Supervisor	Ongoing
	Reduce emissions to surface water	Install management system	Facility Manager	Completed.
	Reduce emissions of leachate from unlined waste body	Maintain leachate collection system.	Facility Manager Contractor	Ongoing
	Reduce long-term impact	Restoration & Aftercare Plan.	Senior Engineer	After landscaping.
Objective 6 To Monitor Management of Facility	Environmental Management System	Environmental Management System developed and included in this submission.	Facility Manager	Reviewed annually
	Environmental Management Programme	Environmental Management Plan established and included in this submission.	Facility Manager	Reviewed Annually
	Establish & Maintain Corrective Action Procedures	Procedures have been developed and are included in this submission.	Facility Manager	Reviewed Annually
	Establish Awareness & Training Procedures to identify training needs.	Procedures have been developed by Waterford City Council.	Facility Manager	Reviewed Annually
	Establish Communications Programme to ensure public access to information	Details included in this submission.	Facility Manager	Reviewed Annually

2012 Schedule of Objectives and Targets

Prepared by: Vincent O'Shea, Facility Manager

Date: January 2012

Approved by: Ms. Colette Byrne, Director of Services, Waterford City Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 6 To Monitor Management of Facility (continued)	Record keeping to ensure proper site management	Written Records to be kept.	Facility Manager	Ongoing

OBJECTIVE 1 – ESTABLISH INFRASTRUCTURE AT THE FACILITY IN ACCORDANCE WITH THE REQUIREMENTS OF WASTE LICENSE 18-1.

It is proposed that the following infrastructure required by the waste license be installed in 2012 :

- Restoration Landscaping

OBJECTIVE 2 – OPERATION & MANAGEMENT OF THE FACILITY IN ACCORDANCE WITH THE CONDITIONS OF THE WASTE LICENSE 18-1.

It is the objective of Waterford City Council to comply with the conditions of the Waste License (18-1) for Kilbarry Landfill Site.

As required by the waste license conditions, written waste acceptance procedures have been developed and ongoing training is being provided for all staff to ensure that they are familiar with them. Regular meetings are undertaken to review the performance of the facility. The meetings are attended by senior management staff and external consultants. The frequency of the meetings is reviewed as necessary. Procedures have been developed for the following:

- Waste acceptance procedures
- Emergency response procedures
- Corrective action procedure
- Communications programme
- Awareness and training

It is proposed that regular site meetings be undertaken to assess the performance of the facility and bring any potential problems to the attention of the Agency and Waterford City Council senior management staff.

OBJECTIVE 3 – TO PREVENT ENVIRONMENTAL NUISANCE & EMISSIONS.

In line with the objective of Waterford City Council to minimise environmental nuisance caused by the operation of the landfill at Kilbarry, actions have been implemented for the following:

- Litter control measures
- Dust control
- Vermin control
- Gas monitoring
- Leachate monitoring
- Groundwater monitoring
- Surface water monitoring

Litter control measures are in place as per condition 6.4 of the waste license.

The dust control measures employed have been outlined in section 6.2.5. The facility manager is responsible for the implementation of the dust control measures.

As part of the ongoing environmental monitoring at the facility the composition of surface water, groundwater and leachate is reported on a quarterly basis, with the analysis of a wider range of parameters on an annual basis. Monitoring of landfill gas is undertaken on a monthly basis with a continual monitoring system installed in the site office and weighbridge office.

In order to prevent landfill gas emissions to the environment the installation of an active gas abstraction system with permanent enclosed flare was begun in 2006 and completed in 2009. It can generally be seen from the monthly monitoring data that there are no migratory gas emissions occurring at the site.

As part of an overall surface water management system 3 existing retention ponds have been redeveloped and expanded in the form of constructed wetlands along with a fourth to be constructed at the southern end of the landfill. A collection drain for surface waters was installed at the top of the perimeter slopes also.

13 leachate abstraction boreholes are in place in the main waste body and a further 5 sumps collect leachate from the slotted pipe which surrounds the waste body at the bottom of the slopes. These all pump leachate to the lagoon at the north of the site.

OBJECTIVE 4 – PROMOTION OF WASTE RECYCLING AT SOURCE AND MINIMISE RELIANCE ON LANDFILL

It is the objective of Waterford City Council to promote recycling and thereby reduce the reliance on landfill for both commercial, household and construction and demolition waste. A three-bin collection system for household waste is operated in the city. This consists of a green bin for dry recyclables, a brown bin for organic waste and a black bin for residual waste.

In addition to this three-bin system the range of goods accepted for recycling at Kilbarry Civic Amenity site are:

- Timber
- Cardboard
- Batteries
- Engine oil
- Cooking oil
- Textiles
- Aluminium cans
- Glass bottles
- Fluorescent tubes
- Energy saving lightbulbs
- Metal
- W.E.E.E.

The services at the civic amenity site are regularly promoted in local newspapers and Waterford City Councils Environmental Officer, Ella Ryan, frequently discusses the benefits and recycling and developments within the area in a column in the local papers also.

OBJECTIVE 5 – TO DEVELOP AND IMPLEMENT PROCEDURES TO MONITOR THE MANAGEMENT OF THE FACILITY

In order to monitor the management of the facility the following procedures have been developed:

- Schedule of Environmental Objectives and Targets
- Environmental Management Programme
- Corrective Action Procedures
- Awareness and Training Procedures
- Communications Programme
- Environmental Management System

It is the objective of Waterford City Council to improve the environmental performance of the site. In order to achieve this the implementation of the following is proposed:

- Prepare an Annual Environmental Report
 - Improve record keeping
 - Prevent non-compliance
 - Continue and improve the environmental monitoring programme
 - Reduce general nuisances
 - Reduce risk of gas migration through the installation of a gas abstraction system
-

7.2 Financial Provisions

Waterford City Council have the ability to meet any financial commitments or liabilities incurred by the carrying out of the disposal activities relating to Kilbarry Landfill. These commitments include compliance with the waste management license and restoration and aftercare of the site as specified in Condition 8 of the license.

Under section 38 of the Waste Management Act, 1996, Waterford City Council “shall provide and operate, or arrange of, such facilities as may be necessary for the recovery and disposal of household waste arising within the functional area”. Compliance with section 38 and all other relevant sections of the waste management act, 1996 is a statutory obligation of Waterford City Council. Waterford City Council annually in the preparation of the “Book of Estimates” and the passing of these estimates shall make provision for any capital works and maintenance works required to fulfil conditions of the waste license for the Kilbarry Landfill.

Appendix I

Landfill Gas Perimeter Borehole Data and Landfill Gas Survey 2011

ID	DATE	CH4 %	CO2 %	O2 %	BALANCE %	CH4 %LEL %	BARO mb	TEMPERATU DegC	REL.PRESSU mb	DIPMETER m	ANEMOMET m/s	CH4/CO2 %	Res Nitrogen %
1...LM1	31/01/2011 08:09	0	0	20.7	79.3	0	1027	>>>>	>>>>	>>>>	>>>>	>>>>	1.05
2...GW2	31/01/2011 08:15	0	0.1	20.8	79.1	0	1027	>>>>	>>>>	>>>>	>>>>	0	0.48
3...GW9	31/01/2011 08:20	49	26.4	5.1	19.5	200	1027	>>>>	>>>>	>>>>	>>>>	1.86	0.22
4...GW17	31/01/2011 08:23	1.5	0.4	20.1	78	30	1028	>>>>	>>>>	>>>>	>>>>	3.75	2.02
5...GW4	31/01/2011 08:28	0.1	0.2	20.5	79.2	2	1028	>>>>	>>>>	>>>>	>>>>	0.5	1.71
6...GW5	31/01/2011 08:33	0.1	0.1	20.6	79.2	2	1028	>>>>	>>>>	>>>>	>>>>	1	1.33
7...GW6	31/01/2011 08:38	0.2	0.1	20.6	79.1	4	1029	>>>>	>>>>	>>>>	>>>>	2	1.23
8...GW15	31/01/2011 08:41	0.2	0.1	20.5	79.2	4	1029	>>>>	>>>>	>>>>	>>>>	2	1.71
9...GW22	31/01/2011 08:44	0.2	0.1	20.5	79.2	4	1029	>>>>	>>>>	>>>>	>>>>	2	1.71
10..GW23	31/01/2011 08:46	0.3	0.1	20.5	79.1	6	1029	>>>>	>>>>	>>>>	>>>>	3	1.61
11..GW24	31/01/2011 08:48	0.3	0.1	20.4	79.2	6	1030	>>>>	>>>>	>>>>	>>>>	3	2.09
12..GW25	31/01/2011 08:51	0.3	0.1	20.4	79.2	6	1030	>>>>	>>>>	>>>>	>>>>	3	2.09
13..GW26	31/01/2011 08:54	0.3	0.1	20.6	79	6	1029	>>>>	>>>>	>>>>	>>>>	3	1.13
14..GW27	31/01/2011 08:56	0.4	0.3	20.5	78.8	8	1030	>>>>	>>>>	>>>>	>>>>	1.33	1.31
15..GW28	31/01/2011 08:59	0.5	0.2	20.6	78.7	10	1029	>>>>	>>>>	>>>>	>>>>	2.5	0.83
1...LM1	28/02/2011 08:17	0	0	20.8	79.2	0	1031	>>>>	>>>>	>>>>	>>>>	>>>>	0.58
2...GW2	28/02/2011 08:21	0	0	20.8	79.2	0	1032	>>>>	>>>>	>>>>	>>>>	>>>>	0.58
3...GW9	28/02/2011 08:28	0.1	0.1	20.7	79.1	2	1032	>>>>	>>>>	>>>>	>>>>	1	0.85
4...GW17	28/02/2011 08:31	2.7	0.6	19.9	76.8	54	1032	>>>>	>>>>	>>>>	>>>>	4.5	1.58
5...GW4	28/02/2011 08:37	0	0	20.6	79.4	0	1033	>>>>	>>>>	>>>>	>>>>	>>>>	1.53
6...GW5	28/02/2011 08:41	0	0	20.7	79.3	0	1033	>>>>	>>>>	>>>>	>>>>	>>>>	1.05
7...GW6	28/02/2011 08:46	0	0	20.6	79.4	0	1034	>>>>	>>>>	>>>>	>>>>	>>>>	1.53
8...GW15	28/02/2011 08:49	0	0	20.6	79.4	0	1034	>>>>	>>>>	>>>>	>>>>	>>>>	1.53
9...GW22	28/02/2011 08:52	0	0	20.6	79.4	0	1034	>>>>	>>>>	>>>>	>>>>	>>>>	1.53
10..GW23	28/02/2011 08:54	0	0	20.6	79.4	0	1034	>>>>	>>>>	>>>>	>>>>	>>>>	1.53
11..GW24	28/02/2011 08:58	0	0	20.6	79.4	0	1034	>>>>	>>>>	>>>>	>>>>	>>>>	1.53
12..GW25	28/02/2011 09:01	0	0	20.7	79.3	0	1034	>>>>	>>>>	>>>>	>>>>	>>>>	1.05
13..GW26	28/02/2011 09:03	0	0.1	20.7	79.2	0	1034	>>>>	>>>>	>>>>	>>>>	0	0.95
14..GW27	28/02/2011 09:05	0	0	20.7	79.3	0	1034	>>>>	>>>>	>>>>	>>>>	>>>>	1.05
15..GW28	28/02/2011 09:06	0	0	20.7	79.3	0	1034	>>>>	>>>>	>>>>	>>>>	>>>>	1.05
16...GW7	28/02/2011 09:10	0	0	20.7	79.3	0	1034	>>>>	>>>>	>>>>	>>>>	>>>>	1.05
00000LM1	02/06/2011 08:24	0	0	21	79	0	0	1039	-0.17	>>>>	0		

00000GW2	02/06/2011 08:30	0	0	21	79	0	0	1039	-0.1	>>>>	0
00000GW9	02/06/2011 08:35	33.9	19.2	9.6	37.3	200		1038	-0.1	1.77	1.01
00000GW17	02/06/2011 08:40	3.8	0.8	19.6	75.8	76	6.1	1038	0	4.75	1.71
00000GW4	02/06/2011 08:46	0	0	21	79	0	0	1038	-0.01	>>>>	0
00000GW5	02/06/2011 08:52	0	0	21	79	0	0	1038	0	>>>>	0
00000GW6	02/06/2011 08:56	0	0	21	79	0	0	1038	0	>>>>	0
Unable to take a reading from GW15 due to borehole being covered with top soil.											
0000GW22	02/06/2011 09:03	0	0	21	79	0	0	1038	0	>>>>	0
0000GW23	02/06/2011 09:04	0	0.8	20.2	79	0	0	1038	-0.01	0	2.64
0000GW24	02/06/2011 09:06	0	0	21.1	78.9	0	0	1038	-0.03	>>>>	0
0000GW25	02/06/2011 09:09	0	0	21.1	78.9	0	0	1038	-0.02	>>>>	0
0000GW26	02/06/2011 09:11	0	0	21.1	78.9	0	0	1038	0	>>>>	0
0000GW27	02/06/2011 09:13	0	0	21.1	78.9	0	0	1038	0	>>>>	0
0000GW28	02/06/2011 09:14	0	0	21.1	78.9	0		1038	0	>>>>	0
0000GW28	02/06/2011 09:15	0	0	21.1	78.9	0	0	1038	0	>>>>	0
00000GW7	02/06/2011 09:19	0.9	0.6	20.7	77.8	18	0.9	1037	0	1.5	0
00000LM1	29/06/2011 08:54	0	0	21.1	78.9	0	0	1026	0.04	>>>>	0
00000GW2	29/06/2011 08:58	0	0	21.1	78.9	0	0	1026	0.04	>>>>	0
00000GW9	29/06/2011 09:03	0	0	21.1	78.9	0	0	1026	0.04	>>>>	0
0000GW17	29/06/2011 09:05	6	1.1	19.7	73.2	120	6.4	1026	0.05	5.45	0
00000GW4	29/06/2011 09:10	0	0	21.1	78.9	0	6.3	1026	0.05	>>>>	0
00000GW5	29/06/2011 09:14	0	0	21.3	78.7	0	0	1026	0.06	>>>>	0
00000GW6	29/06/2011 09:19	0	0	21.2	78.8	0	0	1026	0.03	>>>>	0
0000GW22	29/06/2011 09:24	0	0	21	79	0	0	1025	0.06	>>>>	0
0000GW23	29/06/2011 09:26	0	0	20.8	79.2	0	0	1025	0.06	>>>>	0.58
0000GW24	29/06/2011 09:28	0	0	20.7	79.3	0	0	1025	0.07	>>>>	1.05
0000GW25	29/06/2011 09:30	0	0	20.7	79.3	0	0	1025	0.08	>>>>	1.05
0000GW26	29/06/2011 09:32	0	0	20.6	79.4	0		1025	0.07	>>>>	1.53
0000GW26	29/06/2011 09:33	0	0	20.6	79.4	0	0	1025	0.07	>>>>	1.53
0000GW27	29/06/2011 09:35	0	0	20.7	79.3	0	0	1025	0.08	>>>>	1.05
0000GW28	29/06/2011 09:37	0	0	20.7	79.3	0	0	1025	0.09	>>>>	1.05
00000GW7	29/06/2011 09:40	0	0	20.9	79.1	0	0	1024	0.08	>>>>	0.1
00000LM1	28/07/2011 08:25	0	0	20.7	79.3	0	0	1026	-0.03	>>>>	1.05
00000GW2	28/07/2011 08:30	0	0	20.9	79.1	0	0	1026	0.02	>>>>	0.1

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00000GW4	28/07/2011 08:50	0.3	0.1	21	78.6	6	0.3	1026	0.07	3	0
00000GW6	28/07/2011 08:59	0	0	21.3	78.7	0	0	1027	0.06	>>>>	0
0000GW22	28/07/2011 09:04	0	0	21.3	78.7	0	0	1026	0.03	>>>>	0
0000GW23	28/07/2011 09:06	0	0.5	20.8	78.7	0		1027	0.01	0	0.08
0000GW24	28/07/2011 09:08	0	0	21.3	78.7	0	0	1027	0	>>>>	0
0000GW25	28/07/2011 09:11	0	0	21.3	78.7	0	0	1027	0.03	>>>>	0
0000GW26	28/07/2011 09:14	0	0	21.4	78.6	0	0	1027	0.02	>>>>	0
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0000GW28	28/07/2011 09:19	0	0	21.3	78.7	0		1027	0.02	>>>>	0
00000GW7	28/07/2011 09:23	0	0	21.3	78.7	0	0	1026	-0.04	>>>>	0
00000GW7	31/08/2011 08:23	0	0	21	79	0		1020	-0.15	>>>>	0
00000LM1	31/08/2011 08:30	0	0	21	79	0	0	1020	-0.08	>>>>	0
00000GW2	31/08/2011 08:36	0	0	21	79	0	0	1020	-0.05	>>>>	0
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0000GW28	31/08/2011 09:18	0	0	20.5	79.5	0	0	1018	-0.01	>>>>	2.01
00000GW7	31/08/2011 09:23	0	0	20.6	79.4	0	0	1018	-0.01	>>>>	1.53
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00000GW9	30/09/2011 08:51	0.1	0.1	20.8	79	2	0.1	1019	-0.03	1	0.38
0000GW17	30/09/2011 08:54	6.4	1.3	19	73.3	128	9.4	1019	-0.02	4.92	1.48
00000GW4	30/09/2011 09:00	0.3	0.2	20.8	78.7	6	0.3	1019	0	1.5	0.08
00000GW6	30/09/2011 09:08	0	0	21	79	0	0	1019	-0.01	>>>>	0
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0000GW23	30/09/2011 09:16	0	0	21	79	0	0	1019	0	>>>>	0
0000GW24	30/09/2011 09:18	0	0	21	79	0	0	1019	0	>>>>	0
0000GW25	30/09/2011 09:20	0	0	21	79	0	0	1019	0	>>>>	0
0000GW26	30/09/2011 09:23	0	0	21	79	0	0	1019	0	>>>>	0
0000GW26	30/09/2011 09:23	0	0	21	79	0	0	1019	0	>>>>	0
0000GW27	30/09/2011 09:26	0	0	21	79	0	0	1019	0	>>>>	0
0000GW28	30/09/2011 09:28	0	0	21	79	0	0	1019	-0.04	>>>>	0
00000GW7	30/09/2011 09:32	0	0	21	79	0	0	1018	0	>>>>	0
00000LM1	30/11/2011 09:13	0	0	20.8	79.2	0	0	1016	-0.12	>>>>	0.58
00000GW2	30/11/2011 09:22	0	0	21.2	78.8	0	0	1016	-0.06	>>>>	0
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00000GW6	30/11/2011 09:42	0	0	21.5	78.5	0	0	1016	-0.05	>>>>	0
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0000GW24	30/11/2011 09:50	0	0	21.5	78.5	0	0	1016	-0.08	>>>>	0
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0000GW22	15/12/2011 09:39	0	0	21.8	78.2	0	0	1004	-0.15	>>>>	0
0000GW23	15/12/2011 09:41	0	0	21.8	78.2	0	0	1004	-20.83	>>>>	0
0000GW24	15/12/2011 09:43	0	0	21.8	78.2	0	0	1004	-0.17	>>>>	0
0000GW25	15/12/2011 09:45	0	0.1	21.7	78.2	0	0	1004	-0.15	0	0
0000GW26	15/12/2011 09:48	0	0	21.7	78.3	0	0	1004	-0.17	>>>>	0

0000GW27	15/12/2011 09:50	0	0.1	21.7	78.2	0	0	1004	-0.17	0	0
0000GW28	15/12/2011 09:52	0	0.1	21.7	78.2	0	0	1004	-0.18	0	0
00000GW7	15/12/2011 09:55	0.6	0.5	21.5	77.4	12	0.8	1004	-0.2	1.2	0

A survey of landfill sites to determine the quantity of methane flared and or recovered in utilisation plants for 2011

Please choose from the drop down menu the license number for your site	W0018
Please choose from the drop down menu the name of the landfill site	Kilbarry Landfill Site
Please enter the number of flares operational at your site in 2011	1
Please enter the number of engines operational at your site in 2011	Select
Total methane flared	689,714 kg/year
Total methane utilised in engines	0 kg/year

Please note that the closing date for receipt of completed surveys is 31/03/2012

Introduction

The Office of Climate Licensing and Resource Use (OCLR) of the Environmental Protection Agency acts as the inventory agency in Ireland with responsibility for compiling and reporting national greenhouse gas inventories to the European Commission and the United Nations Framework Convention on Climate Change. In addition to meeting international commitments Ireland's national greenhouse gas inventory informs national agencies and Government departments as they face the challenge to curb emissions and meet Ireland's targets under the Kyoto Protocol. The national inventory also informs data suppliers, making them aware of the importance of their contributions to the inventory process and a means of identifying areas where input data may be improved.

It is on this basis that the Environmental Protection Agency is asking landfill operators to partake in this survey so that the most up to date information on methane flaring and recovery in utilisation plants at landfill sites is used in calculating the contribution of the waste sector to national greenhouse gas emissions

The Environmental Protection Agency wishes to thank you for partaking in this survey. If you have any questions about the survey and how to complete it please view the "Help sheet" worksheet. If however, your query is not answered by viewing the "Help sheet" worksheet please contact:

LFGProject@epa.ie

Once completed please send the completed file as an attachment clearly stating the name and or license number of the landfill site (e.g. W000 Xanadu landfill_2011) to:

LFGProject@epa.ie

to be filled in by licensee	calculated by spreadsheet
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Flare No. 1

Flare type ? If "other" enter flare description here

Is the flare an open or enclosed flare ? Rated flare capacity ? m3/hr

Month /year comissioned ?

Month decomissioned if decomissioned in 2011 ?

What is the function of the flare ? If "other" enter flare function here

Monthly	Method M/C/E	Runtime days/month	Runtime hrs/day	Downtime hrs	Total runtime hrs/month	Average Inlet Pressure (mbg)	Average Flow Rate (m ³ /hr)	Average CH ₄ %v/v	Average CO ₂ %v/v	Average O ₂ %v/v	Combustion efficiency (%)	Total CH ₄ m ³	Total CH ₄ kgs
January	M	31	24.0	0.0	744	-25	311	38.00	17.00	1.00	98.0	86,167	58,026
February	M	28	24.0	1.0	671	-25	328	45.00	18.00	1.00	98.0	97,059	65,361
March	M	31	24.0	55.0	689	-25	313	41.00	18.00	1.00	98.0	86,651	58,352
April	M	30	24.0	0.0	720	-26	311	36.00	17.00	1.00	98.0	78,999	53,145
May	M	31	24.0	144.0	600	-15	256	42.00	18.00	1.00	98.0	63,222	43,005
June	M	30	24.0	96.0	624	-47	439	56.00	21.00	1.00	98.0	150,336	98,985
July	M	31	24.0	0.0	744	-47	425	33.00	18.00	1.00	98.0	102,259	67,330
August	M	31	24.0	0.0	744	-47	412	27.00	16.00	1.00	98.0	81,107	53,403
September	M	30	24.0	0.0	720	-40	437	28.00	14.00	3.70	98.0	86,337	57,258
October	M	14	24.0	0.0	336	-25	405	29.00	14.00	3.20	98.0	38,674	26,044
November	M	31	24.0	72.0	672	-25	310	38.00	16.00	1.00	98.0	77,578	52,242
December	M	31	24.0	0.0	744	-25	320	36.00	17.00	1.00	98.0	83,995	56,563
Total					8,008							1,032,385	689,714

Please note: Only fill the "Yearly" table if data is not available or cannot be calculated nor estimated on a monthly basis

Yearly	Method M/C/E	Runtime days/year	Runtime hrs/day	Downtime hrs	Total runtime hrs/year	Average Inlet Pressure (mbg)	Average Flow Rate m ³ /hr	Average CH ₄ %v/v	Average CO ₂ %v/v	Average O ₂ %v/v	Combustion efficiency (%)	Total CH ₄ m ³	Total CH ₄ kgs
2011					0						98.0	0	0

Appendix II

Ecological Assessment



Waterford City Council

Annual Ecological Monitoring 2011
of
Kilbarry Bog pNHA,
Waterford

WYG Environmental and Planning (Ireland) Ltd

23rd December 2011



REPORT CONTROL

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Project: Kilbarry Bog pNHA Ecological Monitoring

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1.0 INTRODUCTION

1.1 Scope of Works

WYG Environmental and Planning (Ireland) Ltd (WYG) was appointed by Waterford City Council to carry out ecological assessment of the Kilbarry Bog proposed Natural Heritage Area (pNHA) as required by the facility's EPA Waste Licence (W0018-1). Condition 9.20 of the license states the following:

"9.20. Ecological Monitoring

9.20.1. An ecological assessment of the habitats and associated plant and animal communities within and immediately adjoining (i) the Kilbarry Bog proposed Natural Heritage Area and (ii) the associated watercourses, shall be undertaken annually and shall be submitted to the Agency. This assessment shall include a description of remedial measures to be introduced to control discharges of leachate and contaminated water from the landfill into surface and groundwater regime within Kilbarry Bog. The assessment shall establish the status of salmonid species, kingfisher and otter in the watercourses and adjoining habitats within Kilbarry Bog and in the John's River and its tributaries in the immediate vicinity of, upstream and downstream of the landfill."

In 2008 and 2009 WYG carried out the ecological monitoring. In 2010, WYG was awarded a contract to conduct annual ecological monitoring of Kilbarry Bog for five years (2010-2014). This report presents the findings of the 2011 survey, which is the second report on the monitoring completed thus far.

This study presents an assessment of the habitats and plant communities in the form of quantitative habitat mapping. Water quality and salmonid species were assessed by means of biological monitoring and habitat assessment. Otter and kingfisher are assessed by means of field surveys. The findings of the surveys are presented below along with a discussion and recommendations.

1.2 Site Description

Kilbarry Bog is located on the southern outskirts of Waterford City (Grid Ref S602, 905). It is approximately 45 ha in size and is a proposed Natural Heritage Area (pNHA) under the Wildlife Amendment Act (2000). Although the site is called Kilbarry Bog it is not a bog but rather a reed and large sedge swamp. It has an irregular shape. The northern section is narrow and widens in the southern half of the site. The site is flat. Kilbarry Landfill is located to the north west of the pNHA, as presented in Figure 1. The NPWS site synopsis sheet is presented in Appendix A.



The site is predominantly drained by the St John River, which flows in a south to north direction through the site. The Waterford to Tramore road (R675) runs parallel with the St John River and a footpath is located between the road and river. The footpath is situated on the dismantled old Southern Railway line.

The Couse River drains the south eastern section of the site and flows into the St John River within the site boundary. A number of land drains are located across the pNHA. The Lisduggan Stream flows along the northern boundary of the Kilbarry Landfill. A land drain is located around the landfill and forms part of the boundary between the pNHA and the landfill, and is connected to the Lisduggan stream. The Lisduggan Stream and St John's River converge approximately 300m north of the pNHA boundary.

In addition to the landfill, the surrounding area consists of residential and commercial properties to the north and north-east. The land use to the south, west and south-east is predominately agricultural both grazing and cereals. At the southern tip of the bog the road passes within the pNHA boundary.

1.3 Historic extent of Kilbarry Bog

Much of the historic extent of Kilbarry Bog extends under where the Kilbarry Landfill was constructed in the 1970s. It was designated by An Foras Forbartha as Kilbarry Bog Area of Scientific Interest (ASI) and was described in the ASI Report as being "*an area of fen, swamp and open water*" (Young 1972). As a result of the loss of the much of the Kilbarry Bog ASI to the landfill, the adjacent Ballynakill Marsh was incorporated into the boundary of the Kilbarry Bog pNHA. The boundaries of historical Kilbarry Bog ASI and current Kilbarry Bog pNHA are presented in Figure 2.

1.4 Recent Activity

In recent years the Waterford Outer Ring-road dual-carriageway has been constructed along the southern and south western edge of the pNHA.

In 2010, road improvement works on the Tramore road, which passes through the pNHA, was carried out by Waterford City Council to prevent flooding of the road. Most of the works were kept to within the existing road.

The Kilbarry landfill is currently being landscaped to make it into a public amenity park and an entrance and car park were constructed in the North East area of the site during 2010. The park's landscaping is set to be completed by May 2012.

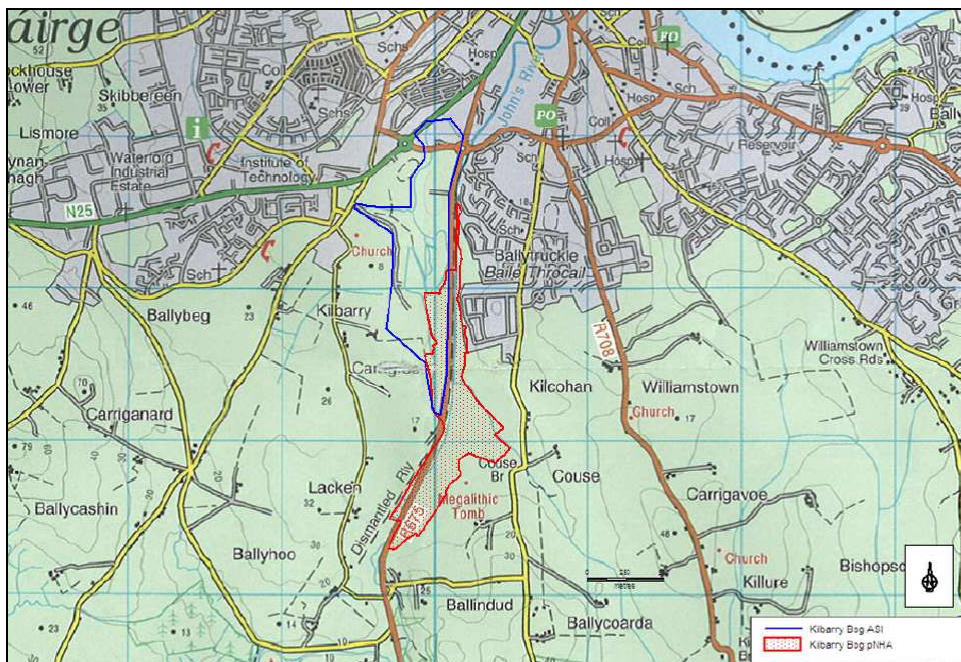


Figure 2: Boundaries of historical Kilbarry Bog ASI and current Kilbarry Bog pNHA (Atkins 2008)

1.5 Previous Studies

As part of the landfill management and facility's waste license conditions, the site has been surveyed a number of times in recent years:

- 2008, 2009 and 2010 by WYG
- 2004 by Limosa Environmental
- 2003 by Biosphere Environmental Services

Government organisations have also reported on the site:

- NPWS Site Synopsis Sheet (2005)
- 1972 - A Report on Areas of Scientific Interest in County Waterford (Young 1972)

In 2008 the draft Kilbarry Bog Management Plan was prepared by Atkins Consulting on behalf of Waterford City Council and is now being revised and updated with the objective of having it adopted by City Council in spring 2012.



1.6 Leachate Management

The waste license requires *"a description of remedial measures to be introduced to control discharges of leachate and contaminated water from the landfill into surface and groundwater regime within Kilbarry Bog"* be presented in the report.

Waterford City Council reported that "leachate management of the site comprises five pumped sumps around the perimeter of the landfill slope and 13 No leachate wells in the waste body itself. The sumps are fed by a slotted high density polyethylene (hdpe) pipe designed to collect any leachate seeping from the side of the waste body. The wells were drilled to various depths into the waste body and have level sensor pumps which periodically pump out leachate collected in the well. All leachate is pumped to the lagoon at the north of the site and allowed to settle. This leachate is then released to the sewer through a monitoring sump which records dissolved methane and pH".

2.0 METHODOLOGY

2.1 Desk Study

In advance of conducting the field survey, a review of aerial photographs, maps, report and plans of the site was completed. This included reports listed in Section 1.4 above.

2.2 Consultation

Consultation with government agencies was carried out by WYG in 2008 with the Dept of Environment, Heritage & Local Government, National Parks and Wildlife Service, Waterford County Council Heritage Officer and Eastern Regional Fisheries Officer. No response was received from these organisations.

In 2009 consultation was conducted with:

- Paul Green, Waterford Vice-County Recorder, Botanical Society of the British Isles (BSBI) – response received.
- Evelyn Moorkens, Mollusc specialist – no response received.

No additional consultation was conducted with these or other organisations in 2010 or 2011.



2.3 Field Survey

The field surveys consisted of the following aspects:

- Habitat Assessment
- Water Quality and Fisheries Assessment
- Otter Survey
- Kingfisher Survey
- Invasive Species Survey

2.3.1 Habitat Assessment

The WYG 2008 monitoring report concluded that habitat monitoring, by means of habitat mapping on an annual basis, did not provide adequate detail or resolution to allow for long term monitoring of Kilbarry Bog. Therefore a semi-quantitative monitoring method, in the form of monitoring permanent quadrats, was recommended. This was carried out in 2009 and 2010 and survey locations were re-surveyed in 2011.

Quadrat Location

In 2009 nine quadrats (Q1 to Q9) were set up and surveyed. Five quadrats (Q1 to Q5) were located on the north western section of the bog close to the landfill. They were concentrated in this area to monitor any future changes in the habitat structure due to interactions with the landfill. A further four quadrats (Q6 to Q9) were surveyed across the rest of the site to establish background trends and to determine if future changes are site wide or localised.

In 2010 a new quadrat was established at the location which corresponded with Q7 from 2009, as the original bamboo stake markers for Q7 could not be found. This new quadrat is called Q7-A and was surveyed during the 2011 habitat assessment. Refer to Figure 3 for the habitat map and Figure 4 for quadrat locations.

Quadrat Set up and Surveying Methodology

Permanent quadrat monitoring stations were established across the site and consisted of the following:

- Quadrats were sized 4m × 4m square. This is the recommended size for tall herb habitats as per the *National Vegetation Classification: Users' handbook* (JNCC 2006) and *Guidelines for a National Fen Survey of Ireland: Survey Manual* (Foss and Crushell 2008).
- Bamboo canes were placed at each of the four corners of the quadrat. The corner which the bamboo cane represented was written in permanent marker e.g. the north east corner was



indicated by “NE Corner”. This will allow surveyors to more easily establish the quadrat area, in the future. Red tape was also placed on the top of each bamboo cane.

- For each quadrat a recording sheet was completed, which was based on the National Fen Survey Manual. Information recorded included vegetation composition, water level, GPS and a photograph.
- A measure of the abundance of all vascular plants was recorded using the DOMIN scale (as described in JNCC 2006). The DOMIN scale is outlined in Table 1 below:

Table 1: DOMIN scale of cover/abundance

Cover	DOMIN score
91–100%	10
76–90%	9
51–75%	8
34–50%	7
26–33%	6
11–25%	5
4–10%	4
<4% (many individuals)	3
<4% (several individuals)	2
<4% (few individuals)	1

The completed quadrat recording sheets are presented Appendix B.

2.3.2 Water Quality Assessment

To monitor the water quality of the St John’s River and adjacent water courses, as required by the facility’s waste license, biological monitoring, through kick samples, was conducted.

Kick Sample Locations

A total of five kick locations were sampled in 2011 to obtain the EPA Q-value score as outlined in Table 2 below. The sampling stations are presented in Figure 5.



Table 2: Freshwater monitoring locations

Location Code	Water course name	Comment	GPS location	Habitat Type
S1	St. John's River	Control	S 59914 08800	Riffle
S3/4	St. John's River	Downstream of NHA and confluence with Lisduggan Stream	S 60225 10894	Depositing
L1	Lisduggan Stream	Upstream of the landfill	S 59455 10592	Riffle
L2	Lisduggan Stream	Along the northern boundary of the landfill	S 59841 10502	Depositing
D1	Landfill Drainage Ditch	Located at north eastern boundary of landfill	S 60047 10351	Depositing

Kick Sample Methodology

The kick sampling methodology follows that used by the EPA in its River Water Quality Q-value Monitoring programme (EPA 2006). It involves a two minute kick sample and one minute stone washing, of riffle habitats, at each sampling location. A 'D' shaped hand net (mesh size 0.5mm, 35cm diameter) is used to collect the samples. The net was placed in the water, with the open end of the net facing into the current. The sampler, standing upstream of the net, kicks the substrate (river bed). The dislodged macroinvertebrates float down current into the net. The stone washing involves placing large cobbles in the mouth of the net which are brushed/rubbed to dislodge any macroinvertebrates which may be clinging to the cobbles.

Once the sample has been collected it is carried in the net to the river bank and decanted into a tray for sorting. Specimens are collected and placed in a labelled plastic container with a 70% methylated spirits (IMS) preservative solution for off-site identification. Specimens were identified to as low a taxonomic level as possible using standard reference keys listed in Section 6.0.

EPA Q-Value

The EPA Q-value system is a biometric index. The water quality of a river or stream is determined primarily on the relative abundance of indicator groups of bottom dwelling (benthic) macroinvertebrates. The indicator groups have different sensitivities to organic pollutants (EPA 2006) and are presented in Table 3 below. Other parameters taken into account in determining the Q-value score include the channel substrate, macrophytes and the presence or absence of sewage fungus and filamentous algae. Physio-chemical parameters (pH, temperature, conductivity and dissolved oxygen) are also considered.



Table 3: Q-value taxa Groups and pollution sensitivity

Group	Pollution Sensitivity	Example of taxa
Group A	Sensitive	Mayfly, stonefly
Group B	Less sensitive	Cased caddis fly
Group C	Tolerant	Beetles
Group D	Very tolerant	Snails
Group E	Most tolerant	Certain worm and fly species

The relative abundance of the indicator groups, in conjunction with the other recorded parameters, is used to determine the Q-value of a water course. The Q-value categories are presented in Table 4.

Table 4: The EPA Q-value categories

Biotic Index	Quality Status	Quality Class
Q5, Q4-5, Q4	Unpolluted	Class A
Q3-4	Slightly polluted	Class B
Q3, Q2-3	Moderately Polluted	Class C
Q2, Q1-2, Q1	Seriously Polluted	Class D

Q-value Limitations

It should be noted that the EPA Q-value is designed to be sampled at riffle type habitats in the water course. This habitat is where the water levels are low and the water can be seen flowing/bubbling over the gravels and cobbles. The turbulent actions add oxygen into the water which is important for allowing the sensitive species to exist. Stretches of rivers that are deeper may be depositing stretches and may be less turbulent and as such have less dissolved oxygen for the sensitive species to be present. These depositing habitats are not considered suitable for applying the Q-value to obtain a Q-value score. The habitat type of each sampling location is presented in Table 2.

2.3.3 Salmonid Assessment

The 2004 and 2008 survey included a fish stock assessment of the St John River and Lisduggan Stream by means of electro-fishing of the watercourses. It was recommended in the 2008 report that electro fishing should not be conducted until there was a significant improvement in water quality and fisheries habitat. The overall water quality and fisheries habitat in the St. John River and Lisduggan Stream has not improved significantly between 2008 and 2011 and therefore there is unlikely to be a significant improvement in fish stock.



2.3.4 Otter Survey

Otter *Lutra lutra* is an Annex II and IV species under the Habitats Directive and is thus afforded special protection. Otters are secretive animals and survey methodology does not rely on seeing the animal to determine if they use an area. However they leave their dropping (spraints) in prominent sites (e.g. bridges, boulders) in their range. These spraints are used to determine if otters are frequenting an area. Other evidence of otter activity includes holts, foot prints and slides.

The ecological assessment of the Kilbarry Bog included an otter survey. The otter survey consisted of a search of bridges within the area at locations identified in Figure 6. Accessible banks of the water courses, within the study area, were surveyed. The pathway along the St John's River was walked and banks of the river searched for otter signs. The River Couse was walked from the Outer Ring Road to where it meets the St. John's River. Accessible sections of the Lisduggan Stream were walked along the northern section of the landfill. The survey was completed on 18th April 2011.

2.3.5 Kingfisher Survey

The kingfisher *Alcedo atthis* is protected under the EC Bird Directive (79/409/EEC). It is listed on the Amber List of *Birds of Conservation Concern in Ireland* (2008 – 2013) (Lynas et al. 2007) indicating that it has 'medium conservation concern'.

The survey consisted of walking along the banks of the water courses outlined above with observations for kingfishers being made. The survey was completed on foot by walking along the footpath beside the banks of the St John River between Outer Ring Road and the Superquinn Roundabout. The River Couse was walked from the Outer Ring Road to where the river meets the St. John's River. The Lisduggan Stream banks were walked, where accessible, along the northern section of the landfill. The kingfisher survey was completed on 18th April and 7th September 2011.

2.3.6 Invasive Species Survey

During the surveys all signs of invasive species encountered were recorded. Invasive species are non-native plants and animals which can "negatively impact on native species, can transform habitats and threaten whole ecosystems causing serious problems to the environment and the economy" (Invasive Species Ireland website (www.invasivespeciesireland.com)).

Examples of invasive species recorded on the site are Japanese knotweed *Fallopia japonica* and Himalayan balsam *Impatiens glandulifera*. When these plants establish on a river or wetland habitat they can cause



bank erosion, outcompete native species and, as such, could have a negative impact on the integrity of the pNHA. Other threats to the site are illegal dumping and infilling. Observations of any such activity were recorded during the site visits.

2.3.7 Seasonal Survey Limitations

- The Quantitative Habitat Mapping was conducted in July. This is within the botanical growing season of April to September.
- The freshwater biological monitoring was carried out in September which is within the optimum period, which is generally considered to be between June to October, when flows are likely to be low and temperatures highest.
- Otters are active at all times of the year and there are no seasonal constraints on surveys, although winter months are preferred when vegetation has died back.
- Kingfisher is resident in Ireland and thus there is not a seasonal limitation to surveying for this species.

3.0 RESULTS

3.1 Habitat Assessment

3.1.1 Site Habitats

As part of the WYG 2008 survey a habitat map of Kilbarry Bog was completed to Fossitt (2000) and in accordance with *Draft Habitat Survey Guidelines* (Heritage Council, 2005). The dominant habitat type within Kilbarry Bog is reed and large sedge swamps (FS1). Other habitats include depositing/lowland rivers (FW2) and drainage ditches (FW4) associated with the St John's and Couse Rivers. There is an area of Wet-willow-alder-ash woodland (WN6) located towards the southern end of the site as well as in the north west corner of the site adjacent to the landfill. Refer to Figure 3 for site habitat map.

3.1.2 Plant list

WYG corresponded with Paul Green, Waterford vice-county BSBI recorder, regarding botanical records for Kilbarry Bog. Paul Green kindly supplied a species list for the site which he has compiled between 1997 and 2007. A total of 237 plant species have been recorded on the site and are presented in Appendix C.





The NPWS Site Synopsis sheet (as presented in Appendix A) states that Summer Snowflake *Leucojum aestivum* was known to be on the site. The last reported sighting was 1979 by L. Farrell. Paul Green states that he has not been able to locate this plant and it is likely to have been located on the part of the bog on which the landfill was constructed.

Paul Green reported that he has not found any species rare in Ireland in Kilbarry Bog but three species which are rare on a county scale are present, namely Mare's-tail *Hippuris vulgaris*, greater bladderwort *Utricularia vulgaris* and pink water speedwell *Veronica catenata*. None of these species were recorded in the nine quadrats surveyed by WYG in 2011.

3.1.3 Quadrat Survey

3.1.3.1 Results for 2011

All the quadrats were surveyed in the "Reed and Large Sedge swamp" habitat type, which was the dominant habitat on the site. The other significant habitat type is Wet-willow-alder-ash Woodland which was not surveyed in the quadrat assessment but is addressed in Section 3.1.4.

Common reed *Phragmites australis* was the dominant vegetation type in seven of the nine quadrats and greater tussock-sedge *Carex paniculata* was the dominant vegetation type in two of the quadrats. A summary of the dominant vegetation type is presented in Table 5 and the completed quadrat field recording sheets are presented in Appendix B. Quadrat locations are presented in Figure 4.

Overall the species diversity was low in each quadrat, with the number of species identified ranging from two to seven. Low species diversity is not uncommon within this type of habitat (Fossitt 2000). Apart from common reed and greater tussock-sedge, other species present in at least one quadrat were water horsetail *Equisetum fluviatile*, meadowsweet *Filipendula ulmaria*, nettle *Urtica dioica*, bindweed *Convolvulus arvensis*, willowherb *Epilobium sp.*, common valerian *Valeriana officinalis*, angelica *Angelica sylvestris*, creeping bent *Agrostis stolonifera*, reed canary-grass *Phalaris arundinacea*, erect bur-reed *Sparganium erectum* and common duckweed *Lemna spp.*



Table 5: Vegetation Quadrat results 2011

Quadrat Code	Dominant Species	DOMIN value	Number of plants in quadrat	Water Level above ground level
Q1	Common Reed <i>Phragmites australis</i>	8	4	1 cm
Q2	Common Reed <i>Phragmites australis</i>	7	5	1 cm
Q3	Common Reed <i>Phragmites australis</i>	10	2	3 cm
Q4	Common Reed <i>Phragmites australis</i>	10	4	3 cm
Q5	Common Reed <i>Phragmites australis</i>	10	4	8 cm
Q6	Greater Tussock-sedge <i>Carex paniculata</i>	8	5	0 cm (damp)
Q7-A	Common Reed <i>Phragmites australis</i>	9	7	1 cm
Q8	Common Reed <i>Phragmites australis</i>	10	4	0 cm (damp)
Q9	Greater Tussock-sedge <i>Carex paniculata</i>	8	5	1 cm

Note: GPS locations presented in field recording sheets in Appendix B.

3.1.3.2 Comparison in survey results from 2009 to 2011

Vegetation

The dominant plant species has not changed in eight of the nine quadrats between 2010 and 2011 as presented in Table 6. The common reed *Phragmites australis* species has become more dominant than greater tussock-sedge *Carex paniculata* in Q2, a continuing trend which has been identified during the quadrat survey in this area of the bog since 2009.

There was a variation in the DOMIN value of the main plant in four of the quadrats (Q1, Q6, Q8 and Q9) between 2010 and 2011. The variation in the DOMIN value of the main plant changed in two of the quadrats between 2009 and 2010.

There was an increase in the number of species in two (Q4 and Q5) of the quadrats and in four (Q1, Q3, Q6 and Q9) quadrats, total species number decreased during 2011. There was no change in the number of plant species in the remaining three (Q2, Q7-A and Q8) quadrats in 2011. The plants which varied generally



made up a small percentage of the quadrat (<5%). Overall there was no significant change in the general vegetation type or structure of any of the quadrats between 2009 and 2011.

Table 6: Changes in Vegetation between 2009 and 2011

Quadrat Code	Dominant Species		DOMIN value			Number of plants in quadrat		
	2010 - 2011	Change?	2009	2010	2011	2009	2010	2011
Q1	Common Reed	No	10	10	8	4	5	4
Q2	Common Reed*	Yes	5	7	7	4	5	5
Q3	Common Reed	No	10	10	10	2	3	2
Q4	Common Reed	No	10	10	10	4	3	4
Q5	Common Reed	No	10	10	10	4	3	4
Q6	Greater Tussock-sedge	No	9	9	8	4	6	5
Q7-A	Common Reed	No	n/a	9	9	n/a	7	7
Q8	Common Reed	No	7	9	10	5	4	4
Q9	Greater Tussock-sedge	No	9	9	8	4	6	5

*Note - Dominate species in Q2 between 2009-2010 was Greater tussock-sedge

Water level

The water levels in 2011 have decreased in six of the quadrats since 2009 as presented in Table 7. There has been a significant difference in the amount of precipitation between 2011, 2010 and 2009, with the summers of 2010 and 2011 becoming dryer year on year.

Table 7: Changes in Water level between 2009 and 2011

Quadrat Code	Water Level above ground level (cm)		
	2009	2010	2011
Q1	11	0 (damp)	1
Q2	2	2	1
Q3	10	5	3
Q4	22	5	3
Q5	20	10	8
Q6	2	0 (damp)	0 (damp)
Q7-A	n/a	0 (damp)	1
Q8	0 (damp)	0 (damp)	0 (damp)
Q9	2 to 3	2	1



3.1.4 Willow Woodland Habitat Assessment

The Ordnance Survey Ireland (OSI) website provides aerial photographs of Ireland from 1995, 2000 and 2005. A review of the aerial photographs of the site from these years indicates that the extent of the Wet-willow-alder-ash woodland habitat has not altered significantly between 1995 and 2005. There has not been a significant increase in the extent of the trees on site. This indicates that the balance between the willow woodland and the surrounding reed habitats has not altered significantly in recent years. Due to copy right it has not been possible to reproduce the aerial photographs in this report. They are available for review on www.osi.ie.

3.2 Water Quality and Salmonid Assessment

3.2.1 Biological Monitoring

The Q-value score for 2011, along with previous years is presented in Table 8 below. The full taxa list for each kick sample is presented in Table 9 and the physio-chemical measurements and sampling location characteristics are presented in Table 10, which are presented at the end of the report.

The results for St John's River indicate that the river continues to suffer from moderate pollution with a Q3 rating recorded in the two monitoring locations (S1 and S3/4). The sampling location S3/4 is located downstream of the landfill continues to shown a modest improvement from Q2-3 in 2008 to Q3 in 2009, 2010 and 2011. Location S1, situated upstream of the landfill, continues to have a score of Q3.

Lisduggan Stream remains seriously polluted with a score of Q1* recorded immediately upstream of the landfill (L1). This is a disimprovement since 2009 when the Q-value was Q1-2. Along the landfill's northern boundary (L2) the Q-value is Q1-2 which is similar to previous years. The drainage ditch along the northwest boundary of the landfill is also seriously polluted.



**Table 8: Biological Monitoring results from 2003 to 2011**

Location Code	Watercourse	2003	2004	2008	2009	2010	2011
S1	St John's River	Q3	Q3	Q3	Q3	Q3	Q3
S3/4	St John's River	Q2-3	Q2-3	Q2-3	Q3	Q3	Q3
L1	Lisduggan Stream	Q2/0	Q1/0	Q1	Q1-2	Q1	Q1*
L2	Lisduggan Stream	Q1-2	Q1	Q1	Q1-2	Q1-2	Q1-2
D1	Drainage Ditch	Q1-2	Q1-2	Q1-2	Q1-2	Q1-2	Q1-2

*indicates heavy siltation of substratum

3.2.2 Salmonid Assessment

The 2008 fish stock assessment reported that the St John River upstream of the site had the highest numbers of brown trout *Salmo trutta* (16), eel *Anguilla anguilla* (9) and brook lamprey *Lampetra planeri* (3) in relation to the other sampling locations. Three-spined stickleback *Gasterosteus aculeatus* was also present. The section of the St John River surveyed downstream of Kilbarry Bog had the same species but in lower densities. The Lisduggan stream had no trout, only one eel and no lampreys. Salmon *Salmo salar* was not recorded in any sampling location on either the St John River or Lisduggan Stream.

In 2010, a brook lamprey was collected in the kick sampling net at S3/4 and stickleback collected at the S3/4, Lisduggan L2 and Drainage Ditch D1. No such species were recorded during kick sampling in 2011.

As there has been no significant improvement in water quality since 2008 it is unlikely that there has been a significant improvement in salmonid populations in these water courses.



3.3 Otter Survey

The 2011 otter survey results are presented in Table 11 along with the results of the otter surveys conducted in 2003, 2004, 2008, 2009 and 2010. Refer to Figure 6 for otter survey map.

Table 11: Otter monitoring results 2003 to 2011

Location (Grid Ref)	Watercourse	Oct 2003	Sept 2004	July 2008	Sept 2009	Sept 2010	April 2011
Tramore Road (S59666 07988)	St John River	Otter spraint	*	*	*	*	*
Sheep’s Bridge (S59906 08789)	St John River	Otter spraint & mink scats	Otter spraint	*	Otter spraint	Otter spraint	Otter spraint
Couse Bridge (S60234 10902)	Couse River	Otter smear	Otter spraint	*	*	*	Otter spraint (upstream of culvert)
Foot Bridge at leisure Centre (S60062 10666)	St John River	-	-	*	Otter spraint	Otter spraint	*
Superquinn Bridge (S60123 10967)	St John River	-	-	-	*	*	*
Drainage Ditch (S59788 10547)	Lisduggan Stream	-	-	-	Mink scats	*	*
Bleach Bridge (S60125 10850)	Lisduggan Stream	Otter spraint	*	*	*	*	Mink Footprints

* indicates no otter signs encountered; - not surveyed

The 2011 survey encountered otter spraint at one location along the St John River – Sheep’s Bridge. Otter spraints were also recorded at this location in 2003, 2004, 2009 and 2010.

The Superquinn roundabout bridge is located at a busy junction with high banks and may not be a favourable location for otters to spraint. No spraints were recorded here in 2009, 2010 and 2011.

There was no evidence of otter on the Lisduggan Stream in 2011. Otter spraint was last detected here in 2003. The water quality of Lisduggan Stream is very poor and does not contain significant fish stocks. Therefore otters may only use the stream intermittently. Mink footprints were identified at Bleach Bridge in 2011.



Otter spraints were recorded on the Couse River upstream of the Waterford Outer Ring Road culvert during the 2011 survey. The spraint remains were observed on a typical otter sprainting site known as a 'seat' comprising of a large flat stone at the rivers bank. Access routes have been constructed during the road works to allow the mammal's safe passage under the road to mitigate from potential habitat fragmentation. No evidence of spraint were recorded at the Couse Bridge in 2011. Table 11 shows evidence of previous otter activity on the Couse River in 2003 and 2004. No otter Holts were located during the survey. Photographs of the spraint remains upstream of the culvert and footprints are present in Appendix D.

3.4 Kingfisher Survey

No kingfishers were observed within the Kilbarry Bog, along the St John's River or along the Lisduggan Stream or Couse River. This is a similar finding to the 2004, 2008, 2009 and 2010 surveys. The 2003 survey identified a kingfisher at the drainage ditch to the east of the landfill.

Reed Warbler

The reed warbler *Acrocephalus scirpaceusa* breeds on the site during the summer months. The Birds of Conservation Concern in Ireland (www.BirdWatchIreland.ie) has placed the reed warbler on its amber list (medium conservational concern) indicating that its national distribution is in decline. Five pairs were recorded in 1999 (NPWS Site Synopsis Sheet). This is a scarce migratory bird species in Ireland and Kilbarry Bog supports between 5% and 10% of the national breeding population.

An adult and juvenile were observed in the north western section (adjacent to Q3) of the bog during the vegetation survey in July 2011. The field characteristics of the reed warbler and distinctive call (guttural churring phrases) from the adult confirmed its identification.

3.5 Invasive Species/Threats to site

The main invasive species noted in the study area is Japanese knotweed which is well established at several locations across the site. Himalayan balsam was recorded at one location along the northern boundary of the landfill, outside of the Kilbarry Bog pNHA boundary. Refer to Table 12 for grid reference location of invasive species/treats to the site and Figure 7 for visual representation of their locations.

Infilling and illegal dumping are a threat to the site. A review of aerial photographs indicates that a significant area of the site (>1ha) was in-filled with hardcore material between 1995 and 2000. This has resulted in the loss of reed and tall sedge habitat. There is illegal dumping of builder's waste and other household material into the bog along the north east corner of the site close to the adjacent housing estate. Whilst at present this activity is minor, if it is allowed to continue it could become more substantial.

**Table 12: Invasive species and other threats to the site**

Threat	Grid Ref
Japanese knotweed	S 60125 09722
Japanese knotweed	S 60125 09832
Japanese knotweed	S 60126 09867
Japanese knotweed	S 60134 10087
Japanese knotweed	S 60121 10217
Himalayan Balsam	S 59782 10557
Builders Waste Material	S 60190 09676
In-filling	S 59973 09682

4.0 DISCUSSION AND CONCLUSION

4.1 Habitat Assessment

As presented in the 2008 report, habitat monitoring by means of habitat mapping only did not provide adequate detail or resolution to allow for long term monitoring of Kilbarry Bog. Therefore a semi-quantitative monitoring method, in the form of permanent quadrats, was recommended and commenced in 2009. Nine quadrats were installed and surveyed across the pNHA.

In 2010 eight of the nine quadrats were re-surveyed. One of the quadrats, Q7, could not be located and a replacement quadrat Q7-A was installed and surveyed. All nine quadrats were surveyed in 2011.

Overall there seems to be an increase in the abundance of common reed, where they had dominated in previous surveys (with the exception of Q1) and a decrease in the abundance of greater tussock-sedge from 2009 to 2011.

A comparison between 2009 and 2011 quadrat survey results indicate that there has been no significant change in the vegetative composition in the quadrats. The dominant plant changed in Q2 from the greater tussock-sedge to the common reed. The increase in abundance of common reed may be due to environmental changes such as the decreasing water levels observed in the bog between 2009 and 2011. The quadrat monitoring over the next few years will allow for a more robust and definitive picture to emerge of the vegetative changes that are occurring in the Kilbarry Bog.



4.2 Water Quality and Fisheries Assessment

The biological monitoring of the St John River, which was surveyed upstream and downstream of Kilbarry landfill, indicated that the river has moderate pollution (Q-value rating of Q3). This is similar to the water quality status of previous monitoring rounds in 2003, 2004, 2008, 2009 and 2010. The land use upstream of the site is predominantly agricultural. Organic pollution from farming activity, e.g. land spreading of farm waste material, may be the main cause of the moderate pollution in the water course.

Lisduggan Stream is seriously polluted upstream of the landfill (Q1*) and remains polluted downstream of the landfill. The EPA conducts analysis of water samples from the Lisduggan Stream and ditches associated with the landfill which indicate that certain parameters in these waters exceed some of the relative comparative standards. Thus, the landfill may be attributing to a certain extent to the poor water quality of the Lisduggan Stream along the landfill boundary but based on the biological monitoring the main cause of the serious pollution in the stream is from a source(s) originating upstream of the site.

Salmonid stocks in the St John River within and downstream of the Kilbarry Bog are poor according to the 2004 and 2008 electro fishing survey. No salmon were recorded upstream or downstream of the landfill, indicating that the moderate pollution of the river has negatively impacted on the salmonid fish population within the study area. Downstream of the pNHA there were low numbers of 3+ aged trout and no juveniles recorded. Upstream of the pNHA however there was relatively high number of trout, including juveniles, recorded.

The river originally meandered through the Kilbarry Bog. However it was channelised as part of the construction of a railway line in the nineteenth Century. Such changes to a river's morphology tend to have a significant impact on the salmonid quality of a river. The bottom of the channel becomes covered with silt and mud and there are less riffle habitats. This reduces the spawning and nursery potential for salmonid as they need silt free gravels in riffle habitats. The silting of the substrate also reduces the levels of macroinvertebrates on which salmonids can feed. The 2008 electro fishing survey indicated that the slow moving, deep water, channelised sections of the St John, within the pNHA boundary, can support older trout but not juveniles. Overall, a combination of moderate pollution and the morphological constraints of the river channel are negatively impacting on salmonid stocks in the Kilbarry Bog within the pNHA boundary.

Salmonid species are absent from the sections of the Lisduggan Streams within or adjacent to the landfill. The Lisduggan Stream is seriously polluted which is considered the main cause of negative impact on the



salmonid stocks. The stream has also been channelised along the northern section of the landfill which would reduce the value to spawning salmonids.

An improvement of water quality in the St John River and Lisduggan Streams, to unpolluted status, may increase trout numbers and lead to a return of salmonid species to the river. However, channelised sections of the water courses will continue to not provide salmonid spawning grounds. Inclusion of gravels and boulders in the channel improve the channel as a spawning/nursery habitat.

4.3 Otter and Kingfisher

The otter survey indicates that otters are frequenting the St John River and are frequenting one of the same locations in 2011 as they did in 2010. A new sprainting site was located during the 2011 survey which was upstream of the Couse River Bridge. Otters have extensive ranges, with territory size varying from c. 3km of river to as much as 30km or more (mean of c. 15-20km). As otters can travel large distances, the evidence observed along the St John River and Couse River within several hundred metres downstream or upstream of the route, indicates their presence on the entire length of that watercourse.

During the current survey, kingfishers were not recorded along the St John River, in line with previous surveys. Within the pNHA boundary the St. John's River is slow moving, lacking tall vertical banks with soft material suitable for nesting and contains few suitable perches for fishing. In addition the dense and overgrown river bank vegetation, combined with the poor water quality recorded, would further indicate the unsuitability of the habitat to support kingfishers. The river channel or water quality has not changed significantly since the 2009 survey so the status of the site for kingfishers has not improved.

The positive identification of the reed warbler adjacent to quadrat Q3 in the north western end of Kilbarry Bog during the vegetation survey was noted in July 2011. This scarce bird species relies on the reed and large sedge swamp habitat for breeding purposes and Kilbarry Bog reportedly supports between 5% and 10% of the national breeding population. No specific survey for this bird was conducted during the site works in 2011.

4.4 Invasive Species Survey

Japanese knotweed was recorded on a number of locations along the footpath and adjacent to the road within the site boundary. If left unchecked the Japanese Knotweed could have a significant impact on the integrity of the pNHA. It could cause bank stability issues along the St John River and may encroach on habitats within the site.





Himalayan balsam was not noted within the pNHA boundary but was noted along the Lisduggan Stream. This plant can spread rapidly along water courses. However, at present the current location of the plant is unlikely to impact on the pNHA as the Lisduggan stream joins the St John River downstream of the site. However, its seeds could be transported by animals brushing the plants.

Aerial photographs indicated that there was infilling of a section of the pNHA with hardcore material about 10 or 15 years ago. There is no evidence that such activity has occurred since then. This type of activity has an impact on the integrity of the pNHA by reducing the extent of natural habitat and possibly impacting on hydrology of the site. It could also lead to the introduction and further spread of invasive species such as Japanese knotweed.





5.0 RECOMMENDATIONS

- The habitat assessment, in the form of quadrat monitoring, should be conducted again in 2012. It was previously recommended that due to insignificant variations in the quadrat composition that the semi-quantitative monitoring should be carried out every two to three years; however the increasing field data will allow for a more accurate and comprehensive assessment of the vegetative changes occurring in the bog over the next three years.
- Water sampling of the St John River is recommended in addition to the Lisduggan Stream which is currently being monitored by the EPA. This would help to accurately assess the chemical pressures affecting the benthic macroinvertebrate fauna.
- A survey of the reed warbler should be conducted during the breeding season to accurately assess their current population status, for which Kilbarry Bog is of national importance.
- Any future ecological monitoring of the site should record invasive species and other threats to the integrity of the pNHA.
- A Japanese Knotweed Management Plan (JKMP) should be prepared for Kilbarry Bog to minimise the threat of the species impacting on the site and to prevent further spread.
- A programme should be put in place to ensure that infilling and fly tipping on the site is prevented.
- The habitat assessment of the site has assessed the habitat and plant communities within the pNHA. However, the animal communities, with the exception of otters and kingfisher, have not been addressed. Macroinvertebrates, in the form of flies, snails, beetles etc, are a key part of the food web and can act as an indicator of the overall quality of an ecological system. To determine which macroinvertebrate community is most suited to be surveyed on an annual basis it may be necessary to survey several different macroinvertebrate communities the first year. It is therefore recommended that a macroinvertebrate survey of the site is conducted in future monitoring rounds. Hoverflies (syrphids) and molluscs should be surveyed across the site and within the standing water areas water beetles should be monitored. All macroinvertebrate surveys should be conducted within the appropriate survey period as per the NRA (2004) guidelines.



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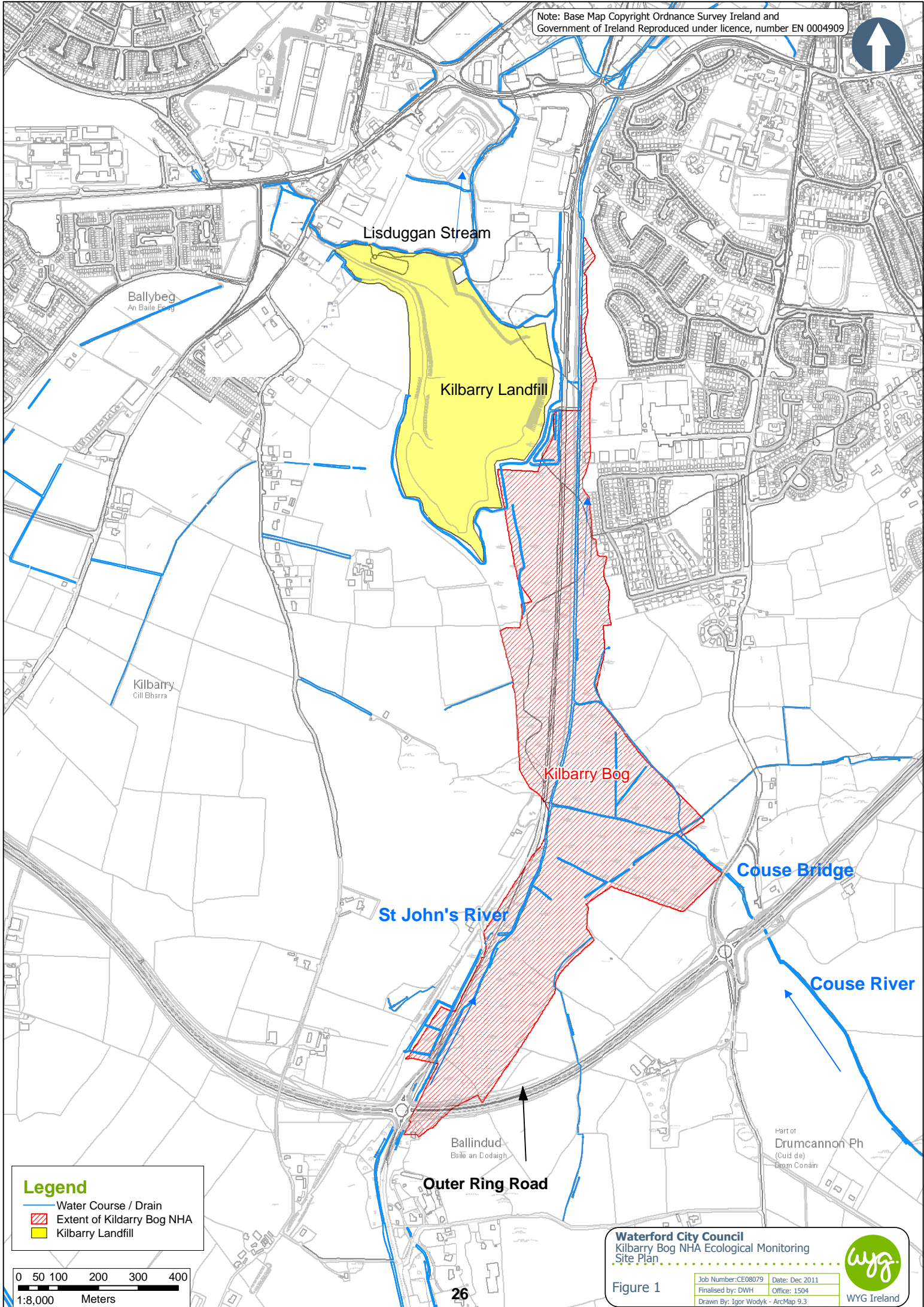
Environmental Protection Agency Ireland (EPA). EPA Data Website (www.epa.ie)

National Parks and Wildlife, the Heritage Service. Heritage Data Website (www.npws.ie)




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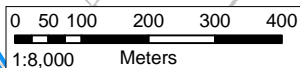
Ordinance Survey of Ireland – (www.osi.ie)

Figures



Legend

-  Water Course / Drain
-  Extent of Kildarry Bog NHA
-  Kilbarry Landfill



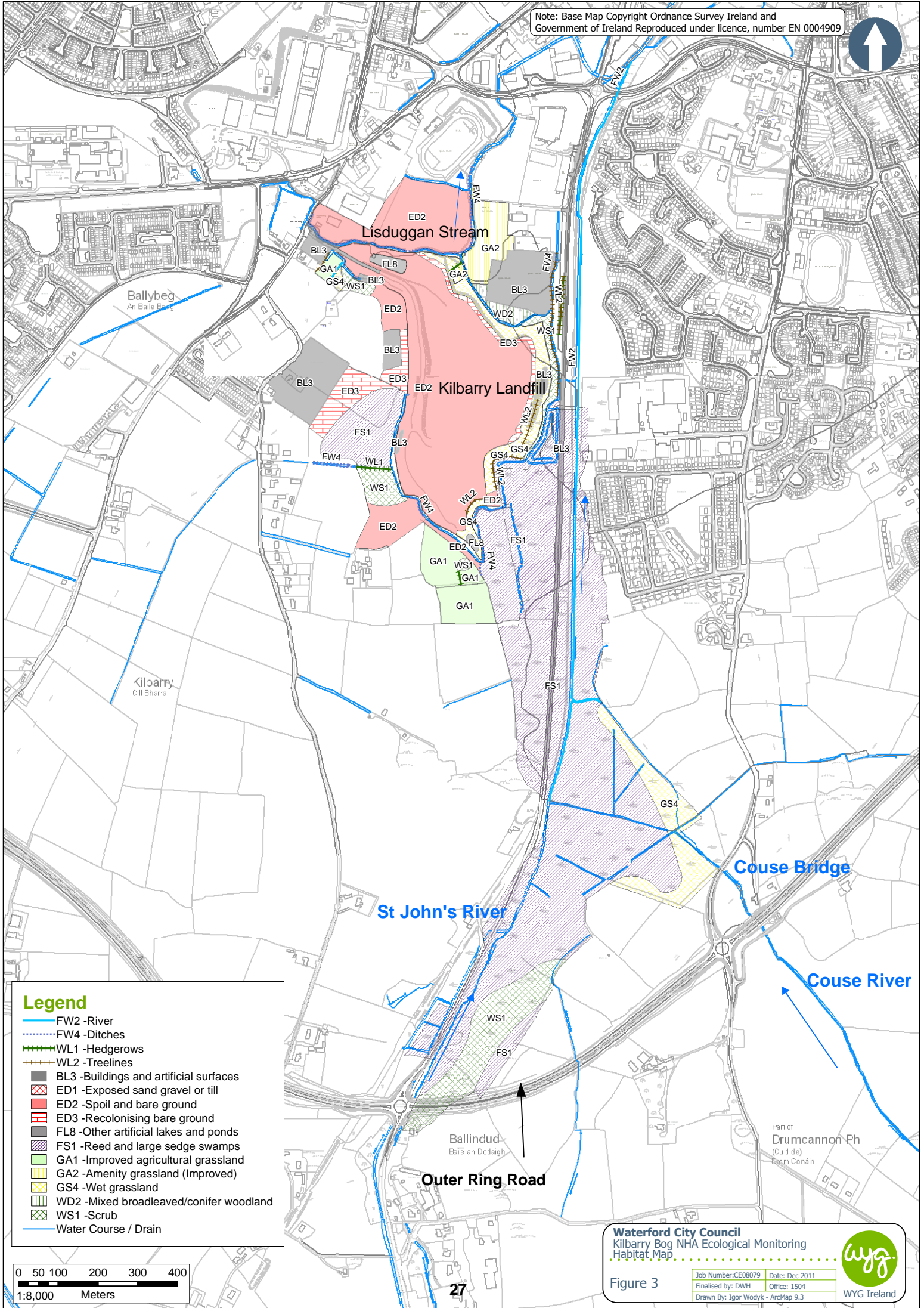
Waterford City Council
 Kildarry Bog NHA Ecological Monitoring
 Site Plan

Figure 1

Job Number: CE08079 Date: Dec 2011
 Finalised by: DWH Office: 1504
 Drawn By: Igor Wodyk - ArcMap 9.3

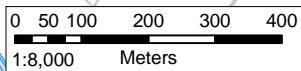


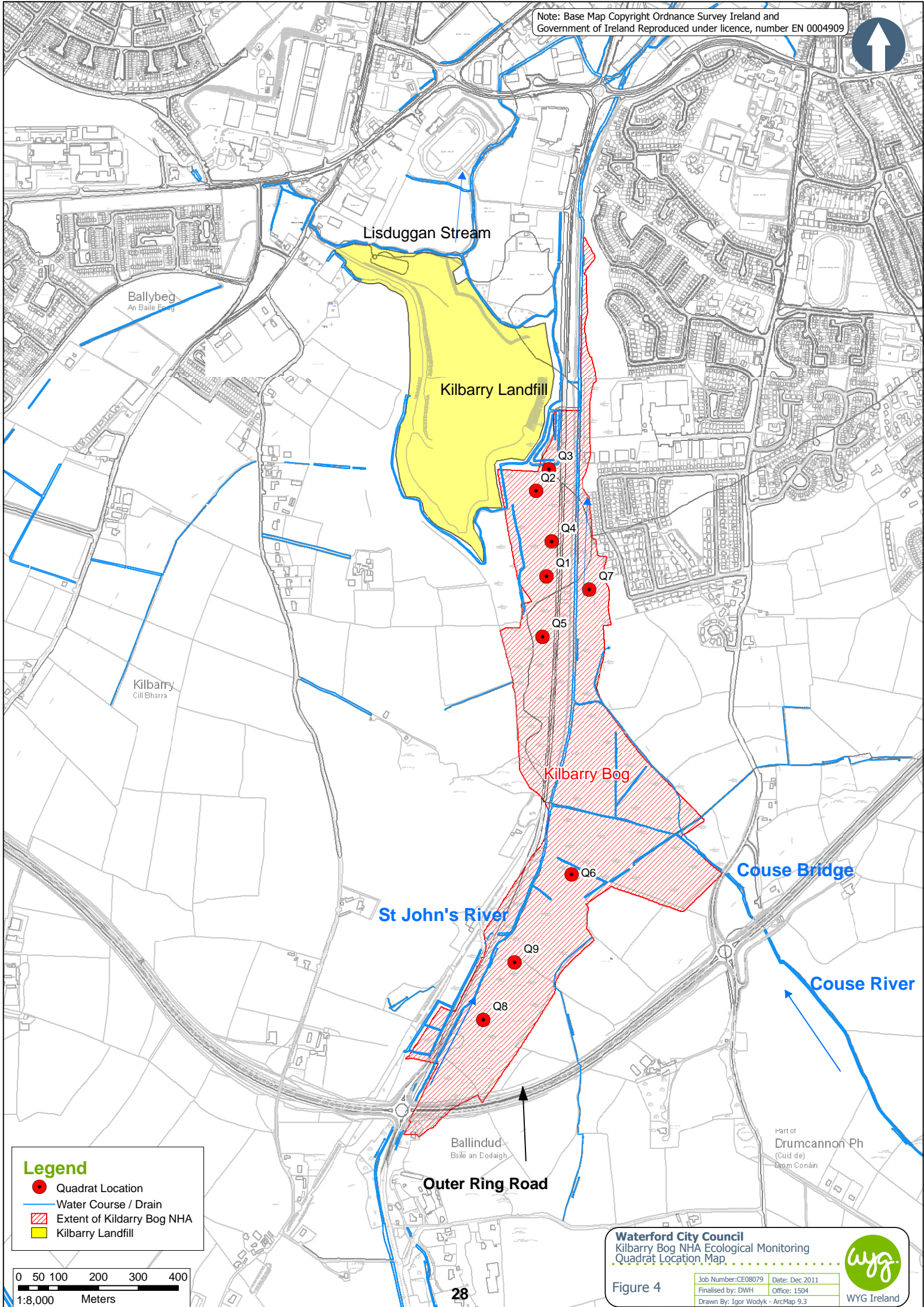
WYG Ireland



Legend

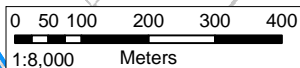
- FW2 -River
- FW4 -Ditches
- WL1 -Hedgerows
- WL2 -Trellines
- BL3 -Buildings and artificial surfaces
- ED1 -Exposed sand gravel or till
- ED2 -Spoil and bare ground
- ED3 -Recolonising bare ground
- FL8 -Other artificial lakes and ponds
- FS1 -Reed and large sedge swamps
- GA1 -Improved agricultural grassland
- GA2 -Amenity grassland (Improved)
- GS4 -Wet grassland
- WD2 -Mixed broadleaved/conifer woodland
- WS1 -Scrub
- Water Course / Drain





Legend

- Quadrat Location
- Water Course / Drain
- Extent of Kildarry Bog NHA
- Kilbarry Landfill



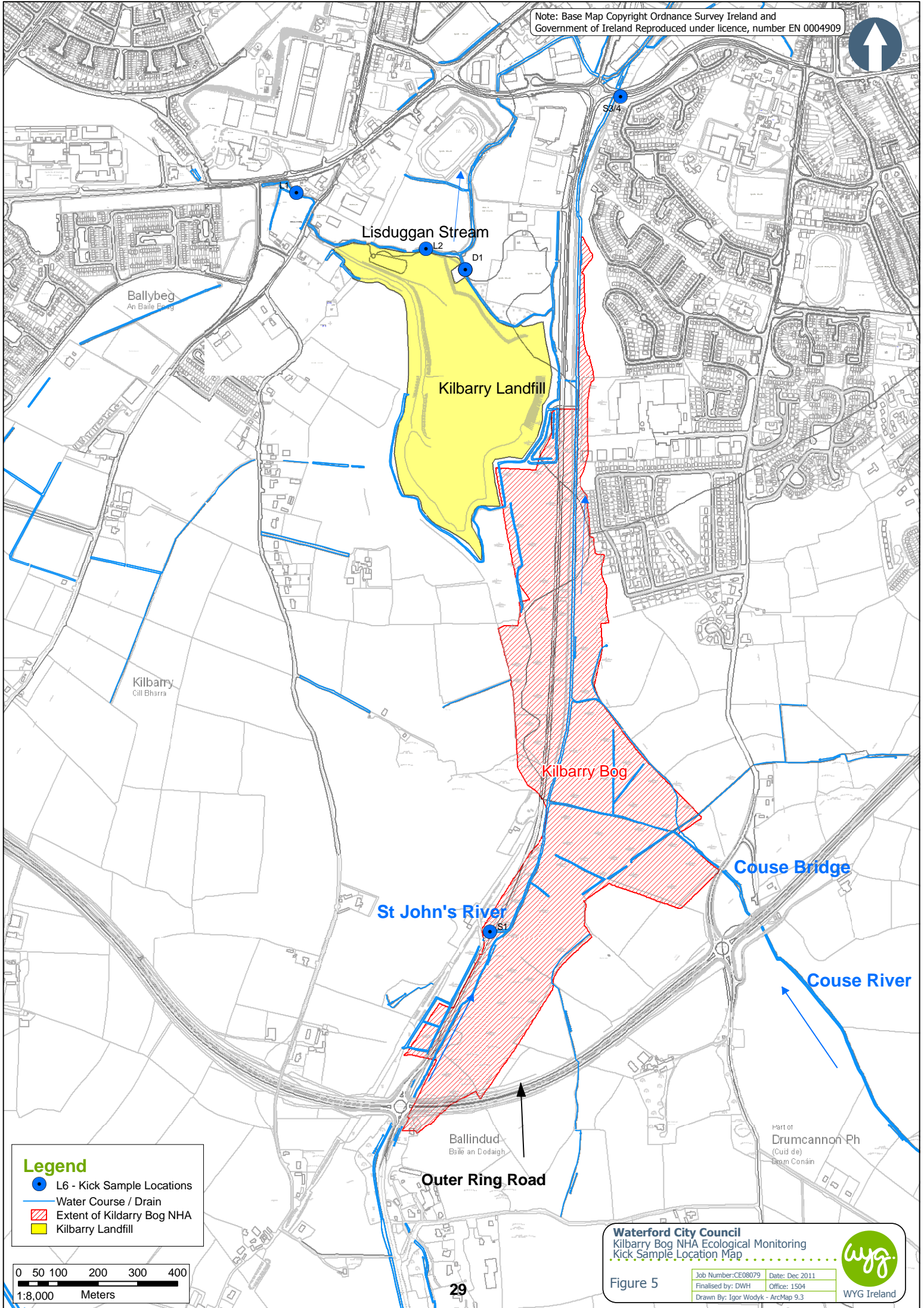
Waterford City Council
 Kilbarry Bog NHA Ecological Monitoring
 Quadrat Location Map

Figure 4

Job Number: CE08079 Date: Dec 2011
 Finalised by: DWH Office: 1504
 Drawn By: Igor Wodyk - ArcMap 9.3

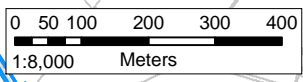


WYG Ireland



Legend

- L6 - Kick Sample Locations
- Water Course / Drain
- ▨ Extent of Kildarry Bog NHA
- Kilbarry Landfill



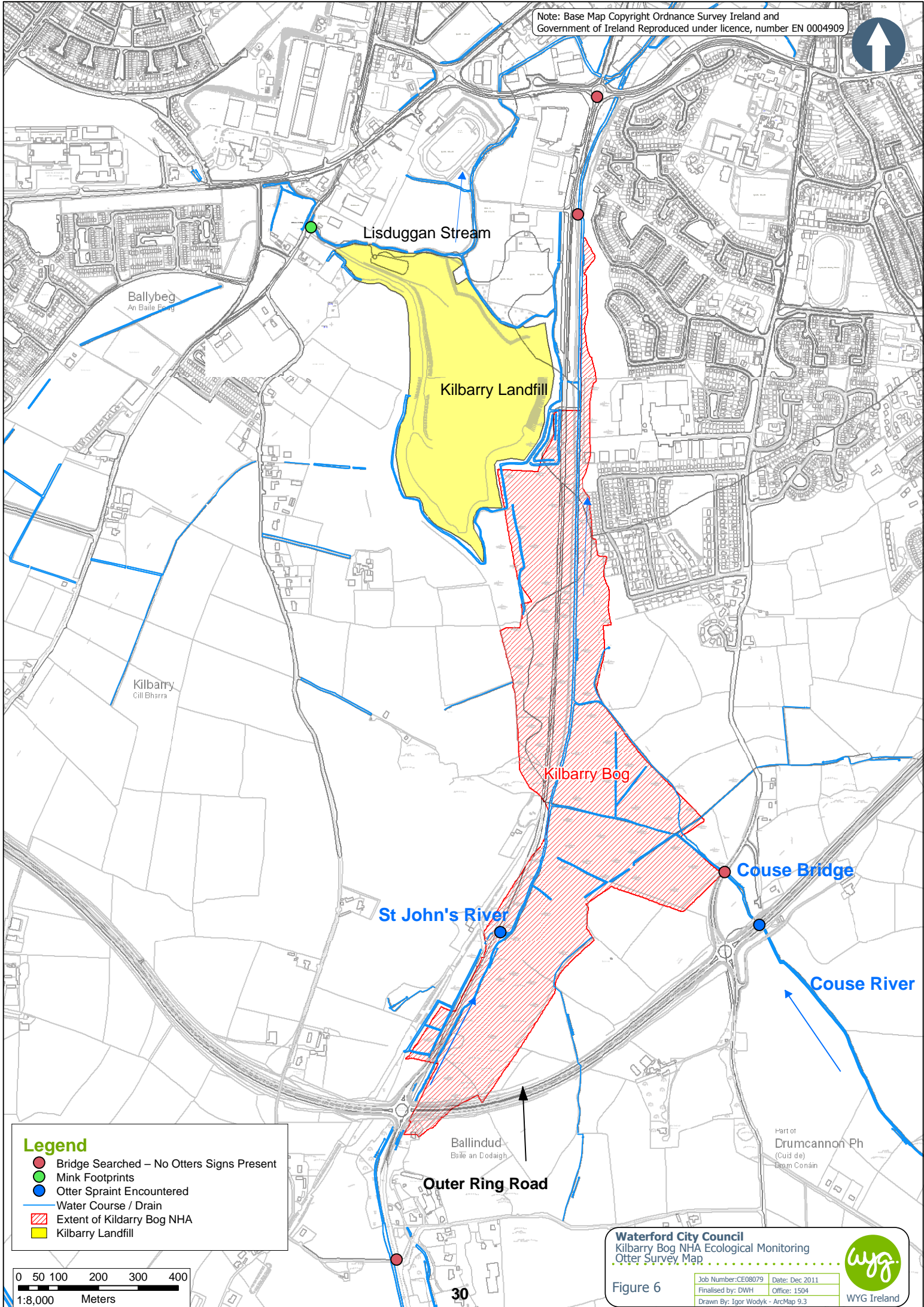
Waterford City Council
Kilbarry Bog NHA Ecological Monitoring
Kick Sample Location Map

Figure 5

Job Number: CE08079	Date: Dec 2011
Finalised by: DWH	Office: 1504
Drawn By: Igor Wodyk - ArcMap 9.3	

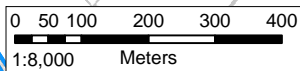


WYG Ireland



Legend

- Bridge Searched – No Otters Signs Present
- Mink Footprints
- Otter Spraint Encountered
- Water Course / Drain
- Extent of Kildarry Bog NHA
- Kilbarry Landfill



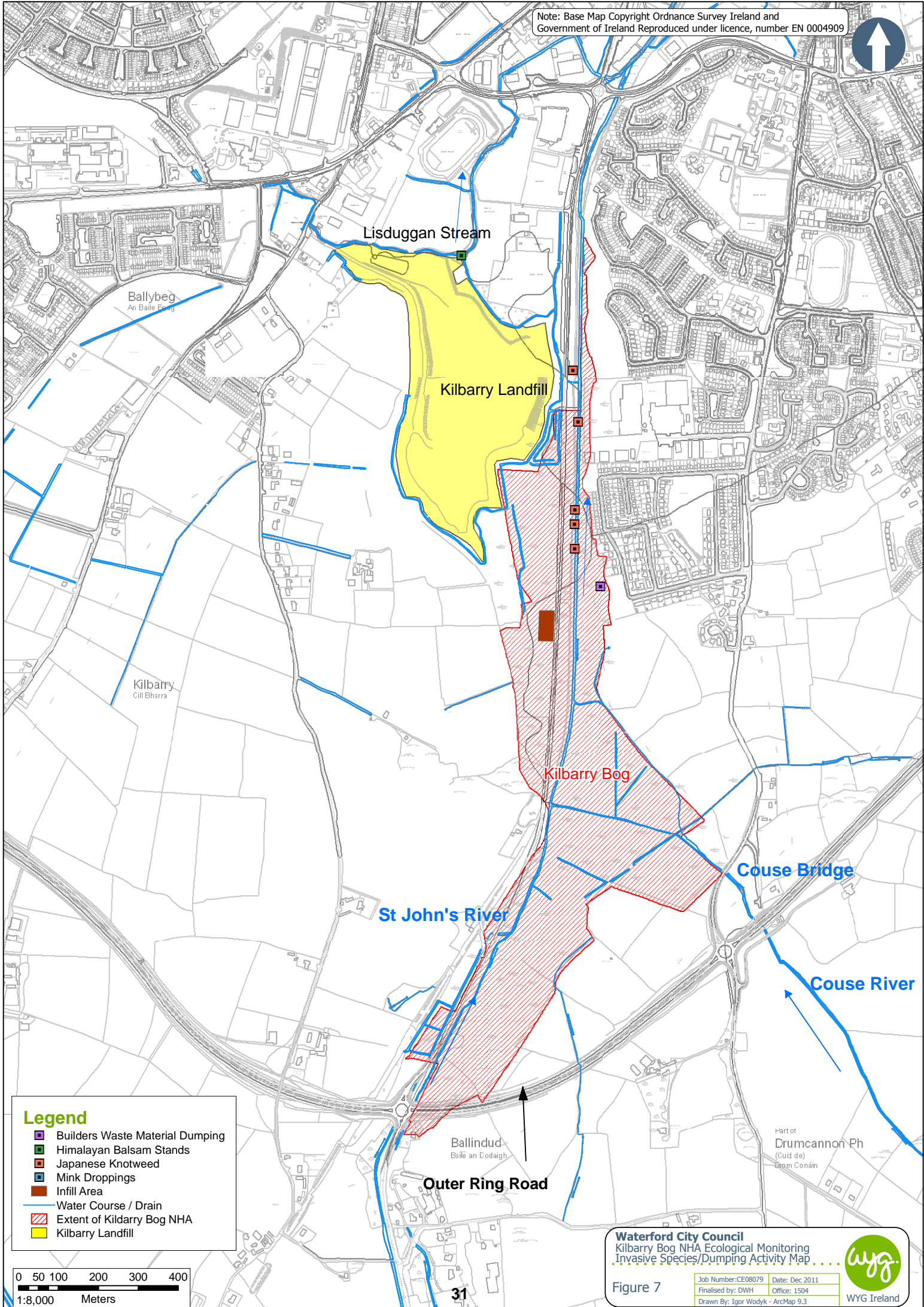
Waterford City Council
Kilbarry Bog NHA Ecological Monitoring
Otter Survey Map

Figure 6

Job Number: CE08079 Date: Dec 2011
Finalised by: DWH Office: 1504
Drawn By: Igor Wodyk - ArcMap 9.3



WYG Ireland



Legend

- Builders Waste Material Dumping
- Himalayan Balsam Stands
- Japanese Knotweed
- Mink Droppings
- Infill Area
- Water Course / Drain
- Extent of Kildarry Bog NHA
- Kilbarry Landfill

0 50 100 200 300 400
1:8,000 Meters

Waterford City Council
Kilbarry Bog NHA Ecological Monitoring
Invasive Species/Dumping Activity Map

Figure 7

Job Number: CE08079 Date: Dec 2011
Finalised by: DWH Office: 1504
Drawn By: Igor Wodyk - ArcMap 9.3



WYG Ireland

Tables

Table 9: Waterford City Council - Kibarry Bog pHNA Ecological Monitoring 2011 - Biological Monitoring - Kick Sample Species List

Sampling Date	Q-value Group	St. John's River		Lisduggan Stream		Ditch
		S1	S3/4	L1	L2	D1
		07/09/2011	07/09/2011	07/09/2011	07/09/2011	07/09/2011
Mayflies (Ephemeroptera)						
<i>Heptageniidae</i>	A					
<i>Ephemeridae</i>	A					
<i>Siphonuridae</i>	A					
<i>Leptophlebiidae</i>	B					
<i>Ephemerellidae</i>	C	6				
<i>Caenidae</i>	C					
<i>Baetidae</i>	B					
<i>Baetis Rhodani</i> **	C	3				
Stoneflies (Plecoptera)						
<i>Perlidae</i>	A					
<i>Perlodidae</i>	A					
<i>Nemouridae</i>	A					
<i>Leuctridae</i>	B					
Caddis flies (Trichoptera)						
Cased						
<i>Sericostomatidae</i>	B	4				
<i>Goeridae</i>	B					
<i>Limnephilidae</i>	B					
<i>Glossosomatidae</i>	B	1				
<i>Lepidostomatidae</i>	B					
Caseless						
<i>Hydropsychidae</i>	C	6				
<i>Philopotamidae</i>	C					
<i>Polycentropodidae</i>	C		1			
<i>Rhyacophilidae</i>	C					
Beetles (Coleoptera)						
<i>Elmidae</i>	C	31	2	3		
<i>Dytiscidae</i>	C	7	3			
Flatworms (Platyhelminthes)						
<i>Planariidae</i>	C					
<i>Dendrocoelidae</i>	C					
Crustaceans (Crustacea)						
<i>Gammaridae</i>	C	107	41		1	
<i>Asellidae</i>	D	9	18	21	59	80
True flies (Diptera)						
<i>Simuliidae</i>	C					
<i>Pediciidae</i>						
<i>Tipulidae</i>	C					
<i>Chironomidae</i>	C	1		15	22	35
<i>Chironomus spp.**</i>	E		2	3	10	29
<i>Syrphidae</i>	E					
Mites (Hydracarina)						
<i>Hydracarina</i>	C	4				
Snails & Limpets (Gastropoda)						
<i>Ancylidae</i>	C	4	3	3		
<i>Hydrobiidae</i>	C	31	13	7		6
<i>Planorbidae</i>	C		4	1	1	
<i>Lymnaeidae</i>	C		63	5		1
<i>Lymnaea peregra</i> **	D				1	2
<i>Physidae</i>	D		1			
Mussels (Bivalvia)						
<i>Sphaeriidae</i>	D					
Leeches (Hirudinae)						
<i>Piscicolidae</i>	C					
<i>Glossiphoniidae</i>	D	2		1	1	2
<i>Erpobdellidae</i>	D			5		
Worms (Oligochaeta)						
<i>Tubificidae</i>	E	3	4	350	22	47
<i>Lumbriculus</i>						1
Stickleback (Gasterosteidae)						
<i>Gasterosteus aculeatus</i>						2
Number of individuals		219	155	414	117	205
Number of types of taxa		10	6	6	5	5
Q-value		Q3	Q3	Q1*	Q1-2	Q1-2

Notes:

* indicates heavy siltation of substratum

**Species level of identification

Table 10: Waterford City Council - Kilbarry Bog pNHA Ecological Monitoring 2011 - Biological Monitoring - Physical observations

Location Reference	Unit	S1	S3/4	L1	L2	D1
Sampling date		07/09/2011	07/09/2011	07/09/2011	07/09/2011	07/09/2011
GPS Grid Reference		S 59914 08800	S 60225 10894	S 59455 10592	S 59841 10502	S 60047 10351
Physio-chemical Observation						
Dissolved Oxygen	mg/l	7.00	5.72	7.35	7.04	6.50
pH	pH Units	7.35	7.19	7.63	7.22	7.10
Conductivity @ 25°C	µS/cm	426	451	390	444	458
Temperature	°C	12.2	13	14.5	14.1	13.8
Physical Observation						
Habitat type		Riffle/Glide & Run	Run	Riffle/Glide	Stagnant	Stagnant
Substrate composition		Gravel, cobbles	Mud, gravelly, concrete blocks	Gravel, sand	Gravel, mud	Sandy/silty
Filamentous Aglae present		No	Yes	Yes	Yes	No
Sewage Fungus present		No	No	No	No	No
Macrophyte abundance	%	50	20	15	70	90
Water shading	%	50	50	70	20	30
Water depth	cm	10 to 30	70 to 100	10 to 20	10 to 20	10 to 20
Comment						Hydrocarbon sheen generated after walking in sediment

Appendix A

SITE SYNOPSIS

SITE NAME: KILBARRY BOG

SITE CODE: 001700

Kilbarry Bog is located on the southern outskirts of Waterford City; it lies on either side of the former Great Southern Railway line, parts of which are today used as a foot path and cycle way. The site is drained by the St John's River in the north, whilst there is a flow of water into the site from the hills to the south-east. This wetland is not, in fact, a bog in the true sense, but rather comprises an area of reed swamp, freshwater marsh, wet grassland and scrub. Parts of the site are known as Ballynakill Marsh.

Over the years the wetland has been reduced in extent by municipal rubbish dumping and subsequent reclamation to the north. The present site includes areas of reed swamp that are dominated by Common Reed (*Phragmites australis*) and with an abundance of Greater Pond-sedge (*Carex riparia*) and Lesser Pond-sedge (*C. acutiformis*). Bushes of Eared Willow (*Salix aurita*) and Grey Willow (*Salix cinerea* subsp. *oleifolia*) are scattered about the site. Other plant species present include Meadowsweet (*Filipendula ulmaria*), Marsh Valerian (*Valeriana officinalis*) and Tufted Hair-grass (*Deschampsia cespitosa*).

Around the swamp margins the vegetation grades into marsh and then to wet grassland; here, such species as Bottle Sedge (*Carex rostrata*), Brown Sedge (*Carex disticha*), Creeping Bent (*Agrostis stolonifera*), Soft Rush (*Juncus effusus*), Yellow Iris (*Iris pseudacorus*), Tall Fescue (*Festuca arundinacea*) and Royal Fern (*Osmunda regalis*) are found.

Summer Snowflake (*Leucojum aestivum*), a scarce species in Ireland, was first recorded from the site in 1900, and was present here at least as recently as 1979.

The site is used by Otter, a protected species in Ireland and one that is listed on Annex II of the E.U. Habitats Directive.

The site supports a good diversity of bird species associated with swamp vegetation. Those found throughout the year include Mallard, Water Rail, Moorhen, Grey Heron, Snipe, Reed Bunting and Grey Wagtail. In summer the site also supports important populations of migrant species, including Sedge Warbler, Reed Warbler, Willow Warbler, Chiffchaff, Whitethroat and Blackcap. Most, if not all, of these species breed at the site; the breeding population of Reed Warbler is of particular significance. This species was proved to be breeding at the site in 1999 (five pairs), the first breeding record for Co. Waterford. This is a scarce species in Ireland and Kilbarry Bog supports between 5% and 10% of the national breeding population. Other species using the site in late summer/autumn include Swallow, House Martin, Swift, Sand Martin and Starling, while in winter the site is

visited by Lapwing, Black-headed Gull, Jack Snipe, Pied Wagtail and additional numbers of Mallard. Kingfisher, a species that is listed on Annex I of the E.U. Birds Directive, has also been recorded from the site.

A range of interesting and often scarce invertebrate species has been recorded from the site. These include dragonflies, butterflies, moths and spiders.

Kilbarry Bog is a site of conservation importance for a variety of reasons: it is the only remaining wetland of its type of significance in the vicinity of Waterford City; it supports a variety of wetland vegetation types and plant species; it is the site of records for the scarce Summer Snowflake; it supports a good diversity of birds, including an important breeding population of Reed Warbler; a range scarce invertebrate species has been recorded from the site.

19.1.2005

Appendix B

Project Name	Kilbarry Bog Ecological Monitoring - Quantitative Habitat Mapping		
Quadrat Code	Q1	Surveyor	David Horgan
GPS Location	S60055 09700	Survey Date	05-Jul-11
Site Name	Kilbarry Bog pNHA	Quadrat Size	4m x 4m
Site Location	Waterford city	Slope	flat
Client	Waterford City Council	Aspect	N - S
Substrate Type	Organic	Water Level	1 cm
Stability	Firm	Fossitt habitat Code	FS1 - Reed and large sedge swamps
Adjacent Habitat Type	Urban (Road), agricultural, landfill		
Land Management	None		

Quadrat Vegetation Composition	
Taxa	Domin value
Common Reed <i>Phragmites australis</i>	8 (change from 10 in 2010)
Greater Tussock-sedge <i>Carex paniculata</i>	6
Water horsetail <i>Equisetum fluviatile</i>	2
Meadowsweet <i>Filipendula ulmaria</i>	1

Comments



Project Name	Kilbarry Bog Ecological Monitoring - Quantitative Habitat Mapping		
Quadrat Code	Q2	Surveyor	David Horgan
GPS Location	S60029 09914	Survey Date	05-Jul-11
Site Name	Kilbarry Bog pNHA	Quadrat Size	4m x 4m
Site Location	Waterford city	Slope	flat
Client	Waterford City Council	Aspect	N - S
Substrate Type	Organic	Water Level	1 cm
Stability	Firm	Fossitt habitat Code	FS1 - Reed and large sedge swamps
Adjacent Habitat Type	Urban (Road), agricultural, landfill		
Land Management	None		

Quadrat Vegetation Composition	
Taxa	Domin value
Common Reed <i>Phragmites australis</i>	7
Bindweed <i>Convolvulus arvensis</i>	6 (change from 8 in 2010)
Greater Tussock-sedge <i>Carex paniculata</i>	6 (change from 8 in 2010)
Nettle <i>Urtica dioica</i>	2
Meadowsweet <i>Filipendula ulmaria</i>	1

Comments
Willow trees to south and east of quadrat



Project Name	Kilbarry Bog Ecological Monitoring - Quantitative Habitat Mapping		
Quadrat Code	Q3	Surveyor	David Horgan
GPS Location	S60061 09968	Survey Date	05-Jul-11
Site Name	Kilbarry Bog pNHA	Quadrat Size	4m x 4m
Site Location	Waterford city	Slope	flat
Client	Waterford City Council	Aspect	N - S
Substrate Type	Organic	Water Level	3 cm
Stability	Soft	Fossitt habitat Code	FS1 - Reed and large sedge swamps
Adjacent Habitat Type	Urban (Road), agricultural, landfill		
Land Management	None		

Quadrat Vegetation Composition	
Taxa	Domin value
Common Reed <i>Phragmites australis</i>	10
Bindweed <i>Convolvulus arvensis</i>	2 (change from 4 in 2010)

Comments
Willow trees within 10m of quadrat



Project Name	Kilbarry Bog Ecological Monitoring - Quantitative Habitat Mapping		
Quadrat Code	Q4	Surveyor	David Horgan
GPS Location	S60068 09788	Survey Date	05-Jul-11
Site Name	Kilbarry Bog pNHA	Quadrat Size	4m x 4m
Site Location	Waterford city	Slope	flat
Client	Waterford City Council	Aspect	N - S
Substrate Type	Organic	Water Level	3 cm
Stability	Firm	Fossitt habitat Code	FS1 - Reed and large sedge swamps
Adjacent Habitat Type	Urban (Road), agricultural, landfill		
Land Management	None		

Quadrat Vegetation Composition	
Taxa	Domin value
Common Reed <i>Phragmites australis</i>	10
Bindweed <i>Convolvulus arvensis</i>	4 (change from 2 in 2010)
Meadowsweet <i>Filipendula ulmaria</i>	4 (change from 2 in 2010)
Nettle <i>Urtica dioica</i>	2 (not recorded in 2010)

Comments
Willow and poplar trees located within 5m of quadrat



Project Name	Kilbarry Bog Ecological Monitoring - Quantitative Habitat Mapping		
Quadrat Code	Q5	Surveyor	David Horgan
GPS Location	S60045 09549	Survey Date	05-Jul-11
Site Name	Kilbarry Bog pNHA	Quadrat Size	4m x 4m
Site Location	Waterford city	Slope	flat
Client	Waterford City Council	Aspect	N - S
Substrate Type	Organic	Water Level	8 cm
Stability	Firm	Fossitt habitat Code	FS1 - Reed and large sedge swamps
Adjacent Habitat Type	Urban (Road), agricultural, landfill		
Land Management	None		

Quadrat Vegetation Composition	
Taxa	Domin value
Common Reed <i>Phragmites australis</i>	10
Water horsetail <i>Equisetum fluviatile</i>	4
Erect Bur-reed <i>Sparagnumium erectum</i>	3
Common Duckweed <i>Lemna spp.</i>	3 (not recorded in 2010)

Comments
 Excavated pool located 5m east of quadrat



Project Name	Kilbarry Bog Ecological Monitoring - Quantitative Habitat Mapping		
Quadrat Code	Q6	Surveyor	David Horgan
GPS Location	S60118 08955	Survey Date	05-Jul-11
Site Name	Kilbarry Bog pNHA	Quadrat Size	4m x 4m
Site Location	Waterford city	Slope	flat
Client	Waterford City Council	Aspect	N - S
Substrate Type	Organic	Water Level	0 cm (damp)
Stability	Firm	Fossitt habitat Code	FS1 - Reed and large sedge swamps
Adjacent Habitat Type	Urban (Road), agricultural, landfill		
Land Management	None		

Quadrat Vegetation Composition	
Taxa	Domin value
Greater Tussock-sedge <i>Carex paniculata</i>	8 (change from 9 in 2010)
Common Reed <i>Phragmites australis</i>	7 (change from 5 in 2010)
Bindweed <i>Convolvulus arvensis</i>	3 (change from 4 in 2010)
Reed Canary-grass <i>Phalaris arundinacea</i>	3 (change from 4 in 2010)
Meadowsweet <i>Filipendula ulmaria</i>	2

Comments



Project Name	Kilbarry Bog Ecological Monitoring - Quantitative Habitat Mapping		
Quadrat Code	Q7-A	Surveyor	David Horgan
GPS Location	S60162 09667	Survey Date	05-Jul-11
Site Name	Kilbarry Bog pNHA	Quadrat Size	4m x 4m
Site Location	Waterford city	Slope	flat
Client	Waterford City Council	Aspect	N - S
Substrate Type	Organic	Water Level	1 cm
Stability	Firm	Fossitt habitat Code	FS1 - Reed and large sedge swamps
Adjacent Habitat Type	Urban (Road), agricultural, landfill		
Land Management	None		

Quadrat Vegetation Composition	
Taxa	Domin value
Common Reed <i>Phragmites australis</i>	9
Meadowsweet <i>Filipendula ulmaria</i>	5 (change from 2 in 2010)
Creeping bent <i>Agrostis stolonifera</i>	4
Bindweed <i>Convolvulus arvensis</i>	4 (change from 2 in 2010)
Greater Tussock-sedge <i>Carex paniculata</i>	3 (change from 4 in 2010)
Angelica <i>Angelica sylvestris</i>	2 (change from 5 in 2010)
Common Valerian <i>Valeriana officinalis</i>	2 (not recorded in 2010)

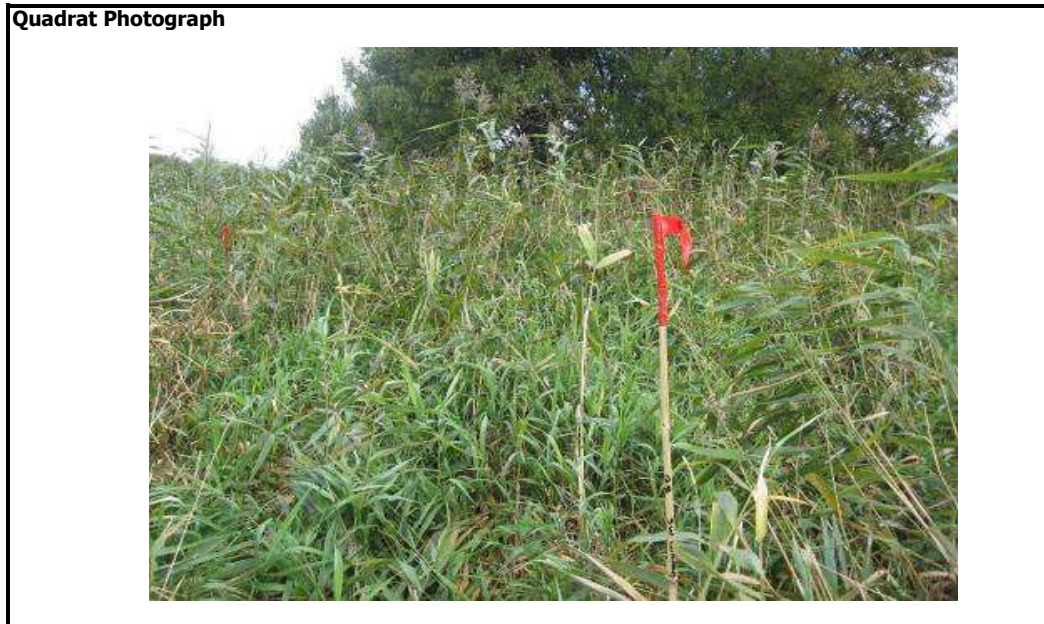
Comments



Project Name	Kilbarry Bog Ecological Monitoring - Quantitative Habitat Mapping		
Quadrat Code	Q8	Surveyor	David Horgan
GPS Location	S59897 08591	Survey Date	05-Jul-11
Site Name	Kilbarry Bog pNHA	Quadrat Size	4m x 4m
Site Location	Waterford city	Slope	flat
Client	Waterford City Council	Aspect	N - S
Substrate Type	Organic	Water Level	0 cm (damp)
Stability	Firm	Fossitt habitat Code	FS1 - Reed and large sedge swamps
Adjacent Habitat Type	Urban (Road), agricultural, landfill		
Land Management	None		

Quadrat Vegetation Composition	
Taxa	Domin value
Common Reed <i>Phragmites australis</i>	10 (change from 9 in 2010)
Nettle <i>Urtica dioica</i>	2 (changed from 4 in 2010)
Meadowsweet <i>Filipendula ulmaria</i>	2
Willowherb <i>Epilobium sp</i>	2

Comments



Project Name	Kilbarry Bog Ecological Monitoring - Quantitative Habitat Mapping		
Quadrat Code	Q9	Surveyor	David Horgan
GPS Location	S59975 08735	Survey Date	05-Jul-11
Site Name	Kilbarry Bog pNHA	Quadrat Size	4m x 4m
Site Location	Waterford city	Slope	flat
Client	Waterford City Council	Aspect	N - S
Substrate Type	Organic	Water Level	1 cm
Stability	Firm	Fossitt habitat Code	FS1 - Reed and large sedge swamps
Adjacent Habitat Type	Urban (Road), agricultural, landfill		
Land Management	None		

Quadrat Vegetation Composition	
Taxa	Domin value
Greater Tussock-sedge <i>Carex paniculata</i>	8 (change from 9 in 2010)
Common Reed <i>Phragmites australis</i>	6
Nettle <i>Urtica dioica</i>	5
Bindweed <i>Convolvulus arvensis</i>	3 (change from 4 in 2010)
Common Valerian <i>Valeriana officinalis</i>	1

Comments



Appendix C



Plant list - Kilbarry Bog

Surveys completed between 1997 and 2007 by Paul Green, Waterford vice-county BSBI Recorder

Common Name	Scientific Name
Alder	<i>Alnus glutinosa</i>
Almond Willow	<i>Salix triandra</i>
American Willowherb	<i>Epilobium ciliatum</i>
Amphibious Bistort	<i>Persicaria amphibia</i>
Annual Meadow-grass	<i>Poa annua</i>
Annual Mercury	<i>Mercurialis annua</i>
Apple	<i>Malus domestica</i>
Ash	<i>Fraxinus excelsior</i>
Atlantic Ivy	<i>Hedera helix subsp. hibernica</i>
Autumn Hawkbit	<i>Leontodon autumnalis</i>
Bittersweet	<i>Solanum dulcamara</i>
Bitter-vetch	<i>Lathyrus linifolius</i>
Black Medick	<i>Medicago lupulina</i>
Black Nightshade	<i>Solanum nigrum subsp. nigrum</i>
Blackthorn	<i>Prunus spinosa</i>
Bladder-sedge	<i>Carex vesicaria</i>
Bottle Sedge	<i>Carex rostrata</i>
Bramble	<i>Rubus fruticosus agg.</i>
Branched Bur-reed	<i>Sparganium erectum</i>
Broad Buckler-fern	<i>Dryopteris dilatata</i>
Broad-leaved Dock	<i>Rumex obtusifolius</i>
Broad-leaved Pondweed	<i>Potamogeton natans</i>
Broad-leaved Willowherb	<i>Epilobium montanum</i>
Brooklime	<i>Veronica beccabunga</i>
Bulrush	<i>Typha latifolia</i>
Bush Vetch	<i>Vicia sepium</i>
Butterfly-bush	<i>Buddleja davidii</i>
Canadian Waterweed	<i>Elodea canadensis</i>
Carnation Sedge	<i>Carex panicea</i>
Cat's-ear	<i>Hypochaeris radicata</i>
Celery-leaved Buttercup	<i>Ranunculus sceleratus</i>
Charlock	<i>Sinapis arvensis</i>
Cleavers	<i>Galium aparine</i>
Cock's-foot	<i>Dactylis glomerata</i>
Colt's-foot	<i>Tussilago farfara</i>
Common Bird's-foot-trefoil	<i>Lotus corniculatus</i>
Common Chickweed	<i>Stellaria media</i>
Common Comfrey	<i>Symphytum officinale</i>
Common Couch	<i>Elytrigia repens</i>
Common Dog-violet	<i>Viola riviniana</i>
Common Duckweed	<i>Lemna minor</i>



Common Field-speedwell	<i>Veronica persica</i>
Common Figwort	<i>Scrophularia nodosa</i>
Common Fleabane	<i>Pulicaria dysenterica</i>
Common Knapweed	<i>Centaurea nigra</i>
Common Marsh-bedstraw	<i>Galium palustre subsp. palustre</i>
Common Mouse-ear	<i>Cerastium fontanum</i>
Common Nettle	<i>Urtica dioica</i>
Common Ragwort	<i>Senecio jacobaea</i>
Common Ramping-fumitory	<i>Fumaria muralis subsp. boraei</i>
Common Reed	<i>Phragmites australis</i>
Common Sorrel	<i>Rumex acetosa subsp. acetosa</i>
Common Valerian	<i>Valeriana officinalis</i>
Common Vetch	<i>Vicia sativa subsp. segetalis</i>
Compact Rush	<i>Juncus conglomeratus</i>
Cow Parsley	<i>Anthriscus sylvestris</i>
Crack-willow	<i>Salix fragilis</i>
Creeping Bent	<i>Agrostis stolonifera</i>
Creeping Buttercup	<i>Ranunculus repens</i>
Creeping Cinquefoil	<i>Potentilla reptans</i>
Creeping Thistle	<i>Cirsium arvense</i>
Crested Dog's-tail	<i>Cynosurus cristatus</i>
Cuckooflower	<i>Cardamine pratensis</i>
Curled Dock	<i>Rumex crispus subsp. crispus</i>
Cut-leaved Crane's-bill	<i>Geranium dissectum</i>
Daisy	<i>Bellis perennis</i>
Dandelion	<i>Taraxacum agg.</i>
Dog-rose	<i>Rosa canina</i>
Dove's-foot Crane's-bill	<i>Geranium molle</i>
Downy Birch	<i>Betula pubescens</i>
Eared Willow	<i>Salix aurita</i>
Elder	<i>Sambucus nigra</i>
Elm-leaved Bramble	<i>Rubus ulmifolius</i>
False Fox-sedge	<i>Carex otrubae</i>
False Oat-Grass	<i>Arrhenatherum elatius</i>
Fat-hen	<i>Chenopodium album</i>
Field Bindweed	<i>Convolvulus arvensis</i>
Field Horsetail	<i>Equisetum arvense</i>
Floating Sweet-grass	<i>Glyceria fluitans</i>
Foxglove	<i>Digitalis purpurea</i>
Garden Privet	<i>Ligustrum ovalifolium</i>
Garden Strawberry	<i>Fragaria ananassa</i>
Germander Speedwell	<i>Veronica chamaedrys</i>
Giant Knotweed	<i>Fallopia sachalinensis</i>
Glaucous Sedge	<i>Carex flacca</i>
Gorse	<i>Ulex europaeus</i>
Great Horsetail	<i>Equisetum telmateia</i>
Great Mullein	<i>Verbascum thapsus</i>



Great Willowherb	<i>Epilobium hirsutum</i>
Greater Bird's-foot-trefoil	<i>Lotus pedunculatus</i>
Greater Bladderwort	<i>Utricularia vulgaris sens. lat.</i>
Greater Plantain	<i>Plantago major subsp. major</i>
Greater Pond-sedge	<i>Carex riparia</i>
Greater Tussock-sedge	<i>Carex paniculata</i>
Ground-elder	<i>Aegopodium podagraria</i>
Ground-ivy	<i>Glechoma hederacea</i>
Groundsel	<i>Senecio vulgaris</i>
Gypsywort	<i>Lycopus europaeus</i>
Hairy Bitter-cress	<i>Cardamine hirsuta</i>
Hairy Sedge	<i>Carex hirta</i>
Hairy Tare	<i>Vicia hirsuta</i>
Hard Rush	<i>Juncus inflexus</i>
Hawthorn	<i>Crataegus monogyna</i>
Hedge Bindweed	<i>Calystegia sepium subsp. sepium</i>
Hedge Mustard	<i>Sisymbrium officinale</i>
Hedge Woundwort	<i>Stachys sylvatica</i>
Hemlock	<i>Conium maculatum</i>
Hemlock Water-dropwort	<i>Oenanthe crocata</i>
Hemp-agrimony	<i>Eupatorium cannabinum</i>
Herb-Robert	<i>Geranium robertianum</i>
Hoary Willowherb	<i>Epilobium parviflorum</i>
Hogweed	<i>Heracleum sphondylium</i>
Honeysuckle	<i>Lonicera periclymenum</i>
Horse-chestnut	<i>Aesculus hippocastanum</i>
Hybrid Knotweed	<i>Fallopia x bohemica</i>
Indian Balsam	<i>Impatiens glandulifera</i>
Ivy-leaved Duckweed	<i>Lemna trisulca</i>
Ivy-leaved Speedwell	<i>Veronica hederifolia</i>
Japanese Knotweed	<i>Fallopia japonica</i>
Jointed Rush	<i>Juncus articulatus</i>
Keeled-fruited Cornsalad	<i>Valerianella carinata</i>
Knotgrass	<i>Polygonum aviculare</i>
Large Bindweed	<i>Calystegia silvatica</i>
Large Bindweed	<i>Calystegia silvatica subsp. disjuncta</i>
Lesser Celandine	<i>Ranunculus ficaria subsp. ficaria</i>
Lesser Pond-sedge	<i>Carex acutiformis</i>
Lesser Spearwort	<i>Ranunculus flammula</i>
Lesser Stitchwort	<i>Stellaria graminea</i>
Lesser Swine-cress	<i>Coronopus didymus</i>
Lesser Trefoil	<i>Trifolium dubium</i>
Lesser Water-parsnip	<i>Berula erecta</i>
Lords-and-Ladies	<i>Arum maculatum</i>
Lousewort	<i>Pedicularis sylvatica</i>
Mare's-tail	<i>Hippuris vulgaris</i>
Marsh Foxtail	<i>Alopecurus geniculatus</i>



Marsh Horsetail	<i>Equisetum palustre</i>
Marsh Pennywort	<i>Hydrocotyle vulgaris</i>
Marsh Ragwort	<i>Senecio aquaticus</i>
Marsh Thistle	<i>Cirsium palustre</i>
Marsh Woundwort	<i>Stachys palustris</i>
Marsh-marigold	<i>Caltha palustris</i>
Meadow Buttercup	<i>Ranunculus acris</i>
Meadow Foxtail	<i>Alopecurus pratensis</i>
Meadow Vetchling	<i>Lathyrus pratensis</i>
Meadowsweet	<i>Filipendula ulmaria</i>
Medium-flowered Winter-ress	<i>Barbarea intermedia</i>
Montbretia (C. aurea x pottsii)	<i>Crocsmia x crocosmiiflora</i>
New Zealand Willowherb	<i>Epilobium brunnescens</i>
Nipplewort	<i>Lapsana communis subsp. communis</i>
Osier	<i>Salix viminalis</i>
Oval Sedge	<i>Carex ovalis</i>
Oxeye Daisy	<i>Leucanthemum vulgare</i>
Parsley-piert	<i>Aphanes arvensis</i>
Pedunculate Oak	<i>Quercus robur</i>
Perennial Rye-grass	<i>Lolium perenne</i>
Petty Spurge	<i>Euphorbia peplus</i>
Pineappleweed	<i>Matricaria discoidea</i>
Plicate Sweet-grass	<i>Glyceria notata</i>
Prickly Sow-thistle	<i>Sonchus asper</i>
Procumbent Pearlwort	<i>Sagina procumbens</i>
Purple-loosestrife	<i>Lythrum salicaria</i>
R. crispus x obtusifolius	<i>Rumex x pratensis</i>
Red Bartsia	<i>Odontites vernus</i>
Red Clover	<i>Trifolium pratense</i>
Red Dead-nettle	<i>Lamium purpureum</i>
Red Fescue	<i>Festuca rubra agg.</i>
Red Valerian	<i>Centranthus ruber</i>
Redshank	<i>Persicaria maculosa</i>
Reed Canary-grass	<i>Phalaris arundinacea</i>
Remote Sedge	<i>Carex remota</i>
Ribwort Plantain	<i>Plantago lanceolata</i>
Rosebay Willowherb	<i>Chamerion angustifolium</i>
Rough Hawk's-beard	<i>Crepis biennis</i>
Rough Meadow-grass	<i>Poa trivialis</i>
Royal Fern	<i>Osmunda regalis</i>
Russian Comfrey (S. asperum x officinale)	<i>Symphytum x uplandicum</i>
Rusty Willow	<i>Salix cinerea subsp. oleifolia</i>
S. aurita x cinerea	<i>Salix x multinervis</i>
Scarlet Pimpernel	<i>Anagallis arvensis subsp. arvensis</i>
Scentless Mayweed	<i>Tripleurospermum inodorum</i>
Scots Pine	<i>Pinus sylvestris</i>
Selfheal	<i>Prunella vulgaris</i>



Sharp-flowered Rush	<i>Juncus acutiflorus</i>
Shepherd's-purse	<i>Capsella bursa-pastoris</i>
Shore Horsetail (E. arvense x fluviatile)	<i>Equisetum x litorale</i>
Short-fruited Willowherb	<i>Epilobium obscurum</i>
Silverweed	<i>Potentilla anserina</i>
Small Pondweed	<i>Potamogeton berchtoldii</i>
Small Sweet-grass	<i>Glyceria declinata</i>
Small-leaved Elm (sensu Stace)	<i>Ulmus minor</i>
Smooth Hawk's-beard	<i>Crepis capillaris</i>
Smooth Meadow-grass	<i>Poa pratensis</i>
Smooth Sow-thistle	<i>Sonchus oleraceus</i>
Soft Shield-fern	<i>Polystichum setiferum</i>
Soft-brome	<i>Bromus hordeaceus</i>
Soft-rush	<i>Juncus effusus</i>
Spear Thistle	<i>Cirsium vulgare</i>
Square-stalked St John's-wort	<i>Hypericum tetrapterum</i>
Sticky Mouse-ear	<i>Cerastium glomeratum</i>
Sun Spurge	<i>Euphorbia helioscopia</i>
Sweet Vernal-grass	<i>Anthoxanthum odoratum</i>
Swine-cress	<i>Coronopus squamatus</i>
Sycamore	<i>Acer pseudoplatanus</i>
Tall Fescue	<i>Festuca arundinacea</i>
Thyme-leaved Speedwell	<i>Veronica serpyllifolia subsp. serpyllifolia</i>
Timothy	<i>Phleum pratense</i>
Toad Rush	<i>Juncus bufonius</i>
Tufted Hair-grass	<i>Deschampsia cespitosa subsp. cespitosa</i>
Tufted Vetch	<i>Vicia cracca</i>
Unbranched Bur-reed	<i>Sparganium emersum</i>
Velvet Bent	<i>Agrostis canina</i>
Water Figwort	<i>Scrophularia auriculata</i>
Water Horsetail	<i>Equisetum fluviatile</i>
Water Mint	<i>Mentha aquatica</i>
Water-cress	<i>Rorippa nasturtium-aquaticum</i>
Water-plantain	<i>Alisma plantago-aquatica</i>
Weld	<i>Reseda luteola</i>
White Clover	<i>Trifolium repens</i>
White Willow	<i>Salix alba</i>
Wild Angelica	<i>Angelica sylvestris</i>
Wild Carrot	<i>Daucus carota subsp. carota</i>
Wild Cherry	<i>Prunus avium</i>
Wild Plum	<i>Prunus domestica</i>
Wild Privet	<i>Ligustrum vulgare</i>
Wild Radish	<i>Raphanus raphanistrum subsp. raphanistrum</i>
Wild Teasel	<i>Dipsacus fullonum</i>
Wild Turnip	<i>Brassica rapa subsp. campestris</i>
Winter Heliotrope	<i>Petasites fragrans</i>
Winter-cress	<i>Barbarea vulgaris</i>



Wood Avens	<i>Geum urbanum</i>
Wood Burdock	<i>Arctium nemorosum</i>
Wood Dock	<i>Rumex sanguineus</i>
Wood Sage	<i>Teucrium scorodonia</i>
Yarrow	<i>Achillea millefolium</i>
Yellow Iris	<i>Iris pseudacorus</i>
Yellow-wort	<i>Blackstonia perfoliata</i>
Yorkshire-fog	<i>Holcus lanatus</i>




Appendix D

Photograph 1 Otter Spraint upstream of Waterford Outer Ring Road culvert on Couse River



Photograph 2 Otter footprint upstream of Waterford Outer Ring Road culvert on Couse River



	Site Location: Kilbarry Bog Ecological Monitoring 2011, Waterford.	Drawing Title: Otter Survey Photographs
WYG Environmental & Planning (Ireland) Ltd. Unit 2, University Technology Centre, Curraheen, Cork. Ph. 021-4933200 Fax 021-4933250	Client: Waterford City Council	Project Number: CE08079

Appendix III

Environmental Management System and E.L.R.A.

Environmental Management System

Version 7, June 2012

Table of Contents

1.0 Environmental Management Plan

2.0 Schedule of Environmental Objectives and Targets

3.0 Corrective Action Procedure

4.0 Awareness and Training Procedures

5.0 Communications Programme

6.0 Waste Acceptance Procedures

7.0 Emergency Response Procedures

Kilbarry Landfill Site

1.0 Environmental Management Plan

1.0 Introduction

Kilbarry Landfill site is located (National Grid Reference 2598E 1103N) on the outskirts of Waterford City on the Dunhill Road, approximately 300m of the N25.

The site occupies an area of 20.1 hectares. Land use in the vicinity of the site is a mixture of open flat farmland with wetland to the southeast. The area to the north and west of the site is a mixture of residential and commercial properties.

The landfilling of waste at the site has resulted in the formation of a mound of waste above ground level. The waste body has a maximum height of 20mOD in the centre of the site. The remainder of the site has a maximum height of 17.5mOD on top of the waste body and a base level of 2m to 3mOD on the edge of the site.

The site has been in operation for approximately 40 years. The landfilling of waste has occurred on a former area of wetland known as Kilbarry Bog. A series of drains or channels are found on the entire western, southern and eastern perimeter of the landfill.

The waste license for the site was issued on the 19th of October 2001. The purpose of this Environmental Management Plan is to act as a site manual for Kilbarry Landfill and Civic Amenity Site. It outlines the requirements of the waste license (18-1) and sets out a programme for achieving the schedule of objectives and targets. A complete copy of the plan shall be kept at the site office and an additional copy at the offices of Waterford City Council.

1.1 Management and Staffing Structure of the Facility

The site is operated by Waterford City Council. The site is under the overall control of Colette Byrne, Director of Services, Waterford City Council. Mr. Richie Walsh, Senior Executive Officer, is responsible for the overall operation of the site. Mr. Vincent O'Shea, Civil Technician, is responsible for reporting to the E.P.A. and fulfilling responsibilities of the waste licence. Pauric McGarrigle, Executive Engineer, is responsible for the day to day supervision and management of the Civic Amenity Site and is assisted by the Facility Supervisor Mr. James Flavin. Details of the additional site staff are provided in Table 1.

Table 1: Operational Staff (Currently on Site)

Employee	<i>Duties and Responsibilities</i>
Mr. James Flavin	Collection of charges. Maintenance of on site records. Implementation of waste acceptance procedures. Site inspections. Monitoring of gas boreholes. Any other duties as required by site manager.
Mr. Ferdy Ozturk	Daily litter patrols. Maintenance of metals recovery compound. Any other duties as required by site manager/supervisor.

The facility manager maintains regular contact with the Senior Executive Engineer. Table 2 shows the current management structure of Kilbarry Landfill.

Table 2: Management Structure for Kilbarry Landfill

Position	Employee Contact Details
Director of Services Colette Byrne	Waterford City Council, Environmental Services, Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849701
Senior Executive Officer Richie Walsh	Waterford City Council, Environmental Services, Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849701
Landfill Manager Vincent O'Shea C.A.S. Manager Pauric McGarrigle Facility Supervisor James Flavin	Kilbarry Landfill Site, Kilbarry, Waterford. Tel: 051 379615 Fax: 051 379615

Any changes to this structure will be submitted to the EPA by the Landfill Manager. It shall be the responsibility of the C.A.S. Manager to organise staff in the absence of the named persons from the facility.

1.2 SITE DESCRIPTION

1.2.1 Waste Management Activities at the Facility

The waste categories and quantities that may be accepted for disposal and recovery, as outlined in Table A.1 of the Waste License, are shown below in Table 3.

Table 3: Waste Categories & Quantities for Disposal and Recovery

Waste Type	Maximum Tonnes Per Annum
Household	17,000
Commercial	12,500
Industrial Non Hazardous	28,500
Treated Sewage Sludges	2,500
Treated Industrial Non Hazardous Sludges	7,500
Construction & Demolition Waste	2,000
Wastes for Recycling & Recovery at the Civic Waste Facility	3,000
Waste for Recycling & Recovery at the Metal Recovery Area	2,000
Total	75,000

As of the 19th January 2003 commercial waste hauliers were stopped from disposing of waste at Kilbarry Landfill. As of 26th August 2005 Kilbarry Landfill ceased accepting domestic waste for landfill disposal. The landfill is currently closed to the public and restoration including permanent capping, gas and leachate abstraction works has been completed. Surface water drainage and landscaping works are to be completed. Currently all domestic waste collected by Waterford City Council is deposited at Veolias waste facility in Six Cross Roads Business Park before being hauled to Homestown Landfill in Wexford.

All waste loads arriving at the site were dealt with as per the waste acceptance procedures.

A civic amenity centre is located adjacent to the site entrance. The following range of goods are accepted for recycling: W.E.E.E., scrap metal, timber, cardboard, batteries, engine oil, cooking oil, glass bottles, aluminium cans, clothes, fluorescent tubes, energy saving light bulbs, aerosols and paint tins.

1.2.2 Methods of Waste Deposition

Previously any vehicle entering the site was weighed and all relevant information recorded. The vehicle was directed to the tipping area where the driver discharged the waste. The machine operator compacted the waste and covered it with daily cover material at the end of the day. Inert waste (such as clay, stone and C&D materials) was used as cover.

Currently all waste for landfilling weighed at Kilbarry is sent to Veolia for haulage to Homestown Landfill in Wexford.

1.2.3 Site Capacity

The site has been in operation in the region of 40 years. The total volume of waste deposited to date is estimated to be 1,094,513m³.

The last area of landfilling was located in the new cell constructed in 2002/2003 located at the northern end of the landfill.

1.3 Engineering Details

1.3.1 Site Description

Kilbarry landfill is located on the outskirts of Waterford City. The landfilling of waste has primarily taken place in unlined cells. Only one lined cell was constructed on site and landfilling has been ongoing in this cell since June 2003. Once this cell was full landfilling operations ceased at the site in August 2005. The landfilling has resulted in the creation of a waste mound up to 20m in height.

A description of the existing situation for each component of the specified engineering works is provided below with details of the proposed works and timescale for completion of the future work.

1.3.2 Fencing, Gates and Other Security

Fencing is installed around the full perimeter of the site. The fencing is a palisade fence, 2.4m high. With the closure of the site the fencing is no longer of intrinsic security value except while works are ongoing onsite for the final capping and gas abstraction systems. The future use of the site is envisaged to be a park landscaped with respect to the NHA bog to the south and the fencing may not be required due to its visual impact.

As per Condition 4.3.2 of the waste license, the facility manager will ensure that any temporary repairs to gates/fencing will be carried out where necessary, before the end of each working day and final repairs will be carried out within three working days. It is the responsibility of the facility manager (or other nominated person) to ensure that all gates shall be locked shut when the facility is unsupervised.

Site lighting is provided at the civic amenity area, which also lights the area around the weighbridge and the site office.

1.3.3 Leachate Management System

A leachate collection trench was installed around the perimeter of the site in 2002/2003. This trench was designed so as to prevent any leachate migrating off site and pump it to the leachate lagoon. The trench is a minimum of 1.2m in depth and 1m wide. The outer wall and floor of the trench are lined with 2mm thick HDPE liner. Perforated pipes run along the floor of the trench to carry any leachate which is collected and the trench is backfilled with a non-calcareous, granular, rounded stone, 16-32mm in size. The collection trench drains to five sumps located at various intervals around the perimeter of the site. The leachate is then pumped from these sumps to the leachate lagoon.

10 leachate abstraction boreholes were installed in the main body of the waste. Leachate is pumped from these boreholes to the leachate lagoon. A further three abstraction boreholes were installed in 2008.

A leachate lagoon was constructed north of the new cell. The lagoon has an overall capacity of 3,670 m³ and allowing for a freeboard of 0.5m a capacity of 2,670m³. The lagoon is pumped directly to the sewer.

A monitoring system was installed on the outfall of the leachate lagoon in accordance with the waste license in 2005. This system continuously monitors for flow, pH and methane. It also provides for a composite sampler that can be event controlled.

1.3.4 Construction of Lined Cell

Work began on the construction of a fully engineered lined cell in September 2002 and was completed in March 2003. The location of the cell is to the north of the site. The cell is made up of a number of different elements to ensure its integrity.

A subcell drainage layer 300mm thick was laid on the floor. Pipes were then laid in this layer to collect and carry and water that may arise. These pipes were then run underneath the western bank of the cell and into the adjoining stream. A 500mm layer of bentonite enhanced soil was then laid on the drainage layer and on the side slopes. The BES was batched on site and regularly tested in the site laboratory to ensure it could achieve the correct permeability. The BES was laid in two layers of 250mm each and compacted with a roller as it was laid. It was then tested using a nuclear densometer to ensure that it had achieved the correct moisture content and density.

A 2mm thick HDPE plastic liner and an 8mm thick geotextile were then laid over the bentonite layer. Over these a 500mm thick leachate collection blanket was laid. This consisted of a non-calcareous granular, rounded stone, 16-32mm grain size. A network of perforated pipes was placed through this collection blanket to collect and carry leachate arisings to the leachate sump. The leachate is then pumped from the sump to the leachate lagoon and on the sewer.

The cell was completed in March 2003 and waste was first placed in the cell on the 6th June. The cell was filled and the landfill closed in August 2005.

1.3.5 Surface Water Ponds

Three surface water ponds have been installed on the site. These ponds were operational while the site was. Since closure and the completion of final capping the surface water management system has become redundant and needs to be reinstated for the new levels onsite. A surface Water Management Plan was submitted to the Agency in April 2008. This was accepted by the Agency in a letter dated 26/11/08. Based on this contract documents were drafted in consultation with National Parks and Wildlife Services for the installation of a new surface water management system which compliments the use of the site as a public park. A further surface water pond was installed to the south of the landfill as part of this contract. These works were completed in early 2011.

1.3.6 Dry Wheel Shakeout Grid

The dry wheel shake out is located north of the metals recovery compound and was completed in late November 2002. All vehicles leaving the facility must first pass over the grid.

The shakeout grid occupies an area of 10m by 4m. As a vehicle travels over the grid, dirt and grit are loosened from the wheels and fall into a chamber below. The spoil is later removed

from the chamber below. A power wash can also be used in tandem with the shakeout grid in particularly bad weather. This shakeout grid has been filled in since completion of all restoration works on site as it is no longer necessary for the operation of the CAS.

1.3.7 Groundwater Monitoring Boreholes

The following is the list of groundwater monitoring boreholes that are now in operation at the site: GW2, GW4, GW5, GW6, GW7, GW12, GW15, GW16 (artesian) and GW17.

Monitoring of groundwater levels is undertaken weekly and sampling occurs quarterly with a more comprehensive analysis on an annual basis.

1.3.8 Leachate

A total of six boreholes were originally installed at the landfill, LM1 – LM6. However over time landfilling operations damaged a number of the boreholes. The damaged boreholes were replaced and an extra two were also installed. However a further two, LM2 and LM3 were damaged at some point prior to the commencement of final capping. During the capping works LM7 and LM8 were buried due to their low levels. For most of the year there was only one operational leachate monitoring borehole, LM1, due to capping works preventing access to the others. There are now currently four operational boreholes on site, LM1, LM4, LM5 and LM6.

Leachate levels are monitored on a weekly basis.

Analysis of the composition of the leachate is undertaken at quarterly intervals for a limited range of parameters with a more comprehensive analysis on an annual basis.

1.3.9 Gas Monitoring Boreholes

82 no. gas abstraction wells have been installed for the active extraction and flaring of gas from the site. These wells can also be used to monitor the gas production in the waste body during field balancing.

Perimeter monitoring: LM1, GW2, GW4, GW5, GW6, GW7, GW9, GW12, GW15, GW17. Three temporary monitoring points GW19, GW20 and GW21 are now inoperable due to works adjacent to the landfill site. 8 new monitoring points have been established on the western perimeter between the landfill and the closest residential houses in Lacken Wood estate. These number GW22 to GW29.

1.3.10 Surface Water

The waste license requires the monitoring of surface water quality at the following locations,

- At monitoring points S1 to S9 inclusive,
- EPA monitoring locations 0300, 0330, 0350 and 0400.

- Water quality monitoring including biological monitoring of the John's River and the Lisduggan Stream and other unnamed watercourses and tributaries upstream and downstream of the facility.

1.3.11 Ecological Monitoring

Annual ecological monitoring is required to include an ecological survey of habitats and associated plant and animal communities within and adjoining Kilbarry Bog proposed NHA.

1.3.12 Noise

Noise monitoring is required at 14 locations in the vicinity of the landfill (B1, B2, B3, B4, B5, B6, B7, NSL2, NSL3, NSL4, NSL5, at the nearest noise sensitive location on the western boundary between NSL3 and NSL5 which has been taken as Templers Hall housing estate, at the nearest noise sensitive locations in residential areas to the south-east and north-east of the eastern facility boundary which have been taken as Avondale housing estate and the Regional Sports Facility respectively.

1.3.13 Dust

Dust monitoring is required at seven locations around the perimeter of the site. It is required three times annually, twice between the months of May and September.

1.3.14 Odours

Odour monitoring is required on a quarterly basis at seven locations in the vicinity of the site. Odour Ireland carry out all odour monitoring required.

1.3.15 Final Capping

Final capping commenced in the October of 2005. There is currently 100% of the landfill area capped to its final levels..

The proposed phasing of the restoration works is as follows:

Table 6: Phasing of the restoration works

Component	Commencement	Completion
Completion of liner and final capping	October 2005	June 2008
Completion of gas abstraction system	November 2006	April 2008
Installation of Permanent Flare	October 2009	October 2009
Installation 3 new leachate wells	January 2008	April 2008
Surface Water Management	September 2010	January 2011
Landscaping	March 2011	April 2012

1.4 Site Operation

1.4.1 Description of the operations

The landfilling of waste has ceased at Kilbarry but a Civic Amenity Site operates at the old landfill entrance to the North of the overall site. Materials accepted here are :

- Timber
- Cardboard
- Batteries
- Engine oil
- Cooking oil
- Textiles
- Aluminium cans
- Glass bottles
- Fluorescent tubes
- Energy saving lightbulbs
- Metal
- W.E.E.E.

1.4.2 Site Opening and Operation Hours

The hours of operation of the Civic Amenity Site are between 11.00am and 4.30pm, Monday to Friday and 11.00am to 2.00pm on Saturdays.

1.4.3 Access

All personnel and vehicles entering the site are required to stop at the weighbridge which is located adjacent to the site entrance gate and report the purpose of their visit to the weighbridge operator. The weighbridge operator then directs vehicles to the relevant area. Public access to the site is limited to the civic amenity area and the metals recovery compound only.

Only personnel who are involved in monitoring, or otherwise authorised by the facility manager shall be permitted access to the landfill area outside the civic amenity/metal compound areas. Access to the site outside of normal working hours is not permitted unless authorised by the facility manager.

1.4.4 Waste Acceptance

All waste entering the facility is subject to the acceptance procedures. All staff involved in waste acceptance at the site are trained in the waste acceptance procedures.

Cars and trailers including light vans carrying materials for recycling or disposal shall be directed to the civic amenity area. The site caretaker shall be responsible for ensuring that the area is kept tidy and that the goods for recycling are placed in the correct collection area.

1.4.5 Control of Nuisances

1.4.5.1 Litter Abatement Measures

It is the responsibility of the facility manager to ensure the prevention of the spread of litter. Regular monitoring and site inspections are carried out to this end.

Contractors transporting materials for recycling offsite are required to ensure that when transporting and discharging these loads that litter is kept to an absolute minimum. All vehicles are required to be totally sealed or covered with a net or tarpaulin to ensure that materials are not blown from the vehicles.

Routine litter patrols are carried out on a daily basis to ensure that any loose litter is collected, this shall include the area surrounding the landfill, all fences and the approach road to the site.

1.4.5.2 Birds

Birds are no longer a nuisance at the site since the landfill closed.

1.4.5.3 Vermin

A contract is in place with Rentokil Ireland. A programme of baiting can be employed as required to control rat infestations with preventative baiting at regular intervals to ensure that large populations do not become established.

1.4.5.4 Flying Insects

This does not pose a nuisance since the closure of the landfill.

1.4.5.5 Fires

The burning of waste or other material is not permitted at the facility. Hot or burning loads of waste arriving at the facility are rejected. In the event that a fire breaks out on the site it is treated as an emergency and dealt with immediately.

1.4.5.6 Odour Control

Odour monitoring is carried out at quarterly intervals and the results for 2008 are contained in Appendix V. There were no odour complaints in 2008 and to date there have been no complaints or results of significance from monitoring.

1.4.5.7 Dust Control

Dust control measures will be employed during the construction/installation of specified engineering works. A mobile sprayer is employed to control fugitive dust emissions from the movement of vehicles during dry and windy weather. This is achieved through the spraying with water of site roads and any other areas used by vehicles. Speed restrictions shall also apply to construction vehicles within the landfill. The results for the dust monitoring for 2008 are contained in Appendix V.

1.4.6 Wheel – Cleaning Procedures

A dry wheel shake out unit has been installed to the north of the metals recovery compound. All vehicles shall be required to pass through the unit on the instruction of the site caretaker prior to exiting the site. The site caretaker shall make an assessment as to the need for the vehicle to pass through the unit based on the site conditions at the time.

1.4.7 Emergency Response Procedures

The emergency response procedures for the facility are contained in Appendix X as part of the overall Environmental Management System

1.4.8 Awareness and Training

An ongoing training programme has been set up to ensure that staff involved with the facility are sufficiently trained in achieving compliance with the conditions of the waste license. The programme is maintained and updated as required.

1.4.9 Communications Programme

A communications programme has been set up in order to allow any local community groups or local resident's access to information concerning the environmental performance of the facility at all reasonable times.

1.4.10 Environmental Monitoring & Maintenance Procedures

Monitoring shall be undertaken at such locations and parameters as outlined in Schedule F: Monitoring of the waste license and as specified in Condition 9. All monitoring is to be carried out in accordance with the EPA Manual on Landfill Monitoring.

The facility manager shall be responsible for implementing the following:

- The monitoring and recording of landfill gas using an infrared gas analyser at the gas monitoring locations specified in the waste license. All monitoring equipment shall be calibrated, maintained and operated in accordance with the manufacturers instructions. Written records of the calibrations and maintenance shall be kept. All equipment used for monitoring landfill gas shall be certified as being intrinsically safe.
- If a gas concentration reading at the site office exceeds the emission limit specified in Schedule G, the Emergency Response Procedures will apply.
- The visual inspection on a weekly basis of surface water monitoring locations as outlined in Schedule F: Monitoring
- The monitoring and recording of leachate levels within the filled waste on a weekly basis.
- Recording of data from the agreed climatological station on a monthly basis.
- The provision of safe and permanent access to all on-site sampling and monitoring points and off-site points.
- The maintenance and clear labelling of all sampling points.
- The replacement of all monitoring infrastructure which proves to be unsuitable for its purpose.

Upon the written instruction of the Agency only the facility manager shall amend that frequency, locations, methods and scope of monitoring, sampling, analyses and investigations and shall provide information concerning such amendments as may be requested in writing by the Agency.

The facility manager shall be responsible for forwarding copies of all environmental monitoring data to the Agency at the frequencies set out in schedule D of the waste license.

In accordance with Condition 9.18 monthly inspections of the landfill for evidence of slippage shall be undertaken.

1.4.10.1 Emission Limits

Any exceedance of the trigger levels for emission limits as listed in Schedule G of the waste license shall be deemed an incident and documented in accordance with Condition 3.2 and 10.7 (a to e) of the waste license and reported to the Agency (and the Southern Regional Fisheries Board if necessary) by the facility manager in accordance with condition 3.3.

1.4.10.2 Annual Environmental Report

The facility manager shall prepare and submit to the Agency for its agreement the annual environmental report. In accordance with Condition 2.4 the facility manager shall submit the annual environmental report within one month of the end of each calendar year.

The facility manager shall ensure that the annual environmental report is prepared in accordance with any relevant written guidance issued by the Agency and includes at a minimum the information specified in Schedule C: Content of Annual Environmental Report.

1.4.11 Operational & Safety Rules Including Safety Statement

The general safety statement of Waterford City Council applies to operation in the Kilbarry Landfill. Regarding work to be constructed by outside contractors each contractor shall provide a specific safety statement and be appointed Project Supervisor Health & Safety as required by the Health, Safety & Welfare at Work Regulations 1995.

1.5 Closure & Aftercare

1.5.1 Final End Use of Site

The site has been turned into a public park.

A layout of the park is contained in Drawing 4 in the Appendices.

1.5.2 Aftercare Monitoring

The EU Directive on the Landfill of Waste (1999/31/EC) and the guidance published in the Agency's Landfill manual "Landfill Restoration & Aftercare" requires that the operators of landfill site continue to monitor the groundwater, surface water, leachate and landfill gas after the closure of the site.

The site management shall ensure that the aftercare programme for Kilbarry Landfill will include stability assessment of the side slopes including slope stabilisation measures if required, monitoring of groundwater quality, leachate composition, surface water quality and landfill gas composition. The monitoring is to be carried out in accordance with the requirements of the EPA Manual on Landfill Monitoring. The following programme is proposed for the initial monitoring subsequent to the closure of the site. The proposed monitoring frequencies are outlined in Table 8 (based on EPA Landfill Monitoring Manual recommendations). The programme shall be reviewed on an annual basis.

Medium	Parameter	Frequency
Surface Water	Composition	Six monthly
Groundwater	Levels Composition	Six monthly
Landfill Gas	Gas Emissions	Six monthly
Stability & Settlement		Annually
Leachate	Levels	Six monthly
	Composition	Six monthly

Sampling to be carried out at representative locations.

1.5.3 Maintenance Programme for Aftercare Phase

It is proposed that maintenance shall be carried out as required at the site. Maintenance of the following equipment is envisaged during the aftercare period.

- Leachate pumps in collection sumps and abstraction wells
- Gas flarestacks and abstraction system
- Fencing and gates

It is recommended that the above items are inspected on a regular basis (minimum six monthly) and that maintenance shall be carried out as required.

3.0 Corrective Action Procedures

Throughout the operation of the landfill facility, there will be a need to resolve any non-compliance's of the waste license that may arise as a result of problems with operation, complaints from the local community, non-conforming subcontractors etc. This procedure defines the approach that will be taken in implementing and evaluating corrective action to prevent the recurrence of non-compliance's. The purpose of this procedure is to ensure that all corrective actions are documented and that the EPA are notified of any incident.

Responsibilities

The facility manager will be responsible for co-ordinating the corrective action procedures for Kilbarry Landfill and is responsible for retaining the corrective action file and forms. The Senior Engineer will be responsible for the review of corrective action forms and ensuring that controls are applied to ensure that corrective actions are implemented and effective. The landfill operational staff shall be responsible for following the procedure.

Corrective action is required in the event of the following:

- Any emission which results in the contravention of any relevant standard, including any standard for an environmental medium, or any relevant emission limit value, prescribed under the relevant enactment.
- Any emission which does not comply with the requirement of the license.
- Any trigger level specified in the license or in the EMS which is exceeded.
- Any indication that environmental pollution has, or may have taken place.
- Any occurrence with the potential for environmental pollution.
- Any emergency.
- Any incident which requires preventative action.
- Any failure to comply with procedures or systems.

Procedures

In the event of a non-compliance or incident occurring, the facility manager shall:

1. Take necessary short-term action to prevent the immediate reoccurrence of the problem or minimise any further impact.
2. Conduct a thorough investigation of the root cause of the problem to identify the nature, source and cause of the incident and any emission.
3. The person reporting the incident will identify the date, time and place of the incident. In the event that any monitoring, sampling or observations indicating that an incident has, or may have occurred the facility manager will be immediately notified.
4. Document the results of the investigation and propose a long-term corrective action to prevent recurrence of the problem on the corrective action form.
5. Enter the corrective action into the corrective action register.
6. Submit the completed corrective action form to the Senior Engineer who shall review the recommendation and accept or require additional investigation. If additional investigation is required the form and attachments will be returned to the facility manager, who will continue with the investigation as detailed by the Senior Engineer. If the recommendation is acceptable the facility manager will implement the corrective action.
7. Monitor the success of the corrective action.
8. Document the evidence that was reviewed to determine the effectiveness of the corrective action on the corrective action form.

9. File the original corrective action and any accompanying paperwork in the corrective action form and copy the completed form to the Senior Engineer.
10. Notify the EPA.
11. Implement changes in procedure resulting from the corrective action.
12. Arrange staff training if required.

Corrective Action Form

Non-compliance:

Briefly describe what the root cause of the problem was after your investigation

Name of investigator:

Signature:

Date:

Short-term Corrective Action:

Briefly describe the immediate action that was taken to prevent further impact

Action taken by:

Signature:

Date:

Long-term Corrective Action:

Briefly describe recommended action to prevent recurrence

Details of further investigation if necessary:

Approved By:

Responsibility assigned to:

Date:

Review of Monitoring:

Briefly describe the evidence that was reviewed to determine the effectiveness of the corrective action

Signature:

Date:

4.0 Awareness and Training Procedures

Purpose

The purpose of this procedure is to identify and provide appropriate training needs for all personnel whose work is related to the operation of Kilbarry Landfill. It shall ensure that personnel are aware of the potential hazards and environmental impacts associated with their work on the landfill.

The operation of a modern landfill requires staff to have the relevant knowledge, training and experience in order to minimise the potential impacts of the landfill on the surrounding environment and to meet the requirements of the waste license and all relevant legislation.

Responsibility

The facility manager will be responsible for the following:

1. To identify and assess the training needs of all staff involved in the operation of the landfill.
2. To ensure that each employee receives the necessary training relating to his or her work procedures.
3. To ensure that contractors have received the relevant training prior to work on the landfill.
4. To organise all training courses.
5. To increase employee awareness of potential hazards and necessary precautions.
6. To ensure that all staff are provided with the necessary instruction and training to carry out their work having due regard to their safety, the safety of others and the public at large and also to ensure that best practice is followed in every respect of the landfill operation.

Procedure

The facility manager shall:

1. Set up a register of all training programmes completed by personnel involved in the operation of Kilbarry landfill.
2. Identify the training needs of staff based on their work procedures.
3. Research suitable training programmes and forward details to Senior Engineer for approval.
4. Organise staff to attend training programmes.
5. Ensure additional training will be provided when new procedures are established, new equipment is obtained or at any time a change in the employees working environment may create a potential hazard.

Documentation

Completion of the training for each individual will be documented on a separate form and maintained by the facility manager to ensure that each member of staff is provided with the information they are required to have to perform their job safely.

5.0 Communications Programme

The communications programme shall ensure that members of the public can obtain information concerning the environmental performance of the facility at all reasonable times.

Introduction

Council Directive 90/313/EEC on the Freedom of Access to Information on the Environment recognised the significance of the public's access to information relating to the environment. To ensure that members of the public can obtain information concerning the environmental performance of Kilbarry landfill the communications programme described below shall be implemented at the facility.

The purpose of this programme is to allow any local community groups, key interest groups, local residents and members of the local community access to information on matters relating to the environmental performance of Kilbarry Landfill. This in turn will address any local community concerns and allow the public the opportunity to provide feedback on the facility

Programme:

1. All requests concerning the environmental performance of the facility should be made in writing to:
Vincent O'Shea,
Facility Manager,
Kilbarry Landfill,
Kilbarry,
Waterford City.
2. The facility manager shall copy all requests to:
Colette Byrne,
Director of Services,
Waterford City Council,
Environment & Water Services Dept.,
Maritana Gate,
Canada Street,
Waterford.
3. Each request should indicate the name, address and contact telephone number of the concerned party, an outline of the information required and the manner in which they require the information.
4. If requested, a suitable member of staff will provide a clear, unbiased explanation of the information provided.
5. The Director of Services or other authorised, nominated representative in Waterford City Council or any other nominated person will deal with replies to requests made by the media for information relating to the environmental performance of the landfill.

Record Keeping

1. All records of request for information regarding the environmental performance of the landfill and all minutes of meetings with concerned parties and details of site visits/open days shall be maintained. All of the aforementioned files shall be stored at the site office at Kilbarry Landfill and at the offices of Waterford City Council, Planning & Environment Department.

6.0 Waste Acceptance Procedures

Kilbarry Landfill comprises of a closed landfill site and a civic amenity centre for recycling for a limited number of streams of waste.

The following procedures have been put in place for waste acceptance by Waterford City Council:

Household Waste:

Household waste in Waterford City is collected by the City Council and transferred to Veolia, Six Cross Roads Depot for transport to Powerstown Landfill in Carlow. There is a crush loader bin lorry kept onsite for any household waste that is brought direct to the civic amenity site by the public. When the waste arrives at the landfill the weighbridge operator instructs the member of the public that it must be bagged if it is not already and that there is a charge of 1 black bin tag per bag of waste.

Following a cursory visual inspection the householder is to be directed to the refuse lorry located in the civic amenity centre where he/she can dispose of the waste. If the weighbridge operator suspects that the load may contain unacceptable material (e.g. recyclables) a more thorough examination is to be carried out. If recyclable material is found that can be disposed of in the C.A. site the householder is to be directed to the appropriate location. If material is found that can neither be disposed of or recycled on site the householder should be instructed to remove said material off-site.

Fridges:

Fridges are a hazardous waste. Fridges are only stored on site before being transported off-site by KMK Recycling for correct disposal. When a householder arrives on-site he/she should be instructed to leave the fridge in or next to one of the two containers for the fridges. Every evening any fridge's that have been deposited that day should be moved into the container if not already done. If the container is nearing full KMK should be contacted and a collection organised.

Small W.E.E.E. :

Anyone bringing small electrical goods to Kilbarry should be directed to the cages for same inside the container in the Civic Amenity Site. These cages are emptied roughly once a week by KMK.

Large W.E.E.E.:

Large white electrical goods are to be stored in the metals compound in a neat and tidy manner for collection. The compound should be checked every evening and morning for signs of vandalism or dumping. Regular collections by KMK are essential to maintaining the compound in a clean and tidy state.

Commercial Waste:

There is no commercial waste of any type to be accepted at Kilbarry Civic Amenity Site.

Cardboard:

Householders bringing cardboard to the Civic Amenity Site should be directed to the compactor onsite and accompanied by a member of staff. The staff member should inspect the cardboard for contamination and remove any waste not suitable for compaction. This can be bagged and charged as per normal domestic waste. The cardboard should be placed into the compactor while it is not operating. Once the hopper is full the staff member should close the hopper and open the control mechanism locked in the compartment on the wall beside the compactor. The staff member can only operate the compactor whilst keeping the emergency stop button control in his hand at all times. The control must be locked away again once the

hopper is empty and ready for more cardboard. The control mechanism must never be left unlocked and accessible to the public.

Other Recyclables:

The following materials are accepted for disposal at the recycling centre:

Aluminium cans

Glass bottles

Untreated timber

Paint Tins

Batteries

Waste oil

Fluorescent tubes

When a person comes in wishing to recycle they should be directed to the appropriate location. If a person wishes to dispose of waste oil a City Council staff member should dispose of it for them.

7.0 Emergency Response Procedures

Condition No: 10.1 Emergency Response Procedures

Condition: The licensee shall, within six months of the date of grant of this licence, submit an updated written Emergency Response Procedure (ERP) to the Agency for its agreement. The ERP shall address any emergency situation which may originate on the facility and shall include provision for minimising the effects of any emergency on the environment.

7.1 Scope / Objective

Condition 10.1 of Waste Licence No. 18-1 granted to Waterford City Council for Kilbarry Landfill site by the Environmental Protection Agency (EPA) requires the City Council to prepare an Emergency Response Procedure (ERP). The ERP will apply to Kilbarry Landfill Site and describes the actions to be taken in the event of a site emergency.

The purpose of this procedure is to propose appropriate actions to ensure health and safety risks to employees and visitors, and damage to property and the environment is minimised.

7.2 Responsibility

This document describes the ERP for the Kilbarry Landfill Site. The ERP will be maintained at the landfill site by the Landfill Engineering Manager. He will be responsible for the implementation of this procedure.

The Landfill Deputy Managers, Weighbridge Clerk and all Waterford City Council employees at the site will be responsible for following this procedure. Changes to the ERP will not be made without written approval from the Agency.

In the event of an emergency the EPA must be notified. The contact details are shown below:

**Ms. Emer O'Reilly,
Environmental Protection Agency,
PO Box 3000,
Johnstown Castle Estate,
Co. Wexford.
Tel: 053 60600
Fax: 053 60699**

7.3 Definition

Emergency

An emergency is defined as an unforeseen or sudden occurrence demanding immediate action.

7.4 Circulation List

The ERP is distributed to those named below and is available for reference from the Landfill Engineering Manager whose copy will be maintained at the site office. In order to maintain control of the procedures within the revision process, the ERP should not be copied without permission from Ms. Colette Byrne, Director of Services. Persons using this document are responsible to ensure that they are using the most up to date version.

	Position
Colette Byrne	Director of Services
Richie Walsh	Senior Executive Officer
Vincent O'Shea	Landfill Manager

7.5 Procedures

7.5.1 Emergency Response Procedures

1. Emergencies can be:-
 - activation of site office fire or gas alarm
 - discovery of a fire within the site boundary
 - landfill gas detected exceeding safe operating levels within the site boundary or outside the site
 - explosions
 - flooding
 - uncontained spillage / leakage
 - major injury or dangerous occurrence
2. In the event of an emergency all employees should react promptly and calmly, following the guidelines outlined in this document.

7.5.2 Activation of Office Fire or Gas Alarms

1. The site's offices is fitted with fire and gas detection systems. The landfill gas concentration limits are 1% v/v for methane and 1.5% v/v for carbon dioxide. The gas alarm will sound if gas is detected above these specified limits and the smoke alarm will sound if smoke is detected in the office.
2. On hearing an alarm all personnel must evacuate the offices, closing all windows and doors behind them, if practical.
3. All personnel should proceed to the assembly point outside the front gates where employees, site visitors and site contractors will be accounted for (the site visitors book and contractors sheets should be checked if accessible).
4. The emergency services should be notified immediately by dialling 999 if it is suspected a fire has broken out or if the fire alarm sounds. Personnel should only tackle a fire if safe to do so and if they have been trained in the use of a fire extinguisher.
5. If the alarm is legitimate, the Landfill Engineering Manager should be notified as soon as is practicable.
6. The EPA should be notified as per condition 3.3 of the waste license (contact details above) and the incident should be recorded in the site incident report form.

7.5.3 Procedure for Dealing with Hot or Burning Loads

1. If on inspection a load is found to be hot or burning it should be refused admission to the site.
2. Details of the load (name, registration number, type of load, site of origin) should be recorded in the appropriate register retained in the site office.
3. If the load has entered the site, prior to deposition, it should be directed to the Quarantine area, away from the Civic Amenity Site to a location where the material can be extinguished. These loads must never be located close to areas of the site which are lined in case of heat damage to the liner.
4. If the load has been deposited it should be spread in a controlled manner and covered with inert material. This should always be carried out by working from the edges of the load inwards toward the centre. Machines must never be driven through the burning material.
5. The EPA should be notified as per condition 3.3 of the waste license (contact details above) and the incident should be recorded in the site incident report form.

Refer to 7.5.4 for dealing with fires.

7.5.4 Procedure for Dealing with Fires and Explosions on Site

The EPA should be notified of all fires and explosions on site.

1. **Procedure for Dealing with Fires**

The Landfill Engineering Manager or deputy should be informed immediately. The previous procedure for fires assumed an operational landfill. Since the closure of the landfill and installation of the gas abstraction system the possibility of a fire in the waste is greatly reduced. The following is the procedure for any fires within the existing site.

- a) All personnel must evacuate the offices. The emergency services should be notified immediately by dialling 999. Personnel should only tackle a fire if safe to do so and if they have been trained in the use of a fire extinguisher
- b) All personnel should proceed to the assembly point outside the front gates where employees, site visitors and site contractors will be accounted for (the site visitors book and contractors sheets should be checked if accessible).
- c) The EPA should be informed as per Condition 3.3 of the Licence (contact details above) and the incident should be recorded in the Site Incident Report Form.

2. **Procedure for Dealing with Explosions**

- a) Ensure all personnel and site visitors are accounted for.
- b) Check site for signs of fires resulting from the explosion. If identified follow the procedure in Section 1 above.
- c) If the explosion results in personal injury the emergency services should be called by the Landfill Engineering Manager or his appointed deputy in his absence. In the event of a fire refer to Section 1 above. In addition, the EPA should be notified as soon as is practicable.
- d) Access to the immediate area should be restricted. Under no circumstances should further waste be deposited until authorised by the Landfill Engineering Manager.
- d) Every effort should be made after (d) above to identify the cause and source of the explosion.
- f) The EPA should be informed as per Condition 3.3 of the Licence (contact details above) and the incident should be recorded in the Site Incident Report Form

7.5.5 Procedure for Dealing with Uncontained Spillage/Leakage

1. Immediately report the occurrence to the Landfill Engineering Manager or in his absence, his appointed deputy.
2. The spill/leak should be contained using the spill kit and the material recovered (if possible) by the most appropriate means available (plant, inert material etc.).
3. Access to the immediate area should be restricted, if necessary.
4. The EPA should be notified as soon as is practicable (contact details in Section 2.0).
5. Having carried out all practicable actions the EPA should be consulted to agree any further action which may be required.
6. The incident will be reported to the Site's Incident Report Form.

7.5.6 Procedure for Dealing with a Serious Injury

1. Immediately report the incident to the Landfill Engineering Manager or in his absence, his appointed deputy. If required, the emergency services should also be notified as soon as is practicable.
2. The immediate area should be kept clear to provide access for the emergency services.
3. Record all injuries in the accident book and note as much information about the accident as possible.
4. Report the incident to the Health and Safety Manager as soon as is practicable. The Health & Safety Officer is Mr. Chris O'Sullivan, telephone number 051 309934.
5. If practicable the area in which the incident took place should remain undisturbed until any investigations into the circumstances are complete.
6. The incident will be reported on the Site's Incident Report Form.

7.5.7 Procedure for Dealing with a Landfill Gas Emergency

The following plan has been drawn up in accordance with the guidelines outlined in WMP 27. Areas around Kilbarry Landfill which may be affected by migrating gas include the landfill site offices and surrounding houses.

1. The landfill site office is currently monitored for the presence of methane and carbon dioxide.
2. If concentrations of methane and carbon dioxide in the office exceed 2,500ppm (0.25% v/v) and 5,00ppm (0.5% v/v) respectively, the building shall be ventilated and monitored until it can be demonstrated that concentrations remain below these levels.
3. If concentrations of methane and carbon dioxide in the landfill office exceed 10,000ppm (1% v/v) and 15,000ppm (1.5% v/v) respectively, the alarm will sound and the building shall be ventilated and then evacuated immediately.
4. The alarm will deactivate when the gas levels fall below the above levels. The building should be left to ventilate for another 15-20 minutes and then re-entered wearing the appropriate Personal Protective Equipment (PPE) and monitored until it can be demonstrated that concentrations remain below 0.25% and 0.5% for methane and carbon dioxide respectively.
5. The residence at the front of the landfill should be contacted and gas samples taken from the house to ascertain gas levels. The contact for this residence is Ms. Ann Kennedy, Kilbarry, Tel: 087 6717516.
6. If the gas levels exceed those in Step 2 the building should be monitored until it can be demonstrated that concentrations remain below those levels.
7. If gas levels persist both the Gardai (Telephone no. 051 305300) and Bord Gais (Telephone no. 1850 205 050) should be contacted.

7.6 Unable to Accept Waste

The inability to accept waste may be caused by one of the following:-

- Mechanical failure;
- Power failure;
- Industrial disputes;
- Fire;

In the event of a mechanical breakdown of plant at the site the Landfill Engineering Manager will make arrangements for the prompt repair of the machine. If the repair work will be prolonged then the Manager will make arrangements for replacement equipment.

7.7 Review

The Landfill Engineering Manager will review the cause of the emergency and will put appropriate measures in place to prevent the reoccurrence of such an emergency.

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REPORT ON

**ENVIRONMENTAL LIABILITY RISK ASSESSMENT
AND FINANCIAL PROVISION FOR KILBARRY
LANDFILL SITE, DUNHILL ROAD, KILBARRY,
WATERFORD CITY, CO. WATERFORD**

Submitted to:

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1.0 INTRODUCTION

This document represents the methodology and findings of an Environmental Liability Risk Assessment (ELRA), undertaken for the Kilbarry Landfill, Dunhill Road, Kilbarry, Waterford City, Co. Waterford. The document has been prepared by Golder Associates Ireland Ltd (Golder) on behalf of Waterford City Council. The document has been produced in compliance with Condition 8 (Restoration and Aftercare) and condition 11 (Charges & Financial Provision) of Waste Licence Register No. W0018-01. It is noted that no mention to ELRA is made in the waste licence as it predates the concept. This ELRA has been produced in response to a letter sent by the Agency to all licensed sites on the 13th of August 2008 seeking to assess the take-up of the ELRA concept by EPA licensed sites.

In addition, the Environmental Liability Directive 2004/35/EC which seeks to provide for the prevention and remediation of environmental damage and gives form and substance to the polluter pays principle was consulted in the preparation of this ELRA. It seeks to promote good environmental practice by inducing those concerned to adopt measures and develop practices that minimise the risks of environmental damage and reduce their exposure to financial liabilities.

A Closure Restoration Aftercare Management Plan (CRAMP) was sent to the Agency in September 2003. According to correspondence (Ref: cb/ol/letters08) sent to the Department of Environment, Heritage and Local Government from Director of Services and Environmental Services at Waterford City Council, it is envisaged that restoration of Kilbarry Landfill will be completed by summer of 2009.

The methodology outlined in the EPA *Guidance on Environmental Liability Risk Assessments, Residual Management Plans and Financial Provision* as well as the EU draft regulations transposing the Environmental Liability Directive have been followed in the preparation of this document.

2.0 SCOPE OF ENVIRONMENTAL LIABILITY RISK ASSESSMENT

The scope of this has been developed using the EPA Guidance and includes the following:

- A review of the activities that were and are carried out at the site is presented in section 3.3;
- The initial screening approach is set out in section 4.1;
- An examination of the potential hazards, pathways and associated receptors is set out in section 4.3, 4.4 & 4.5;

- The Known and Unknown liabilities associated with the closure and capping of the landfill are presented in section 4.2 and 4.3 with detailed figures presented in Appendix 2;
- Examination and assessment of mitigation measures at the site are presented in section 4.6;
- Conclusions are set out in section 4.7;
- The financial provision element of the ELRA is dealt with in section 4.; and
- Figure 1 Rev A and associated site photographs are presented in appendix 5.

3.0 SITE DETAILS

Kilbarry landfill is located (National Grid Reference 2598E 1103N) on the outskirts of Waterford City on the Dunhill Road.

The entire site occupies an area of 20.1 hectares. Land use surrounding the site is a mixture of open flat farmland with wetland to the south-east. The area to the north and west of the site is a mixture of residential and commercial properties. The landfill was in operation for 40 years until its closure in 2005 and has since been capped and a gas management system has been installed. The landfill opened in the mid 1960's but didn't become very active until the 1970's. A mixture of commercial, domestic and mixed municipal waste was accepted at the site until 2003 under Waste Licence W0018-01 when commercial waste deposition ceased. Waste license W0018-01 for the site was issued on the 19th of October 2001.

The landfilling of waste at the site has resulted in the formation of a mound of waste above ground level. The waste body has a maximum height of 20mOD in the centre of the site. The remainder of the site has a maximum height of 17.5mOD and a base level of 2 m to 3 mOD on the edge of the site. The final stage of the landfill consisted of a fully engineered cell in the north of the site. This cell comprised a total void size of 35,000 m³ and was constructed between 2002 and 2004. According to figures supplied by Kilbarry Landfill management, the total estimated wastes deposited at closure amounted to 1,112,410 m³. A topographical survey drawing indicating the current (June 2008) conditions is presented in Appendix 5.

3.1 Geology

The geology of the City is vital to the natural environment of Waterford City as the geology shapes the landscape and determines the overlying soil types and vegetation, all of which is integral to supporting a diverse flora and fauna. The city of Waterford stands on a bedrock of

rhyolitic volcanic rock; slaty mudstone formed about 450 million years ago (mya), during the Ordovician period, and reddish sandstone and conglomerate from the Devonian “Old Red Sandstone”, (ORS), period about 350 million years ago.

The bedrock beneath the site is classified as a Regionally Important Aquifer using the classification system prepared by the Geological Survey of Ireland (GSI). The direction of groundwater flow is from the south to the north/north west. A well search identified that there are no beneficial users of groundwater within 500 m of the site and all of the residents within 1 km of the site are connected to the Public Kilbarry water supply.

3.2 Hydrogeology

The major local discharge zone for the recharge area is Kilbarry Bog in which the landfill sits. The remaining areas of the bog to the south and east are now form a National Heritage Area.

The primary receptors of the identified environmental hazards include groundwater, surface water and the atmosphere. The secondary receptors of the environmental hazards would include humans, flora, fauna and livestock.

3.3 Activities Undertaken at the Site

The following processes and activities have been undertaken at the site in accordance with Schedule A: Waste Acceptance of Waste Licence W0018-01.

- i. The disposal of non-hazardous household, commercial and industrial waste;
- ii. The disposal of de-watered non-hazardous industrial treated sewage sludge/filtercake;
- iii. The disposal of treated industrial non-hazardous sludges;
- iv. The disposal of construction and demolition waste;
- v. Waste for recycling and recovery at the Civic waste site; and
- vi. Waste for recycling and recovery at the metal recovery area.

Moreover, a civic amenity site is located within the main site entrance accepting the following range of wastes for recycling:

- Metal;
- Timber;
- Cardboard;
- Batteries;
- Engine oil;
- Glass bottles;
- Fluorescent tubes; and
- Energy saving light bulbs.

4.0 ENVIRONMENTAL LIABILITY RISK ASSESSMENT

In the following, an approach as described in the ‘*Guidance Environmental Liability Risk Assessment, Residuals Management Plans incorporating Financial Provision*’ (EPA, 2006) has been adopted to describe and assess the ELRA for the facility. The Guidance proposes a system whereby higher risk facilities can reduce their risk profile through risk management in order to reduce the costs of implementing financial provision.

A systematic step-wise approach is outlined in the Guidance and has been adopted into this document:

- *Step 1 – Initial Screening & Operational Risk Assessment*
- *Step 2 – Preparation of a Closure, Restoration and Aftercare Management Plan (CRAMP) for KNOWN liabilities*
- *Step 3 – Environmental Liability Risk Assessment (ELRA) for UNKNOWN liabilities*
- *Step 4 – Identification of Financial Provision (FP) and Instruments*

4.1 Step 1 - Initial Screening and Operational Risk Assessment

Environmental risk may be assessed by considering the probability of occurrence of a defined hazard and the magnitude of the consequences of that occurrence.

To characterise and assess the risks identified in step 1 the risk assessment model set out in the EPA’s Guidance Document has been employed.

The risk assessment scores presented in Table 2 are based on the risk assessment methodology contained in Appendix 3.

The rationale for the likelihood and severity weightings is presented in Appendix 1.

These assessments have been undertaken with consideration to the findings outlined in Step 1 of this report and are based on the residual risk posed by the landfill after assessment of the engineering and operational controls deployed at the site.

A register of the risks, which is based on the site specific characteristics and the Classification Tables for Occurrence and Severity included in the Agency’s guidance document is presented in Table 2 below. The risk score is calculated by multiplying the likelihood score by the severity score. The assignment of the severity rating scores is based on the site specific assessment described in section 4.

Using the risk categorisation calculation tables presented in the Guidance document, the site can be given an accurate score and hence a risk category. The procedure is arranged using a combination of complexity, environmental sensitivity and the site’s compliance record.

Using the tables set out Appendix B (IPPC & Waste Activities Complexity look-up Tables) of the Guidance document, sites can be given a risk banding ranging from G1 – least complex to G5 – most complex.

Closed landfill facilities are set a complexity rating of G4. This complexity band equates to an automatic category **3** status according to the guidance.

Table 2: Environmental Risk Register for the Site

Risk ID	Description of Risk	Likelihood Score	Severity Score	Risk Score
R1	Discharge of landfill gas to sub-soils.	2	3	6
R2	Discharge of leachate to groundwater.	2	3	6
R3	Cracking of Landfill’s capping system resulting in uncontrolled release of landfill gas to the atmosphere.	2	3	6
R4	Failure of the Landfill’s gas management infrastructure, resulting in uncontrolled release of gas to the atmosphere.	2	3	6
R5	Failure of leachate pipe work or lagoon resulting in release of leachate to surface water.	2	2	4
R6	Operational accident resulting in release of oils/chemicals to the Landfill surface water.	1	2	2
R7	Uncontrolled landfill fire resulting in a release of noxious gas to the environment	1	4	4
R8	Uncontrolled landfill fire resulting in contamination of surface water from the water/foam and litter discharged during fire fighting.	1	4	4

4.2 Step 2 - Closure, Restoration, Aftercare Management Plan (CRAMP) – Known Liabilities

A Closure, Restoration Aftercare Management Plan (CRAMP) was submitted to the Agency in September 2003. Costs associated with the closure and restoration plan are presented in Appendix 2.

4.3 Step 3 - Environmental Liability Risk Assessment (ELRA) – Unknown Liabilities

The methodology used for the risk identification component of the ELRA is as follows;

1. Identification of possible **hazard sources**;
2. Identification of potential hazard **pathways**; and,
3. Identification and assessment of environmental **receptors** for those identified pathways.

The aim of the process is to provide an analysis of the environmental conditions at the landfill so to provide a baseline by which environmental liabilities may be established and assessed.

Identification of the environmental pathways and receptors has been undertaken with reference to Waste Licence W0018-01 of 2001, and in light of the environmental monitoring undertaken over the past seven years.

4.3.1 Identification of Environmental Hazards

The major environmental hazards associated with landfilling activities involve an emission of either hydrocarbons/chemical, leachate or landfill gas that has the potential to result in pollution of the receiving environment. In addition noise monitoring and dust deposition monitoring is carried out as per the licence. A total monitoring cost of €15,342.80 was spent in 2008.

4.3.2 Hydrocarbons/ Chemicals Stored on Site

The landfill has been closed since 2003 and capping will be completed in summer 2009. The civic amenity site is located at the main entrance to the site and no chemicals or hydrocarbons are used or stored on-site. Site vehicles are all fuelled off-site.

4.3.3 Leachate

A leachate collection drain, consisting of a 150mm slotted HDPE pipe around the perimeter of the waste body which directs leachate to 5 sumps at various points on the perimeter.

Leachate is pumped from the sumps via an 80mm rising main to a lined lagoon at the Northern tip of the landfill. In addition to this there are 13 additional pumped boreholes located throughout the waste body accessed by manholes on the upper level of the site. These boreholes provide coverage of the landfill area for leachate abstraction. The borehole pumps and perimeter sump pumps are controlled from panels located to the north and east of the site. It has been found that since the final capping little leachate has been pumped to lagoon. This would be assumed to be due to the inability of rain waters to permeate the waste body.

At the point of outlet from the lagoon to sewer there is a sump which contains monitoring equipment for the determination of pH, dissolved methane and flow. The leachate is released from the lagoon via a gravity feed and a valve allows a percentage of the outflow into the sump where readings can be taken for the prescribed parameters set out in table F.5.5 of Schedule F: Monitoring of the waste licence.

While leachate is being released, the quality is monitored daily. Any breach of limits requires the flow to be stopped and an alternative disposal method used, e.g. tanker and haul the liquid for disposal.

4.3.4 Landfill Gas

Commercial and industrial wastes have been deposited historically at Kilbarry Landfill. These wastes contain some biodegradable materials such as paper, wood, textiles etc. Gases have formed in the landfill due to the development of anaerobic conditions.

In total, 81 gas abstraction wellheads are currently installed at Kilbarry Landfill and are connected by a network of 110mm and 160mm pipes, which connect via 5 manifolds to a 225mm ring main. This terminates at a compound west of the leachate lagoon where the gas is flared. Currently 1 No.1000 m³/hr open flare is operational onsite with plans to install a 500 m³ enclosed flare. All collection pipes fall back towards the wellheads to allow condensate to exit the system.

A total of 5 no. condensate traps were placed onsite, four near the manifolds and one approximately 25m before the flare. The trap at the flare is not in the waste body and therefore the condensate is pumped to the adjacent leachate lagoon for disposal. In addition to the gas abstraction system there are a series of boreholes around the perimeter of the waste body for the monitoring of landfill gas to ensure migration is not occurring.

Most recently, residential dwellings were built within 250m of the site and 7 new boreholes were installed between the landfill and these houses specifically to ensure gas was not migrating in this direction. These boreholes are currently monitored daily but due to the active abstraction system in place and the lack of evidence of gas migration this monitoring is going to be scaled back to a weekly basis in agreement with the Agency.

4.3.5 Dust Deposition

Dust deposition surveys were undertaken at 7 no. locations three times per year in 2008 as specified in Tables F.3 and F.3.2 of the waste licence. Dust samples were set out at the landfill for a period of between 28 and 30 days. The samples were then sent to Bodycote Consultus Laboratories in Cork for gravimetric analysis in accordance with standard methodology. Over the course of the three dust monitoring surveys, elevated levels of dust were recorded at 2 locations in total over the year. This elevation was attributed to on-going rehabilitation works at the site.

4.3.6 Noise

Noise monitoring was undertaken at 7 no. on-site locations and 4 no. noise sensitive locations once during 2008 as specified in schedule F.4.2 of the waste licence. Although there were some elevations above the 55 dB(A) limit as specified in the licence, the sources of this noise were attributed to off-site activities.

4.4 Identification of Environmental Pathways

The primary pathways for hazards from the waste body to the environment is through the atmosphere (emissions to air), overland (emissions to surface water or land) or through the ground (emissions to the soil or groundwater).

4.4.1 Air

Metrological data is obtained from Waterford Regional Airport and indicates that the prevailing wind directions is to the south and west, while the average wind speed is 10.6 km/hr.

4.4.2 Groundwater

Groundwater quality is measured by samples taken by the Agency on a quarterly basis at the 7 no. active groundwater monitoring locations situated around the site. All parameters required under Table F.5.5 of Schedule F of Waste Licence Register Number W0018-01 are analysed for.

Currently, groundwater samples retrieved from the monitoring boreholes indicate that some pollution of the groundwater has taken place with several parameters being above guideline values. Currently, 7 no. groundwater monitoring boreholes are active at the site. These are labelled GW2, GW4, GW5, GW6, GW15, GW16, GW17.

4.4.3 Surface Water

The EPA carry out surface water monitoring at the site at designated monitoring locations on a frequency in line with the requirements of Waste Licence W0018-01. The analysis indicates that the surface water has been impacted upon by the presence of historic wastes that were deposited at the site in the past. It is noted that the site has been a landfill since the 1960's and at that time, the lining of landfills and protection of the environment was not enforced. However, a surface water management programme was recently submitted to the Agency and was approved. Funding has been made available which will enable the existing surface water ponds to be repaired and allow the construction of further collection ponds bringing the total on site to 4.

4.5 Identification of Environmental Receptors

4.5.1 Local Air Quality

Quarterly monitoring of ambient air is carried out by Odour Monitoring Ireland. The conclusions from the reports indicate that the air quality is good with hydrogen sulphide levels at levels below 3 ppm and general odour quality less than 45 odour units m³.

The results of the air quality assessment found that concentrations of VOC, mercaptans and sulphide compounds were below detection levels.

4.5.2 Flora and Fauna

Kilbarry landfill is located in Kilbarry bog. Kilbarry bog (Provisional National Heritage Area pNHA) comprises an area of reed swamp, freshwater marsh, wet grassland and scrub. It is a site of conservation importance for a variety of reasons:

- It is the only remaining wetland of its type of significance in the vicinity of Waterford City;
- It supports a variety of wetland vegetation types and plant species; it is the site of records for the scarce Summer Snowflake;

- It supports a good diversity of birds, including an important breeding population of Reed Warbler; and a range of scarce invertebrate species has been recorded from this site; and
- The site is also used by Otter, a protected species in Ireland and one that is listed on Annex II of the E.U. Habitats Directive. (NPWS, 2005).

Waterford City Development Plan 2007-2013 identifies Kilbarry Bog as being important for biodiversity. The bog is considered of national importance for Reed Warbler and of regional importance for aquatic biodiversity. In a recent report the National Parks & Wildlife Service (NPWS) recommended that consideration be given to designating the site as a Nature Reserve (Waterford City Council, 2008).

4.5.3 Local Population and Land Use

The surrounding area around the landfill is dominated by industrial, commercial and residential premises with Waterford Crystal located within 0.5 km of the site. Waterford Institute of Technology is located approximately 1 km from the site also. Kilbarry landfill is also situated close to the Six Cross Business Park. The land use is dominated by industrial premises. According to the 2006 census, the population of Waterford City grew to 45,800 over the course of that year.

4.6 Identification and Assessment of Mitigation Measures

4.6.1 Lining System

The site has been operational for over 40 years and is unlined.

4.6.2 Capping System

The capping system for the Landfill was developed considering the requirements of the EPA's Landfill Manuals – Site Design and the UK Environment Agency's Technical Guidance on Capping and Restoration of Landfills. The installation of the cap was supervised and project managed by MCOS RPS Plc. Consultant Engineers and a CQA program was completed for its construction.

The capping system comprises, starting at the waste surface and working upwards to the completed restored surface:

- 80mm layer of quarry fines with maximum aggregate size of 20mm free of sharp stones;
- Gas collection layer – Geosynthetic layer with Geotextile filter/separator on top and bottom and similar or equivalent to Finesse Pozidrain 6S240D/NW8;
- Barrier layer – Geotextile protection layer similar or equivalent to Bentomat Cap 75 geosynthetic clay liner, GCL, with a minimum hydraulic conductivity of 1×10^{-9} m/s;
- Surface water drainage layer – Geosynthetic layer with Geotextile filter/separator on top and bottom similar or equivalent to Pozidrain 6S240D/NW8;
- Subsoil – 850mm silty sandy gravel; and
- Topsoil – 150mm.

4.6.3 Landfill Gas Management System

The gas management system or components of it, will be employed and maintained as long it is required to ensure control and management of landfill gas in compliance with the waste licence.

4.6.4 Surface Water Management System

Three (3 no.) surface water monitoring ponds were provided in accordance with licence conditions 7.6, 9.3 and 9.6. Surface water was planned to be diverted to these ponds for monitoring and storage before being discharged into peripheral drains. This situation had to be re-evaluated following the completion of the final capping layer.

The landfill falls from a high central level outwards to the external edges of the cap. A continuous surface water drain and compacted clay bund have already been proposed as part of the final restoration. The surface water from this upper circumferential drain would then be collected at 4 points before being conveyed to the lower level area via heavy duty PVC pipes. The drain will be inclined to each collection point and each pond will serve an estimated 25% of the site area.

The following surface water management program proposal which was accepted by the Agency on the 26th of November 2008 (Ref: W0018-01/ap01cok.doc) is as follows:

All existing surface water ponds that have been idle since the closure of the landfill be reinstated and repaired.

1. A fourth surface water pond will be constructed in the south of the site. This will be lined with a HDPE layer and secured and ballasted to prevent flotation due to tidal conditions.
2. Discharge trigger levels for surface water will be proposed to the Agency within 8 weeks based on sampling results from surrounding water courses.
3. A schedule of grab sampling will be initiated rather than the continuous monitoring. The frequency will be altered to reflect a weekly monitoring program whereby the current required parameters of pH, Conductivity and Total Organic Carbon will be analysed for. Should the samples reveal that the collected waters are below trigger level values, they will be allowed to be discharged to the peripheral drains. However, if the samples exceed the trigger levels, the surface water will be collected in the ponds and tankered and discharged to the leachate lagoon for later disposal to the foul sewer.
4. The weekly grab sampling schedule will be maintained for a period of 6 months after which point if the analysed parameters prove to be consistently clean, the monitoring frequency period will be addressed once more.

Currently, grass growth on the east and south of the capped landfill is plentiful with further growth already visible on rest of the site. This will assist greatly in the capture and control of surface water on the landfill.

4.6.5 Identification and Assessment of Operational Control Measures

Environmental Management System

Kilbarry Landfill operates an Environmental Management System. The system ensures continual improvement through a process of internal audit, management review and the setting of target and objectives relating to environmental hazards.

Waste Acceptance Procedures

Waste acceptance at Kilbarry Landfill was carried out in compliance with the requirements of Council Decision 2003/33/EC on establishing criteria and procedures for the acceptance of waste at landfills, and pursuant to Article 16 and Annex II of Council Directive 1999/31/EC on landfill waste. Waste acceptance at the site comprised waste characterisation, compliance testing and on-site verification.

Emergency Response Procedures

Kilbarry Landfill has developed site specific emergency response procedures. These procedures outline the actions that are required to be undertaken in the event of an emergency and cover both general and specific emergency situations.

Emergency situations covered by these procedures include:

- Activation of alarm;
- Gas in building emergency;
- Accident;
- Fire;
- Overturned vehicle;
- Spillage; and
- Handling hazardous and chemical wastes.

4.7 Conclusion

Considering the hazard, pathway and receptor model for the site, and in light of an assessment of current mitigation measures employed at the Landfill, the following have been identified and outlined as environmental risks at the Site.

Table 1 is not meant to be a comprehensive list of all potential environmental liabilities associated with the Landfill. The table considers those environmental liabilities that have the potential to have significant financial implication on the Landfill, both in terms of the cost associated with the repair of infrastructure and the cost arising from the environmental remediation that may be required if the incident was to occur.

Table 1: Environmental Risks Identified at Kilbarry Landfill

Risk Register No.	Description of Risk
R1	Discharge of landfill gas to sub-soils.
R2	Discharge of leachate to groundwater.
R3	Cracking of Landfill's capping system resulting in uncontrolled release of landfill gas to the atmosphere.
R4	Failure of the Landfill's gas pipe work or flares resulting in uncontrolled release of gas to the atmosphere.
R5	Failure of leachate pipe work or sumps resulting in release of leachate to surface water.
R6	Operational accident resulting in release of oils/chemicals to the Landfill surface water management system
R7	Landfill fire resulting in a release of noxious gas to the environment
R8	Landfill fire resulting in contamination of surface water from the water/foam and litter discharged during fire fighting.

4.8 Step 4 - Financial Provision – Known and Unknown Liabilities

The financial provision requirements for the site have been assessed in relation to the known and unknown liabilities associated with the site. Details of the financial provision for these liabilities spent to date at the site and monies that are expected in 2009 are presented in Appendix 2.

4.9 Known Liabilities

A full break-down of costs associated with the KNOWN closure and remediation of the Kilbarry Landfill area from the Department of Environment, Heritage & Local Government (DEHLG) Landfill Remediation Grant Scheme is presented in Appendix 2. A full breakdown of associated closure costs from 2006 to present is also presented.

The table presented in Appendix 2 has been compiled by Waterford City Council and issued by the DEHLG and can be verified by contacting Waterford City Council directly.

4.10 Financial Provision for Unknown Environmental Liabilities

In terms of the UNKOWN environmental liabilities at the site, Waterford City Council as a public body is insured with the Irish Public Bodies Mutual Insurances Ltd. Public liability insurance of €12.7 million is already in place.

However, following detailed advice from the Agency, it is apparent that separate and specific environmental liability insurance cover be prepared in order to cover the costs associated with future unknown liabilities. This insurance procedure is currently on-going.

It has been made clear by the Agency that when the appropriate insurance is in place, provision must be made that allows the Agency access to the insurance funds in respect to the unknown liabilities at the site.

Details of the environmental liability cover at the site are presented in appendix 4.

5.0 REVIEW OF THE ELRA AND FINANCIAL PROVISION

The Restoration and Aftercare Plan will be reviewed as necessary to reflect any changes on site or at a minimum every three years following agreement with the Agency. Any Changes to the plan will be documented and submitted to the Agency for approval.

APPENDICES

APPENDIX 1

COMPLETED ENVIRONMENTAL LIABILITIES RISK ASSESSMENT TABLES

Table A1: Environmental Liabilities Risk Assessment Tables

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R1	Discharge of landfill gas to sub-soils.	<p>Build up of gases in confined spaces resulting in the potential for asphyxiation.</p> <p>Release of greenhouse gases</p> <p>Risk of explosion</p>	2	<p>While it is considered that landfill liner will deteriorate over time, the amount of deterioration in the first 30 years of its operation is expected to be minimal and the risk that deterioration of liner with cause environmental harm is considered low.</p>	3	<p>If liner deterioration were to become acute, the cost of detection of the deterioration and repair of the lining system would be significant.</p> <p>The discharge of gas into sub soil surrounding the site would be significant over the short term, but would have a minor long term effect on the environment.</p>	6

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R2	Discharge of leachate to groundwater.	Groundwater contamination	2	While it is considered that landfill liner will deteriorate over time, the amount of deterioration in the first 30 years of its operation is expected to be minimal and the risk that deterioration of liner will cause environmental harm is considered low .	3	The cost of repair of the lining system as outlined above would, be significant . The discharge of leachate to groundwater has the potential to cause significant long term harm to the underlying aquifer. It should be noted however, that quality of the receiving groundwater has been previously affected by pollution from the existing unlined landfill that has been in place for several decades.	6

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R3	Cracking of Landfill's capping system resulting in uncontrolled release of landfill gas to the atmosphere.	Release of greenhouse gases Risk of explosion	2	The landfill cap was designed, constructed and installed in accordance with EPA Guidelines, therefore the risk of the cap cracking is considered low .	3	In the event of cracking of the Landfill cap the cost of locating and repairing the crack would be significant . The discharge of gas into atmosphere surrounding the site would be significant over the short term, but would have an insignificant long term effect on the environment.	6

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R4	Failure of the Landfill's gas management infrastructure, resulting in uncontrolled release of gas to the atmosphere.	Release of greenhouse gases Risk of explosion	2	Due to the advanced monitoring system, the preventative maintenance program in place the risk of failure of the infrastructure is considered to be low .	3	In the event failure of the gas management system the cost of repair is expected to be significant . Due to its short term nature, the excepted environmental impact is considered to be minor .	6

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R5	Failure of leachate pipe work or lagoon resulting in release of leachate to surface water.	Contamination of soil, ground water and surface water.	2	Due to the advanced monitoring system, and preventative maintenance program, the risk of failure of the infrastructure is considered to be low .	2	In the event of failure of leachate management infrastructure the cost of repair to the system is considered to be minor . In the event that leachate contaminated soil or groundwater, the environmental impact would be considered minor due to the minimal volume of discharge expected.	4

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score <small>Note 1</small>	Basis of Likelihood	Severity Score <small>Note 2</small>	Basis Of Severity	Risk Score <small>Note 3</small>
R6	Operational accident resulting in release of oils/chemicals to the Landfill surface water.	Contamination of soil, ground water and surface water.	1	The risk of an operational accident resulting in the spillage of either hydrocarbons or chemicals is considered very low due to the fact that that there are no continuing landfilling operations on site and operations ceased in 2005.	2	In the event on a hydrocarbon or chemical spill contaminating soil or groundwater, the environmental impact would be considered minor due to the minimal volume of discharge possible.	2

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score <small>Note 1</small>	Basis of Likelihood	Severity Score <small>Note 2</small>	Basis Of Severity	Risk Score <small>Note 3</small>
R7	Uncontrolled landfill fire resulting in a release of noxious gas to the environment	Release of greenhouse gases. Potential harm to the local population.	1	Due to the emergency response procedures in place, the capping design and the operational practices which were used to deposit waste, the risk of a landfill fire is considered to be very low .	4	The cost associated with a release of noxious gas/ smoke that would arise from a landfill fire has the potential to result in severe impact on the local population.	4

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score <small>Note 1</small>	Basis of Likelihood	Severity Score <small>Note 2</small>	Basis Of Severity	Risk Score <small>Note 3</small>
R8	Uncontrolled landfill fire resulting in contamination of surface water from the water/foam and litter discharged during fire fighting.	Pollution of surface water from contaminated fire fighting water and litter.	1	Due to the emergency response procedures in place, the capping design and the operational practices which were used to deposit waste, the risk of a landfill fire is considered to be very low .	4	The cost of remediation of local water course from the contamination caused by a landfill has the potential to be severe .	4

Note 1 **Rating for likelihood score is based on Risk Assessment Table A3.1 in Appendix 3**

Note 2 **Rating for Severity is based on Risk Assessment Table A3.2 in Appendix 3**

Note 3 **Risk score is based on likelihood of the hazard occurring and the severity of that hazard. The relationship between likelihood, severity and overall risk is shown in Table A3.3 in Appendix 3**

APPENDIX 2
FINANCIAL COST MODEL

Table A2 Most Likely Cost Financial Model

Risk Register No.	Likelihood Score	Likelihood of Occurrence Range ^{Note 1}	Median Likelihood of Occurrence	Severity Score	Likely Cost Range ^{Note 2}	Median Likely Cost	Most Likely Cost Scenario ^{Note 3}
R1	2	5-10%	7.5%	3	€100,001-€200,000	€ 150,000	€ 11,250
R2	2	5-10%	7.5%	3	€100,001-€200,000	€ 150,000	€ 11,250
R3	2	5-10%	7.5%	3	€100,001-€200,000	€ 150,000	€ 11,250
R4	2	5-10%	7.5%	3	€100,001-€200,000	€ 150,000	€ 11,250
R5	2	5-10%	7.5%	2	€10,0001 - €100,000	€ 55,000	€ 4,125
R6	1	0-5%	2.5%	2	€10,0001 - €100,000	€ 55,000	€ 1,375
R7	1	0-5%	2.5%	4	€200,001 - €500,000	€ 350,000	€ 8,750
R8	1	0-5%	2.5%	4	€200,001 - €500,000	€ 350,000	€ 8,750
R9	1	0-5%	2.5%	4	€200,001 - €500,000	€ 350,000	€ 8,750
R10	1	0-5%	2.5%	2	€10,0001 - €100,000	€ 55,000	€ 1,375
R11	2	5-10%	7.5%	2	€10,0001 - €100,000	€ 55,000	€ 4,125
R12	2	5-10%	7.5%	2	€10,0001 - €100,000	€ 55,000	€ 4,125
Total							€ 86,375

^{Note 1} See Table A3.1 for likelihood of occurrence ranges.

^{Note 2} See Table A3.2 for cost ranges.

^{Note 3} The most likely cost scenario is based on the median likelihood of occurrence, multiplied by the median likely cost.

**Department of Environment, Heritage & Local Government
Landfill Remediation Grant Scheme**

Local Authority	Waterford City Council				
Landfill Site	Kilbarry	Claim No.	5		
Grant Ref No	LR/09/08	Period of Claim	08/07/2008 – 02/12/2008		
Summary of Expenditure Details					
Approved Category	Approved Expenditure	Expenditure previous claims	Expenditure this claim	Total Expenditure claimed to date	Approved Expenditure - to be claimed
Preparatory Works	€ 130,298.14	€120,298.14	Nil	€120,298.14	€10,000.00
Leachate Collection	€ 182,541.29	€80,496.79	€72,488.89	€152,985.68	€29,555.61
Gas Collection	€2,341,605.90	€1,706,387.70	€223,730.44	€1,930,118.14	€411,487.76
Capping	€2,682,126.18	€2,442,802.36	€226,028.04	€2,668,830.40	€13,295.78
Landscaping	€1,209,910.00	Nil	Nil	Nil	€1,209,910.00
Project Management	€ 122,713.69	€52,713.69	€45,517.98	€98,231.67	€24,482.02
Other (Surface Water Management)	€ 350,000.00	Nil	Nil	Nil	€350,000.00
Expenditure Total	€7,019,195	€4,402,698.68	€567,765.35	€4,970,464.03	€2,048,731.17

Summary of Grant Claim Details					
	Total Grant Approved	Grant previous claims	Grant this claim (75% of expenditure this claim)	Total Grant claimed to date	Approved Grant – to be claimed
Grant Total	€5,264,396	€3,302,024.01	€425,824.01	€3,727,848.02	€1,536,547.98

Return Form to: Waste Infrastructure & Regulation Section, Department of Environment, Heritage & Local Government, Custom House, Dublin 1.

**Department of Environment, Heritage and Local Government Landfill Remediation
Grant Application/Renewal of Grant Scheme**

Local Authority	Waterford City Council
Name of Landfill	Kilbarry Landfill LRG/05/06
EPA Licence Reference No.	18-1
Confirm that Restoration & Aftercare Plan is agreed with the Agency	Yes
Estimated Net-Total Cost of Plan	€7,019,194 (Est. Cost in '06 €6,943,416
Indicate if grant assistance was approved in 2006 or 2007	'06 -

Categories	Total costs incurred to 31/12/06	Total costs incurred to 31/12/07	Total costs estimated for 2008	Total estimated costs from 2009 onwards
1. Preparatory works (incl. design & consultation fees.	€73,650.58	€120,298.14	€10,000.00	
2. Leahate Collection	€71,493.76	€80,496.79	€102,044.00	
3. Gas Collection	€186,719.45	€1,523,878.80	€596,460.00 €182,508.90 *	
4. Capping	€2,518,536.75	€2,320,394.80	€238,192.00 €123,539.38 *	
5. Landscaping			€500,000.00	€709,910.00
6. Project Management	€50,078.09	€52,713.69	€50,000.00	€20,000.00
7. Other (Specify) Surface water mgmt Extracts			€350,000.00 €38,758.89	
Total Costs	€2,900,478.63	€4,097,782.22	€2,191,503.17	€729,910.00

*Included in claim 4

Additional Comments:

All grant aid approved has been claimed. Approval for additional expenditure of €2,615,285.00 now sought. The current estimated cost of €7,019,195.00 is €75,779.00 above the '06 estimate.

Signed Director of Service	Colette Byrne
County/City Council	Waterford City Council
Date	28/07/08

APPENDIX 3

RISK ASSESSMENT TABLES

Table A3: 1 – Risk Assessment - Likelihood

Rating	Likelihood		
	Description	Likelihood of Occurrence (%)	Category
1	Less than 5% of hazard occurring in 30 year period	0-5	Very Low
2	Low chance (5-10%) of hazard occurring in 30 year period	5-10	Low
3	Medium chance (10-20%) of hazard occurring in 30 year period	10-20	Medium
4	High chance (20-50%) chance of hazard occurring in 30 year period	20-50	High
5	Greater than 50% chance of the hazard occurring in 30 year period	>51	Very High

Table A3: 2 – Risk Assessment - Severity

Rating	Severity		
	Description	Cost of Remediation (€)	Category
1	No damage or negligible change to the environment	0-10,000	Insignificant
2	Minor impact/localised nuisance	10,001-100,000	Minor
3	Moderate damage to environment	100,001- 200,000	Significant
4	Severe damage to the environment	200,001-500,000	Severe
5	Catastrophic damage to a large area, irreversible in medium term	>500,001	Catastrophic

Table A3.3 – Risk Assessment - Overall Risk

The following risk assessment matrix is based the methodology proposed in the EPA’s Guidance Documents and Assessment Tools on Environmental Liabilities Risk Assessment and Residual Management Plan incorporation Environmental Liabilities Risk Assessment.

The matrix is designed to represent risk in terms of likelihood multiplied by severity and should be read in conjunction with Risk Assessment Tables A3.1 and A3.2.

			Risk Identification Number				
LIKELIHOOD	Very High	5					
	High	4					
	Medium	3					
	Low	2					
	Very Low	1					
Very Low Risk 1-5			1	2	3	4	5
Low Risk 6- 10			Insignificant	Minor	Significant	Severe	Catastrophic
Medium Risk 11-15							
High Risks 16- 20			SEVERITY				
Very High Risks 21-25							

The above risk assessment matrix is based the methodology proposed in the EPA’s Guidance Documents and Assessment Tools on Environmental Liabilities Risk Assessment and Residual Management Plan incorporation Environmental Liabilities Risk Assessment.

APPENDIX 4

**COPY OF ENVIRONMENTAL LIABILITY INSURANCE POLICY AND PROPERTY
INSURANCE POLICY**

APPENDIX 5

FIGURES & SITE PHOTOGRAPHS

Appendix IV

PRTR 2011



[Guidance to completing the PRTR workbook](#)

AER Returns Workbook

Version 1.1.13

REFERENCE YEAR	2011
-----------------------	------

1. FACILITY IDENTIFICATION

Parent Company Name	Waterford City Council
Facility Name	Kilbarry Landfill Site
PRTR Identification Number	W0018
Licence Number	W0018-01

Waste or IPPC Classes of Activity

No.	class_name
3.1	Deposit on, in or under land (including landfill).
3.11	Blending or mixture prior to submission to any activity referred to in a preceding paragraph of this Schedule.
3.13	Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.
3.2	Land treatment, including biodegradation of liquid or sludge discards in soils.
3.4	Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons.
3.5	Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment.
3.7	#####
4.11	Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule.
4.12	Exchange of waste for submission to any activity referred to in a preceding paragraph of this Schedule.
4.13	Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced.
4.3	Recycling or reclamation of metals and metal compounds.
4.4	Recycling or reclamation of other inorganic materials.
4.9	Use of any waste principally as a fuel or other means to generate energy.
Address 1	Kilbarry
Address 2	Waterford City
Address 3	Co. Waterford
Address 4	
	Waterford
Country	Ireland
Coordinates of Location	-7.12405 52.2422
River Basin District	IESE
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	Vincent O Shea
AER Returns Contact Email Address	vnoshea@waterfordcity.ie
AER Returns Contact Position	Facility Manager
AER Returns Contact Telephone Number	051 849534
AER Returns Contact Mobile Phone Number	087 1217027
AER Returns Contact Fax Number	051 849763
Production Volume	0.0
Production Volume Units	
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	0
User Feedback/Comments	
Web Address	

2. PRTR CLASS ACTIVITIES

Activity Number	Activity Name
5(d)	Landfills
5(c)	Installations for the disposal of non-hazardous waste
5(d)	Landfills
50.1	General

3. SOLVENTS REGULATIONS (S.I. No. 543 of 2002)

Is it applicable?	
Have you been granted an exemption ?	
If applicable which activity class applies (as per Schedule 2 of the regulations) ?	
Is the reduction scheme compliance route being used ?	

4.1 RELEASES TO AIR

[Link to previous years emissions data](#)

| PRTR# : W0018 | Facility Name : Kilbarry Landfill Site | Filename : 11. PRTR W0018_2011.xls | Return Year : 2011 |

20/06/2012 11:10

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

POLLUTANT		METHOD			Please enter all quantities in this section in KGs			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Flare 1 Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
01	Methane (CH4)	C	OTH	Calculation below	0.0	74140.09	0.0	74140.09
02	Carbon monoxide (CO)	C	ALT	Flue gas analyser, Testo 350/454 MXL	7.3515672	7.3515672	0.0	0.0
08	Nitrogen oxides (NOx/NO2)	C	ALT	Flue gas analyser, Testo 350/454 MXL	289.4722728	289.4722728	0.0	0.0
11	Sulphur oxides (SOx/SO2)	C	EN 13649:2001		167.7054696	167.7054696	0.0	0.0
03	Carbon dioxide (CO2)	C	EN 13649:2001		0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING PRTR POLLUTANTS

POLLUTANT		METHOD			Please enter all quantities in this section in KGs			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Flare 1 Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
80	Chlorine and inorganic compounds (as HCl)	C	EN 1911-1 to 3:2003		11.2862088	11.2862088	0.0	0.0
84	Fluorine and inorganic compounds (as HF)	C	EN 1911-1 to 3:2003		10.526892	10.526892	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION C : REMAINING POLLUTANT EMISSIONS (As required in your Licence)

POLLUTANT		METHOD			Please enter all quantities in this section in KGs			
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Flare 1 Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
351	Total Organic Carbon (as C)	C	ALT	Charcoal tube/GCMS	15.53148	15.53148	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

Additional Data Requested from Landfill operators

For the purposes of the National Inventory on Greenhouse Gases, landfill operators are requested to provide summary data on landfill gas (Methane) flared or utilised on their facilities to accompany the figures for total methane generated. Operators should only report their Net methane (CH4) emission to the environment under T(total) KG/yr for Section A: Sector specific PRTR pollutants above. Please complete the table below:

Landfill:

Kilbarry Landfill Site

Please enter summary data on the quantities of methane flared and / or utilised

	T (Total) kg/Year	M/C/E	Method Used		Facility Total Capacity m3 per hour
			Method Code	Designation or Description	
Total estimated methane generation (as per site model)	763854.09	C	GasSim	Model calculation	N/A
Methane flared	689714.0	M	-	Calculated based on flare flow and recorded run-time	0.0 (Total Flaring Capacity)
Methane utilised in engine/s	0.0	-	-	-	0.0 (Total Utilising Capacity)
Net methane emission (as reported in Section A above)	74140.09	C	Calculated	Calculated	N/A

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

| PRTR# : W0018 | Facility Name : Kilbarry Landfill Site | Filename : 11. PRTR W0018_2011.xls | Return Year : 2011 |

20/06/2012 11:10

Please enter all quantities on this sheet in Tonnes

3

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non-Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	19 07 03	No	60.0	landfill leachate other than those mentioned in 19 07 02	D9	M	Weighed	Offsite in Ireland	Waterford City Waste Water Treatment Plant,-	Waterford City Waste Water Treatment Plant,Christendom,Ferrybank ,Waterford City,Ireland		

* Select a row by double-clicking the Description of Waste then click the delete button

Appendix V

AER Templates 2011

Facility Information Summary

Licence Register Number
 Name of site
 Site Location
 NACE Code
 Class of Activity
 RBME risk category
 National Grid Reference (6E, 6 N)

W0018-01
Kilbarry Landfill
Kilbarry Lane, Waterford City
3821
Treatment and Disposal of Non Hazardous Waste
B1
2598E, 1103N

A brief description of the activities/process at the site for the reporting year. This should include information such as production increases or decreases on site, any infrastructural changes, environmental performance improvements which were measured during the reporting year;

City Council Civic Amenity Site is located at the northern area of the landfill site and accepts small amounts of mixed

Declaration:
 All the data and information presented in this report has been checked and certified as being accurate. The quality of the information is assured to meet licence requirements.

Signature Group/Facility manager <small>(or nominated, suitably qualified and experienced deputy)</small>	Date
---	------

AER summary template-AIR emissions

Additional information

1 Does your site have licensed air emissions? If yes please complete table 1, 2 and 3 below for the current reporting year and answer further questions. If **you do not have** licenced emissions and **do not complete a solvent management plan** (table 5 and 6) you only need to complete table 1 fugitive emissions on site below

Yes	
-----	--

Table 1 Fugitive emissions

Parameter /Substance	Annual fugitive emission (kg/annum)	Quantificaton method M/C/E
SELECT		SELECT
Methane (CH4)	74140	C

Periodic/Non-Continuous Monitoring

2 Are there any results in breach of licence requirements? If yes please provide brief details in the comment section of Table 2 below

No	
Yes	

3 Was all monitoring carried out in accordance with EPA guidance note AG2 and using the basic air monitoring checklist? [Basic air monitoring checklist](#)

[AGN2](#)

Table 2: Licensed Mass Emissions/Ambient data-periodic monitoring (non-continuous)

Emission reference no:	Parameter/ Substance	Date of Monitoring	ELV in licence or any revision therof	Licence Compliance criteria	Measured value	Unit of measurement	Compliant with licence limit	Method of analysis	Annual mass load (kg)	% change in mass load from previous year +/-	Comments
	volumetric flow	30/06/2011	3000m3/hr	100 % of values < ELV	394	m3	yes	ESTIMATE			
	volumetric flow	14/12/2011	3000m3/hr	100 % of values < ELV	292	m3	yes	ESTIMATE			
2	Carbon monoxide (CO)	30/06/2011	50mg/Nm3	100 % of values < ELV	2.13	mg/Nm3	yes	ALT			
2	Carbon monoxide (CO)	14/12/2011	50mg/Nm3	100 % of values < ELV	2.07	mg/Nm3	yes	ALT	7.35		
8	Nitrogen oxides (NOx/NO2)	30/06/2011	150mg/Nm3	100 % of values < ELV	83.87	mg/Nm3	yes	ALT			
8	Nitrogen oxides (NOx/NO2)	14/12/2011	150mg/Nm3	100 % of values < ELV	30.52	mg/Nm3	yes	ALT	289.47		
11	Sulphur oxides (SOx/SO2)	30/06/2011	na		48.59	mg/Nm3	yes	EN 13649:2001			

11	Sulphur oxides (SOx/SO2)	14/12/2011	na		23.57	mg/Nm3	yes	EN 13649:2001	167.7		
80	Chlorine and inorganic compounds (as HCl)	30/06/2011	<50mg/Nm3	100 % of values < ELV	3.27	mg/Nm3	yes	EN 1911-1 to 3:2003	11.29		
80	Fluorine and inorganic compounds (as HF)	30/06/2011	<5mg/Nm3	100 % of values < ELV	3.05	mg/Nm3	yes	EN 1911-1 to 3:2003	10.53		
	TA Luft organic substances class 1	30/06/2011	20mg/m3	100 % of values < ELV	4.5	mg/Nm3	yes	EN 13649:2001	17.52		

Note 1: Volumetric flow shall be included as a reportable parameter

Continuous Monitoring

4	Does your site carry out continuous air emissions monitoring? If yes please review your continuous monitoring data and report the required fields below in Table 3 and compare it to its relevant Emission Limit Value (ELV)	Yes	
5	Did continuous monitoring equipment experience downtime? If yes please record downtime in table 3 below	No	
6	Do you have a proactive service agreement for each piece of continuous monitoring equipment?	Yes	
7	Did your site experience any abatement system bypasses? If yes please detail them in table 4 below	No	

Table 3: Summary of average emissions -continuous monitoring

Emission reference no:	Parameter/ Substance	ELV in licence or any revision thereof	Averaging Period	Compliance Criteria	Units of measurement	Annual Emission	Annual maximum	Monitoring Equipment downtime (hours)	% compliance current reporting year	Comments
	SELECT			SELECT	SELECT					

note 1: Volumetric flow shall be included as a reportable parameter.

Table 4: Abatement system bypass reporting table

[Bypass protocol](#)

Date*	Duration** (hours)	Location	Reason for bypass	Corrective action

* this should include all dates that an abatement system bypass occurred

** an accurate record of time bypass beginning and end should be logged on site and maintained for future Agency inspections please refer to bypass protocol link

AER Monitoring returns summary template-WATER/WASTEWATER(SEWER)

<p>1 Does your site have licensed emissions direct to surface water or direct to sewer? If yes please complete table 3 and 4 below for the current reporting year and answer further questions. If you do not have licensed emissions you <u>only</u> need to complete table 1 and /table 2 below for ambient monitoring and visual inspections</p> <p>2 Was it a requirement of your licence to carry out visual inspections on any surface water discharges or watercourses on or near your site? If yes please complete table 2 below summarising <u>only</u> any evidence of contamination noted during visual inspections</p>	Additional information No No
---	--

Table 1 Ambient monitoring

Location reference	Location relative to site activities	PRTR Parameter	Licensed Parameter	Monitoring date	ELV or trigger level in licence or any revision thereof*	Licence Compliance criteria	Measured value	Unit of measurement	Compliant with licence	Comments
	SELECT	SELECT	SELECT			SELECT		SELECT	SELECT	

*trigger values may be agreed by the Agency outside of licence conditions

Table 2 Visual inspections-Please only enter details where contamination was observed.

Location Reference	Date of inspection	Description of contamination	Source of contamination	Corrective action	Comments
			SELECT		
			SELECT		

Licensed Emissions to water and /or wastewater(sewer)-periodic monitoring (non-continuous)

<p>3 Was there any result in breach of licence requirements? If yes please provide brief details in the comment section of Table 3 below</p> <p>4 Was all monitoring carried out in accordance with EPA guidance and checklists for Quality of Aqueous Monitoring Data Reported to the EPA? If no please detail what areas require improvement in additional information box</p>	Additional information SELECT SELECT
--	--

Table 3: Licensed Emissions to water and /or wastewater (sewer)-periodic monitoring (non-continuous)

Emission reference no:	Emission released to	Parameter/ Substance ^{Note 1}	Type of sample	Date of Monitoring	Averaging period	ELV or trigger values in licence or any revision thereof ^{Note 2}	Licence Compliance criteria	Measured value	Unit of measurement	Compliant with licence	Method of analysis	Procedural reference source	Procedural reference standard number	Annual mass load (kg)	% change in mass load from previous year +/-	Comments
	SELECT	SELECT	SELECT		SELECT		SELECT		SELECT	SELECT	SELECT	SELECT				

Note 1: Volumetric flow shall be included as a reportable parameter

Note 2: Where Emission Limit Values (ELV) do not apply to your licence please compare results against EQS for Surface water or relevant receptor quality standards

Continuous monitoring

5 Does your site carry out continuous emissions to water/sewer monitoring? Additional Information

SELECT	
--------	--

If yes please summarise your continuous monitoring data below in Table 4 and compare it to its relevant Emission Limit Value (ELV)

6 Did continuous monitoring equipment experience downtime? If yes please record downtime in table 4 below

SELECT	
--------	--

7 Do you have a proactive service contract for each piece of continuous monitoring equipment on site?

SELECT	
--------	--

8 Did abatement system bypass occur during the reporting year? If yes please complete table 5 below

SELECT	
--------	--

Table 4: Summary of average emissions -continuous monitoring

Emission reference no:	Emission released to	Parameter/ Substance	ELV or trigger values in licence or any revision thereof	Averaging Period	Compliance Criteria	Units of measurement	Annual Emission for current reporting year (kg)	% change +/- from previous reporting year	Monitoring Equipment downtime (hours)	% compliance current reporting year	Comments
	SELECT	SELECT		SELECT	SELECT	SELECT					
	SELECT	SELECT		SELECT	SELECT	SELECT					

note 1: Volumetric flow shall be included as a reportable parameter.

Table 5: Abatement system bypass reporting table

Date	Duration (hours)	Location	Resultant emissions	Reason for bypass	Corrective action*	Was a report submitted to the EPA?	When was this report submitted?
						SELECT	

*Measures taken or proposed to reduce or limit bypass frequency

Groundwater /Contaminated land summary report

	Comments
1 Are you required to carry out groundwater monitoring as part of your licence requirements?	yes
2 Are you required to carry out soil monitoring as part of your licence requirements?	no
3 Do you extract groundwater for use on site? If yes please specify use in comment section	no
4 Is there contaminated land and /or groundwater on site? If yes please answer q's 5-12	yes
5 Is the contamination related to operations at the facility (either current and/or historic)	yes
6 Have actions been taken to address contamination issues?If yes please summarise remediation strategies proposed/undertaken for the site	yes Leachate Manage
7 Please specify the proposed time frame for the remediation strategy	SELECT Complete d
8 Is there a licence condition to carry out/update ELRA for the site?	yes
9 Has any type of risk assesment been carried out for the site?	yes
10 Has a Conceptual Site Model been developed for the site?	no
11 Have potential receptors been identified on and off site?	yes
12 Is there evidence that contamination is migrating offsite?	no

Table 1: Upgradient Groundwater monitoring results

Date of sampling	Sample location reference	Parameter/ Substance	Methodology	Monitoring frequency	Maximum Concentration++	Average Concentration+	unit	GTV/s*	IGV	% change in average concentration previous year +/-	Upward trend in pollutant concentration over last 5 years of monitoring data
2012	GW6 (Outside Waste Body)	Ammonia		Quarterly	1.7	0.78	mg/l		0.15		yes
2012	GW6 (Outside Waste Body)	Chloride		Quarterly	24	23	mg/l		30		no
2012	GW6 (Outside Waste Body)	Total Oxidised Nitrogen		Quarterly	5.41	4.97	mg/l				no
2012	GW6 (Outside Waste Body)	Potassium		Quarterly	2.3	1.7	mg/l		5		no
2012	GW6 (Outside Waste Body)	Sodium		Quarterly	25	21.8	mg/l		150		no
2012	GW6 (Outside Waste Body)	Flouride		Annually	<0.05		mg/l		1		no
2012	GW6 (Outside Waste Body)	Sulphate		Annually	19		mg/l		200		no
2012	GW6 (Outside Waste Body)	Boron		Annually	100		ug/l		1000		no
2012	GW6 (Outside Waste Body)	Cadmium		Annually	<0.5		ug/l		1		no
2012	GW6 (Outside Waste Body)	Calcium		Annually	70		mg/l		200		no
2012	GW6 (Outside Waste Body)	Chromium		Annually	0.9		ug/l		50		no
2012	GW6 (Outside Waste Body)	Iron		Annually	550		ug/l		200		no
2012	GW6 (Outside Waste Body)	Lead		Annually	<0.5		ug/l		10		no
2012	GW6 (Outside Waste Body)	Magnesium		Annually	20		mg/l		50		no
2012	GW6 (Outside Waste Body)	Manganese		Annually	<25		ug/l		50		no
2012	GW6 (Outside Waste Body)	Mercury		Annually	<0.5		ug/l		1		no
2012	GW6 (Outside Waste Body)	Zinc		Annually	23		ug/l		100		no
2012	GW5 (Inside Waste Body)	Ammonia		Quarterly	600	570	mg/l		0.15		yes
2012	GW5 (Inside Waste Body)	Chloride		Quarterly	967	898	mg/l		30		yes
2012	GW5 (Inside Waste Body)	Total Oxidised Nitrogen		Quarterly	<0.5	<0.5	mg/l				no
2012	GW5 (Inside Waste Body)	Potassium		Quarterly	340	335	mg/l		5		no
2012	GW5 (Inside Waste Body)	Sodium		Quarterly	1200	910	mg/l		150		yes
2012	GW5 (Inside Waste Body)	Flouride		Annually	3.6		mg/l		1		yes
2012	GW5 (Inside Waste Body)	Sulphate		Annually	9.2		mg/l		200		yes
2012	GW5 (Inside Waste Body)	Boron		Annually	12000		ug/l		1000		no
2012	GW5 (Inside Waste Body)	Cadmium		Annually	<0.5		ug/l		1		no

2012	GW5 (Inside Waste Body)	Calcium	Annually	190	mg/l	200	no
2012	GW5 (Inside Waste Body)	Chromium	Annually	18	ug/l	50	no
2012	GW5 (Inside Waste Body)	Iron	Annually	12000	ug/l	200	yes
2012	GW5 (Inside Waste Body)	Lead	Annually	3.3	ug/l	10	no
2012	GW5 (Inside Waste Body)	Magnesium	Annually	110	mg/l	50	no
2012	GW5 (Inside Waste Body)	Manganese	Annually	770	ug/l	50	no
2012	GW5 (Inside Waste Body)	Mercury	Annually	<0.5	ug/l	1	no
2012	GW5 (Inside Waste Body)	Zinc	Annually	22	ug/l	100	no
2012					SELECT		SELECT

Table 3: Soil results

Date of sampling	Sample location reference	Parameter/ Substance	Methodology	Monitoring frequency	Maximum Concentration	Average Concentration	unit
							SELECT
							SELECT

Where additional detail is required please enter it here in 200 words or less

Environmental Management Programme (EMP)/Continuous Improvement Programme		Additional Information
Highlighted cells contain dropdown menu click to view		
1	Do you maintain an Environmental Mangement System for the site. If yes, please detail in additional information	Yes
2	Does the EMS reference the most significant environmental aspects and associated impacts on-site	Yes
3	Does the EMS maintain an Environmental Management Programme (EMP) as required in accordance with the licence requirements	Yes
4	Do you maintain an environmental documentation/communication system to inform the public on environmental performance of the facility, as required by the licence	Yes

Environmental Management Programme (EMP) report					
Objective Category	Target	Status (% completed)	How target was progressed	Responsibility	Intermediate outcomes
Reduction of emissions to Air	Install gas abstraction	100	Contract	Individual	Reduced emissions
Groundwater protection	Leachate management	100	Contract	Individual	Reduced emissions
Reduction of emissions to Air	Dust control	100	Monitoring and operational procedure	Individual	Increased compliance with licence conditions
Reduction of emissions to Water	Surface Water Management	100	Contract	Section Head	Reduced emissions
Reduction of emissions to Water	Leachate management	100	Contract	Individual	Reduced emissions

Noise Monitoring Report Summary

- | | |
|---|---|
| 1 Was noise monitoring a licence requirement for the AER period?
If yes please fill in table 1 noise summary below | <input style="width: 80px; height: 20px;" type="text" value="Yes"/> |
| 2 Was noise monitoring carried out using the EPA Guidance note including completion of the "Checklist for noise measurement report" included in the guidance note as table 6? | <input style="width: 80px; height: 20px;" type="text" value="Yes"/> |
| 3 Does your site have a noise reduction plan | <input style="width: 80px; height: 20px;" type="text" value="No"/> |
| 4 When was the noise reduction plan last updated? | <input style="width: 80px; height: 20px;" type="text"/> |
| 5 Have there been changes relevant to site noise emissions (e.g. plant or operational changes) since the last noise survey? | <input style="width: 80px; height: 20px;" type="text" value="No"/> |

Draft Noise
Guidance

Table 1: Noise monitoring summary

Date of monitoring	Time period	Noise location (on site)	Noise sensitive location -NSL (if applicable)	LA _{eq}	LA ₉₀	LA ₁₀	LA _{max}	Tonal or Impulsive noise* (Y/N)	If tonal /impulsive noise was identified was 5dB penalty applied?	Comments (ex. main noise sources on site, & extraneous noise ex. road traffic)	Is <u>site</u> compliant with noise limits (day/evening/night)?
11/07/2011	30 minutes	B1		54	58	39	53	Yes			Yes
11/07/2011	30 minutes	B2		43	46	36	<36	Yes			Yes
11/07/2011	30 minutes	B3		41	44	33	<33	Yes			Yes
11/07/2011	30 minutes	B4		53	56	44	<44	Yes			Yes
11/07/2011	30 minutes	B5		48	51	43	<43	Yes			Yes
11/07/2011	30 minutes	B6		44	46	39	<39	Yes			Yes
11/07/2011	30 minutes	B7		39	38	32	<32	Yes			Yes
12/07/2011	30 minutes		NSL2	54	53	46	<46	Yes			Yes
12/07/2011	30 minutes		NSL3	43	42	38	38	Yes			Yes
11/07/2011	30 minutes		NSL4	63	67	45	49	Yes			Yes
12/07/2011	30 minutes		NSL5	62	65	50	53	Yes			Yes
12/07/2011	30 minutes		NSL6	51	47	43	<43	Yes			Yes
12/07/2011	30 minutes		NSL7	54	52	42	<42	Yes			Yes
12/07/2011	30 minutes		NSL8	65	70	46	<46	Yes			Yes

*Please ensure that a tonal analysis has been carried out as per guidance note NG4. These records must be maintained onsite for future inspection

If noise limits exceeded as a result of noise attributed to site activities, please choose the corrective action from the following options?

** please explain the reason for not taking action/resolution of noise issues?
Any additional comments? (less than 200 words)

Resource usage/ Energy Efficiency

Additional information

- 1 When did the site carry out the most recent energy efficiency audit? Please list the recommendations in table 3 below
- 2 Is the site a member of any accredited programmes for reducing energy usage/water conservation such as the SEAI programme linked to the right? If yes please list them in additional information
- 3 Where Fuel Oil is used in boilers on site is the sulphur content compliant with licence conditions? Please state percentage in additional information

no	
SELECT	

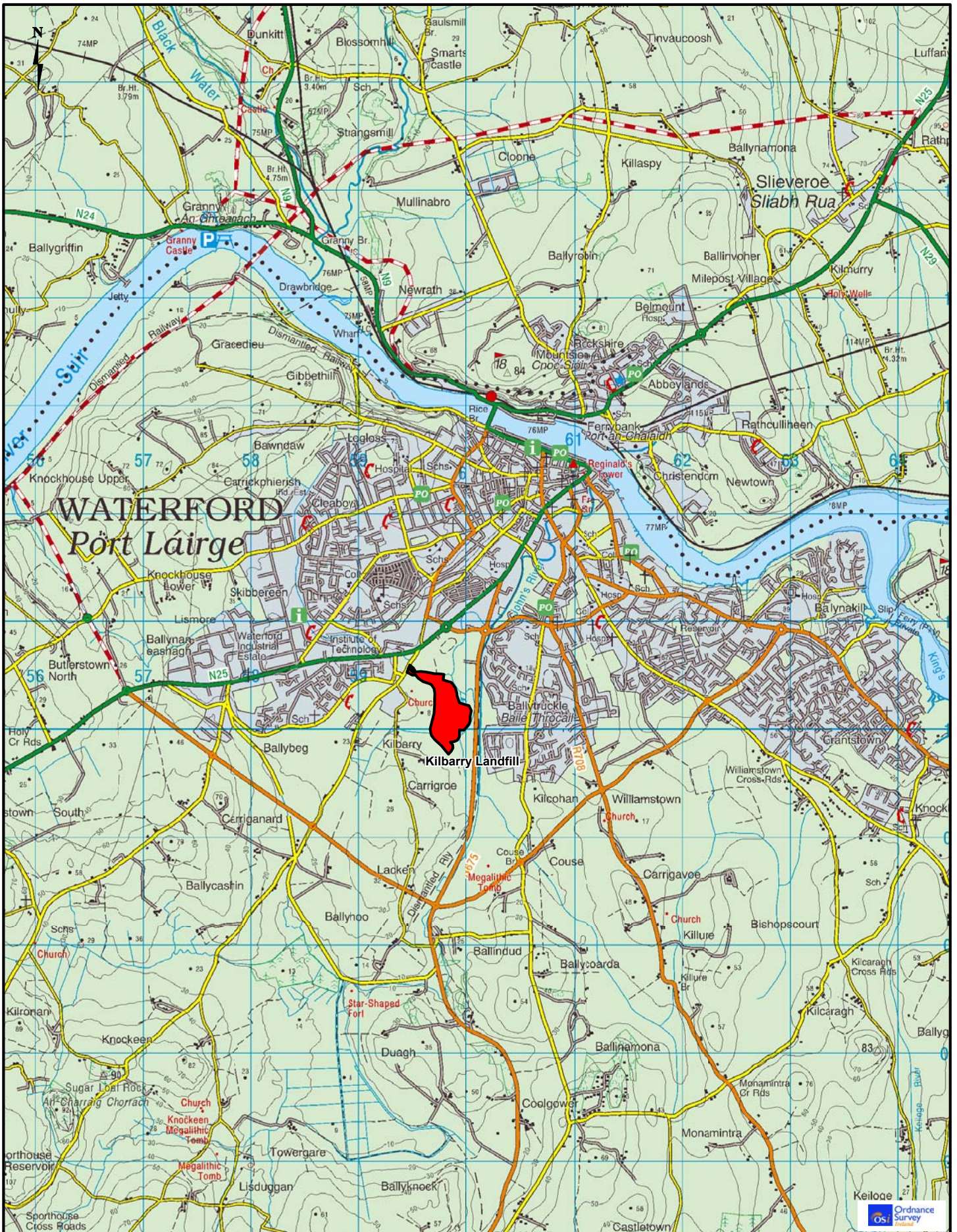
Table 1 Energy usage on site				
Energy Use	Previous year kWh	Current year kWh	Production +/- % compared to previous reporting year**	Energy Consumption +/- % vs overall site production*
Total				
Electricity				
Fossil Fuels:	0	0	0	0
Heavy Fuel Oil	0	0	0	0
Light Fuel Oil	0	0	0	0
Natural gas	0	0	0	0
Coal/Solid fuel	0	0	0	0
Renewable energy generated on site	0	0	0	0

* where consumption of energy can be compared to overall site production please enter this information as percentage increase or decrease compared to the previous reporting year
 ** where site production information is available please enter percentage increase or decrease compared to previous yea

Table 2 Water usage on site				
Water use	Previous year m3/yr.	Current year m3/yr.	Production +/- % compared to previous reporting year**	Energy Consumption +/- % vs overall site production*
Groundwater	0	0	0	0
Surface water	0	0	0	0
Public supply	5	5	0	0
Total	5	5	0	0

* where consumption of water can be compared to overall site production please enter this information as percentage increase or decrease compared to the previous reporting year
 ** where site production information is available please enter percentage increase or decrease compared to previous yea


Table 3: Energy Audit finding recommendations								
Date of audit	Recommendations	Description of Measures proposed	Origin of measures	Predicted energy savings %	Implementation date	Responsibility	Completion date	Status and comments
			SELECT					
			SELECT					
			SELECT					



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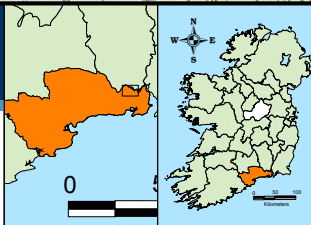
Client
Waterford City Council



Project
Kilbarry Landfill Permanent Gas Flare Contract

Title
1:50,000 Site Location Map

Figure **DG0001**



Issue Details			
Drawn by:	C. Doyle	Project No.	MCW0568
Checked by:	B. O'Leary	File Ref.	MCW0568M0001B01
Approved by:	K. O'Sullivan	Drawing No.	Dg0001
Scale:	NTS	Rev.	B01
Date:	03.02.09		

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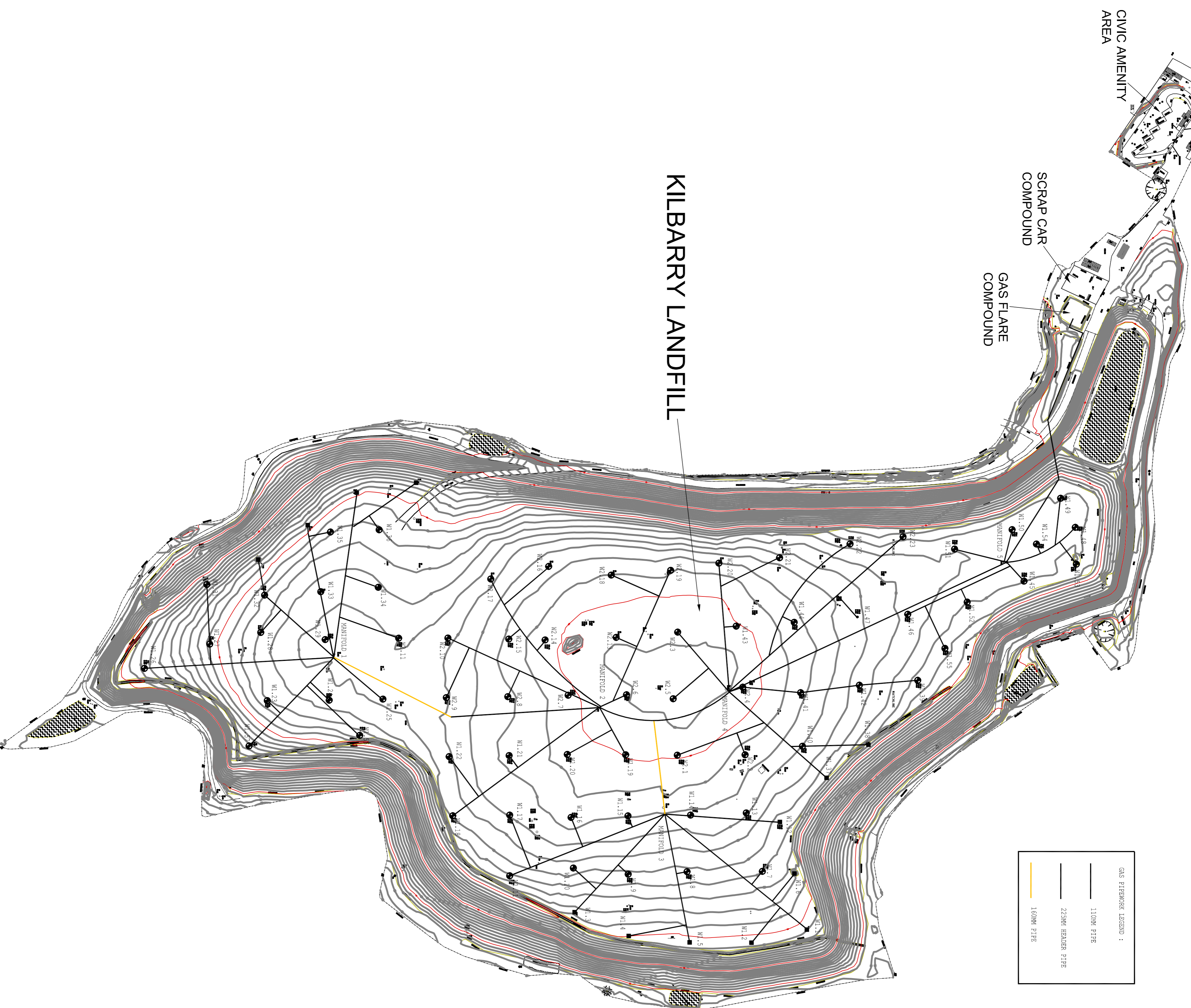
ENTRANCE

CIVIC AMENITY AREA

SCRAP CAR COMPOUND

GAS FLARE COMPOUND

KILBARRY LANDFILL



GAS PIPEWORK LEGEND :	
	1100W PIPE
	2250W HEADER PIPE
	1600W PIPE

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No.	Date	Amendment / Issue	App
B01	Feb.09	ISSUE FOR TENDER	
A01	Nov.08	ISSUE FOR APPROVAL	

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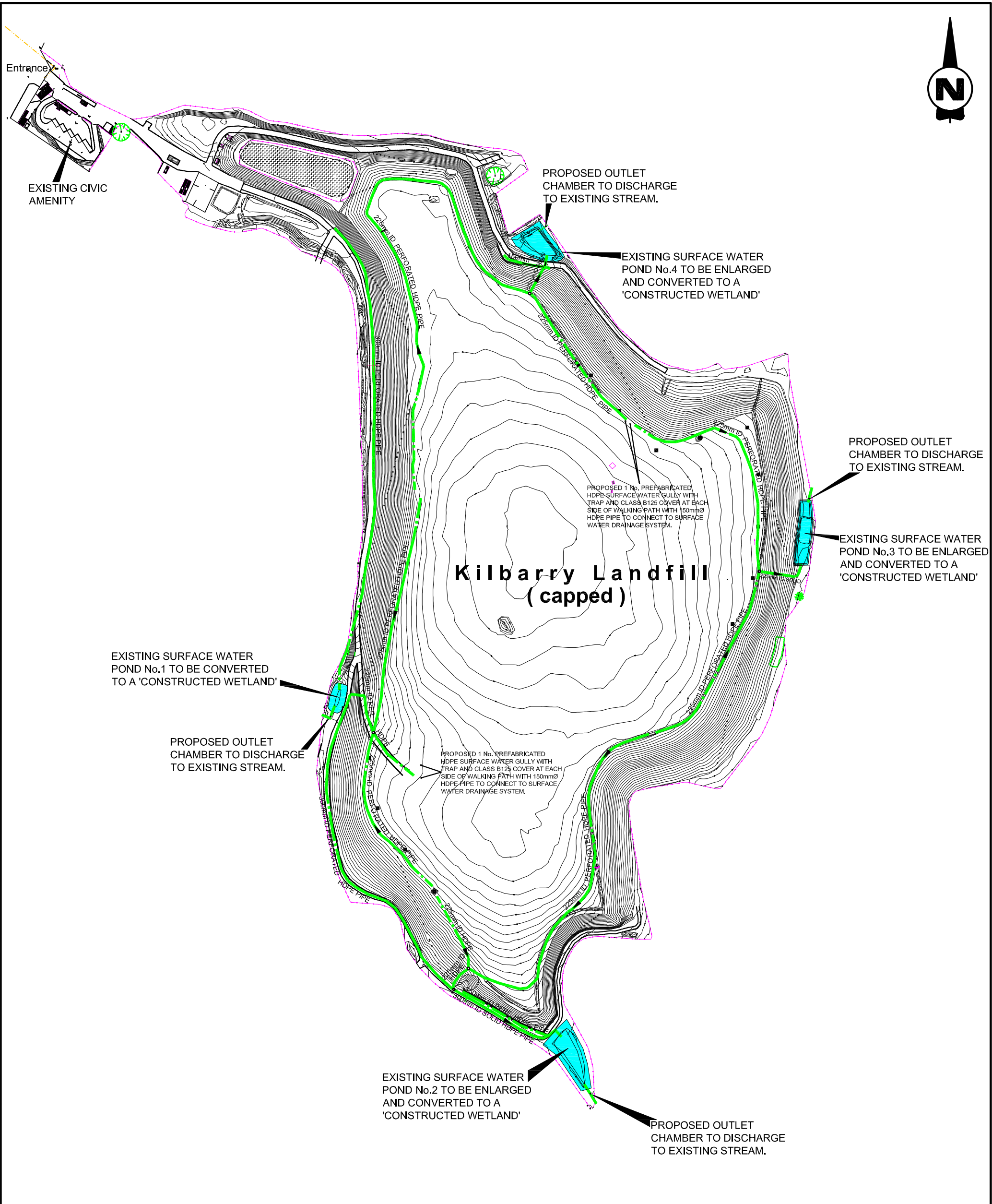
Client
WATERFORD CITY COUNCIL

Project
**KILBARRY LANDFILL :
 PERMANENT GAS FLARE CONTRACT**

Title
**LAYOUT PLAN OF LANDFILL
 SHOWING GAS NETWORK**

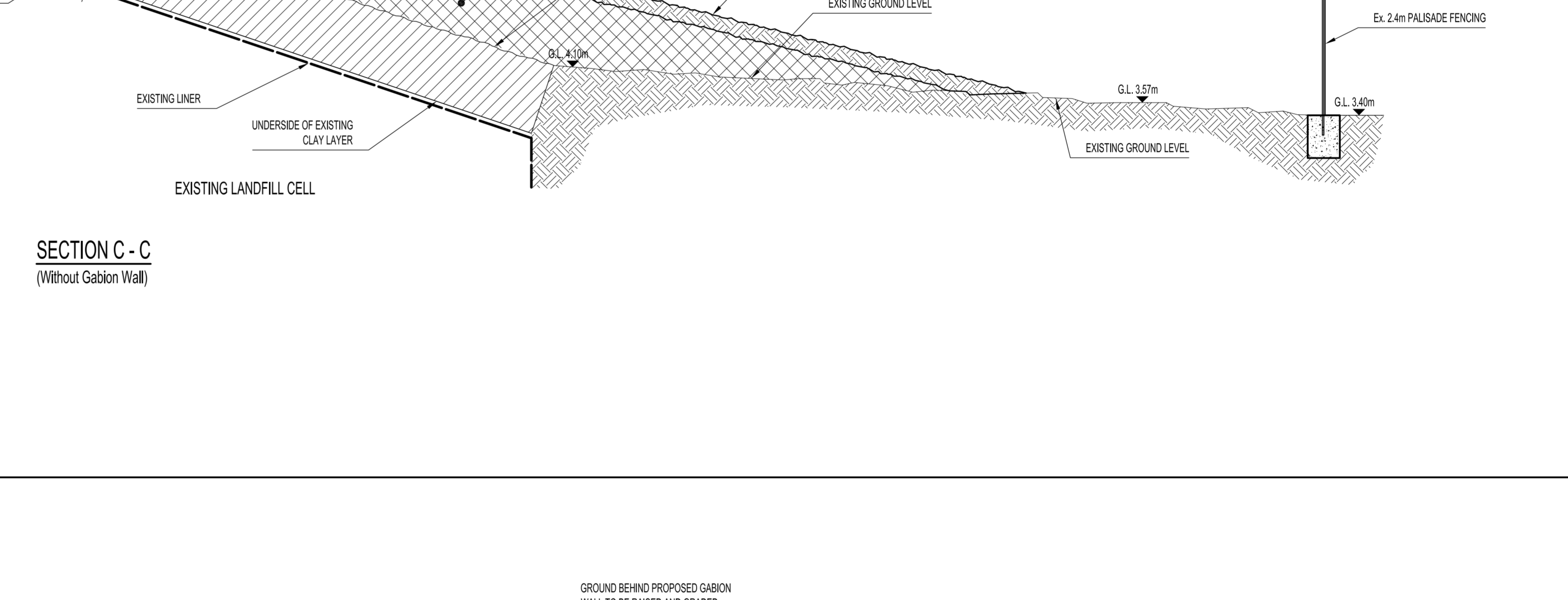
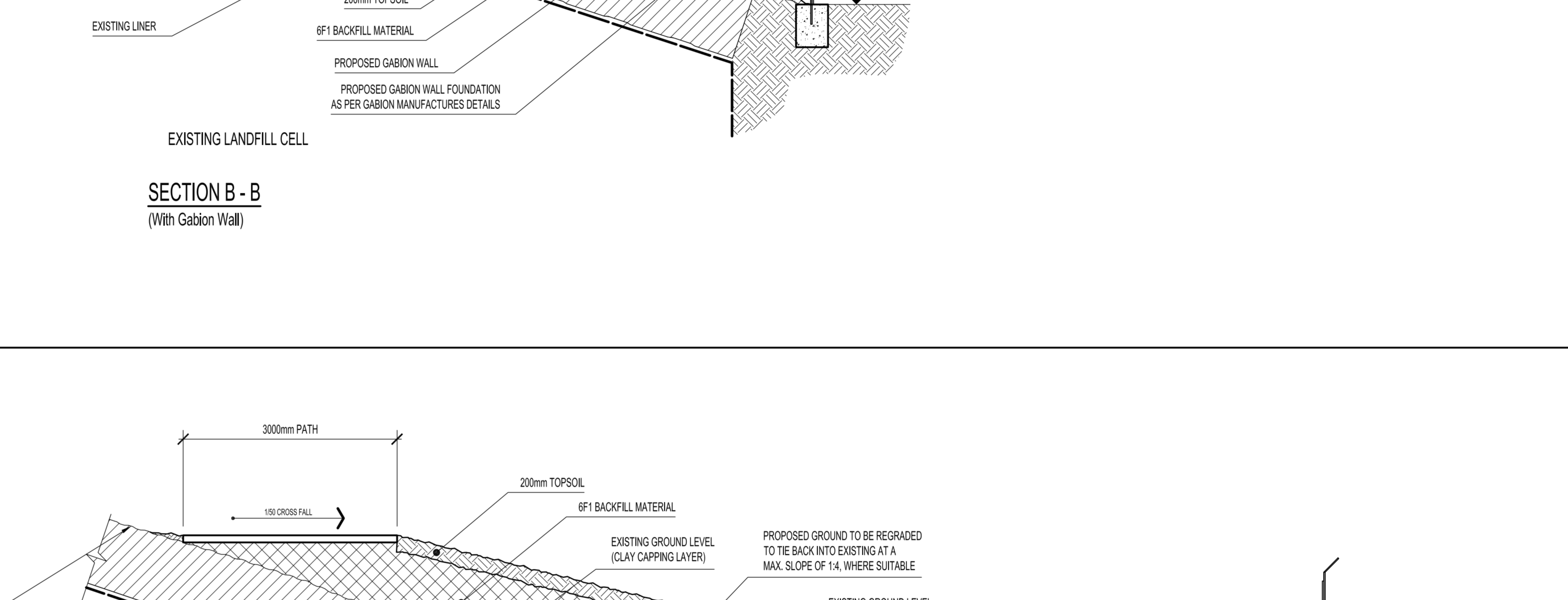
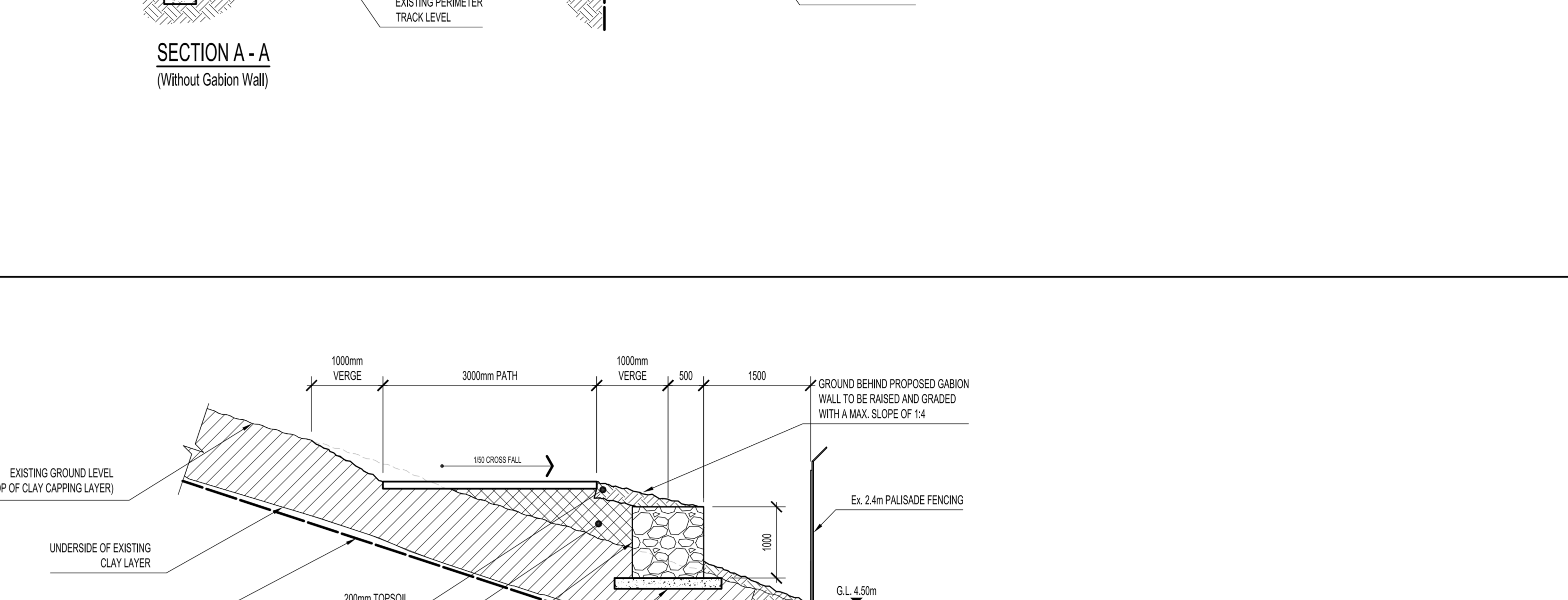
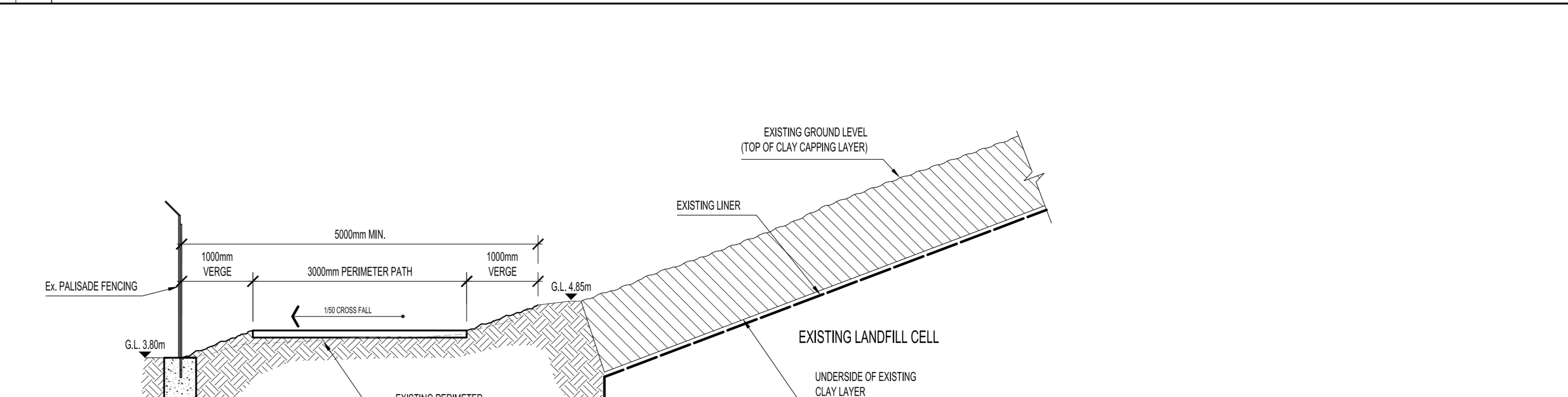
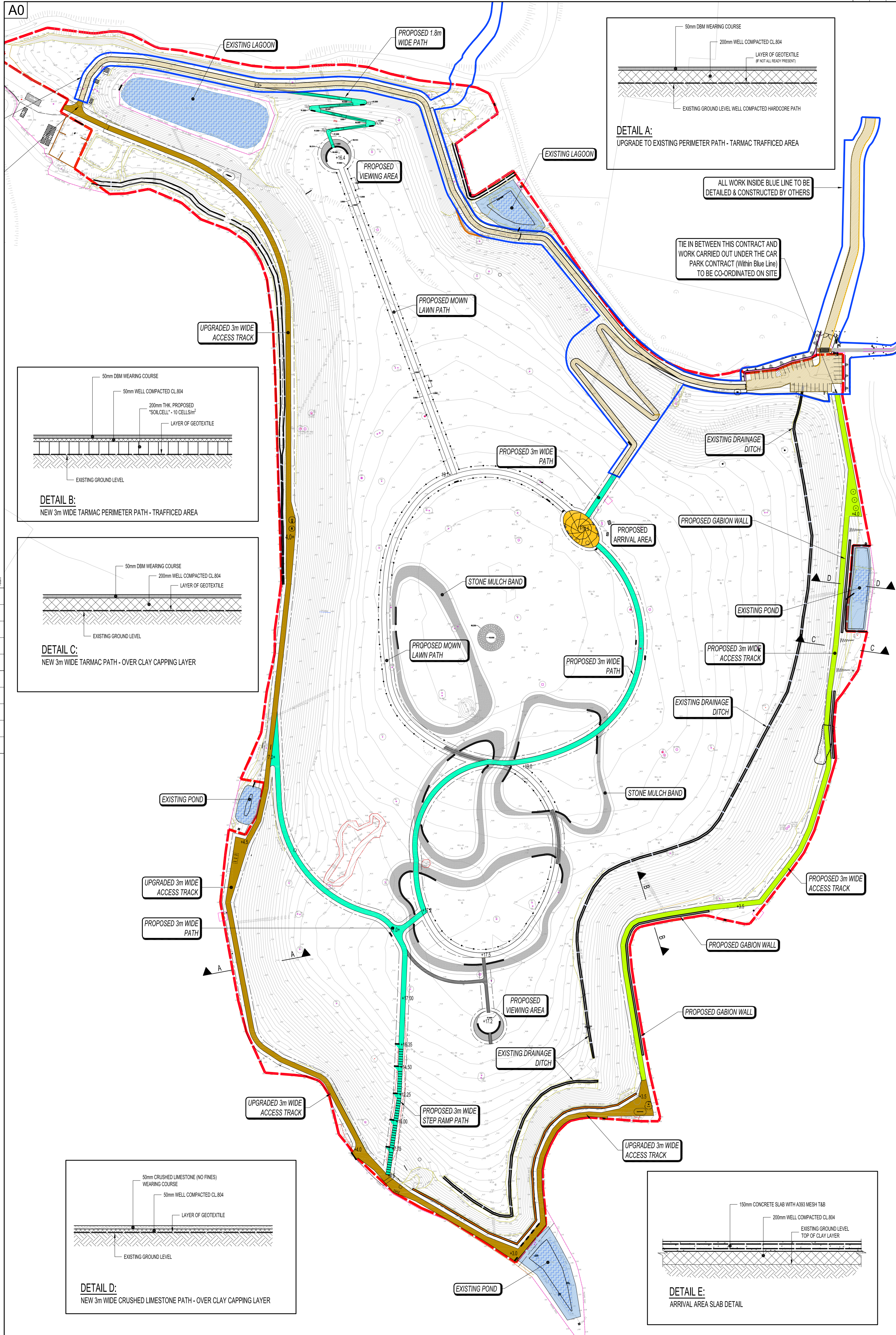
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For Tender	A1	1:1500

Drawn By	Checked By	Approved By	Date
JM	CD	KPOS	Nov.08



D01	Mar.'10	JM	CD	DRAFT ISSUE	KPOS
No.	Date	Dr	Chk	Amendment / Issue	App

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	06	D01				
Project	Title					
KILBARRY LANDFILL - WASTE LICENCE REVIEW	SURFACE WATER MANAGEMENT SYSTEM.					
Client	WATERFORD CITY COUNCIL					
Drawing Status	Sheet Size	Drawing Scale	Drawn By	Checked By	Approved By	Date
Draft	A3	-	JM	CD	KPOS	Jan. 2010



NOTES:

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- THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS AND SPECIFICATIONS.
- REFER TO ARCHITECTS DRAWINGS FOR SETTING OUT DETAILS OF ALL PATHWAYS.
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LEGEND:

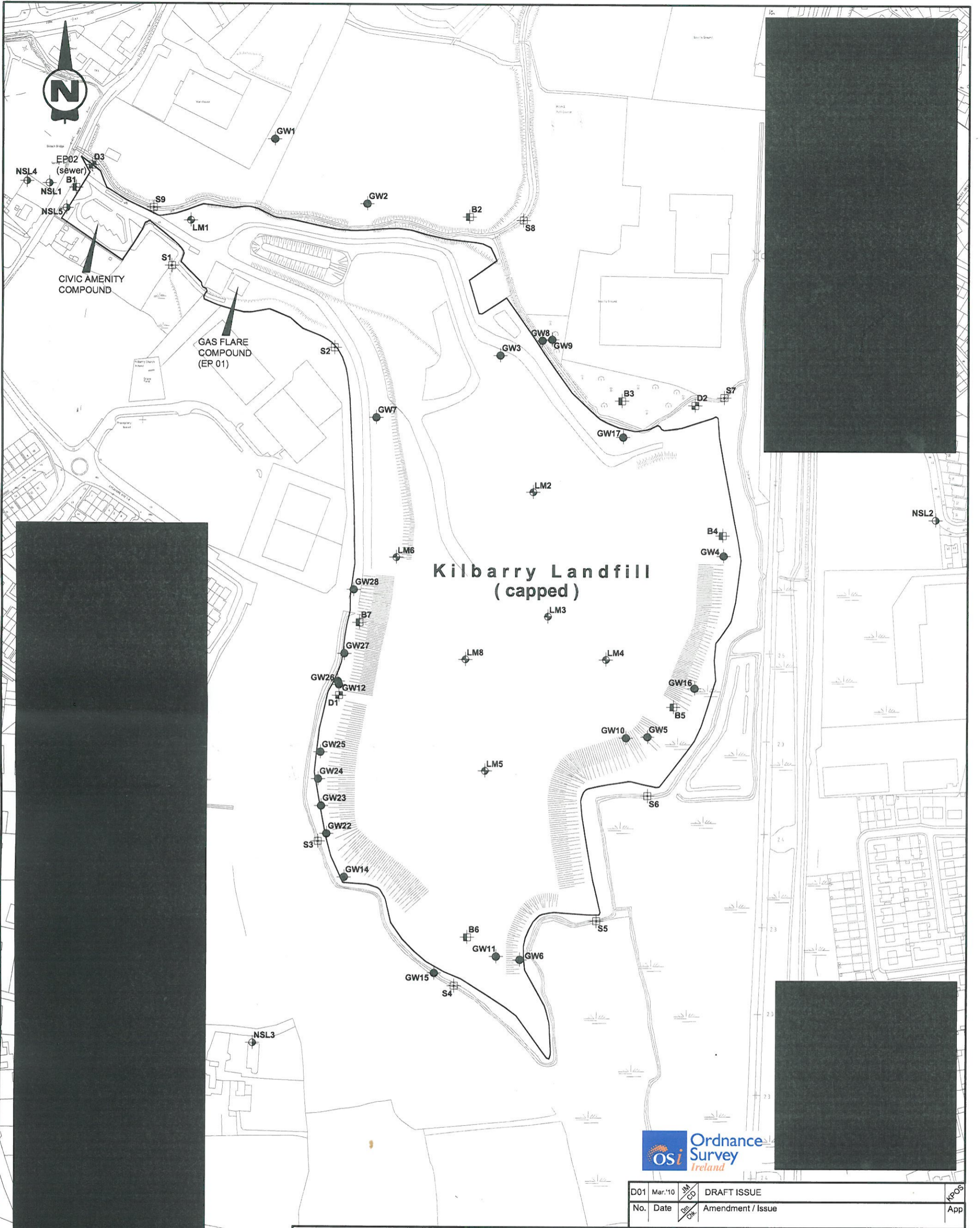
- PROPOSED SITE BOUNDARY
- ALL WORKS WITHIN BLUE LINE CARPARK CONTRACT TO BE DETAILED & CONSTRUCTED BY OTHERS
- TARMAC SURFACE - DETAIL A
- TARMAC SURFACE - DETAIL B
- TARMAC SURFACE - DETAIL C
- CRUSHED LIMESTONE SURFACE - DETAIL D
- STONE MULCH BAND BY ARCHITECTS
- MOWN LAWN PATH BY ARCHITECT

Rev.	Date	By	Description	Issued For
T1		J.B.	ISSUED FOR TENDER	JMacC

TENDER

LANDSCAPE REMEDIATION WORK AT KILBARRY LANDFILL

PROPOSED SITE LAYOUT



D01	Mar.'10	JM	CD	DRAFT ISSUE	KPOS
No.	Date	Drn	Chk	Amendment / Issue	App

	Innishmore Ballincollig Co. Cork Ireland	T +353 21 4665900 F +353 21 4873742 W www.rpsgroup.com/ireland E ireland@rpsgroup.com	Drawing Number	Rev		
			10	D01		
Project			Title			
KILBARRY LANDFILL - WASTE LICENCE REVIEW			MONITORING LOCATIONS PLAN			
Client						
WATERFORD CITY COUNCIL						
Drawing Status	Sheet Size	Drawing Scale	Drawn By	Checked By	Approved By	Date
Draft	A3	-	JM	CD	KPOS	Jan. 2010