Appendix A7.7 SKM Enviros 2013 Odour Control Plan

Kerdiffstown Landfill

TASK 7: KERDIFFSTOWN ODOUR CONTROL PLAN

- Final
- August 2013

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1. Introduction

The former landfill and waste processing facility at Kerdiffstown has now closed and is in the early stages of remediation. The Environmental Protection Agency (EPA) are using powers under Section 56 of the Waste Management Act 1996 (as amended) to restore the site and put in place appropriate aftercare measures to prevent and limit pollution from the materials which are present at the site.

In February 2013 SKM Enviros (SKME) were appointed as a framework contractor by the EPA to provide technical environmental support services in relation to the remediation of Kerdiffstown Landfill. Phase 1 of the contract involves the completion of a number of discrete technical tasks in order to progress towards identification of potential remedial options for the site.

Task 7 of Phase 1 involves the development an overall strategy for the control of odours from the site. This strategy has be formed following the undertaking of a number of subtasks which included

- Review of current sources of odour; and,
- Review of odour characteristics.

This report outlines the findings of the above tasks and details the Odour Management Plan (Chapter 4) to be established as part of the remediation project.

1.1. Background to Odours at Kerdiffstown Landfill

Odour emissions at Kerdiffstown landfill are primarily linked with diffuse landfill gas emissions, while other potential secondary odour sources include the leachate lagoon and gas flare emissions. Landfill gas is made up of a mixture of components, including methane, carbon dioxide, nitrogen and many trace gases. It can be explosive and hazardous to humans at high concentrations, but disperses to non-hazardous concentrations once diluted in the atmosphere. However, it is the sensory odour impact of landfill gas that can cause the most immediate deterioration of quality of life to nearby sensitive receptors.

While the site was operational, the odour emissions from Kerdiffstown landfill gave rise to sustained complaints from people living in and visiting the area. This culminated in serious concerns regarding odour and air pollution when an underground landfill fire ignited in January 2011.

1.2. Measures Implemented by the EPA

The site was under the control of the Kildare Fire Service until late February 2011, when it was handed over to the care of the EPA, who took emergency measures (under powers of the Waste Management Act) to contain and limit the environmental impact of the site. Since the fire was brought under control and extinguished in 2011 the site remains under “emergency measures” and the EPA have implemented a series of follow up works to deal with the most immediate risks presented at the site.

A landfill gas management system was implemented as a priority to reduce the risk of further fires which consisted of the installation of an active landfill gas collection system. There are two flares on site, one with capacity 250m^3/hr, the second with capacity 500m^3/hr. Currently, all gas extracted from wellfields in the northwest and the lined cell is being burnt at the 250m^3/hr flare.

Currently gas is extracted at a rate of c. 150m^3/hr. The overall quality of gas entering the flare has declined gradually over time with current (April 2013) levels noted at 23% methane, 23% carbon dioxide and 0.3% oxygen.

The management of the landfill gas in this way has also assisted with controlling odour issues in the north western boundary area and in the south-eastern lined cell area. Both of these areas are in close proximity to a number of sensitive receptors and as such represent locations where active gas management was most necessary.

The active gas management system has the dual function of controlling diffuse emissions to atmosphere (and hence control of odours) as well as preventing lateral migration along the north-western boundary of the site). The system has been operational for approximately 18 months, and has been successful in meeting both of these objectives.

Odour issues and/or complaints are now rare occurrences on site, with only six complaints logged by the EPA between February 2011 and March 2013. Some complaints related directly to intrusive site investigations that were taking place in 2012 when boreholes were drilled through the waste body to prove depth to natural ground and provide information of waste. The odour experienced on site during these investigations was logged, and provides an insight into the type of odour emissions that have to be anticipated during remediation works, when waste material will again be disturbed. This information has been transposed onto a plan of the site as provided as Drawing 1 at the end of this report.

1.3. Requirement for future Odour Management Plan

The scoping for the Odour Management Plan (OMP) for Kerdiffstown landfill site has been drawn up in recognition of past odour concerns arising from the operational landfill. In view of the required remediation of the site, and development of end-use options, it is recognised that odour management must be implemented at every stage of the remediation works.

The final OMP will be designed to be implemented in conjunction with the overall Landfill Gas Management Plan (LGMP). The LGMP provides an estimate of the duration and quantity of gas production in the site. Based on the assessments carried out the site waste is currently at peak gas production. The gas quantities will diminish, but will continue to require gas management over the next 30 years.

At the present time it should be noted that a detailed remedial design for the site including detailed engineering designs, phasing of works and timescales for implementation has not yet been finalised. Therefore, the objectives of this Odour Management Plan at the present time are to:

- Identify current and future potential odour emission sources on the site (Chapter 2)
- Review the Odour Characteristics identified at Kerdiffstown and qualitatively assess the risk of odours impacting on sensitive receptors (Chapter 3);
- Scope an initial Odour Management Plan (OMP), including mitigation measures to inform current and future site conditions. The final OMP will be worked up and implemented as part of the preferred remediation and after-use design. (Chapter 4)

Once detailed designs become available, then it is anticipated that information contained within this report can be used as a basis against which a detailed OMP can be development for implementation during site remedial works.

2. Sources of Odour

The main sources of odour from Kerdiffstown are due to diffuse gases arising from the decomposition of waste in the landfill. These emissions have been monitored as part of various baseline studies, and are described in the **Environmental Baseline Report**.

A summary of surveys, and resultant identification of predominate areas from which odours are known to arise is provided below. While these assessments have set out to identify and characterise the odour arisings, it is accepted in guidance literature on landfill odour (*EA Horizontal Odour Guidance*[1] ; *EPA: AG5 -Odour Assessment Guidance*[2]) that odour incidents which give rise to complaints can often be episodic and short-lived, and therefore difficult to witness and record. In addition, emissions are greatly diluted from their point of release, and are often below detection limits of instruments, but as odour thresholds of some compounds are very low, they may still be detected by people. Furthermore, the taking of chemical odour samples on a sorption device can only provide average chemical concentrations. These may bear little relevance to the peak events that can cause annoyance, or offence to nearby sensitive receptors.

It must therefore be appreciated that odour emissions can by their very nature be difficult to quantify. However, this does not diminish the importance of implementing rigorous odour mitigation measures.

A total of six odour complaints have been received regarding odour issues at the site since the EPA took control in February 2011 up to March 2013. This low number of complaints indicates that odours are not currently a significant source of nuisance.

2.1. Odour Emissions Assessment (Sniff Test)

The current odour emissions at Kerdiffstown have been qualitatively assessed. Regular odour checks are carried out by site personnel during daily and weekly site surveys. Any odours noted are logged in the daily site assessment records, together with metrological conditions and details of works taking place on site.

An Odour Assessment (Sniff Test) in line with the *EPA: AG 5 (Ref 2)* was carried out on the 10th April 2013 (onsite) and on the 13th May 2013 (offsite) by SKME staff. The onsite assessment was carried out by two qualified personnel. The entire site was assessed, with particular emphasis in the areas in which previous odour logs had identified prevalence of strong odours.

As part of the onsite odour assessment, ten locations were assessed on the northern half of the site. In line with the EPA assessment method, an odour Intensity of 0 to 4 (most intense) was logged, and an odour persistence between 0 and 2 (most persistent). The most persistent and intense odours were noted on the top of the northern site, around Borehole 36B, with a strong rotten cabbage/ rotten egg smell being evident. This area, and the northern end of the NW gas field, is generally the location of strongest diffuse odours on site.

1 EA Additional Guidance to H4 Odour Management: How to comply with your Environmental Permit; 2011

2 EPA Air Guidance Note 5 (AG5) Odour Impact Assessment Guidance for EPA Licensed Sites

On the survey carried out on 10th April the wind was blowing from a south / south-easterly direction, and was occasionally gusty, leading to concentrated pockets of odour being blown in a north-westerly direction. The southern half of the site was included in the odour survey; however, no odours were apparent in the southern site.

As part of the offsite odour assessment, eight locations surrounding the perimeter of the site were assessed. During the survey there was a light to gentle breeze blowing from the NW. No odour was detectable at any of the upwind locations (OMP1-4 as shown in Drawing 2). Intermittent faint to moderate odours were detected at OMP 6 and OMP 7 during the assessment. At both locations the odour was noted as "sweet rotten eggs". These locations are adjacent to the EPA air quality monitoring shelters located along the driveway connecting Kerdiffstown House to the L2005 road.

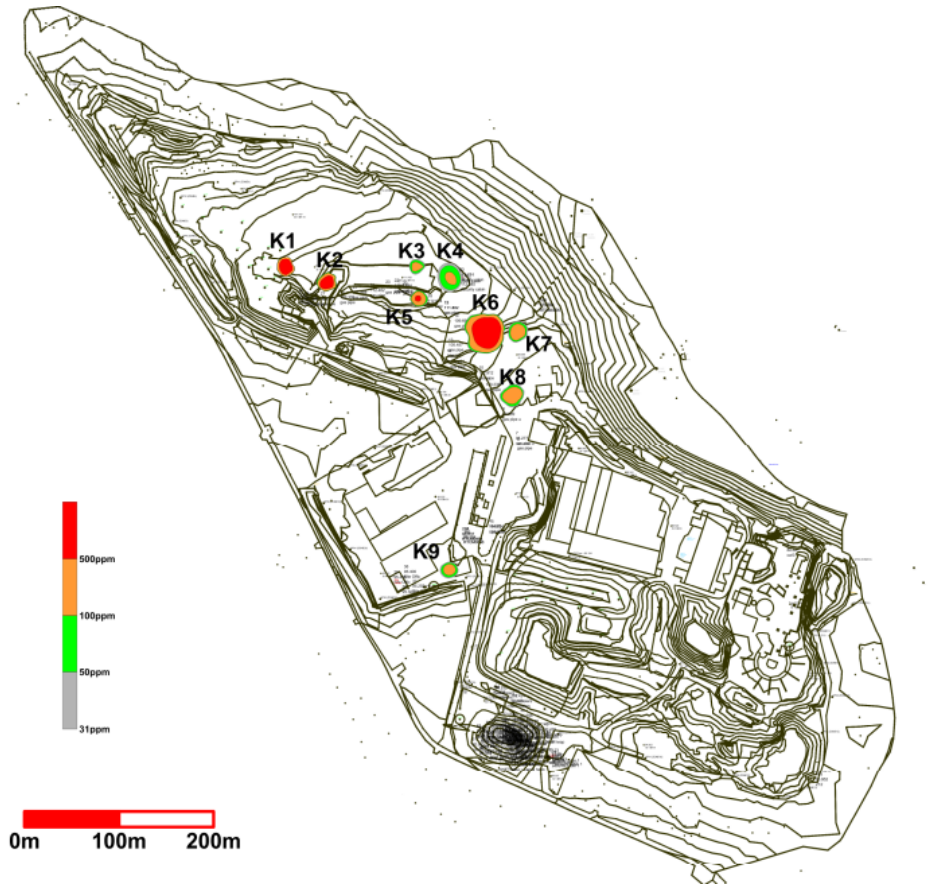
2.2. Surface VOC monitoring

Surface emission monitoring of volatile organics diffusing from the site has been carried out annually between 2008 and 2012 by Odour Monitoring Ireland, in accordance with the *EPAs AG 6 Air Guidance* [3]. Surface VOC monitoring was carried out with a hand-held flame ionisation detector (FID). It provides an instantaneous indication of areas in which landfill gas is diffusing out of the waste body. While the FID measures total VOCs, as a component of landfill gas, it does not quantify the other constituent landfill gas components.

The most recent Surface VOC monitoring was carried out in October 2012, see Figure 2.1 below. During this survey nine individual surface emission zones of landfill gas were identified, all in the centre and north-west of the site. These locations corresponds to the results of the Odour 'Sniff'' surveys discussed above, and soil core odour logs detailed in Section 2.1.

3 EPA Air Guidance Note 6 (AG6) Surface VOC Emissions Monitoring on Landfill Facilities

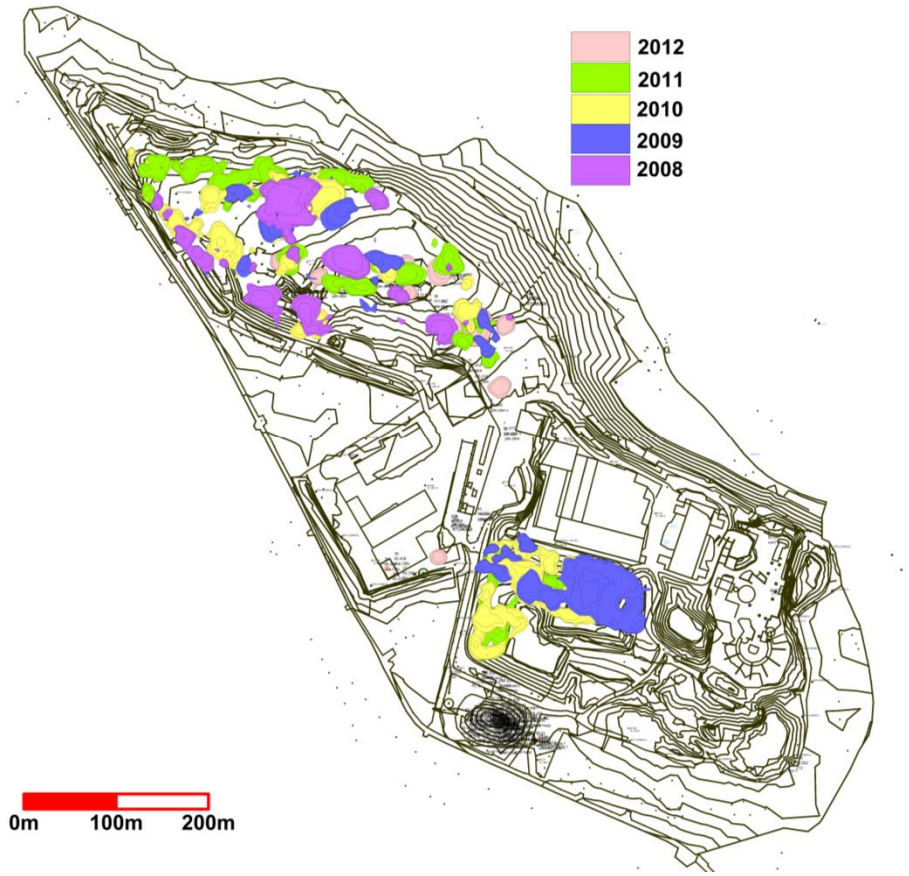
Figure 2.1.: VOC Surface Emission mapping 2012 at Kerdiffstown Site (Source: Odour Monitoring Ireland)



No diffuse VOC emissions were indicated in the south-east lined cell area, which currently has a temporary cap placed on it. This change in emissions, compared to previous years (see Figure 2.2) is evidence of the effectiveness of capping for emission and odour management procedures.

Figure 2.2 provided below shows the change in surface emission locations recorded over the past five years. This figure does not indicate VOC **concentrations**, just changes in **locations** of diffuse emissions arising. Overall VOC surface emission locations have decreased at the site, most significantly in the south-east. The elimination of surface emissions in the south-east of Kerdiffstown has been due to the lining of this site area, thereby preventing diffuse emission releases.

Figure 2.2.: VOC Surface Emission location mapping 2008-2012 at Kerdiffstown (Source: Odour Monitoring Ireland)



2.3. Summary Odour Source Locations

Current Odour Source Location

By combining the results of the Odour Assessments with the results of the Surface VOC emission survey, a clear picture emerges regarding the area of the main diffuse odour emissions in the northern part of the site. Figure 2.1 delineates the current odour emission locations.

Odour Source locations expected during Remediation orks

These emissions are mainly released from the uncapped NW waste area, north of the 2011 fire zone. The temporarily capped south east area is currently not considered a source of odours, however, this will change once during remediation works, when the temporary cap potentially may be removed and waste material disturbed as part of the landfill re-profiling.

For the purpose of odour management during site remediation works, the entire waste body, and certainly the areas marked in Figure 2.2, must be considered as potential odour sources, as any lifting of temporary caps, and disturbance of waste material can lead to mobilisation of odorous gases.

3. Review of Odour Characteristics

3.1. Sub ective Odour Characteristic Identification

During the site walk over surveys, such as described above, odour characteristics are routinely recorded on the field sheets, in addition to odour strength and metrological data. The subjective odour characteristics most frequently used to describe the perceived impact from Kerdiffstown are 'rotten eggs'; rotten cabbage' and 'oily petroleum'.

Odour characteristics during Site Investigation Activities

Odour characteristics were also assessed on a qualitative basis during site investigation works, whereby soil cores were removed from the site during two intrusive site investigations carried out in 2012. Soil core samples were removed from over 50 boreholes, in some cases from depths up to 25 meters into the waste body. Odour ranging from faint to very strong smells was logged. The characteristics of smells were described as burnt (from the previous fire area), oily, indicating hydrocarbons, rotten eggs, indicating hydrogen sulphide and rotten cabbage/ vegetable, indicating mercaptan smells.

The strongest odours were recorded from soil cores taken from the northern centre of the site and the north-western gas field. Boreholes 14, 16, 30B, 35A, 36B and 43B indicated particularly strong smells.

Records of these odours and the depths at which they occur have been transposed onto a plan to further assist the remediation works when they are undertaken. This is presented in Drawing 1 as part of this report.

3.2. Trace-gas Analysis

In order to better characterise the odours arising from Kerdiffstown landfill, trace-gas monitoring of speciated VOC's, was carried out from four in-waste gas wells and boreholes on 24th April 2013. The monitoring involved sampling on tenax/ multimedia tubes and subsequent GCMS analysis of a typical landfill trace-gas suite. The assessment was undertaken in accordance with the *EA Guidance on Tracegas Analysis.*[4] Total VOC emissions were not sampled on this occasion, rather the sampling was undertaken to provide chemical characterisation of the VOC compounds generated within the site.

The predominant VOC compounds identified at the four in-waste gas sampling locations are shown in the table below against their associated odour thresholds and characteristics. As stated previously, gases such as hydrogen sulphide and mercaptans have very low odour detection thresholds. In addition, it is known from published studies that trace-gas concentrations in a landfill can vary significantly due to fluctuation of temperature, atmospheric pressure and humidity. Therefore, the analysis carried out took cognisance of compounds detected, even where the concentrations indicated were at or below the analytical margin of error. The very low odour threshold of the compounds characterised in the landfill emissions highlight the importance of managing activities that may release potentially odorous emissions, as even very low levels of these gases can cause significant impacts.

4 EA Guidance on monitoring trace components in landfill gas, LFTGN04 v 3.0 2010

The table below lists the compounds identified their odour thresholds and typical smell characteristics. The indicated odour characteristics tally closely with the description of odours previously noted from complaints, during site walk-over surveys and as part of sniff tests.

Table 3.1. VOC Trace-Gas Analysis Component identification at Kerdiffstown Landfill 24-04-2013

Parameter	Odour Detection Limit mg/m^3 Ref [5] [6]	Odour Character	Location 1 LG-18 (SE Site)	Location 2 LG34 (N site)	Location 3 LG10 (N site)	Location 4 BH36B- (N central)
Hydrogen Sulphide	0.0001	rotten eggs	x	x	x	x
Dimethyl sulphide	0.0037	rotten vegetables		x		
Dimethyl disulphide	0.004				x	
Methylmercaptan	0.08	sewer/ rotten cabbage	x	x	x	x
Styrene	0.07	rubbery plastic	x	x	x	
Butyl mercaptan	0.04	skunk	x	x		
Ethyl mercaptan	0.18	garlic/ sewer/ rotten cabbage		x		x
1, Pentene	0.16	pungent petrol	x	x		
Carbon Disulphide	0.7	rotten vegetables	x	x	x	x
Toluene	0.7	floral, pungent	x	x		x
1,3 Butanidiene	1.1	petrol				x
Trichloroethylene	3	Solvent		x		
Benzene	9.0	Solvent	x	x		
Chloroethane	39	Etheral	x	x		x
Furan	Not known	Etheral	x			

Information on odour generated by different waste components in provided in the *EA Guidance Quantification of Trace components in Landfill Gas, 2004* [7] which points to mixture of domestic and commercial waste types, for the type of odours characterised above.

5 SEPA Odour Guidance 2010
6 EA Guidance on Landfill Gas Flaring version 2.1, 2002
7 EA Quantification of Trace Components in Landfill Gas, 2004

3.3. Qualitative Odour Risk Assessment

Based on the findings above, comprising odour sources, locations, and odour characteristics, a *qualitative* Odour Risk Assessment has been carried out. This assessment considered the following factors:

- Current Complaint History and Daily Walk-over Records;
- Community responses to past Odour Sources;
- Sensitive Receptors and locations of likely Odour Impacts;
- Routine and non-routine causes of Odour Sources;
- Observed dispersion of odour under all different weather conditions; and,
- Risks to effectiveness of emission controls and mitigation measures in place.

A summary of the considerations identified for this risk assessment are given below, whereas mitigation measures are included in the scoped Odour Management Plan (presented below).

3.4. Current Complaint History and Daily alk-over Records

Complaints have significantly reduced since 2011m with a total of 6 complaints logged by the site management and notified to the EPA between July 2011 and March 2013. Two of these complaints came from the Naas Golf Course, located to the North-West of the site, and three from one resident located about one kilometre South-West of the site. In accordance with site management protocol, an odour investigation was carried out by the site supervisor following each complaint. Some, but not all, incidences could be accounted for due to prevailing wind conditions or site works. There is no apparent pattern to the recent complaint history.

Daily walk-over records are logged by the site supervisor, which include observations on all site conditions, including any evident odour at any locations. These daily records are maintained by the site management, and provide a record of odour prevalence and weather conditions. The daily records confirm that the primary odour sources from the site are diffuse emissions from the northern waste body.

3.5. Community Reponses to past Odour Sources

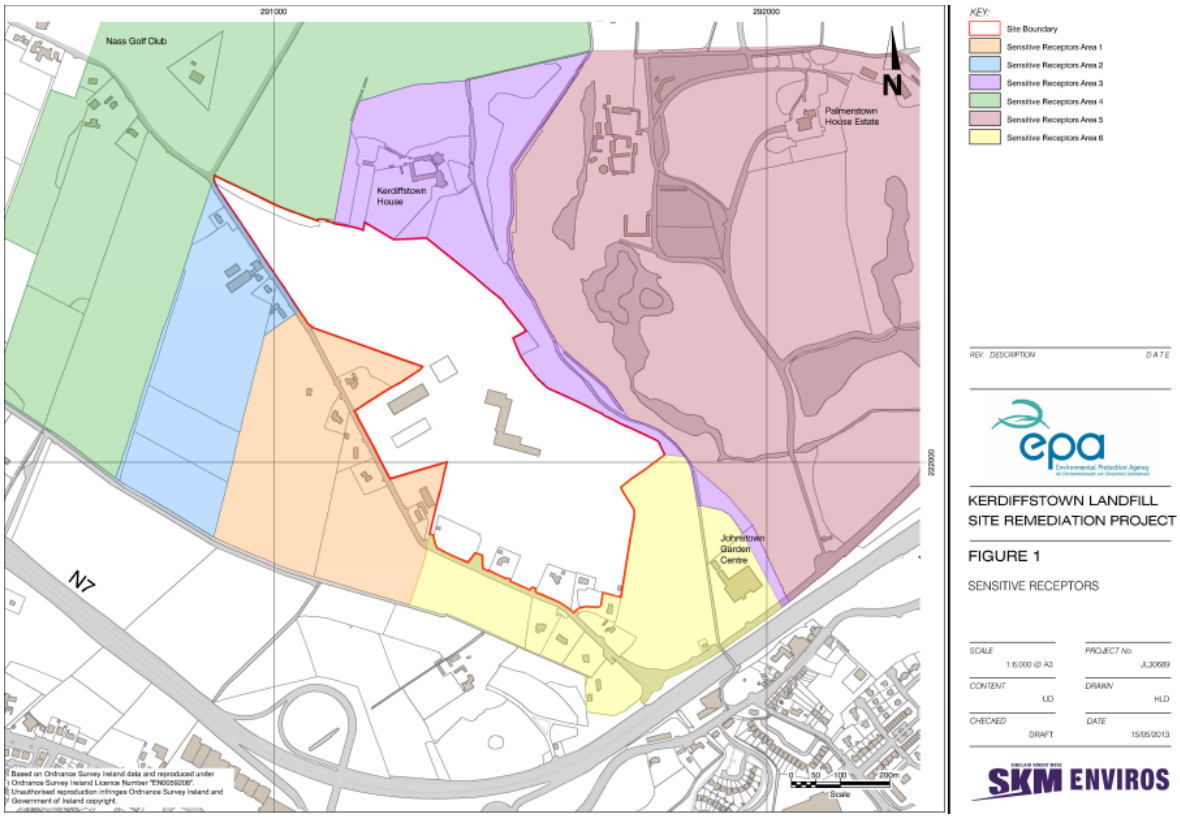
The community in the vicinity of Kerdiffstown site are sensitised to the odours arising from the landfill, due to the past history of complaints relating to the site. For many years, up to 2011, the area including a few kilometres radius around the site was subjected to very strong odours. While these odours have reduced significantly with the current site management and provision of landfill gas control systems, it is inevitable that stronger odours could potentially be released during site remediation works.

The EPA has fostered a good relationship with local community representatives and residents groups, who will be kept informed of all planned remediation works. The involvement of the residents groups throughout the remediation works will assist in enabling an understanding and tolerance for the short term necessary impacts that will arise during site remediation.

3.6. Sensitive Receptors and locations of likely Odour Impacts

The closest locations of sensitive receptors around the site have been grouped into 6 areas, as shown on the Figure below. It is evident that the closest receptors, the residential houses along the local road, and identified as SR-1 and SR-2 are located upwind of the prevailing wind direction, whereas SR-3, Kerdiffstown House, SR-4, Naas Golf Club, and SR-5, Palmerstown House Golf Club, are located to the north and north-east, more directly in the prevailing wind direction. These receptors are also closest to the main waste deposition area in the north-of the site, and are therefore most at risk of odour impacts.

Figure 3.1: Sensitive Receptors



Currently, the main location of diffuse odours arising at the site is from the northern waste deposit area. The intensity of odours is of a fluctuating nature, even when the waste body is undisturbed. The odour emissions can vary depending on prevailing metrological conditions, such as wind direction, wind speed, barometric pressure and air temperature.

The prevailing wind at the site is south-westerly. The sensitive receptors to the north and north-east of the site are therefore at higher risk of receiving odour impacts. However, no complaints from these locations have been received over the past 2 years.

During remediation works the risk of odour impacts will increase significantly, when waste containing materials potentially will become exposed. Odour mitigation measures are discussed in the Odour Management Plan.

3.7. Routine and Non-Routine Causes of Odour

The current condition of the Kerdiffstown landfill is an inactive, yet only provisionally controlled, landfill site. While no fresh waste deposition is being carried out, the site does not have comprehensive landfill gas management infrastructure or permanent capping in place. Although an active gas collection and flaring system has been installed, the infrastructure currently only accounts for the removal of gas from approximately one fifth of the site area. Diffuse landfill gas emissions can therefore still emit from the uncapped surface of the landfill in the northern waste area, as evidenced above**.** These emissions are the current 'routine emissions'.

Non-routine causes of odour will arise when site remediation works will cause disturbance of the waste body in the northern waste body, as well as in the south of the site, where temporarily capped waste may be re-opened and require re-emplacement. These non-routine odours will arise during the remediation works, but the duration and extent of the works that will cause odour releases will be minimised as far as practicable. As such, the entire north and south waste-body has to be considered as a potential, non-routine odour source.

Other non-routine sources of odour may arise if the leachate lagoon in disturbed. The management and impact minimisation from leachate is discussed separately.

In addition, odours may be emitted if any stagnant bodies of water are pumped out, such as accumulated water in tanks to the east of the site, in the prior waste processing area. Mitigation measures will be taken during these activities, and local sensitive receptors will be notified in advance of any non-routine works being carried out.

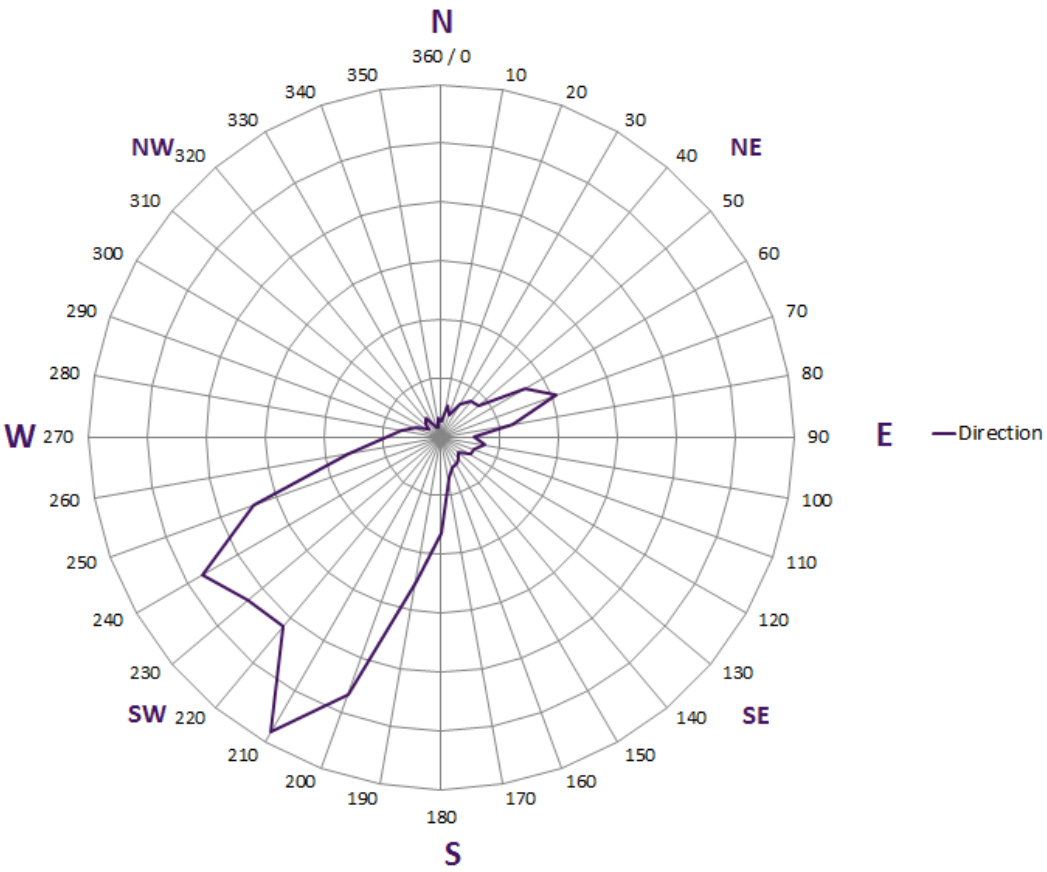
3.8. Dispersion of Odour under different eather Conditions

Daily site logs and the detailed odour assessments carried out at the site consistently indicate that the odours at Kerdiffstown landfill are most prevalent along the northern edge of the north-eastern waste body.

The main prevailing wind direction applicable to the Kerdiffstown site is from the south-west, as indicated on the Casement Wind Rose, depicted below. The main receptors located in the prevailing wind direction are therefore Kerdiffstown House Retreat Centre (SR 3) and Palmerstown House Golf Course (SR-5).

The prevalence of odours can change with weather conditions, in that the strongest odours are experienced on site during low wind conditions, when there is little dilution of air. In addition, at landfills a sudden drop in barometric pressure tends to result in an increase in gas diffusing from the waste body, until the pressure differential between the soil and air has balanced out again. High atmospheric temperatures also stimulate gas particle movement, and lead to increased gas diffusion, resulting in more odours being released in warm weather.

Figure 3.2. indrose from Casement Metrological Station Casement (2006-2013) (Source EPA)



3.9. Risks to Effectiveness of Emission Control and Mitigation Measures

The main mitigation measures are discussed in the OMP scoping section below. The mitigation measures primarily rely on good management, planning of remediation phases, provision of temporary cover to contain odour arisings, and good communication with affected receptors.

A daily odour protocol is already in place at Kerdiffstown site, and the finalising of the remediation works phasing plan will enable the details of the OMP to be planned, re-assessed, developed and implemented on a day to day basis. The effectiveness of the OMP, regarding emission control and implementation of mitigation measures, will be assessed as a Continuous Improvement Loop, whereby daily effectiveness of odour control during remediation works will be checked and documented by on-site staff/management.

3.10. Summary Risk Assessment

Diffuse Odours

This qualitative risk assessment considers that the risk of diffuse odours impacting on sensitive receptors is currently **low to medium** during the absence of works, while the site is in its current situation. While there is some diffusion of gas from the uncapped landfill surface in the northern waste-body, this is maintained at a low level due to active gas extraction/flaring, and prevention of waste disturbance. The southern waste body is temporarily capped, and does not indicate any diffuse emissions.

When remediation works commence, involving waste material movement, the potential risk of odours being emitted from any working face at the site will be **high**. Comprehensive odour mitigation measures will be required to be implemented as a daily priority. The risk of high odour emissions will be a temporary occurrence, for the duration of remediation works.

Once remediation works are completed, the site will be fully capped, and comprehensive landfill gas extraction and flaring infrastructure will be in place. In the End-Use phase the risk of diffuse odour emissions will be **very low.**

Odours from Landfill Flare

A quantitative air dispersion model (AERMOD) of potential impacts from the landfill flare emissions was carried out in 2012 by the EPA. No likely impact from flare gas emissions was predicted in the model. Therefore, odour emissions from landfill gas flaring operations are not anticipated from the site.

Table 3.1. Risk Assessment of Odour Emissions during foreseeable Site Phases

Qualitative Risk Assessment Site Phase	Current Dormant Site	Remediation orks Phase	After-use Phase
Diffuse Odour Emissions	Medium- Low	High	Very Low
Odours from Flare Emissions	Low	Low	Low
Odours from other sources (leachate/ stagnant water/ diesel fuel spillage)	Low	Medium	Low

Odour Risk from other Sources

The risk of odours arising from other sources, including from the disturbance of leachate or stagnant water or other materials such as diesel fuel spillage, has been considered. The risk from these sources is considered low during the current dormant site conditions.

The risk of other odour sources is considered medium during site remediation works, as the leachate lagoon will be disturbed as part of engineering works. Similarly any stagnant water in defunct storage tanks will be pumped out, leading to disturbance of potentially anaerobic and odorous liquids. Mitigation measures set out in 4.4. will apply to any such works.

During the after-use phase it is considered that the risk of odours arising from other sources will be low.

4. Odour Management Plan

This section sets out the scoping for a comprehensive odour management plan (OMP), which will be worked up as part of the overall Remediation Works Management Plan. The overarching objectives of this OMP scoping are to:

- identify appropriate odour mitigation methods, including monitoring and contingencies, to control and minimise odour pollution;
- identify appropriate methods to prevent unacceptable odour nuisance at all times;
- reduce the risk of odour releasing incidents or accidents by anticipating them and planning accordingly.

This OMP scoping has considered the above requirements, as set out in the *UK EA Horizontal Guidance on Odour Management*, *Ref 2,* which is considered Best Available Technique (BAT). The requirements are applicable for current 'dormant' site conditions, as well as for the future remediation works and end-use phase. In doing so the OMP will address the following points and will contain various associated documents and protocols, which are already in place as part of the current EPA controlled site management.

- Summary of the site and surrounding area;
- Odour sources and location of sensitive receptors;
- Odour management procedures;
- Site procedures for dealing with odour complaints;
- Response to odour issues and mitigation measures;
- Operative training;
- Record keeping;
- Housekeeping;
- Maintenance and inspection of odour controlling plant and material;
- Spillage/contaminated material management procedures;
- Emergency/incident response planning; and,
- Community relations.

4.1. Summary of Site and Surrounding Areas

The details of the site and surrounding area are discussed in the Environmental Baseline Report, Chapters 1-3.

4.2. Odour sources and location of sensitive receptors

Details of Odour Sources and the location of sensitive receptors are provided in Section 2.1 and 3.6, above.

4.3. Odour Management Procedures

For the Kerdiffstown Landfill, the remediation works will give rise to the highest risk of odour releases. While activities which may disturb waste, such as excavation and reprofiling of slopes, or replacement of materials, will be unavoidable, this OMP provides outline mitigation measures to minimise odour impacts as can be anticipated.

It must be noted, however, that a detailed phasing and daily/ weekly specification of most appropriate mitigation measures cannot be provided, until the full remediation plan has been finalised.

Odour Management during Current Site Conditions

At the present time it is considered that odour occurrences are being minimised at the site through best practice and regular monitoring. This is in line with guidance provided in the *EPA Landfill Manuals, Landfill Monitoring*[8] .

Current Odour Minimisation and Prevention measures which are currently implemented includes:

- Carrying out sniff tests and logging details of odorous emissions during daily and weekly site assessments;
- Noting wind direction, temperature and barometric pressure on a daily basis;
- Ensuring that landfill gas flaring is balanced and optimised to maximise gas collection from installed gas wells and flaring according to operational recommendations;
- Investigating any odour that appears stronger than the normal emission;
- Logging any odour complaints, and investigating circumstances on the day the complaint was made. This includes correlating wind direction and speed, barometric pressure, and whether any site works were being carried out; and,
- Notifying nearby sensitive receptors prior to any works being carried out, that may disturb the waste body and cause odours to be released (such as intrusive site investigations).

Odour Management during Remediation Works

During the remediation works ground disturbance will be unavoidable. Such ground disturbance is likely to occur when waste movement for the reprofiling of the NW area will be required, as well as re-emplacement of waste into the lined cell in the SE area. As the specifics of the remediation works are not finalised, the phasing and duration of such emissions cannot currently be fully assessed.

8 EPA Landfill Manuals, Landfill Monitoring, 2nd Edition, 2003

In addition, currently none of the facility areas are permanently capped. Capping will alter the location and rate of any landfill gas emissions from the site, as it will prevent diffuse emissions through the top of the facility. A potential impact of capping the site could be to direct the gas emissions sideways towards any pathways of least resistance. This could result in landfill gas migrating offsite, if not adequately managed with the landfill gas infrastructure.

Nevertheless, a comprehensive OMP will be drawn up to cover the anticipated remediation works, and specify most suitable odour minimisation methods, based on the details provided below. A daily odour protocol is already in place at Kerdiffstown site, and the finalising of the remediation works phasing plan will enable the details of the OMP to be planned, reassessed and improved on a day to day basis. The effectiveness of the OMP, regarding emission control and implementation of mitigation measures, will be assessed as a Continuous Improvement Loop, whereby daily effectiveness of odour control during remediation works will be checked and documented by the site supervisor.

4.4. Odour Mitigation Measures

Minimise Evaporation of Odours Compounds

The first step to mitigating diffuse odour emissions from a landfill is by minimising the potential evaporation of odorous compounds. This will be enacted during remedial works through adoption of measures such as the following:

- Provision of an adequate supply of temporary cover material prior to any works commencing (e.g. clean topsoil, clay or liner membrane,);
- Any exposure of odorous waste will be kept to the minimum practical duration;
- The surface area of exposed waste will be kept to a minimum size at all times;
- Temporary cover will be applied to all works areas as quickly as practicable;
- The carrying out of major waste movements during hot weather when odours volatise most readily will be avoided;
- Leaving open waste exposed in direct sunlight, which increases evaporation, will be avoided;
- Water spray to lower the temperature of exposed waste, and inhibit evaporation will be used;
- Screening of materials containing waste, unless adequately contained, will be avoided;
- Any waste containing material that has to be transported from one side of the site to another will be covered and contained during transport;
- If unacceptable odours are generated from a particular activity it may be necessary to cover the exposed waste, and cease the activity until additional odour control measures can be put in place. This may include the provision of additional water bowsers, cooler weather conditions, or the use of odour suppressants/ masking substances; and,
- During normal circumstances the use of odour masking agents will not be promoted, as these substances can become a source of odour nuisances in their own right.

Informing nearby Sensitive Receptors

The Naas Community Liaison Group is well established, and will be kept informed of the progress and plans regarding the remediation and end-use of the site. They will be made aware of the nature of the site works, which will include the necessary reprofiling and movement of some waste materials, in order to achieve the final approved landforms.

The site management will request their patience; on the understanding that once remediation works have been completed, they will no longer experience nuisances, deterioration of their quality of life, or reduction of property value.

Nearby sensitive receptors will be informed prior to any remediation works being carried out. They will be informed of the works phasing plan, and the locations of works planned for the duration of remediation works will be regularly updated and communicated. Where adverse metrological conditions coincide with works phasing that cannot be averted, residents will be informed of the heightened risk of short-term odour nuisances.

Monitoring of Odorous Emissions

During remediation works the odour emissions from the site will be a requirement for monitoring which is likely to include the following:

- Frequent sniff sampling and logging of odour characteristics at the working face, in accordance with EPA AG5 (Ref 2);
- Frequent sniff tests at the site perimeter downwind from the working face;
- Frequent sampling of specified compounds with colour indicator tubes specified at appropriately low detection ranges. These should include indicative sampling for benzene, chloroethane, 1,4 epoxy 1.3-butanidiene (furan), and hydrogen sulphide. Such sampling will assure that health related emission concentrations do not arise;
- Frequent sampling of Total VOC concentrations using a FID handheld field detector; and,
- Regular sniff tests off-site near sensitive receptor locations.

If monitoring indicates higher than expected odour emissions, or impacts at sensitive receptors, additional mitigation measures will need to be implemented. If necessary, and in adverse conditions, the works may have to be stopped and the workface contained with a temporary cover, until adequate mitigation can be assured.

4.5. Odour Impacts during After-use Phase

It is not anticipated that any diffuse odour impacts will occur during the after-use phase, as the remediation, capping, and on-going landfill gas management of the site will control any diffuse odours from arising.

Post Remediation Landfill Gas Management

It is recognised that when the site is fully restored, a comprehensive gas management system needs to be in place across the whole site to meet the following objectives:

- Prevent off-site horizontal migration;
- Control vertical emissions of gas through the cap to ensure restoration planting is not impacted by gas build up in the root zone; and,
- Prevent gas accumulating in any on-site buildings and other confined areas.

A detailed gas management plan will be worked up as part of the preferred restoration and after-use design. Active extraction and flaring of gas will be required.

It is envisaged that within the main body of the site, gas extraction wells will be installed on a nominal 40m grid spacing, with closer spacing of wells close to the perimeter to prevent migration, typically at 20 to 25 m centres along most sensitive boundaries such as adjacent to the north-west corner where housing is closest to the site boundary. The system needs to be flexible to allow it to adapt to falling gas levels and generation rate, as wastes progressively degrade.

4.6. Site procedures for dealing with Odour Complaints

The site procedures for dealing with odour complaints will remain as current in place. This will include a procedure to log a complaint, and notify the EPA on the Incident Form. The complaint will then be investigated by the site supervisor or other suitably trained site staff. The odour investigation will consist of a site walk-over assessment and sniff test, during which metrological conditions will be logged, as well as any odours characterised, odour strength determined and locations of strongest odour impact identified. The sniff test will follow the EPA Guidance AG 5 (Ref 2). The investigation will consider the following

- Are any unplanned activity occurring on site;
- Have the specified control measures been implemented correctly;
- Can control procedures be increased for the current activity;
- What are the metrological conditions on the day;
- Did the complaints arise from a downwind location from the days activities;
- Investigate results from the daily health indicator testing and VOC sampling, to ascertain that no health impacts are associated with the odours complained about

The complaint investigation will be made available for public viewing.

4.7. Operative Training

All site operatives tasked to carry out odour assessments must be environmental professionals who can demonstrate suitably familiarity with the EPA Odour Assessment Guidance AG-5. A list of operatives who carry out odour assessments and their relevant qualifications will be kept on site.

4.8. Record keeping

The record keeping procedure for odour management will be in line with the overall site record keeping protocol. This will be provided in an Appendix of the OMP.

4.9. Housekeeping

Odour minimisation on a landfill is intrinsically linked with good site management and housekeeping. The pertinent considerations that must be carried out for the minimisation of odours are set out above.

4.10. Maintenance and inspection of odour controlling plant and material

The landfill gas control infrastructure is the main odour controlling plant, consisting of the in-waste pipelines, valves, gas well, pumps, and flaring units. The regular balancing of the gas fields, and proper maintenance of the flares is a primary aspect of the site supervisors duties. The landfill gas procedures are set out, and will be provided in an Appendix of the OMP.

4.11. Spillage/contaminated material management procedures

Spillages that could give rise to odours include spillages of leachate or stagnant water, or spillages of diesel fuels. No other odorous liquids are likely to be transported or used at the site. Any spillages of such liquids will be dealt with as per the site incident and emergency procedures. A copy of these will be provided in an Appendix of the OMP.

Material spillages could occur if odorous waste containing materials are transported across the site for planned re-emplacement. If this occurs this will be covered by the Odour Minimisation procedures.

4.12. Emergency/incident response planning

The overall site management has detailed emergency and incident response procedures in place, and these will be revised and amended to address all possible occurrences during the remediation period. Unexpected odour is a consequence of an unplanned incident or mismanagement of an unforeseen event. As such, the management of odour arising from an incident will be intrinsic to the management of the source of emergency. Such emergency measures will be drawn up in detail once the remediation plan has been finalised.

4.13. Community relations

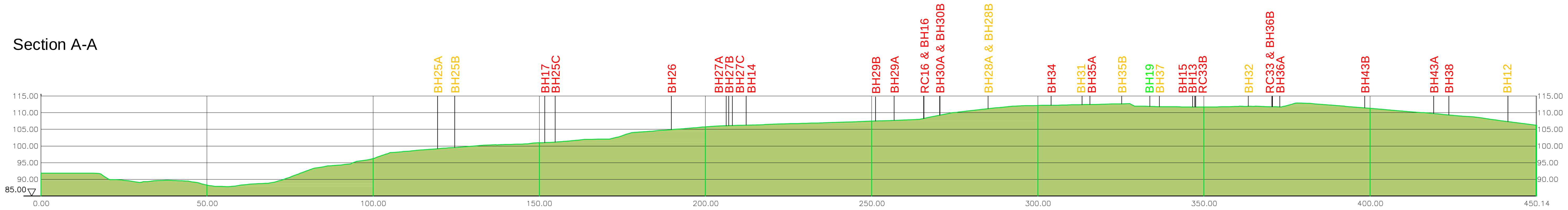
Community relations have been well established by the EPA. The channels of communication will be maintained, and community groups as well as residents will be informed of works phasing through the duration of works occurring at Kerdiffstown site.

Drawings

Drawing 1: Odour Profile

Drawing 2: Odour Monitoring Locations

Section A-A



1.00	No gas odour	Strong gas odour	Moderate/ Strong Odour	Moderate gas odour	Very strong rotten eggs gas odour	Very strong gas odour (rotten eggs)	Strong rotten eggs gas odour	Slightly rotten eggs gas odour	Moderate Odour	No gas odour
2.00	Moderate odour of rotten eggs	Slight gas odour	Medium odour of oil	Strong gas odour	Very strong rotten eggs gas odour	Medium gas odour	Strong rotten eggs gas odour	Medium rotten eggs	Moderate/ Strong Odour	Medium rotten eggs gas odour
3.00			Medium odour of oil	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour	Medium gas odour	Strong rotten eggs gas odour	Strong rotten eggs	Moderate/ Strong Odour	Medium rotten eggs gas odour
4.00			Medium odour of oil	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour	Medium gas odour	Strong rotten eggs gas odour	Strong rotten eggs	Moderate/ Strong Odour	Medium rotten eggs gas odour
5.00			Medium odour noted	Moderate gas odour of rotten eggs	Slightly rotten eggs gas odour	Medium gas odour	Strong rotten eggs gas odour	Strong rotten eggs	Moderate/ Strong Odour	Medium rotten eggs gas odour
6.00			Medium odour noted	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour	Medium gas odour	Strong rotten eggs gas odour	Strong rotten eggs	Moderate Odour	Medium rotten eggs gas odour
7.00			Medium/ Strong Odour	Moderate gas odour of rotten eggs	Medium rotten eggs gas odour	Medium gas odour	Strong rotten eggs gas odour	Strong rotten eggs	Moderate Odour	Medium rotten eggs gas odour
8.00			Medium/ Strong Odour	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour		Strong rotten eggs gas odour	Strong rotten eggs	Moderate Odour	Medium rotten eggs gas odour
9.00			Medium/ Strong Odour	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour			Strong rotten eggs	Moderate Odour	Medium rotten eggs gas odour
10.00			Slight odour noted	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour			Strong rotten eggs	Moderate Odour	Strong rotten eggs gas odour
11.00			Medium odour of oil	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour			Strong rotten eggs	Strong Odour	Strong rotten eggs gas odour
12.00			Medium odour of oil	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour			Strong rotten eggs	Strong Odour	Strong rotten eggs gas odour
13.00			Strong Odour	Moderate gas odour of rotten eggs	Very strong rotten eggs gas odour				Moderate Odour	Very strong rotten eggs gas odour
14.00			Strong Odour	Moderate gas odour of rotten eggs	Very strong rotten eggs gas odour				Moderate Odour	Strong rotten eggs gas odour
15.00			Strong Odour	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour				Strong Odour	Strong rotten eggs gas odour
16.00			Not recorded	Moderate gas odour of rotten eggs	Strong rotten eggs gas odour				Completed by Rotary - no odour readings recorded	Strong rotten eggs gas odour
17.00			Slight odour noted	Moderate gas odour of rotten eggs	Medium rotten eggs gas odour					Strong rotten eggs gas odour
18.00			Slight odour noted		Strong rotten eggs gas odour					
19.00					Strong rotten eggs gas odour					
20.00					Very strong rotten eggs gas odour					
21.00					Slightly rotten eggs gas odour					
22.00					Strong rotten eggs gas odour					
23.00					Strong rotten eggs gas odour					
24.00					Strong rotten eggs gas odour					
25.00					Strong rotten eggs gas odour					
26.00					Strong rotten eggs gas odour					
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36.00										
37.00										
38.00										
39.00										

1.00	No gas odour	Slight odour	Medium oil and rotten eggs gas odour	Strong rotten eggs gas odour	No gas odour	Not recorded, see BH28A	Medium oil gas odour	Slightly gas odour	Medium rotten eggs gas odour	Not recorded, see BH35A
2.00	Medium oily gas odour	Slight odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour	Medium rotten eggs		Medium oil gas odour	Slightly gas odour	Medium rotten eggs gas odour	Not recorded, see BH35A
3.00	Medium oily gas odour	Slight odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour			Medium oil gas odour	Slightly gas odour	Strong rotten eggs gas odour	Not recorded, see BH35A
4.00	Medium oily gas odour	Slight odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour			Medium oil gas odour	Slightly gas odour	Strong rotten eggs gas odour	Not recorded, see BH35A
5.00	Medium rotten eggs gas odour	Slight odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour			Medium oil gas odour	Slightly gas odour	Strong rotten eggs gas odour	Not recorded, see BH35A
6.00	Medium rotten eggs gas odour	Strong Odour of H_2S	Medium rotten eggs gas odour	Strong rotten eggs gas odour			Medium oil gas odour	Slightly gas odour	Strong rotten eggs gas odour	Not recorded, see BH35A
7.00	Medium rotten eggs gas odour	Strong Odour of H_2S	Medium rotten eggs gas odour	Strong rotten eggs gas odour			Medium oil gas odour	Slightly gas odour	Strong rotten eggs gas odour	Not recorded, see BH35A
8.00	Medium rotten eggs gas odour	Strong Odour of H_2S	Medium rotten eggs gas odour	Strong rotten eggs gas odour			Strong rotten eggs gas odour	Slightly gas odour	Strong rotten eggs gas odour	
9.00		Moderate/ Strong Odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour			Strong rotten eggs gas odour	Slightly gas odour	Strong rotten eggs gas odour	
10.00		Moderate/ Strong Odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour			Strong rotten eggs gas odour	Strong gas odour	Strong rotten eggs gas odour	
11.00		Moderate/ Strong Odour	No gas odour	Strong rotten eggs gas odour			Strong rotten eggs gas odour	Strong gas odour		
12.00		Moderate/ Strong Odour	No gas odour	Strong rotten eggs gas odour			Strong rotten eggs gas odour	Slightly gas odour		
13.00		Moderate/ Strong Odour		Strong rotten eggs gas odour			Strong rotten eggs gas odour	Strong gas odour		
14.00		Moderate/ Strong Odour		Strong rotten eggs gas odour			Strong rotten eggs gas odour			
15.00		Moderate/ Strong Odour		Strong rotten eggs gas odour			Strong rotten eggs gas odour			
16.00		Moderate/ Strong Odour		Strong rotten eggs gas odour			Strong rotten eggs gas odour			
17.00		Moderate/ Strong Odour		Strong rotten eggs gas odour			Strong rotten eggs gas odour			
18.00		Moderate/ Strong Odour					Strong rotten eggs gas odour			
19.00		Moderate/ Strong Odour					Strong rotten eggs gas odour			
20.00		Completed by Rotary - no odour readings recorded					Strong rotten eggs gas odour			
21.00							Strong rotten eggs gas odour			
22.00							Strong rotten eggs gas odour			
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36.00										
37.00										
38.00										
39.00										

1.00	No odour		Moderate odour of H_2S	Moderate Odour	Slightly gas odour	Medium rotten eggs gas odour	Medium rotten eggs gas odour	No odour	Medium oily gas odour	Slight gas odour	Slight odour
2.00	No odour	Slight gas odour	Moderate odour of H_2S	Moderate Odour	Slightly gas odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour	Medium rotten eggs gas odour	Medium oily gas odour	Strong rotten eggs gas odour	No odour
3.00	No odour	Slight gas odour	Moderate odour of H_2S	Moderate Odour	Slightly gas odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	No odour
4.00	No odour	Slight gas odour	Moderate odour of H_2S	Moderate Odour	Slightly gas odour	Medium rotten eggs gas odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Odour of H_2S
5.00	No odour	Slight gas odour	Moderate odour of H_2S	Moderate Odour	Slightly gas odour	Strong rotten eggs gas odour	Medium rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Odour of H_2S
6.00	Not recorded	Slight gas odour	Moderate odour of H_2S	Moderate Odour	Slightly gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Odour of H_2S
7.00	Not recorded	Slight gas odour	Strong Odour of H_2S	Very strong odour	Strong gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Very strong rotten eggs gas odour	Strong rotten eggs gas odour	Odour of H_2S
8.00	Not recorded	Slight gas odour	Very Strong Odour of H_2S	Very strong odour	Strong gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Very strong rotten eggs gas odour	Strong rotten eggs gas odour	Medium odour of H_2S
9.00	No odour	Medium oily gas odour	Not recorded	Very strong odour	Strong gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Very strong rotten eggs gas odour	Strong rotten eggs gas odour	Moderate odour
10.00	No odour	Slight gas odour	Completed by Rotary - Strong odour noted	Moderate Odour	Strong gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Very strong rotten eggs gas odour	Strong rotten eggs gas odour	Moderate odour
11.00	Not recorded	Slight gas odour		Moderate Odour	Medium gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Very strong rotten eggs gas odour	Strong rotten eggs gas odour	Moderate odour
12.00	Completed by Rotary - no odour readings recorded	Slight gas odour		Moderate Odour	Medium gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Strong rotten eggs gas odour	Very strong rotten eggs gas odour	Strong rotten eggs gas odour	Moderate odour
13.00		Slight gas odour		Moderate Odour		Strong rotten eggs gas odour				Very strong rotten eggs gas odour	Not recorded
14.00		Slight gas odour		Moderate Odour		Strong rotten eggs gas odour				Very strong rotten eggs gas odour	Not recorded
15.00		Slight gas odour		Moderate Odour		Very strong rotten eggs gas odour				Strong rotten eggs gas odour	No odour
16.00		No odour		Moderate Odour		Very strong rotten eggs gas odour				Strong rotten eggs gas odour	Completed by Rotary - odour noted
17.00		No odour		Moderate Odour		Very strong rotten eggs gas odour				Medium rotten eggs gas odour	
18.00		No odour		Strong Odour		Very strong rotten eggs gas odour				Strong rotten eggs gas odour	
19.00		No odour		Strong Odour		Very strong rotten eggs gas odour				Strong rotten eggs gas odour	
20.00		No odour		Completed by Rotary - no odour readings recorded		Very strong rotten eggs gas odour				Strong rotten eggs gas odour	
21.00		No odour				Very strong rotten eggs gas odour				Strong rotten eggs gas odour	
22.00		No odour				Very strong rotten eggs gas odour				Strong rotten eggs gas odour	
23.00						Very strong rotten eggs gas odour				Strong rotten eggs gas odour	
24.00						Very strong rotten eggs gas odour				Strong rotten eggs gas odour	
25.00						Strong rotten eggs gas odour				Strong rotten eggs gas odour	
26.00						Drilling completed by Rotary Rig therafter no odour monitoring noted on logs				Strong rotten eggs gas odour	
27.00										Strong rotten eggs gas odour	
28.00										Strong rotten eggs gas odour	
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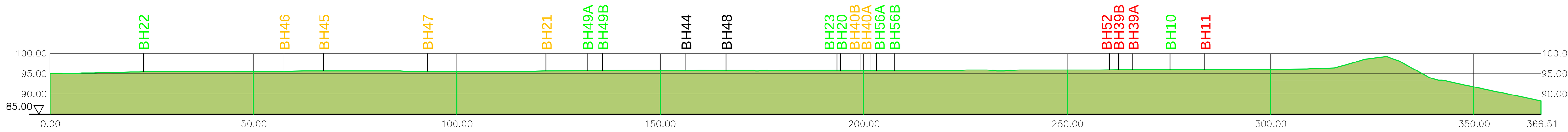
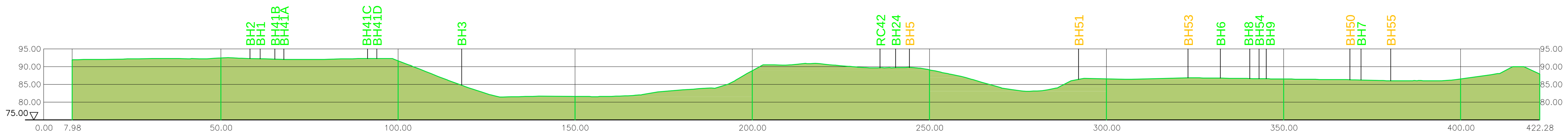
Section B-B



1.00	No odour	No gas odour	Slight gas odour	Slight gas odour	No odour	No gas odour	No gas odour	Not recorded	Not recorded	Medium musk gas odour	Medium musky smell	No odours noted on BH logs (very shallow BH)	Slight odour of rotten eggs	Medium smoke gas odour	Medium smoke gas odour	No odour	No odour
2.00	No odour	No gas odour	Slight gas odour	Slight gas odour	Slight odour	No gas odour	No gas odour	Not recorded		Medium musk gas odour			Medium odour of rotten eggs	Medium smoke gas odour	Medium smoke gas odour	Not recorded	Odour of burned material noted
3.00	Not recorded	Slight gas odour	Slight gas odour	Slight gas odour	Slight odour	No gas odour	No gas odour	Not recorded		Medium musk gas odour			Medium odour of rotten eggs	Medium smoke gas odour		Not recorded	Odour of burned material noted
4.00	Not recorded	Slight gas odour	Slight gas odour	Slight gas odour	No odour	No gas odour	No gas odour	Not recorded		Medium musk gas odour			Medium odour of rotten eggs	Medium smoke gas odour		Not recorded	Odour of burned material noted
5.00		Slight gas odour	Slight gas odour	Medium oil gas odour	No odour			Not recorded		Medium musk gas odour			Medium odour of rotten eggs	Medium smoke gas odour		Not recorded	Odour of burned material noted
6.00		Slight gas odour	Slight gas odour	Medium oil gas odour	No odour			Not recorded		No odour			Medium odour of rotten eggs	Medium smoke gas odour		Not recorded	Odour of burned material noted
7.00		Slight gas odour	Slight gas odour	Medium oil gas odour				No odour		No odour			Medium odour of rotten eggs	Medium smoke gas odour		Not recorded	Odour of burned material noted
8.00		Slight gas odour	Slight gas odour	Medium oil gas odour				No odour		No odour			Medium odour of rotten eggs	Medium smoke gas odour		Not recorded	Pungent odour of burned material noted
9.00		Slight gas odour	Slight gas odour	Medium oil gas odour				No odour		No odour			Medium odour of rotten eggs	No gas odour			Pungent odour of burned material noted
10.00		Slight gas odour	Medium oil gas odour	Medium oil gas odour				No odour		No odour			Medium odour of	No gas odour			Pungent odour of
11.00		No gas odour	Medium oil gas odour	Medium oil gas odour				No odour		No odour			Medium odour of rotten eggs	No gas odour			Very pungent
12.00		No gas odour	Medium oil gas odour	Medium oil gas odour				No odour		No odour			Medium odour of	No gas odour			Very pungent
13.00		No gas odour	Medium oil gas odour	Slight gas odour				No odour		No odour			No odour	No gas odour			Not recorded
14.00		No gas odour	Medium oil gas odour	No gas odour				No odour		No odour				No gas odour			Not recorded
15.00		No gas odour	No gas odour							No odour				No gas odour			Not recorded
16.00			No gas odour														

Section C-C



1.00	No odour	No odour	No waste present, no odours recorded	No waste present, no odours recorded	No waste present, no odours recorded	No waste present, no odours recorded	Slight Odour	Rotary Borehole only. Not recorded	Not recorded	Odour of H_2S	Very slight gas odour	Slight gas odour	Not recorded but gravels so unlikely	No odour	No gas odour	Odour of H_2S	Slight gas odour	Not recorded but gravels so unlikely	Slight organic odour
2.00	No odour	No odour					No odour		Not recorded	Odour of H_2S	Very slight gas odour	Slight gas odour	Not recorded but gravels so unlikely	Clay with boulders - no odour	No gas odour	Not recorded	Slight gas odour	Not recorded but gravels so unlikely	Slight organic odour
3.00	No odour	No odour					Not recorded but gravels so unlikely		Not recorded	No odour	Very slight gas odour	Slight gas odour	Not recorded but gravels so unlikely		No gas odour	Not recorded	Slight gas odour	Not recorded but gravels so unlikely	Slight organic odour
4.00	No odour						Not recorded but gravels so unlikely		No odour		Very slight gas odour	Slight to medium gas odour			No gas odour	Not recorded	Slight gas odour	Not recorded but gravels so unlikely	Slight organic odour
5.00	No odour						Not recorded but gravels so unlikely		No odour		Very slight gas odour	Slight to medium gas odour			No gas odour	Not recorded	Slight gas odour	Not recorded but gravels so unlikely	Slight organic odour
6.00	No odour						Not recorded but gravels so unlikely		No odour		Very slight gas odour	Slight to medium gas odour			No gas odour	Not recorded	Medium gas odour	Not recorded but gravels so unlikely	
7.00	No odour								No odour			Slight gas odour			No gas odour	Not recorded	Medium gas odour	Not recorded but gravels so unlikely	
8.00	No odour								No odour							Not recorded			
9.00																Not recorded			
10.00																Not recorded			

Section Location Plan (1:5,000)

KEY:

- Former W0047-02 Waste Licence Boundary
- No Odour Detected
- Slight Odour Detected
- Moderate/Medium Odour Detected
- Strong Odour Detected
- Very Strong Odour Detected

NOTES:

KERDIFFSTOWN LANDFILL
SITE REMEDIATION PROJECT

DRAWING 1
ODOUR PROFILE

SCALE	1: 1,000 @ A1	PROJECT No.	JL30689
CONTENT	UD	DRAWN	HLD
CHECKED	DRAFT	DATE	22/05/2013

SINCLAIR KNIGHT MERZ
SKM ENVIROS

File name: HLD3837.dwg
Plot date: May 29, 2013 - 2:04pm

291000

292000

222000

Nass Golf Club

Palmerstown
House Estate

Kerdiffstown
House

OMP1

OMP8

LG10

OMP7

BH36B

LG34

OMP6

OMP2

LG18

OMP3

Johnstown
Garden
Centre

OMP4

OMP5

N7

N

0 50 100 200m

Scale

File name: HLD3833.dwg

Plot date: May 23, 2013 - 5:18pm

Ref: I:\Enviros\Design\PROJECTS\JL\WM\JL30689\Figures\Task 7\

KEY:

- Former WA0047-02 Waste Licence Boundary
- LG24 — On-site Trace Gas Analysis Location
- OMP3 — Off-site Odour Monitoring Point

REV.	*DESCRIPTION*	*DATE*

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

KERDIFFSTOWN LANDFILL SITE REMEDIATION PROJECT

DRAWING 2

ODOUR MONITORING LOCATIONS

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Appendix A7.8 SKM Enviros 2013 Outline Life Cycle Assessment

SINCLAIR KNIGHT MERZ
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Kerdiffstown Landfill

TASK 14 OUTLINE LIFE CYCLE ASSESSMENT

- Final
- August 2013

Kerdiffstown Landfill

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- Final
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Contents

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1. Introduction

The former landfill and waste processing facility at Kerdiffstown has now closed and is in the early stages of remediation. The Environmental Protection Agency (EPA) are using powers under Section 56 of the Waste Management Act 1996 (as amended) to restore the site and put in place appropriate aftercare measures to prevent and limit pollution from the materials which are present at the site.

In February 2013 SKM Enviros (SKME) were appointed as a framework contractor by the EPA to provide technical environmental support services in relation to the remediation of Kerdiffstown Landfill. Phase 1 of the contract involves the completion of a number of discrete technical tasks in order to progress towards identification of potential remedial options for the site.

Task 14 sets out considerations that apply to the Life Cycle Assessment (LCA) of the remediation and potential end use scenarios at Kerdiffstown landfill. This assessment looks at the overall impact of the various possible remediation scenarios to the extent that they are known at the present time, including different quantities and types of emissions that would be generated, (volumes of leachate, quantities of landfill gas, total LCA GHG emissions) against a Do Nothing scenario.

For the purpose of this study, in the absence of detailed remedial proposals or designs, the difference of potential environmental impacts, in terms of leachate, surface water and landfill gas emissions, as well as the predicted total carbon equivalent rating arising from associated material movement, transportation and imbedded carbon have been compared at a high level making various assumptions in terms of emissions estimates and timescales for remedial works.

The feasibility of arriving at meaningful life-cycle comparisons relating to the likely end-use options and remediation scenarios are set out below

1.1. End-use Options for the Site

A range of potential end use options have been considered during the Phase 1 assessment, including; (a) medium to high density mixed use development; (b) completion of the site in accordance with previous planning permissions and restoration proposals; and, (c) some form of passive amenity function/open space end use. Currently, the preferred option is the latter, due to improved potential landscape and visual impacts, flexibility with remedial proposals and longer term provision of an amenity site for the local community. Such an end-use could typically include a car park, and recreational features, for instance a mountain bike track, playground, or educational habitat zoning. It is unlikely that the end-use will feature any high intensity process or major new emission sources, industrial uses, or significant traffic emissions. As such, it is considered that the emissions from the remediated site will vary insignificantly during end-use, regardless of the finer details of the final end-use design option.

The essential emission control systems for the remediated site, including landfill gas flaring, and leachate collection/ removal, will remain as long-term requirements regardless of which end use option is selected. The predicted emissions that will arise during the end-use will be determined by the chosen remediation infrastructure, which are summarised below. A detailed emissions appraisal for the end-use phase of the site is therefore not considered warranted, as the end-use options are expected to all feature very similar emission and carbon considerations.

1.2. Remediation Scenarios Appraisal

The Scenarios available for the remediation of the site do require a detailed emissions and carbon appraisal, as their emissions impact may vary significantly. For the purposes of this assessment it is considered relevant to compare proposed remediation of the site against an essentially un-remediated site baseline (i.e. Do Nothing). Therefore, the following scenarios were assessed:

- **Scenario 1 –Do Nothing-**

  Assume that the landfill site will not be remediated, and remains uncapped, and with only partial liner facilitating incomplete leachate collection. Under this scenario, all the gas generated in the waste body is released as fugitive emissions.

- **Scenario 2 – "In situ" remediation of landfill –**

  Assume the waste remains in situ to extent possible, with waste re-profiling or waste excavation/ movement minimised. The whole site will be capped, reducing surface water infiltration, and reducing diffuse landfill gas emissions. Gas extraction will occur from the full site after 2015. However the site remains unlined in the northwestern area of the site.

- **Scenario 3 – Full site remediation –**

  This includes lining of waste body and full capping. This scenario would require all waste to be moved, landfill liners to be placed at the bottom of engineered waste cells, and all waste to be re-emplaced. The re-emplaced waste would be fully capped, facilitating more complete landfill gas extraction, as well as more complete leachate capture. Under this scenario the restoration period would last longer, with no effective gas extraction until site works have finished, estimated for 2020. A phased reduction of fugitive emissions would be anticipated during the construction period (say notionally for the purposes of this assessment 2014-2020), and finally a more complete emission control achieved after 2020 following successful remediation.

The above Scenarios have been assessed in the following sections for PRTR emissions reporting, and for a LCA of GHG emissions. The assessments are based on the existing site conditions (landfill gas generation and flaring, current leachate removal volumes, etc.) and modelled emission projections were generated to compare the three scenarios highlighted above.

2. PRTR and ELV Assessment

Emissions from a landfill activity are generally reported to the EPA as part of the facilities' annual environmental report (AER) and would include monitoring of the in-waste landfill gas and flares against set emissions limit values (ELVs), reporting of the quantity and constituents of leachate removed from the site, as well as reporting on licensed discharges to surface waters, where relevant. Depending on the quantity of emissions, reporting is also required under the European Pollution Release and Transfer Register (E-PRTR), as well as inclusion in the National Greenhouse Gas (GHG) reporting.

The EPA has combined the reporting by licensed facilities of PRTR, ELV and GHG in one web-based reporting tool, which all licensed facilities have to complete as part of their AER. The EPA in turn reports to the EU any emissions that exceed the E-PRTR thresholds, and compiles the submitted data for the National GHG report.

2.1. E-PRTR

E-PRTR Regulation (EC) No 166/2006 concerning the establishment of a European Pollutant Release and Transfer Register came into force in February 2006, and was brought into Irish law through S.I. No. 123 of 2007. It set up a European wide data-base of significant environmental emissions, which is accessible and searchable by any member of the public. The aim of PRTR is to enhance public access to environmental information across Europe, to contribute to prevention and reduction of pollution, as well as to deliver data for policy makers and environmental decision makers.

The Regulations list 65 types of industries (mainly IPPC and Waste facilities) that have to report if they emit any of 91 specified substances to air or water (direct or indirect) and exceed the set reporting thresholds for those substances. Exceeding the reporting thresholds does not imply licence non-compliance, but is merely an indication of the facility being a significant contributor to national emissions, and therefore to be included in the National PRTR report. Accidental Emissions and diffuse source emissions, such as fugitive landfill gas, must also be quantified.

For landfills, such as Kerdiffstown, the relevant emissions which may have to be reported under PRTR include Methane, Carbon Dioxide, Carbon Monoxide, Nitrous Oxides, Ammonia and Sulphur Oxides, if the emissions exceed the specified reporting thresholds. (e.g. above 100,000 kg/annum of methane emissions). In addition the PRTR reporting requires wastes transferred offsite for treatment or recovery to be reported. This applies to leachate removal for offsite treatment, where more than 2,000 tonnes /per year is removed. PRTR reporting of emissions to surface water would include Total Nitrogen, Phosphorous, Chlorides, Metals and solvents, where the reporting thresholds are exceeded.

32 landfills in Ireland were included in the 2011 Irish PRTR Report, with methane emissions and leachate transfers off-site being the main reported parameters in this sector. Emissions to surface water did not feature above PRTR thresholds from any landfills. Details of the Irish PRTR reporting can be viewed at http://prtr.epa.ie/map/default.aspx

The current assessment establishes the current and projected annual emissions from Kerdiffstown, and assesses the likely emission quantities that may require reporting under PRTR, depending on which remediation Scenarios is chosen.

Predicted methane generation for the site has been undertaken using GasSim, an industry and regulator recognised model, which has been calibrated using site specific information obtained from previous ground investigations and results of collecting and flaring gas from parts of the landfill for over two years.. The modelling was undertaken using current estimated amounts of 3.1 million tonnes of waste in the landfill, and a 35% bio-degradability factor within the wastes. Key outputs for the PRTR and ELV assessment are presented in Tables 1 to 3.

Table 1 below summarises current and peak methane, ammonia and chloride emissions from the landfill.

Table 1.: Current and Peak Emissions from Kerdiffstown Landfill

	Total Estimated Methane Generation kg/annum (GasSIM-Calculation)	Methane Flared (Measured 2011-2012) kg/annum	Net Methane Emissions (Calculated) kg/annum	EPRTR Threshold Reporting Methane >100,000 kg/annum
Estimated peak gas production 2009	**2,775,000**	**none**	**2,775,000**	Above PRTR reporting
Current 2013 (Partial flaring)	**2,163,000**	**222,158**	**1,940,842**	Above PRTR reporting
Leachate				
	Leachate Volume tonnes/annum	**Ammonia (as Total Nitrogen kg/annum**	**Chlorides kg/annum**	
PRTR reporting Threshold	**2,000 t/a removal**	**50,000**	**2,000,000**	
Scenario 1 –Do nothing Based on current leachate removal	13,540	4,375	5,972	Above PRTR (Volume reporting only)

Table 2 shows the predicted methane emissions from the landfill for the three scenarios highlighted for the period between 2012 and 2044 (i.e. including aftercare), which takes into account an estimate of amount of methane that might be flared off for each Scenarios.

Table 2: Total predicted Methane Emissions over Aftercare (2012 to 2044)

	Total Estimated Methane (Diffuse Emission) in kg (Total methane generated minus amount of projected methane flared in each Scenario)
Scenario 1 –Do nothing	41,415,000
Scenario 2– In situ remediation	19,079,000
Scenario 3 – Waste re-emplacement	13,958,000

Based on the above information included in the above tables it is then possible to evaluate PRTR reporting requirements for each of the above scenarios as summarised in Table 3.

Table 3: PRTR Reporting under all scenarios (including Do Nothing)

Landfill Gas				
	Total Estimated Methane Generation kg/annum (GasSIM-Calculation)	**Methane Flared (Calculated) kg/annum**	**Net Methane Emissions (Calculated) kg/annum**	**EPRTR Threshold Reporting Methane >100,000 kg/annum**
Scenario 1 – Do nothing--				
2016	1,796,000	none	1,796,000	PRTR reporting required
2026	993,000	none	993,000	Not required
Scenario 2 – In situ remediation				
2016	1,796,000	1,208,000	588,000	Not required
2026	993,000	670,000	323,000	Not required
Scenario 3 – Waste re-emplacement				
2016	1,796,000	539,000	1,257,000	PRTR reporting required
2026	993,000	894,000	99,000	Not required
Leachate				
	Leachate Volume tonnes/annum	**Ammonia (as Total Nitrogen)**	**Chlorides**	
PRTR reporting Threshold	**2,000 t/a removal**	**50,000 kg/annum**	**2,000,000 kg/annum**	
Scenario 1 –Do nothing Based on current leachate removal	13,540	4,375	5,972	Volume report only
Scenario 2 – In situ remediation Based on current volume x 3	40,620	13,125	17,916	Volume report only
Scenario 3 – Waste re-emplacement Based on current volume x 5	67,700	21,875	29,860	Volume report only

2.2. PRTR Discussion

The PRTR assessment for landfill gas emissions and leachate volumes from Kerdiffstown has been carried out for the three remediation scenarios highlighted in Chapter 1. This assessment indicates the following over the total time span of the remaining landfill aftercare (30 years),

- Scenario 2 would provide significant landfill gas and leachate control over the shortest time period (within 3 years);
- Scenario 3 would provide most complete landfill gas control, by maximising the extraction and flaring of methane, but only after 6 years of remediation works;
- Scenario 3 would provide the most complete infrastructure to facility leachate removal from the site, but only after 6 years of remediation works, and,
- Scenario 3 would provide about 12% better methane control than Scenarios 2.

In completing the relative merits in terms of emissions, various other factors and other emission considerations, must be borne in mind. These relate primarily to long term disturbance of site conditions, if the Scenario 3 is chosen, with an estimated timescale for remediation of say 6 years, against a current estimated timescale of 3 years for Scenario 2.

Odour emissions, in particular, would be increased significantly under Scenario 3, as the movement and re-emplacing of all the waste would cause heightened odour emissions over extended periods of time. The long-term disturbance of the site under Scenario 3 would also have significant implications for dust and noise emissions, which would require detailed modelling once a phasing plans was finalised.

Regarding the benefit of Scenario 3 for leachate management, it is evident that improved leachate extraction and removal would be provided by provision of full lining for all wastes. However, this must be weighed up against current evidence of leachate impacting on ground or surface waters, and the long-term disturbance that Scenario 3 would entail.

3. Life Cycle Assessment of GHG emissions

The Life Cycle Assessment of GHG emissions looks at the total GHG emissions from direct and indirect activities associated with the project. This assessment looks at annual emissions and also looks at overall emissions over the lifetime of the project (up to 2044). In assessing the overall impact of the remediation scenarios highlighted in Chapter 1 the following activities have been taken included:

1) Emissions resulting from the energy use of existing and new site buildings;

2) Emissions resulting from the energy use of on-site plant and equipment;

3) Fugitive emissions of methane within landfill gas – CO_2 fugitive emissions, or CO_2 from flared methane are considered to be short-cycle carbon

4) Embodied emissions resulting from use of materials for construction of additional structures;

5) Emissions resulting from transport of materials to and off-site; and,

6) Carbon savings resulting from sequestration from reinstated land cover.

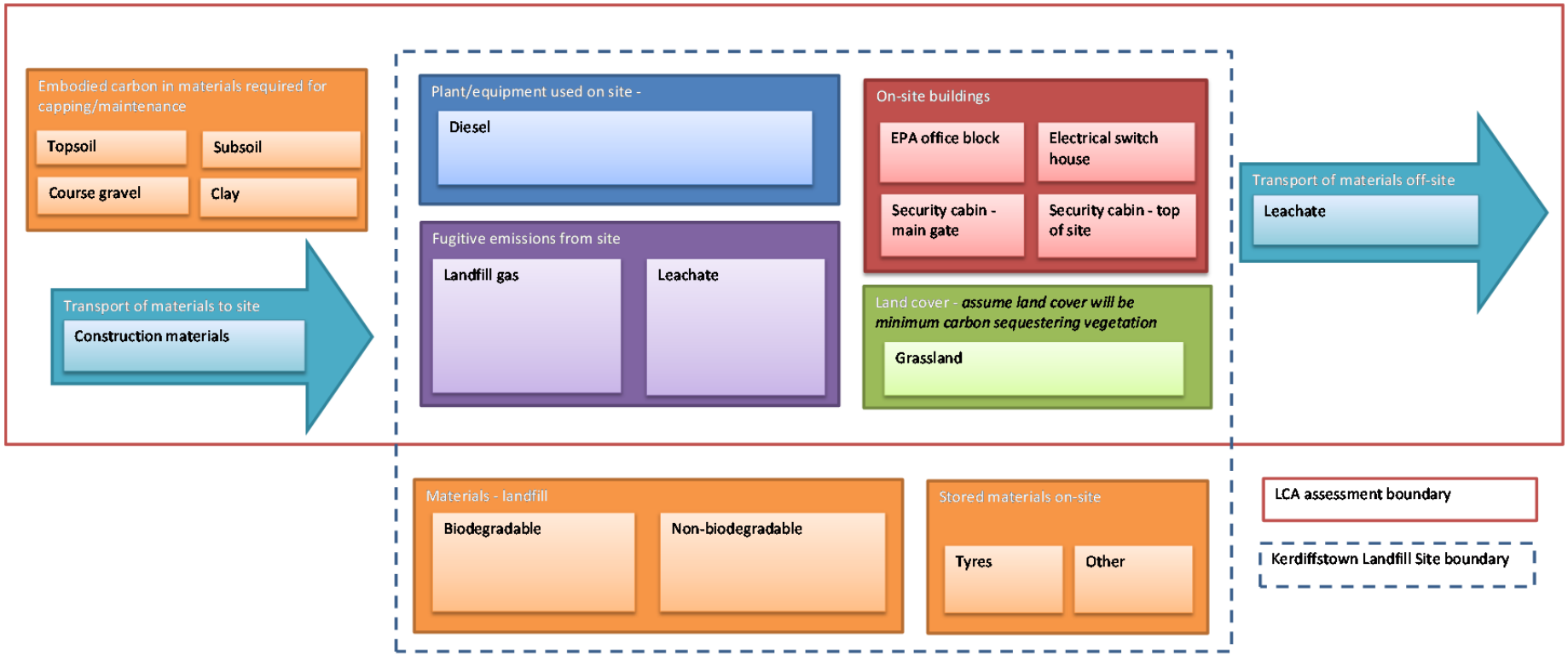
Since methane and other GHGs are likely to be a significant part of the overall current site emissions, the inventory is not a full GHG inventory but measured in tonnes of CO_2e. A simple model of the site, with variables that can be adjusted to model different scenarios has been written in excel, using standard emission factors applicable, where possible, for Ireland or failing that, the UK. The model has been used initially to produce a relative ranking of the three scenarios described previously. As more detailed remedial plans are developed this model will enable refinement of the scenarios and outcomes throughout the initial scoping, design and impact assessment process.

A simplified boundary of the site and the emissions was drawn up for each of the three scenarios. Although there are some minor differences between the boundaries for each of the three scenarios, depending on the site activities that will take place, the basic boundary used is shown on Figure 1 below.

The red line boundary shows the assessment boundary, which includes reasonably anticipated on and off-site activities to the extent that they are currently known. The blue dotted line boundary, shows the site boundary, which includes the materials in the landfill as well as materials stored on-site.

Since none of the remediation Scenarios seek to extract and reuse materials from the landfill (minimal amounts of stored clay could be used in capping but this has been taken off total clay quantities required), the embodied carbon in the materials in the landfill will be the same for all scenarios. Due to the difficulties in calculating this carbon value, they have been excluded for the boundary of all three scenarios.

Figure 1: Indicative boundary for LCA assessment



3.1. Results from the LCA assessment

The initial results of the LCA assessment for the three scenarios are shown in Table 4 below. This shows that Scenario 1 (do nothing) has the highest overall net emissions; Scenario 2 is the lowest (38% less than Scenario 1); and, Scenario 3 is in between with estimated emissions 29% lower than Scenario 1.

For all three Scenarios, the largest single source of emissions is from the methane in fugitive landfill gas. Since Scenarios 2 and 3 involve capping the landfill, capturing the landfill gas and flaring it, the fugitive emissions are lower than for Scenario 1 (uncapped with no flaring).

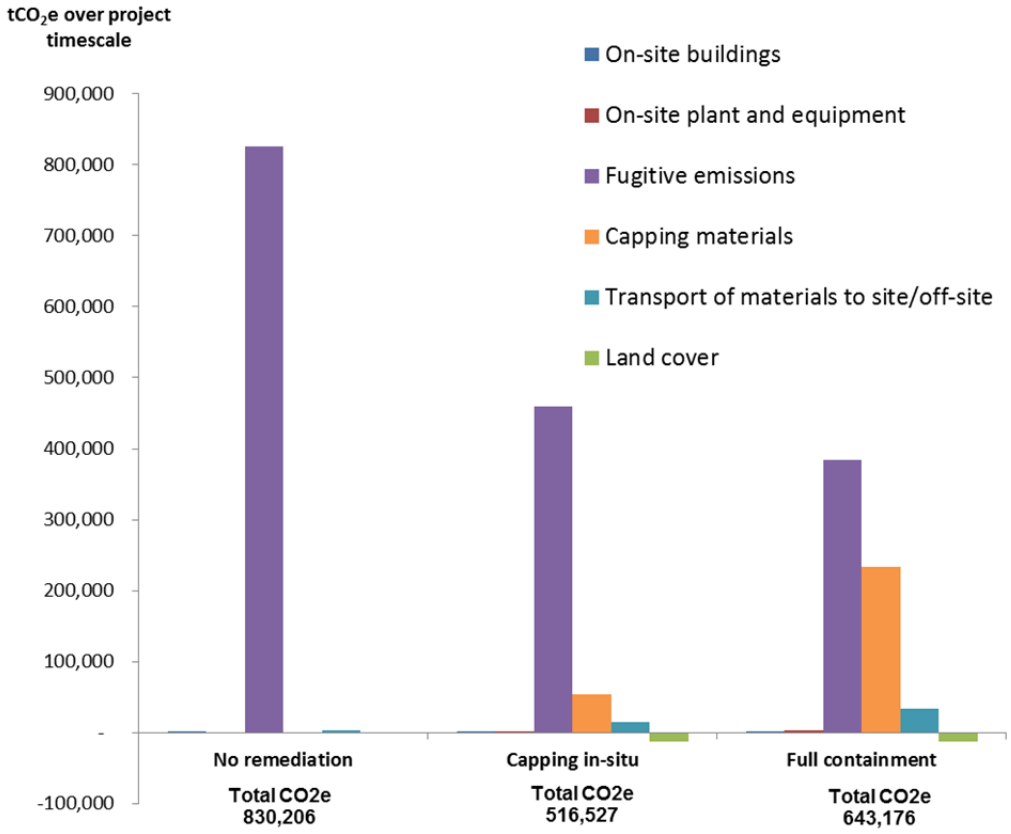
Once landfill gas has been captured and flared, it is converted to CO_2 and is no longer within the boundary of the assessment as this CO_2 is considered to come from a biogenic short-cycle carbon source. However, capping the landfill comes at a cost of embodied carbon for materials and transport of those materials to site. Scenario 3 has higher emissions associated with both capping materials and transport due to the likely greater volume of materials required. There are also more on-site plant emissions due to greater movement of materials around the site. *However, the relative contribution of these activities indicates that, based on current information, the best way to reduce the overall LCA emissions from the site would be to maximise the efficiency of the landfill capture and flaring, but aiming to use the least capping material possible to achieve this outcome*.

Table 4.: Overall emissions over project lifetime under the different Scenarios

Activity	Total lifetime emissions (tonnes of CO2e)		
	Scenario 1	Scenario 2	Scenario 3
On-site buildings	1,055	728	934
On-site plant and equipment		914	2,741
Fugitive emissions	826,554	459,764	384,762
Capping materials		53,861	233,960
Transport of materials to site/off-site	2,994	14,119	33,637
Land cover		-12,858	-12,858
Total	**830,603**	**516,527**	**643,176**

Figure 2 below shows the relative emissions from different activities for the three scenarios. For all three scenarios, the largest single source of emissions is from the methane in fugitive landfill gas. As highlighted above, the relative contribution of the various emissions included within the current model (buildings, plant and equipment, capping and cover materials and transport of materials), the most effective way to reduce the overall LCA emissions from the site would be to maximise the efficiency of the landfill capture and flaring and aiming to use the least capping material possible to achieve this outcome.

Figure 2.: Total estimated lifecycle GHG emissions (tCO2e) over project timescale for different activities



The following three figures (3, 4 and 5) show the distribution of emissions over the assessed timescale (2010 to 2044) for the three scenarios. For all three scenarios, the highest emissions are in the early years (pre-2010 to 2020) when the production of landfill gas is highest and, for scenarios where remedial works are implemented there is maximum activity.

Figure 3.: Annual estimated lifecycle carbon emissions for Scenario 1 – 'No remediation' (tCO2e/annum)

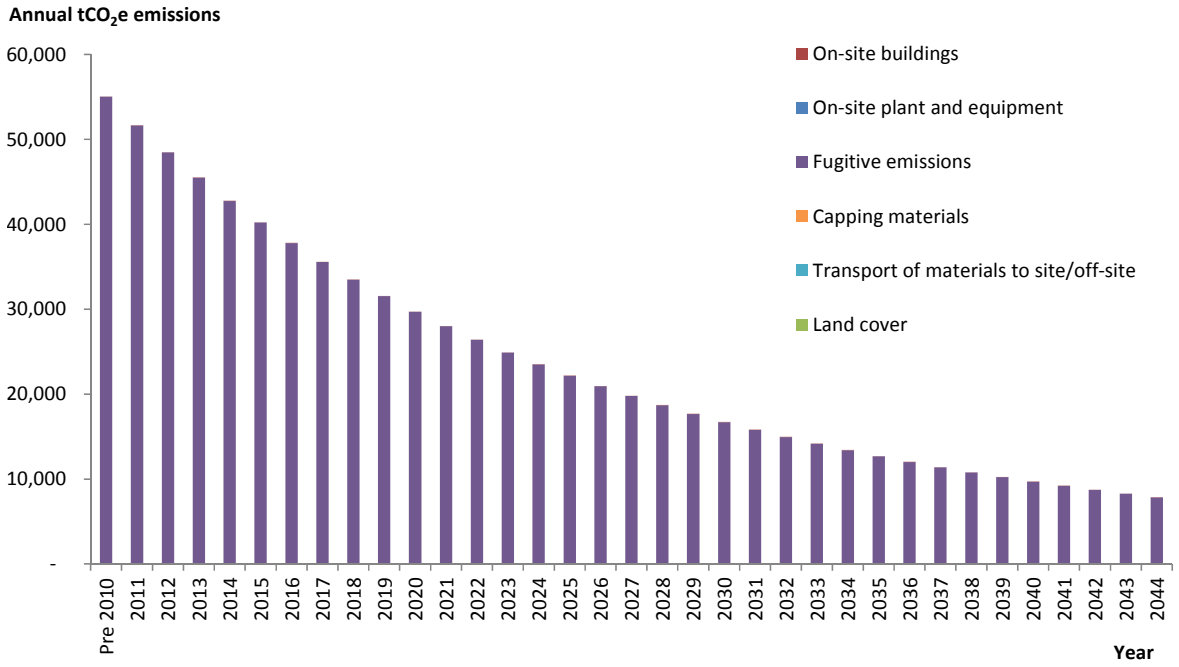


Figure 4.: Annual estimated lifecycle carbon emissions for Scenario 2 – 'Capping In Situ' (tCO2e/annum)

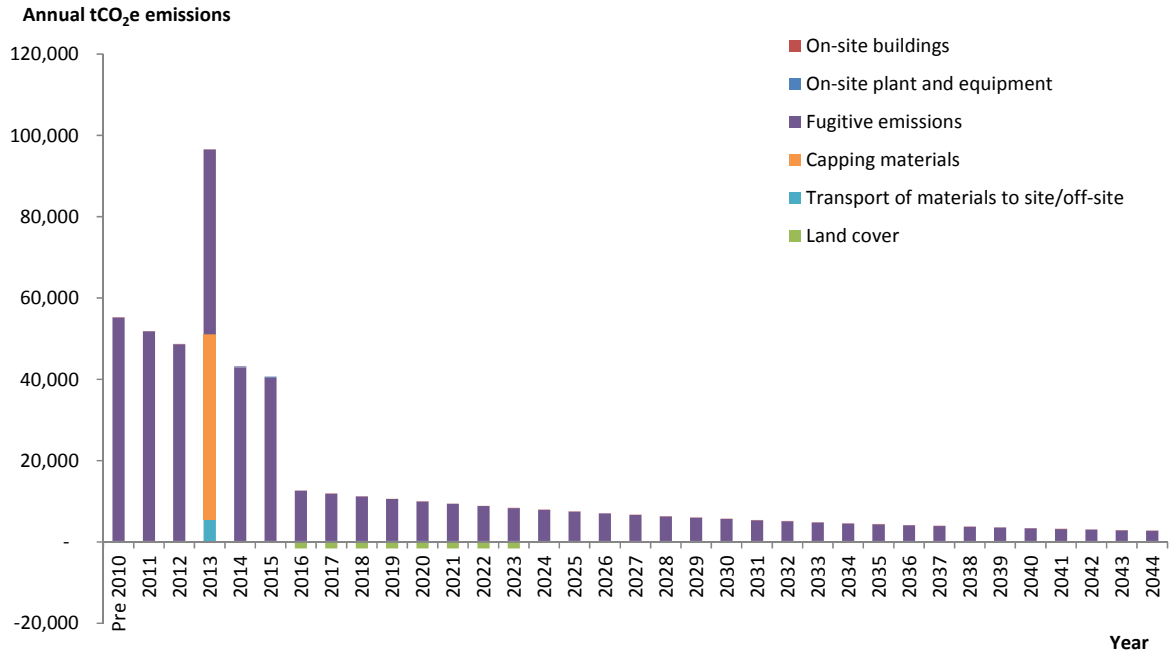
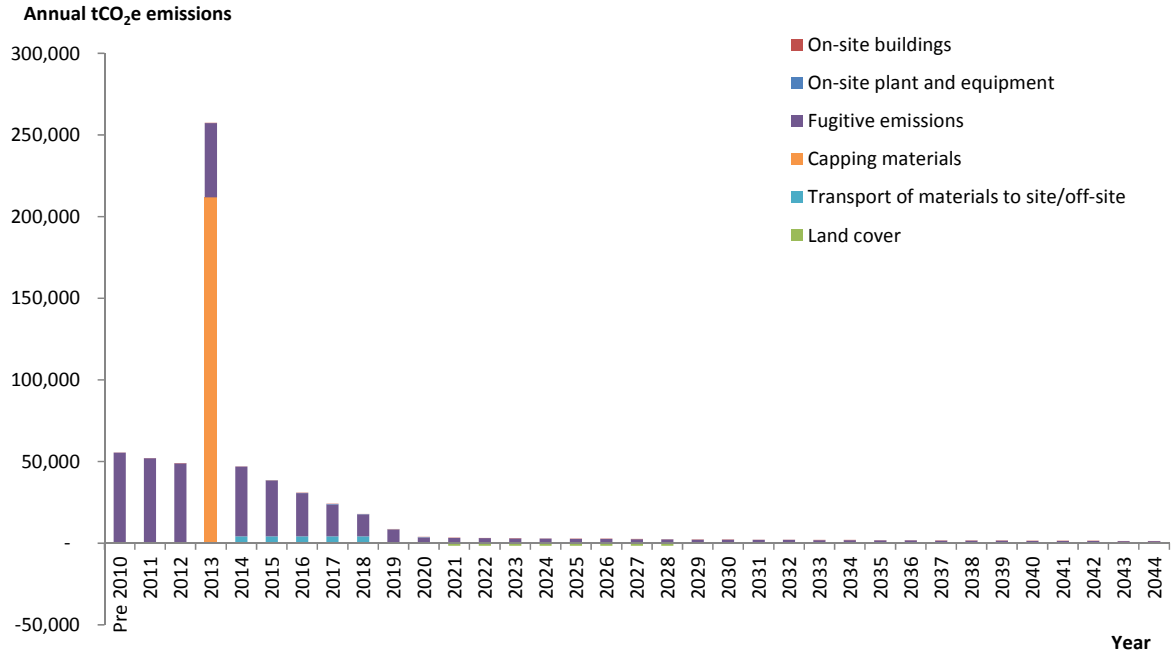


Figure 5.: Annual estimated lifecycle carbon emissions for Scenario 3 – 'Full Remediation' (tCO2e/annum)



3.2. Limitations of Current Models

In completing the assessment at this stage when only high level remedial Scenarios are available then there is a significant degree of uncertainty in relation to some of the key variables which affect the overall outcome of the modelling. The two variables responsible for the large majority of emissions in all scenarios are as follows:

1) Fugitive emissions of methane within landfill gas – CO_2 fugitive emissions or CO_2 from flared methane are considered to be short-cycle carbon;
   - The exact proportion of biodegradable material and hence landfill gas production is not fully known given the history of waste deposition at the site – the current model assumes 35% biodegradable material within the waste to arrive at estimates for future methane generation. However, if this is lower, the fugitive emissions of methane are likely be reduced. Notwithstanding this, all three scenarios would be affected equally;
   - There are a number of assumptions around the proportion of landfill gas that will be fugitive under different scenarios and therefore, improved information about the likely capture rates could change overall emissions for the Scenarios 2 and 3.

2) Embodied emissions resulting from use of materials for construction of additional structures;

- One of the key sources of embodied emissions in the model is from clay, used as a capping material. At the present time the actual source of materials to form the cap, the actual design of the cap in terms of use of clay based capping systems or used of geotextiles has not yet been established. However, the emission factor used in the model is for '*Simple baked clay products'* as there is no factor available for clay as a none-baked material. This factor is likely to significantly overestimate the embodied carbon in clay, which when used in this form, would require very minimal energy input apart from extraction and transport. Once potential sources of clay for capping purposes have been evaluated then the model could be refined further.
- The quantities of materials for Scenario 3 have been estimated based on Scenario 2 and increasing the gravel and clay quantities by a factor of five for initial modelling purposes on the basis that more materials would be required to complete remedial works under this scenario. More detailed work in the future will enable these assumptions to be refined.

3.3. LCA discussion

The results of this initial study indicate that Scenario 1 (Do Nothing), is unlikely to be optimal from the LCA GHG emissions perspective; although this scenario does not require GHG emissions for construction materials and activities, without capping the landfill and enabling capture and flaring of the landfill gas. Emissions resulting from fugitive releases of methane are likely to be very high relative to all other factors.

Currently, at this stage of the overall remediation project there is no design information on which to provide details on construction materials, sourcing, timescales etc., for Scenarios 2 and 3, then there is inherent uncertainty in the selection of key parameters for input into the existing models. Therefore, it is not currently possible to discriminate with a great degree of certainty between Scenarios 2 and 3 in terms of LCA and GHG emissions, although in broad terms it is anticipated that requirements for materials and timescales for remediation would be significantly greater for Scenario 3 than for Scenario 2. However, for both Scenarios, if effective capping and landfill gas capture can be put in place while minimising the need for materials and plant/equipment, this is likely to be optimal in terms of achieving reduction in GHG emissions. Post-remediation site activities, as currently anticipated (i.e. low intensity site end use for public open space/amenity type functions) are unlikely to have a significant impact on the overall LCA emissions.

Appendix A7.9 Dispersion Modelling Assessment Results

Element	Existing 250 Flare Assessment
Assessment details	Meteorological Data Set This data shows the effect on the modelling predictions of using different years of meteorological data for the assessment.
Data sets	Casement Aerodrome 2013 - 2015

Air Quality Standard		Predicted incremental contribution, µg/m^3		
		2013	2014	2015
Particulate Matter, PM_{10}				
24-hour limit not to be exceeded more than 35 times/year (90.4th %ile)	50 µg/m^3	0.35	0.35	0.24
Annual limit	40 µg/m^3	0.12	0.12	0.12
Particulate Matter, $PM_{2.5}$				
Annual limit	25 µg/m^3	0.12	0.12	0.12
Limit from 2020	20 µg/m^3	0.12	0.12	0.12
Carbon Monoxide, CO				
8-hour limit	10,000 µg/m^3	< 1	< 1	< 1
Sulphur dioxide, SO_2				
Hourly limit - not to be exceeded more than 24 times/year (99.7th %ile)	350 µg/m^3	129	128	116
Daily limit - not to be exceeded more than 3 times/year (99.2th %ile)	125 µg/m^3	55	55	55
Annual limit	20 µg/m^3	6.9	6.5	6.7
Nitrogen Dioxide NO_2				
Hourly limit - not to be exceeded more than 18 times/year (99.8th %ile)	200 µg/m^3	2.8	2.8	2.7
Annual limit for protection of human health	40 µg/m^3	0.35	0.35	0.35
Nitrogen oxides, NO_x				
Annual limit for protection of vegetation	30 µg/m^3	0.35	0.35	0.35

Table A7.9.1 Existing 250 Flare Dispersion Modelling Predictions

Element	Existing 250 Flare Assessment
Assessment details	Meteorological Data Set This data set compares the predictions for meteorological data from different Stations
Data sets	Dublin Airport and Casement Aerodrome 2015, 8M

Air Quality Standard		Predicted incremental contribution, µg/m³	
		Dublin Airport 2015	Casement Aerodrome 2015
Particulate Matter, PM_{10}			
24-hour limit not to be exceeded more than 35 times/year (90.4th %ile)	50 µg/m³	0.29	0.24
Annual limit	40 µg/m³	0.11	0.12
Particulate Matter, $PM_{2.5}$			
Annual limit	25 µg/m³	0.11	0.12
Limit from 2020	20 µg/m³	0.11	0.12
Carbon Monoxide, CO			
8-hour limit	10,000 µg/m³	< 1	< 1
Sulphur dioxide, SO_2			
Hourly limit - not to be exceeded more than 24 times/year (99.7th %ile)	350 µg/m³	131	116
Daily limit - not to be exceeded more than 3 times/year (99.2th %ile)	125 µg/m³	54.5	55
Annual limit	20 µg/m³	11.2	6.7
Nitrogen Dioxide NO_2			
Hourly limit - not to be exceeded more than 18 times/year (99.8th %ile)	200 µg/m³	2.8	2.7
Annual limit for protection of human health	40 µg/m³	0.23	0.35
Nitrogen oxides, $NO_{x0.36}$			
Annual limit for protection of vegetation	30 µg/m³	0.23	0.35

Table A7.9.2 Existing 250 Flare Dispersion Modelling Predictions

Element	Existing 250 Flare Assessment
Assessment details	Stack Height This data set compares the modelling predictions for different stack heights
Data sets	Casement Aerodrome 2015

Air Quality Standard		Predicted incremental contribution, µg/m^3		
		8m	9m	11m
Particulate Matter, PM_{10}				
24-hour limit not to be exceeded more than 35 times/year (90.4th %ile)	50 µg/m^3	0.24	0.21	0.15
Annual limit	40 µg/m^3	0.12	0.11	0.08
Particulate Matter, $PM_{2.5}$				
Annual limit	25 µg/m^3	0.12	0.11	0.08
Limit from 2020	20 µg/m^3	0.12	0.11	0.08
Carbon Monoxide, CO				
8-hour limit	10,000 µg/m^3	< 1	< 1	< 1
Sulphur dioxide, SO_2				
Hourly limit - not to be exceeded more than 24 times/year (99.7th %ile)	350 µg/m^3	116	81.3	40.4
Daily limit - not to be exceeded more than 3 times/year (99.2th %ile)	125 µg/m^3	55	33.4	20.3
Annual limit	20 µg/m^3	6.7	6.2	4.4
Nitrogen Dioxide NO_2				
Hourly limit - not to be exceeded more than 18 times/year (99.8th %ile)	200 µg/m^3	2.7	1.7	0.85
Annual limit for protection of human health	40 µg/m^3	0.35	0.22	0.15
Nitrogen oxides, NO_x				
Annual limit for protection of vegetation	30 µg/m^3	0.35	0.22	0.15

Table A7.9.3 Existing 250 Flare Dispersion Modelling Predictions

Element	Proposed 600 Flare Assessment
Assessment details	Meteorological Data Set This data compares the modelling predictions using different years of meteorological data
Data sets	Casement Aerodrome 2013 - 2015

Air Quality Standard		Predicted incremental contribution, µg/m^3		
		2013	2014	2015
Particulate Matter, PM_{10}				
24-hour limit not to be exceeded more than 35 times/year (90.4th %ile)	50 µg/m^3	0.38	0.38	0.38
Annual limit	40 µg/m^3	0.12	0.12	0.12
Particulate Matter, $PM_{2.5}$				
Annual limit	25 µg/m^3	0.12	0.12	0.12
Limit from 2020	20 µg/m^3	0.12	0.12	0.12
Carbon Monoxide, CO				
8-hour limit	10,000 µg/m^3	< 1	< 1	< 1
Sulphur dioxide, SO_2				
Hourly limit - not to be exceeded more than 24 times/year (99.7th %ile)	350 µg/m^3	75	75	73.1
Daily limit - not to be exceeded more than 3 times/year (99.2th %ile)	125 µg/m^3	27.3	22.8	22.8
Annual limit	20 µg/m^3	7	6.7	7
Nitrogen Dioxide NO_2				
Hourly limit - not to be exceeded more than 18 times/year (99.8th %ile)	200 µg/m^3	1.4	1.4	1.4
Annual limit for protection of human health	40 µg/m^3	0.1	0.1	0.1
Nitrogen oxides, NO_x				
Annual limit for protection of vegetation	30 µg/m^3	0.1	0.1	0.1

Table A7.9.4 Proposed 600 Flare Dispersion Modelling Predictions

Element	Proposed 600 Flare Assessment
Assessment details	Meteorological Data Set This data compares the modelling predictions using meteorological data from different stations
Data sets	Dublin Airport and Casement Aerodrome 2015

Air Quality Standard		Predicted incremental contribution, µg/m^3	
		Dublin Airport 2015	Casement Aerodrome 2015
Particulate Matter, PM_{10}			
24-hour limit not to be exceeded more than 35 times/year (90.4th %ile)	50 µg/m^3	0.35	0.38
Annual limit	40 µg/m^3	0.20	0.12
Particulate Matter, $PM_{2.5}$			
Annual limit	25 µg/m^3	0.20	0.12
Limit from 2020	20 µg/m^3	0.20	0.12
Carbon Monoxide, CO			
8-hour limit	10,000 µg/m^3	< 1	< 1
Sulphur dioxide, SO_2			
Hourly limit - not to be exceeded more than 24 times/year (99.7th %ile)	350 µg/m^3	88.6	73.1
Daily limit - not to be exceeded more than 3 times/year (99.2th %ile)	125 µg/m^3	21.9	22.8
Annual limit	20 µg/m^3	8.4	7
Nitrogen Dioxide NO_2			
Hourly limit - not to be exceeded more than 18 times/year (99.8th %ile)	200 µg/m^3	1.5	1.4
Annual limit for protection of human health	40 µg/m^3	0.1	0.1
Nitrogen oxides, $NO_{x0.36}$			
Annual limit for protection of vegetation	30 µg/m^3	0.1	0.1

Table A7.9.5 Proposed 600 Flare Dispersion Modelling Predictions

Element	Proposed 600 Flare Assessment
Assessment details	Stack Height This data compares the predictions for different stack heights
Data sets	Casement Aerodrome 2015

Air Quality Standard		Predicted incremental contribution, µg/m^3		
		9m	10m	11m
Particulate Matter, PM_{10}				
24-hour limit not to be exceeded more than 35 times/year (90.4th %ile)	50 µg/m^3	0.38	0.38	0.38
Annual limit	40 µg/m^3	0.3	0.2	0.12
Particulate Matter, $PM_{2.5}$				
Annual limit	25 µg/m^3	0.3	0.20	0.12
Limit from 2020	20 µg/m^3	0.3	0.20	0.12
Carbon Monoxide, CO				
8-hour limit	10,000 µg/m^3	< 1	< 1	< 1
Sulphur dioxide, SO_2				
Hourly limit - not to be exceeded more than 24 times/year (99.7th %ile)	350 µg/m^3	171.1	130.1	73.1
Daily limit - not to be exceeded more than 3 times/year (99.2th %ile)	125 µg/m^3	45.9	32.3	22.8
Annual limit	20 µg/m^3	15.2	11.5	7
Nitrogen Dioxide NO_2				
Hourly limit - not to be exceeded more than 18 times/year (99.8th %ile)	200 µg/m^3	2.1	2.1	1.4
Annual limit for protection of human health	40 µg/m^3	0.17	0.17	0.1
Nitrogen oxides, NO_x				
Annual limit for protection of vegetation	30 µg/m^3	0.17	0.17	0.1

Table A7.9.6 Proposed 600 Flare Dispersion Modelling Predictions

Appendix A8.1 Noise Monitoring Survey Report

1. Scope

This report presents the results of a baseline environmental noise survey carried out at a number of different noise monitoring locations in the vicinity of the Kerdiffstown Landfill Remediation Project (hereafter referred to as "the proposed Project").

2. Regional Environmental Setting

Kerdiffstown Landfill is located in County Kildare and comprises a former quarry, landfill and waste processing facility. The site has been progressively backfilled with wastes since the 1950's until 2010. The site poses a number of risks due to large areas of uncapped waste, remnants of buildings and structures, over-steep slopes and absence of appropriate capping to the lined cell. The proposed Project comprises the remediation of the site to reduce the risks to public health and safety and the environment (the Remediation Phase), whilst developing the site to provide an amenity to the local community, comprising a public park with multi-use sports pitches (the Operational Phase).

The proposed Project site is located in a semi-rural area with significant population centres located within a few kilometres of the site. The site is located in County Kildare, approximately 3km north-east of central Naas, approximately 400m north-west of Johnstown village and in close proximity to the strategically important M7/N7 corridor. There are a number of one-off houses located along the L2005 Kerdiffstown Road which runs along the western and southern boundaries of the site. To the northeast is land associated with Kerdiffstown House, to the north is a golf course and to the south west and south east are a mixture of land uses including residential, agricultural and worked out quarries.

The surrounding road network, in particular the N7 dual carriage-way which runs less than 300m south of the site boundary and the M7 Motorway which runs approximately 500m west of the site boundary, carries high volumes of traffic travelling at significant speeds, typically greater than 90kph.

3. Noise Sensitive Receptors

The noise monitoring locations were chosen in order to best represent the current noise climate at the nearest noise sensitive receptor (NSR) locations in the vicinity of the former landfill site. Eight noise monitoring locations (N1 to N8) were selected at various locations and these are shown on Figure 8.1, an extract of which is provided below and summarised in Table 1 below.

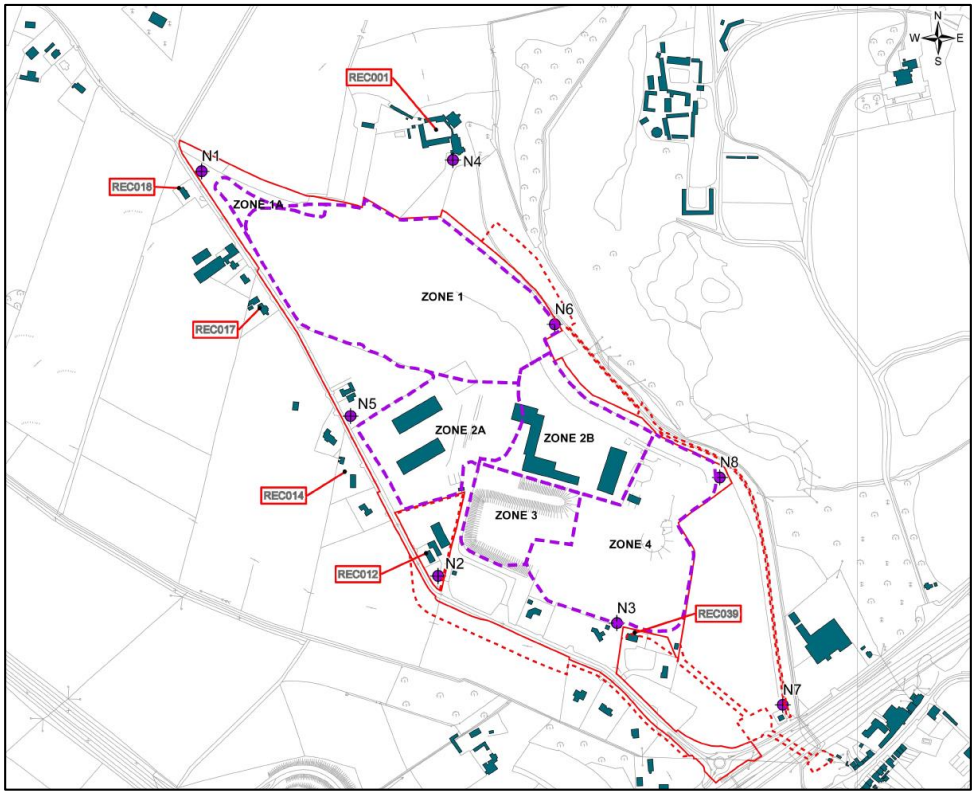


Diagram 1 Location of Noise Sensitive Receptor Locations

Table 1: Noise Monitoring Locations

Monitoring Location	Description
N1	North-western corner boundary adjacent golf course
N2	Outside private residence adjacent site entrance
N3	Elevated location along southern boundary
N4	On green area 25m from Kerdiffstown House
N5	On western site boundary close to private residence
N6	Elevated location on northern boundary overlooking golf club
N7	In field 30m from the L2005 road
N8	Elevated location on north eastern boundary overlooking golf club

Noise measurements were carried out at or near the boundaries of the NSRs where possible and this noise survey is an accurate representation of the current daytime, evening time and night-time noise levels in the vicinity of the proposed Project.

4. Survey Protocol

4.1 Monitoring Locations

The monitoring locations were selected in accordance with the *ISO 1996 Acoustics - Description and Measurement of Environmental Noise* guidelines. Monitoring was carried out in accordance with the above-mentioned document and in all cases; the instrument was positioned in the location most sensitive to noise from

the proposed site. Due care was taken to minimise potential interference from wind generated noises from trees etc. during the course of the measurement programme.

4.2 Instrumentation and Methodology

Noise measurements were made according to the requirements of *ISO 1996: Acoustics - Description and Measurement of Environmental Noise* and in addition, with reference to the EPA publication; *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), 2016.* The measurements were made using a Bruel & Kjaer (B&K) 2250 Light meter fitted with a 1:1 and 1:3 octave band filter. The instrument was calibrated *in situ* at 94 dB prior to use and the calibration was cross-checked after the measurements using a B&K acoustic calibrator. The sound level meter was orientated towards the noise source and mounted on a tripod at 1.5m above ground level. This instrument is a Type 1 instrument in accordance with IEC 651 regulations. The Time Weighting used was Fast and the Frequency Weighting was A-weighted as per IEC 651.

4.3 Survey Implementation

TMS Environment Ltd personnel (Johnnie Armstrong, Enda Flood and Tim Hurley) conducted the noise monitoring survey on the 8th, 13th and 14th of September 2016 and also on the 15th and 16th of March 2017. All monitoring was carried out in accordance with the methodology set out above.

The measurement parameters included meteorological observations of prevailing conditions at the time of the survey. The main measurement parameter was the equivalent continuous A-weighted sound pressure level, $L_{Aeq, T}$. Monitoring periods for the noise survey were 30 minute intervals for the daytime measurements and 15-minute intervals for the evening time and night-time measurements. A statistical analysis of the measurement results was also completed so that the percentile levels, $L_{AN, T}$, for N = 90% and 10% over the measurement intervals were also recorded. The percentile levels represent the noise level in dB(A) exceeded for N% of the measurement time.

5. Weather Conditions

The weather conditions were generally dry with a light or no breeze blowing. There was a little drizzle during the evening on the 8th of September but was dry otherwise.

6. Survey Results

The results of the baseline environmental noise survey are presented in Tables 2 to 9 below.

Table 2: Results for Monitoring Location N1

Period	Date	Time	Measured Noise Levels / dB(A)				
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	L_{ArT}
Daytime 07.00 - 19.00	14.09.2016	12.38-13.08	55	47	55	90	55
	14.09.2016	13.10-13.40	54	49	56	77	54
	14.09.2016	13.41-14.11	56	48	57	76	56
	Average		**55**	**48**	**56**		**55**
Evening time 19.00-23.00	08.09.2016	19.53-20.07	52	48	54	78	52
Night-time 23.00–07.00	16.03.2017	01.04-01.19	42	40	44	57	42
	16.03.2017	01.19-01.34	42	39	43	52	42
	Average		**42**	**40**	**44**		**42**

Daytime Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road. Maximum noise levels associated with vehicle movement on the L2005 close to noise meter.

Evening time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road. Maximum noise levels associated with vehicle movement on the L2005 close to noise meter.

Night-time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway.

Table 3: Results for Monitoring Location N2

Period	Date	Time	Measured Noise Levels / dB(A)				
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	L_{ArT}
Daytime 07.00 - 19.00	13.09.2016	10.36-11.06	52	44	53	87	52
	13.09.2016	11.09-11.39	50	43	52	79	50
	13.09.2016	11.40-12.10	51	45	52	63	51
	Average		**51**	**44**	**52**		**51**
Evening time 19.00-23.00	08.09.2016	20.13-20.28	56	54	57	65	56
Night-time 23.00–07.00	15.03.2017	23.00-23.15	55	52	57	65	55
	15.03.2017	23.15-23.30	54	52	56	61	54
	Average		**55**	**52**	**57**		**55**

Daytime Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road. Maximum noise levels associated with vehicle movement on the L2005 close to noise meter.

Evening time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway.

Night-time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road

Table 4: Results for Monitoring Location N3

Period	Date	Time	Measured Noise Levels / dB(A)				
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	L_{ArT}
Daytime 07.00 - 19.00	12.09.2016	15.22-15.52	55	52	58	71	55
	12.09.2016	15.52-16.22	54	51	54	80	54
	12.09.2016	16.22-16.52	54	50	54	85	54
	Average		**54**	**51**	**55**		**54**
Evening time 19.00-23.00	08.09.2016	21.28-21.43	57	55	59	57	57
Night-time 23.00–07.00	16.03.2017	01.48-02.03	49	44	52	61	49
	16.03.2017	02.03-02.18	51	47	54	60	51
	Average		**50**	**46**	**53**		**50**

Daytime Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road. Birdsong noted.

Evening time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road.

Night-time Comments: Main noise source is the passing traffic on the N7 dual carriage-way and the M7 motorway.

Table 5: Results for Monitoring Location N4

Period	Date	Time	Measured Noise Levels / dB(A)				
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	L_{ArT}
Daytime 07.00 - 19.00	14.09.2016	10.59-11.29	49	45	49	82	49
	14.09.2016	11.29-11.59	50	47	52	70	50
	14.09.2016	11.59-12.29	50	48	52	64	50
	Average		**50**	**47**	**51**		**50**
Evening time 19.00-23.00	08.09.2016	19.15-19.30	50	49	51	72	50
Night-time 23.00–07.00	15.03.2017	23.47-00.02	45	43	46	65	45
	16.03.2017	00.02-00.17	45	42	46	71	45
	Average		**45**	**43**	**46**		**45**

Daytime Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Birdsong noted.

Evening time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Birdsong noted.

Night-time Comments: Main noise source is the passing traffic on the N7 dual carriage-way and the M7 motorway.

Table 6: Results for Monitoring Location N5

Period	Date	Time	Measured Noise Levels / dB(A)				
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	L_{ArT}
Daytime 07.00 - 19.00	08.09.2016	13.04-13.34	53	51	54	70	53
	08.09.2016	13.48-14.18	53	51	54	69	53
	08.09.2016	14.45-15.15	53	51	54	66	53
	Average		**53**	**51**	**54**		**53**
Evening time 19.00-23.00	08.09.2016	20.31-20.46	53	52	55	73	53
Night-time 23.00–07.00	16.03.2017	02.25-02.40	45	42	48	56	45
	16.03.2017	02.40-02.55	44	40	46	54	44
	Average		**45**	**41**	**47**		**45**

Daytime Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road. Birdsong noted. Maximum noise levels associated with vehicle movement on the L2005.

Evening time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road. Maximum noise levels associated with vehicle movement on the L2005.

Night-time Comments: Main noise source is the passing traffic on the N7 dual carriage-way and the M7 motorway.

Table 7: Results for Monitoring Location N6

Period	Date	Time	Measured Noise Levels / dB(A)				
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	L_{ArT}
Daytime 07.00 - 19.00	08.09.2016	15.17-15.47	53	51	54	79	53
	08.09.2016	15.48-16.18	54	52	55	65	54
	08.09.2016	16.18-16.48	52	51	53	72	52
	Average		**53**	**51**	**54**		**53**
Evening time 19.00-23.00	08.09.2016	20.50-21.05	53	51	54	69	53
Night-time 23.00–07.00	16.03.2017	03.03-03.18	45	42	47	53	45
	16.03.2017	03.18-03.33	46	43	47	71	46
	Average		**46**	**43**	**47**		**46**

Daytime Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some noise from players on golf course. Birdsong noted. Maximum noise levels associated with nearby golf players.

Evening time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway.

Night-time Comments: Main noise source is the passing traffic on the N7 dual carriage-way and the M7 motorway.

Table 8: Results for Monitoring Location N7

Period	Date	Time	Measured Noise Levels / dB(A)				
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	L_{ArT}
Daytime 07.00 - 19.00	14.09.2016	09.19-09.49	59	57	61	81	59
	14.09.2016	09.52-10.22	58	56	60	70	58
	14.09.2016	10.23-10.53	58	56	60	82	58
	Average		**58**	**56**	**60**		**58**
Evening time 19.00-23.00	08.09.2016	19.36-19.51	63	61	65	70	63
Night-time 23.00–07.00	16.03.2017	00.27-00.42	57	51	60	66	57
	16.03.2017	00.42-00.57	58	51	61	68	58
	Average		**58**	**51**	**61**		**58**

Daytime Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road.

Evening time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway. Some traffic passing on the L2005 Kerdiffstown Road.

Night-time Comments: Main noise source is the passing traffic on the N7 dual carriage-way and the M7 motorway.

Table 9: Results for Monitoring Location N8

Period	Date	Time	Measured Noise Levels / dB(A)				
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	L_{ArT}
Daytime 07.00 - 19.00	12.09.2016	13.35-14.05	60	58	61	69	60
	12.09.2016	14.16-14.46	58	57	60	67	58
	12.09.2016	14.47-15.17	57	55	59	73	57
	Average		**58**	**57**	**60**		**58**
Evening time 19.00-23.00	08.09.2016	21.10-21.25	52	50	53	66	52
Night-time 23.00–07.00	16.03.2017	03.43-03.58	47	43	49	56	47
	16.03.2017	04.01-04.16	46	43	48	64	46
	Average		**47**	**43**	**49**		**47**

Daytime Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway.

Evening time Comments: Main noise source is the continuous passing traffic on the N7 dual carriage-way and the M7 motorway.

Night-time Comments: Main noise source is the passing traffic on the N7 dual carriage-way and the M7 motorway.

7. Evaluation of Results

7.1 Daytime Noise Survey

This survey was completed in order to assess the existing baseline noise environment in the vicinity of the project site, the former Kerdiffstown landfill. The baseline data collected can be used to identify the potential for impact that activities associated with the proposed Project could have on the local noise environment.

The daytime noise measurements were carried out between the hours of 07.00 and 19.00 and ranged in value from 49dB $L_{Aeq,15mins}$ at monitoring location N4 to 60dB $L_{Aeq,15mins}$ at monitoring location N8. The background noise characterised by the L_{A90} measurements ranged from 43dB L_{A90} at monitoring location N2 to 58dB L_{A90} at monitoring location N8.

It was generally observed that the main source of noise at all noise monitoring locations was anthropogenic in nature and was predominantly passing traffic on the N7 dual carriageway and on the M7 motorway. Non anthropogenic noise sources including birdsong and the breeze blowing through trees etc. had only a minor impact on the noise environment at the noise monitoring locations.

7.2 Evening Time Noise Survey

The evening time noise measurements were carried out between the hours of 19.00 and 23.00 and ranged in value from 42dB $L_{Aeq,15mins}$ at monitoring location N9 to 69dB $L_{Aeq,15mins}$ at monitoring location N2. The background noise characterised by the L_{A90} measurements ranged from 48dB L_{A90} at monitoring location N1 to 61dB L_{A90} at monitoring location N7.

Again, the main source of noise at all noise monitoring locations during the evening time period was anthropogenic in nature and was predominantly passing traffic on the N7 dual carriageway and on the M7. Non anthropogenic noise sources such as birdsong and the breeze blowing through trees etc had only a minor impact on the noise environment at the noise monitoring locations.

7.3 Night-time Noise Survey

The night-time noise measurements were carried out between the hours of 23.00 and 07.00 and ranged in value from 42dB $L_{Aeq,15mins}$ at monitoring location N1 to 58dB $L_{Aeq,15mins}$ at monitoring location N7. The background noise characterised by the L_{A90} measurements ranged from 39dB L_{A90} at monitoring location N1 to 52dB L_{A90} at monitoring location N2.

Again, the main source of noise at all noise monitoring locations during the night-time period was anthropogenic in nature and was predominantly passing traffic on the N7 dual carriageway and on the M7. Non anthropogenic noise sources such as breeze blowing through trees etc had only a minor impact on the noise environment at the noise monitoring locations.

Appendix A8.2 Calibration Certificates

NSAI

National Metrology Laboratory

Certificate of Calibration

Issued to	TMS Environment Ltd. 53 Broomhill Drive Tallaght Dublin 24
Attention of	Martin Kearns

Certificate Number	**151658**
Item Calibrated	Bruel and Kjaer 2250 Light Sound Level Meter, complete with Type 4950 Microphone and Type ZC0032 Preamp
Serial Numbers	2625696 (Sound Level Meter), 2621489 (Microphone) and 8606 (Preamp)
Client ID Number	--------
Order Number	D158325
Date Received	23 Sep 2015
NML Procedure Number	AP-NM-09
Method	The above sound level meter was allowed to stabilise for a suitable period in laboratory conditions. It was then calibrated by carrying out the verification tests detailed in IEC 61672-3 (2006), *Periodic tests, specification for the verification of sound level meters*. This standard specifies a procedure for the periodic verification of conformance of a sound level meter or integrating-averaging meter to IEC 61672-1 (2003).
Calibration Standards	Norsonic 1504A Calibration System incorporating: SR DS360 Signal Generator, No. 0735 [Cal. Due Date: 30 Sep 2015] Agilent 34401A Digital Multimeter, No. 0736 [Cal Due Date: 20 Jul 2016] B&K 4134 Measuring Microphone, No. 0742 [Cal Due Date: 13 Jan 2016] B&K 4228 Pistonphone, No. 0741 [Cal Due Date: 13 Jan 2016] B&K 4226 Acoustical Calibrator, No. 0150 [Cal Due Date: 06 May 2016]

Calibrated by	David Fleming	**Approved by**	Paul Hetherington
Date of Calibration	28 Sep 2015	**Date of Issue**	28 Sep 2015

CIPM MRA

This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)

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Ambient laboratory conditions :

Barometric Pressure :	102.9 kPa ± 0.5 kPa
Temperature :	22.0 °C ± 1 °C
Relative Humidity:	47 % ± 5 %

Summary of Results:

The following table summarises the results of the verification tests. The detailed results are given in the subsequent tables.

IEC 61672 Test	Test Title	Status
10	Self-generated Noise (Electrical)	See Notes
11	Acoustical Signal	PASS
12	Frequency Weighting	PASS
13	Frequency and Time Weighting @ 1 kHz	PASS
14	Level Linearity Test on Reference Level Range	PASS
15	Level Linearity including Range Control	Not Applicable
16	Toneburst Response	PASS
17	Peak C	PASS
18	Overload Indication	PASS

Detailed Results.

Prior to carrying out the verification tests the sound level meter was checked ensure it was reading correctly using its associated calibrator (Brüel & Kjær 4231, Serial Number: 2623773).

Self-generated Noise Test (Electrical Input) (Test #10) [1]

Range: 140 dB
Mode: Leq

SLM Configuration	Freq. Weighting Network	SLM Reading[2],[3]
Microphone installed	A	21.5 dB
Microphone replaced by electrical signal device and Fitted with a short-circuit	A	13.9
	C	15.3
	Z (Linear)	20.9

Acoustical signal test of a frequency weighting (Test #11) [1]

Range: 140 dB
Frequency Weighting setting: A
Time Weighting response: Slow

Input Level[4]	Input Freq.	SLM Error of Indication[5]	Tolerance[6] (±)	Uncertainty of Measurement (±)
94.0 dB	1000 Hz	0.0 dB	1.0 dB	0.3 dB
	125	0.0	1.0	0.3
	4000[7]	+0.3	1.0	0.5
	8000[7]	+0.8 £	1.5, -3.0 dB	0.9

Electrical signal tests of frequency weightings (Test #12)[1]

Range: 140 dB

Freq. (nominal)	Input Level[4]	SLM Reading	SLM Error of Indication[5]	Tolerance[6] (±)	Uncertainty of Measurement (±)
A-Weighting					
63 Hz	95 dB	95.0 dB	0.0 dB	1.5 dB	0.20 dB
125	95	95.0	0.0	1.5	0.20
250	95	95.0	0.0	1.4	0.20
500	95	95.0	0.0	1.4	0.20
1000	95	95.0	0.0	1.1	0.20
2000	95	95.0	0.0	1.6	0.20
4000	95	94.9	-0.1	1.6	0.20
8000	95	94.7	-0.3	2.1, -3.1	0.20
16000	95	95.6	0.6	3.5, -17	0.20
C-Weighting					
63 Hz	95 dB	95.0 dB	0.0 dB	1.5 dB	0.20 dB
125	95	95.0	0.0	1.5	0.20
250	95	95.0	0.0	1.4	0.20
500	95	95.0	0.0	1.4	0.20
1000	95	95.0	0.0	1.1	0.20
2000	95	95.0	0.0	1.6	0.20
4000	95	94.9	-0.1	1.6	0.20
8000	95	94.7	-0.3	2.1, -3.1	0.20
16000	95	95.5	0.5	3.5, -17	0.20
LIN Weighting					
63 Hz	95 dB	94.9 dB	-0.1 dB	1.5 dB	0.20 dB
125	95	95.0	0.0	1.5	0.20
250	95	95.0	0.0	1.4	0.20
500	95	95.0	0.0	1.4	0.20
1000	95	95.0	0.0	1.1	0.20
2000	95	95.0	0.0	1.6	0.20
4000	95	94.9	-0.1	1.6	0.20
8000	95	94.7	-0.3	2.1, -3.1	0.20
16000	95	95.6	0.6	3.5, -17	0.20

Frequency and time weightings at 1 kHz (Test #13)[1]

Range: 140 dB

Time Weighting Setting	Frequency Weighting Setting	Input Level[4]	Deviation from Reference	Tolerance[6] (±)	Uncertainty. of Measurement (±)
Fast	A	94.0 dB	Ref.	-	0.20 dB
	C		0.0 dB	0.4 dB	0.20
	Z		0.0	0.4	0.20
Slow	A	94.0 dB	0.0	0.3	0.20
Leq.	A	94.0 dB	0.0 dB	0.3 dB	0.20 dB
SEL	A	114.0 dB	0.0 dB	0.3 dB	0.20 dB

Linearity level on the reference range (Test #14)[1]

Input Frequency: 8 kHz
SLM Measuring Mode: SPL

Range	Input Level[4]	SLM Reading	SLM Error of Indication[5]	Tolerance[6] (±)	Uncertainty of Measurement (±)
140 dB	94 dB	94.0 dB	0.0 dB	1.1 dB	0.20 dB
	99	99.0	0.0	1.1	0.20
	104	104.0	0.0	1.1	0.20
	109	109.1	0.1	1.1	0.20
	114	114.1	0.1	1.1	0.20
	119	119.1	0.1	1.1	0.20
	124	124.1	0.1	1.1	0.20
	129	129.1	0.1	1.1	0.20
	134	134.1	0.1	1.1	0.20
	137	137.1	0.1	1.1	0.20
	138	138.1	0.1	1.1	0.20
	139	139.1	0.1	1.1	0.20
	140	140.1	0.1	1.1	0.20
	141	141.1	0.1	1.1	0.20
	94	94.0	0.0	1.1	0.20
	89	89.1	0.1	1.1	0.20
	84	84.0	0.0	1.1	0.20
	79	79.1	0.1	1.1	0.20
	74	74.0	0.0	1.1	0.20
	69	69.0	0.0	1.1	0.20
	64	64.0	0.0	1.1	0.20
	59	59.0	0.0	1.1	0.21
	54	54.0	0.0	1.1	0.21
	49	49.0	0.0	1.1	0.21
	44	44.1	0.1	1.1	0.21
	39	39.1	0.1	1.1	0.21
	34	34.2	0.2	1.1	0.23
	28	28.2	0.2	1.1	0.25
	27	27.3	0.3	1.1	0.25
	26	26.4	0.4	1.1	0.25
	25	25.4	0.4	1.1	0.25
	24	24.5	0.5	1.1	0.25

Toneburst response (Test #16)[1]

Range: 140 dB

Burst Type	SLM Mode	Input Level[4]	SLM Error of Indication[5]	Tolerance[6] (±)	Uncertainty of Measurement (±)
200 ms	LAF	119.0 dB	0.0 dB	0.8 dB	0.3 dB
2.0 ms	LAF	102.0	-0.1	1.3	0.3
0.25 msec	LAF	93.0	-0.1	1.3, -3.3	0.3
200 ms	LAS	112.6 dB	0.0 dB	0.8 dB	0.3 dB
2.0 ms	LAS	93.0	-0.1	1.3, -1.8	0.3
200 ms	SEL	113.0 dB	0.0 dB	0.8 dB	0.3 dB
2 .0 ms	SEL	93.0	-0.1	1.3	0.3
0.25 ms	SEL	84.0	-0.1	1.3, -3.3	0.3

Peak C sound level (Test #17)[1]

Range: 140 dB

Pulse Type	Pulse Frequency	Input Level[4] (peak value)	SLM Error of Indication[5]	Tolerance[6] (±)	Uncertainty of Measurement (±)
1 cycle	8 kHz	138.4 dB	0.3 dB	2.4 dB	0.35 dB
Pos. ½ cycle	500 Hz	137.4 dB	-0.2 dB	1.4 dB	0.35 dB
Neg. ½ cycle	500 Hz	137.4 dB	-0.2 dB	1.4 dB	0.35 dB

Overload indication (Test #18)[1]

Range: 140 dB
SLM Measuring Mode: LAEq

Test description	Overload occurred at (±)	Meas. Diff. (Pos – Neg)	Tolerance[6] (±)	Uncertainty of Measurement (±)
Positive ½ cycle at 4 kHz	143.2 dB	-	-	-
Negative ½ cycle at 4 kHz	143.1 dB	-	-	-
Level difference of positive & negative pulses	-	0.1 dB	1.8 dB	0.30 dB

Notes :

(1) The test number, given in parentheses after the section heading, refers to the relevant clause in IEC 61672-3 (2006).

(2) SLM denotes Sound Level Meter

(3) The measured self generated noise was found to be marginal to specification. This is likely due to the influence of ambient noise levels.

(4) All input levels are given in dB relative to a 20 µPa reference level.

(5) The SLM Error of Indication is defined as follows :
SLM Error of Indication = (SLM Reading - Input Level)
Any error of indication that exceeds the relevant tolerance limits [see note (6)] is indicated using a $ symbol.
£ indicates a marginal-to-specification condition. That is, the measured value, extended by its associated uncertainty, overlaps the specified accuracy limit.

(6) The figures in the column labelled 'Tolerance' are the acceptance limits given in IEC 61672-1(2003). These tolerance limits include an allowance for the maximum expanded uncertainty of the test laboratory. The criteria for compliance with the tolerance is that the measurement result, extended by its associated uncertainty, lies within the specified limits.

(7) Microphone response at 4 and 8 kHz was measured using an electrostatic actuator. Free field corrections of +1.2 and +4.0 dB respectively were applied to the measured actuator response.
This measurement is not included in NML's tables of Calibration and Measurement Capabilities, approved under the CIPM MRA.
For information, the measured sensitivity and frequency response of the microphone is given in an addendum to this certificate.

Comments:

The above sound level meter was found to meet the requirements of IEC 61672-3 (2006), with the exception of the 8 kHz electrostatic actuator test, where it was found to be marginal-to-specification.

Uncertainty of Measurement:

The measurement uncertainty is reported as a standard uncertainty multiplied by a coverage factor k=2 which, for a normal probability distribution, corresponds to a coverage probability of approximately 95%. The given uncertainty refers to the measured values only and carries no implication regarding the long-term stability of the item calibrated.

Traceability:

The reported measurement results are traceable, via national standards maintained by NSAI National Metrology Laboratory (NML), to internationally accepted realisations of the SI units.

NSAI
National Metrology Laboratory

Addendum to Certificate 151658

Brüel & Kjær
Type: 4950

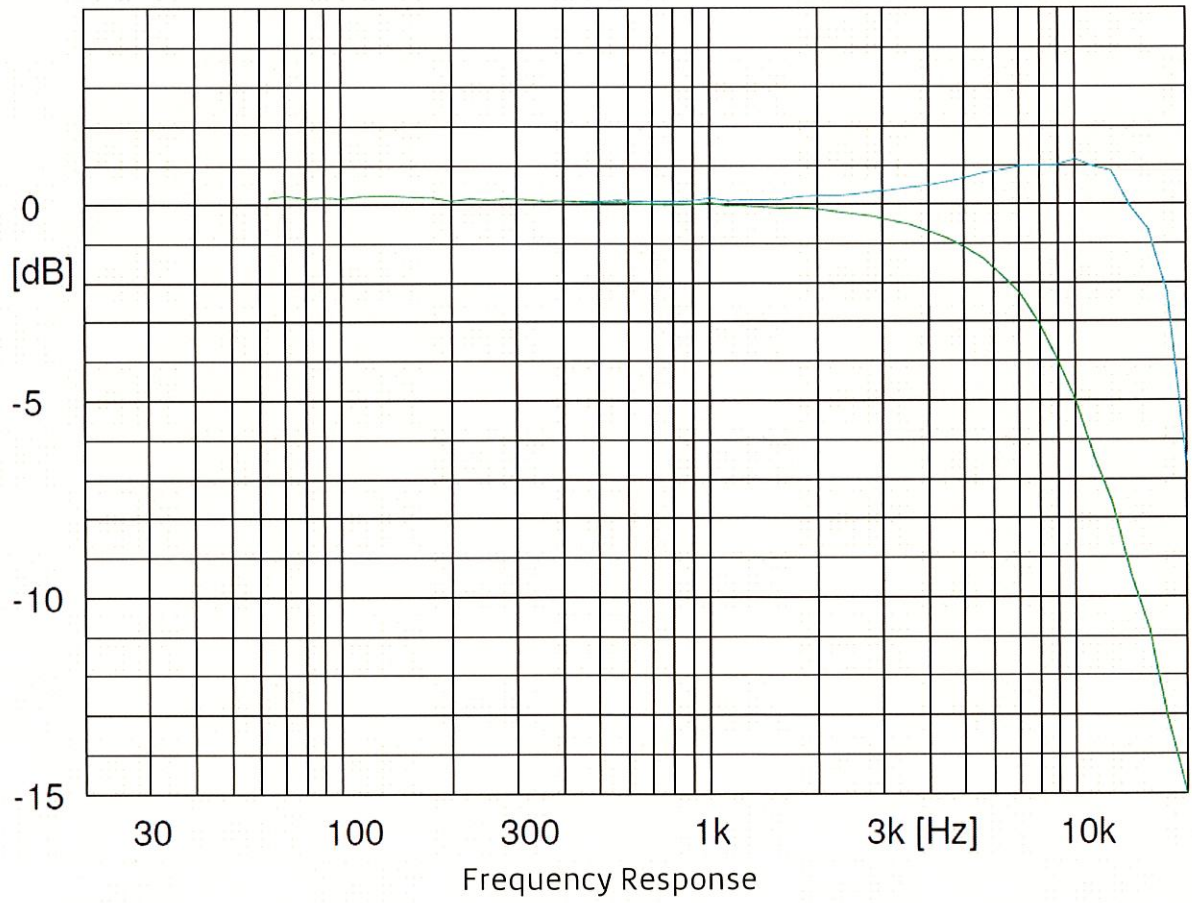
Serial no: 2621489

Sensitivity: 46.7 mV/Pa
-26.6 ±0.10 dB re. 1 V/Pa

Date: 28/09/2015

Measurement conditions:	
Polarisation voltage:	0.0 V
Pressure:	102.99 ±0.00 kPa
Temperature:	21.4 ±1.0 °C
Relative humidity:	46.9 ±2.1 %RH
Results are normalised to the reference conditions.	

Free field response
Pressure (Actuator) response



MSE-25-2.
14 Sept 16

NSAI
National Metrology Laboratory

Certificate of Calibration

Issued to	TMS Environment Limited 53 Broomhill Drive Tallaght Dublin 24
Attention of	Graham Adams

Certificate Number	162928
Item Calibrated	Bruel & Kjaer Type 4231 Sound Level Calibrator
Serial Number	2623773
Client ID Number	None
Order Number	D168825
Date Received	30 Aug 2016
NML Procedure Number	AP-NM-13
Method	The above calibrator was allowed to stabilize for a suitable period in laboratory conditions. It was then calibrated by measuring the sound pressure level generated in its measuring cavity (half-inch configuration). The calibrator's operating frequency was also measured.
Calibration Standards	Norsonic 1504A Calibration System incorporating: Agilent 34401A Multimeter, No. 0736 [Cal due: 31 Aug 2016] B & K 4134 Measuring Microphone, No. 0743 [Cal due: 19 Jan 2017] B & K 4228 Pistonphone, No. 0740 [Cal due: 12 Jan 2017]

Calibrated by	David Fleming	Approved by	Paul Hetherington
Date of Calibration	30 Aug 2016	Date of Issue	31 Aug 2016

CIPM MRA

This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)

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Measuring Conditions:

Ambient Pressure:	(101.4 ± 0.5) kPa
Ambient Temperature:	(21.8 ± 1.0) °C
Ambient Rel. Humidity:	(52 ± 5) %RH

Results:

The measured sound pressure level(s) reported below refer to the reference conditions specified by the manufacturer. Corrections were applied using sensitivity coefficients provided by the manufacturer, where available. These reference conditions and sensitivity coefficients are listed below.

Parameter	Reference Value	Sensitivity Coefficient
Ambient Pressure	101.325 kPa	0.000 8 dB/kPa
Ambient Temperature	20 °C	0.000 dB/°C (1)
Ambient Relative Humidity	65 %RH	0.000 dB/%RH (1)

Calibrator Setting	Measured Parameter	Measured Value (2)		Tolerance (3)	Meas. Uncertainty (4)
		Before Adj.	After Adj.	(±)	(±)
94 dB	Sound Pressure Level	93.95 dB	*	0.40 dB	0.15 dB
	Frequency	999.97 Hz	*	10 Hz	0.25 Hz
114 dB	Sound Pressure Level	113.97 dB	*	0.40 dB	0.15 dB
	Frequency	999.97 Hz	*	10 Hz	0.25 Hz

Notes: (1) No sensitivity coefficient information was available for this parameter.
(2) * indicates that no calibration adjustment was made.
$ indicates an out-of-tolerance condition. Note that for acoustic calibrators which meet IEC 60942 (2003), the instrument is considered out of tolerance if the measured deviation from the set level, extended by it associated uncertainty, exceeds the specified tolerance limits.
(3) IEC 60942 (2003), Sound Calibrators, Class 1.
(4) The measurement uncertainty is reported as a standard uncertainty multiplied by a coverage factor k=2 which, for a normal probability distribution corresponds to a coverage probability of approximately 95%. The given uncertainty refers to the measured values only and carries no implication regarding the long-term stability of the item calibrated.

Comments:

The sound level calibrator was found to comply with the requirements of IEC 60942 (2003), Class 1, for sound pressure level and frequency measurements.
When using the calibrator with a sound level meter any manufacturer's guidelines regarding free-field corrections should be observed.

Traceability:

The reported measurement results are traceable, via national standards maintained by NSAI National Metrology Laboratory (NML), to internationally accepted realisations of the SI units.

Appendix A9.1 Visual Impact Appraisals at Selected Viewpoints

1. Visual Impact Sensitivity

To assess the susceptibility of viewers and the amenity value of views, the assessor uses a range of criteria and provides a four point weighting scale to indicate how strongly the viewer/view is associated with each of the criterion identified in Chapter 9 (9.2.4).

Strong value	Moderate value	Mild value	Negligible value

Values associated with the view	VP1	VP2	VP3	VP4	VP5	VP6	VP7	VP8	VP9
Viewer Susceptibility									
Recognised scenic value of the view									
Views from within highly sensitive landscape areas									
Intensity of use, popularity (number of viewers)									
Provision of vast, elevated panoramic views									
Sense of remoteness / tranquillity									
Degree of perceived naturalness									
Presence of striking or noteworthy features									
Sense of Historical, cultural and / or spiritual significance									
Rarity or uniqueness of the view									
Integrity of the landscape character within the view									
Sense of place at the viewing location									
Sense of awe									
Visual Receptor Sensitivity	**ML**	**M**	**M**	**M**	**L**	**M**	**M**	**L**	**L**

VH = Very High, H = High, HM = High-medium, M = Medium, ML = Medium-low, L = Low, VL = Very-low

Viewshed Reference Point		Direction of View
VP1	Access road to Kerdiffstown House	W

Representative of:

- A demesne landscape
- A public facility (Society of Saint Vincent De Paul)

Receptor Sensitivity

Medium low

Existing View

This is a contained view to the west from the Kerdiffstown House driveway. This section of the approach to Kerdiffstown house broadens between the Kerdiffstown landfill to the west and the mature riparian woodland associated with the Morell River to the east. At this point, Kerdiffstown House is in view to the north but it is not an axial avenue view – it is more of a meandering approach towards the southern end of the House. The landfill rises relatively steeply to the west as a scrub covered slope beyond a thin veil of mixed species trees on the boundary of the site. The profile of the visible northern (Zone 1) end of the landfill is an elongated mound.

Visual Impact at remediation stage

During the remediation stage the visible portion of the landfill will be subject of capping. This will result in the entire foreground slopes being stripped of vegetation and re-profiled to incorporate the geotextile membrane (cap) and subsequent soil layers. The view will consist of a bare-earth mound and associated earthmoving machinery. There is also likely to be equipment associated with the installation of a network of buried gas wells. It will appear as a substantial and busy construction site that will contrast with the mature parkland landscape of Kerdiffstown Demesne, The Morell River Corridor and Palmerstown House Estate across the river. Such effects will, however, be temporary as they take place during phase 1 of the remediation process. However, during this period the visual impacts will be of a **High-medium** magnitude.

Visual Impact at Operational Stage (year 1)

Immediately following the remediation stage, grassland will be established on the capped landfill slopes along with some shrub vegetation to mask the view of the various gas outlet risers. A surface water bio-swale will have been constructed in the lower foreground. Construction activity will have ceased and only recreational users are likely to be seen on the remediated landfill. The 'green' appearance of the landfill slopes will begin to assimilate with the parkland landscape context surrounding the viewer in all other directions at this location. Even though the landfill is likely to be slightly more noticeable than it currently is in this setting it will not detract from visual amenity to any greater degree than the current baseline scenario. The magnitude of visual impact post construction is deemed to be **Neutral**.

Visual Impact at Operational Stage post mitigation establishment (approx. 7yrs)

Following the establishment of mitigation screen planting along the nearest side of the swale feature there will be only a veiled view of the lower slopes of the remediated landfill with grassed slopes rising just above. There will also be something of an 'ecological aesthetic' associated with the vegetated drainage swale at the base of the slope. The magnitude of visual impact post mitigation establishment is deemed to be **Positive** in comparison to the baseline scenario.

Summary

Based on the assessment criteria and matrices outlined at Section 9.2.4 of Chapter 9, the significance of residual visual impact is summarised below.

	Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Remediation Stage	Medium-low	High-medium	**Moderate**
Operational stage Pre-mitigation	Medium-low	Neutral	**Imperceptible**
Operational stage Residual	Medium-low	Positive	**Enhanced**

Viewshed Reference Point		Direction of View
VP2	Walled Garden at Kerdiffstown House	SW

Representative of:

- A demesne landscape
- A public facility (Society of Saint Vincent De Paul)

Receptor Sensitivity

Medium

Existing View

This is a view from the centre of the walled garden that lies contiguous to the western side of Kerdiffstown House. The view uphill to the south-west takes in clusters of mature trees within the garden and a patch of woodland that lies on the boundary between the walled garden and Kerdiffstown Landfill. The mounded Northern (Zone 1) end of the landfill is barely visible through this heavy veil of trees even within the winter period depicted in the photomontage baseline scenario.

Visual Impact at remediation stage

The Northern (Zone 1) end of the landfill will be subject to substantial clearance and profiling as part of the capping works. This will result in a view of bare earth across the entire mound as well as the associated earth moving machinery. However, both the landfill and the machinery will be barely visible from here through the existing woodland vegetation, which will remain in place. During winter months it is considered that there may be a temporary **Low negligible** visual impact at this location.

Visual Impact at Operational Stage (year 1)

Following the remediation stage it is likely that the grassed slopes of the landfill will not be discernible as more than the general massing that is currently sensed through the dense woodland screen. Thus the visual impact magnitude will be **Neutral**.

Visual Impact at Operational Stage post mitigation establishment (approx. 7yrs)

It will not be possible to add significant additional tree planting to the landfill side of the boundary woodland as it would compromise the integrity of the cap. The limited tree planting that can take place right on the site boundary will serve to reinforce the visual screen towards the landfill, but the magnitude of visual impact will remain **Neutral**.

Summary

Based on the assessment criteria and matrices outlined at Section 9.2.4 of Chapter 9, the significance of residual visual impact is summarised below.

	Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Remediation Stage	Medium	Low-negligible	**Slight-imperceptible**
Operational stage Pre-mitigation	Medium	Neutral	**No Effect**
Operational stage Residual	Medium	Neutral	**No Effect**

Viewshed Reference Point		Direction of View
VP3	2nd Hole of Palmerstown House Golf Course	W

Representative of:

- A recreational amenity (Private)

Receptor Sensitivity

Medium

Existing View

This is a view across the 2nd fairway of the Palmerstown House Golf Course towards the corridor of the Morell River which is defined by a narrow band of mature riparian woodland. In winter, a filtered view is afforded of the North-eastern slopes of the Kerdiffstown landfill a short distance beyond. These slopes are cloaked in rough grassland and scrub.

Visual Impact at remediation stage

During the remediation stage the visible slopes of the landfill will present as bare earth as capping works take place in this section of the landfill. These are temporary works, but they will involve the use of heavy machinery, which will also be visible from here and may detract slightly from the parkland-like surroundings and sense of tranquillity. During summer months when the leaves are on the intervening trees there will be glimpses of the landfill afforded. Overall, it is considered that the worst-case magnitude of visual impact at the remediation stage will be Medium-low.

Visual Impact at Operational Stage (year 1)

Once construction activity has ceased and grassland has been established on the visible aspect of the landfill, it is unlikely to draw attention from this locality. It will begin to visually assimilate with the surrounding parkland tones and textures as an extension of this setting, but not quite to the degree of the mottled vegetative cover of the landfill that exists at present. Consequently, the magnitude of visual impact is deemed to be **Negligible**.

Visual Impact at Operational Stage post mitigation establishment (approx. 7yrs)

Once mitigation tree planting along the swale at the base of the landfill slope becomes established along with some areas of shrub land cover on the landfill itself, there will be a stronger sense of visual assimilation with the surrounding land cover patterns and the site will appear more manicured than its baseline condition. The boundary trees will also serve to screen the landfill to a greater degree and deemphasise its height above surrounding ground levels. The residual visual impact is judged to be **Positive**.

Summary

Based on the assessment criteria and matrices outlined at Section 9.2.4 of Chapter 9, the significance of residual visual impact is summarised below.

	Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Remediation Stage	Medium	Medium-low	**Moderate-slight**
Operational stage Pre-mitigation	Medium	Negligible	**Imperceptible**
Operational stage Residual	Medium	Positive	**Enhanced**

Viewshed Reference Point		Direction of View
VP4	3rd Hole of Palmerstown Golf Course	NW

Representative of:

- A recreational amenity (Private)

Receptor Sensitivity

Medium

Existing View

This is a relatively contained view across the 3rd fairway of the Palmerstown golf course. Even in this winter view, the mature treeline that marks the corridor of the Morell River allows only heavily filtered views towards the mound at the northern end of the Kerdiffstown landfill. This lies a short distance away across the entrance avenue to Kerdiffstown House, which is not apparent from here. The principal viewing direction is southwards along the fairway.

Visual Impact at remediation stage

During the remediation stage the north-eastern slopes of the landfill will be visible as bare earth. These temporary capping works will involve the use of heavy machinery, which will also be visible from here and may reduce the sense of tranquillity and consequently, visual amenity. However, during summer months only glimpses of the landfill slopes and any construction activity will be afforded through small gaps in the treeline. On the basis of these reasons, it is considered that the worst-case magnitude of visual impact at the remediation stage will be Medium-low.

Visual Impact at Operational Stage (year 1)

Once construction activity has ceased and grassland has been established on the visible slopes of the landfill, it will begin to blend with the surrounding golf course (parkland) setting. Although this represents a tidier form of land cover than exists at present it will not have quite the degree of camouflage as the existing scrub covered slopes of the landfill. On balance, the magnitude of visual impact is deemed to be **Negligible**.

Visual Impact at Operational Stage post mitigation establishment (approx. 7yrs)

Once mitigation tree planting along the swale at the base of the landfill slope becomes established as well as some small areas of shrub planting on the landfill itself, the scheme will blend more readily with the surrounding landscape context than immediately post remediation. The boundary trees will also serve to screen the landfill to a greater degree and deemphasise its height above surrounding ground levels. The residual visual impact is, therefore, judged to be **Positive**.

Summary

Based on the assessment criteria and matrices outlined at Section 9.2.4 of Chapter 9, the significance of residual visual impact is summarised below.

	Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Remediation Stage	Medium	Medium low	**Moderate slight**
Operational stage Pre-mitigation	Medium	Negligible	**Imperceptible**
Operational stage Residual	Medium	Positive	**Enhanced**

Viewshed Reference Point		Direction of View
VP5	L2005 Kerdiffstown Road	NE

Representative of:
- Local community views

Receptor Sensitivity
Low

Existing View
This is one of the few brief windows of visibility towards the Kerdiffstown Landfill site from the local road that flanks its western side as much of this road is enclosed by vegetation. The view is also adjacent to one of the closest dwellings to the site. More open panoramic views are afforded in the opposite direction (west) over farmland and the environs of Naas. The view to the east is contained at a short distance by the mounded Northern (Zone 1) end of the landfill, which is cloaked in a mottled combination of rough grassland and scrub.

Visual Impact at remediation stage
During the remediation phase, the visible portion of the landfill will be undergoing capping works and an internal site construction road will be utilised along the nearest boundary of the site. The landfill mound will appear as bare-earth and there will be a substantial amount of machinery and HGV movement along the construction road and on the mound itself. A low berm will be constructed along the boundary using the side-cast material from the road. The dwelling and associated sheds will be removed from the foreground along with the low masonry wall. The dense conifer hedge will be retained as an established visual screen. This conifer hedge will substantially screen the construction works for the proposed sports pitches and associated lighting and ball-stop nets from view at this precise location. However, there will be potential for a brief, but relatively close glimpse of the nearest sports pitches through the gap in roadside vegetation from just to the left of this viewpoint. The landfill and sports facility will present as a substantial construction site within the eastward view from this section of road and will noticeably reduce visual amenity from the baseline scenario. The visual impact during the remediation stage will be temporary in duration but is still deemed to be **High medium** in terms of magnitude.

Visual Impact at Operational Stage (year 1)
Once construction activity ceases, the visual impacts experienced here will reduce. The grassed slopes of the mound will appear tidier than they do at present though there will be an array of gas riser outlets penetrating out of the mound with safety fencing around them. The brief glimpse of the adjacent sports pitch and associated infrastructure will still be afforded through this gap in the roadside vegetation (where not blocked by the conifer hedge) and this may reduce the sense of rural amenity slightly. On balance the visual impact magnitude is deemed to be **Low**.

Visual Impact at Operational Stage post mitigation establishment (approx. 7yrs)
It will be possible to plant the boundary berm with semi-mature trees as this is beyond the extent of the capping layer. Once these have established there will be a filtered view of the grassed landfill mound with recreationalists occasionally passing by on the internal site trails. The view of a parkland context is considered preferable to the unkempt baseline scenario and the magnitude of visual impact is therefore considered to be **Positive** once mitigation planting has become established.

Summary
Based on the assessment criteria and matrices outlined at Section 9.2.4 of Chapter 9, the significance of residual visual impact is summarised below.

	Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Remediation Stage	Low	High medium	**Moderate slight**
Operational stage Pre-mitigation	Low	Neutral	**No Effect**
Operational stage Residual	Low	Positive	**Enhanced**

Viewshed Reference Point		Direction of View
VP6	Clubhouse of Naas Golf Course	S

Representative of:
- A recreational amenity (private)

Receptor Sensitivity
Medium

Existing View
This is a picturesque, framed view along the 1st and 18th fairways from the slightly elevated site of the Club House at Naas Golf Course. Banks of mature coniferous and broadleaf trees along the fairways enhance the parkland setting. In the distance along the 1st fairway can be seen the mottled and scrubby land cover of the top of the northernmost mound of Kerdiffstown Landfill, which tend to blend into this scene.

Visual Impact at remediation stage
During the remediation stage the visible aspect of the landfill will be stripped of vegetation to undertake the capping works. This will generate a view of bare-earth and the movement of earth moving machinery on the site, which will detract slightly from the visual amenity of this tranquil parkland scene. Whilst the landfill is a background feature from this specific viewpoint, similar views at closer proximity are likely to occur along the first fairway. The magnitude of visual impact is deemed to be **Low** during the remediation stage.

Visual Impact at Operational Stage (year 1)
Once construction activity has ceased and the capped landfill mound is grassed the site is likely to appear as a visual extension of the golf course. The gas riser outlets are not likely to be readily discernible from here and overall the visual impact is considered to be **Positive** even prior to the establishment of mitigation planting.

Visual Impact at Operational Stage post mitigation establishment (approx. 7yrs)
There will be some limited additional tree planting possible around the stormwater management pond proposed for the northern tip of the site and once this has become established it will serve to blend the view of the landfill within this parkland vista to a marginally greater extent. A **Positive** visual impact remains.

Summary
Based on the assessment criteria and matrices outlined at Section 9.2.4 of Chapter 9, the significance of residual visual impact is summarised below.

	Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Remediation Stage	Medium	Low	**Slight**
Operational stage Pre-mitigation	Medium	Positive	**Enhanced**
Operational stage Residual	Medium	Positive	**Enhanced**

Viewshed Reference Point		Direction of View
VP7	7th Green of Naas Golf Course	SW

Representative of:

- A recreational amenity (private)

Receptor Sensitivity

Medium

Existing View

This is a relatively broad view from the elevated 7th green of Naas Golf Course looking to the south-west. The lower fore-to-middle ground consist of the fairways and greens of the golf course, beyond which can be seen the northern façade of Kerdiffstown House and its accommodation wing. Mature woodland trees substantially screen the view of the northernmost mound of Kerdiffstown landfill though the profile can be read and occasional glimpses of its slopes are afforded.

Visual Impact at remediation stage

During the capping process of the remediation stage of the proposed Project it may be possible to see earth moving machinery on top of the Northern (Zone 1) mound. Bare earth may also show though the branches of the intervening woodland trees to a marginally greater degree than the more camouflaged vegetation covered slopes of the baseline scenario. This may temporarily affect the parkland tranquillity of this visual context, however, such effects are deemed to be of a **Low** magnitude.

Visual Impact at Operational Stage (year 1)

Once remediation activity has ceased at this end of the landfill, the partially visible grassed slopes of the Northern (Zone 1) mound will present as an extension of the parkland / golf course visual context. This is likely to be slightly more noticeable the existing vegetated slopes of the landfill, but will appear tidier and more managed in keeping with the golf course. Thus, the visual impact is deemed to be **Positive**.

Visual Impact at Operational Stage post mitigation establishment (approx. 7yrs)

There may be the opportunity to plant additional woodland trees on the wooded boundary of the site where this will not interfere with the capping layer of the landfill of the siltation pond at the northern end of the site. This will further enhance the woodland setting and the visual impact will remain **Positive**.

Summary

Based on the assessment criteria and matrices outlined at Section 9.2.4 of Chapter 9, the significance of residual visual impact is summarised below.

	Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Remediation Stage	Medium	Low	**Slight**
Operational stage Pre-mitigation	Medium	Positive	**Enhanced**
Operational stage Residual	Medium	Positive	**Enhanced**

Viewshed Reference Point		Direction of View
VP8	N7 Pedestrian Overpass to Johnstown	N

Representative of:	• Local community views
Receptor Sensitivity	**Low**
Existing View	This is a relatively broad vista afforded from the N7 pedestrian overpass to the south of the site. The visual context is dominated by the busy transport route below viewer, which then gives way to a mixed semi-rural landscape to the north. The substantial Johnstown Garden Centre occurs a short distance to the north-east and is surrounded by mature woodland trees. The farmed slopes in the immediate foreground also contain two large broadleaf trees. To the left of this field is a caravan sales operation backed by a dense line of conifers. Between these conifers and another stand of broadleaf trees can be seen the southern end of Kerdiffstown Landfill as a scrub covered mound. Other dwellings emerge from within the sporadic vegetation that flanks the local road that runs away from the viewer. There is also a prominent earth mound rising in the middle ground context within the site.
Visual Impact at remediation stage	There will be considerable modification of that aspect of the site that can be seen from here (Zones 3, 4 and 2B) throughout the remediation stage. Site entrance works, which involve an offset roundabout will occur just to the right of the local road alignment resulting in the loss of some existing vegetation and re-profiling of slopes. The local access road in the lower foreground will also be widened to include two-way cycle lane on its eastern side. This will result in the loss of some roadside vegetation and a more substantial corridor that will appear more urban and less rural than it does at present. The prominent mound of earth that can be seen on the skyline will also be redistributed to other locations within the site. A leachate management compound and methane flare will be constructed just beyond the line of conifers that occupy the centre of the depicted view and the 11m flare will rise above these trees. The scrub-covered mound to the right of the conifers will be stripped of vegetation and re-profiling slightly temporarily revealing bare-earth. All of these processes will result in the constant movement of HGVs along the local access road and earth moving machinery within the site. There is also likely to be site lighting required during winter months to facilitate remediation works. The appearance of a construction with an associated intensity of activity will detract from this semi-rural scene temporarily and the magnitude of visual impact is deemed to be **Medium**.
Visual Impact at Operational Stage (year 1)	Following the completion of remediation stage works, construction activity at the site will cease and exposed areas of bare-ground will be grassed. There will be a higher degree of built development within view (compared to the baseline scenario) associated with the site entrance works, the leachate compound and new methane flare. However, such development will result in a generally tidier and more managed appearance for the site. The scene is likely to appear as more peri-urban than semi-rural in nature. Whilst the view will noticeably change, the visual impact is deemed to be **Neutral** on balance of the factors outlined above.
Visual Impact at Operational Stage post mitigation establishment (approx. 7yrs)	Woodland planting will be established around wetland ponds proposed at the southern end of the site and this will merge visually with the mature woodland trees that are to be retained along the south-eastern boundary of the site. There will also be additional perimeter tree planting and screen planting around the leachate compound / methane flare. Once established there will be something of a parkland aesthetic established which is deemed to result in a **Positive** visual outcome in comparison to the current baseline scenario.
Summary	Based on the assessment criteria and matrices outlined at Section 9.2.4 of Chapter 9, the significance of residual visual impact is summarised below.

	Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Remediation Stage	Low	Medium	**Slight**
Operational stage Pre-mitigation	Low	Neutral	**No effect**
Operational stage Residual	Low	Positive	**Enhanced**

Viewshed Reference Point		Direction of View
VP9	Maudlins Interchange Overbridge	NW

Representative of:
- A major route

Receptor Sensitivity
Low

Existing View
This an elevated and relatively broad vista afforded from an overpass of the busy N7 road corridor which dominates the lower foreground. A vegetated off-ramp embankment on the northern side of the road corridor merges visually with a dense woodland setting beyond, which is the golf course context of Palmerstown House Estate. The northernmost mound of Kerdiffstown landfill can be seen above and just to the right of the main cluster of mature woodland trees in the intervening landscape. The mound is cloaked in scrubby grassland vegetation.

Visual Impact at remediation stage
During the remediation stage, the visible mound will be subject to capping, which will result in a view of bare earth and the activity of construction machinery. This may result in a marginal reduction in visual amenity in this particular section of the view, which is currently a tranquil parkland aspect. However, at this distance and in the context of the busy road corridor and variety of other intensive land uses in the immediate vicinity the visual change will be of a **Low-negligible** magnitude.

Visual Impact at Operational Stage (year 1)
Immediately following the remediation stage the visible mound will be grassed and construction machinery gone. It is likely to be slightly more noticeable than the somewhat camouflaged baseline context and may appear slightly ambiguous above the intervening treeline, appearing as a man-made landscape feature. However it will not noticeably detract from visual amenity at this location and will have a tidy appearance. Consequently, the magnitude of visual impact is judged to be **Neutral** at the beginning of the operational stage.

Visual Impact at Operational Stage post mitigation establishment (approx. 7yrs)
Some proposed tree planting along the nearest boundary adjacent to the proposed bio-swale might emerge into view and partially screen the lower slopes of the landfill mound in view. Areas of shrub planting on the capped mound will give a more mottled appearance to the mound and help to assimilate it with the surrounding parkland landscape. The scheme is then likely to contribute to the prevailing landscape aesthetic to a greater degree than the unkempt vegetation of the baseline scenario, resulting in a **Positive** visual impact.

Summary
Based on the assessment criteria and matrices outlined at Section 9.2.4 of Chapter 9, the significance of residual visual impact is summarised below.

	Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Remediation Stage	Low	Low-negligible	**Imperceptible**
Operational stage Pre-mitigation	Low	Neutral	**No effect**
Operational stage Residual	Low	Positive	**Enhanced**

Appendix A10.1 Impact Assessment and the Cultural Heritage Resource

1. Potential Impacts on Archaeological and Historical Remains

Impacts are defined as '*the degree of change in an environment resulting from a development*' (Environmental Protection Agency 2003, p.31). They are described as profound, significant or slight impacts on archaeological remains. They may be negative, positive or neutral, direct, indirect or cumulative, temporary or permanent.

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological and historical resources potentially affected. Development can affect the archaeological and historical resource of a given landscape in a number of ways.

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape.

- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery; disturbance by vehicles working in unsuitable conditions; or burial of sites, limiting accessibility for future archaeological investigation.

- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or longer-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits.

- Visual impacts on the historic landscape sometimes arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic monuments and historic landscape elements as well as their visual amenity value.

- Landscape measures such as tree planting can damage sub-surface archaeological features, due to topsoil stripping and through the root action of trees and shrubs as they grow.

- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluviums or peat deposits.

- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, and service trenches.

Although not widely appreciated, positive impacts can accrue from developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments, and the increased level of knowledge of a site or historic landscape as a result of archaeological assessment and fieldwork.

2. Predicted Impacts

The severity of a given level of land-take or visual intrusion varies with the type of monument, site or landscape features and its existing environment. Severity of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;

- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected;

- Assessment of the levels of noise, visual and hydrological impacts, either in general or site specific terms, as may be provided by other specialists.

Appendix A10.2 Geophysical Survey

GEOPHYSICAL SURVEY

REPORT

Kerdiffstown, Naas,

County Kildare

Date:
22/03/2017

Licence: 17R0027

J. M. Leigh Surveys Ltd.
124 Oaklawn West
Leixlip
County Kildare
www.jmlsurveys.com
01 615 4647

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GEOPHYSICAL SURVEY SUMMARY SHEET
KERDIFFSTOWN, NAAS, COUNTY KILDARE

Site Name	Kerdiffstown, Naas, County Kildare	**Ref No.**	17008
Townland	Kerdiffstown	**Licence No.**	17-R-0027
County	Kildare	**Licence Holder**	Joanna Leigh
ITM (centre)	E691113, N722222	**Purpose**	Pre-planning
Client	IAC Ltd. & Kildare County Council	**Planning No.**	NA
Closest RMP	KD019:018	**Classification**	Mound
ITM	E691101, N722239	**Location**	Within the application area.
Townland	Kerdiffstown		

Ground Conditions	Ground conditions were suitable for survey. The spoil from the adjacent landfill site formed the eastern boundary of the field. Wire fencing was located around the field.
Survey Type	Detailed gradiometer survey totalling c.1.3 hectares

Summary of Results

A large magnetic shadow from the adjacent spoil of the landfill site obscures a large section of the data. The location of the recorded mound (KD019:018) lies partially within the magnetic shadow. No responses indicative of an archaeological mound was recorded.

In the south of the application area (Area B) a faint curving trend has been identified. Although this is barely discernible in the data, this may represent the remains of a circular archaeological feature, although this is speculative.

Report Date	22/03/2017	**Report Author**	Joanna Leigh

Contents

Geophysical Survey Report
Kerdiffstown, Naas, County Kildare

1 Introduction

1.1 A geophysical survey has been conducted by J. M. Leigh Surveys at a site in the townland of Kerdiffstown, on the outskirts of Naas, County Kildare. This survey has been conducted as part of a pre-planning archaeological investigation by IAC Ltd. on behalf of Kildare County Council.

1.2 The geophysical survey has been requested to investigate a triangular field totalling 1.3 hectares to the north-east of Naas Town and c.800m to the north-west of Johnstown Garden Centre and immediately adjacent to the Kerdiffstown landfill site.

1.3 A recorded Mound (KD019:018) is located in the centre of the field. The mound was investigated in 1952 by NMI after partial destruction by quarrying. Finds included two comb fragments, and a fragment of bronze wire. Dark soil, possibly habitation refuse, was also noted (NMI Topographical file). There are no visible traces of the mound at ground level and it is possible that it has been removed through quarrying activity.

1.4 The location of the application area and the recorded monument are presented in Figure 1, at a scale of 1:5,000.

1.5 The main aim of the survey was to identify any geophysical responses indicative of archaeological remains, with particular consideration to the recorded mound (KD019:018). The main objective of the survey was to indicate the possible state of preservation of the mound.

2 Survey ground conditions and further information

2.1 Survey ground conditions were suitable at the time of survey, comprising of short grass. The survey area was sub-divided (Area A and B) to facilitate fieldwork. Post and wire fencing separates the two areas.

2.2 To the north-east of the survey, substantial spoil heaps from the Kerdiffstown landfill site were observed. The modern magnetic material within the spoil heaps has resulted in a magnetic ‘shadow’ which is evident within the data set.

2.3 Further modern magnetic disturbance was recorded, resulting from the post and wire fences surrounding the field.

3 Survey Methodology for the Detailed Gradiometer Survey

3.1 A detailed gradiometer survey detects subtle variations in the local magnetic field and measurements are recorded in nano-Tesla (nT). Some archaeological features such as ditches, large pits and fired features have an enhanced magnetic signal and can be detected through recorded survey.

3.2 Data was collected with a Bartington Grad 601-2 instrument. This is a specifically designed gradiometer for use in archaeological prospection. The gradiometer operates with a dual sensor capacity making survey fast and effective.

3.3 The instrument is calibrated in the field to ensure a constant high quality of data. Extremely sensitive, these instruments can detect variations in soil magnetism to 0.01nT, affording diverse application throughout a variety of archaeological, soil morphological and geological conditions.

3.4 All data was collected in 'zigzag' traverses. Grid orientation remained constant throughout each field to facilitate the data display and interpretation.

3.5 Data was collected with a sample interval of 0.25m and a traverse interval of 1m, providing 6400 readings per 40m x 40m grid. The survey grid was set-out using a GPS VRS unit. Survey tie-in information is available upon request.

3.6 The survey methodology, data presentation and report content adheres to the European Archaeological Council (EAC) (2015) 'Guidelines for the use of Geophysics in Archaeology'.

4 Data display

4.1 A summary greyscale image and accompanying interpretation diagram are presented in Figures 3 and 4, at a scale of 1:1,250.

4.2 Numbers in parenthesis in the test refer to specific responses highlighted in the interpretation diagram (Figure 4).

4.3 Isolated ferrous responses highlighted in the interpretation diagram most likely represent modern ferrous litter and debris and are not of archaeological interest.

4.4 The raw gradiometer data is presented in archive format in Appendix A1.01 to A1.03. The raw data is displayed as an xy-trace plot and greyscale image, both at a scale of 1:625. The archive plots are used to aid interpretation of the results and are for reference only. The archive plots are available upon request.

4.5 The display formats referred to above and the interpretation categories are discussed in the summary technical information section at the end of this report.

5 Survey Results & Conclusion (Figures 3 & 4)

Area A

5.1 A large magnetic shadow (1) from the adjacent spoil from the landfill site obscures a large section of the data. The location of the recorded mound (KD019:018) lies partially within the magnetic shadow and no responses indicative of an archaeological mound were recorded. It is possible that the recorded mound lies undetected within the magnetic shadow. However, it is equally possible that the mound has been removed through quarrying activity and modern agricultural activity. There are no geophysical responses indicative of the archaeological mound within the recorded data.

5.2 A large ferrous response (2) is evident in close proximity to the recorded location of the mound. However, this response most likely represent modern ferrous and is not considered to be associated with the recorded mound.

5.3 An area of disturbance and linear ferrous response (3) is evident in the south of Area A. This may represent the remains of a former fence, or possible pipe. The response appears to correlate with a distinct bank in the topography. Although the exact origin of this response is unclear it is considered to be most likely modern in origin.

5.4 Another broad area of magnetic disturbance (4) corresponds with an area of modern rubbish. This is not of archaeological interest.

Area B

5.5 Area B consists of modern disturbance from the surrounding post and wire fencing.

5.6 A faint curving trend (5) has been recorded. Although this is barely discernible in the data, an archaeological interpretation must be considered. This may represent the remains of a circular archaeological feature with a possible diameter of 10m. Interpretation is cautious as there are no clear archaeological responses present but this interpretation must be considered.

5.7 Consultation with a licensed archaeologist and with the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs is recommended to establish if any additional archaeological works are required.

Technical Information Section

Instrumentation & Methodology

Detailed Gradiometer Survey

This is conducted to clearly define any responses detected during scanning, or can be applied as a stand-alone methodology. Detailed survey is often applied with a sample interval of 0.25m and a traverse interval of 1m. This allows detection of potential archaeological responses. Data is collected in grids 40m x 40m, and data is displayed accordingly. A more detailed survey methodology may be applied where archaeological remains are thought likely. A survey with a grid size of 10m x 10m and a traverse interval of 0.5m will provide a data set with high resolution.

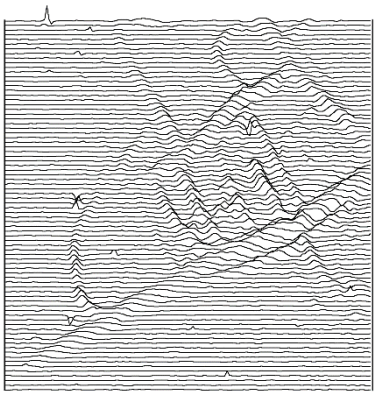
Bartington GRAD 601-2

The Bartington Grad 601-2 instrument is a specifically designed gradiometer for use in archaeological prospection. The gradiometer operates with a dual sensor capacity making survey very fast and effective. The sensors have a separation of 1m allowing greater sensitivity.

Frequent realignment of the instruments and zero drift correction; ensure a constant high quality of data. Extremely sensitive, these instruments can detect variations in soil magnetism to 0.1nT, affording diverse application throughout a variety of archaeological, soil morphological and geological conditions.

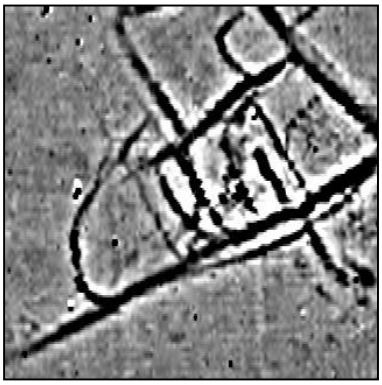
Gradiometer Data Display & Presentation

XY Trace



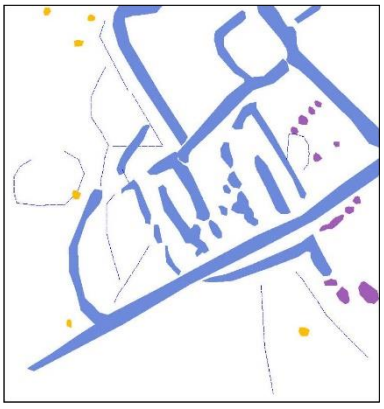
The data are presented as a series of linear traces, enabling a semi-profile display of the respective anomalies along the X and Y-axes. This display option is essential for distinguishing between modern ferrous materials (buried metal debris) and potential archaeological responses. The XY trace plot provides a linear display of the magnitude of the response within a given data set.

*Greyscale**



As with dot density plots, the greyscale format assigns a cell to each datum according to its location on the grid. The display of each data point is conducted at very fine increments, allowing the full range of values to be displayed within the given data set. This display method also enables the identification of discrete responses that may be at the limits of instrument detection. In the summary diagrams processed, interpolated data is presented. Raw un-interpolated data is presented in the archive drawings along with the xy-trace plots.

Interpretation



An interpretation of the data is made using many of the plots presented in the final report, in addition to examination of the raw and processed data. The project managers' knowledge and experience allows a detailed interpretation of the survey results with respect to archaeological potential.

**XY Trace and raw greyscale plots are presented in archive form for display of the raw survey data. Summary greyscale images of the interpolated data are included for presentation purposes and to assist interpretation.*

Glossary of Interpretation Terms

Archaeology

This category refers to responses which are interpreted as of clear archaeological potential, and are supported by further archaeological evidence such as aerial photography or excavation. The term is generally associated with significant concentrations of former settlement, such as ditched enclosures, storage pits and associated features.

? Archaeology

This term corresponds to anomalies that display typical archaeological patterns where no record of comparative archaeological evidence is available. In some cases, it may prove difficult to distinguish between these and evidence of more recent activity also visible in the data.

? Industrial

Such anomalies generally possess a strong magnetic response and may equate with archaeological features such as kilns, furnaces, concentrations of fired debris and associated industrial material.

Area of Increased Magnetic Response

These responses often lack any distinctive archaeological form, and it is therefore difficult to assign any specific interpretation. The resulting responses are site specific, possibly associated with concentrations of archaeological debris or more recent disturbance to underlying archaeological features.

Trend

This category refers to low-level magnetic responses barely visible above the magnetic background of the soil. Interpretation is tentative, as these anomalies are often at the limits of instrument detection.

Ploughing/Ridge & Furrow

Visible as a series of linear responses, these anomalies equate with recent or archaeological cultivation activity.

? Natural

A broad response resulting from localised natural variations in the magnetic background of the subsoil; presenting as broad amorphous responses most likely resulting from geological features.

Ferrous Response

These anomalies exhibit a typically strong magnetic response, often referred to as ‘iron spikes,’ and are the result of modern metal debris located within the topsoil.

Area of Magnetic Disturbance

This term refers to large-scale magnetic interference from existing services or structures. The extent of this interference may in some cases obscure anomalies of potential archaeological interest.

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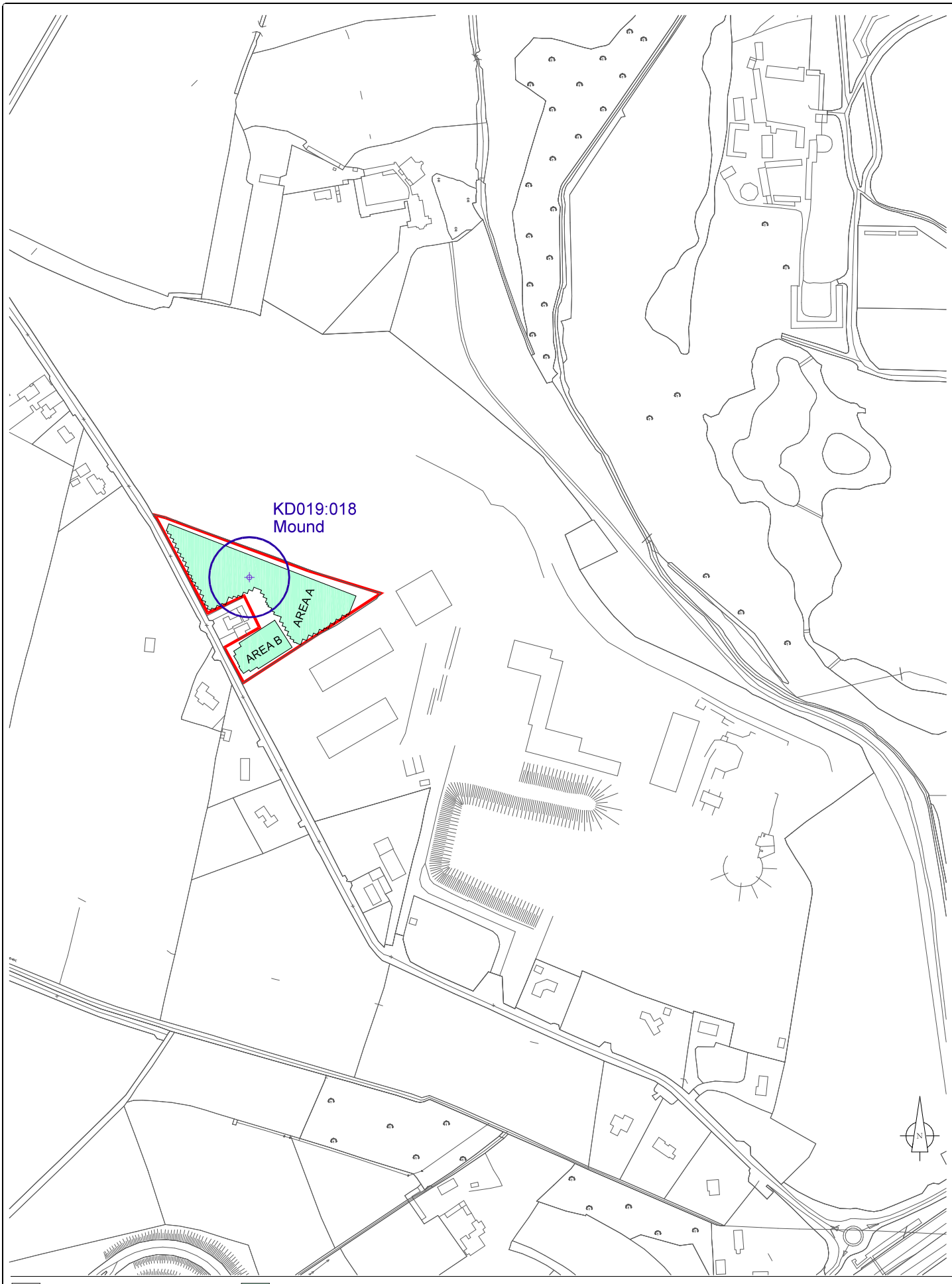
List of Figures

Archive Data Supplied as a PDF Upon Request

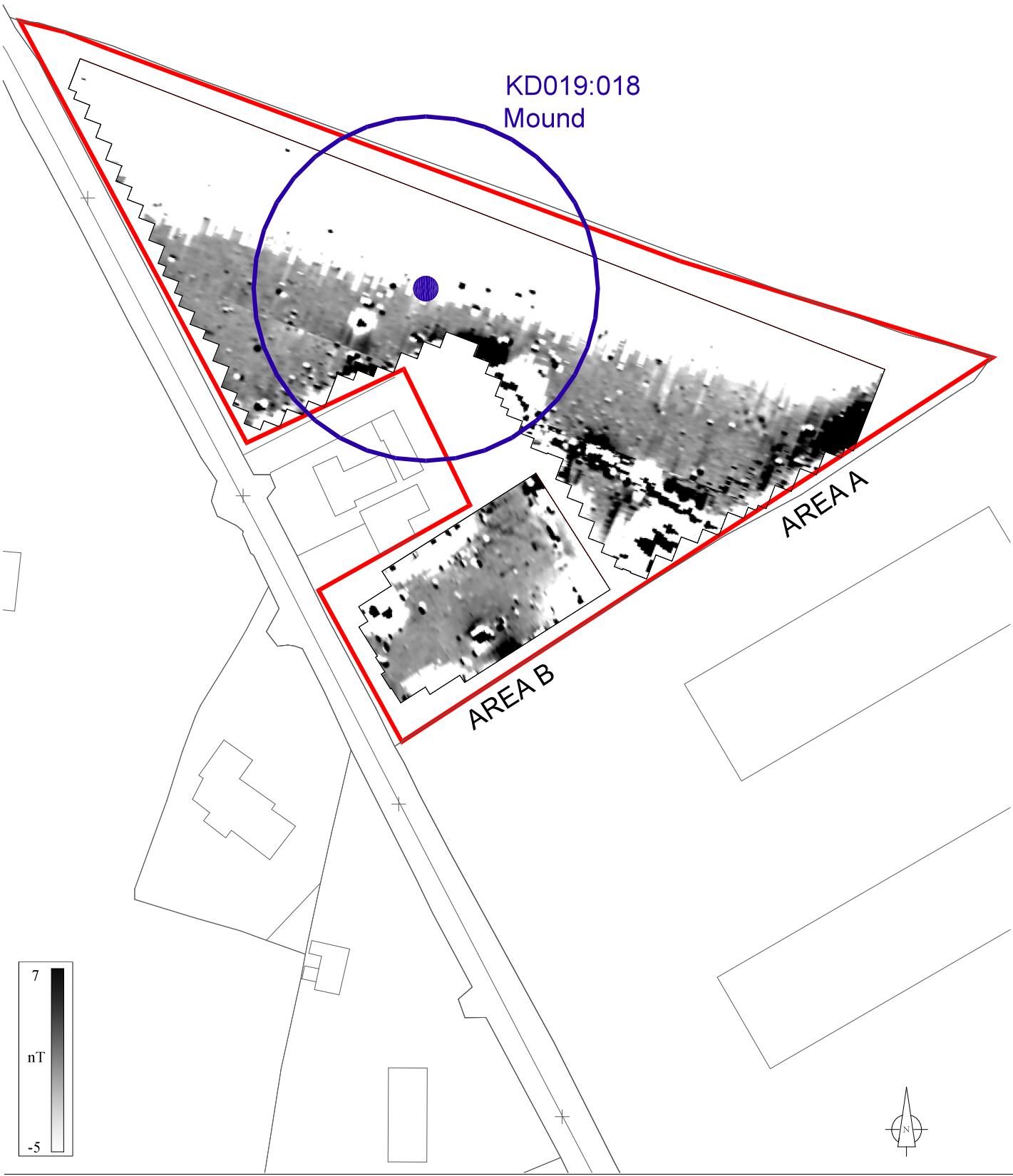


Application area

Detailed gradiometer survey

0 metres 200

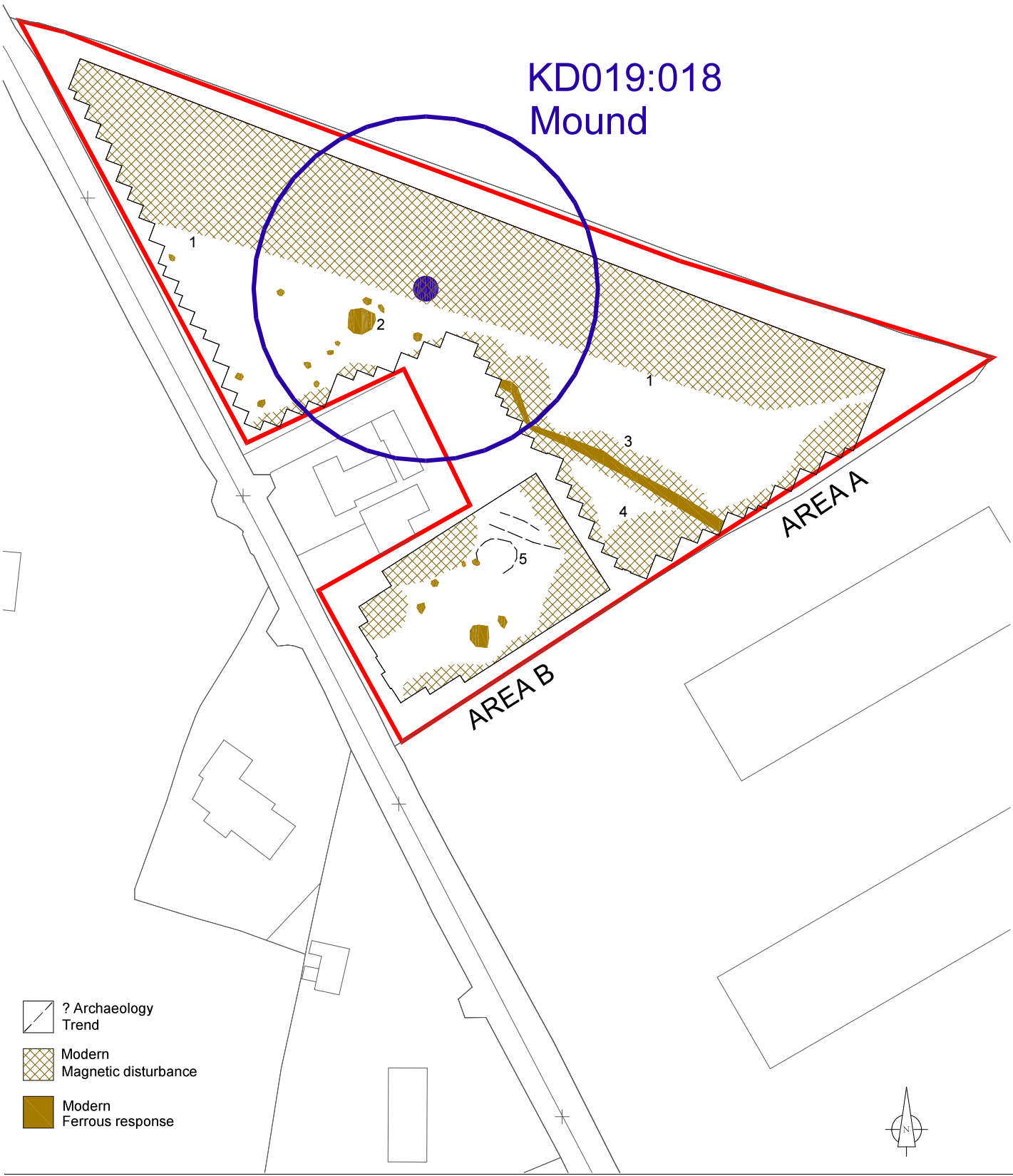
Client: IAC Ltd. & Kildare County Council	Project: Kerdiffstown, County Kildare	Title: Geophysical Survey: Site & Survey Location Diagram	J.M.Leigh surveys www.jmlsurveys.com	Scale @ A4: 1:5,000 Figure: 1 Licence No.: 17-R-0027 Issue Date: 22.03.2017



Application area

0 metres 50

Client:	Project:	Title:		
IAC Ltd. & Kildare County Council	Kerdiffstown, County Kildare	Geophysical Survey: Summary greyscale image	J.M.Leigh surveys www.jmlsurveys.com	Scale @ A4: 1:1,250 Figure: 2 Licence No.: 17-R-0027 Issue Date: 22.03.2017



Application area

0 metres 50

Client:	Project:	Title:		
IAC Ltd. & Kildare County Council	Kerdiffstown, County Kildare	Geophysical Survey: Summary interpretation	J.M.Leigh surveys www.jmlsurveys.com	Scale @ A4: 1:1,250 Figure: 3 Licence No.: 17-R-0027 Issue Date: 22.03.2017

Appendix A10.3 Recorded Monuments and Places within the Surrounding Area

SMR No.	KD019-006001-4
RMP	Yes
Townland	Kerdiffstown
Parish	Kerdiffstown
Barony	North Naas
ITM	691436 722271
Classification	Church, graveyard & two grave slabs
Distance from site	To the immediate east
Description	1 – According to Fitzgerald (1912-14, 182), the church was dedicated to St. Lawrence. In a graveyard (KD019-006002-). The poorly preserved, ivy-clad remains of a rectangular structure comprise a nave (int. dims. L 12.9m E-W; Wth 5.4m) and levelled chancel (int. dims. est. L c. 5.2m E-W; Wth 5.1m), built mainly of rubble limestone masonry with occasional random coursing, and some tufa in the quoins. The W-end of the nave is reduced to rubble-covered, lower wall courses, and a gap (Wth 1.7m) at the upstanding W-end of the S wall may mark an original entrance. A second gap (Wth 0.9m), near the E-end of the wall may be a robbed-out window, and is matched by a similar gap (Wth 0.9m), almost opposite, in the N wall, which also contains a reconstructed window near its centre. The nave's very high, steeply pitched, E-gable wall survives and is pierced by a round, chancel arch (Wth 2.7m; H 2.15m) of rubble masonry, located slightly off-centre, to the S. The lower A-line of the chancel roof is marked by thin flags projecting E (c.0.3m) from the gable wall face, and the E-face of the wall is set back (c. 0.10m) above the chancel arch. The chancel's N, E and S walls have been levelled and scar lines of the N and S walls are visible in the gable wall of the nave. A low scarp (H 0.5m) may mark the line of the E gable wall. While the very steep pitch of the nave's E gable wall suggests a pre-Norman date for the original church, with the chancel added later, O'Carragáin (pers. comm. SMR File) comments that the nave and chancel may well be contemporary. Fitzgerald also recorded, 'portions of a handsome, early sixteenth century window' originally from the church, but which had lain scattered in the graveyard (KD019-006002-) and were removed to Kerdiffstown House c. 400m to the NNE, but the present whereabouts of which are unknown. (Sherlock 1899-1902, 298; Herity 2002, 60-61 (176-77); Mc Cabe 1991, 218-21; 20003, 187-9). 2 - In a narrow 'pass' between the small, N-flowing, Morell River, c. 35m to the E, and a low, steep-sided, NW-SW ridge to W, at the foot of which the graveyard lies. It contains a medieval church (KD019-006001-), a medieval graveslab (KD019-006003-) and a 17th century graveslab (KD019-006004-). A very overgrown, apparently unenclosed but roughly square area (est. dims. L c. 40m; Wth c. 40m) contains the legible remains of mainly 18th and 19th century burial markers. (Mc Cabe 20003, 187-9). 3 - Discovered in 1990 by Mr. Brian Mc Cabe (1991, 218-21), lying face down, c. 8m W of Kerdiffstown Church (KD019-006001-). A gently tapering, granite slab (dims. L 1.22m; Wth at top 0.46m; Wth at base 0.32m; T at top 0.2m; T at base 0.16m) bears an incised, floriate cross on one face and dates to the 13/14 c. 4 - An old, re-transcribed slab commemorates the death of Mary Kerdiffe in 1690 and her husband John in 1702.
Reference	www.archaeology.ie

SMR No.	KD019-018
RMP	Yes

Townland	Kerdiffstown
Parish	Kerdiffstown
Barony	North Naas
ITM	691099 722243
Classification	Mound
Distance from site	0m
Description	A mound investigated in 1952 by the NMI after partial destruction by quarrying. Finds included two comb fragments, and a fragment of bronze wire. Dark soil, possibly habitation refuse, was also noted (NMI Topographical file).
Reference	www.archaeology.ie

SMR No.	KD019-067
RMP	Yes
Townland	Palmerstown Demesne
Parish	Johnstown
Barony	North Naas
ITM	691592 722298
Classification	Architectural fragment
Distance from site	146m northeast
Description	Discovered by Mr. Brian McCabe, a local historian. Located in a narrow strip of overgrown tree and scrub-covered ground along the W shore of a small lake in Palmerstown Demesne, which has been developed as a golf course. A well-dressed, chamfered limestone arch-stone (L 1.2m; Wth 0.25m; T 0.21m), with parallel tooling on the faces and punch-dressing on the soffit is reused to form the N side of a very low ope (H 1m) in the E gable wall of a small, poorly preserved, ivy clad structure, of which only portions of the N and E gable walls survive (L 7.2m E-W; Wth 4.4m N-S; H 3m), built of heavily mortared, mixed large and small roughly dressed stones. The walls (T 0.46m) are each pierced by a tall ope in pointed, Gothic-arch style with rough, undressed voussoirs, and some tufa is used in the jambs (N wall ope H 2.4m; Wth 0.87m: S wall ope (to the N of the arch stone) H 2.5m; Wth 1.48m). This structure appears to be landscape demesne feature, while the reused arch-stone may have come from Kerdiffstown Church (KD019-006001-) c. 150m to the W.
Reference	www.archaeology.ie

SMR No.	KD019-059
RMP	Yes (and RPS)
Townland	Mauldings
Parish	Naas
Barony	North Naas
ITM	691786 721430
Classification	Standing stone
Distance from site	360m southeast
Description	On a gentle E-facing pasture slope, c. 35m W of the N-flowing Morell River. A tall, almost square, granite stone (H 1.62m; L 0.29m; Wth 0.26m) is orientated on a NE-SW axis. A small perforation pierces the top of the stone NW-SE. Believed locally to be a scratching post, but exhibits no obvious signs of wear.
Reference	www.archaeology.ie

SMR No.	KD0190014001-4
RMP	Yes
Townland	Palmerstown Demesne
Parish	Johnstown
Barony	North Naas
ITM	691442, 722274
Classification	Church, graveyard, font, graveslab
Distance from site	425m east-southeast
Description	1 – May have been built originally by the Knights Hospitallers of St John of Jerusalem, from whom Johnstown village took its name. Stands on a slight rise near the centre of a graveyard (KD019-014002-). A partially restored, rectangular structure (int dims L 13.4m E-W; Wth 5.2m) is built of rubble, limestone masonry (av. wall T 0.9m), with some tufa and granite boulders, and may once have been a chancel: the W gable wall contains a large, rebuilt, two-centred arch (H 4.3m; Wth 2.3m) erected off-centre, to the N. It incorporated the N, tufa-built jamb of an earlier, wider arch, the S jamb of which is visible in the masonry to the S. The entrance doorway (Wth 1.2m) in the N wall may be a later insertion. The E gable wall contains a restored double ogee-headed window in a broad, square-headed embrasure with a steeply plunging sill. Most of the S wall has been rebuilt, and a round-headed window-piece is reused to face a small niche on the inner wall face to act as a stoup. The interior contains the 15th century 'Flatesbury Monument' (KD019-014003-), a medieval font (KD019-014004-) and a 19th century high cross marking the burials of the Bourke (Mayo) family. (Herity 2002, 60 (176); Fitzgerald 1903-5, 257; Meagher 1979-80, 117) 2 - Although the OSL (Herity 2002, 60 (176)) record, ' … in the graveyard … there is still burial', the site is not named as a graveyard on the 1st ed. (1838) of the OS 6-inch map. A well-maintained, roughly rectangular, roadside graveyard (dims L c. 50m NW-SE; Wth c. 30m NE-SW) contains a medieval church (KD019-

	014001-), the 'Flatesbury Monument' (KD019-014003-), a font (KD019-014004-), and a 19th century high cross marking the burials of the Bourke (Mayo) family, the most famous of whom was probably Richard Southwell, Sixth Earl of Mayo (1822-1872), who - apart from serving as Chief Secretary for Ireland three times - was appointed Viceroy of India, from where, following his assassination in 1872, he was apparently shipped home in a barrel of rum, and became known in village lore as 'The Pickled Earl". (Fitzgerald 1903-5, 257; Meagher 1979-80, 117) 3 - In a niche in the N wall of a church (KD019-014001-). A tall, gently tapering, limestone slab (H 1.65m; Wth at top 0.6m; Wth at base 0.55m) carries an eight-pointed cross of mixed floriated and pointed terminals, on a stepped-base, and two heraldic shields, carved in relief. Known as the 'Flatesbury Monument', it possibly commemorates the marriage of Eleanor Wogan and James Flatesbury in 1564 . (Vicars 1903-5, 92-4; Meagher 1979-80, 117) 4 - A small, well-preserved portion of an octagonal limestone font (dims L; 0.34m; Wth 0.34m; H 0.28m) with a central, circular depression (diam. 0.2m; D 0.18m).
Reference	www.archaeology.ie

SMR No.	KD019-064
RMP	Yes
Townland	Palmerstown Demesne
Parish	Johnstown
Barony	North Naas
ITM	691617 722771
Classification	Mill
Distance from site	460m northeast
Description	Mr. Martin Byrne of Byrne Mullins & Associates, Archaeological Consultants, 7 Cnoc na Greine Square, Kilcullen, Co. Kildare (045-480688), supplied a copy of a brief, undated, report compiled by Dr. Colin Rynne on the mill and a nearby hydraulic ram. These monuments date to the 19th century and fall outside the current remit of the Archaeological Survey of Ireland.
Reference	www.archaeology.ie

Appendix A10.4 Stray Finds within the Surrounding Area

Information on artefact finds from the study area in County Kildare has been recorded by the National Museum of Ireland since the late 18th century. Location information relating to these finds is important in establishing prehistoric and historic activity in the study area.

Artefacts from the site of the recorded Bronze Age burials in the townland of Ploopluck (KD019-017) are recorded within the topographical files (NMI registration numbers 1935:3-10, 17, 544-548).

1952:1-3 (Kerdiffstown). Two bone comb fragment and a section of bronze wire. UCD Archaeological Society visited a site that had been excavated mechanically and was reported to contain potential archaeological remains. On investigation, the site had been completely removed / bulldozed. Driver of bulldozer / mechanical excavator said that there has been a mound which was removed. The dumps of spoil from the site were evident during the visit but archaeological investigation was not deemed possible owing to the condition of the site. It was agreed that the site likely represented an early medieval settlement.

Appendix A10.5 Legislation Protecting the Archaeological Heritage Resources

Protection of Cultural Heritage

The cultural heritage in Ireland is safeguarded through national and international policy designed to secure the protection of the cultural heritage resource to the fullest possible extent (Department of Arts, Heritage, Gaeltacht and the Islands 1999, p.35). This is undertaken in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention), ratified by Ireland in 1997.

The Archaeological Resource

The National Monuments Act 1930 to 2014 and relevant provisions of the National Cultural Institutions Act 1997 are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. A National Monument is described as '*a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto*' (National Monuments Act 1930 Section 2).

A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places, and the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

Ownership and Guardianship of National Monuments

The Minister may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Register of Historic Monuments

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the register is illegal without the permission of the Minister. Two months notice in writing is required prior to any work being undertaken on or in the vicinity of a registered monument. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Preservation Orders and Temporary Preservation Orders

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Record of Monuments and Places

Section 12(1) of the 1994 Act requires the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for the Arts, Heritage, Regional, Rural and Gaeltacht Affairs) to establish and maintain a record of monuments and places where the Minister believes that such monuments exist. The record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the state. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994. All recorded monuments on the proposed Project site are represented on the accompanying maps.

Section 12(3) of the 1994 Act provides that '*where the owner or occupier (other than the Minister for Arts, Heritage, Gaeltacht and the Islands) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage, Gaeltacht and the Islands to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the work until two months after the giving of notice*'.

Under the National Monuments (Amendment) Act 2004, anyone who demolishes or in any way interferes with a recorded site is liable to a fine not exceeding €3,000 or imprisonment for up to 6 months. On summary conviction and on conviction of indictment, a fine not exceeding €10,000 or imprisonment for up to 5 years is the penalty. In addition they are liable for costs for the repair of the damage caused.

In addition to this, under the European Communities (Environmental Impact Assessment) Regulations 1989, Environmental Impact Assessment Report (EIAR) are required for various classes and sizes of development project to assess the impact the proposed Project will have on the existing environment, which includes the cultural, archaeological and built heritage resources. These document's recommendations are typically incorporated into the conditions under which the proposed Project must proceed, and thus offer an additional layer of protection for monuments which have not been listed on the RMP.

The Planning and Development Act 2000

Under planning legislation, each local authority is obliged to draw up a Development Plan setting out their aims and policies with regard to the growth of the area over a five-year period. They cover a range of issues including archaeology and built heritage, setting out their policies and objectives with regard to the protection and enhancement of both. These policies can vary from county to county. The Planning and Development Act 2000 recognises that proper planning and sustainable development includes the protection of the archaeological heritage. Conditions relating to archaeology may be attached to individual planning permissions.

Kildare County Development Plan 2017–2023 - Policies

AH 1: To manage development in a manner that protects and conserves the archaeological heritage of the country, avoids adverse impacts on sites, monuments, features or objects of significant historical or archaeological interest and secures the preservation in-situ or by record of all sites and features of historical and archaeological interest. The Council will favour preservations in-situ in accordance with the recommendation of the Framework and Principals for the Protection of Archaeological Heritage (1999) or any superseding national policy.

AH2: To have regard to the Record of Monuments and Places (RMP), the Urban Archaeological Survey and archaeological sites identified subsequent to the publication of the RMP when assessing planning applications for development. No development shall be permitted in the vicinity of a recorded feature, where it detracts from the setting of the feature or which is injurious to its cultural or educational value.

AH 3: To secure the preservation (in-situ or by record) of all sites, monuments and features of significant historical or archaeological interest, included in the Record of Monuments and Places and their settings, in accordance with the recommendations of the Framework and principles for the Protection of the Archaeological Heritage, DAHG (1999), or any superseding national policy document.

AH4: To ensure that development in the vicinity of a site of archaeological interest is not detrimental to the character of the archaeological site or its setting by reason of its location, scale, bulk or detailing and to ensure that such proposed developments are subject to an archaeological assessment. Such an assessment will seek to ensure that the development can be sited and designed in such a way as to avoid impacting on archaeological heritage that is of significant interest including previously unknown sites, features and objects.

AH5: To contribute towards the protection and preservation of the archaeological value of underwater or archaeological sites associated with rivers and associated features.

AH 6: To contribute towards the protection of historic burial grounds within the county and encourage their maintenance in accordance with conservation principles in co-operation with the Historic Monuments Advisory Committee and National Monuments Section of the Department of Arts, Heritage and the Gaeltacht (DAHG).

AH 7: To promote and support in partnership with the National Monuments Section of the Department of the Arts, Heritage and the Gaeltacht (DAHG), the concept of Archaeological Landscapes where areas contain several Recorded Monuments.

AH 8: To encourage, where practicable, the provision of public access to sites identified in the Record of Monuments and Places under the direct ownership, guardianship or control of the Council and/or the State.

AH 9: To encourage the provision of signage to publicly accessible recorded monuments.

Appendix A10.6 Legislation Protection of Architectural Heritage Resource

The main laws protecting the built heritage are the Architectural Heritage (National Inventory) and National Monuments (Miscellaneous Provisions) Act 1999 and the Local Government (Planning and Development) Acts 1963–1999, which has now been superseded by the Planning and Development Act, 2000. The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The background to this legislation derives from Article 2 of the 1985 Convention for the Protection of Architectural Heritage (Granada Convention). This states that: For the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member state will undertake to maintain inventories of that architectural heritage.

The National Inventory of Architectural Heritage (NIAH) was established in 1990 to fulfil Ireland's obligation under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architecture of Ireland (NIAH 2011, pg 2). As inclusion in the inventory does not provide statutory protection, the survey information is used in conjunction with the Architectural Heritage Protection Guidelines for Planning Authorities to advise local authorities on compilation of a Record of Protected Structures as required by the Planning and Development Act, 2000.

Protection under the Record of Protected Structures and County Development Plan

Structures of architectural, cultural, social, scientific, historical, technical or archaeological interest can be protected under the Planning and Development Act, 2000, where the conditions relating to the protection of the architectural heritage are set out in Part IV of the act. This act superseded the Local Government (Planning and Development) Act, 1999, and came into force on 1st January 2000.

The act provides for the inclusion of Protected Structures into the planning authorities' development plans and sets out statutory regulations regarding works affecting such structures. Under new legislation, no distinction is made between buildings formerly classified under development plans as List 1 and List 2. Such buildings are now all regarded as 'Protected Structures' and enjoy equal statutory protection. Under the act the entire structure is protected, including a structure's interior, exterior, attendant grounds and also any structures within the attendant grounds.

The act defines a Protected Structure as (a) a structure, or (b) a specified part of a structure which is included in a Record of Protected Structures (RPS), and, where that record so indicates, includes any specified feature which is in the attendant grounds of the structure and which would not otherwise be included in this definition. Protection of the structure, or part thereof, includes conservation, preservation, and improvement compatible with maintaining its character and interest. Part IV of the act deals with architectural heritage, and Section 57 deals specifically with works affecting the character of Protected Structures or proposed Protected Structures and states that no works should materially affect the character of the structure or any element of the structure that contributes to its special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. The act does not provide specific criteria for assigning a special interest to a structure. However, the National Inventory of Architectural Heritage (NIAH) offers guidelines to its field workers as to how to designate a building with a special interest, which are not mutually exclusive. This offers guidance by example rather than by definition:

Archaeological

It is to be noted that the NIAH is biased towards post-1700 structures. Structures that have archaeological features may be recorded, providing the archaeological features are incorporated within post-1700 elements. Industrial fabric is considered to have technical significance, and should only be attributed archaeological significance if the structure has pre-1700 features.

Architectural

A structure may be considered of special architectural interest under the following criteria:

- Good quality or well executed architectural design
- The work of a known and distinguished architect, engineer, designer, craftsman

- A structure that makes a positive contribution to a setting, such as a streetscape or rural setting
- Modest or vernacular structures may be considered to be of architectural interest, as they are part of the history of the built heritage of Ireland.
- Well designed decorative features, externally and/or internally

Historical

A structure may be considered of special historical interest under the following criteria:

- A significant historical event associated with the structure
- An association with a significant historical figure
- Has a known interesting and/or unusual change of use, e.g. a former workhouse now in use as a hotel
- A memorial to a historical event.

Technical

A structure may be considered of special technical interest under the following criteria:

- Incorporates building materials of particular interest, i.e. the materials or the technology used for construction
- It is the work of a known or distinguished engineer
- Incorporates innovative engineering design, e.g. bridges, canals or mill weirs
- A structure which has an architectural interest may also merit a technical interest due to the structural techniques used in its construction, e.g. a curvilinear glasshouse, early use of concrete, cast-iron prefabrication.
- Mechanical fixtures relating to a structure may be considered of technical significance.

Cultural

A structure may be considered of special cultural interest under the following criteria:

- An association with a known fictitious character or event, e.g. Sandycove Martello Tower, which featured in Ulysses.
- Other structure that illustrate the development of society, such as early schoolhouses, swimming baths or printworks.

Scientific

A structure may be considered of special scientific interest under the following criteria:

- A structure or place which is considered to be an extraordinary or pioneering scientific or technical achievement in the Irish context, e.g. Mizen Head Bridge, Birr Telescope.

Social

A structure may be considered of special social interest under the following criteria:

- A focal point of spiritual, political, national or other cultural sentiment to a group of people, e.g. a place of worship, a meeting point, assembly rooms.
- Developed or constructed by a community or organisation, e.g. the construction of the railways or the building of a church through the patronage of the local community
- Illustrates a particular lifestyle, philosophy, or social condition of the past, e.g. the hierarchical accommodation in a country house, philanthropic housing, vernacular structures.

Artistic

A structure may be considered of special artistic interest under the following criteria:

- Work of a skilled craftsman or artist, e.g. plasterwork, wrought-iron work, carved elements or details, stained glass, stations of the cross.
- Well designed mass produced structures or elements may also be considered of artistic interest.

(From the NIAH Handbook 2011 pages 12-18)

The Local Authority has the power to order conservation and restoration works to be undertaken by the owner of the protected structure if it considers the building to be in need of repair. Similarly, an owner or developer must make a written request to the Local Authority to carry out any works on a protected structure and its environs, which will be reviewed within three months of application. Failure to do so may result in prosecution.

Kildare County Development Plan 2017–2023 - Policies

PS 1: To conserve and protect buildings, structures and sites contained on the Record of Protected Structures of special architectural, historic, archaeological, artistic, cultural, scientific, social or technical interest.

PS 2: To protect the curtilage of protected structures or proposed protected structures and to refuse planning permission for inappropriate development within the curtilage or attendant grounds of a protected structure which would adversely impact on the special character of the protected structure including loss of or damage to the special character of the protected structure and loss of or damage to, any structures of architectural heritage value merit within the curtilage of the protected structure. Any proposed development within the curtilage and/or attendant grounds must demonstrate that it is part of an overall strategy for the future conservation of the entire built heritage complex and contributes positively to that aim.

PS 3: To require that new works will not obscure views of principal elevations of protected structures.

PS 7: To promote best practice and the use of skilled specialist practitioners in the conservation of, and any works to, protected structures. Method statements should make reference to the DAHG's Advice Series on how best to repair and maintain historic buildings. As outlined in the DAHG's Architectural Heritage Protection Guidelines, a method statement is a useful tool to explain the rationale for the phasing of works. The statement could summarise the principal impacts on the character and special interest of the structure or site and describe how it is proposed to minimise these impacts. It may also describe how the works have been designed or specified to have regard to the character of the architectural heritage.

PS 8: To encourage high quality design in relation to planning applications that are made for the construction of extensions or new buildings affecting protected structures or older buildings of architectural merit not included in the RPS.

PS 9: To favourably consider the change of use of any structure included on the Record of Protected Structures provided such a change of use does not adversely impact on its intrinsic character.

PS 10: To actively encourage uses that are compatible with the character of protected structures. In certain cases, the Planning Authority may relax site zoning restrictions / development standards in order to secure the preservation and restoration of the structure.

PS 11: To promote the maintenance and appropriate reuse of buildings of architectural, cultural, historic and aesthetic merit which make a positive contribution to the character, appearance and quality of the streetscape or landscape and the sustainable development of the county. Any necessary works should be carried out in accordance with best conservation practice.

PS 12: To promote the retention of original or early building fabric including timber sash windows, stonework, brickwork, joinery, render and slate. Likewise the Council will encourage the re-instatement of historically correct traditional features.

PS 13: To retain where practicable a protected structure which has been damaged by fire, and to retain those elements of that structure that have survived (either in whole or in part) and that contribute to its special interest.

PS 14: To refuse planning permission for the demolition of any protected structure unless the Council is satisfied that exceptional circumstances exist. The demolition of a protected structure with the retention of its façade will likewise not generally be permitted.

PS 15: To require an architectural heritage assessment report, as described in Appendix B of the DAHG's *Architectural Heritage Protection, Guidelines for Planning Authorities*, 2011, in all applications involving a protected structure.

PS 16: To protect and retain important elements of the built heritage including historic gardens, stone walls, landscapes and demesnes, and curtilage features.

PS 17: To encourage appropriate change of use and reuse of industrial buildings, provided such a change does not seriously impact on the intrinsic character of the structure and that all works are carried out in accordance with best conservation practice.

PS 18: To require where appropriate that a Conservation Plan is prepared in accordance with DAHG Guidelines and conservation best practice to inform proposed visual or physical impacts on a Protected Structure, its curtilage, demesne and setting.

PS 19: To have regard where appropriate to DAHG Guidelines and conservation best practice in assessing the significance and conservation of a Protected Structure its curtilage, demesne and setting.

PS 20: To have regard where appropriate to DAHG Guidelines and conservation best practice in assessing the impact of development on a Protected Structure its curtilage, demesne and setting.

Appendix A10.7 Recorded Structures and NIAH Structures within the Surrounding Area

RPS No:	B19-23
NIAH No.:	11812025
Townland:	Kerdiffstown
Parish:	Kerdiffstown
Barony:	Naas North
NGR:	289160, 222622
Classification:	House
Dist. from development:	150m north
Description:	Detached five-bay three-storey over basement former house, c.1860, retaining early fenestration with three-bay full-height canted projecting entrance bay to centre and three-bay three-storey side elevations to north-west and to south-east. Renovated, c.1940, with single-bay single-storey flat-roofed projecting porch added to centre to accommodate use as nursing home.
Categories of Special Interest:	Artistic, architectural, historical, social
Rating:	Regional

RPS No:	B19-23
NIAH No.:	11812022
Townland:	Kerdiffstown
Parish:	Kerdiffstown
Barony:	Naas North
NGR:	292109, 221586
Classification:	demesne walls/gates/railings
Dist. from development:	210m east-southeast
Description:	Gateway, *c*. 1940, comprising four limestone ashlar panelled tapered piers with stringcourses, pyramidal capping, cast-iron double gates and cast-iron flanking pedestrian gates. Set back from line of dual carriageway with former road to front.
Categories of Special Interest:	Artistic, architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812028
Townland:	Maudlings
Parish:	Naas
Barony:	Naas North
NGR:	289025, 220118
Classification:	Demesne walls/gates/railings
Dist. from development:	300m south
Description:	Gateway, c. 1870, comprising pair of open work wrought iron piers with wrought iron double gates, flanking pedestrian gates, rendered outer piers with moulded stringcourses and pyramidal capping having wrought iron gas lamp holders, rendered curved flanking walls with cut-stone coping and rendered terminating piers. Set back from line of dual carriageway with grass verge to front.
Categories of Special Interest:	Artistic, architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812018
Townland:	Kerdiffstown
Parish:	Kerdiffstown
Barony:	Naas North
NGR:	291863, 221427
Classification:	Bridge 1830–1870
Dist. from development:	315m southeast
Description:	Two-arch rubble stone road bridge over river, c. 1850, with rubble stone voussoirs. Renovated, c. 1880, with parapet walls raised having rubble stone diagonal coping. Rubble stone walls. Rubble stone diagonal coping. Two shallow elliptical arches. Rubble stone voussoirs and soffits. Sited spanning Morell River. Grass banks to river.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812017
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292035, 221534
Classification:	House 1790–1830
Dist. from development:	c. 60m south
Description:	End-of-terrace three-bay two-storey house, c. 1810. Reroofed and renovated, c.1980, with single-bay single-storey gabled projecting porch added to centre. Refenestrated, c.1990. Gable-ended roof (gabled to porch). Replacement artificial slate, c. 1980.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	B19-22
NIAH No.:	11812020
Townland:	Maudlings
Parish:	Naas
Barony:	Naas North
NGR:	291852, 221421
Classification:	Johnstown House
Dist. from development:	340m southeast
Description:	Attached three-bay three-storey Georgian house, c. 1800, originally detached on an L-shaped plan retaining early fenestration with round-headed opening to centre and two-bay three-storey return to rear to south-east. Hipped roof on an L-shaped plan with slate. Detached eight-bay two-storey outbuilding, c. 1800, to south-east with elliptical-headed integral carriageway. Now disused and part derelict. Elliptical-headed integral carriageway.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812015
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292005, 221552
Classification:	House 1800–1860
Dist. from development:	350m southeast
Description:	Terraced four-bay two-storey house, c. 1790, retaining early fenestration with round-headed integral carriageway to left ground floor. Reroofed, c. 1990. Gable-ended roof. Replacement artificial slate, c. 1990. Concrete ridge tiles. Rendered chimney stacks.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812010
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292024, 221567
Classification:	Outbuilding, 1830–1870
Dist. from development:	350m southeast
Description:	Detached four-bay single-storey rubble stone outbuilding with half-attic, c. 1850, with square-headed integral carriageways. Now disused. Hipped and gable-ended roof with slate. Red clay ridge tiles. Remains of cast-iron rainwater goods. Random rubble stone construction. Set perpendicular to road in own part-overgrown grounds with side (south-east) elevation fronting on to road.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812008
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292029, 221575
Classification:	Former stables
Dist. from development:	360m southeast
Description:	End-of-terrace seven-bay two-storey coach house, c. 1820, retaining original fenestration with pair of elliptical-headed integral carriageways to ground floor, tripartite window openings and three-bay single-storey return to rear to north-west. Renovated, c. 1980, with some window openings remodelled to ground floor rear (north-west) elevation. Now disused. Hipped roof with slate (gable-ended to return). Enclosed overgrown grounds to rear to north-west.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	B19-37
NIAH No.:	11812004
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292058, 221602
Classification:	Former hotel
Dist. from development:	360m southeast
Description:	Terraced five-bay three-storey former house, c. 1790, possibly originally two-storey retaining early fenestration. Now in use as hotel. Gable-ended roof with slate. Timber panelled door. Sidelights. Set back from line of road. Gravel verge to front.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812013
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292013, 221511
Classification:	Water pump, 1890–1920
Dist. from development:	365m southeast
Description:	Freestanding cast-iron water pump, c. 1905, comprising cylindrical shaft with raised horizontal banding, fluted upper section with fluted spout, fluted ogee-domed capping and 'cow-tail' handle having pierced finial. Now disused. Set back from road on gravel verge. Freestanding cut-granite trough.
Categories of Special Interest:	Artistic, architectural, historical, social
Rating:	Regional

RPS No:	B19-39
NIAH No.:	11812029
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	291927, 221488
Classification:	Three terrace houses
Dist. from development:	370m southeast
Description:	Group of three terraced three-bay single-storey Gothic-style houses, c. 1880, retaining original fenestration with single-bay single-storey gabled projecting open porches to centres. Individually extended, c. 1920, comprising single-bay single-storey flat-roofed returns to rear to south-east. One of a pair of terraces. Set back from road in own grounds. Sections of iron railings to boundaries.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812005
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	291896, 221608
Classification:	Former coaching Inn (1760–1780)
Dist. from development:	370m southeast
Description:	Terraced three-bay two-storey Georgian former coaching inn, c. 1770, retaining early aspect with tripartite window openings and single-bay full-height bowed return to rear to north-west. Renovated, c. 1860, with single-bay single-storey flat-roofed advanced open porch added to centre. Now disused. Gable-ended roof with slate. Wrought iron gates to porch. Set back from line of road. Rubble stone boundary wall to front with cut-stone wheel guard.
Categories of Special Interest:	Artistic, architectural, historical, social
Rating:	Regional

RPS No:	B19-38
NIAH No.:	11812012
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	291969, 221534
Classification:	Three houses
Dist. from development:	375m southeast
Description:	Group of three terraced three-bay single-storey Gothic-style houses, c. 1880, retaining original fenestration with single-bay single-storey gabled projecting open porches to centres. Individually extended, c. 1920, comprising single-bay single-storey flat-roofed returns to rear to south-east. House to centre reroofed, c. 1990. One of a pair of terraces. Hipped roof (shared) with slate (replacement artificial slate, c. 1990, to centre) (gabled roofs to porches). Set back from road in own grounds. Lawns to front. Sections of iron railings to boundaries.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	B19-21
NIAH No.:	11812011
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292015, 221560
Classification:	Former RIC Barracks in use as house
Dist. from development:	385m east-southeast
Description:	Detached three-bay two-storey former Royal Irish Constabulary barracks, c. 1840, with tripartite window openings. Renovated and extended, c. 1900, comprising three-bay two-storey parallel range along rear elevation to south-east. Extended, c. 1960, comprising single-bay single-storey flat-roofed return to rear to south-east to accommodate residential use. Renovated, c. 1980, with single-bay single-storey projecting glazed porch added to centre. Roughcast boundary wall to front with roughcast piers having iron gate.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812002
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292091, 221646
Classification:	Cottage 1790–1810, original school
Dist. from development:	400m east-southeast
Description:	Terraced six-bay single-storey former schoolhouse, c. 1800, possibly originally two separate buildings. Renovated, c. 1880, with some openings remodelled having canopy over. Now disused. Gable-ended roof with slate. Stone flagged verge to front with cast-iron boot scraper.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812001
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292092, 221622
Classification:	Cottage 1780–1820
Dist. from development:	400m east-southeast
Description:	End-of-terrace three-bay single-storey house with half-dormer attic, c. 1800, with render pilaster doorcase having consoles with canopy over. Extensively renovated, c. 1960. Refenestrated, c. 1990. Gable-ended roof (shared to south-west). Replacement artificial slate, c. 1960. Gateway, c. 1800, to north-east comprising pair of rendered piers with elliptical-headed carriageway having gable over with cut-stone dressings forming 'pediment?
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812006
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292098, 221650
Classification:	Stone Cobbling
Dist. from development:	410m east-southeast
Description:	Sections of stone cobbling, c. 1800. These sections of stone cobbling are of considerable historical interest, attesting to the former method of street paving that was once prolific throughout Ireland, but which has become increasingly rear due to replacement with more economic and less time-consuming tarmacadam. The cobbling at Johnstown is a rare survival and is an example of the items of street furniture that are often overlooked by passers-by.
Categories of Special Interest:	Historical, social
Rating:	Regional

RPS No:	n/a
NIAH No.:	11812009
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292046, 221589
Classification:	Cemetery/ graveyard
Dist. from development:	425m east-southeast
Description:	Remains of detached rubble stone church, c. 1600. Now in ruins and mostly collapsed. Graveyard to site with various cut-stone grave markers, c. 1600–1900. Freestanding cut-stone Celtic High Cross-style grave marker, dated 1872, with Celtic-style motifs. Rubble stone boundary wall wrought iron railings over having arrow motifs and wrought iron gates.
Categories of Special Interest:	Artistic, architectural, archaeological, historical, social
Rating:	Regional

RPS No:	B19-20
NIAH No.:	11812007
Townland:	Palmerstown
Parish:	Johnstown
Barony:	Naas North
NGR:	292057, 221625
Classification:	House 1830–1850
Dist. from development:	425m east-southeast
Description:	Detached five-bay single-storey house, c. 1840, retaining early fenestration. Extended, c. 1890, comprising single-bay two-storey gabled end bay to south-west having single-bay two-storey canted bay window, three-bay side elevation to south-west and two-bay two-storey double-pile lower return to rear to south-east. Extended, c. 1920, comprising single-bay two-storey flat-roofed return to rear to south-east. Detached two-bay single-storey outbuilding with attic, c. 1840, to south-east with two-bay single-storey end bay to south-east.
Categories of Special Interest:	Architectural, historical, social
Rating:	Regional