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**KNOCKHARLEY LANDFILL FACILITY
KENTSTOWN,
CO. MEATH**

Waste Licence Ref: W0146-02

**Environmental Liabilities Risk Assessment
(ELRA)**

Final Report

31st May 2013

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1.0 INTRODUCTION AND BACKGROUND

1.1 Our Brief

SLR Consulting Ireland (SLR) has prepared this independent Environmental Liabilities Risk Assessment (ELRA) in relation to Greenstar's existing Knockharley Landfill Facility, near Kentstown, Co. Meath (Ref. No. W0146-02) .

1.2 About SLR Consulting

SLR Consulting is a major international multi-disciplinary environmental consultant, employing 900 staff in Ireland, the UK, North America, Australia and South Africa. In Ireland, the company trades as SLR Consulting Ireland, and employs around 30 environmental specialists, engineers and support staff at offices in Dublin and Hillsborough.

Recent Clients of SLR include the European Union, national governments, government departments, international lending agencies, UK and Irish regional and local authorities / agencies, waste treatment technology providers and private sector waste management companies.

SLR employs the largest team of waste management experts in the UK and Europe. Approximately 150 staff are employed on a full-time basis on waste management projects in Ireland and the UK. Specialist staff are employed across 30 separate technical disciplines.

1.3 Planning and Licensing History

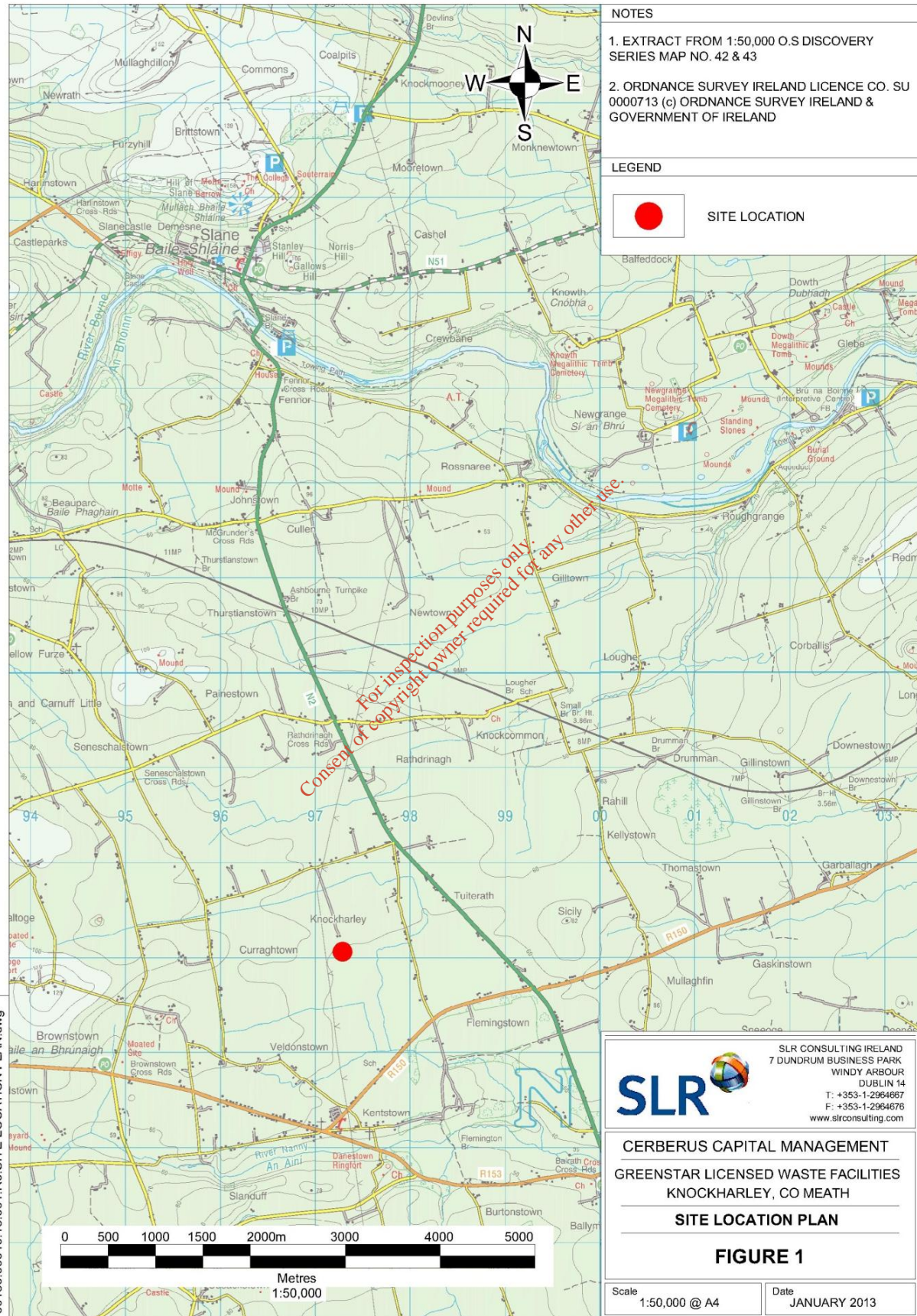
Prior to grant of planning permission for waste deposit, the land within the site was greenfield land, under arable crops and pasture. Planning permission was granted by Meath County Council in 2001 (Ref 01/5006), but following appeal of the planning permission both by the applicant, and a number of interested parties, revised planning permission was granted by An Bord Pleanála in 2002 (Ref 17.125891).

A Waste Licence (Reg No W0146-01) was issued by the Environmental Protection Agency (EPA) for the site in March 2003. That licence was amended by the EPA in October 2005 under section 76(4) of the Waste Management Acts 1996 to 2003. In accordance with Article 34 of the Waste Management (Licensing) Regulations, the Agency issued a revised Waste Licence (Reg No W0146-02) in March 2010.

1.4 Site Location and Description

The site is located 1.5km to the north of the village of Kentstown, Co. Meath, approximately 7km south of Slane, and 12.5km east of Navan (see Figure 1 below). The site is accessed off the N2.

**Figure 1
Site Location**



An aerial view of the site and its immediate surrounds is shown in Figure 2 below

Figure 2
Aerial View of Site and Immediate Surrounds (from Google Earth)



The facility's total area is 135 hectares, with the landfill, positioned in the centre of the site (see Plate 1 below), covering an area of approximately 25 hectares. At present, approximately 12 hectares of the landfill has been developed in preparation for waste deposit, with approximately 3.5 hectares (of that 12) having been restored. The licensee is currently applying for a further 6 hectares of final capping, planned for 2013. A 100m buffer is maintained between the site boundary and the engineered landfill footprint.

Under the waste licence, which principally provides for the disposal of waste by landfilling, Knockharley Landfill accepts residual, non-hazardous, household, commercial and industrial waste arising in the north-east counties of Ireland. The licensed waste intake is limited to 200,000 tonnes of waste per annum (see breakdown below) and the facility has an operating life of approximately 14 years. Under the planning permission, however, the waste input is limited to 88,000 tonnes per annum within the same 14 year lifespan. Waste deposit is scheduled to continue until 2016, when the site will close.

Waste Type	Maximum (Tonnes per Annum)
Household	100,000
Commercial	45,000
Industrial	30,000
Sub-total Waste for Disposal	175,000
Construction and demolition for recovery at the facility	25,000
TOTAL	200,000

Plate 1 – General View of Landfill Area



The Knockharley facility has an Environmental Management System in place which is certified to ISO14001.

The Landfill Environmental Management Plan was revised and updated in compliance with Condition 2.3.2.2 in December 2011 for changes to:

- permitted annual tonnage from 132,000tpa to 88,000tpa;
- out-of-hours security arrangements;
- management staff structure;
- site opening hours;
- updated objectives and targets;
- updated group Environment, Health and Safety Policy; and
- updated ISO 14001 certificate (valid until 2014).

In 2011 a total of 89,577 tonnes of permitted waste was deposited and 36,549 tonnes of permitted waste recovered.

1.5 Site Infrastructure, plant and equipment

The following principal infrastructure and equipment are established at the facility:

- The engineered containment landfill;
- Administration and Weighbridge Offices, Maintenance Shed; wheelwash; services-utilities including water, electricity and telephone, septic tank (domestic only);
- Internal road network (paved and un-paved), paved parking area, hardstand quarantine bay; bunded fuel storage tank; leachate storage lagoon, surface water lagoon; landfill gas utilisation plant (4 No. engines) and back up flares; landfill gas and

leachate extraction and monitoring wells and pipework; groundwater monitoring boreholes; and

- Mobile plant and machinery as required for landfill development and operations (tractors, landfill compactors, site vehicles etc).

There are no direct discharges of effluent to surface water or groundwater. Leachate is tankered off-site to a waste water treatment plant.

Key infrastructure and equipment are shown in Plates 2 to 7 below, photographs taken by SLR Consulting on 8th January 2013.

Plate 2 – Leachate lagoon/ removal point



Plate 3 – Quarantine Bay



Plate 4 – Landfill Gas Plant Compound



Plate 5 – Engineered Cell



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Plate 6 – Surface seal, cover soils and LFG collection infrastructure



Plate 7 – Restored landfill flank



1.6 Facility Operations

Greenstar Holdings Limited is permitted to operate the landfill facility under the following:

Licensed Waste Disposal Activities, in accordance with the Third Schedule of the Waste Management Acts 1996 to 2010

- **Class 1. Deposit on, in or under land (including landfill):**

This activity is limited to the deposit of non-hazardous wastes specified in Condition 1.4 in lined cells that are on, in and under land.

- **Class 4. Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons:**

This activity is limited to the storage of leachate in a lagoon prior to disposal off-site at a suitable waste water treatment plant and the use of a surface water pond to control the quality and quantity of the surface water run-off from the site.

- **Class 5. Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment:**

This activity is limited to the deposition of non-hazardous waste into lined cell(s).

- **Class 6 Biological treatment not referred to elsewhere in this Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1. to 10. of this Schedule:**

This activity is limited to possible future biological pre-treatment of leachate subject to the agreement of the Agency.

- **Class 13 Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced:**

This activity is limited to the temporary storage on-site of unacceptable waste in the waste quarantine area prior to transport to another site.

Licensed Waste Recovery Activities, in accordance with the Fourth Schedule of the Waste Management Acts 1996 to 2010

- **Class 4. Recycling or reclamation of other inorganic materials:**

This activity is limited to the use of recycled construction and demolition waste as cover and/or construction material at the site.

- **Class 9 Use of any waste principally as a fuel or other means to generate energy:**

This activity is limited to the utilisation of landfill gas.

- **Class 11. Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule:**

This activity is limited to the use of construction and demolition waste on-site.

- **Class 13. Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced:**

This activity is limited to the storage of construction and demolition waste on site prior to reuse.

1.7 Site Monitoring

The licence requires routine monitoring and reporting for landfill processes and emissions, to include; landfill gas, landfill leachate, groundwater, surface water (biological and chemical assessments), air emissions, nuisance (including noise), meteorological conditions, site levels (topography), stability (of side slopes), at approved on and off site monitoring point and locations.

SLR has reviewed the most recent monitoring data, being that contained in the Quarterly Monitoring Reports for Q1 to Q3 2012 and in the Annual Environmental Report (2011), as available at EPA's Offices and accessible on-line (www.epa.ie).

SLR concludes that the facility operates in general compliance with the licence and its specified emission limits/ trigger values (ref. Condition 6 and Schedule C) and Groundwater Trigger Levels as proposed and agreed by the EPA.

1.7.1 Leachate Monitoring

Leachate monitoring was carried out at ten locations on four occasions during 2011, including sumps LC1 through to LC10 inclusive (within Cells 1 to 10) and at location LL (the leachate lagoon).

Concentrations of key determinands were assessed by the AER's Author who stated that the leachate was consistent with "the typical composition of leachate sampled from large landfills, and in line with the levels presented in the Environmental Protection Agency (EPA) Landfill Manual on Landfill Site Design (2000)" and indicating "an increase in leachate strength throughout the reporting period, which is expected given the age of the facility."

The total volume of leachate tankered off-site at the end of 2011 was 22,535.5t. Of this, 10,559.8t was consigned to Navan Wastewater Treatment Plant and the balance of 11,975.7t consigned to Rilta (WwTP), Dublin.

1.7.2 Groundwater Monitoring

Groundwater was sampled and analysed from 7 No. groundwater monitoring wells on a monthly basis during 2011 and in Quarters 1, 2, and 3 of 2012 (the Q4 report is not yet on File). Analysis complied with the range of parameters specified in the Licence.

It is noted that Greenstar's Consultant forwarded revised groundwater trigger levels (GWTL) to the EPA, with approval given by the EPA on the 23rd December 2011. Groundwater quality (data) was assessed by Greenstar's Consultant against baseline groundwater results for their 2011 AER¹, with groundwater data assessed against the approved GWTL going forwards from that point (Q1 2012).

The direction of groundwater flow is northwest to southeast. Groundwater wells MW1d, MW2d, MW3d and MW7d are located up-gradient from the landfill and wells MW5d, MW6d and MW16d are located down-gradient from the landfill.

The 2011 AER concluded that:

- Groundwater pH and electrical conductivity levels were within the normal ranges.
- Electrical conductivity, with the exception of a spike in levels in Q4 at MW3d (up-gradient and above baseline levels) remained consistent, with EC being consistent with unpolluted groundwater.
- Ammoniacal nitrogen concentrations are reasonably consistent however, up-gradient concentrations above the baseline levels were reported at MW1d and MW2d.
- Chloride (Cl) levels showed some variability in reported concentrations. Although all results were within the Interim Guideline Values, (IGV) set out in the Environmental Protection Agency, (EPA) Groundwater "Towards Setting the Guideline Values for the Protection of Groundwater in Ireland".
- Total Organic Carbon (TOC) concentrations were frequently below the analytical (laboratory's) limit of detection however; TOC concentrations above baseline concentrations were recorded at up-gradient locations MW1d, MW2d and MW3d in addition to down gradient locations MW6d and MW16d.
- In Q4 (2011), Potassium concentrations were reported above both the IGV and the baseline results at up-gradient monitoring wells MW3d and MW5.
- Faecal and total coliforms were recorded in a number of wells during the reporting period. Historically, total and faecal coliforms have been detected in all groundwater monitoring boreholes around the site. All the monitored groundwater boreholes are dedicated monitoring wells and not used for any other purpose than groundwater monitoring.

It was concluded for 2011, that in general, groundwater conditions at the site have not altered significantly from the baseline results, with the monitoring program confirming that site activities are not impacting on groundwater quality.

The above summaries are in line with historical Quarterly Monitoring and Annual Environmental Reports reviewed by SLR Consulting Ltd dating back to Q1 2005.

¹ Annual Environmental Report: Report Period: January 2011 – December 2011. Fehily Tmoney & Company (April 2012)

1.7.3 Surface Water

Chemical Assessment

Two surface water bodies are sampled on a quarterly basis across 2011, namely the Knockharley Stream and the Nanny River. In addition, Greenstar carries out weekly visual inspections of the surface water drainage system.

The following summaries are from the 2011 AER:

- pH: downward trend (towards neutral) observed across 2011 until Q3 when this reversed (slight increase).
- Electrical Conductivity: overall slight reduction in EC albeit with slight increases in Q2 and Q3, but results within normal ranges for surface water.
- Chloride: concentrations were consistent across all locations (little overall change) but with increases reported over baseline levels at three upstream locations (SW1, SW3 and SW5) and thus not due to landfilling activities.
- Ammoniacal Nitrogen: Concentrations varied across 2011, with elevated concentrations reported in upstream sample locations SW5 (in Q3) and SW7 (Q4). All other results were recorded below 0.4 mg/l as N with a number of results under the laboratory limit of detection
- Total Suspended Solids (TSS): Concentrations were all within the normal range for surface waters with the exception of the results for SW5 and SW8 during Q2, which were recorded marginally above the baseline range.
- Chemical Oxygen Demand (COD): Concentrations throughout 2011 followed past trends, with reported concentrations at upstream locations SW3 and SW5 and downstream locations SW7 and SW8 marginally above the baseline range.
- Concentrations of other parameters including total oxidised nitrogen, calcium, cadmium, chromium, copper, iron lead, magnesium, manganese, mercury and zinc are all recorded below the baseline range of results for all monitoring locations.
- Potassium concentrations were mostly below the baseline results both upstream and downstream however; a number of minor exceedences above baseline concentrations were reported at some upstream and downstream locations.
- Sodium concentrations were above baseline concentrations at all monitoring locations, except SW6 (downstream) which is recorded below baseline levels.
- Sulphate concentrations were above the baseline levels at most upstream and downstream locations, with the exception of upstream locations SW2 and SW3 which remained below the baseline levels.

Biological Assessment

The AER concluded for the biological assessment that “EPA monitoring results from the upper reaches of the River Nanny indicate that there is a history of “unsatisfactory “biological water quality” and that “EPA monitoring results downstream of the site indicate satisfactory results (good status, Q4) in 2008 and 2005, with a slight deterioration in 2010 (Q3-4)”.

The AER's Author concluded that current and previous biological assessments do not indicate that the operation of the facility is having an adverse impact on the biological quality of receiving water courses in the area and that based on all available information including EPA results, diffuse sources of pollution such as agricultural sources (run-off from grassland or sediment from tilled land) in the area, are most likely influencing biological water quality in the area upstream and downstream of the site.

Surface Water Discharge

The surface water discharge emission limit value (suspended solids only) at monitoring location SW9 (surface water pond outlet) is 35mg/l.

Reported suspended solids concentrations were below this concentration for all 2011 monitoring rounds.

Surface water: overall assessment and conclusion

The AER's Author concluded that in general, surface water quality in the surface water bodies surrounding the site is good and operations at the site have not resulted in any adverse impacts on the water quality during the reporting period.

This summary is in line and in general keeping with information reported in Quarterly Monitoring and Annual Environmental Reports reviewed by SLR Consulting Ltd dating back to Q1 2005.

1.7.4 Landfill Gas Monitoring

Monthly monitoring of landfill gas (LFG) concentrations was carried out throughout 2011 in the perimeter gas boreholes (spaced at approximate 50 m intervals around the landfill footprint) and in the in-waste gas wells (density of 2 wells per Cell).

For the perimeter, beyond-waste monitoring wells:

Methane concentrations were recorded above the 1.0%v/v trigger level on 4 No. occasions:

- Wells LG-03 and LG-12 in Q1 and;
- Wells LG-12 in Quarter 3 in Q3.

Methane: Concentrations were measured at 0%v/v for these wells in all other monthly monitoring rounds. The trigger level was not exceeded in any other well during the reporting period.

Carbon dioxide: Concentrations exceeded the 1.5%v/v trigger level on numerous occasions at numerous monitoring wells in 2011. Carbon dioxide has historically been present at some concentration in all perimeter monitoring wells during monthly monitoring rounds since monitoring commenced in November 2004 and prior to waste deposition.

The AER's Author attributes the carbon dioxide exceedences to the naturally occurring in-situ sub-soils and silty organic clays present throughout (beneath) the site.

1.7.5 Emissions to Air (Landfill Gas Combustion Plant)

The following plant is installed and was in operation at the facility during 2011:

- 2 No. Haase 1,500m³/hr high temperature enclosed landfill gas flares installed in the dedicated gas management compound in 2007 and February 2009 respectively;

- 1 No. high temperature (Haase 2,500m³/hr) enclosed landfill gas flare installed in December 2009;
- 1 No. temporary open flare (Flaretech 500m³/hr), used on occasion as a standby flare since its installation in 2005, and;
- 4 No. landfill gas utilisation engines, installed within the gas management compound.

Landfill gas flare and utilisation plant monitoring was undertaken in May 2011 in accordance with Licence Schedule D, with gas generation rates (as m³/hr) and utilisation rates (as CH₄; kg/hr) per flare and engine presented. No emissions monitoring results were included in the 2011 AER for flare or engine emissions testing and monitoring (as per Schedule D.7).

1.7.6 Noise Monitoring

Four quarterly noise surveys were undertaken during 2011. The boundary limit value is 55dB (daytime). With the exception of noise levels at monitoring location N2 in Q2 and Q4 which were measured at 58dB and 59dB respectively, the 55dB limit was not exceeded. The noise sources leading to the Q2 and Q4 exceedences were attributed to off-site traffic movements on the adjacent N2 public road and local road.

1.7.7 Odour

It is noted that Greenstar Holdings Limited was prosecuted in the District Court of Navan in June 2009 by the EPA for breaching conditions in its licence following complaints of odour from beyond the facility boundary. Greenstar Holdings Limited was fined €500 and EPA awarded costs of €13,747.50.

1.7.8 Dust and Particulate Matter (PM₁₀)

For the four quarterly monitoring rounds, the licence's specified PM₁₀ trigger level (50µg/m³) was exceeded at two locations, exceedences attributed by the AER's Author to "an incomplete sampling run as a result of a (monitor's) battery failure".

Dust depositional rates for the four sampling rounds were all recorded below the licence's specified limit of 350mg/m²/day.

1.7.9 Site Audits/ Inspections

The record of EPA's Site Inspections and Audit Reports dating back to 2005 were reviewed by SLR. Overall, these show that the site is generally operated in a professional manner and in general compliance with its licence.

However, nuisances and complaints have been reported, as well as non-compliances with licence conditions. Most complaints and non-conformances concern (mal)odour being detected beyond the facility boundary at nearby sensitive receptors, the principal causes being inadequate gas control measures in place. Odour issues and complaints and EPA intervention were frequent occurrences during the initial and early stages of landfilling, with a decline in the number of complaints made to the EPA from then to present.

Other observations made and reported by EPA relate to operational and management issues such as the timely provision of reports and information; inadequate gas management controls to prevent odour emissions and surface emissions of landfill gas/ Volatile Organic Compounds (VOCs) as enhanced greenhouse gases above trigger levels.

Inspection and audit findings and complaints were investigated, reported and followed up/ actioned by both the EPA and Greenstar. In response to ongoing, recurring or isolated issues, the operator has made considerable efforts to address these matters. It is clear that the site operator is using best available techniques to minimise incidents and nuisances at the site.

In 2010, there were three incidents reported- one concerning a small fire on the exhaust of a waste ejector trailer's donkey engine and two relating to the emission limit for VOCs being exceeded.

In 2011 one incident was reported concerning a rejected load of non-conforming waste and a second incident relating to the emission limit for VOCs being exceeded.

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2.0 INITIAL SCREENING AND OPERATIONAL RISK ASSESSMENT

2.1 Introduction

In order to determine the requirements for an Environmental Liability Risk Assessment (ELRA), a relatively simple risk assessment decision matrix is employed to classify the site into one of three risk categories. The specific requirements for an ELRA are dependent on the resultant risk classification.

The decision matrix used to determine the risk classification for the Knockharley Facility is that set out in Chapter 2 of EPA publication *Guidelines on Environmental Liability, Risk Assessment, Residuals Management Plans and Financial Provision*.² This decision matrix essentially looks at three key factors:

- (i) **Complexity:** a factor which takes account of the extent and magnitude of potential hazards due to the operation of the waste facility. A complexity band is assigned to the waste facility on the basis of look-up table in Appendix B of the EPA guidance document. Complexity ratings range from G1 for the least complex site to G5 for the most complex.
- (ii) **Environmental Sensitivity:** a factor which takes account of the receiving environment in the immediate vicinity of the waste facility, with more sensitive locations given a higher score (due to proximity of aquifers, high quality surface water features or human receptors). Environmental sensitivity is assessed on a site specific basis using a matrix presented in Table 2.2 of the EPA guidance document.
- (iii) **Compliance Record:** a factor which takes account of the compliance history of the waste facility and whether activities carried out are in compliance with licence requirements and emission limits.

Each of the three factors assessed above is multiplied to give the total score for the waste facility and this is used to place it into an appropriate risk category (identified as Category 1 to Category 3), as outlined in Table 2-1 below.

**Table 2-1
Risk Category**

Risk Category	Total Score
Category 1	< 5
Category 2	5 – 23
Category 3	> 23

Having determined the facility category, it is then possible to establish specific requirements for the ELRA and associated financial provisions.

2.2 Complexity

The complexity band assigned to the Knockharley Facility is obtained from the 'look-up table' in Appendix B of the EPA publication *Guidelines on Environmental Liability, Risk Assessment, Residuals Management Plans and Financial Provision*.

² Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision, EPA (OEE), 2006.

The operations permitted at the facility are principally landfilling and the recovery of certain materials for landfill development and operation that are listed in the EPA 'look-up table'³. The licence limits the disposal of waste to 200,000tpa however the actual disposal rate is limited to 88,000tpa by the site's planning permission. The facility is therefore assigned a Band G4 rating- a Band G4 activity assigned a complexity factor of 4 by the EPA guidance document.

Complexity Factor = 4

2.3 Environmental Sensitivity

The environmental sensitivity of the facility is assessed using a matrix presented in Table 2.2 of the EPA guidance document. This matrix assigns an environmental attribute score to the facility under six separate headings

- (i) Human occupation
- (ii) Groundwater protection
- (iii) Sensitivity of receiving waters
- (iv) Air quality and topography
- (v) Protected ecological sites and species
- (vi) Sensitive agricultural receptors

Applying the criteria set out in Table 2.2 of the EPA guidance document, the environmental attribute scores for the facility for each of the six headings listed above are as shown underlined and bold in Table 2-2 below.

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³ see Page B10 of EPA Document

**Table 2-2
Environmental Sensitivity of the Knockharley Site**

Environmental Attribute	Environmental Attribute Score
Human Occupation¹	
< 50m	5
50m - 250m	3
250m - 1000m	1
> 1km	0
Groundwater Protection^{2,3}	
Regionally Important Aquifer	2
Locally Important Aquifer	1
Poor Aquifer	0
Vulnerability Rating - Extreme	3
Vulnerability Rating - High	2
Vulnerability Rating - Moderate	1
Vulnerability Rating - Low	0
Sensitivity of Receiving Waters⁴	
Class A	3
Class B	2
Class C	1
Class D	0
Designated Coastal & Estuarine Waters ⁵	2
Potentially Eutrophic Coastal & Estuarine Waters ⁶	1
Air Quality & Topography	
Complex terrain ⁷	2
Intermediate terrain ⁸	1
Simple terrain⁹	0
Protected Ecological Sites and Species¹⁰	
Within or directly bordering species protected site	2
< 1km to protected site	1
> 1km from protected site	0
Sensitive Agricultural Receptors¹¹	
Fruit, vegetable or dairy farming < 50m from the activity footprint	2
Fruit, vegetable or dairy farming 50m-150m from the activity footprint	1
Fruit, vegetable or dairy farming > 150m from the activity footprint	0
Total Environmental Sensitivity Score for Knockharley Facility =	6

Notes *

1. Measured from activity/footprint to public or private occupied building
2. Groundwater Classifications according to DoELG, EPA, GSI Groundwater Protection Schemes (1999)
3. Aquifer Classification Score to be added to Groundwater Vulnerability Score
4. Site located within catchment of EPA Surface Water Classification (1996) or adjacent to transitional water body- Nanny River downstream EPA monitoring station (08N01); Good-Moderate Status 2008.
5. Designated as Sensitive Areas UWWT Regulations (2001)
6. EPA (2002) Water Quality in Ireland 1998-2000
7. Generally elevated terrain such as a mountain or the side of a valley, where receptors are at elevations above the stack tip elevation, US EPA (2000) Meteorological Monitoring Guidance for Regulatory Modelling Applications
8. Intermediate terrain where the elevations of receptors lie between the stack tip elevation and the plume rise elevation, US EPA (2000) Meteorological Monitoring Guidance for Regulatory Modelling Applications
9. Relatively flat terrain, where receptor elevations are between stack base and the stack tip elevations, US EPA (2000) Meteorological Monitoring Guidance for Regulatory Modelling Applications
10. Distance from activity/footprint to protected areas designated as pNHA (Irish Wildlife Acts 1976, 2000), cSAC (Habitats Directive 1992) and/or SPA (Birds Directive 1979).
11. Distances derived from UK Department for Environment, Food and Rural Affairs (2003), Local Air Quality Management - Technical Guidance LAQM.TG(3)

*** or more recent equivalent reference material**

The Geological Survey of Ireland (GSI) on-line database shows that the bedrock underlying the site is categorised as a Poor Aquifer with very low yields (<10m³/day). A number of private (domestic and farm) supply wells are reported (2011 AER) to the north and east of the facility. The groundwater direction of flow across the site is to the south east, at a rate of approximately <1m/year.

- The GSI database also shows a ‘Low’ vulnerability rating for bedrock underlying the site due to the presence of thick (10>20m), very low permeability glacial till deposits (tested in-situ permeability as 4.6×10^{-11} m/s) overlying bedrock.
- The site is located in the catchment of the Nanny River which is categorised as ‘Good’.
- The topography of the site and surrounding area is quite flat and the terrain is considered to be simple.
- There are no protected ecological sites within 1 km of the site. There is one proposed Natural Heritage Area, Balrath Woods, approximately 0.6km southeast from the facility.
- Agricultural land immediately adjoins the facility’s boundary, such that farming activities are assumed to take place within 50m of the active area of the site.

The accumulated Environmental Attribute Scores for the site is therefore 6. The EPA guidance determines that a score of <7 means that the site achieves an Environmental Sensitivity Classification of 1 (**Low sensitivity**).

Environmental Sensitivity Factor = 1

2.4 Compliance Record of the Facility

The EPA guidance document indicates that the compliance factor for a facility with minor emission non compliances (<5 non compliances over a 12 month period) are classified as Minor Non-compliant and have a compliance factor of 3.

Compliance Factor = 3

2.5 Risk Category

The scores for Complexity (4), Environmental Sensitivity (1) and Compliance Record (3) are multiplied, giving a **total score of 12** which falls within Category 2 in the EPA guidance Table 2.1, reproduced in Table 2-3 below:

**Table 2-3
Risk Category for Knockharley Facility**

Risk Category	Total Score
Category 1	< 5
Category 2	5 – 23
Category 3	> 23

Risk Category = Category 2

Figure 1.1 of the EPA guidance document indicates that sites categorised under Risk Category 2 require ‘Generic Approaches’ to address unknown liabilities. However, Condition 12.2.2 of the facility’s waste licence requires a “comprehensive and fully costed Environmental Liabilities Risk Assessment to assess the liabilities from past and present activities.”

The remainder of this report contains a site-specific ELRA for the Knockharley facility.

3.0 SITE SPECIFIC ELRA

3.1 Objectives and Scope

According to the EPA guidance document, the objectives of a site-specific ELRA are as follows:

- To identify and quantify environmental liabilities at the facility focusing on: unplanned, but possible and plausible events occurring during the operational phase;
- To calculate the value of financial provisions required to cover unknown liabilities;
- To identify suitable financial instruments to cover each of the financial provisions; and
- To provide a mechanism to encourage continuous environmental improvement through the management of potential environmental risks.

The EPA advise that the ELRA should cover environmental risks leading to a potential or anticipated liability. Environmental risks will be deemed to cover all risks to: surface water, groundwater, atmosphere, land and human health.

The EPA guidance document on ELRA, Residuals Management Plans and Financial Provision (referenced above) includes an 'Example Site-Specific ELRA' in Appendix D. The example 'Project Risk Register' in Appendix D of the Guidance includes risks that are clearly Health and Safety risks, rather than environmental risks. For example, the register includes '20. Employee struck by large plant or reversing trucks' and '21. Drowning in lagoons, stormwater settling tanks, the White River or inspection chambers.'

In light of the Guidance, this ELRA includes H&S risks as well as environmental risks and these are all expected to be covered by standard insurance policies. The conclusions section then highlights the potential environmental liabilities, separate from the potential H&S liabilities.

3.2 Risk Classification and Identification

The EPA guidance recommends that risks are identified and classified following a 'Risk Management Workshop' involving the facility management, environmental manager and independent environmental consultant.

To inform the ELRA process, SLR staff visited the site on 8th January 2013 and met with site management for a site walkover and to discuss site activities and operations and reviewed information held by the EPA through Public File viewing at their Dublin Regional Office as well as made available on-line (www.epa.ie).

3.2.1 Identification of Processes / Hazards

The landfilling activities (development/ construction and operation/ disposal) carried out at the site will generate products, as sources of potential pollution or hazards to the environment and/ or human health, which have the potential to migrate or be released (emitted) beyond the facility boundary at unacceptable levels if not properly managed in accordance with the licence. These emissions include:

- Leachate- a liquid of varying strength and generated at different rates (volumes), produced as rainfall passes through emplaced waste, extracting solutes and

suspended solid, and which contains liquid (moisture) that is also present in waste. Liquids waste is not permitted to be accepted at the facility.

- Landfill gas- principal constituents being carbon dioxide and methane present at varying relative concentrations, generated from the biological degradation of emplaced organic wastes.
- Landfill Gas combustion plant (utilisation engines and flare)- emissions to atmosphere.
- Site surface water- incidental rainfall and possible fire-fighting water flows as surface run-off from restored landfill areas and hardstanding to be collected within the facility boundary and discharged to receiving watercourse.
- Wastewater- generated from office W.Cs and kitchen areas. This is collected and treated at the on-site waste water treatment plant which is in turn connected to the leachate lagoon for off-site removal, final treatment and disposal.
- Odour- mainly organic compounds associated with fresh and degrading (organic) waste.
- Noise- generated by the use of plant and equipment during landfilling and operational/ development activities.
- Dust and particulate matter ('PM₁₀') generated from the storage and use of materials used for site engineering/ development/ operations, from haul roads and dry/ dusty waste.
- Products used in Operations- to include 1 No. 60,000 litre capacity bunded above ground diesel storage tank; small quantities of hydraulic oil (stored in maintenance garage).

These potential and known hazards are addressed individually below.

Leachate

Leachate is stored within the facility- within cells (on the basal containment liner) where it is collected in sumps and extracted (pumped) for temporary storage in the lined (containment) lagoon, prior to off-site disposal by road tanker to the receiving waste water treatment works for treatment and disposal. The extraction of leachate from the landfill is necessary to ensure the leachate level, or head acting on the containment liner, is less than the licence's specified limit of a maximum of 1m above the base of the cell.

The leachate road tanker parking and coupling point at the leachate lagoon is of impermeable hardstand (leachate spill pad), served with a drainage system connected back into the lagoon.

Landfill Gas

Landfill Gas is generated and is present within the waste mass within the engineered landfill. If not contained, landfill gas could potentially migrate off-site through the sub-surface (unsaturated zone present within engineered formation layers or geological deposits or strata) and accumulate at concentrations at which point carbon dioxide could cause asphyxiation (worst case scenario) or cause vegetation stress, and methane could ignite causing fires/ explosions.

Surface water

Uncontaminated surface run-off, as incidental rainfall on hardstanding, impermeable surfaces, buildings and restored landfill areas is collected and discharged to the surface water storage pond via a Class 1 Oil Interceptor. Discharges with the potential to pollute downstream surface water could arise through the release of, for example, oils, leachate and fire water contaminated run-off.

The licence requires the inlet to the surface water storage pond to be monitored continuously for electrical conductivity, pH and total organic carbon as well as routine monitoring of the pond outlet (discharge).

In addition, surface water sampling and monitoring is carried out at agreed up- and downstream locations in local watercourses (Kentstown Stream and Nanny River) for a range of chemical parameters and biological indicators annually for a wider range of parameters. In summary, the reported discharges (from the facility/ pond outlet) are within the specified emission limit of 35mg/l for suspended solid.

Fire water run-off

Combustible materials present within the site include landfilled waste, building materials and similar, so there is a risk of fire at the facility. Water used to extinguish fires or combustion on or within the landfilled waste body will be contained by the containment lining system with additional protection afforded by the low permeability formation layer and geological deposits (glacial till) present beneath and across the site. Water used to extinguish fires elsewhere within the facility would run-off impermeable areas and be collected by the drainage system and conveyed to the surface water pond. The facility's fire response and Emergency Response procedures are intended to minimise potential adverse impacts and would be instigated, to include the on-site retention of contaminated fire water within the storage pond and its testing to ascertain the most appropriate disposal option – discharge if deemed appropriate or treatment prior to discharge, or off-site disposal.

Odour

The waste types accepted at the site have the potential to generate odours which if not properly managed can be released beyond the facility boundary. Odour complaints have been made to the EPA (from neighbouring residents) and annual non-conformances raised by the EPA since waste acceptance commenced number as follows: 58 complaints received in 2005, 242 complaints received in 2006, 317 complaints in 2007 and over 150 in 2008. In 2010, 77 odour complaints were made and in 2011, 57 odour complaints were received.

The 2011 AER and historical monitoring reports reviewed by SLR however, show that with time and the progressive implementation of active and passive landfill gas control measures (collection/ extraction and flaring/ utilisation and progressive surface sealing and capping) as well as maintenance of, for example, seals around in-waste gas extraction wells, have been effective in improving odour emissions and the number of complaints and non-conformances received.

Noise

The facility licence sets an emission limit value of 55dB(A) for daytime levels at noise sensitive locations in the vicinity of the site and a level of 45dB(A) for night-time levels at these locations.

Noise monitoring results are discussed earlier in this report and indicate that the facility site is compliant with the licence in this regard. Occasional exceedences have been reported however the cause of these is attributed to vehicle movements on nearby, off-site roads.

Dust and Particulate Matter (PM₁₀)

The facility licence sets an emission limit value of 350 mg/m²/day for dust deposition levels and a maximum concentration of 50µg/m³ for PM₁₀. The 2011 AER and historical routine monitoring reports reviewed by SLR indicate that the dust control measures in use at the facility are successful in controlling dust and PM₁₀ emissions rates such that off-site exceedences are prevented.

Diesel Storage

A 60,000 litre bunded diesel tank is located between the leachate lagoon and maintenance garage. This is a potential source of contamination for consideration in this risk assessment. Minor spillages of hydrocarbons are managed through the implementation of the spill procedures and use of the spill kit. However, while the tank is bunded and the fill point (coupling) and dispensing pump are located on concrete hardstand, these are outside the bunded area and the concrete pad is without containment (edge) kerbing which would not prevent significant releases. It is noted that at the time of SLR's visit, there was visible evidence of drips and spills under the fill point/ dispensing pump area and the bund was water filled, thus reducing the storage capacity in the event of a leak from the tank- see plates 8 and 9 and below.

Plate 8 – Diesel Storage Tank



Plate 9 –fill and dispensing points



A major spill of diesel from this tank (or its fill and dispensing points) could enter the drainage system and/or be released directly to adjacent unpaved land (soil) due to the absence of edge kerbing and cross falls on the concrete hardstand. Liquids could reach the receiving surface water course via the site's drainage system and oil interceptor if the system is not maintained or is overwhelmed (catastrophic failure and release of entire tank contents). In this scenario, the operator must be able to halt the discharge to the receiving watercourse until such time as leaked diesel can be removed. Failure to provide working pollution prevention control systems and procedures could result in significant contamination of the receiving water course and on-site land (soils).

The risk and consequences of an occurrence of this nature are discussed later in this report.

Other hydrocarbon products

Relatively small volumes of fuel and hydraulic oils (as product and waste) are used on site. These raw materials and wastes are stored within the bunded area within the maintenance shed. Minor spills of these materials can be contained locally and cleaned using spill-kits. Major spills are unlikely as the stored volumes are relatively small. However, if several drums are simultaneously spilled and the bund wall is simultaneously destroyed, liquids should be retained within the shed- minor volumes could escape the building but will enter the drainage system and enter the surface water storage pond via the oil interceptor.

The risk and consequences of this occurrence are assessed later in this report.

3.2.2 Identification of Environmental Receptors

The processes and hazards described above have the potential to impact on environmental receptors such as those described below.

Employees or Other Site Users

Landfill facilities pose hazards to site operatives such as the risk of hearing injury from noise sources, respiratory issues associated with dust inhalation, exposure to and inhalation of hazardous gases or injuries from contact with vehicles, plant or machinery.

Occupied Houses

Occupied houses are located (>250m from the facility boundary) and facility emissions- odour, dust and noise- have the potential to adversely impact on the occupants of these houses.

Groundwater

The Geological Survey of Ireland (GSI) on-line database shows that the bedrock underlying the site comprises fine grained sandstone and siltstone/ mudstone.

The GSI categorises the bedrock aquifer as Poor with bedrock aquifer yields typically <10m³/day and the aquifer vulnerability is categorised as Low. Although bedrock aquifer yields are low, there are reported to be a number of private (domestic and farm) supply wells to the north and east of the site.

Although the Till is water bearing, in-situ Till permeability ranges and observed groundwater gradients across the site indicate a groundwater flow rate of <1m/yr, the direction of flow being to the south east. The water table is generally within 1.5m of the ground surface.

Surface Water

The local drainage network is characterised by a network of small, unnamed watercourses (field drainage network) with an overall west to east direction of flow. One such watercourse transects the northern extent of the facility footprint before returning to flow north to south along the east and south-east boundary and the surface water storage pond, as Knockharley Stream.

The site is located within the Nanny River catchment, close to the divide with the River Boyne catchment. The Nanny River hydrology is characterised by sudden high or peak flows coincidental with high rainfall events and low flows in the drier summer months.

Monitoring of the surrounding river network up and downstream from the facility as carried out by the EPA and the licence holder indicate that the natural surface water chemistry has elevated hardness levels and concentrations of iron.

Ecological Designations

There are no designated sites within 1km of the facility's footprint.

Amenity Areas

There appear to be no amenity areas in close proximity to the site.

3.3 Assessment of Risks

All known and unknown potential environmental risks associated with the facility that have been identified by SLR, are included in the Project Risk Register presented in Table 3-1 below.

**Table 3-1
Project Risk Register**

Risk Ref. No.	Potential Failure Mode/Risk
1	Excessive dust / particulate matter emissions during landfilling or dusty surfaces
2	Excessive noise emissions during operations
3	Excessive odour emissions- diffuse from un-restored areas/ point sources- defective cap/ management infrastructure
4	Landfill containment failure- discharge of leachate to groundwater
5	Leachate lagoon containment failure/ discharge to soils, groundwater
6	Accidental release of leachate during lagoon emptying
7	Landfill containment failure- sub-surface gas migration
8	Landfill surface emissions of gas (VOCs) to atmosphere through waste surface or defective restoration cap
9	Contaminated surface water run-off and discharge to watercourse
10	Diesel tank leak or spillage and release to groundwater or soil
11	Employee or visitor struck by vehicles or plant
12	Minor Fire at the facility
13	Deep-Seated Fire in the Landfill
14	Severe Weather

Table 3-2 below provides a classification of risks in terms of likely occurrence and estimated severity. The Financial Costs quoted below are consistent with the EPA Guidance manual.

**Table 3-2
Risk Classification Table**

Rating	Occurrence		Severity	
	Description	Probability (%) (in a 30 year period)	Description	Financial Cost
1	Very Low	0-5	Trivial	0 - €1,000
2	Low	5-10	Minor	€1,000 - €10,000
3	Medium	10-20	Moderate	€10,000 - €50,000
4	High	20-50	Major	€50,000 - €100,000
5	Very High	>50	Massive	€100,000 - €1,000,000

The Risk Assessment Table provided in Table 3-3 below assigns an unmitigated 'Risk Score' to the risks identified in the Project Risk Register based on the likely occurrence and severity of the event. The Risks are then ranked on the basis of the most serious to the least serious.

At this point of the report, mitigation measures are not considered when assessing the risks. These are addressed in the next section of this report, where use of such mitigation reduces the likely occurrence or severity of the risks.

**Table 3-3
Risk Assessment Table for Unmitigated Risks**

Risk Ref. No.	Potential Failure Mode/Risk	Occurrence Rating	Severity Rating	Risk Score
1	Excessive dust / particulate matter emissions during operations or from dusty surfaces	3	2	6
2	Excessive noise emissions during operations	2	2	4
3	Excessive odour emissions- diffuse from un-restored areas/ point sources- defective cap/ management infrastructure	5	5	25
4	Landfill containment failure- discharge of leachate to groundwater	3	3	9
5	Leachate lagoon containment failure/ discharge to soils, groundwater	2	3	6
6	Accidental release of leachate during lagoon emptying/ discharge to land, ground or surface water	2	1	2
7	Landfill containment failure- sub-surface landfill gas migration	2	5	10
8	Landfill surface emissions of gas (VOCs) to atmosphere through defective restoration cap	3	1	3
9	Contaminated surface water run-off and discharge to watercourse (including fire water)	2	2	4
10	Diesel tank leak or spillage and release to groundwater or soil	3	4	12
11	Employee or visitor struck by vehicles or plant	3	5	15
12	Minor Fire at the facility	4	3	12
13	Deep-Seated Fire in the Landfill	2	5	10
14	Severe Weather	5	3	15

The rationale behind the risk scores assigned above is discussed as follows:

1. Excessive dust / particulate matter (PM₁₀) emissions:

Ejection and compaction of dusty waste, internal traffic movements on unpaved roads and stockpiles of cover/ engineering material containing fine fractions have the potential to generate dust and particulate matter which can result in health and nuisance issues and complaints. Dust and particulate emissions beyond the facility boundary have not attracted complaints in the recent past (it is noted that dust related complaints were made to the EPA in May 2005) and ongoing routine monitoring indicates that dust deposition and PM₁₀ concentrations to be within trigger levels.

Smoke from a fire can cause air pollution. It is accepted that air emissions from accidental fires cannot be easily controlled and are an unfortunate consequence of such events. Fires are however usually short term events, where the external cost to the environment is not normally quantified or applied to the business in question.

Excessive levels of dust can impact on the health of employees, visitors and neighbours, depending on individual sensitivities. The severity of such events will increase with event duration and frequencies of occurrence. On balance, the severity of such an event is considered to be 'minor'.

2. Excessive noise emissions:

The primary noise source is traffic arriving at and departing from the site. Internal vehicle and plant movements and the operation of the landfill gas combustion plant also contribute to the noise source. Noise monitoring surveys suggest that the noise contribution made by the facility operation does not exceed the daytime limit of 55dB or the 45dB night-time limit at the off-site noise sensitive locations. We consider that the severity of such an event is 'minor'.

3. Excessive odour emissions

Odours were historically released beyond the facility boundary, leading to complaints and compliance issues (resulting in a prosecution and fine in 2009). The occurrence rating, if unmitigated, is considered to be 'very high'.

Although odour, as an emission, is not dealt with by the Environmental Liability Directive, it is prudent to consider the potential for litigation by the Regulator and the possibility of fines being imposed and (temporary) closure of the facility.

It is considered that there is some risk of legal action being taken against the Operator and the severity, should litigation be successful and the site temporarily closed, could be potentially 'moderate' to 'massive'. For this facility it is suggested that provisions are made for a worst case outcome ('massive' severity).

4. Landfill containment failure- discharge of leachate to groundwater

For leachate to be released from the containment landfill, the artificial liner and low permeability mineral layer would need to be breached and at a point within 1m from the base of the cell where free leachate will be present (maximum permitted leachate head is 1m above the base).

Released leachate should migrate downwards through to eventually enter the formation layer and overburden (superficial deposits) which extend across the site. The geological deposits are thick (10>20m thick) and continuous glacial till, with very low permeability ranges from 1×10^{-9} m/s to 4.6×10^{-11} m/s. The water table is generally within 1.5m of the

ground surface. The Till is known to be water bearing with a groundwater direction of away from known off-site private wells, at an indicative groundwater flow rate of <1m/yr.

We consider the likelihood of such an occurrence to be 'medium' and the severity of such an event to be 'moderate'.

5. Leachate lagoon containment failure/ discharge to soils, groundwater

The leachate lagoon is an engineered lagoon, its containment lining system as per the landfill's lining system. The assessment applied to the release of leachate from the engineered landfill into groundwater applies to the lagoon with the exception being the greater maximum depth of leachate stored within the lagoon (and thus the head acting on the lagoon base and sides).

We consider the likelihood of such an occurrence to be 'low' and the severity of such an event to be 'moderate'.

6. Leachate release during lagoon emptying/ discharge to land, ground or surface water

The existing dedicated leachate removal point (road going vacuum tanker coupling point) serving the lagoon is located on concrete impermeable hardstand which is laid to fall to a linear drainage channel to drain liquids back into the lagoon. The pad also has raised edges to contain any accidental releases or spills.

In the event of leachate being accidentally released during tanker filling, releases would not be able to enter land, surface or groundwater.

We consider the likelihood of such an occurrence to be 'low' and the severity of such an event to be 'trivial'.

7. Landfill containment failure- sub-surface landfill gas migration

Sub-surface and lateral landfill gas migration could occur if there was liner containment failure at a point below surrounding ground level. In such an event, gas would need to migrate through and beyond the engineered formation and in-situ superficial glacial till deposits. These materials are known to exhibit low hydraulic permeabilities and it is assumed they will also exhibit low gas permeabilities. The gas response zone is restricted, vertically, to the unsaturated zone between ground level and the (perched/ superficial) groundwater level at c.1.5mbgl. Gas behaviour is such that landfill gas would tend to migrate to ground surface at 'its earliest opportunity' rather than continue to migrate sub-surface. The natural sub-surface conditions are not likely to lend themselves as a preferential gas migration pathway. However, made ground or fill such as porous and permeable material below internal access roads, buried service (ducts, trenches) are considered as preferential gas migration pathways.

The likelihood of failure, significant enough to allow large volumes or high gas release rates to occur is considered to be 'low' as is the potential for gas to migrate laterally through the sub-surface any significant distance from the engineered void, unless gas enters preferential pathways such as utility/ service ducts and trenches, porous and permeable fill under paved areas and accumulates in confined or enclosed spaces within the facility e.g. inspection chambers, and buildings. A worst case scenario would be gas entering and migrating along preferential pathways to accumulate in confined or enclosed spaces, with resultant explosion or asphyxiation- the severity of such an event (asphyxiation being the absolute worst case) would be potentially 'massive'.

8. Landfill surface emissions- gas (VOCs) to atmosphere through defective restoration cap

Emissions of VOCs (methane as an enhanced green house gas) through waste surfaces can occur when there are insufficient emissions management control systems in place during the operational, phased restoration and post-restoration phases. Emissions have, on a few occasions, exceeded (very low trigger levels). These occurrences were attributed to poor surface seals around in-waste gas extraction wells which were easily and quickly rectified. The severity of such an event is considered 'trivial'.

9. Contaminated surface water run-off (including fire water)/ discharge to ground or surface water

Best practice waste facilities including this facility, are designed to minimise the contamination of clean incidental rainwater falling on the site. Fire fighting water would be contained, along with rainwater that may fall during the course of a fire, by the sites drainage system, or the landfill containment liner should there be a landfill fire.

There have been no fires at the facility (buildings, structures or landfilled waste) from commencement of operations to date, aside from one small and quickly extinguished waste vehicle engine exhaust fire. The likelihood of a fire occurring or contaminated fire discharging to surface or groundwater is considered to be 'low'; the severity for such an occurrence is considered to be 'minor'.

10. Diesel tank leak or spillage and release to groundwater or soil

The site contains a 60,000 litres above ground diesel storage tank with an underlying concrete bund, located in a fenced compound. There are no barriers to protect the tank and or the dispensing pump and fill point which are both located outside the bund, from accidentally being struck by vehicles or plant using it- this could result in the entire tank's contents being lost. The concrete apron serving the tank and fill and dispense points does not have raised edges or containment to all sides and appears to have a slight cross fall to the unpaved (grassed) area beside it. There is the 'medium' likelihood for diesel to be accidentally released to land (soil) and groundwater from the fill point and dispensing pump in the event of accidental damage.

The severity of such a release (worst case assumed being the maximum stored volume) occurring outside the bund and entering land or groundwater is considered 'major'.

The severity of an accidental release within the bund is considered to be 'moderate' due to the associated costs of removing diesel contained within the sump (either for off-site disposal or possible use after treatment).

There are no direct release pathways to off-site watercourse- any releases that enter the site's surface water drainage system should be contained within drainage pipework and by the Oil Interceptor prior to flows entering the surface water pond which is inspected daily and continuously monitored.

Other hazardous spills

Hydraulic and waste oils are stored on site- within a bund inside the maintenance shed. The likelihood of these materials entering surface water, groundwater or land (soils) is also volume dependant. An Emergency Response Plan is in place, which includes procedures to deal with spillages using the spill kit that is maintained on-site. In addition, an Oil Interceptor is installed upstream from the inlet to the surface water pond.

The likelihood of such an event occurring is considered to be 'low' and the severity is considered to be 'trivial'.

11. Employee or visitor struck by vehicles or plant

There have been a number of incidents of this nature at waste facilities in Ireland in recent years involving mobile plant, particularly during busy periods or when views of operational areas are restricted (new lifts in cell, break in sight-line). However, no such incidents have occurred at Knockharley as activities are well separated, internal haul roads are well designed and maintained and there are relatively few visitors. Without mitigation, the likely occurrence of an impact of this nature is considered 'medium' and the severity of an employee or visitor being struck by site plant or machinery, such as a compactor or waste vehicle is considered to be 'massive' as such impacts are often fatal.

12. Minor Fire at the Facility

The likelihood of a minor fire occurring at the facility is considered to be 'high' as over-extraction of landfill gas can draw air into hotspots in the landfill and combustion is possible.

The severity will depend on the fire's location and the extent of its affects, e.g. the loss of the entire site office or localised heat and smoke damage resulting from a small kitchen fire, through to a fire on the landfill requiring considerable effort to contain and extinguish it and to carry out any remedial works. As such, the severity could range from 'minor' to 'massive'.

Minor fires are addressed here and a worst case scenario of a deep-seated landfill fire with a 'massive' severity is addressed below as a separate risk, due to the fact that such an event is very rare in modern landfills.

The severity of a minor fire in unmitigated circumstances is considered to be 'moderate' as it may require fire-fighting and replacement of some gas collection infrastructure.

13. Deep-Seated Fire in the Landfill

With no mitigation, there is a 'low' risk of a deep-seated fire in a modern landfill, as there is generally insufficient oxygen to sustain combustion.

The severity of such a fire is potentially 'massive' as it could take a prolonged period of time and/or specialist techniques to quench and infrastructure for containment and collection of leachate and gas could be damaged.

14. Severe Weather

The likelihood of severe weather such as flooding, storm force winds and/or freezing conditions is considered to be 'very high' when considered over a period of thirty years.

The landfill is located in an area that is not prone to flooding, so the impact of high rainfall is limited to increases in leachate production that can be accommodated within the waste body over short periods and balanced over time.

High winds could cause temporary restrictions on the acceptance of waste due to the risk of litter emissions, but this is an operational issue that can generally be resolved in a few hours, so the severity is considered to be 'low'.

Freezing conditions and heavy snow falls can also lead to temporary restrictions on waste acceptance at the site, but more importantly can lead to blockages in the leachate and gas extraction systems. The severity of such an event, without mitigation, is considered to be 'moderate' as it could lead to increased odour emissions for a short period of time.

Severe weather can cause power cuts and this would have a similar impact to frozen pipes as the gas and leachate extraction infrastructure could be temporarily disabled. We understand that the site has a back-up generator capable of running most of the site including almost all flaring requirement.

3.4 Risk Matrix

The ranking of the unmitigated risks identified above can be visualised on a 'Risk Matrix' diagram, as presented on Table 3-4 below.

In line with the EPA Guidance, the risks have been colour coded in the matrix to provide a broad indication of the critical nature of each risk. The colour code is as follows:

- | | |
|--------------------------|---|
| Red – | These are considered to be high-level risks requiring priority attention. These risks have the potential to be catastrophic and as such should be addressed quickly. |
| Amber – | These are medium-level risks requiring action, but are not as critical as a red coded risk. |
| Green (light and dark) - | These are lowest-level risks and indicate a need for continuing awareness and monitoring on a regular basis. Whilst they are currently low or minor risks, some have the potential to increase to medium or even high-level risks and must therefore be regularly monitored and if cost effective mitigation can be carried out to reduce the risk even further this should be pursued. |

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**Table 3-4
Risk Matrix of Unmitigated Risks**

30 year Probability %		Ranking of Unmitigated Risks				
		>50%	Very High 5			14
20%-50%	High 4			12		
10%-20%	Medium 3	8	1	4	10	11
5%-10%	Low 2	6	2, 9	5		7, 13
<5%	Very Low 1					
Impact		Trivial 1	Minor 2	Moderate 3	Major 4	Massive 5
Estimated Cost		€0- €1k	€1-10k	€10-50k	€50-100k	€100k - €1,000k

Severity

The Risk Matrix shows that Risks No. 3 (odour emissions), No. 7 (landfill gas migration, explosion or asphyxiation), No.11 (injury or fatality) and No. 13 (deep-seated fire) require attention as they have the potential for massive (financial) outcomes.

The other risks are lower priority, but all are improved by mitigation as described in the next section of this report. Much of this mitigation is required by and specified in the facility licence and already in place with the licence holder potentially facing enforcement or legal action in the event of failure to implement any of these mitigation measures.

3.5 Identification and Assessment of Mitigation Measures

The risk levels identified above can be mitigated in a number of ways as presented in Table 3-5 below.

**Table 3-5
Risk Reduction due to Mitigation Measures**

RISK IDENTIFICATION			RISK ASSESSMENT						
No.	Risk	Impact	BEFORE CONTROL			Mitigation Measures	AFTER CONTROL		
			Occurrence	Severity	Risk Level		Occurrence	Severity	Risk Level
1	Excessive dust emissions	Potential nuisance or impact on the health of neighbours.	3	2	6	a) Dust and mud control measures are implemented when facility construction/ development and operational stages, to include the use of a wheelwash, road sweeper, water bowser. b) The application of daily cover will prevent dust being released from the waste surface.	2	2	4
2	Excessive noise emissions	Potential nuisance or health impact on the health neighbours.	2	2	4	a) Where noise emissions from the site exceed the day and/or night-time emission limit values, the site operator should employ further mitigation in the form of improved working practices and/or better performing plant and machinery.	1	2	2
3	Excessive odour emissions	Potential nuisance or impact on the health of neighbours.	5	5	25	a) Waste handling, deposition and covering is carried out in accordance with the Agency's Landfill Manual "Landfill Operational Practices", including minimisation of uncovered working area and progressive development of landfill capping. b) Site specific Odour Management Plan is prepared which specifies the operational requirements for the waste placement, the landfill gas management infrastructure and addresses all aspects of odour control. c) Any loads with a particular potential for generation of odours are rejected in accordance with the waste acceptance procedures. The level areas of the working face are covered on a continuous basis during the day and the slope of the working face covered completely with artificial coversheets at the end of each working day. d) An odour neutralizing misting spray is installed along several sections of the litter fencing to mitigate potential waste odours. A mobile misting unit and contact neutralizer are also available on site and are used as necessary.	3	5	15

RISK IDENTIFICATION			RISK ASSESSMENT						
No.	Risk	Impact	BEFORE CONTROL			Mitigation Measures	AFTER CONTROL		
			Occurrence	Severity	Risk Level		Occurrence	Severity	Risk Level
4	Landfill Containment failure- release of leachate	Potential for groundwater pollution	3	3	9	a) Cell containment design and construction (Specified Engineering Works) follow stringent engineering design and construction quality control and assurance and reporting procedures, to include rigorous testing of the installed lining system. b) Leachate levels are monitored and removed to ensure head is <1m. c) Groundwater is sampled and data evaluated.	2	3	6
5	Leachate lagoon containment failure- release of leachate	Potential for groundwater pollution	2	3	6	a) The lagoon's design and construction (Specified Engineering Works) follows stringent engineering design and construction quality control and assurance and reporting procedures, to include rigorous testing of the installed lining system. b) Leachate levels are monitored. c) Leachate is removed. d) Groundwater is sampled and data evaluated.	2	3	6
6	Accidental leachate release during lagoon emptying	Potential for groundwater pollution.	3	2	6	a) Road tanker parking area, at coupling point is impermeable hardstand, laid to fall to liner collection drain to convey releases back into lagoon. b) Spill response plan in place and spill materials available on site.	2	1	2
7	Landfill containment failure- sub-surface landfill gas migration	Trigger level exceedences: asphyxiation, fire, explosion, vegetation damage	2	5	10	a) Waste is contained within an engineered containment landfill- designed and constructed (Specified Engineering Works) following stringent engineering design and construction quality control and assurance and reporting procedures, to include rigorous testing of the installed lining system. b) Active gas management system in operation (flare and utilisation engines) – gas field balanced and extraction rates managed. c) Progressive surface sealing, capping and extension of gas collection system d) Use of daily and interim cover to waste surfaces	2	3	6

RISK IDENTIFICATION			RISK ASSESSMENT						
No.	Risk	Impact	BEFORE CONTROL			Mitigation Measures	AFTER CONTROL		
			Occurrence	Severity	Risk Level		Occurrence	Severity	Risk Level
						e) Gas management plan in place- responsive and reactive procedures. f) LFG monitoring network and evaluation of data.			
8	Landfill surface emissions- Landfill Gas/ VOCs	Air quality (enhanced green house gas effect), odour, trigger level exceedences	3	1	3	a) Active gas management system in operation (flare and utilisation engines) – gas field balanced and extraction rates managed (to generation rates) b) Progressive surface sealing, capping and extension of gas collection system c) Use of daily and interim cover to waste surfaces d) Gas management plan in place- responsive and reactive procedures. e) Inspection of surface seal/ cap and infrastructure penetrations- repairs to defects; fugitive and point source emission points	2	1	2
9	Contaminated surface water (including fire water) discharge to watercourse	Potential for surface water pollution	2	2	4	a) The site is served by a formal, engineered storm water collection and storage system, with an oil interceptor installed up-line from the surface water storage pond inlet. The reed bed will provide additional buffering and reduction in contaminant loadings in discharges. A continuous water quality monitoring system is in use whereby key storage pond water quality indicators can be viewed real-time, enabling discharges to be stopped. b) In the event of a large fire at the facility (outside the landfill footprint) the surface water pond storage capacity is considered to be adequate to contain fire-fighting water, with or without the addition of rainwater. c) It may be possible to discharge firewater conveyed to the surface water pond directly to the local watercourse without causing downstream pollution. It is recommended that a precautionary approach is taken whereby discharges are not made until samples are tested and results evaluated.	1	2	2

RISK IDENTIFICATION			RISK ASSESSMENT						
No.	Risk	Impact	BEFORE CONTROL			Mitigation Measures	AFTER CONTROL		
			Occurrence	Severity	Risk Level		Occurrence	Severity	Risk Level
10	Above ground diesel storage tank/ dispensing and fill point- diesel leak or spillage. Other, internally stored oils and waste oils- leak or spillage	Potential for pollution of land (soil), surface water and/or groundwater.	3	4	12	a) The AST is bunded (110% capacity) – rainfall should be removed as soon as practical from the sump to ensure holding capacities are maintained in the event of tank failure. b) Dispensing pump and fill point hoses and pipework are located on concrete hardstand but outside the bunded area- minor drips and spills should be removed as soon as practical to prevent accumulation and run-off. c) Protection barriers or similar should be erected to protect the tank and fill and dispensing points and lines from accidental vehicle damage. d) Fill point should be repositioned so as to be within the containment bund. e) Edge containment kerbing should be provided to edge of concrete pad to prevent run-off and entry into adjacent unpaved soil, groundwater and to contain major releases. f) Spill kits are stored on site and are easily accessible. g) Drainage from the yard passes through oil interceptor. Drainage infrastructure is inspected and serviced regularly. h) Continuous monitoring and visual inspection of surface water entering storage pond- inflow and discharge can be stopped (shut-off valves). i) Minor quantities of hydraulic oils, waste oil are currently stored in a storage bund within maintenance shed- the bund and shed concrete floor and walls of this building will contain the materials if spilled.	2	2	4

RISK IDENTIFICATION			RISK ASSESSMENT						
No.	Risk	Impact	BEFORE CONTROL			Mitigation Measures	AFTER CONTROL		
			Occurrence	Severity	Risk Level		Occurrence	Severity	Risk Level
11	Employee or visitor struck by vehicles or plant	Potential injury or fatality to employee or visitor.	3	5	15	a) Compulsory use of hi-visibility clothing. b) Low speed limit is set and should be enforced. c) Plant and machine operators must be made aware of other personnel on site and must be fully trained- mobile / 2-way communications systems. d) All employees should be adequately trained in H&S. e) Mobile plant fitted with clearly audible reversing alarms. f) Adequate lighting used during hours of darkness. g) All visitors should be accompanied by site staff whilst on site and in high risk areas – landfill tipping area. h) Designated walkways should be provided for staff and visitors.	2	5	10
12	Minor Fire within the facility	Potential for air pollution, human health effects, damage to liner, emissions management infrastructure	4	3	12	a) No smoking policy in force. b) Senior facility staff are qualified or trained to be able to fulfil assigned roles and responsibilities- Health and Safety Management, Operations Management. Employees are also provided training (H&S, fire-safety, emergency procedures etc). c) Visitors are also required to be inducted in fire safety and evacuation procedures. d) Incoming wastes are inspected for evidence of combustion or smouldering (hot loads) and systems are in place to deal with these including loads/ vehicles being isolated and extinguished. e) Plant and machinery are designed and maintained for fire safety. f) No hot work or welding, unless intrinsically safe; Risk assessments carried out in advance of dangerous activities such as hot work (welding, angle grinding) etc at the facility. g) The storage capacity provided by the engineered void is considered to be adequate to contain fire	2	3	6

RISK IDENTIFICATION			RISK ASSESSMENT						
No.	Risk	Impact	BEFORE CONTROL			Mitigation Measures	AFTER CONTROL		
			Occurrence	Severity	Risk Level		Occurrence	Severity	Risk Level
						fighting water. h) Fire response procedures and extinguishing media available on site- portable extinguishers, water (and leachate) supply, inert materials etc.			
13	Deep-Seated Landfill Fire	Potential for air pollution, human health effects, damage to liner, emissions management infrastructure	2	5	10	a) Minor surface fires are extinguished quickly before they can become deep-seated. b) Fires in the waste body caused by over-extracting landfill gas are generally rapidly extinguished by starving the fire of oxygen, i.e. by extracting less gas. c) Site security measures are employed in a manner that discourages vandalism, including arson when the site is closed.	1	5	5
14	Impact of Severe Weather	Malfunction of emissions control infrastructure due to freezing or power cuts	5	3	15	a) Power from the gas utilisation plant can be used in the event of a power cut. b) Design and maintenance of the gas & leachate collection pipework keeps condensation and collection blockages to a minimum.	3	3	9

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3.6 Risk Reduction

By continuing to implement the mitigation measures, the risks posed by the site activities are reduced. This risk reduction is shown in Table 3-5 and the resulting mitigated risks ranked in Table 3-6.

The full risk reduction can only be achieved in practice by the site operator applying and putting into effect all mitigation measures. Failure to do so could result in a risk being realised that falls between the unmitigated and the mitigated positions. Identified risks are within the green zone after mitigation, aside from 3 (Odours) which remains in the amber zone.

Odour is not considered to be an environmental liability per se (in the context of the Environmental Liability Directive) and injuries to person(s) are considered to be a health and safety matter. It is important that the operator has adequate employee liability and public liability insurance to cover risks. Fire related insurance is also critical in this context.

3.7 Mitigated Risks

Table 3-6 below shows the Risk Matrix for the facility after full mitigation is considered.

**Table 3-6
Risk Matrix of Mitigated Risks**

30 year Probability %		Ranking of Mitigated Risks				
		Trivial 1	Minor 2	Moderate 3	Major 4	Massive 5
Occurrence	>50% Very High 5					
	20%-50% High 4					
	10%-20% Medium 3			14		3
	5%-10% Low 2	6, 8	1, 10	4, 5, 7, 12		11
	<5% Very Low 1		2, 9			13
Impact		Trivial 1	Minor 2	Moderate 3	Major 4	Massive 5
Estimated Cost		€0- €1k	€1-10k	€10-50k	€50-100k	€100k - €1,000k
		Severity				

Each of the identified risks has a reduced likelihood of occurrence and severity in the mitigated scenario. Compliance with the waste permit and health and safety legislation

should ensure that the identified risks stay within the Green Zone (Low Risk) in the Risk Matrix.

Risk 3 (Odour) within the Amber Zone will require further consideration. The financial severity remains potentially 'massive' due to the possibility of enforced closure of the site if the EPA considers that the site is continuously operating in non-compliance with the licence conditions. The operator must continue to use best available techniques to minimise odour to a manageable level.

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4.0 RISK MANAGEMENT

4.1 General

The risks identified in the previous section must be managed to ensure that they remain in the Green Zone (low risk) category. The mitigation identified in this report requires ongoing inspection and management. The site requires a Risk Management Programme, whereby risks are allocated to 'Risk Owners', who have responsibility for maintaining or improving mitigation measures that are needed to minimise the risks.

Additional hazards can arise from, for example, the storage and use of new materials, further operational development. Additional mitigation measures can become available or better techniques developed. The staff structure can change and new responsibilities allocated to the site management team.

4.2 Risk Management Programme

The proposed mitigation measures presented in Table 3-5 should be reviewed by the operator against the licence requirements and the various existing management systems and plans (including the facility's certified environmental management system).

4.3 Risk Management Review

The Risk Management Programme is a dynamic process that must be updated to reflect changes that occur on site, in working practice and in legislation. New risks may emerge with new processes or new methods of working. Additional hazards can arise from the use of new materials for maintenance or fuelling at the site. Additional mitigation measures can become available or better techniques developed. The staff structure can change and new responsibilities allocated to the site Management Team.

As mentioned earlier, the site has been accredited with ISO 14001 and the effective management of these systems is the most appropriate way to ensure that all mitigation measures are consistently implemented at the site. In doing so, the identified risks are expected to be well managed and well mitigated. As the ISO system is dynamic in nature, requiring regular internal and external audits, new risks and new mitigation measures can be fully addressed at the site by revising existing or preparing new procedures. All measures to be implemented should then be assigned by the Management Team to 'Risk Owners'.

5.0 ASSESSMENT OF POTENTIAL ENVIRONMENTAL LIABILITIES

5.1 Best Case Scenario

In the best case scenario, the mitigation measures will succeed in preventing any environmental (in this scenario, including health and safety and nuisance) liability, so the cost to the operator will be zero.

5.2 Worst Case Scenario

Worst case scenarios would include:

- A fatality occurring on site- most likely due to impact with a vehicle or mobile plant. This could incur a cost of up to €1,000,000, depending on the estimated loss associated with the potential future earnings of the individual.

The possibility that two people could be struck and killed by an item of mobile plant, such as a reversing front loading shovel, cannot be ruled out. The likelihood of occurrence of this event is however considered to be less than 1% in a 30 year period. The operator must have sufficient insurance to cover this eventuality, as a minimum.

The risk of health problems for employees or visitors due to noise, dust or contact with hazardous materials should be covered by public liability and employee liability insurances. The risk of occurrence of these problems is considered low if the proposed mitigation measures are fully implemented.

- Odour emissions and prosecution cannot be ruled out- Greenstar was successfully prosecuted in 2009 (€13k fine imposed) for breach of conditions. Odour nuisance and complaints continue to be received by EPA from residents. Regulator led prosecutions, if successful, could lead to significant fines/ awards for damage.

The potential for further litigation against the operator should be low with the various approved systems, management plans and infrastructure in place and in use. Even with this and based on the history and number of complaints on file, the likelihood of occurrence is assessed as 'medium'. While this could mitigate the amount of fines or awards, the outcome could potentially be 'massive' with large fines or costs imposed. It is suggested that a minimum amount of €1m (excluding Expert, Legal and Court costs) is provisioned for this low potential event.

- Fire risk has been identified and should be covered by insurance of buildings, equipment, services, infrastructure and containment infrastructure (including liner damage). The insurance cover provided should be adequate to cover destruction of the premises and all equipment. Risk of injury or death to employees or the public during a fire event should be covered under the most relevant insurance policy held by the operator. We suggest that Employer's Liability and Public Liability insurance cover of €5m each should be adequate to cover this risk.
- The severity of a major spill from the 60,000 litre AST diesel tank into the bund and from the fill and dispensing points outside the bund have been identified as 'major' but reducing to 'low' probability and 'minor' severity with all mitigation measures in place. An accidental release would be contained with the bund and surrounding containment area (when in place) thus minimising the risk of environmental damage. The cost would be incurred in removing product from for off-site treatment for re-use, or disposal, estimated at up to €10k.

5.3 Most Likely Scenario

The most likely scenario is based on the median probability and severity for each risk after implementation of the Risk Management Programme, as shown in Table 5-1 below. The costs used are consistent with the EPA guidance:

**Table 5-1
Most Likely Scenario**

Risk Identification	Occurrence Rating	Probability	Severity Rating	Cost Range	Median Probability	Median Severity	Most Likely Scenario Cost
1 Excessive dust emissions	2	5-10%	2	€1,000 - €10,000	7.5%	€5,500	€412.5
2 Excessive noise emissions	1	0-5%	2	€1,000 - €10,000	2.5%	€5,500	€137.50
3 Excessive odour emissions	3	10-20%	5	€100,000 – €1m	15%	€550,000	€82,500
4 Landfill containment failure- release of leachate	2	5-10%	3	€10,000 - €50,000	7.5%	€30,000	€2,250
5 Leachate lagoon containment failure- release of leachate	2	5-10%	3	€10,000 - €50,000	7.5%	€30,000	€2,250
6 Accidental leachate release during lagoon emptying	2	5-10%	1	€0 - €1,000	7.5%	€500	€37.50
7 Landfill containment failure- sub-surface landfill gas migration	2	5-10%	3	€10,000 - €50,000	7.5%	€30,000	€2,250
8 Landfill surface emissions- Landfill Gas/ VOCs	2	5-10%	1	€0 - €1,000	7.5%	€500	€37.50
9 Contaminated surface water (including fire water) discharge to watercourse	1	0-5%	2	€1,000 - €10,000	2.5%	€5,500	€137.50
10 Diesel leak or spillage. Other oils and waste oils- leak or spillage	2	5-10%	2	€1,000 - €10,000	7.5%	€5,500	€412.50
11 Employee or visitor struck by vehicles or plant	2	5-10%	5	€100,000 - €1m	7.5%	€550,000	€41,250
12 Minor Fire within the facility-	2	5-10%	3	€10,000 - €50,000	7.5%	€30,000	€2,250

Risk Identification		Occurrence Rating	Probability	Severity Rating	Cost Range	Median Probability	Median Severity	Most Likely Scenario Cost
13	Deep-Seated Landfill Fire	1	0-5%	5	€100,000 – €1m	2.5%	€550,000	€13,750
14	Impact of Severe Weather	3	10-20%	3	€10,000 - €50,000	15%	€30,000	€4,500
							Total	€152,175

6.0 CONCLUSIONS

6.1 All Identified Liabilities

In consideration of the worst case scenario and the most likely scenario as discussed above, we recommend that the site operator should have the following insurances in place:

- Employers Liability – indemnified for at least €5 million.
- Public Liability – indemnified for at least €5 million.
- Buildings and contents insurance - indemnified for an amount consistent with the total cost of removal of fire-fighting water, replacing all buildings, plant, machinery, etc. and ideally covering business interruption caused by a fire at the facility.

The 'Most Likely Scenario', as detailed in Table 5-1 above, incurs an estimated cost of €152,175, but this figure is not relevant, as most of the costs identified are covered by insurance policies. Items No.1, No.2, No.3 and No.11 on Table 5-1 above are primarily H&S and commercial issues and should be covered by Employee Liability, Public Liability, Buildings and Contents insurances. However, a persistent odour nuisance could attract fines and associated legal costs and we assume that these would not be covered by public liability insurance.

Provision should be made by any future operator of the site to cover the other items (environmental liabilities) on Table 5-1 (Items 4 to 10 and 12 to 14) and these would incur an estimated annual cost of €27,875 in the 'most likely' scenario.

In addition, in each scenario the future operator should provide for any 'excess' included in the insurance policies.

In summary, the 'worst case' and 'most likely case' scenarios can be covered as follows:

Worst Case:

- Employers Liability Insurance – indemnified for at least €5 million.
- Public Liability Insurance – indemnified for at least €5 million.
- Buildings and contents insurance - indemnified for an amount consistent with the total cost of removal of fire-fighting water, replacing all buildings, plant, machinery, etc. and ideally covering business interruption caused by a fire at the facility.
- Provide for 'excess' in relation to insurance cover.

- Provision for a potential liability of up to €1m for a deep-seated fire or a fatal accident.

Most Likely Case:

- Employers Liability Insurance – indemnified for at least €2 million.
- Public Liability Insurance – indemnified for at least €2 million.
- Buildings and contents insurance - indemnified for an amount consistent with the total cost of removal of fire-fighting water, replacing all buildings, plant, machinery, etc. and ideally covering business interruption caused by a fire at the facility.
- Provide for ‘excess’ in relation to insurance cover.
- Annual allowance of €27,875 potential environmental liabilities costs.

6.2 Worst Case Environmental Liabilities

This section highlights the estimated costs of liabilities that are strictly environmental in nature. These costs are a subset of the costs identified in the previous section.

Our ‘environmental’ designation goes beyond the environmental liabilities that are subject to the EU Environmental Liabilities Directive⁵, as it includes air emissions and measures to prevent air pollution.

These issues are considered relevant to the waste licence for the facility and provision for these potential liabilities should be covered by the licensee to comply with the ELRA and financial provision conditions of the waste licence.

Table 6-1 below details SLR’s estimates in this regard.

**Table 6-1
Worst Case Environmental Liabilities**

	Risk Identification	Potential Environmental Impact	Remediation Required	Estimated Worst Case Remediation Cost
1	Excessive dust emissions from site processes	Dust Deposition	Road sweeping	€5,000
3	Excessive Odour Emissions	Nuisance to neighbours	Improved effectiveness of gas extraction system and and/or capping system	€50,000
4	Landfill containment failure- release of leachate	Contamination of soil and/or groundwater	Repair lining system	€50,000
5	Leachate lagoon containment failure- release of leachate	Contamination of soil and/or groundwater	Repair lining system	€50,000
6	Accidental leachate release during lagoon emptying	Contamination of surface water or groundwater	Spill containment and clean-up	€1,000

⁵ DIRECTIVE 2004/35/CE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage

7	Landfill containment failure- sub-surface landfill gas migration	Risk of impact on plants and/or animals (including humans)	Repair lining system and vent gas ⁶	€50,000
8	Landfill surface emissions- Landfill Gas/ VOCs	Greenhouse gas emissions	Sealing gas extraction wells	€1,000
9	Contaminated surface water	Contamination of surface water	Containment and possible tankering of contaminated water	€10,000
10	Diesel tank leak or spillage	Contamination of surface water or groundwater	Soil, groundwater or surface water clean-up (localised)	€10,000
12	Minor Fire at the Facility	Air emissions, potential surface water contamination and damage to critical infrastructure.	Fire-fighting and repair or replacement of infrastructure.	€50,000
13	Deep-Seated Landfill Fire	Air emissions, potential surface water contamination and damage to critical infrastructure.	Fire-fighting and repair or replacement of infrastructure.	€1,000,000
14	Impact of Severe Weather	Damage to critical infrastructure and potential gas and odour emissions.	Repair or replacement of infrastructure.	€50,000
Total				€1,327,000

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⁶ H&S issues associated with the risk of gas explosions are not considered in this section, but should be covered under public and employee liability insurances.

7.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and data supplied by Greenstar and has been accepted in good faith as being accurate and valid.

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