

Limerick Former Gasworks Remediation

Preliminary Environmental Liability Risk Assessment Report

August 2013

For Bord Gais Eireann

Prepared by




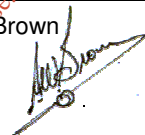
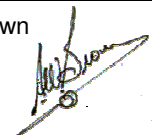
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1 Introduction

1.1 Terms of Reference

Mouchel has been commissioned by Bord Gais, to provide an Environmental Liability Risk Assessment in relation to the Former Gasworks Site, Limerick. This report assesses the potential environmental risks and liabilities associated with the proposed remedial works at the site.

1.2 Development Proposals/Legislative Context

An Environmental Liabilities Risk Assessment report (ELRA) is required to comply with the Waste Management Acts 1996-2013 and the Environmental Liability Directive. The ELRA has been carried out with reference to the following document;

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

1.3 Objectives and Scope

The objective of this report is to consider the risk of unplanned events occurring during the operation of the remediation that could result in unknown liabilities materialising.

The format of the report comprises:-

- A description of the works proposed.
- Identification of potential Environmental liabilities.
- A summary table of potential Environmental liabilities.
- Conclusions.

This preliminary ELRA has been produced in advance of procurement of Remediation Contractors for the works, this document will be further developed by the successful Contractors and submitted to the EPA for approval prior to the

commencement of remedial works. General descriptions have been taken from the Design Specifications for the works submitted with the Waste Licence Application.

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2 Brief description of the Works proposed under the Waste Licence

The 1.4ha site is located in the City of Limerick approximately 100m south-east of the River Shannon. It is roughly rectangular and generally level but drops from approximately 8m MHD (Malin Head Datum) at the south-eastern boundary to approximately 5m MHD at the north-western boundary (adjacent to the Dock Road). The site is currently derelict although the former Bord Gais offices are still present with an electricity sub-station (near the boundary with O'Curry Street) and a former Generator Building (No. 5 Stores). The Generator Building and the Dock Road wall have Protected Status.

In the 1830's, a limestone quarry was situated in the eastern part of the site, with a small gas works located to the north-west. In 1872, the gas works occupied the majority of the site. The quarry had been backfilled by 1938 with the gasworks operations now covering this area. Coal gas manufacture had ceased in 1974 and the works became an oil gas plant until 1986 when natural gas was introduced. Demolition and site clearance took place between 1988 and 1995.

The residues of historical gas making can include hazardous chemicals, which may be toxic to humans, plants and animals, depending on the level of exposure. In order to allow future development to take place on this site, the hazardous materials (soil and water) must be remediated.

The unavailability of landfill or other approved methods of disposal nationally restricts safe disposal options in Ireland. Consequently, following the extensive investigation, risk assessment and options appraisal works, the Limerick former gasworks remediation strategy comprises two distinct phases;

Phase 1- DNAPL (Dense Non Aqueous Phase Liquid- i.e. tars and oils) recovery ('pump and treat')

Phase 2- excavation, stabilisation (using a 'binder' to lock in contaminants, often comprised of cement and lime with additives) and replacement

Phase 1- DNAPL recovery ('pump and treat')

The DNAPL recovery works are proposed for two purposes;

To recover the free phase DNAPL present at the site (the groundwater risk assessment model makes the assumption that all free phase has been removed, as is standard for groundwater risk models)

To remove DNAPL from tanks to reduce the odorous nature of the material present and reduce the hydrocarbon content prior to the Phase 2 works. As the tanks will be fully excavated and stabilised in Phase 2.

Phase 2- Excavation, stabilisation and replacement of material

It is proposed that the top 3m of the site will be excavated, stabilised and replaced, including the full depth of any tanks encountered during the works.

The risk assessment has calculated a set of leachability criteria that the replaced stabilised material would be required to meet.

Criteria to apply to any material imported to site as part of the works would be determined by the end use of the site, once known.

It is expected that Phase 1 would be completed within 12 months, followed by 6 months for Phase 2.

Phase 2 Soil excavation works would be carried out by excavators, assisted by dump trucks. Breaking out of old foundations would generally be carried out by breakers fixed to hydraulic excavators. A screening/crushing plant would be used with front-loading shovels or hydraulic excavators, to screen and crush material for re-use on the site. Diesel fuel would be used for these vehicles.

The overall objective of the scheme is to clean up the soil and groundwater of the site to an agreed standard, without environmental pollution, on behalf of Bord Gáis Éireann.

A chronological summary of the works proposed is given below:-

1. Set up site accommodation and plant for Phase 1
2. Drilling of pumping/extraction wells
3. Pump and treat process
4. Disposal of DNAPL residue
5. Decommissioning of Phase 1 plant and accommodation
6. Set up site accommodation and plant for Phase 2
7. Excavation of site to required depths to remove material
8. Screen and sort excavated material into stockpiles of hard, suitable and unsuitable materials.
9. Stabilisation of material

10. Removal of unsuitable and recyclable materials by lorry to suitable facilities
11. Treat waters from the site encountered in the excavations and dispose to sewer, under licence.
12. Crush and test hard materials
13. Backfill site using suitable material from site, plus imported fill, as required.
14. Decommissioning of Phase 2 plant and accommodation

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3 Environmental liabilities

The environmental liabilities identified as attached to the above items of work are assessed below.

Costs associated with any incidents would be covered by the Contractor's Insurances.

3.1 Set up site accommodation and plant for Phase 1

This would include the provision of welfare facilities including a decontamination unit, treatment plant, plus wheel wash and storage tanks for fuel etc used on site. Any tanks on site will be bunded to guard against the effects of their failure. Water from the wheel wash will be disposed of via the temporary on-site treatment works and thence to foul sewer whilst water from any welfare facilities will be discharged directly to foul sewer.

Some minor environmental risks therefore remain in relation to accidental discharges from the above. Where the discharges occur onto untreated areas of the site, the environmental risk is further reduced.

3.2 Drilling of injection/extraction wells

The expected process for the drilling of the injection/extraction wells is set out below, extracted from the design specification document. Environmental risks would be associated with the use of the drilling equipment and the potential creation of contaminant pathways.

a) All Ground Investigation works and well installation on site shall be carried out in accordance with the Specification and Related Documents for Ground Investigation in Ireland, October 2006, prepared by the institution of Engineers of Ireland/Geotechnical Society of Ireland and BS10175:2011 Investigation of Potentially Contaminated Sites: Code of Practice.

b) The Contractor shall procure and arrange for a specialist site investigation contractor to install the injection/extraction/monitoring wells as required for his chosen methodology with particular attention to the ground conditions and the required programme.

c) The construction of the wells (including cable percussive boreholes, sonic, rotary boreholes and/or window-sampler boreholes, as applicable) is to be carried out in accordance with the 'Specification and Related Documents for Ground Investigation in Ireland, October 2006, prepared by the institution of Engineers of Ireland/Geotechnical Society of Ireland and BS10175:2011.

3.3 Pump and treat process

The expected process for the pump and treat Phase is set out below extracted from the design specification document. Environmental risks would be associated with a failure of the process equipment leading to a surface release of potentially contaminated groundwater/ process residue.

The Contractor shall provide, operate, maintain and remove on completion all items of plant and equipment necessary in order for him to complete the remediation works within the programme period, including for the provision of road sweeping/cleaning facilities. It is envisaged that the following main items of work would also be undertaken by the Contractor:-

- Liaison with Limerick City Council Water Services Department.
- All fees associated with the works
- Installation of an injection and extraction wells.
- Establishment of DNAPL plant
- Any other work required to successfully remove DNAPL.

All plant and equipment shall be provided and maintained in a safe condition, with all maintenance and service documentation available for inspection by the Engineer.

The Contractor shall determine his own plant requirements to allow the satisfactory and timely completion of the Remediation works.

A DNAPL Removal and Recovery Plant, which will be under the control of the Contractor is anticipated to be required and is considered likely to comprise the following components as necessary to remove free product:

- Pre-treatment of the lagoon to keep it in the range pH 7.5 to 9

- Oil/water separation (two stage);
- Filtration, to remove suspended solids;
- Granular activated carbon, or similar, treatment to remove polar organic compounds
- Flow meter and discharge arrangements.

The removal and recovery plant shall be sized to be capable of operating 24 hours per day and treating contaminated water. The treated water shall meet all discharge criteria set under the trade effluent/discharge consent and the Waste Licence. All water removed from the ground shall pass through the water treatment plant, unless agreed otherwise with the Engineer.

3.4 Disposal of DNAPL and drilling works residue

Disposal of material off site will be required during Phase 1 as detailed below.

It is envisaged that the majority of material requiring removal off site as part of this contract shall be DNAPL, removed from the groundwater by the DNAPL recovery and treatment plant. A volume of 340m³ is roughly estimated from previous investigations.

Depending upon the Contractors methodology, it is possible that contaminated drill arisings will be generated that shall require off site disposal.

As part of his tender the Contractor shall provide details of his chosen recycling or disposal route including details of the receiving facility (operator, location, licence etc). In addition, the Contractor shall provide details of the handling and transportation of the material from the site to the receiving facility.

Contaminated material will be removed from site for transfer to appropriate facilities. Associated potential environmental liabilities would be related to the following;-

Vapours/contact with material affecting the driver – Driver will remain in cab during loading, so avoiding physical contact. Lorries used will be sheeted, minimising odours/fumes and material is likely to be within sealed containers.

Spoil/vapours/leachate affecting general public along route - Lorries used will be watertight, sheeted and inspected prior to leaving site, such that impact on public will be negligible under normal operating conditions.

Accident involving lorry - under a worst case scenario, the lorry would lose its load, potentially coming in contact with members of the public and surface water drainage, e.g. rainfall run-off to public sewers. The Police and Fire Services will be informed of the Works and the route involved so that they would be able to respond accordingly. The contamination will generally be stabilised to facilitate transport and hence is unlikely to be so contaminated as to cause a major impact, in relation to the short term exposure levels which any member of the public is likely to be subjected. Booms, barriers and absorbent materials would be available from site to counter any spillage of contaminated material.

3.5 Decommissioning of Phase 1 plant and accommodation

The decommissioning of the Phase 1 works is detailed below. On completion of the pump and treat works the Contractor shall decommission the wells as directed by the Engineer on site. Closure decommissioning shall comply with the methodology set-out below.

- i) The permeability of the infill material used shall match the surrounding stratum as far as reasonably practicable, i.e. sand and/or gravel of suitable particle size shall be used in highly permeable material, and cement-bentonite grout shall be used in low permeability soils.
- ii) Cement-bentonite grout shall comprise 1 part Ordinary Portland cement, 3 parts of sodium bentonite powder and potable water. It shall be mixed by hand or using suitable equipment to a uniform consistency, with a moisture content not exceeding 250%.
- iii) The grout shall be pumped into each well, delivered through a tremmie pipe, which shall be raised as filling proceeds. The well shall be filled up to the specified level. The volume of grout used is to be monitored and recorded.
- iv) Measures should be taken to prevent spillage of grout and any spillage is to be removed and the area made good.

Plant/accommodation removal would include the removal from site of welfare facilities including a decontamination unit, plus wheel wash and storage tanks

for fuel etc used on site and removal of water treatment works. Some minor environmental risks therefore remain in relation to accidental discharges from the above during decommissioning.

3.6 Set up site accommodation and plant for Phase 2

This would include the provision of welfare facilities including a decontamination unit, plus wheel wash and storage tanks for fuel etc used on site. Any tanks on site will be bunded to guard against the effects of their failure. Water from the wheel wash will be disposed of via the temporary on-site treatment works and thence to foul sewer whilst water from any welfare facilities will be discharged directly to foul sewer.

Some minor environmental risks therefore remain in relation to accidental discharges from the above. Where the discharges occur onto untreated areas of the site, the environmental risk is further reduced,

3.7 Site excavation to required depths remove contamination

It is proposed that the upper 3m of soils across the site are excavated except where site constraints preclude excavation to this depth or limestone is encountered at shallower depth.

Excavations shall be undertaken on a 10m x 10m grid cell basis, using the chemical analysis results obtained from the previous assessments to determine treatment streams. These may include:-

- i) 'hard dig material' (concrete, brick etc) requiring no treatment which, following crushing/screening could be used as a capping layer (provided the soil criteria for site won crushed materials are not exceeded – to be tested at a rate of one test per 100m³),
- ii) material requiring stabilisation/ solidification,
- iii) highly contaminated untreatable material. It may be more cost effective to remove this material from site for disposal/ treatment rather than add large quantities of binder to try to stabilise them.

Where tanks extend to below 3m depth, the contents shall be excavated to the base of the tank and treated appropriately. The tank shall then be backfilled to a depth of 3m below ground level with suitable fill materials that shall comply with the soil criteria for stabilised / solidified, site won or imported crushed materials. The sides (below 3m depth) and the base do not need to be excavated.

All buried structures within the 3m excavation depth shall be broken out, excavated and crushed for re-use as appropriate subject to chemical testing. This will result in the majority of underground structures being removed to facilitate the possible future redevelopment of the site.

Any remaining obstructions at the 3m dig depth shall be surveyed to record their exact locations for future reference.

Excavations may extend below the groundwater table in some areas of the site. This may give rise to contaminated water and could also cause odours. The risks associated with contaminated waters are dealt with in Item 3.9 below. Odours will be controlled as far as possible by the provision of odour control sprays at and around the excavation where required.

Site workers will be protected from the risks emanating from the contamination. All staff will be subjected to a site induction identifying the risks involved with works on the Project. They will be provided with suitable personal protective equipment, comprising overalls, gloves, boots and, where necessary, dust/gas masks plus personal dosimeters to measure volatile compounds etc. The site will be separated into 'clean' and 'dirty' areas with restricted access to the 'dirty' areas. In addition, site staff will be subjected to occupational health checks at the start and end of their employment on site and at intermediate times, where relevant, to monitor their health and identify any adverse effects which might be due to the working environment. Smoking and eating will not be permitted in the 'dirty' areas of the site.

Monitoring of dust and odours will take place at locations around the site boundary on a regular basis.

Any costs arising in respect of additional protective measures or monitoring would be covered under the Contract.

3.8 Screen and sort material into stockpiles of hard, suitable and unsuitable material

Excavated material will be screened using appropriate screening plant and equipment to remove coarse and unsuitable material. The coarse material removed will be stockpiled to await either removal from site for disposal or for re-use on site as backfill. Similar environmental risks (i.e. direct contact by site personnel or inhalation of fumes/dust) arise from these operations as from excavation and these will be similarly controlled. In addition, stockpiles are to be sprayed regularly, when open, to reduce odour and dust generation and will otherwise be covered by a 'clean' layer of soil or tarpaulins. Water bowsers fitted with a spray will also be used in dusty conditions to reduce dust generation along haulage routes.

Potential environmental liabilities would be generally associated with leaks or spillages from site equipment.

3.9 Stabilisation of material

The Contractor shall determine his own plant requirements to allow the satisfactory and timely completion of the Remediation works, however, the following plant, all of which will be under the control of the Contractor, is anticipated to be required.

A range of excavators, loading shovels with suitable weighing devices fitted, dump trucks, stabilisation plant, dozers, vibratory rollers and ground water pumps.

Potential environmental liabilities would be generally associated with leaks or spillages from site equipment.

3.10 Removal of unsuitable and recyclable materials by lorry to suitable facilities

Unsuitable/recyclable material will be removed from site for transfer to appropriate facilities. Associated potential environmental liabilities would be related to the following:-

Accident involving lorry - under a worst case scenario, the lorry would lose its load, potentially coming in contact with members of the public and surface water drainage, e.g. rainfall run-off to public sewers. The Police and Fire Services will be informed of the Works and the route involved so that they would be able to respond accordingly. The material will generally be stabilised to facilitate transport and hence is unlikely to be so contaminated as to cause a major impact, in relation to the short term exposure levels which any member of the public is likely to be subjected. Booms, barriers and absorbent materials would be available from site to counter any spillage of contaminated material.

3.11 Treat waters from the site encountered in the excavations and dispose to sewer, under licence.

Excavation below the groundwater table and emptying of any tanks on site will result in the likely need to remove groundwater, which is potentially contaminated. This water presents a similar risk to site personnel as the contaminated soils, with a slightly greater risk of contact through splashing.

All the waters arising from site works will be collected and pumped to a site treatment works where it will be passed through an oil-water separator screened, filtered and treated by passing through an activated carbon filter or similar as a minimum to remove organic compounds, prior to being discharged to foul sewer, under Licence. Testing will be carried out to confirm the discharge is at acceptable levels. In addition, failure or loss of efficiency of the treatment works could also result in the accidental discharge of contaminated water to the foul sewer.

3.12 Crushing of hard materials.

The use of an on-site crusher may give rise to localised noise and dust pollution and with the potential for small scale fuel/oil spills. Any on-site crusher would be located as far as possible from adjacent properties.

3.13 Backfill site using suitable material from site, plus imported fill, as required.

This activity is unlikely to give rise to any significant environmental liabilities, works would utilise site plant such as excavators, dumper trucks and rollers with the potential for small scale fuel/oil spills.

3.14 Decommissioning of Phase 2 plant and accommodation

Plant/accommodation removal would include the removal from site of welfare facilities including a decontamination unit, plant (excavators, dumper trucks, rollers etc) plus wheel wash and storage tanks for fuel etc used on site and removal of water treatment works. Some minor environmental risks therefore remain in relation to accidental discharges from the above during decommissioning.

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4 Risk Classification Tables

The Tables included in Appendix A comprise the following:

- Environmental Liability Risk Assessment- identifying potential hazards with a qualitative assessment of the anticipated severity and probability of occurrence, resulting in a Risk Score.
- Risk Register- Table with the potential hazards ranked by risk score
- Risk Mitigation table- The risk scores for each hazard have been reassessed with possible mitigation measures identified. Mitigation measures are detailed within the design specification documents for Phases 1 and 2.
- Risk Matrix- A risk matrix is included showing the likely nature of the risk for each hazard before and after mitigation
- The definition of the severity and occurrence classifications.

Based on these, an assessment has been made of the overall level of risk involved, before and after mitigation measures are adopted.

This preliminary assessment of potential liabilities will be further developed by the Contractors and the updated ELRA issued to the EPA prior to works starting on site.

5 Conclusion

Environmental risks associated with the works have been identified. These risks are considered to be manageable.

In addition, the cost of any environmental liabilities which may arise as a result of accident or otherwise, will be adequately covered by the Contract for the Works and the Insurances included within it.

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References

Phase 1: Specification and Drawings- Part 3 Mouchel- 1021927/R/22- April 2012

Phase 2: Specification and Drawings- Part 3 Mouchel- 1021927/R/26- April 2012

Guidance on Environmental Liability Risk Assessment, Residuals management Plans and Financial Provision- EPA- 2006

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Appendix A Risk Classification Tables

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LIMERICK GASWORKS: ENVIRONMENTAL LIABILITY RISK ASSESSMENT

Risk ID	Process	Potential Hazards	Environmental Effect	Severity Rating	Basis of Severity	Occurrence Rating	Basis of Occurrence	Risk Score
1	Phase 1 site set up	Minor spillages during site set up	Small scale localised impact to the site and underlying strata	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Medium chance due to amount of equipment used during set up	6
2	Drilling of injection /extraction wells	Leaks or spillages from drilling equipment	Small scale localised impact to the site and underlying strata	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Medium chance, could be multiple rigs and high number of wells to drill	6
3	Drilling of injection /extraction wells	Creation of pathway into the underlying limestone	Further pathway creation into underlying strata from onsite contamination	3	Possible sitewide issue as a worst case	3	Medium chance, could be multiple rigs and high number of wells to drill	9
4	Pump and treat process	Equipment failure leading to surface release of contaminated groundwater/process residue	Possible release migration off site coming into contact with off site people or surface / ground waters	3	Possible off site damage	3	Medium chance over the 9-12 month period of works	9
5	Disposal of DNAPL residue	Vapours released from loads	Impact on drivers and other road users and pedestrians	3	Possible off site damage	3	Medium Chance as the material is likely to produce vapours	9

LIMERICK GASWORKS: ENVIRONMENTAL LIABILITY RISK ASSESSMENT

Risk ID	Process	Potential Hazards	Environmental Effect	Severity Rating	Basis of Severity	Occurrence Rating	Basis of Occurrence	Risk Score
6	Disposal of DNAPL residue	Road accident leading to contamination release	Impact on members of the public and surface waters via drainage	3	Possible off site damage	2	Limited off site disposal so a low chance	6
7	Decommissioning of Phase 1 plant and accommodation	Minor spillages during site decommissioning	Small scale localised impact to the site and underlying strata	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Medium chance due to amount of equipment used during decommissioning	6
8	Set up site accommodation and plant for Phase 2	Minor spillages during site set up	Small scale localised impact to the site and underlying strata	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Medium chance due to amount of equipment used during set up	6
9	Excavation of site to required depths to remove material	Leaks or spillages from site equipment	Small scale localised impact to the site and underlying strata	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Medium chance due to the amount of plant potentially used.	6
10	Excavation of site to required depths to remove material	Dust/odours	Site staff and members of the public coming into contact with dust and odours	2	Minor nuisance impact based on evidence from previous gasworks	4	Some short term localised nuisance is likely to occur so a high chance	8

LIMERICK GASWORKS: ENVIRONMENTAL LIABILITY RISK ASSESSMENT

Risk ID	Process	Potential Hazards	Environmental Effect	Severity Rating	Basis of Severity	Occurrence Rating	Basis of Occurrence	Risk Score
					remediation			
11	Excavation of site to required depths to remove material	Direct contact with contaminated materials	Contact with material by site personnel	2	Potential moderate impact to individuals as a results of short term exposure	3	Medium chance due to interaction with material during works.	6
12	Screen and sort excavated material into stockpiles of hard, suitable and unsuitable materials.	Leaks or spillages from site equipment	Small scale localised impact to the site and underlying strata	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Medium chance due to amount of activity expected during works.	6
13	Stabilisation of material	Leaks or spillages from site equipment	Small scale localised impact to the site and underlying strata	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Medium chance due to the amount and type of plant potentially used.	6
14	Removal of unsuitable and recycleable materials by lorry to suitable facilities	Road accident leading to contamination release	Impact on members of the public and surface waters via drainage	3	Possible off site damage	2	Limited off site disposal so a low chance	6
15	Treat waters from the site encountered in the excavations and	Equipment failure leading to surface release of contaminated groundwater	Possible migration off site coming into contact with off site people, surface	3	Possible off site damage	3	Medium chance due to the likely type of plant and amount of	9

LIMERICK GASWORKS: ENVIRONMENTAL LIABILITY RISK ASSESSMENT

Risk ID	Process	Potential Hazards	Environmental Effect	Severity Rating	Basis of Severity	Occurrence Rating	Basis of Occurrence	Risk Score
	dispose to sewer, under licence.		waters or into sewers				water pumped	
16	Crush and test hard materials	Leaks or spillages from site equipment and potential for dust and noise	Small scale localised impact to the site and underlying strata, and surrounding nuisance	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Likely to be some potential nuisance in the form of dust and noise	6
17	Backfill site using suitable material from site, plus imported fill, as required.	Leaks or spillages from site equipment	Small scale localised impact to the site and underlying strata	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Medium chance due to the amount and type of plant potentially used.	6
18	Decommissioning of Phase 2 plant and accommodation	Minor spillages during site decommissioning	Small scale localised impact to the site and underlying strata	2	Limited likely damage caused, due to scale of event and existing site conditions	3	Medium chance due to amount of equipment used during decommissioning	6

LIMERICK GASWORKS: RISK REGISTER RANKED BY RISK SCORES					
Risk ID	Process	Potential Hazards	Severity Rating	Occurrence Rating	Risk Score
3	Drilling of injection /extraction wells	Creation of pathway into the underlying limestone	3	3	9
4	Pump and treat process	Equipment failure leading to surface release of contaminated groundwater/process residue	3	3	9
5	Disposal of DNAPL residue	Vapours released from loads	3	3	9
15	Treat waters from the site encountered in the excavations and dispose to sewer, under licence.	Equipment failure leading to surface release of contaminated groundwater	3	3	9
10	Excavation of site to required depths to remove material	Dust/odours	2	4	8
1	Phase 1 site set up	Minor spillages during site set up	2	3	6
2	Drilling of injection /extraction wells	Leaks or spillages from drilling equipment	2	3	6
6	Disposal of DNAPL residue	Road accident leading to contamination release	3	2	6
7	Decommissioning of Phase 1 plant and accommodation	Minor spillages during site decommissioning	2	3	6

LIMERICK GASWORKS: RISK REGISTER RANKED BY RISK SCORES					
Risk ID	Process	Potential Hazards	Severity Rating	Occurrence Rating	Risk Score
8	Set up site accommodation and plant for Phase 2	Minor spillages during site set up	2	3	6
9	Excavation of site to required depths to remove material	Leaks or spillages from site equipment	2	3	6
11	Excavation of site to required depths to remove material	Direct contact with contaminated materials	2	3	6
12	Screen and sort excavated material into stockpiles of hard, suitable and unsuitable materials.	Leaks or spillages from site equipment	2	3	6
13	Stabilisation of material	Leaks or spillages from site equipment	2	3	6
14	Removal of unsuitable and recycleable materials by lorry to suitable facilities	Road accident leading to contamination release	3	2	6
16	Crush and test hard materials	Leaks or spillages from site equipment and potential for dust and noise	2	3	6
17	Backfill site using suitable material from site, plus imported fill, as required.	Leaks or spillages from site equipment	2	3	6
18	Decommissioning of Phase 2 plant and accommodation	Minor spillages during site decommissioning	2	3	6

LIMERICK GASWORKS: RISK MITIGATION ASSESSMENT							
Risk ID	Process	Potential Hazards	Risk score before mitigation	Possible Mitigation Measures	Revised Severity rating	Revised Occurrence Rating	Revised Risk Score
1	Phase 1 site set up	Minor spillages during site set up	6	Experienced contractor undertaking works following requirements of design specification, method statements and good housekeeping	2	2	4
2	Drilling of injection /extraction wells	Leaks or spillages from drilling equipment	6	Experienced contractor undertaking works following requirements of design specification, method statements and good housekeeping, bunding around rigs, spill kits available.	2	2	4
3	Drilling of injection /extraction wells	Creation of pathway into the underlying limestone	9	Reduced casing for drilling with a seal if drilling into rock. Wells to be decommissioned after use.	3	2	6
4	Pump and treat process	Equipment failure leading to surface release of contaminated groundwater/process residue	9	Experienced contractor undertaking works following requirements of design specification, method statements and good housekeeping, bunding around treatment plant, spill kits available, inspection and	3	2	6

LIMERICK GASWORKS: RISK MITIGATION ASSESSMENT							
Risk ID	Process	Potential Hazards	Risk score before mitigation	Possible Mitigation Measures	Revised Severity rating	Revised Occurrence Rating	Revised Risk Score
				maintenance of plant.			
5	Disposal of DNAPL residue	Vapours released from loads	9	DNAPL to be removed within sealed containers, lorries to be sheeted.	3	2	6
6	Disposal of DNAPL residue	Road accident leading to contamination release	6	Experienced licensed contractors to undertake works, safety record could be assessed. Traffic routes to be agreed with hauliers	3	1	3
7	Decommissioning of Phase 1 plant and accommodation	Minor spillages during site decommissioning	6	Experienced contractor undertaking works following requirements of design specification, method statements and good housekeeping	2	2	4
8	Set up site accommodation and plant for Phase 2	Minor spillages during site set up	6	Experienced contractor undertaking works following requirements of design specification, method statements and good housekeeping	2	2	4
9	Excavation of site to required depths to remove material	Leaks or spillages from site equipment	6	Experienced contractor undertaking works following requirements of design	2	2	4

LIMERICK GASWORKS: RISK MITIGATION ASSESSMENT							
Risk ID	Process	Potential Hazards	Risk score before mitigation	Possible Mitigation Measures	Revised Severity rating	Revised Occurrence Rating	Revised Risk Score
				specification, method statements and spill kits available			
10	Excavation of site to required depths to remove material	Dust/odours	8	Odour/dust suppression at point of excavation and site boundaries with sprays and surface damping down. Groundwater to be pumped from excavations.	2	3	6
11	Excavation of site to required depths to remove material	Direct contact with contaminated materials	6	Direct contact to be minimised through methods of working, PPE to be worn as required.	2	2	4
12	Screen and sort excavated material into stockpiles of hard, suitable and unsuitable materials.	Leaks or spillages from site equipment	6	Experienced contractor undertaking works following requirements of design specification, method statements and spill kits available	2	2	4
13	Stabilisation of material	Leaks or spillages from site equipment	6	Experienced contractor undertaking works following requirements of design specification, method statements and spill kits available. Inspection and maintenance of plant.	2	2	4

LIMERICK GASWORKS: RISK MITIGATION ASSESSMENT							
Risk ID	Process	Potential Hazards	Risk score before mitigation	Possible Mitigation Measures	Revised Severity rating	Revised Occurrence Rating	Revised Risk Score
14	Removal of unsuitable and recycleable materials by lorry to suitable facilities	Road accident leading to contamination release	6	Experienced licensed contractors to undertake works, safety record could be assessed. Traffic routes to be agreed with hauliers	3	1	3
15	Treat waters from the site encountered in the excavations and dispose to sewer, under licence.	Equipment failure leading to surface release of contaminated groundwater	9	Experienced contractor undertaking works following requirements of design specification, method statements and spill kits available. Bunding of plant, inspection and maintenance of plant.	3	2	6
16	Crush and test hard materials	Leaks or spillages from site equipment and potential for dust and noise	6	Experienced contractor undertaking works following requirements of design specification, method statements and spill kits available, silencers to be used where possible	2	2	4
17	Backfill site using suitable material from site, plus imported fill, as required.	Leaks or spillages from site equipment	6	Experienced contractor undertaking works following requirements of design specification, method statements	2	2	4

LIMERICK GASWORKS: RISK MITIGATION ASSESSMENT							
Risk ID	Process	Potential Hazards	Risk score before mitigation	Possible Mitigation Measures	Revised Severity rating	Revised Occurrence Rating	Revised Risk Score
				and spill kits available			
18	Decommissioning of Phase 2 plant and accommodation	Minor spillages during site decommissioning	6	Experienced contractor undertaking works following requirements of design specification, method statements and good housekeeping	2	2	4

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LIMERICK GASWORKS: RISK MATRIX BEFORE MITIGATION							
OCCURRENCE	V.High	5					
	High	4		10			
	Medium	3		1, 2, 7, 8, 9, 11, 12, 13, 16, 17, 18	3, 4, 5, 15		
	Low	2			6, 14		
	V low	1					
			1	2	3	4	5
			Trivial	Minor	Moderate	Major	Massive
SEVERITY							

LIMERICK GASWORKS: RISK MATRIX AFTER MITIGATION							
OCCURRENCE	V.High	5					
	High	4					
	Medium	3		10			
	Low	2		1, 2, 7, 8, 9, 11, 12, 13, 16, 17, 18	3, 4, 5, 15		
	V low	1			6, 14		
			1	2	3	4	5
			Trivial	Minor	Moderate	Major	Massive
SEVERITY							

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 / Yellow – These are medium-level risks requiring action, but are not as critical as a red coded risk.

Green (light and dark green) – 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.

Risk Classification Tables

Rating	Occurrence		
	Category	Description	Likelihood of Occurrence (%)
1	Very Low	Very Low chance (0-5%) of hazard occurring during scheme	0-5
2	Low	Low chance (5-10%) of hazard occurring during scheme	5-10
3	Medium	Medium chance (10-20%) of hazard occurring during scheme	10-20
4	High	High chance (20-50%) of hazard occurring during scheme	20-50
5	Very High	Greater than 50% chance of hazard occurring during scheme	>50

Rating	Severity	
	Category	Description
1	Trivial	No damage or negligible change to the environment
2	Minor	Minor impact/localised or nuisance
3	Moderate	Moderate damage to environment
4	Major	Severe damage to local environment
5	Massive	Massive damage to a large area, irreversible in medium term

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