ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

KNOCKHARLEY LANDFILL LTD.

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED DEVELOPMENT AT KNOCKHARLEY LANDFILL

VOLUME 3 - APPENDICES

NOVEMBER 2018

Knockharley Landfill Ltd.
Kentstown, Navan,Co.Meath

FEHILY TIMONEY & COMPANY

LIST OF APPENDICES

LIST OF APPENDICES – Cont'd…

Appendix 1.1

Waste Licence Final Decision

This licence was amended on 15th January 2013 under Section 42B(1)(c) of the Waste Management Acts, 1996 to 2011. The details of Amendment A must be read in conjunction with this licence. The amendment document is entitled “Technical Amendment A”

This licence was amended on 1st October 2013 under Section 42B(1)(c) of the Waste Management Acts, 1996 to 2013. The details of Amendment B must be read in conjunction with this licence. The amendment document is entitled “Technical Amendment B”.

This licence was amended on 20 December 2013 under Section 76A(11) of the Waste Management Act 1996 as amended. The details of the Amendment must be read in conjunction with this licence. The amendment document is entitled “IED Amendment”

LICENCE REG NO W0146-02 HAS BEEN TRANSFERRED

Please note that Licence Reg No W0146-02 was transferred to Knockharley Landfill Limited on 04/03/2014, for further information on this please refer to Transfer Notification on the Agency’s website

This licence was amended on 15th November 2016 under Section 96(1)(c) of the Environmental Protection Agency Act, as amended. The details of Amendment C must be read in conjunction with this licence. The amendment document is entitled “Technical Amendment C”

Headquarters,
P.O. Box 3000,
Johnstown Castle Estate
County Wexford, Ireland

WASTE LICENCE
LANDFILL FOR NON-HAZARDOUS WASTE

Waste Licence Register Number:	W0146-02
Licensee:	Greenstar Holdings Limited
Location of Facility:	Knockharley Landfill, Knockharley, Navan, County Meath (includes townlands of Tuiterath and Flemingstown).

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WASTE MANAGEMENT ACTS, 1996 to 2010

WASTE LICENCE

Decision of the Agency, under Section 46(8)(a) of the Waste Management Acts, 1996 to 2010

Waste Licence Register No: **W0146-02**

Further to notice dated the 19th day of October 2009, the Agency in exercise of the powers conferred on it by the Waste Management Acts, 1996 to 2010, for the reasons hereinafter set out in the attached Decision, grants this revised waste licence to Greenstar Holdings Limited, Knockharley, Kentstown, County Meath to carry on the waste activities set out below at Knockharley Landfill, Knockharley, Navan, County Meath. (Includes Townlands of Tuiterath & Flemingstown) subject to twelve Conditions, as set out in the schedules attached thereto.

A copy of the Decision is attached.

Licensed Waste Activities

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.

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.

Sealed by the seal of the Agency on this the 23rd day of March 2010.

PRESENT when the seal of the Agency was affixed hereto:

Laura Burke, Director

INTRODUCTION

This introduction is not part of the licence and does not purport to be a legal interpretation of the licence.

This licence is for the operation and development of a landfill at Knockharley, Navan, County Meath (includes townlands of Tuiterath and Flemingstown). The waste for disposal consists of residual, non-hazardous household, commercial and industrial waste arising in the north-east.

The waste intake is limited to 200,000 tonnes of waste per annum and the facility has an operating life of approximately 14 years. The proposed facility covers an area of 135 hectares. The landfill, which is positioned in the centre of the site, will cover approximately 25 hectares. The licence requires a buffer zone i.e. an area where no waste will be deposited between the landfill and the nearest residences. A 50m band of this area, inside the facility boundary, will be planted with woodland.

The facility consists of the landfill, an administration building, leachate lagoon, surface water pond, weighbridges, wheelwash and a landfill gas collection and flaring system. The associated infrastructure is necessary so as to control the emissions from the facility. Infrastructure to control emissions to the environment must meet BAT standards. There are no direct discharges of effluent to surface water or groundwater. Leachate will be tankered off-site to a Sanitary Authority waste water treatment plant.

This review of the licence is primarily concerned with ensuring that the landfill is operating in compliance with all relevant requirements of the Landfill Directive (1999/31/EC) including the need to divert biodegradable municipal waste from landfill. Waste must be treated before disposal in the landfill and treatment must now reflect pre-treatment technical guidelines published in 2009 by the Agency – *Municipal Solid Waste – Pre-treatment and Residuals Management: An EPA Technical Guidance Document.* Limits on the acceptance of biodegradable municipal waste are introduced. There is a consequential need, set out in the licence, to update and revise waste acceptance procedures, maintain records to demonstrate compliance with new requirements and provide periodic reports on waste disposal and recovery at the facility. New conditions for the prevention control and monitoring of odour have been introduced.

The licensee must manage and operate the facility to ensure that the activities do not cause environmental pollution. The licensee has to carry out regular environmental monitoring and submit all monitoring results, and a wide range of reports on the operation and management of the facility, to the Agency.

The conditions of this licence set out in detail the legal constraints under which Greenstar Holdings Limited is allowed to operate and manage the Knockharley Facility.

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DECISION & REASONS FOR THE DECISION

Reasons for the Decision

The Environmental Protection Agency (the Agency) is satisfied, on the basis of the information available that, subject to compliance with the Conditions of the licence, any emissions from the activity will comply with and will not contravene any of the requirements of Section 40(4) of the Waste Management Acts, 1996 to 2010.

In reaching this decision the Agency has considered the documentation and objection received from the licensee, objection received from another party and the reports of its inspectors.

Part I Activities Licensed

In pursuance of the powers conferred on it by the Waste Management Acts, 1996 to 2010, the Agency under Section 46(8)(a) of the said Acts hereby grants this Waste Licence to Greenstar Holdings Limited, Unit 6, Ballyogan Business Park, Ballygoan Road, Sandyford, Dublin 18 to carry on the waste activities listed below at the Knockharley Landfill, Knockharley, Navan, County Meath (includes Townlands of Tuiterath and Flemingstown) subject to twelve conditions, with the reasons therefor and the associated schedules attached thereto set out in the licence. For the purpose of Article 48 of the Waste Management (Licensing) Regulations 2004 (S.I. No. 395) this facility is classed as a non-hazardous waste landfill.

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.

INTERPRETATION

All terms in this licence should be interpreted in accordance with the definitions in the Waste Management Acts 1996 to 2010, (the Acts), unless otherwise defined in this section.

Adequate lighting	20 lux measured at ground level.
Agreement	Agreement in writing.
Annually	At approximately twelve monthly intervals.
Attachment	Any reference to Attachments in this licence refers to attachments submitted as part of the waste licence application.
Application	The application by the licensee for this waste licence.
Appropriate facility	A waste management facility, duly authorised under relevant law and technically suitable.
BAT	Best Available Techniques.
Biodegradable waste	Waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste and paper and cardboard.
Biodegradable municipal waste (BMW)	The biodegradable component of municipal waste, not including bio-stabilised residual waste. Biodegradable municipal waste is typically composed of food and garden waste, wood, paper, cardboard and textiles.
Bio-stabilised residual waste	Residual biodegradable municipal waste that has been treated to achieve an EPA-approved biodegradability stability standard (as defined in this licence) prior to landfilling or alternative use agreed.
Buffer Zone	The zone between the area within which no waste shall be deposited and the boundary of the facility.
Characterisation of waste	The sampling and analysis of waste to determine, amongst other things, its nature and composition, including the proportions of biodegradable, recyclable and other materials in the waste.
Classification of waste	The classification of waste as inert, non-hazardous or hazardous for the purpose of article 4 of Council Directive (1999/31/EC) on the landfill of waste.
Coding of waste	The allocation of a European Waste Catalogue/Hazardous Waste List code and a concise/standardised description of the waste, including information on the source of the waste, e.g. municipal, industrial, construction and demolition etc.
Condition	A condition of this licence.

Construction and Demolition Waste	All wastes which arise from construction, renovation and demolition activities.
Containment boom	A boom which can contain spillages and prevent them from entering drains or watercourses.
Cover material	Bricks, crushed concrete, tarmac, earth, soil, sub-soil, stone, rock or other similar natural materials or other cover material the use of which has been agreed by the Agency.
Daily Cover	Is the term used to describe material spread (about 150mm if soil cover is used) over deposited waste at the end of each day. Synthetic materials may also be used. Its objective is to minimise odour, the amount of litter generated and to control flies and access to the waste by birds and vermin. Where soils are used for daily cover, it is recommended that they be removed at the start of the day and subsequently reused as much as possible.
Daytime	8.00 a.m. to 10.00 p.m.
Documentation	Any report, record, result, data, drawing, proposal, interpretation or other document in written or electronic form which is required by this licence.
Drawing	Any reference to a drawing or drawing number means a drawing or drawing number contained in the application, unless otherwise specified in this licence.
Emergency	Those occurrences defined in Condition 9.4.
Emission Limits	Those limits, including concentration limits and deposition levels established in *Schedule C: Emission Limits*, of this licence.
Environmental Damage	(a) damage to protected species and natural habitats, which is any damage that has significant adverse effects on reaching or maintaining the favourable conservation status of such habitats or species. The significance of such effects is to be assessed with reference to the baseline condition, taking account of the criteria set out in Annex I; Damage to protected species and natural habitats does not include previously identified adverse effects which result from an act by an operator which was expressly authorised by the relevant authorities in accordance with provisions implementing Article 6(3) and (4) or Article 16 of Directive 92/43/EEC or Article 9 of Directive 79/409/EEC or, in the case of habitats and species not covered by Community law, in accordance with equivalent provisions of national law on nature conservation. (b) water damage, which is any damage that significantly adversely affects the ecological, chemical and/or quantitative status and/or ecological potential, as defined in Directive 2000/60/EC, of the waters concerned, with the exception of adverse effects where Article 4(7) of that Directive applies;

	(c) land damage, which is any land contamination that creates a significant risk of human health being adversely affected as a result of the direct or indirect introduction, in, on or under land, of substances, preparations, organisms or micro-organisms.
European Waste Catalogue (EWC)	A harmonised, non-exhaustive list of wastes drawn up by the European Commission and published as Commission Decision 94/3/EC and any subsequent amendment published in the Official Journal of the European Community.
Footprint	Area where waste is deposited of in lined cells.
Green waste	Waste wood (excluding timber), plant matter such as grass cuttings, and other vegetation.
Hours of Operation	7.30 to 18.30 Monday to Saturday.
Hours of Waste Acceptance	8.00 to 18.00 Monday to Saturday.
Inert waste	Waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater.
Intermediate Cover	Refers to placement of material (minimum 300mm if soil is used) for a period of time prior to restoration or prior to further disposal of waste.
Landfill	Refers to the area of the facility where the waste is disposed of by placement on the ground or on other waste.
Landfill Gas	Gases generated from the landfilled waste.
LEL (Lower Explosive Limit)	The lowest percentage concentration by volume of a mixture of flammable gas with air which will propagate a flame at $25^{o}C$ and atmospheric pressure.
Licence	A Waste Licence issued in accordance with the Acts.
Licensee	Greenstar Holdings Limited, Unit 6, Ballyogan Business Park, Ballyogan Road, Sandyford, Dublin 18.
List I/II Organics	Substances classified pursuant to EC Directives 76/464/EEC and 80/68/EEC.
Liquid Waste	Any waste in liquid form and containing less than 2% dry matter. Any waste tankered to the facility.
Maintain	Keep in a fit state, including such regular inspection, servicing and repair as may be necessary to adequately perform its function.

Mobile Plant	Self-propelled machinery used for the emplacement of wastes or for the construction of specified engineering works.
Monthly	A minimum of 12 times per year, at approximately monthly intervals.
Municipal solid waste (MSW)	Household waste as well as commercial and other waste which, because of its nature or composition, is similar to household waste. Excluding municipal sludges and effluents.
Night-time	10.00 p.m. to 8.00 a.m.
Recyclable Materials	Those waste types, such as cardboard, batteries, gas cylinders, etc, which may be recycled.
Residual waste	The fraction of collected waste remaining after a treatment or diversion step, which generally requires further treatment or disposal.
Quarterly	At approximately three monthly intervals.
Sample(s)	Unless the context of this licence indicates to the contrary, samples shall include measurements by electronic instruments.
SCADA system	Supervisory Control and Data Acquisition system.
Sludge	The accumulation of solids resulting from chemical coagulation, flocculation and/or sedimentation after water or wastewater treatment with between 2% and 14% dry matter.
Specified Emissions	Those emissions listed in *Schedule C: Emission Limits* of this licence.
Specified Engineering Works	Those engineering works listed in *Schedule B: Specified Engineering Works* of this licence.
Treated Sludge	Sludge which has undergone biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use.
Treatment/pre-treatment	In relation to waste, any manual, thermal, physical, chemical or biological processes that change the characteristics of waste in order to reduce its volume or hazardous nature or facilitate its handling, disposal or recovery.
Trigger Level	A parameter value specified in the licence, the achievement or exceedance of which requires certain actions to be taken by the licensee.
White Goods	Refrigerators, cookers, ovens and other similar appliances.
EPA Working Day	Refers to the following hours; 9.00 a.m. to 5.30 p.m. Monday to Friday inclusive.

Working Face	The area of the site in which waste other than cover material or material for the purposes of the construction of specified engineering works is being deposited.

PART II CONDITIONS

CONDITION 1 SCOPE OF THE LICENCE

1.1. Waste activities at the facility shall be restricted to those listed and described in Part I: Activities Licensed and authorised by this licence.

1.2. For the purposes of this licence, the facility is the area of land outlined in bold red on Drawing No. 2000-144-01-01 entitled Landfill Layout and Figure B2.2 Location Map of the application. Any reference in this licence to "facility" shall mean the area thus outlined in red.

1.3. This licence is for the purposes of waste licensing under the Waste Management Acts 1996 to 2010 only and nothing in this licence shall be construed as negating the licensee's statutory obligations or requirements under any other enactments or regulations.

1.4. Municipal Waste, Commercial Waste and Industrial Waste may be disposed of at the facility subject to the maximum quantities and other constraints listed in *Schedule A: Waste Acceptance*, of this licence.

1.5. No hazardous wastes or liquid wastes shall be disposed of at the facility.

1.6. Waste Treatment

Only waste that has been subject to treatment shall be accepted for disposal at the landfill facility.

(i) Treatment shall reflect published EPA technical guidance as set out in *Municipal Solid Waste – Pre-treatment and Residuals Management*, EPA, 2009.

(ii) With the agreement of the Agency, this condition shall not apply to:

- inert wastes for which treatment is not technically feasible;
- other waste for which such treatment does not contribute to the objectives of the Landfill Directive as set out in Article 1 of the Directive by reducing the quantity of the waste or the hazards to human health or the environment.

1.7. Whole used tyres (other than bicycle tyres and tyres with an outside diameter greater than 1400mm) shall not be disposed of at the facility. Shredded tyres shall not be disposed of at the facility.

1.8. No waste which in the conditions of the landfill, is explosive, corrosive, oxidising, highly flammable or flammable as defined in EU Council Directive 91/689/EEC shall be accepted at the landfill.

1.9. Gypsum wastes shall not be placed in any landfill cell accepting biodegradable waste

1.10. The dilution or mixture of waste solely in order to fulfil relevant waste acceptance criteria established under Condition 5.3 is prohibited.

1.11. Waste Acceptance Hours and Hours of Operation

1.11.1 Waste shall only be accepted at the facility for disposal at the landfill between the hours of 8.00 to 18.00 Monday to Saturday inclusive.

1.11.2 The facility shall only be operated during the hours of 7.30 to 18.30 Monday to Saturday inclusive.

1.11.3 Waste shall not be accepted at the landfill on Public Holidays.

1.12. The following shall constitute an incident for the purposes of this licence:

a) an emergency;

b) any emission which does not comply with the requirements of this licence;

c) any trigger level specified in this licence which is attained or exceeded;

d) any indication that environmental pollution has, or may have, taken place and

e) any rejected load of waste.

1.13. Limit on acceptance of biodegradable municipal waste

1.13.1. Unless otherwise as may be specified by the Agency, the following limits shall apply:

(i) From 1 July 2010 to 30 June 2013 inclusive, a maximum of 47% by weight of municipal solid waste (MSW) accepted for disposal to the body of the landfill shall comprise biodegradable municipal waste (BMW), measured on a calendar year basis or, in 2010 and 2013, part thereof,

(ii) From 1 July 2013 to 30 June 2016 inclusive, a maximum of 30% by weight of MSW accepted for disposal to the body of the landfill shall comprise BMW, measured on a calendar year basis or, in 2013 and 2016, part thereof, and

(iii) From 1 July 2016, a maximum of 15% by weight of MSW accepted for disposal to the body of the landfill shall comprise BMW, measured on a calendar year basis or, in 2016, part thereof.

1.13.2. Two or more licensed landfills may seek the agreement of the Agency that collectively they will arrange to comply with condition 1.13.1. Such agreement may be sought by review of the landfill licence for any facility seeking an increase in the limits set out in condition 1.13.1, and by technical amendment of any licence for a facility seeking a decrease. Such agreement will be contingent on the net combined acceptance of biodegradable municipal waste at the participating facilities remaining unchanged.

1.14. Determination of biodegradable municipal waste content of municipal waste

1.14.1. The licensee shall determine the biodegradable municipal waste content of MSW accepted for disposal to the body of the landfill. Waste that has been bio-stabilised in accordance with condition 1.14.4 shall not be considered BMW.

1.14.2. Bio-stabilised residual wastes meeting the requirements of

- Condition 1.14.4, or
- an alternative protocol as may be agreed by the Agency based on biological treatment process parameters (e.g. validated residence time and temperature parameters at the treatment facility),

received at the landfill facility may be included in the determination of MSW quantities accepted at the facility for the purposes of Condition 1.13.1.

1.14.3. In determining BMW content, the licensee shall use approved calculation factors for BMW content of municipal waste streams published by the EPA. With the agreement of the EPA, alternative factors can be used if they have been determined following waste characterisation carried out in accordance with EPA-approved characterisation protocols including, where appropriate, the use of EPA-approved contractors.

1.14.4. In the case of bio-stabilised residual wastes, stabilisation means the reduction of the decomposition properties of the waste to such an extent that offensive odours are minimised and that the respiration activity after four days is <10mg O_2/g DM until 1 January 2016 and <7mg O_2/g DM thereafter.

1.14.5. Bio-stabilised residual wastes shall be monitored in accordance with *Schedule D.9: Waste Monitoring*, of this licence.

1.14.6. Waste that was accepted to the body of the landfill as stabilised waste but subsequently is found not to meet the stabilisation standard set out in Condition 1.14.4 shall be notified to the Agency and included in the calculation of BMW accepted to the body of the landfill when assessing compliance with Condition 1.13.1.

1.14.7. The licensee is required to maintain on-site as part of their waste acceptance procedures and associated documentation, evidence to demonstrate compliance with condition 1.13.1, which shall be available for inspection by Agency personnel.

1.15. Where the Agency considers that a non-compliance with any condition of this licence has occurred, it may serve a notice on the licensee specifying:

1.15.1. That only those wastes as specified, if any, in the notice are to be accepted at the facility after the date set down in the notice;

1.15.2. That the licensee shall undertake the works stipulated in the notice, and/or otherwise comply with the requirements of the notice as set down therein, within the time-scale contained in the notice; and

1.15.3. That the licensee shall carry out any other requirement specified in the notice.

1.15.4. When the notice has been complied with, the licensee shall provide written confirmation that the requirements of the notice have been carried out. No waste, other than that which is stipulated in the notice, shall be accepted at the facility until written permission is received from the Agency.

1.16. Bio-stabilised residual waste shall only be used as landfill cover where it has been stabilised in accordance with Condition 1.14.4 (or meets the requirements of an alternative protocol as may be agreed under condition 1.14.2), complies with any requirements of the Department of Agriculture, Fisheries and Food relating to the management of animal by-products and has been agreed in advance with the Agency.

1.17. Every plan, programme or proposal submitted to the Agency for its agreement pursuant to any Condition of this licence shall include a proposed timescale for its implementation. The Agency may modify or alter any such plan, programme or proposal in so far as it considers such modification or alteration to be necessary and shall notify the licensee in writing of any such modification or alteration. Every such plan, programme or proposal shall be carried out within the timescale fixed by the Agency but shall not be undertaken without the agreement of the Agency. Every such plan, programme or proposal agreed by the Agency shall be covered by the conditions of this licence.

1.18. This licence is being granted in substitution for the waste licence granted to the licensee on 19th March 2003 and bearing Waste Licence Register W0146-01. The previous waste licence (Register No: W0146-01) is superseded by this licence.

REASON: ***To clarify the scope of this licence.***

CONDITION 2 MANAGEMENT OF THE FACILITY

2.1 Facility Management

2.1.1 The licensee shall employ a suitably qualified and experienced facility manager who shall be designated as the person in charge. The facility manager or a nominated, suitably qualified and experienced, deputy shall be present on the facility at all times during its operation.

2.1.2 Both the facility manager and deputy, and any replacement manager or deputy, shall successfully complete both the FAS waste management training programme (or equivalent agreed by the Agency) and associated on site assessment appraisal within twelve months of appointment.

2.1.3 The licensee shall ensure that personnel performing specifically assigned tasks shall be qualified on the basis of appropriate education, training and experience, as required and shall be aware of the requirements of this licence.

2.2 Management Structure

2.2.1 The licensee shall maintain onsite written details of the management structure of the facility. Any proposed replacement in the management structure shall be notified in advance in writing to the Agency. Written details of the management structure shall include the following information:

a) the names of all persons who are to provide the management and supervision of the waste activities authorised by the licence, in particular the name of the facility manager and any nominated deputies;

b) details of the responsibilities for each individual named under a) above; and

c) details of the relevant education, training and experience held by each of the persons nominated under a) above.

2.3 Environmental Management System (EMS)

2.3.1 The licensee shall establish and maintain an EMS. The EMS shall be updated on an annual basis with amendments being submitted to the Agency for its agreement.

2.3.2 The EMS shall include as a minimum the following elements:

2.3.2.1 Schedule of Environmental Objectives and Targets

The licensee shall prepare and maintain a Schedule of Environmental Objectives and Targets. The schedule shall, as a minimum, provide for a review of all operations and processes, including an evaluation of practicable options, for energy and resource efficiency, the use of cleaner technology (including emissions prevention/reduction), and the beneficial recovery/recycling of waste in subsequent landfill engineering operations. The schedule shall include time frames for the achievement of set targets and shall address a five-year period as a minimum. The schedule shall be reviewed annually and amendments thereto notified to the Agency for agreement as part of the Annual Environmental Report (AER).

The licensee shall ensure insofar as practicable that environmental objectives and targets are met according to the stated schedule.

2.3.2.2 Landfill Environmental Management Plan (LEMP)

Within 12 months from the date of grant of this licence, the licensee shall prepare and maintain a LEMP, including a time schedule, for achieving the Environmental Objectives and Targets prepared under Condition 2.3.2.1. The LEMP shall have regard to the guidance set out in the EPA Manual on *Landfill Operational Practices*. The LEMP shall replace any existing EMP and shall include:

- designation of responsibility for targets;
- the means by which they may be achieved; and
- the time within which they may be achieved.

The LEMP shall be reviewed annually and take into account operational experiences at the facility, the stage of development of the facility (active, closure, aftercare), evolving legislative and BAT requirements, as well as any Agency instructions that may issue. Amendments shall be notified to the Agency for agreement as part of the Annual Environmental Report (AER).

A report on the programme, including the success in meeting agreed targets, shall be prepared and submitted to the Agency as part of the AER. Such reports shall be retained on-site for a period of not less than seven years and shall be available for inspection by authorised persons of the Agency.

2.3.2.3 Corrective Action Procedures

The Corrective Action Procedures shall detail the corrective actions to be taken should any of the procedures detailed in the EMS not be followed.

2.3.2.4 Awareness and Training Programme

The Awareness and Training Programme shall identify training needs, for personnel who work in or have responsibility for the licensed facility.

2.4 Communications Programme

2.4.1 The licensee shall establish and maintain a Communications Programme to inform and involve the local community and to ensure that members of the public can obtain information at the facility, at all reasonable times, concerning the environmental performance of the facility.

2.5.1 Resource Use and Energy Efficiency

2.5.1 The licensee shall carry out an audit of the energy efficiency of the site within one year of the date of grant of this licence. The audit shall:-

(i) identify all opportunities for energy use reduction and efficiency;

(ii) be carried out in accordance with the guidance published by the Agency - "Guidance Note on Energy Efficiency Auditing"; and

(iii) be repeated at intervals as required by the Agency.

The recommendations of the audit will be incorporated into the Schedule of Environmental Objectives and Targets under Condition 2.3.2.1 above.

2.5.2 The licensee shall identify opportunities for reduction in the quantity of water used on site including recycling and reuse initiatives, wherever possible. Reductions in water usage shall be incorporated into the Schedule of Environmental Objectives and Targets.

2.5.3 The licensee shall undertake an assessment of the efficiency of use of raw materials in all processes, having particular regard to the reduction in waste generated. The assessment should take account of best international practice for this type of activity. Where improvements are identified, these shall be incorporated into the Schedule of Environmental Objectives and Targets.

REASON: ***To make provision for the proper management of the activity on a planned basis having regard to the desirability of ongoing assessment, recording and reporting of matters affecting the environment. To provide for the efficient use of resources and energy in all site operations.***

CONDITION 3 FACILITY INFRASTRUCTURE

3.1 The licensee shall establish all infrastructure referred to in this licence prior to the commencement of the licensed activities or as required by the conditions of this licence.

3.2 Specified Engineering Works

3.2.1 The licensee shall submit proposals for all Specified Engineering Works, as defined in *Schedule B: Specified Engineering Works*, of this licence to the Agency for its agreement at least two months prior to the intended date of commencement of any such works. No such works shall be carried out without the prior agreement of the Agency.

3.2.2 All specified engineering works shall be supervised by a competent person(s) and that person, or persons, shall be present at all times during which relevant works are being undertaken.

3.2.3 Following the completion of all specified engineering works, the licensee shall complete a construction quality assurance validation. The validation report shall be made available to the Agency on request. The report shall include the following information:

a) a description of the works;

b) as-built drawings of the works;

c) records and results of all tests carried out (including failures);

d) drawings and sections showing the location of all samples and tests carried out;

e) daily record sheets/diary;

f) name(s) of contractor(s)/individual(s) responsible for undertaking the specified engineering works;

g) name(s) of individual(s) responsible for supervision of works and for quality assurance validation of works;

h) records of any problems and the remedial works carried out to resolve those problems; and

i) any other information requested in writing by the Agency.

3.3 Facility Notice Board

3.3.1 The licensee shall provide and maintain a Facility Notice Board on the facility so that it is legible to persons outside the main entrance to the facility. The minimum dimensions of the board shall be 1200 mm by 750 mm.

3.3.2 The board shall clearly show:

a) the name and telephone number of the facility;

b) the normal hours of opening;

c) the name of the licence holder;

d) an emergency out of hours contact telephone number;

e) the licence reference number; and

f) where environmental information relating to the facility can be obtained.

3.4 Facility Security

3.4.1 Security and stockproof fencing, gates and infrastructure shall be installed and maintained as described in Section 3.1.6 'Site Security' of the EIS. The locations shall be as shown on Drawing No's. 2000-144-01-11 'Fencing Details' and 2000-144-01-12 'Security & Fencing Layout' unless otherwise agreed by the agency. The base of the fencing shall be set in the ground.

3.4.2 The licensee shall remedy any defect in the gates and/or fencing as follows:

a) a temporary repair shall be made by the end of the working day; and,

b) a repair to the standard of the original gates and/or fencing shall be undertaken within three working days.

3.4.3 A Closed Circuit Television (CCTV) system shall be maintained at the facility as described in Section 3.1.6 'Site Security' of the EIS.

3.5 Facility Roads, Access Roads and Hardstanding

3.5.1 Effective site roads shall be provided and maintained to ensure the safe movement of vehicles within the facility. The proposed internal road network system and hardstanding areas shall be provided and maintained.

3.5.2 Access to and from the facility shall only be from the N2 via the existing access road.

3.5.3 The licensee shall consult with the roads authority on the prohibition of construction, waste disposal or leachate vehicles using the R150 road or the county road CR384 north and east of the facility en route to or from the facility.

3.6 Facility Office

3.6.1 The licensee shall provide and maintain an office at the facility. The office shall be constructed and maintained in a manner suitable for the processing and storing of documentation.

3.6.2 The licensee shall provide and maintain a working telephone and a method for electronic transfer of information at the facility.

3.7 Waste Inspection and Quarantine Areas

3.7.1 A Waste Inspection Area and a Waste Quarantine Area shall be maintained at the facility.

3.7.2 These areas shall be constructed and maintained in a manner suitable, and be of a size appropriate, for the inspection of waste and subsequent quarantine if required. The waste inspection area and the waste quarantine area shall be clearly identified and segregated from each other.

3.7.3 Drainage from these areas shall be directed to the leachate lagoon.

3.8 Weighbridge

3.8.1 The licensee shall provide and maintain two weighbridges at the facility.

3.9 Wheel Cleaning

3.9.1 The licensee shall maintain a dry wheel shake and wheelwash at the facility.

3.9.2 The wheel cleaner units shall be inspected on a daily basis and drained as required. Silt, stones and other accumulated material shall be removed as required from the wheel cleaner units. Following construction of the leachate lagoon, dirty water from the wheel cleaner shall be pumped to the lagoon.

3.10 Waste Water Treatment Plant

3.10.1 The licensee shall provide and maintain a Wastewater Treatment plant at the facility for the treatment of domestic wastewater arising on-site.

3.10.2 The outlet from the treatment plant shall discharge to the leachate lagoon.

3.10.3 During construction all wastewater arising on site shall be collected and disposed of off-site at a suitable Waste Water Treatment Plant unless otherwise agreed by the Agency.

3.11 Tank and Drum Storage Areas

3.11.1 The licensee shall provide and maintain a bunded fuel storage area at the facility.

3.11.2 All tank and drum storage areas shall be rendered impervious to the materials stored therein.

3.11.3 All tank and drum storage areas shall, as a minimum, be bunded, either locally or remotely, to a volume not less than the greater of the following:

(a) 110% of the capacity of the largest tank or drum within the bunded area; or

(b) 25% of the total volume of substance which could be stored within the bunded area.

3.11.4 All drainage from bunded areas shall be diverted for collection and safe disposal.

3.11.5 All inlets, outlets, vent pipes, valves and gauges must be within the bunded area.

3.11.6 Bunds should be designed having regard to Agency guidelines '*Storage and Transfer of Materials for Scheduled Activities*' (2004). The integrity and water tightness of all the bunds, tanks and containers and their resistance to penetration by water or other materials stored therein shall be tested and demonstrated by the licensee and shall be reported to the Agency following their installation and prior to their use as a fuel storage area. This testing shall be carried out by the licensee at least once every three years thereafter and reported to the Agency on each occasion. The licensee shall also maintain a record on the storage of fuels at the facility. A written record of all integrity tests and any maintenance or remedial work arising from them shall be maintained by the licensee.

3.11.7 All tanks and containers, including tankers used to transport leachate from the facility, shall be labelled to clearly indicate their contents.

3.12 Landfill Lining:

3.12.1 The landfill liner shall comprise:

(i) a composite liner consisting of a 1m layer of compacted soil with a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s, (or equivalent to be agreed by the Agency) overlain by a 2mm thick high density polyethylene (HDPE) layer;

(ii) a geotextile protection layer placed over the HDPE layer;

(iii) a 500mm thick drainage layer placed over the geotextile layer with a minimum hydraulic conductivity of 1 x 10^{-3} m/s, of pre-washed, uncrushed, granular, rounded stone (16 - 32mm grain size) incorporating leachate collection drains;

(iv) the side walls shall be designed and constructed to achieve an equivalent protection.

3.12.2 The liner system for the two leachate storage lagoons and the surface water pond shall comprise the following: a composite liner consisting of at minimum a basal soil/clay layer of at least 1m in thickness with a permeability of less than 1×10^{-9}m/s overlain by a 2mm thick high density polyethylene (HDPE) layer unless otherwise agreed in advance with the Agency.

3.12.3 The liner detailed design and its construction shall be in accordance with the guidelines provided in the Agency's Landfill Manual, Landfill Site Design.

3.12.4 Formation levels of the cells shall be as shown on Drawing No. 2000 –144-01-06 'Landfill Section' of the EIS.

3.13 Buffer Zone

3.13.1 A Buffer Zone, in which no waste shall be landfilled, shall be provided and maintained within the facility.

The Buffer Zone shall be a minimum of 100m between the landfill footprint (area being filled with waste) and the facility boundary.

3.14 Leachate Management Infrastructure

3.14.1 Effective leachate management infrastructure shall be provided and maintained at the facility as described in Section 3.1.3.9 'Leachate Collection System and Management Plan' of the EIS.

3.14.2 The licensee shall provide and maintain leachate storage lagoons at the facility to facilitate the storage of leachate abstracted/collected from the waste

3.14.3 The location of the leachate storage lagoons shall be as detailed on Drawing No. 2000-144-01-01 'Landfill Layout' unless otherwise agreed by the Agency.

3.14.4 All structures for the storage and/or treatment of leachate shall be fully enclosed except for inlet and outlet piping.

3.14.5 All leachate management structures on-site shall be inspected and certified fit for purpose on an annual basis by an independent and appropriately qualified chartered engineer. Any remedial works recommended in this report must be implemented immediately.

3.15 Landfill Gas Management

3.15.1 Landfill gas management at the facility shall be carried out as described in Section 3.1.4 Gas Management of the EIS submitted with the application unless the licence conditions require otherwise.

3.15.2 A Landfill Gas Flare and associated infrastructure shall be installed and maintained at the facility.

i) The flare shall be of an enclosed type design and shall comply with the emission limits in *Schedule C: Emission Limits*, of this licence.

ii) The relocation of the gas flaring system to the west of the facility shall be investigated prior to the final location being agreed by the Agency. The report of the investigation will accompany the proposal for installation of landfill gas management infrastructure required under Condition 3.2.1 and shall include the results of modelling carried out on the expected level of emissions.

3.15.3 Flare unit efficiency shall be tested upon installation, upon commencement of landfill gas combustion and once every three years thereafter.

3.15.4 The licensee shall maintain all gas wells, pipework, valves, pumps, flares and other infrastructure that form part of the landfill gas management scheme in a safe and fully operational manner.

3.15.5 Until the operation of the landfill gas flare, passive landfill gas management at the facility shall be carried out. Landfill gas management and infrastructure shall meet the recommendations outlined in the Agency Manuals on 'Landfill Site Design' and "Landfill Operational Practices".

3.15.6 All buildings constructed on the facility shall have regard to the guidance given in the Department of Environment 1994 publication "Protection of New Buildings and Occupants from Landfill Gas" and any subsequent revisions.

3.15.7 Where the utilisation of landfill gas as an energy resource is feasible, as may be agreed by the Agency, a system for such utilisation shall be installed within a timeframe agreed by the Agency. Such a system shall, where feasible and practicable, provide heat energy to other premises/facilities at and in the vicinity of the facility and a fuel for on-site vehicles.

3.15.8 The licensee shall install continuous carbon monoxide monitors on the outlets of the gas engine(s).

3.16 Surface Water Management

3.16.1 Effective surface water management infrastructure shall be provided and maintained at the facility during construction, operation, restoration and aftercare of the facility.

3.16.2 Surface water management infrastructure shall be provided and maintained at the facility. As a minimum, the infrastructure shall be capable of the following:

a) the prevention of contaminated water and leachate discharges into surface water drains and courses; and

b) the collection/diversion of run off arising from capped and restored areas, incorporating adequately sized swales.

3.16.3 The surface water ponds, surface water management infrastructure and stream diversions shall be constructed and operational prior to the commencement of other construction works.

3.16.4 The surface water from all roads, hardstanding areas and all areas of the facility where surface water has the potential to become contaminated shall be directed to the surface water pond.

3.16.5 The design and capacity of the surface water pond shall ensure that it is capable of fulfilling the requirements of this licence and dealing with all surface water run-off from potentially contaminated areas of the facility. The surface water pond shall be constructed and maintained at the location as shown in Drawing No. 2000-114-01-05 'Leachate Lagoon and Storm Water Pond Details' unless otherwise agreed by the Agency.

3.16.6 The inlet to the surface water pond shall be fitted with a Class I Full Oil Interceptor.

The discharge from the surface water pond shall be controlled by an actuated penstock that will prevent surface water discharging in the event that monitoring should indicate contamination of the surface water.

3.17 Groundwater Management

3.17.1 Effective groundwater management infrastructure shall be provided and maintained at the facility during construction, operation, restoration and aftercare of the facility. As a minimum, the infrastructure shall be capable of the following:

a) the protection of the groundwater resources from pollution by the waste activities; and

b) the protection of other infrastructure, such as the liner, from any adverse effects caused by the groundwater.

3.18 A perimeter berm shall be constructed at the facility as described in Section 4.10.3 'Mitigation, Construction Aspects' of the EIS.

3.19 Telemetry

3.19.1 A telemetry system shall be installed and maintained at the facility. All facility operations linked to the telemetry system shall also have a manual control which will be reverted to in the event of break in power supply or during maintenance.

3.20 Monitoring Infrastructure

3.20.1 Landfill Gas

(i) The construction of the monitoring boreholes shall be phased so as to match the phased development of cells. The licensee shall install landfill gas monitoring infrastructure at the following locations.

(a) perimeter monitoring boreholes at 50m intervals around the periphery of the landfill footprint,

(b) site office and all other site buildings; and

(c) a minimum of two monitoring boreholes per hectare within the waste mass.

(ii) The licensee shall install and maintain a permanent continuous gas monitoring system with an alarm in the site office and in any other enclosed structures at the facility.

3.20.2 Groundwater

(i) The licensee shall install and maintain the following borehole monitoring points to allow for the sampling and analyses of groundwater:

a) MW1d, MW2d, MW3d, MW5d, MW6d, MW7d and MW16d as detailed in Table J.1 and Figure J.1 'Suggested Monitoring Locations' of the EIS.

3.20.3 Leachate

(i) The licensee shall install and maintain leachate monitoring points in each active cell and in each leachate storage lagoon to allow for the sampling and analyses of leachate.

3.20.4 Replacement of Infrastructure

(i) Monitoring infrastructure which is damaged or proves to be unsuitable for its purpose shall be replaced within three months of it being damaged or recognised as being unsuitable.

3.21 Meteorological Monitoring

3.21.1 Prior to the commencement of waste activities the licensee shall provide and maintain a meteorological station at the facility capable of monitoring the parameters listed in *Schedule D.6: Meteorological Monitoring* of this licence.

3.22 The licensee shall consult with Bord Gáis prior to construction or development work within 100m of the gas pipeline.

3.23 Prior to commencement of any construction works, the licensee shall submit to the Agency for its agreement, a proposal after consulting the National Parks and Wildlife Service and the Department of Agriculture, Fisheries and Food on the relocation of badgers, newts, frogs, bats and barn owls within the facility. Timetables for removal of trees and preliminary development work shall be in accordance with the requirements of the Wildlife Act 1976.

REASON: To provide appropriate infrastructure for the protection of the environment.

CONDITION 4 RESTORATION AND AFTERCARE

4.1. The licensee shall maintain and implement a Restoration and Aftercare Plan for the facility. The Restoration and Aftercare Plan shall have regard to the guidance published in the Agency's Landfill Manual on "Landfill Restoration and Aftercare" or any other relevant guidance as agreed by the Agency. The licensee shall restore the facility on a phased basis. In particular the plan shall include:

a) Potential restoration options;

b) The proposed consultation process in relation to the restoration options for the facility; and

c) Proposals for nature conservation and woodland restoration.

The plan shall be reviewed annually and proposed amendments notified to the Agency for agreement as part of the AER. No amendments may be implemented without the prior agreement of the Agency.

4.2. The final profile/height of the facility shall be a maximum of 74mOD Malin and be domed in shape. The licensee shall submit a map showing the final contour layout within three months of the date of grant of licence.

4.3. Final Capping

4.3.1. Unless otherwise agreed by the Agency, the final capping shall consist of the following:

a) top soil (150 -300mm);

b) subsoils, such that total thickness of top soil and subsoils is at least 1m;

c) drainage layer of 0.5m thickness having a minimum hydraulic conductivity of $1x10^{-4}$ m/s or an equivalent geosynthetic layer;

d) compacted mineral layer of a minimum 0.6m thickness with a permeability of less than $1x10^{-9}$ m/s or a geosynthetic material (e.g. GCL) or similar that provides equivalent protection; and

e) gas collection layer of natural material (minimum 0.3m) or a geosynthetic layer.

4.4. The licensee shall maintain a stockpile of capping materials at the facility containing the requisite volume of capping materials for a six-month period. If using geosynthetic material, the licensee shall ensure that adequate secure supplies are available.

4.5. No material or object that is incompatible with the proposed restoration of the facility shall be present within one metre of the final soil surface levels.

4.6. Where tree planting is to be carried out above waste-filled areas, a synthetic barrier shall be used to augment the clay cap in accordance with the EPA Manual on Landfill Restoration And Aftercare.

4.7. Soil Storage

4.7.1. All soils shall be stored to preserve the soil structure for future use.

4.8 A final validation report to include a certificate of completion for the Restoration and Aftercare Plan, for all or part of the site as necessary, shall be submitted to the Agency within three months of execution of the plan. The licensee shall carry out such tests, investigations or submit certification, as requested by the Agency, to confirm that there is no continuing risk to the environment.

REASON: ***To provide for the restoration of the facility.***

3.18 A perimeter berm shall be constructed at the facility as described in Section 4.10.3 'Mitigation, Construction Aspects' of the EIS.

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3.19.1 A telemetry system shall be installed and maintained at the facility. All facility operations linked to the telemetry system shall also have a manual control which will be reverted to in the event of break in power supply or during maintenance.

3.20 Monitoring Infrastructure

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(i) The construction of the monitoring boreholes shall be phased so as to match the phased development of cells. The licensee shall install landfill gas monitoring infrastructure at the following locations.

(a) perimeter monitoring boreholes at 50m intervals around the periphery of the landfill footprint,

(b) site office and all other site buildings; and

(c) a minimum of two monitoring boreholes per hectare within the waste mass.

(ii) The licensee shall install and maintain a permanent continuous gas monitoring system with an alarm in the site office and in any other enclosed structures at the facility.

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(i) The licensee shall install and maintain the following borehole monitoring points to allow for the sampling and analyses of groundwater:

a) MW1d, MW2d, MW3d, MW5d, MW6d, MW7d and MW16d as detailed in Table J.1 and Figure J.1 'Suggested Monitoring Locations' of the EIS.

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3.21.1 Prior to the commencement of waste activities the licensee shall provide and maintain a meteorological station at the facility capable of monitoring the parameters listed in *Schedule D.6: Meteorological Monitoring* of this licence.

3.22 The licensee shall consult with Bord Gáis prior to construction or development work within 100m of the gas pipeline.

3.23 Prior to commencement of any construction works, the licensee shall submit to the Agency for its agreement, a proposal after consulting the National Parks and Wildlife Service and the Department of Agriculture, Fisheries and Food on the relocation of badgers, newts, frogs, bats and barn owls within the facility. Timetables for removal of trees and preliminary development work shall be in accordance with the requirements of the Wildlife Act 1976.

REASON: To provide appropriate infrastructure for the protection of the environment.

CONDITION 4 RESTORATION AND AFTERCARE

4.1. The licensee shall maintain and implement a Restoration and Aftercare Plan for the facility. The Restoration and Aftercare Plan shall have regard to the guidance published in the Agency's Landfill Manual on "Landfill Restoration and Aftercare" or any other relevant guidance as agreed by the Agency. The licensee shall restore the facility on a phased basis. In particular the plan shall include:

a) Potential restoration options;

b) The proposed consultation process in relation to the restoration options for the facility; and

c) Proposals for nature conservation and woodland restoration.

The plan shall be reviewed annually and proposed amendments notified to the Agency for agreement as part of the AER. No amendments may be implemented without the prior agreement of the Agency.

4.2. The final profile/height of the facility shall be a maximum of 74mOD Malin and be domed in shape. The licensee shall submit a map showing the final contour layout within three months of the date of grant of licence.

4.3. Final Capping

4.3.1. Unless otherwise agreed by the Agency, the final capping shall consist of the following:

a) top soil (150 -300mm);

b) subsoils, such that total thickness of top soil and subsoils is at least 1m;

c) drainage layer of 0.5m thickness having a minimum hydraulic conductivity of $1x10^{-4}$ m/s or an equivalent geosynthetic layer;

d) compacted mineral layer of a minimum 0.6m thickness with a permeability of less than $1x10^{-9}$ m/s or a geosynthetic material (e.g. GCL) or similar that provides equivalent protection; and

e) gas collection layer of natural material (minimum 0.3m) or a geosynthetic layer.

4.4. The licensee shall maintain a stockpile of capping materials at the facility containing the requisite volume of capping materials for a six-month period. If using geosynthetic material, the licensee shall ensure that adequate secure supplies are available.

4.5. No material or object that is incompatible with the proposed restoration of the facility shall be present within one metre of the final soil surface levels.

4.6. Where tree planting is to be carried out above waste-filled areas, a synthetic barrier shall be used to augment the clay cap in accordance with the EPA Manual on Landfill Restoration And Aftercare.

4.7. Soil Storage

4.7.1. All soils shall be stored to preserve the soil structure for future use.

4.8 A final validation report to include a certificate of completion for the Restoration and Aftercare Plan, for all or part of the site as necessary, shall be submitted to the Agency within three months of execution of the plan. The licensee shall carry out such tests, investigations or submit certification, as requested by the Agency, to confirm that there is no continuing risk to the environment.

REASON: ***To provide for the restoration of the facility.***

CONDITION 5 FACILITY OPERATIONS AND WASTE MANAGEMENT

5.1 Wastes shall not be deposited in any cell or part of the landfill without the prior agreement of the Agency.

5.2 Waste shall only be accepted at the facility from holders of waste collection permits under the Waste Management (Collection Permit) Regulations 2007. The licensee must maintain copies of these waste permits on-site.

5.3 Waste Acceptance and Characterisation Procedures

Within one month of the date of grant of this licence, the licensee shall submit to the Agency for its agreement updated written procedures for the acceptance and handling of all wastes. These procedures shall include details of the treatment of all waste to be carried out in advance of acceptance at the facility and shall also include methods for the characterisation, classification and coding of waste. The procedures shall have regard to the Council Decision (2003/33/EC) establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC on the landfill of waste.

5.4 All wastes shall be checked at the working face. Any waste deemed unsuitable for acceptance at the facility and/or in contravention of this licence shall be immediately separated and removed from the facility at the earliest possible time. Temporary storage of such wastes shall be in a designated Waste Quarantine Area. Waste shall be stored under appropriate conditions in the quarantine area to avoid putrefaction, odour generation, the attraction of vermin and any other nuisance or objectionable condition.

5.5 The licensee shall ensure that inert waste accepted at the facility is subject to pre-treatment where technically feasible and appropriate.

5.6 Working Face

5.6.1 Unless the prior agreement of the Agency is given, the following shall apply at the landfill:

a) only one working face shall exist at the landfill at any one time for the deposit of waste other than cover or restoration materials; and

b) the working face of the landfill shall be no more than 25 metres long and 25 metres wide (i.e. <625m^2 surface area), no more than 2.5 metres in height after compaction, and have a slope no greater than 1 in 3.

5.6.2 All waste deposited at the working face shall be compacted, using a steel wheeled compactor, and covered as soon as is practicable and at any rate prior to the end of the working day.

5.6.3 The working face, or faces, shall each day at the end of the day, be covered with suitable material.

5.7 Daily and Intermediate Cover

5.7.1 Daily and Intermediate capping material shall be as described in Section 3.1.5.1 'Intermediate Capping' of the EIS. Daily cover should be 150mm in depth while intermediate capping should be 300mm in depth unless otherwise agreed by the Agency.

5.7.2 The working face of the operational cell shall, at the end of each day, be covered with suitable material to minimise any nuisances occurring.

5.7.3 Any cover material at any location within the facility which is eroded, washed off or otherwise removed shall be replaced by the end of the working day.

5.8 Landscaping

5.8.1 Landscaping of the facility shall be as described in Section 4.10 'Landscape and Visual Aspects' and associated figures of the EIS.

5.8.2 Apart from the removal of hedgerow to facilitate the facility entrance, the existing hedgerow network which forms the boundary of the facility shall be retained by the licensee as indicated in Section 4.10 'Landscape and Visual Aspects' of the EIS.

5.8.3 The Licensee shall submit a report, as part of the AER, on the implementation of the landscaping programme. In particular the report shall outline progress in meeting objectives outlined in Section 4.10.3 of the EIS, planting, die back rate and enhancement of natural biodiversity.

5.9 Operational Controls

5.9.1 The landfill shall be filled in accordance with the seven phase sequence outlined in Sections 3.1.3 as specified in the EIS.

5.9.2 All large hollow objects and other large articles deposited at the facility shall be crushed, broken up, flattened or otherwise treated.

5.9.3 Wastes once deposited and covered shall not be excavated, disturbed or otherwise picked over with the exception of works associated with the construction and installation of the landfill gas collection system only with the prior agreement from the Agency.

5.9.4 Completed areas of the landfill shall be profiled so that no depressions exist in which water may accumulate.

5.9.5 Unless otherwise agreed, filled cells shall be permanently capped within 24 months of the cells having been filled to the required level.

5.9.6 Scavenging shall not be permitted at the facility.

5.9.7 Gates shall be locked shut when the facility is unsupervised.

5.9.8 The licensee shall provide and use adequate lighting during the operation of the facility in hours of darkness.

5.9.9 Fuels shall only be stored at appropriately bunded locations on the facility.

5.9.10 All tanks and drums shall be labelled to clearly indicate their contents.

5.9.11 No smoking shall be allowed on the facility (other than in the administration/office block as shown on Drawing No. 2000-144-01-02 "Site Facilities Services Layout").

5.10 Off-site Disposal and Recovery

5.10.1 Waste sent off-site for recovery or disposal shall only be conveyed by a waste contractor agreed by the Agency.

5.10.2 All waste transferred from the facility shall only be transferred to an appropriate facility agreed by the Agency.

5.10.3 All waste removed off-site for recovery or disposal shall be transported from the facility to the consignee in a manner which will not adversely affect the environment.

5.11 Leachate Management

5.11.1 The licensee shall submit details for agreement with the Agency on any proposals for the pre-treatment of leachate on-site prior to carrying out such an activity. The details shall include information on the proposed leachate treatment system including its operational criteria, the proposed standards for treated leachate and a timescale for the construction and commissioning of the system.

5.11.2 Leachate levels in the waste shall not exceed a level of 1.0m over the top of the liner at the base of the landfill.

5.11.3 The level of leachate in the pump sumps shall be continuously monitored.

5.11.4 Unless otherwise agreed by the Agency leachate stored in the leachate storage lagoon shall be disposed of by tankering off-site in fully enclosed road tankers and discharging to an agreed Sanitary Authority Waste Water Treatment Plant as per Condition 6.7.1. The frequency of leachate removal from the leachate lagoon shall be such that a minimum freeboard of 0.75m shall be maintained in the leachate lagoon at all times.

5.12 Leachate Re-circulation

5.12.1 Re-circulation of leachate or other contaminated water shall not be undertaken without the prior agreement of the Agency and shall only be undertaken within cells, which have been lined and capped to the satisfaction of the Agency.

5.13 Noise

5.13.1 In order to mitigate against noise emissions from the facility the licensee shall:

a) Construct an earth berm, three metres in height, around the perimeter of the waste disposal cells;

b) Plant a 50 metre wide band of woodland plantation inside the entire facility boundary where it does not interfere with overhead powerlines;

c) Impose vehicle speed limits on all internal site roads; and

d) Fit all heavy machinery used on-site with acoustic panels in the engine bays and acoustic mufflers (exhaust silencers).

5.14 Maintenance

5.14.1 All treatment/abatement and emission control equipment shall be calibrated and maintained, in accordance with the instructions issued by the manufacturer/supplier or installer. Written records of the calibrations and maintenance shall be made and kept by the licensee.

5.14.2 The licensee shall maintain and clearly label and name all sampling and monitoring locations.

5.14.3 The wheel-wash shall be inspected on a daily basis and drained as required. Silt, stones and other accumulated material shall be removed as required from the wheel-wash and disposed of at the working face or to a skip.

5.15 The waste acceptance procedures established under Condition 5.3 shall provide:-

(i) For the checking of waste documentation on receipt of waste in the waste reception area;

(ii) For non pre-cleared customers, the visual inspection and testing of waste in the waste inspection area pending acceptance/rejection;

(iii) For the visual inspection of waste when deposited at the working face;

(iv) For the keeping for two months of any samples associated with on-site verification sampling of waste accepted at the facility.

REASON: ***To provide for appropriate operation of the facility to ensure protection of the environment.***

CONDITION 6 EMISSIONS

6.1. No specified emission from the facility shall exceed the emission limit values set out in *Schedule C: Emission Limits*, of this licence. There shall be no other emissions of environmental significance.

6.2. The licensee shall ensure that the activities shall be carried out in a manner such that emissions do not result in significant impairment of, or significant interference with the environment beyond the facility boundary.

6.3. Landfill Gas

6.3.1. The following are the trigger levels for landfill gas emissions from the facility measured in any service duct or manhole on, at or immediately adjacent to the facility and/or at any other point located outside the body of the waste:

a) Methane, greater than or equal to 1.0% v/v; and

b) Carbon dioxide, greater than or equal to 1.5% v/v.

6.3.2. The concentration limits for emissions to atmosphere specified in this licence shall be achieved without the introduction of dilution air and shall be based on gas volumes under standard conditions of :-

a) in the case of landfill gas flare:

Temperature 273 K, pressure 101.3 kPa, dry gas at 3% oxygen; and

b) in the case of landfill gas combustion plant:

Temperature 273 K, pressure 101.3 kPa, dry gas; at 5% oxygen.

6.3.3. Emission limits for landfill gas emissions to atmosphere in this licence shall be interpreted in the following way:-

6.3.3.1. Continuous monitoring

(i) No 24 hour mean value shall exceed the emission limit value.

(ii) 97% of all 30 minute mean values taken continuously over an annual period shall not exceed 1.2 times the emission limit value.

(iii) No 30 minute mean value shall exceed twice the emission limit value.

6.3.3.2 Non-Continuous Monitoring

(i) For any parameter where, due to sampling/analytical limitations, a 30 minute sample is inappropriate, a suitable sampling period should be employed and the value obtained therein shall not exceed the emission limit value.

(ii) For all other parameters, no 30 minute mean value shall exceed the emission limit value.

(iii) For flow, no hourly or daily mean value shall exceed the emission limit value.

6.4. Emissions to Surface Water

6.4.1. Surface water emissions from the surface water pond shall only be made to the adjacent stream at a location agreed in advance by the Agency.

6.4.2. No raw leachate, treated leachate or contaminated surface water shall be discharged to the adjacent stream or any part of the Nanny River catchment.

6.4.3. No substance shall be discharged in a manner, or at a concentration which, following initial dilution causes tainting of fish or shellfish.

6.5. There shall be no direct emissions to groundwater.

6.6. Within three months of the date of grant of this licence, the licensee shall submit to the Agency for its agreement groundwater monitoring trigger levels in accordance with the requirements of Directive 1999/31/EC.

6.7. Disposal of Leachate

6.7.1 The licensee shall maintain an agreement or agreements between the licensee and a Sanitary Authority for accepting leachate from the facility at a waste water treatment plant.

6.8 Trigger Levels for PM_{10}

6.8.1 The trigger level for PM_{10} from the facility measured at any location on the boundary of the facility is:

a) PM_{10} greater than $50\mu g/m^3$ for a daily sample.

6.9 Noise Emissions

6.9.1 There shall be no clearly audible tonal component or impulsive component in the noise emissions from the facility at the facility boundary.

6.10 Odour Control and Monitoring

6.10.1 Within six months of the date of grant of this licence, the licensee shall submit to the Agency for agreement an Odour Management Plan (OMP) for the facility. The plan, as agreed, shall be implemented from the time of commencement of waste activities unless otherwise agreed by the Agency.

6.10.2 The OMP referred to in Condition 6.10.1 shall include measures to control potential sources of odour nuisance, including inter alia, provisions regarding:

(a) Requirements of relevant conditions of this licence;

(b) Adequate resources and training on-site to provide for the maintenance, monitoring and operation of the landfill gas extraction system;

(c) Acceptance and management of odorous waste deliveries;

(d) Arrangements for the biannual preparation of an independent assessment and report on surface VOC emissions at the facility following completion of waste acceptance in any cell/sub-cell;

(e) Use of sacrificial gas extraction systems; phased capping of the waste body; and an interim capping system at inter-cell boundaries;

(f) Working face/active cell sizing and covering;

(g) Landfill gas collection:- locations of infrastructure including access/haul roads, well design and density, monitoring, condensate management, field balancing, flare/combustion plant operation;

(h) Identification of fugitive sources of landfill gas emissions (e.g. from leachate management infrastructure and/or from side slopes);

(i) Monitoring:- VOC surface emissions from capped areas, odour checks off- and on-site, receipt and evaluation/verification of odour complaints received.

6.10.3 To meet the requirements of the OMP, the licensee shall carry out a monthly review of odour control measures in place at the facility and maintain findings in a monthly report. This shall include:

(a) Consideration of odour complaints received during period (including details and nature of complaints, times and weather conditions, any unusual circumstances, problems, etc.);

(b) Review of any monitoring, including ambient odour monitoring in accordance *Schedule D.10: Ambient Odour Monitoring*, of this licence, carried out (and including investigation of complaints and actions taken where relevant);

(c) An update on the existing landfill gas control infrastructure (including operational status, number of wells & vents connected and unconnected to the landfill gas collection system, quantity of gas collected and flared/utilised, estimated quantity of landfill gas being produced, details of any problems with equipment during period);

(d) Details of any remedial/corrective actions taken, where relevant, including actions taken on foot of recommendations from previous report; and recommendations.

The licensee shall maintain these reports on site and forward them to the Agency on request.

6.10.4 The OMP shall be reviewed annually and any updates/amendments submitted to the Agency as part of the Annual Environmental Report.

6.10.5 In relation to surface emissions from the waste body and identified features, the following shall constitute a trigger level:

(a) VOC greater than or equal to 50ppmv as methane average over capped area; or

(b) VOC greater than or equal to 100ppmv as methane instantaneous reading on open surfaces within the landfill footprint; or

(c) VOC greater than or equal to 500ppmv as methane around all identified features.

6.10.6 Leachate holding tanks/lagoons shall be covered, and head gases vented to treatment as may be required by the Agency.

6.10.7 All odorous or odour-forming wastes shall be covered as soon as practicable and in any case at the end of the working day.

6.10.8 Where it is proposed to take biological sludges at the facility, these must be subject to appropriate pre-treatment in advance of acceptance at the facility.

6.10.9 When siting and operating landfill gas infrastructure, regard shall be had to the potential for, and mitigation of, odour nuisance.

6.11 Air Emissions

The licensee shall install a continuous VOC monitor with directional information at the school (if agreed) otherwise at a location on a site agreed by the Agency. This requirement will be reviewed by the Agency on an annual basis.

REASON: ***To control emissions from the facility and provide for the protection of the environment.***

CONDITION 7 NUISANCE CONTROL

7.1 The licensee shall ensure that vermin, birds, flies, mud, dust, litter and odours do not give rise to nuisance at the facility or in the immediate area of the facility. Any method used by the licensee to control any such nuisance shall not cause environmental pollution.

7.2 The road network in the vicinity of the facility shall be kept free from any debris and deposited waste caused by vehicles entering or leaving the facility. Any such debris or deposited waste shall be removed without delay.

7.3 Litter Control

7.3.1 Litter fencing and netting shall be installed and maintained around the perimeter of the active tipping area prior to the disposal of any waste in any cell. The netting shall meet the guidance provided in the Agency's Manual on "Landfill Operational Practices". The height of the netting shall be minimised so as to not cause visual intrusion and the netting shall be kept tidy. Litter trapped in the netting shall be removed as soon as practicable. Portable litter nets/screens shall also be used at the active tipping face.

7.3.2 All litter control infrastructure shall be inspected on a daily basis. The licensee shall remedy any defect in the litter netting as follows:

a) a temporary repair shall be made by the end of the working day; and,

b) a repair to the standard of the original netting shall be undertaken within three working days.

7.3.3 All loose litter or other waste, placed on or in the vicinity of the facility, other than in accordance with the requirements of this licences, shall be removed, subject to the agreement of the landowners, immediately and in any event by 10.00am of the next working day after such waste is discovered.

7.3.4 The licensee shall ensure that all vehicles delivering waste to and removing waste and materials from the facility are appropriately covered.

7.4 Dust Control

7.4.1 From the commencement of construction of the facility the Dust Control Measures outlined in Sections 3.3.3, 4.2.2.1 and 4.2.3.1 Dust Emissions of the EIS shall be implemented at the facility.

7.4.2 In dry weather, site roads and any other areas used by vehicles shall be sprayed with water as and when required to minimise airborne dust nuisance.

7.4.3 All stockpiles shall be adequately contained to minimise dust generation.

7.5 Prior to exiting the facility, all waste vehicles shall use the wheelwash.

7.6 Bird Control

7.6.1 Birds shall be prevented from gathering on and feeding at the facility by the use of birds of prey and/or other bird scaring techniques. The birds of prey and/or other techniques shall be in place on the facility at least two weeks prior to any waste being disposed of and shall maintain their presence every day, from before dawn to after dark, until the waste activities cease and all the waste is capped to the written satisfaction of the Agency.

7.6.2 The licensee shall, as may be required by the Agency, carry out an assessment of the effectiveness of the bird control measures at the facility. This assessment shall include, where required:

a) proposals for additional bird control measures;

b) method for assessing the effectiveness of such additional measures; and,

c) timescales for the implementation of such measures.

7.7 Vermin Control

7.7.1 The licensee shall maintain and apply vermin control procedures and measures which shall include as a minimum the following:

(a) details on the insecticides(s) and rodenticides(s) to be used;

(b) operator training;

(c) mode and frequency of application and measurers to contain sprays at the facility boundary;

(d) details on the precautions (including supporting documentation) to be taken to minimise the secondary poisoning of birds and other species from the use of the insecticides and rodenticides proposed;

(e) copies of any comments received from National Parks and Wildlife Service on the vermin control proposed; and

(f) response proposed to complaints received about any vermin adjacent to the facility.

REASON: To provide for the control of nuisances.

CONDITION 8 MONITORING

8.1 The licensee shall carry out such monitoring and at such locations and frequencies as set out in *Schedule D: Monitoring*, of this licence and as specified in this licence.

8.2 The licensee shall amend the frequency, locations, methods and scope of monitoring as required by this licence only upon the written instruction of the Agency and shall provide such information concerning such amendments as may be requested in writing by the Agency. Such alterations shall be carried out within any timescale nominated by the Agency.

8.3 Monitoring and analysis equipment shall be operated and maintained in accordance with the manufacturers' instructions (if any) so that all monitoring results accurately reflect any emission, discharge or environmental parameter.

8.4 The licensee shall provide safe and permanent access to all on-site sampling and monitoring points and to off-site points as required by the Agency.

8.5 All persons conducting the sampling, monitoring and interpretation as required by this licence shall be suitably competent.

8.6 Landfill Gas

8.6.1 All landfill gas monitoring equipment, other than permanent monitoring systems within buildings, shall be certified as being intrinsically safe.

8.7 Groundwater Monitoring

8.7.1 Subject to the agreement of the well owners, all private wells within 1km of the landfill footprint shall be included in the monitoring programme set out in *Schedule D: Monitoring*, of this licence.

8.8 Surface Water Monitoring

8.8.1 The licensee shall implement a continuous monitoring programme for the water in the surface water pond. This programme shall include the criteria/trigger levels, which will determine which the automated penstock in the outlet from the surface water pond shall be closed. Such continuous monitoring shall, as a minimum, include conductivity, pH and TOC and shall be carried out on the inlet to the surface water pond at a monitoring location to be agreed by the Agency.

8.9 Topographical Survey

8.9.1 A topographical survey shall be carried out annually at the facility. The survey shall include a measurement of the remaining available void space. The survey shall be in accordance with any written instructions issued by the Agency.

8.10 Biological Assessment

8.10.1 An annual biological assessment of the Kentstown Stream and Nanny River shall be undertaken. This assessment shall use appropriate biological methods such as the EPA Q-rating system for the assessment of rivers and streams. The report shall include a map showing the location of monitoring points, each identified by a unique number and a twelve-point grid reference. The scope, content and details of the contractor carrying out the assessment shall be submitted to the Agency for its agreement prior to the assessment.

8.11 Archaeological Assessment

8.11.1 Prior to the development of any undisturbed area, the holy well or farm building, the advice of the National Parks and Wildlife Service or relevant expertise in the Department of Environment, Heritage and Local Government (DOEHLG) shall be sought. On completion of such development a report of the results of any archaeological monitoring shall be submitted to the DOEHLG and to the Agency.

8.12 Stability Assessment

8.12.1 The licensee shall carry out an annual stability assessment of the side slopes of the facility.

8.13 Nuisance Monitoring

8.13.1 The licensee shall, at a minimum of one-week intervals, inspect the facility and its immediate surrounds for nuisances caused by litter, vermin, birds, flies, mud, dust and odours unless otherwise agreed or instructed by the Agency.

8.14 The licensee shall ensure that any waste acceptance testing and analysis required by this licence shall be carried out by competent laboratories in accordance with CEN-standards. If CEN standards are not available, ISO, national or international standards or alternative methods shall apply with the agreement of the Agency.

REASON: To ensure compliance with the conditions of this licence by provision of a satisfactory system of monitoring of emissions.

CONDITION 9 CONTINGENCY ARRANGEMENTS

9.1. In the event of an incident the licensee shall immediately:

a) identify the date, time and place of the incident;

b) carry out an immediate investigation to identify the nature, source and cause of the incident and any emission arising therefrom;

c) isolate the source of any such emission;

d) evaluate the environmental pollution, if any, caused by the incident;

e) identify and execute measures to minimise the emissions/malfunction and the effects thereof;

f) provide a proposal to the Agency for its agreement within one month of the incident occurring to:

i) identify and put in place measures to avoid reoccurrence of the incident; and

ii) identify and put in place any other appropriate remedial action.

9.2. The licensee shall maintain, review annually and update as necessary a written Emergency Response Procedure (ERP), which shall be to the satisfaction of the Agency. The ERP shall address any emergency situations which may originate on the facility and shall include provision for minimising the effects of any emergency on the environment. This shall include a risk assessment to determine the requirements at the facility for fire fighting and fire water retention facilities. The Fire Authority shall be consulted by the licensee during this assessment.

9.3. The licensee shall have in storage an adequate supply of containment booms and/or suitable absorbent material to contain and absorb any spillage at the facility. Once used the absorbent material shall be disposed of at an appropriate facility.

9.4. Emergencies

9.4.1. All significant spillages occurring at the facility shall be treated as an emergency and immediately cleaned up and dealt with so as to alleviate their effects.

9.4.2. No waste shall be burnt within the boundaries of the facility. A fire at the facility shall be treated as an emergency and immediate action shall be taken to extinguish it and notify the appropriate authorities.

9.4.3. In the event that monitoring of local wells indicates that the facility is having a significant adverse effect on the quantity and/or quality of the water supply this shall be treated as an emergency and the licensee shall provide and fund an alternative supply of water to those affected.

9.4.4. In the event that monitoring of the slide slopes of the facility indicate that there may be a risk of slope failure this will be treated as an emergency.

9.4.5. In the event that monitoring should indicate contamination of the site surface water in the Knockharley stream, the stream shall be diverted to the surface water lagoon.

9.5 After construction of the facility, or part thereof, and prior to the disposal of any waste in the facility or part thereof, and prior to the use of any infrastructure at the facility, an independent third party shall carry out a risk assessment of the facility, or part thereof, as agreed in advance with the Agency. The risk assessment shall pay particular regard to any accidents, emergencies, or other incidents, which might occur at the facility and their effect on the environment, on the neighbours of the facility and on adjoining land-uses. The assessment and recommendations, including a timescale for implementation, shall be submitted to the Agency for agreement. The agreed recommendations shall be implemented within the agreed timescale.

9.6 The licensee shall maintain a documented Accident Prevention Policy which will address the hazards on-site, particularly in relation to the prevention of accidents with a possible impact on the environment. This procedure shall be reviewed annually and updated as necessary.

REASON: To ensure compliance with the conditions of this licence by provision of a satisfactory system of monitoring of emissions. To provide for the protection of the environment.

CONDITION 10 RECORDS

10.1 The licensee shall keep the following documents at the facility office.

a) the current waste licence relating to the facility;
b) the current EMS for the facility;
c) the previous year's AER for the facility;
d) all written procedures produced by the licensee which relate to the licensed activities.

10.2 The licensee shall maintain a written record for each load of waste arriving at the facility. The licensee shall record the following:

a) the date and time;
b) the name of the carrier (including if appropriate, the waste carrier registration details);
c) the vehicle registration number;
d) the trailer, skip or other container unique identification number (where relevant)
e) the name of the producer(s)/collector(s) of the waste as appropriate;
f) the name of the waste facility (if appropriate) from which the load originated including the waste licence or waste permit register number;
g) a description of the waste including the associated EWC/HWL codes;
h) the quantity of the waste, recorded in tonnes;
i) details of the treatment(s) to which the waste has been subjected;
j) the classification and coding of the waste, including whether MSW or otherwise;
k) Whether the waste is for disposal or recovery and if recovery, for what purpose;
l) the name of the person checking the load; and,
m) where loads or wastes are removed or rejected, details of the date of occurrence, the types of waste and the facility to which they were removed.

10.3 Written Records

The following written records shall be maintained by the licensee:

a) the types and quantities of waste recovered and disposed of at the facility each year. These records shall include the relevant EWC Codes;

b) all training undertaken by facility staff;

c) results from all integrity tests of bunds and other structures and any maintenance or remedial work arising from them;

d) details of all nuisance inspections; and

- e) the names and qualifications of all persons who carry out all sampling and monitoring as required by this licence and who carry out the interpretation of the results of such sampling and monitoring.

10.4 The licensee shall maintain a written record of all complaints relating to the operation of the activity. Each such record shall give details of the following:

- a) date and time of the complaint;
- b) the name of the complainant;
- c) details of the nature of the complaint;
- d) actions taken on foot of the complaint and the results of such actions; and,
- e) the response made to each complainant.

10.5 A written record shall be kept of each consignment of leachate removed from the facility. The record shall include the following:

- a) the name of the carrier;
- b) the date and time of removal of leachate from the facility;
- c) the volume of leachate, in cubic metres, removed from the facility on each occasion;
- d) the name and address of the Waste Water Treatment Plant to which the leachate was transported;
- e) any incidents or spillages of leachate during its removal or transportation.

10.6 A written record shall be kept at the facility of the programme for the control and eradication of vermin and fly infestations at the facility. These records shall include as a minimum the following:

- a) the date and time during which spraying of insecticide is carried out;
- b) contractor details;
- c) contractor logs and site inspection reports;
- d) details of the rodenticide(s) and insecticide(s) used;
- e) operator training details;
- f) details of any infestations;
- g) mode, frequency, location and quantity of application; and,
- h) measures to contain sprays within the facility boundary.

REASON: To provide for the keeping of proper records of the operation of the facility.

CONDITION 11 REPORTS AND NOTIFICATIONS

11.1 Unless otherwise agreed by the Agency, all reports and notifications submitted to the Agency shall:

- a) be sent to the Agency's Headquarters;
- b) comprise one original and two copies unless additional copies are required;
- c) be formatted in accordance with any written instruction or guidance issued by the Agency;
- d) include whatever information as is specified in writing by the Agency;
- e) be identified by a unique code, indicate any modification or amendment, and be correctly dated to reflect any such modification or amendment;

f) be submitted in accordance to the relevant reporting frequencies specified by this licence, such as in *Schedule E: Recording and Reporting to the Agency*, of this licence;

g) be accompanied by a written interpretation setting out their significance in the case of all monitoring data; and

h) be transferred electronically to the Agency's computer system if required by the Agency.

11.2 In the event of an incident occurring on the facility, the licensee shall:

a) notify the Agency as soon as practicable and in any case not later than 10.00 am the following working day after the occurrence of any incident;

b) submit a written record of the incident, including all aspects described in Condition 9.1(a-e), to the Agency as soon as practicable and in any case within five working days after the occurrence of any incident;

c) in the event of any incident which relates to discharges to surface water or groundwaters, notify Eastern Regional Fisheries Board as soon as practicable and in any case not later than 10:00am on the following working day after such an incident; and

d) Should any further actions be taken as a result of an incident occurring, the licensee shall forward a written report of those actions to the Agency as soon as practicable and no later than ten days after the initiation of those actions.

11.3 Waste Recovery Reports

The licensee shall as part of the Annual Environmental Report for the site submit a report on the contribution by this facility to the achievement of the waste recovery objectives stated in Condition 2.3.2.1 and as otherwise may be stated in National and European Union waste policies and shall, as a minimum, include tonnages of the following:

(i) the recovery of Construction and Demolition Waste;

(ii) the recovery of other waste in landfill operations, including restoration;

(iii) the recovery of energy through landfill gas combustion.

11.4 Reports relating to Facility Operations

11.4.1. Leachate Handling Procedures

The licensee shall maintain and implement handling procedures for leachate which include (1) procedures for the handling of leachate during removal from the lagoons and subsequent transport/discharge to a waste water treatment plant and (2) monitoring infrastructure details and procedures for monitoring the level of leachate in the pump sumps, the cells and the lagoon.

11.4.2. Operation in Adverse Wind Conditions

The licensee shall maintain and implement procedures for the operation of the facility in adverse wind conditions.

11.5 Vermin and Flies

11.5.1. The licensee shall maintain and implement procedures for the control and eradication of vermin and fly infestations at the facility. The procedures shall include as a minimum, operator training, details on the rodenticide(s) and insecticide(s) to be used, mode and frequency of application and measures to contain sprays within the facility boundary.

11.6 Monitoring Locations

11.6.1. The licensee shall maintain an appropriately scaled drawing(s) showing all the monitoring locations that are stipulated in this licence. The drawing(s) shall include the reference code of each monitoring point.

11.7 Annual Environmental Report

11.7.1 The licensee shall submit to the Agency for its agreement by 31st March of each year an Annual Environmental Report (AER), covering the previous calendar year.

11.7.2 The AER shall include as a minimum the information specified in *Schedule F: Content of Annual Environmental Report*, of this licence and shall be prepared in accordance with any relevant written guidance issued by the Agency.

11.8 Waste Receipts

The licensee shall provide a written acknowledgement (to carrier/waste contractor) of receipt of each delivery of waste to the facility (for disposal in the landfill).

11.9 The licensee shall, in writing, notify the Agency without delay of any waste that arrived at the facility that does not meet the waste acceptance criteria.

11.10 Reporting to Demonstrate Compliance with Diversion Targets

The Licensee shall report to the Agency such data and records, and at such frequency, as may be specified by the Agency in order to demonstrate compliance with the requirements of Condition 1.13.1. From 1 July 2010, and unless otherwise advised by the Agency, the licensee shall submit quarterly summary reports to the Agency within one week of the end of each quarter on the quantity of MSW and BMW accepted at the landfill during the preceding quarter and on a cumulative basis for the calendar year to date. The report shall detail the tonnage of MSW and BMW accepted and the basis (including all calculation factors) on which the figures have been calculated.

REASON: To provide for proper report to and notification of the Agency.

CONDITION 12 CHARGES AND FINANCIAL PROVISIONS

12.1 Agency Charges

12.1.1 The licensee shall pay to the Agency an annual contribution of €29,156, or such sum as the Agency from time to time determines, having regard to variations in the extent of reporting, auditing, inspection, sampling and analysis or other functions carried out by the Agency, towards the cost of monitoring the activity as the Agency considers necessary for the performance of its functions under the Waste Management Acts 1996 to 2010. The first payment shall be a pro-rata amount for the period from the date of grant of this licence to the 31st day of December, and shall be paid to the Agency within one month from the date of grant of the licence. In subsequent years the licensee shall pay to the Agency such revised annual contribution as the Agency shall from time to time consider necessary to enable performance by the Agency of its relevant functions under the Waste Management Acts 1996 to 2010, and all such payments shall be made within one month of the date upon which demanded by the Agency.

12.1.2 In the event that the frequency or extent of monitoring or other functions carried out by the Agency needs to be increased the licensee shall contribute such sums as determined by the Agency to defraying its costs.

12.2 Environmental Liabilities

12.2.1 The licensee shall as part of the AER, provide an annual statement as to the measures taken or adopted at the site in relation to the prevention of environmental damage, and the financial provisions in place in relation to the underwriting of costs for remedial actions following anticipated events (including closure) or accidents/incidents, as may be associated with the carrying on of the activity.

12.2.2 The licensee shall arrange for the completion, by an independent and appropriately qualified consultant, of a comprehensive and fully costed Environmental Liabilities Risk Assessment (ELRA) to address the liabilities from past and present activities. A report on this assessment shall be submitted to the Agency for agreement within twelve months of date of grant of this licence. The ELRA shall be reviewed as necessary to reflect any significant change on site, and in any case every three years following initial agreement. The results of the review shall be notified as part of the AER.

12.2.3 As part of the measures identified in Condition 12.2.1 the licensee shall, to the satisfaction of the Agency, make financial provision to cover any liabilities associated with the operation (including closure and aftercare) of the facility. The amount of indemnity held shall be reviewed and revised as necessary, but at least annually. Proof of renewal or revision of such financial indemnity shall be included in the annual 'Statement of Measures' report identified in Condition 12.2.1.

12.2.4 The licensee shall have regard to the Environmental Protection Agency Guidance on Environmental Liability Risk Assessment, Decommissioning Management Plans and Financial Provision when implementing Conditions 12.2.2 and 12.2.3 above

12.2.5 Unless otherwise agreed any revision to aspects of the fund dealing with restoration and aftercare shall be computed using the following formula:

Cost = (ECOST x WPI) + CiCC

Where:

Cost = Revised restoration and aftercare cost

ECOST = Existing restoration and aftercare cost

WPI = Appropriate Wholesale Price Index [Capital Goods, Building & Construction (i.e. Materials & Wages) Index], as published by the Central Statistics Office, for the year since last closure calculation/revision.

CiCC = Change in compliance costs as a result of change in site conditions, changes in law, regulations, regulatory authority charges, or other significant changes.

12.3 Cost of landfill of waste

In accordance with the provisions of Section 53A of the Waste Management Acts 1996 to 2010, the licensee shall ensure the costs involved in the setting up and operation of the facility, as well as the costs of closure and after-care (including cost of provision of financial security) for a period of at least 30 years (post closure) shall be covered by the price to be charged for the disposal of waste at the facility. The statement required under Section 53A(5) of said Acts is to be included as part of the AER.

REASON: ***To provide for adequate financing for monitoring and financial provisions for measures to protect the environment.***

SCHEDULE A : Waste Acceptance

A.1 Waste Acceptance

Table A.1 Waste Categories and Quantities

WASTE TYPE	MAXIMUM (TONNES PER ANNUM)
Household	100,000
Commercial	45,000
Industrial	30,000
Sub Total **Waste for Disposal**	**175,000**
Construction & Demolition for recovery at the facility	25,000
TOTAL	**200,000**

Table A.2. Total Permitted Landfill Capacity

Total quantity of waste permitted to be placed at the landfill facility (over authorised life of facility)	3,616,955 m^3

SCHEDULE B : Specified Engineering Works

Specified Engineering Works
Development of the facility including preparatory works and lining.
Final capping.
Installation of Landfill Gas Management Infrastructure.
Installation of Leachate Management Infrastructure.
Installation of Groundwater Control Infrastructure.
Installation of Surface Water Management Infrastructure.
Any other works notified in writing by the Agency.

SCHEDULE C : Emission Limits

C.1 ***Noise Emissions:*** (Measured at the noise sensitive monitoring points indicated in Table D.1.1 Monitoring Locations).

Day dB(A) L_{Aeq}(30 minutes)	**Night dB(A) L_{Aeq}(30 minutes)**
55	45

C.2 ***Landfill Gas Concentration Limits:*** (Measured in any building on or adjacent to the facility).

Methane	**Carbon Dioxide**
20 % LEL (1% v/v)	1.5 % v/v

C.*3* ***Dust Deposition Limits:*** (Measured at monitoring locations at or dust sensitive locations).

Level (mg/m^2 /day)[Note 1]
350

Note 1: 30 day composite sample with the results expressed as $mg/m^2/day$.

C.4 ***Surface Water Discharge Limits:*** Measured at the discharge point from the surface water pond to the adjacent stream (grid reference to be submitted to the Agency).

Level (Suspended Solids mg/l)
35

C.5 Emission Limits Values for Landfill Gas Plant & Gas Flares

Emission Point reference nos: (to be agreed by the Agency)
Location: Landfill Gas combustion plant and flarestacks
Maximum volume to be emitted: 3000m^3/hr
Minimum discharge height: 5m

Parameter	**Emission Limit Value** (Notes 3 &4)
Nitrogen oxides as (NO_2)	500 mg/m^3 (150mg/m^3) Note 1
CO	650 mg/m^3 (50mg/m^3) Note 1
Particulates	130 mg/m^3
TA Luft Organics Class I (Note 2)	20 mg/m^3 - at mass flows > 0.1 kg/hr (Not applicable) Note 1
TA Luft Organics Class II(Note 2)	100 mg/m^3 -at mass flows > 2 kg/hr (Not applicable) Note 1
TA Luft Organics Class III (Note 2)	150 mg/m^3 at mass flows > 3kg/hr (Not applicable) Note 1
Total Organic Carbon	10mg/m^3
Hydrogen Chloride	50 mg/m^3 - at mass flows > 0.3 kg/h)
Hydrogen Fluoride	5 mg/m^3 -at mass flows > 0.05 kg/h

Note 1: Emission limit values in brackets represent limit values for flare units.
Note 2: In addition to the above individual limits, the sum of the concentrations of Class I, II and III shall not exceed the Class III limits.
Note 3: These emission limit values may be revised with the agreement of the Agency on the basis of the technology employed.
Note 4: Dry gas referenced to 5% oxygen by volume for utilisation plants and 3% oxygen by volume for flares.

SCHEDULE D : Monitoring

Monitoring to be carried out as specified below.

D.1 Monitoring Locations

Monitoring locations shall be those as set out in Table D.1.1.

Table D.1.1 Monitoring Locations

LANDFILL GAS Note 1 & 2	DUST Note 1 & 5	PM_{10} Note 1 & 5	NOISE Note 4 & 5	SURFACE WATER Note 1	GROUND WATER Note 1, 3, 5 & 6	LEACHATE Note 1 & 2	LANDFILL GAS FLARE Note 1
STATIONS	STATIONS	STATION	STATIONS	STATIONS	STATIONS	STATIONS	STATIONS
Perimeter boreholes at 50m intervals.	D1	North of the facility	N1	SW1	MW1d	Each active cell	To be agreed
Site office & other buildings	D2	East of the facility	N2	SW2	MW2d	Each storage lagoon	
Two boreholes per hectare within the waste mass	D3	South-west of the facility	N3	SW3	MW3d		
	D4	P4	N4	SW5	MW5d		
	D5	P5		SW6	MW6d		
	D6	P6		SW7	MW7d		
	D7			SW8	MW16d		
	D8				Private wells within 1km Note 3		
	D9						
	D10						

Note 1: The licensee shall maintain an appropriately sized and referenced drawing along with twelve digit national grid references for landfill gas, landfill gas combustion plant, additional surface water, dust, leachate and groundwater monitoring locations.

Note 2: This information shall be updated with the phased development of cells.

Note 3: Subject to the agreement of the owners / occupiers.

Note 4: The licensee shall maintain an appropriately sized and referenced drawing along with twelve digit national grid references for all noise monitoring locations that have been agreed by the Agency.

Note 5: As per Figure J.1 Suggested Monitoring Locations submitted as Article 14 Response – April 2001. Additional locations to be agreed by the Agency.

Note 6. All private wells within 1km of the facility as per Condition 8.

D.2 Landfill Gas

Table D.2.1 Landfill Gas Monitoring Parameters, Frequency and Technique

Parameter	Monitoring Frequency		Analysis Method$^{\text{Note1}}$/Technique $^{\text{Note2}}$
	Gas Boreholes/ Vents/Wells	Site Office	
Methane (CH_4) % v/v	Monthly	Continuous	Infrared analyser/flame ionisation detector
Carbon dioxide (CO_2)%v/v	Monthly	Continuous	Infrared analyser/ flame ionisation detector
Oxygen(O_2) %v/v	Monthly	Continuous	Electrochemical cell
Atmospheric Pressure	Monthly	-	Standard
Temperature	Monthly	-	Standard

Note1: All monitoring equipment used should be intrinsically safe.
Note 2: Or other methods agreed in advance with the Agency.

D.3 Dust

Table D.3.1 Dust Monitoring Frequency and Technique

Parameter (mg/m^2/day)	Monitoring Frequency	Analysis Method/Technique
Dust	Monthly $^{\text{Note 2}}$	Standard Method $^{\text{Note 1}}$
PM_{10}	Quarterly	Standard Method $^{\text{Note 2}}$

Note 1: Standard method VDI2119 (Measurement of Dustfall, Determination of Dustfall using Bergerhoff Instrument (Standard Method) German Engineering Institute). A modification (not included in the standard) which 2 methoxy ethanol may be employed to eliminate interference due to algae growth in the gauge.

Note 2: As described in prEN12341 "Air Quality – field test procedure to demonstrate reference equivalence of sampling methods for PM_{10} fraction of particulate matter" or an alternative agreed in writing with the Agency

D.4 Noise

Table D.4.1 Noise Monitoring Frequency and Technique

Parameter	Monitoring Frequency	Analysis Method/Technique
$L(A)_{EQ}$ [30 minutes]	**Quarterly**	Standard $^{\text{Note 1}}$
$L(A)_{10}$ [30 minutes]	**Quarterly**	Standard $^{\text{Note 1}}$
$L(A)_{90}$ [30 minutes]	**Quarterly**	Standard $^{\text{Note 1}}$
Frequency Analysis(1/3 Octave band analysis)	**Quarterly**	Standard $^{\text{Note 1}}$

Note 1: "International Standards Organisation. ISO 1996. Acoustics - description and Measurement of Environmental noise. Parts 1, 2 and 3."

D.5 Surface Water, Groundwater and Leachate

Table D.5.1 Water and Leachate - Parameters /Frequency

Parameter Note 1	**SURFACE WATER Monitoring Frequency**	**GROUNDWATER** Note 9 **Monitoring Frequency**	**LEACHATE Monitoring Frequency**
Visual Inspection/Odour Note 2	Weekly	Quarterly	Quarterly
Groundwater Level	Not Applicable	Monthly	Not Applicable
Leachate Level	Not Applicable	Not Applicable	Weekly
Ammoniacal Nitrogen	Quarterly Note 6	Quarterly	Quarterly
BOD	Quarterly Note 6	Not Applicable	Quarterly
COD	Quarterly	Not Applicable	Quarterly
Chloride	Quarterly	Quarterly	Quarterly
Dissolved Oxygen	Quarterly	Quarterly	Not Applicable
Electrical Conductivity	Quarterly Note 6	Quarterly	Quarterly
pH	Quarterly Note 6	Quarterly	Quarterly
Total Suspended Solids	Quarterly Note 6	Not Applicable	Not Applicable
Temperature	Quarterly Note 6	Monthly	Quarterly
Boron	Not Applicable	Annually	Annually
Cadmium	Annually	Annually	Annually
Calcium	Annually	Annually	Annually
Chromium (Total)	Annually	Annually	Annually
Copper	Annually	Annually	Annually
Cyanide (Total)	Not Applicable	Annually	Annually
Fluoride	Not Applicable	Annually	Annually
Iron	Annually	Quarterly	Annually
Lead	Annually	Annually	Annually
List I/II organic substances Note3	Note 8	Annually	Note 8
Magnesium	Annually	Annually	Annually
Manganese	Annually	Annually	Annually
Mercury	Annually	Annually	Annually
Potassium	Annually	Quarterly	Annually
Sulphate	Annually	Annually	Annually
Sodium	Annually	Quarterly	Annually
Total Alkalinity	Annually	Annually	Annually Note 5
Total Phosphorus / orthophosphate	Annually Note 6	Annually	Annually
Total Oxidised Nitrogen	Annually	Quarterly	Quarterly
Total Organic Carbon	Not Applicable	Quarterly	Not Applicable
Residue on evaporation	Not Applicable	Annually	Not Applicable
Zinc	Annually	Annually	Annually
Phenols	Not Applicable	Quarterly	Not Applicable
Faecal Coliforms Note 4	Not Applicable	Quarterly	Annually

Parameter [Note 1]	SURFACE WATER Monitoring Frequency	GROUNDWATER [Note 9] Monitoring Frequency	LEACHATE Monitoring Frequency
Total Coliforms [Note 4]	Not Applicable	Quarterly	Annually
Biological Assessment	Annually [Note7]	Not Applicable	Not Applicable

Note 1: All the analysis shall be carried out by a competent laboratory using standard and internationally accepted procedures.

Note 2: Where there is evident gross contamination of leachate, additional samples should be analysed.

Note 3: Samples screened for the presence of organic compounds using Gas Chromatography / Mass Spectrometry (GC/MS) or other appropriate techniques and using the list I/II Substances from EU Directive 76/464/EEC and 80/68/EEC as a guideline. Recommended analytical techniques include: volatiles (US Environmental Protection Agency method 524 or equivalent), semi-volatiles (US Environmental Protection Agency method 525 or equivalent, and pesticides (US Environmental Protection Agency method 608 or equivalent).

Note 4: In the case where groundwater is extracted for drinking water, if there is evidence of bacterial contamination, the analysis at up gradient and downgradient monitoring points should include enumeration of total bacteria at 22°C and 37°C and faecal streptococci.

Note 5: Only to be analysed in instances of on-site treatment of leachate.

Note 6: Discharge of diverted surface water/groundwater shall be monitored on a monthly basis for these parameters unless flow in that month does not allow such monitoring.

Note 7: Appropriate biological methods (such as EPA Q-Rating System to be used for the assessment of rivers and streams).

Note 8: Once off for List I/II organic substances.

Note 9: All private wells within 1Km of the landfill footprint shall be analysed annually for ammonical N, K, Na, pH, electrical conductivity and TOC. A written report and interpretation shall accompany the analysis results.

D.6 Meteorological Monitoring

Table D.6.1 Meteorological Monitoring:

Data to be obtained from the on-site meteorological station. The location of the on-site meteorological station shall be in accordance with advice from Met Eireann and agreed in advance with the Agency.

Parameter	Monitoring Frequency	Analysis Method/Technique
Precipitation Volume	Daily	Standard
Temperature (min/max.)	Daily	Standard
Wind Force and Direction	Daily	Standard
Evaporation	Daily	Standard
Evapotranspiration	Daily	Standard
Humidity	Daily	Standard
Atmospheric Pressure	Daily	Standard

D.7 Landfill Gas Combustion Plant/Enclosed Flare

Location: Utilisation plant and enclosed flare (exact location of flare to be agreed by the Agency in advance).

Table D.7.1 Landfill Gas Utilisation Plant/Enclosed Flare Parameters and Monitoring Frequency

Parameter	Flare (enclosed) Monitoring Frequency	Utilisation Plant Monitoring Frequency	Analysis Method[Note1]/Technique[Note2]
Inlet			
Methane (CH_4) % v/v	Continuous	Weekly	Infrared analyser/flame ionisation detector/thermal conductivity
Carbon dioxide (CO_2)%v/v	Continuous	Weekly	Infrared analyser/ thermal conductivity
Oxygen (O_2) %v/v	Continuous	Weekly	Electrochemical/thermal conductivity
Total Sulphur	Annually	Annually	Ion chromatography
Total Chlorine	Annually	Annually	Ion chromatography
Total Fluorine	Annually	Annually	Ion Selective Electrode
Process Parameters			
Combustion Temperature	Continuous	Quarterly	Temperature Probe/datalogger
Outlet			
CO	Continuous	Continuous	Flue gas analyser/datalogger
NOx	Annually	Annually	Flue gas analyser
SO_2	Annually	Annually	Flue gas analyser
Particulates	Not applicable	Annually	Isokinetic/Gravimetric
TA Luft Class I, II, III organics	Not applicable	Annually	Adsorption/Desorption /GC/GCMS [Note 3]
TOC	Annually	Not applicable	Flame ionisation
Hydrochloric acid	Annually	Annually	Impinger / Ion Chromatography
Hydrogen fluoride	Annually	Annually	Impinger / Ion Chromatography

Note 1: All monitoring equipment used should be intrinsically safe.

Note 2: Or other methods agreed in advance with the Agency.

Note 3: Test methods should be capable of detecting acetonitrile, dichloromethane, tetrachlorethylene and vinyl chloride as a minimum.

D.8 VOC Monitoring

Parameter	Monitoring Frequency	Analysis
VOC	Continuous	To be agreed by the Agency

D.9 Waste Monitoring

Table D.9.1 Waste Monitoring

Waste class	**Frequency**	**Parameter**	**Method**
Bio-stabilised residual waste	Every 500 tonnes from each source^{Note 1}	Respiration activity after 4 days	To be agreed by the Agency

Note 1: Frequency can be reduced if an alternative protocol is agreed by the Agency under condition 1.14.2.

D.10 Ambient Odour Monitoring

Table D.10.1 Ambient Odour Monitoring

Parameter	**Frequency**	**Analysis Method/Technique**
Odour	Monthly	As agreed by the Agency

SCHEDULE E : Recording and Reporting to the Agency

Report	Reporting Frequency Note1	Report Submission Date
Environmental Management System Updates	Annually	One month after the end of the year reported on.
Annual Environment Report (AER)	Annually	By 31 March each year.
Record of incidents	As they occur	Within five days of the incident.
Bund, tank and container integrity assessment	Every three years	One month after end of the three year period being reported on.
Specified Engineering Works reports	As they arise	Prior to the works commencing.
Monitoring of landfill gas	Quarterly	Ten days after end of the quarter being reported on.
Monitoring of Surface Water Quality	Quarterly	Ten days after end of the quarter being reported on.
Monitoring of Groundwater Quality	Quarterly	Ten days after end of the quarter being reported on.
Monitoring of Leachate	Quarterly	Ten days after end of the quarter being reported on.
Meteorological Monitoring	Annually	One month after end of the year being reported on.
Dust Monitoring	Three times a year	Ten days after the period being reported on.
Noise Monitoring	Bi-annually	One month after end of the year being reported on.
Odour Management Plan (OMP)	As required	Six months after date of grant of licence.
Environmental Liabilities Risk Assessment (ELRA)	Every three years	Within 12 months after date of grant of licence and at least every three years thereafter as part of the AER.
Any other monitoring	As they occur	Within ten days of obtaining results.

Note 1: Unless altered at the request of the Agency.

SCHEDULE F : Content of the Annual Environmental Report

Annual Environmental Report Content

Reporting Period.
Waste activities carried out at the facility.
Quantity and Composition of waste received, disposed of and recovered during the reporting period and each previous year.
Calculated remaining capacity of the facility and year in which final capacity is expected to be reached.
Methods of deposition of waste.
Summary report on emissions.
Summary of results and interpretation of environmental monitoring.
Resource and energy consumption summary.
Proposed development of the facility and timescale of such development.
Volume of leachate produced and volume of leachate transported / discharged off-site.
Feasibility study on alternatives to treating leachate off-site.
Report on development works undertaken during the reporting period, and a timescale for those proposed during the coming year.
Report on restoration of completed cells/ phases.
Site survey showing existing levels of the facility at the end of the reporting period.
Estimated annual and cumulative quantities of landfill gas emitted from the facility.
Annual water balance calculation and interpretation.
Report on the progress towards achievement of the Environmental Objectives and Targets contained in previous year's report.
Schedule of Environmental Objectives and Targets for the forthcoming year.
Full title and a written summary of any procedures developed by the licensee in the year, which relates to the facility operation.
Tank, pipeline and bund testing and inspection report.
Reported incidents and Complaints summaries.
Review of Nuisance Controls.
Reports on financial provision made under this licence, management and staffing structure of the facility, and a programme for public information.
Report on training of staff.
Statement of compliance of facility with any updates of the relevant Waste Management Plan.
Statement on the achievement of the waste acceptance and treatment obligations.
Updates of the Landfill Environmental Management Plan (LEMP).
Updates on Environmental Liabilities Risk Assessment (ELRA).
Statement of Measures for prevention of environmental damage and financial provisions.
Updates of the Restoration and Aftercare Plan (RAP).
Treatment of waste received.
Any other items specified by the Agency.

◆

Sealed by the seal of the Agency on this the 23rd day of March 2010.

PRESENT when the seal of the Agency
Was affixed hereto:

Laura Burke, Director

Appendix 1.2

Technical Amendment A to Waste Licence

Headquarters
P.O. Box 3000
Johnstown Castle Estate
County Wexford
Ireland

AMENDMENT A
TO
WASTE LICENCE

Licence Register Number:	W0146-02
Licensee:	Greenstar Holdings Limited
Location of Facility:	Knockharley Landfill Knockharley Navan County Meath

Reasons for the Decision

The Environmental Protection Agency has examined the terms of the Waste Licence Reg. No. W0146-02 granted on 23/03/2010, as required by the provisions of Article 12 of the European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended, and determined that the licence can be brought into conformity with the provisions and requirements of said regulations by the exercise of the powers conferred by Section 42B(1)(c) of the Waste Management Acts 1996 to 2012.

The Environmental Protection Agency is satisfied, on the basis of the information available, that subject to compliance with the conditions of Waste Licence Reg. No. W0146-02 granted on the 23/03/2010, as well as any amendments noted herein, any emissions from the activity will comply with and not contravene any of the requirements of Section 40(4) of the Waste Management Acts 1996 to 2012.

Technical Amendment

In pursuance of the powers conferred on it by Section 42B(1)(c) of the Waste Management Acts 1996 to 2012, the Agency amends the licence, granted to Greenstar Holdings Limited, Knockharley, Kentstown, County Meath for a facility located at Knockharley Landfill, Knockharley, Navan, County Meath.

This technical amendment is limited to the following Interpretation and Condition(s):

Amendments

Interpretation

Insert terms in Interpretation:

Compliance Point	The point (location, depth) at which a compliance value should be met. Generally it is represented by a borehole or monitoring well from which representative groundwater samples can be obtained.
Compliance Value	The concentration of a substance and associated compliance regime that, when not exceeded at the compliance point, will prevent pollution and/or achieve water quality objectives at the receptor.
Incident	The following shall constitute as incident for the purposes of this licence: (i) an emergency; (ii) any emission which does not comply with the requirements of this licence; (iii) any exceedance of the daily duty capacity of the waste handling equipment; (iv) any trigger level specified in this licence which is attained or exceeded; (v) any compliance value specified in this licence which is attained or exceeded; and, (vi) any indication that environmental pollution has, or may have, taken place.

Amend the Interpretation to include the above.

Conditions of Licence

8.7.2 Within eighteen months of the date of this technical amendment, the licensee shall carry out a risk screening and where necessary a technical assessment in accordance with the *Guidance on the Authorisation of Discharges to Groundwater*, published by the Environmental Protection Agency. A report on the outcome of the screening and where relevant the recommendations of the technical assessment in relation to the setting of groundwater compliance points and values, shall be included in the next AER. Any actions required to demonstrate compliance with the European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended shall be agreed by the Agency and implemented before 22nd December 2015. Groundwater monitoring results shall be submitted annually or as required in the Schedules to this licence.

Amend Condition 8.7 to include the above condition after condition 8.7.1

◆

This Amendment shall be cited as Amendment A to the licence.

Sealed by the seal of the Agency on this the 15th day of January, 2013

PRESENT when the seal of the Agency
was affixed hereto:

Mary Turner, Authorised Person.

Appendix 1.3

Technical Amendment B to Waste Licence

Headquarters
P.O. Box 3000
Johnstown Castle Estate
County Wexford
Ireland

TECHNICAL AMENDMENT B
TO
WASTE LICENCE

Licence Register Number:	W0146-02
Licensee:	Greenstar Holdings Limited
Location of Facility:	Knockharley Landfill Knockharley Navan Co. Meath

Reasons for the Decision

The Environmental Protection Agency is satisfied, on the basis of the information available, that subject to compliance with the conditions of licence Reg. No. W0146-02 granted on 23/03/2010, and amended on 15/01/2013, as well as any amendments noted herein, any emissions from the activity will comply with and not contravene any of the requirements of Section 40(4) of the Waste Management Acts 1996 to 2013.

Technical Amendment

In pursuance of the powers conferred on it by Section 42B(1)(c) of the Waste Management Acts 1996 to 2013, the Agency amends Licence Reg. No. W0146-02, granted to Greenstar Holdings Ltd, Unit 6, Ballyogan Business Park, Ballyogan Road, Stillorgan, Dublin 18.

Henceforth, the licence shall be read in conjunction with Amendment A issued on 15/01/2013 and the amendments set out below.

This technical amendment is limited to Condition 5 of the licence.

Amendment

Conditions of Licence

5.16 Temporary trial for metal recovery from incinerator bottom ash

5.16.1 The licensee may install a mobile processing plant and carry out a trial as proposed in correspondence to the Agency dated 3/9/2013 to evaluate the potential for extracting ferrous and non-ferrous metals from incinerator bottom ash.

5.16.2 The licensee shall seek the Agency's agreement prior to commencement of the trial.

5.16.3 The trial shall be conducted according to any limitations agreed or imposed by the Agency and subject to the Agency's ongoing agreement.

5.16.4 A maximum of 4,000 tonnes of incinerator bottom ash shall be processed in the trial.

5.16.5 The trial shall continue for a maximum of 8 weeks from its date of commencement, or up to 10 weeks if agreed by the Agency in case of delays arising following commencement.

5.16.6 The date of commencement of the trial shall be notified to the Agency within 48 hours of its commencement.

To be inserted after condition 5.15 of the existing licence.

This technical amendment shall be cited as Amendment B (in pursuance of Section 42B(1) of the Waste Management Acts 1996 to 2013) to Waste Licence Register Number W0146-02.

Sealed by the seal of the Agency on this the 1st day of October 2013

PRESENT when the seal of the Agency was affixed hereto:

Mary Turner, Authorised Person

Appendix 1.4

Technical Amendment C to IED Licence

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Headquarters
P.O. Box 3000
Johnstown Castle Estate
County Wexford
Ireland

TECHNICAL AMENDMENT C
TO
INDUSTRIAL EMISSIONS LICENCE

Licence Register Number:	W0146-02
Company Registration Number:	529325
Licensee:	Knockharley Landfill Limited
Location of Installation:	Knockharley Navan (includes the Townlands of Tuiterath and Flemingtown) County Meath

Reasons for the Decision

The Environmental Protection Agency is satisfied, on the basis of the information available, that subject to compliance with the conditions of licence Reg. No. W0146-02 granted on the 23 March 2010 and amended on 15 January 2013, 1 October 2013 and 20 December 2013 as well as any amendments noted herein, any emissions from the activity will comply with and not contravene any of the requirements of Section 83(5) of the Environmental Protection Agency Act 1992 as amended.

A screening for Appropriate Assessment was undertaken to assess, in view of best scientific knowledge and the conservation objectives of the site, if the activity, individually or in combination with other plans or projects is likely to have a significant effect on any European Site. In this context, particular attention was paid to the European Sites at River Boyne and Blackwater SAC (Site Code: 002299), River Boyne and Blackwater SPA (Site Code: 004232), River Nanny Estuary and Shore SPA (Site Code: 004158).

The activity is not directly connected with or necessary to the management of any European Site and the Agency considered, for the reasons set out below, that it can be excluded, on the basis of objective information, that the activity, individually or in combination with other plans or projects, will have a significant effect on any European Site and accordingly determined that an Appropriate Assessment of the activity was not required.

The reasons for which the Agency determined that an Appropriate Assessment of the proposed activity is not required are as follows:

- The installation is not located within the above listed European Sites.
- There are no emissions to water courses from the installation and there will be no change on foot of the proposed technical amendment.
- There are no emissions to groundwater from the installation and there will be no change on foot of the proposed technical amendment.
- Storm water is passed through an oil interceptor before being collected on site in a lined surface water pond.
- Controls are in place to prevent discharge of contaminated storm water from the surface water pond.
- The proposed activity will not result in damage to, or loss of, species and habitats of these European Sites.

Technical Amendment

In pursuance of the powers conferred on it by Section 96(1)(c) of the Environmental Protection Agency Act 1992 as amended, the Agency amends the licence, granted to Knockharley Landfill Limited, 23 Meadowfield, Sandyford, Dublin 18 for an installation located at Knockharley, Navan (includes the Townlands of Tuiterath and Flemingtown), County Meath.

Henceforth, the licence shall be read in conjunction with a Section 76A(11) Amendment issued on 20 December 2013, Amendment A issued on 15 January 2013, Amendment B issued on 1 October 2013 and the amendments set out below.

This technical amendment is limited to the following:

Condition 1

Condition 12

Schedule D

Amendments

Amend Condition 1 to include the following after Condition 1.18

1.19 Unless otherwise directed by the Agency, in addition to the maximum annual intake of waste authorised in Table A.1 of *Schedule A: Waste Acceptance* of Licence Register Number W0146-02 and for the period from the date of this amendment to 31 December 2016, the licensee may accept an additional quantity of waste, as follows:

- a) disposal within the void of the landfill: 80,000 tonnes of waste;
- b) for use as daily cover: 15,000 tonnes.

1.20 Unless otherwise agreed by the Agency, the acceptance of waste under Condition 1.19 shall be limited as follows:

1.20.1 in relation to waste accepted for disposal within the void of the landfill, only municipal waste shall be accepted; and

1.20.2 in relation to waste accepted for use as daily cover, only the following shall be accepted:

- a) inert waste,
- b) waste soil and stone,
- c) woodchip, and
- d) bio-stabilised residual waste that meets the requirements of Condition 1.14.4 of this licence.

Amend Condition 12 to include the following after Condition 12.1.2

12.1.3 In addition to the annual contribution or revised annual contribution provided for in Condition 12.1.1 of Licence Register Number W0146-02, the licensee shall pay to the Agency an additional contribution of €5,978, or such sum as the Agency determines, having regard to variations in the extent of reporting, auditing, inspection, sampling and analysis or other functions carried out by the Agency, towards the additional cost of monitoring the activity on foot of this amendment. Payment shall be made within one month of the date upon which demanded by the Agency.

Delete Table D.10.1 of Schedule D.3 and replace it with the following table:

Table D.10.1 Ambient Odour Monitoring

Parameter	**Frequency**	**Analysis method/technique**
Odour	Weekly	As agreed by the Agency

This technical amendment shall be cited as Amendment C to the licence.

Sealed by the Seal of the Agency on this the 15th day of November, 2016

PRESENT when the seal of the Agency was affixed hereto

Mary Turner, Authorised Person

Appendix 1.5

Technical Amendment D to IED Licence

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Headquarters
P.O. Box 3000
Johnstown Castle Estate
County Wexford
Ireland

TECHNICAL AMENDMENT D
TO
INDUSTRIAL EMISSIONS LICENCE

Licence Register Number:	W0146-02
Company Registration Number:	529325
Licensee:	Knockharley Landfill Limited
Location of Installation:	Knockharley Navan (includes the townlands of Tuiterath and Flemingtown) County Meath

Reasons for the Decision

The Environmental Protection Agency is satisfied, on the basis of the information available, that subject to compliance with the conditions of Licence Reg. No. W0146-02 granted on 23 March 2010 and amended on 15 January 2013, 1 October 2013, 20 December 2013 and 15 November 2016 as well as any amendments noted herein, any emissions from the activity will comply with and not contravene any of the requirements of Section 83(5) of the Environmental Protection Agency Act 1992 as amended.

A screening for Appropriate Assessment was undertaken to assess, in view of best scientific knowledge and the conservation objectives of the site, if the activity, individually or in combination with other plans or projects is likely to have a significant effect on any European Site. In this context, particular attention was paid to the European Sites River Boyne and Blackwater SAC (Site Code: 002299), River Boyne and Blackwater SPA (Site Code: 004232), River Nanny Estuary and Shore SPA (Site Code: 004158).

The activity is not directly connected with or necessary to the management of any European Site and the Agency considered, for the reasons set out below, that it can be excluded, on the basis of objective information, that the activity, individually or in combination with other plans or projects, will have a significant effect on any European Site and accordingly determined that an Appropriate Assessment of the activity was not required.

The reasons for which the Agency determined that an Appropriate Assessment of the proposed activity is not required are as follows:

- The installation is not located within the above listed European Sites.
- There are no emissions to water courses from the installation and there will be no change on foot of the proposed technical amendment.
- There are no emissions to groundwater from the installation and there will be no change on foot of the proposed technical amendment.
- Storm water is passed through an oil interceptor before being collected on site in a lined surface water pond.
- Controls are in place to prevent discharge of contaminated storm water from the surface water pond.
- The proposed activity will not result in damage to, or loss of, species and habitats of these European Sites.

Technical Amendment

In pursuance of the powers conferred on it by Section 96(1)(c) of the Environmental Protection Agency Act 1992 as amended, the Agency amends the licence, granted to Knockharley Landfill Limited, 23 Meadowfield, Sandyford, Dublin 18 for an installation located at Knockharley, Navan (includes the townlands of Tuiterath and Flemingtown), County Meath.

Henceforth, the licence shall be read in conjunction with a Section 76A(11) Amendment issued on 20 December 2013, Amendment A issued on 15 January 2013, Amendment B issued on 1 October 2013, Amendment C issued on 15 November 2016 and the amendments set out below.

This technical amendment is limited to the following:

Condition 1
Condition 12

Amendments

Amend Condition 1 to include the following after Condition 1.20

1.21 Unless otherwise directed by the Agency, in addition to the maximum annual intake of waste authorised in Table A.1 of *Schedule A: Waste Acceptance* of Licence Register Number W0146-02, the licensee may accept an additional quantity of waste, as follows:

a) waste generated from the excavation by Meath County Council of the Timoole landfill:

- 70,000 tonnes;

b) waste for use as daily cover and conditioning of or mixing with the waste accepted from the Timoole landfill:

- 70,000 tonnes, or
- no more than the total quantity of waste accepted from the Timoole landfill,

whichever is the smaller.

1.22 Unless otherwise agreed by the Agency, the acceptance of waste under Condition 1.21(b) shall be limited as follows:

- inert waste;
- soil and stone (whether classified as waste or by-product);
- woodchip;
- C&D fines; and

- biostabilised residual waste that meets the requirements of Condition 1.14.4 of this licence.

1.23 The licensee shall maintain adequate records such that waste accepted under Condition 1.21 can be clearly distinguished from other waste accepted for recovery and disposal.

Amend Condition 12 to include the following after Condition 12.1.3

12.1.4 In addition to the annual contribution or revised annual contribution provided for in Condition 12.1.1 of Licence Register Number W0146-02, the licensee shall pay to the Agency an additional contribution of €5,978, or such sum as the Agency determines, having regard to variations in the extent of reporting, auditing, inspection, sampling and analysis or other functions carried out by the Agency, towards the additional cost of monitoring the activity on foot of this amendment. Payment shall be made within one month of the date upon which demanded by the Agency.

This technical amendment shall be cited as Amendment D to the licence.

Sealed by the Seal of the Agency on this the 28th day of March, 2018

PRESENT when the seal of the Agency was affixed hereto

Karen Creed.

Dr Karen Creed, Authorised Person

Appendix 1.6

An Bord Pleanála letter confirming closing S.I.D. Process

An Bord Pleanála

Board Direction

Ref: 17.PC0223

At a meeting held on 8th November 2017, the Board considered the report of the inspector (dated 12th April 2017) and her addendum report (dated 25th October 2017) as well as the documents on file.

The Board determined that the proposed development is strategic infrastructure development, generally in accordance with the Inspector's reasoning and recommendation.

In relation to the schedule of prescribed bodies (Appendix 1), the following changes are recommended:

- Include each of the three regional waste management regional offices in Ireland in the notification.
- Apart from Meath County Council, notification to individual local authorities is not considered necessary.
- Include the Irish Aviation Authority in the notifications.

Board Member: ______________________ Date: 10th November 2017
Conall Boland

Appendix 1

The following is a schedule of prescribed bodies considered relevant in this instance for the purposes of Section 37E(3)(c) of the Act.

Minister for Housing, Planning, Community and Local Government

Minister for Communications, Climate Action and the Environment

Minister for Arts, Heritage, Regional, Rural and Gaeltacht Affairs

Meath County Council

Fingal County Council

Dublin City Council

South Dublin County Council

Dun Laoghaire Rathdown County Council

Kildare County Council

Laois County Council

Longford County Council

Louth County Council

Offaly County Council

Wicklow County Council

Westmeath County Council

Irish Water

Transport Infrastructure Ireland

Eastern Midlands Regional Waste Office

Eastern and Midlands Regional Assembly

An Chomhairle Ealaíon

An Taisce

Fáilte Ireland

Heritage Council

Inland Fisheries Ireland

Environmental Protection Agency

Health Service Executive

Geological Survey

Appendix 1.7

Index of Mitigation Measures

N/A

Appendix 1.8

Contributors to the EIAR

Bernie Guinan

Project Director

Bernie is Director with FT and a **Chartered Waste Manager.** She is responsible for Waste & Resource Management, Environmental Science and Data Management. She has **20 years'** experience in delivering and managing projects and infrastructure delivery in the **waste** and **environmental** sectors including the **preparation and management of Environmental Impact Assessments**. Bernie has extensive experience in all aspects of municipal solid waste and bio-waste strategic management planning and waste infrastructure development in Ireland, the UK, KSA and UAE. She is an experienced **waste policy analysis** and **strategic planner**. She has in-depth knowledge of all **waste, environment and planning policy, legislation** and **guidance**. She has been providing waste management consultancy services to Local Authorities for over 20 years.

Qualifications

MSc, BSc (Envi. Sci. & Tech)

Dip. Pollution Assessment Control

Dip. Business Development

Professional Memberships

Chartered Institution of Wastes Management (CIWM)

Employment History

2006 – Present
Fehily Timoney & Company,
Dublin;

2000 - 2006
Fehily Timoney & Company,
Cork;

1999 – 2000
Entec UK Ltd
Dublin;

1997 – 1999
A. T Cross Ltd.
Galway.

Key Projects

Environmental Impact Assessment

- **EIS for Aviation Fuel Pipeline Dublin Port to Dublin Airport, Ireland, €18.6m 2011 - 2016**
  Project Director for the preparation of planning application, EIS, NIS and flood risk assessment for a 14km pipeline route through Dublin City. A dual application to both Dublin City Council and Fingal County Council requiring over three years consultation with various sections of the local authorities on route selection and EIS scoping.
- **Cork Dockyard Scrap Metal Recycling Facility, Co. Cork Ireland €1.5m 2011 – 2013**
  Project Director for the development of a scrap metal recycling facility (45,000 tpa) an RDF storage facility (45,000 tpa) including pre-application consultations, preliminary design, EIS, Stage 1 AA screening report, flood risk assessment and planning application. Permission was refused by Cork County Council but was successfully appealed by FTC to An Bord Pleanala in 2013.
- **Powerstown Landfill Extension of Time Application, Co. Carlow, Ireland € Confidential, 2012**
  Project Director for the preparation of the strategic infrastructure application and EIS for the extension of the life of Powerstown Landfill, Co. Carlow. This site had a complex planning history and required significant liaison with the local authorities' senior counsel on the most appropriate way forward.
- **Railway Procurement Agency, Light Rail Schemes, Dublin, Ireland - 2007 – 2011**
  Project Director for the preparation of the soils, geology, water quality and waste section of the EISs for the Metro North Depot, Metro West and BXD light rail schemes. Role included participation on scoping workshops and preparing expert witness testimony for the metro west and BXD projects.
- **Peer reviewer of EIS for Silvermines Rehabilitation Project, Co. Tipperary, Ireland, € Confidential, Complete 2009**
  Responsible for the independent review of the EIS for the rehabilitation of Silvermines to determine compliance with planning and environmental legislation.
- **Tegral Holdings Ltd, Athy, Co. Kildare, Ireland €100m - Complete 2009**
  Project Director for the planning application and EIS for the re-location of the Tegral production facilities from Athy town to a greenfield site (46,000 m2 of building development). Preparation of response to third party appeal to An Bord Pleanala. Permission granted by the Board in 2009.
- **Ballywalter Farms Ltd Bioenergy Facility, Co. Wexford, Ireland €50m, Complete 2009**
  Project Director for the preparation of the planning application, preliminary design EIS and NIS for a 99,000 tpa bioenergy facility. This project proposed the technology anaerobic digestion and substantial on-site wastewater treatment and bio-gas management.
- **Derryclure Landfill, Co. Offaly, Ireland €5m – 2009**
  Project Director for the preparation of the EIS and waste licence review application for the intensification of waste acceptance activities at Derryclure landfill from 40,000 tpa to 100,000 tpa.
- **Curraleigh West to Midleton Gas Pipeline, Co. Cork, Ireland €50m - Complete 2008**
  Project co-ordinator of the strategic infrastructure application for 47 km Bord Gais pipeline
- **Biological Treatment Facility, Portlaoise, Co. Laois, Ireland €20m - Complete 2008**
  Project Manager for the preparation of the EIS and waste licence application for a 99,000tpa biological treatment facility for a Private Client.
- **Private Client, Co. Wexford, €50M, Complete**
  Project Director for the preparation of planning application, EIS and waste licence application for a 100,000 tpa bioenergy facility

Bernie Guinan

Project Director

Waste Management Planning

- **Integrated Waste Management Plan for the Emirate of Abu Dhabi 2015 – 2017.** Project Manager for the above waste plan covering the period 2015 to 2040. The plan was the first country wide waste plan for Abu Dhabi and included legal and environmental review, waste characterisation and situational analysis, legacy waste issues and the strategy for and development of new waste facilities country wide for a population of 2.7m people.
- **Jeddah Environmental Assessment (JEA) and Jeddah Environmental & Social Masterplan (JESMP), 2012 — 2014** Waste Management Team Leader for the JEA and JESMP which included environmental assessment and baseline establishment across 15 technical disciplines including Waste and Resource Management. The JESMP included 4 Response Plans which included the Waste Response Plan for the Governorate prepared by FT, the Waste Response Plan deals with MSW, Commercial and Industrial Waste, litter and street sweepings for a population of 4.5m people.
- **Evaluation of the Waste Management Plan for the Midlands Region, 2012** Project Manager for the evaluation of the Plan. This evaluation was carried out on behalf of five local authorities. The project included stakeholder meetings to discuss progress made and implementation challenges faced over the lifetime of the Plan. A review of waste management policy was conducted to determine its applicability going forward. A legislative and policy review was carried out to determine the elements of the Plan which need to be revised.
- **Evaluation of the Waste Management Plan for the County Kildare**, **2012** Project Manager for the evaluation of the Plan The project included stakeholder meetings to discuss progress made and implementation challenges faced over the lifetime of the Plan. A review of waste management policy was conducted to determine its applicability going forward. A legislative and policy review was carried out to determine the elements of the Plan which need to be revised.
- **Evaluation of the Waste Management Plan for the South-East Waste Management Region, 2012** Project Manager for the evaluation of the Plan. This evaluation was carried out on behalf of six local authorities. The project included stakeholder meetings to discuss progress made and implementation challenges faced over the lifetime of the Plan. A review of waste management policy was conducted to determine its applicability going forward. A legislative and policy review was carried out to determine the elements of the Plan which need to be revised.
- **Waste Management Strategy and Sustainability Appraisal Dorset (UK), 2008** Project Manager for the preparation of a Sustainability Appraisal and peer reviewer for the Dorset Waste Management Strategy. This involved the carrying out of a scoping assessment prior to the formulation of the Sustainability Appraisal as per the guidance laid out in the 'Sustainability Appraisal of Regional Spatial Strategies and Local Development Documents' guidance documentation (UK). Population ~400,000.
- **South East Region —Waste Management Plans, 2002 and 2006** Bernie was Project Manager of the development of the statutory waste management planning for the 6 counties comprising the South-East Region. plans set out in detail the waste management requirement for the region in terms of public communication, prevention, recycling, recovery and final disposal (EfW). Pop ~400,000
- **Wicklow County Council — Review of Wicklow Waste Management Plan, 2005 – 2006** Bernie was Project Manager for the review of the Wicklow Waste Management Plan which set out the waste management policy for the County for the period 2005-2006. Plan included Mechanical Biological Treatment with recovery and landfilling of non-recoverable residuals.
- **Kildare County Council — Waste Management Plan 2002 and Review of Kildare Waste Management Plan, 2006** Bernie was Project Manager for the original plan 2002 and for the review of the Kildare Waste Management Plan which set out the waste management policy for the County for the period 2004-2009. Plan included Mechanical Biological Treatment with recovery and landfilling of non-recoverable residuals.

Landfill Design

- **East Galway Landfill, Galway County Council 2016- ongoing.** Project Director for the design of 380,000 M^3 of Landfill Cell void at East Galway Landfill and restoration and remediation of 125,000M^2 of landfill cap.
- **Knockharley Landfill, AGB Ltd 2015.** Project Director for the design of engineered cells encompassing an area of 20,000 m^2 and requiring the placement of 20,000 m^3 of engineered clay ($k \leq 1 \times 10^{-9}$ m/s) and the laying and welding of 20,000 m^2 of 2 mm HDPE liner. These works also included gas extraction wells, collection pipework, leachate collection chambers, monitoring wells and the associated M&E Plant, Instrumentation and SCADA reporting system.
- **Knockharley Landfill, AGB Ltd 2014 – Ongoing.** Project Manager for the preparation of an EIS/EIAR for intensification of landfilling activities from 88,000 tpa to 440,000 tpa and the construction of a dedicated Incineration Bottom Ash cell and a 25,000 Biological Aerobic Digestion Facility.

- **East Galway Landfill, Galway County Council 2016- ongoing.** Project Director for the design of 380,000 M^3 of Landfill Cell void at East Galway Landfill and restoration and remediation of 125,000M^2 of landfill cap.
- **Knockharley Landfill, AGB Ltd 2015.** Project Director for the design of engineered cells encompassing an area of 20,000 m^2 and requiring the placement of 20,000 m^3 of engineered clay ($k \leq 1 \times 10^{-9}$ m/s) and the laying and welding of 20,000 m^2 of 2 mm HDPE liner. These works also included gas extraction wells, collection pipework, leachate collection chambers, monitoring wells and the associated M&E Plant, Instrumentation and SCADA reporting system.

Derek Milton

Principal Scientist

Derek Milton is a Principal Scientist with Fehily Timoney and Company. He has over 15 years' experience in the environmental sector and hold a Masters in Applied Environmental Sciences from Queens University of Belfast and a postgraduate diploma in Renewable Energy and Energy Management from the University of Ulster. He is also an IPMA certified project management associate and is a Chartered Member of the Institute of Wastes Management. Derek is a former Secretary of the Irish Bioenergy Association (IrBEA).

Derek has extensive experience in EPA licensing, planning, EIAR preparation and waste technology assessment and has project managed a wide variety of waste and other related projects. He also has extensive experience in biological waste treatments through his current role and previous employment. Derek has acted as agent for previous Bord na Móna planning applications for waste management facilities in Co. Laois and beyond and is experienced in the delivery of successful planning applications on behalf of Bord na Móna to the quality and standard expected.

Qualifications

B.Sc. (General), National University of Ireland, Galway, 1998

M.Sc. in Applied Environmental Sciences, Queens University of Belfast, 2000

Pg. Dip. in Renewable Energy and Energy Management, University of Ulster, Jordanstown, 2010

Professional Memberships

Irish Project Management Institute, Project Management Associate

Member of the Chartered Institute of Wastes Management (MCIWM)

Secretary, Irish Bioenergy Association

Employment History

2006 - Present
Fehily Timoney & Company
Cork & Dublin

2003 – 2006
Celtic Composting Systems Ltd.
Cork

2002 – 2003
Kerry Group PLC
Monaghan

2000 – 2002
Nutrisolv Ltd
Sligo

Selected Projects

- **Millennium Business Park, Dublin, Ireland 2016 – Ongoing**
  Project manager the preparation of the preliminary design, strategic infrastructure development (SID) planning application, AA screening, industrial emission licence application and EIS preparation for a 170,000 tonnes per annum materials recycling and waste transfer facility at Millennium Business Park, Dublin 11 for a private sector waste management client. SID planning permission recently secured, while decision pending regarding IE licence application.
- **Landfill Development, Co. Meath, 2016 - Ongoing**
  Project manager the preparation of the preliminary design, strategic infrastructure development (SID) planning application, AA screening, industrial emission licence review application and EIS preparation for revision to an existing landfill facility for a private sector waste management client in Co. Meath.
- **Bord na Móna Drumman Project, 2009 — 2013**
  Project Manager for the preparation of the preliminary design, planning, AA screening and waste licence applications and EIS preparation for a 99,000 tonnes per annum materials recycling and waste transfer facility at Drumman, Co. Offaly. Successful achievement of all statutory applications.
- **Drehid Biological Waste Treatment Facility, 2010 — 2013**
  Project Manager for the provision of environmental support to the selected Contractor for the design, construction and commissioning of a 25,000 tonnes per annum composting at the Bord na Móna Drehid facility. Support provided included the preparation of all documentation to achieve animal by-product approvals, the carrying out of occupational noise assessment and biofilter odour assessment over a prolonged period to demonstrate contractual adherence and ad hoc support for a range of operational and start-up issues.
- **Bord na Móna Cúil na Móna Project, 2010**
  Project Manager for the preparation of the preliminary design, planning and waste licence applications and EIS preparation for a 99,000 tonnes per annum materials recycling and waste transfer facility at Cúil na Móna, Portlaoise, Co. Laois, which was placed on hold by the client upon completion of final document drafting, prior to application.
- **Bord na Móna, Kyletalesha Facility, 2011 - 2014**
  Project Manager for the preparation of 2 no. planning applications to Laois County Council, with accompanying EISs and AA screening reports, in order to regularise planning compliance at this facility, following enforcement action taken by the Council.
- **Waterford City Council Biological Treatment Facility, 2011**
  Project Manager for the procurement of a preferred candidate through Negotiated Procedure to lease, develop and operate a biological treatment facility at an existing, disused composting facility owned by WCC: responsibilities included preparation of contraction documentation, submission evaluation, bidder meetings and management of lease signing.
- **Anaerobic Digestion Facility, 2012 - 2013**
  Project Manager for the preparation of all regulatory approval applications for a 20,000 tonnes per annum anaerobic digestion facility for a private client including Part 8 planning application, waste licence review application and animal by-product application. All approvals were ultimately successfully achieved.
- **States of Guernsey Waste Infrastructure Procurement Project, UK, 2012 — 2014**
  Project team member for the provision of support services to the Public Services Department of States of Guernsey for the planning, design and procurement of waste infrastructure including in-vessel composting, materials recycling and residual waste processing.
- **Glasgow City Council - Redevelopment of MRF, Glasgow, Scotland, 2012 — 2013**
  Project Manager for the initial conversion of an existing waste transfer building into a material recycling facility (MRF) designed to treat up to 50k tonnes of co-mingled dry recyclable waste per annum and to re-deign an existing waste transfer station to increase the annual throughput to 100,000 tonnes per annum.

Tanya Ruddy

Principal Scientist - EIS/EIAR LEAD

Tanya is a Chartered Scientist and holds a Masters in Environmental Management.

Tanya has 17 years' experience in waste management and specifically in landfill. She has experience in planning and strategy, statutory consent applications, waste permitting/legislation, landfill operations, environmental compliance, remediation and restoration and in various aspects of environmental assessment, monitoring and interpretation. She is experienced in the preparation of waste management plans and their review and evaluation. She has experience in the preparation of EIAR including pre-application and statutory consultation and waste permit/licence and planning applications, landfill remediation and site investigations. She has prepared a number of waste licence and IE licence applications and has extensive experience in landfill gas management and prediction modelling, water quality assessment and all aspects of landfill monitoring, data management and interpretation. She has carried out extensive water quality, both surface water and groundwater monitoring and interpretive reports. Tanya is experienced in stakeholder engagement.

Qualifications

BA Mod Environmental Science, The University of Dublin, Trinity College, 2000

MSc Environmental Management, University of Ulster, 2001

Professional Memberships

Member of Chartered Institution of Wastes Management (MCIWM).

Member of the Chartered Institution of Water and Environmental Management (CIWEM).

Chartered Scientist (CSci)

Employment History

2001 – Present
Fehily Timoney & Company, Cork

2000 - 2001
National Health Service (East & South Belfast Health and Social Services Trust)

Publications

A management and auditing model for balancing landfill gas extraction:

C. J. Cronin, P. Kelly, E. Hanley, T. Ruddy, J. Smith
Proceedings Waste 2008

A spread sheet tool to calibrate LANDGEM gas modelling balancing landfill gas extraction. Draft Currently Under Peer Review:

C. J. Cronin, P. Kelly, T. Ruddy, D. Smyth, S. Meyler.
Proceedings Sardinia 2011.

Key Projects

- **EIS/EIAR for the South Kerry Greenway, 2017**
  Lead Coordinator of an EIAR/EIS for a shared cycling and pedestrian 32 km route from Glenbeigh to Reenard on the line of the former Great Southern and Western rail line. Coordination of chapter experts, communication of information, pre-application consultation, preparation of description of the proposed development, identification of gaps and client liaison.

- **Moanvane Windfarm EIS, 2017**
  Preparation of the water quality chapter of the EIS.

- **Maighne Windfarm EIS, 2015**
  Responsibility for review of existing surface water and groundwater environment for a 47 no. turbine windfarm of 1,244 ha spread over five clusters and the assessment of two potential HV grid connection routes of 32 km and 22 km. Responsibility for examination of the potential impact of the proposed wind farm, and associated infrastructure, on the existing water quality of the local environment. Consideration of drainage of the proposed development, taking account of mitigation measures to reduce or eliminate any residual impacts on the water quality. Consultation meeting with IFI and review of submissions with respect to surface water and groundwater.

- **Aviation Fuel Pipeline EIS, 2014**
  Responsibility for water quality assessment in the study area concentrated on a corridor of 25 m either side of the proposed 14.4 km pipeline corridor from Dublin Port to Dublin Airport, which included the public road, footway and verges within the boundary lines between public and private property. As the proposed pipeline corridor is to be constructed generally in an urban setting and is to be limited to this corridor, the potential receptors were likely to be generally located within 10-25 m of the construction activities. The waterbody catchments that the proposed pipeline corridor traversed were identified and the assessment included the hydrological pathways from these waterbody catchments as far as their outfalls into the receiving estuaries, up to 5 km downstream in some instances.

- **N8 Dunkettle Interchange Upgrade Scheme 2018 ongoing**
  Environmental Lead for the pre-construction contract for the upgrade of the Dunkettle Interchange in Cork. Responsible for delivery and coordination of all environmental monitoring and ecological survey work and reporting during the 12 month pre-construction phase. Ensuring that the environmental protection measures in the Schedule of Commitments and the contract are adhered to. Communication of environmental constraints to the design team in Fehily Timoney and Company, Ramboll and Clandillon Consulting Ltd. and working with the Contractor- Sisk to implement mitigation measures. Key ecological constraints include invasive species, rare plants, protected species and exclusion zones for works. Environmental monitoring includes surface water, tidal, groundwater, noise, vibration, dust and particulates.

- **IPPC to IED Review Application Eli Lilly Pharmaceuticals, Cork, Ireland, 2012**
  Senior Scientist for the preparation of IPPC licence review for the pharmaceutical manufacturing facility in Cork, Ireland. This involved the incorporation of details of new process operations such a new biopharmaceutical facility, technology alterations, updates in environmental processes and procedures. A number of client meetings were held to ensure the necessary data was collected and included in the application. Responsibility for licence review application and baseline study.

Key Projects cont'd.

- **Waste Licence Application for Kilquade Waste Soils Recovery Facility, Co. Wicklow, 2016**
  Responsibility for preparation of the waste licence application including all attachments and supporting documentation and drawings.

- **IE Licence Review, Powerstown Landfill, 2014**
  Preparation of a licence review application for Powerstown Landfill to increase the waste acceptance rate on behalf of Carlow County Council.

- **Waste Licence Application for a MRF, Dublin, 2007**
  Project manager for the preparation of a waste licence application for a 100,000 tpa materials recovery facility. Coordinated with preparation of an EIS for the facility.

- **Odour Impact Assessment, EPA 2010**
  Project Manager for an on-site resource at a landfill in Ireland on behalf of the EPA. The project staff were responsible for carrying out odour assessments in line with the EPA protocol at and around the landfill site and for assessing landfill operational practices with regard to odour management.

- **Licence Compliance Monitoring at Knockharley Landfill, AGB Landfills Ltd., 2012 – 2017 (and ongoing)**
  Project Manager for licence compliance monitoring. Prior to the transfer of the landfill to new owners, FT was responsible for all monitoring on site excluding stack monitoring. Post transfer, the new Client has taken on the role of sampling, FT is retained to carry out groundwater sampling and to prepare the quarterly interpretive reports for all monitoring activities. Responsibility for preparation of the slope stability analysis, integrity testing, AER and PRTR.

- **Licence Compliance Monitoring at Bologna Landfill, Dun Laoghaire-Rathdown County Council, 2014 – 2016 and 2016-2019**
  Project Manager for environmental monitoring at the landfill in compliance with the conditions of the waste licence. Monitoring includes dust, landfill gas, groundwater, surface water, noise leachate, sewer, leachate treatment. Responsible for the completion of all sampling, management of the laboratory, procurement and management of the stack testing, interpretation of results, compliance reporting and using EDEN on behalf of the DLRCC. Responsibility for preparation of the AER and PRTR.

- **Engineering and Environmental Consultancy Services to Ballyogan Landfill, Dun Laoghaire-Rathdown County Council, 2014 – 2016 and 2016-2019**
  Project Manager for the provision of consultancy services. Client liaison, budget and quality management. Coordination of various services to DLRCC as required including site investigations and recommendations on the installation of a sub-surface 220kv electricity line through the landfill site. Responses to EPA site audits. Responsibility for the preparation of an Emergency Response Plan, a site condition survey including mapping of all monitoring points, manholes, discharge points and infrastructure. Responsibility for liaison with the EPA.

- **Licence Compliance Monitoring at Balleally Landfill, Fingal County Council, 2008 – 2015**
  Responsibility for winning the competitive tender process and Project Manager since 2012. Site is licensed by the EPA. Acted as a sampler on site, monitoring landfill gas, dust, PM10, groundwater, surface water, leachate and noise. Responsible for the completion of all sampling, management of the laboratory, procurement and management of the stack testing, interpretation of results and compliance reporting. Responsibility for preparation of the AER and PRTR.

- **Licence Compliance Monitoring at Balleally and Dunsink Landfills, Fingal County Council, 2016-2020**
  Responsibility for winning the competitive tender process and Project Manager. Both sites are licensed by the EPA. Responsibility for staff carrying out monitoring of landfill gas, dust, PM10, groundwater, surface water, leachate and noise. Responsible for quality control, Health and Safety, management of budgets, management of the laboratory, procurement and management of the stack testing, interpretation of results and compliance reporting. Review of all quarterly reports to the EPA. Responsibility for preparation of the AER and PRTR.

- **Licence Compliance Monitoring at East Galway, Galway County Council, 2016 – 2020**
  Project Manager for environmental monitoring at the landfill in compliance with the conditions of the IED licence. Responsibility for staff carrying out monitoring of dust, PM10, landfill gas, groundwater, surface water, noise and leachate. Responsible for quality control, Health and Safety, management of budgets, management of the laboratory, interpretation of results, quarterly compliance reporting. Responsibility for preparation of the AER and PRTR. Responsible for procurement of quarterly topographical surveys and responsible for delivery of biannual VOC surface emission surveys.

- **Development of a Technical Information Resource for Landfill for the EPA, 2010**
  Project Manager for the preparation of an information resource for the EPA's internal website where staff could reference all relevant legislation, policy and EPA guidance on landfill. Project manager with responsibility for coordination the production of the resource. Compilation of all relevant legislation, policy and guidance on landfill, preparation of sketches, figures and flow charts to optimise presentation of the information.

- **Estimates of Methane Recovery in Landfill Gas Flaring and Utilisation, 2008/2009**
  This project involved surveying all licensed landfills, compilation and analysis of results. The outputs included the volume of methane flared and utilised in Ireland annually 1996 to 2008. It makes recommendations of management practices and infrastructure to improve the efficiency of methane recovery. It included the design of reporting systems to collate this information from licensees in the future.

Key Projects cont’d.

STRATEGIC WASTE POLICY

- **Waste Management Plan for Abu Dhabi, 2013-2016**
  Responsibility for collation, analysis and presentation of waste collection and facility data for the Emirate. Presentation of findings and recommendations for future waste handling and reporting.

- **Jeddah Environmental Assessment and Jeddah Environmental and Social Masterplan, 2012 – 2013**
  Responsibility for carrying out a review and gap analysis of waste management legislation in Jeddah and the Kingdom of Saudi Arabia. Cooperation on the generation of the technical waste chapter for the JEA considering the current status of waste management in Jeddah, the environmental impacts and recommending mitigation measures.

- **Evaluation of the Waste Management Plan for the Midlands Region, 2012**
  This was carried out on behalf of five local authorities. The project included a stakeholder meeting in order to discuss progress made and challenges faced over the lifetime of the Plan. A review of waste management policy was conducted to determine its applicability going forward. A legislative and policy review was carried out to determine the elements of the Plan which need to be revised.

- **Evaluation of the Waste Management Plan for the Midlands Region, 2012**
  This was carried out on behalf of five local authorities. The project included a stakeholder meeting in order to discuss progress made and challenges faced over the lifetime of the Plan. A review of waste management policy was conducted to determine its applicability going forward. A legislative and policy review was carried out to determine the elements of the Plan which need to be revised.

- **Evaluation of the Waste Management Plan for the County Kildare**, **2012**
  The project included a stakeholder meeting in order to discuss progress made and challenges faced over the lifetime of the Plan. A review of waste management policy was conducted to determine its applicability going forward. A legislative and policy review was carried out to determine the elements of the Plan which need to be revised.

- **Review of Wicklow Waste Management Plan 2006**
  Review of the Waste Management Plan for County Wicklow, review of submissions, policies and objectives, review of waste arisings, waste forecasts, and assessment of progress since the previous plan period strategic planning

- **PRTR Reporting Various Landfills, Ireland, 2007 – 2012**
  Calculation of emissions to ground, water and air from waste licensed facilities and presentation in EPA electronic report format.

- **Landfill Gas Field Audits and Balancing, Various Landfills, Ireland, 2008**
  Project manager with responsibility for auditing problematic landfill gas collection and extraction systems. Auditing the gas fields included; flow measurement in each gas zone, gauge pressure and gas quality monitoring, inspection of infrastructure including extraction well performance, pipelines knock out pots, valve and monitoring infrastructure. Review of monitoring and flaring/utilisation records. Determination of issues and snag lists to correct. Responsibility for training of site staff.

- **Landfill Gas Migration Investigation, Kinsale Road Landfill, Cork City, 2001 - 2003**
  Investigation of potential landfill gas migration incident investigative work included geophysical surveys, trial pit investigations, installation of monitoring boreholes, extensive monitoring, data management and interpretation carried out. Sampling of gas for trace constituents. Interpretative reporting to define source.

- **Management and Auditing Model, Arthurstown Landfill, Co. Kildare**
  Responsibility for data collation for the design of a landfill gas field management and auditing model. Development of a flow based extraction philosophy for Ireland’s largest landfill gas field. Also involved in the adaptation of this modelling tool for other landfills.

Chris Cronin

Project Manager

Chris Cronin,B.Sc. (Hons) M.Sc., C.Eng, C. Env, MCIWM, MIEI, MIAgEng., is a Technical Director of Fehily Timoney and Company. Chris has 38 years' experience providing both contracting and consultancy services on major engineering and civil engineering projects, 17 years of which have been in the design, contract administration and delivery of waste management and remediation projects for Fehily Timoney and Co in Ireland and overseas.

Chris has extensive project management, detailed design, preparation of tender documents, procurement and construction administration experience in both landfill remediation, landfill design, landfill gas, wetlands, groundwater management and a wide range of civil, mechanical and electrical projects and protection works associated with dams, rivers and coastal protection.

Chris has specialist interests in landfill gas and groundwater remediation.

Qualifications

Bachelor of Science Degree,
Soil & Water Engineering (Hons),
Cranfield Institute of Technology,
Bedfordshire, UK, 1979;
Master of Science Degree, Drainage
Cranfield Institute of Technology,
Bedfordshire, UK, 1982.

Professional Memberships

Chartered Engineer (1989 UK Engineering Council).
Chartered Environmentalist (2005).
Chartered Waste Manager (2011)
Member, Institution of Engineers of Ireland.
Member, Institution of Wastes Management.
Registered Engineer EI Historic Landfill Register.
Member, Institution of Agric. Engineers.

Employment History

2000—Present Fehily Timoney & Company, currently Technical Director.
1998- 2000 Technical Director Nomix Chipman
1979—1998 Different consultants and contractors overseas.

Publications

Techniques for Non-destructive Monitoring of Sub Surface Drains. P Leeds Harrison, RK Fry, CJ Cronin, JE Gregory. Journal of Agric. Eng. Research 1983 28:479-484.

Symposium on Land Drainage for Salinity Control in Arid and Semi-Arid Areas, Cairo, February 1990 Mole Drainage Installation for Leaching Purposes, G Spoor, CJ Cronin and PB Leeds Harrison.

A management and auditing model for balancing landfill gas extraction. C.J. Cronin, P. Kelly, E. Hanley, T. Ruddy, J. Smith Proceedings Waste 2008.

A spread sheet tool to calibrate LANDGEM Gas modelling prediction software for site specific MSW facilities using data from Gas Extraction Audits. C. J. Cronin, P. Kelly, T. Ruddy, D. Smyth, S. Meyler. Proceedings Sardinia 2011.

A spreadsheet tool to calculate landfill gas flow across a range of control valves or to select appropriate valves based on design flows. C.J.Cronin, A. Riordan, N. Menzies, S. Willacy, B. Ward, J. McFeat.

Key Projects

Contaminated Land & Remediation Projects

Chris was involved in the following remediation projects:

- **Scotch Corner Landfill Remediation** (2018 - ongoing) for Monaghan County Council. Chris was responsible for the technical design submission for a design & build proposal for the installation of leachate pumping wells as part of a remediation plan for a 'dilute and disperse' area of the landfill.
- **Timoole Unauthorised Landfill Remediation (**2017). Chris was responsible for technical review of FT designs for Priority Construction Ltd in its remediation of Timoole requiring removal/reinstatement of 40,000 m^3 MSW/soil materials. Key elements of the technical review were temporary works (excavation >9.0m) and risk of rotational failure.
- **Environmental Remediation Hazardous Waste Remediation Design** for Louth County Council. Chris was responsible for technical review of SI interpretive report, remediation design and contract documents for removal of non-hazardous (1,200 t) and hazardous (1,800 t) wastes.
- **Rehabilitation of Gortmore Tailings Management Facility for North Tipperary County Council 2008.** FT as a sub-consultant to SRK Consulting were responsible for capping design of tailings ponds and wetlands. Chris was the Principle Engineer responsible for detailed design works.
- **Haulbowline Remediation 2017**. Chris was responsible for the technical design submission for John Sisk and Son in its design build proposal for the remediation & capping of the former Haulbowline East Tip site, including metal recovery, on the old Irish Steel Works site.
- **Buhair Landfill Site Remediation, Bahrain for Bauer Resources GMBH 2014.** Chris prepared the remediation plan and detailed designs for remediation works including but not limited to management of: landfill gas, odour, fire, groundwater extraction, groundwater treatment, surface water diversion.

Groundwater and Environmental Risk Assessments

Chris has extensive landfill related relevant experience which will supplement the remediation experience described above: Chris was responsible for technical reviews, design studies, remediation works and groundwater risk assessments using Landsim, Modflow and EPA "Guidance on Management of Contaminated Land and Groundwater at the following licensed sites: Arthurstown, Bottlehill, Ballydonagh, Balleally, Marlinstown, Youghal Landfills Basketstown Ballaghveny and Silliot hill.

Chris also was responsible for Miscellaneous Tier I/II Landfill Risk Assessments on historic landfills (using EPA Code of Practice for Environmental Risk Assessment for Unregulated Waste Disposal Sites (2007) for following sites 4 historic landfills in Co Meath, Tipperary, Kilkenny, Fingal. Work required review of site investigation, interpretation of environmental monitoring results, environmental risk assessment reports, assignation of risk categories, and recommendations as to the extent of additional assessments required at each site.

Landfill Design and Remediation

Miscellaneous Landfills (2000-2018). Chris since 2000, in roles of Resident Engineer, Principal Engineer and Technical Director has been involved in remediation the following landfills: Talbotsinch, Gowran, Skehana, Sevenhouses, Thorpes, Oldcourt, Ballyragget, Curheen, Killycard, Knockcronaghan, Drumlish, Longford Town no.1, Ballymaurice, Cartron Big, Ballymulvey, Callaghstown, Tipperary Town, Bray Landfill, Curkeen, Kinsale Road, Beaumont quarry, Bottlehill, Youghal, Marlinstown, Ballydonagh, Killurin, Holmstown, Donohill, Silliot Hill, Drehid, Knockharley, North Kerry, Banemore, Basketstown, Ballaghveny, East Galway, KTK, Ballealy, Ballynagran, Gozo (Malta), Sajja (UAE) Buhair (Bahrain) Jeddah (KSA).

Protection Works

Chris has extensive protection related work over 20 years (riprap, scour, launching apron, groynes on large agricultural and river related development works overseas) and coastal development works in Ireland at: Cobh Sewer outfall, 2008, energy dissipator and launching apron; Carrigrennan WWTP, 2003, coastal protection – rock armour, scour and launching aprons; Bray landfill, 2016, – coastal protection using rock armour and launching aprons; Wexford marina, 2015, geotech and tidal surveys for EIS marina design; Bantry bay 2004

Siún McCarthy

Landscape & Visual Specialist

Siún McCarthy is a Project Planner with Fehily Timoney and Co. and works as part of the Energy and Environment Team.

Siún holds a BA in Geography and an MPlan Masters in Planning and Sustainable Development from University College Cork. Siún is a Corporate Member of the Irish Planning Institute and a Licentiate Member of the Royal Town Planning Institute.

Qualifications

BA Geography and Religion, University College Cork (2012)

MPlan Masters in Planning and Sustainable Development, University College Cork (2014)

Professional Memberships

Corporate Member of the Irish Planning Institute

Licentiate Member of the Royal Town Planning Institute

Employment History

2015 – Present
Fehily Timoney & Company, Cork;

2014 –2015
Bath and North East Somerset Council

June - August 2014
An Bord Pleanála (Internship)

August – September 2013
Cork City Council (Internship)

Key Projects

- **Knockharley Landfill – Knockharley Landfill Ltd.** Preparation of EIAR for the extension to an existing landfill including Policy, Population and Human Health and Landscape and Visual Impact.
- **Castletownmoor Wind Farm – Element Power**
  Preparation of Non-Technical Summary, Policy, Public Consultation and Human Environment chapters of an EIS for a Strategic Infrastructure Development windfarm in the Greater Dublin Area. Preparation of a Planning Report and Site Selection Report.
- **Moanvane Wind Farm – Element Power**
  Preparation of Non-Technical Summary, Policy, Public Consultation, Material Assets, Alternatives and Human Beings, Population and Human Heath chapters of an EIS/EIAR for a 12no. wind turbine development in Co. Offaly.
- **South Kerry Greenway EIAR – Kerry County Council**
  Preparation of Non-Technical Summary, Policy, Public Consultation, Site Selection and Alternatives and Population and Human Health Chapters of an EIAR for a Greenway Route in South Kerry.
- **Development Plan Monitoring**
  Monitoring of Development Plans and Local Area Plans on behalf of clients and submissions on behalf of clients on the preparation of County Development Plans and Local Area Plans.
- **Site Appraisals**
  Preparation of site appraisals for a variety of developments including renewable energy projects and urban development projects assessing the proposed development in the context of planning and environmental risks and opportunities.
  - **Planning Application for End of Life Vehicle Facility, Patrickswell, Co. Limerick**
  - **Preparation of Planning Application for A Composting Facility in North Cork**
- **Dennistown Solar Farm, Co. Wexford**
  Preparation of Landscape and Visual Impact Assessment for the proposed development of a solar farm at Dennistown, Co. Wexford.
- **Raragh Wind Farm Cable Route – Mainstream Renewables**
  Preparation of Non-Technical Summary, Policy, Public Consultation, Site Selection and Alternatives, Landscape and Human Environment chapters of an EIS for a proposed cable route between a permitted wind farm and an existing substation.
- **Carragraigue Solar Farm**
  Preparation of a solar farm planning applications and supporting planning and environmental reports for a 5MW solar farm in North County Cork.
- Preparation of Section 5 application and EIA Screening for a cable route associated with a wind farm in Co. Kerry
- Preparation of an integrated tourism development masterplan for a development adjacent to the Lower River Shannon SAC, Ardclooney, Co. Clare.
- Preparation of an Application for mixed use indoor sports and recreation facility, at the former Burlington Facility, Co. Clare.
- **Planning Report, Lee Road Water Treatment Plant Upgrade – Irish Water**

Jon Kearney

Biodiversity / Appropriate Assessment Team Lead

Jon is a principal ecologist with 12 years' experience in both the UK and Ireland. His skills include an extensive knowledge of field survey techniques and methodology, ornithological surveys, mitigation design, water quality assessment, Appropriate Assessment and Ecological Impact Assessment. Jon has extensive experience of ornithological, reptile, mammal and amphibian surveying; habitat surveying, botanical surveying and invertebrate sampling techniques and identification. Jon has completed ecological assessments, EcIAs and Appropriate Assessments for a wide variety of projects in Ireland and the UK including over 35 wind farm applications, solar farms, pipelines, road schemes, greenways and commercial developments. He has considerable experience of EIS and ecological constraints work, which often includes extensive reference to, and interpretation of, Article 6 of 'The Habitats Directive', and to other EU, UK and Irish conservation legislation.

Qualifications

2005 M.Sc Ecological Management and Biological Conservation from Queens University Belfast

2004 B.Sc Applied Ecology from University College Cork

Professional Memberships

MCIEEM Full member of the Institute of Ecology and Environmental Management

Employment History

July 2015 – Present
Fehily Timoney & Company, Cork

2010 — 2015
Malachy Walsh & Partners

2009 — 2010
Renewable Energy Systems Ltd.

2007 — 2009
RPS Consulting Engineers

2007
Mott McDonald

2006 — 2007
Mouchel

2005 — 2006
Freelance Ecologist

Expert Witness

Expert witness at the following Oral Hearings:

Pairc Ui Chaoimh

Doolin Pier

Cluddaun Wind Farm

Publications

Jon Kearney (2010). Kerry slug (*Geomalacus maculosus*) recorded at Letercraffroe Co. Galway. Irish naturalists Journal **31** No. 1 p68-69

Key Projects

- **Millennium Park Materials Processing and Transfer Facility, Dublin City**
  The proposed development was for a materials processing and transfer facility at the Millennium Business Park site for the acceptance of up to 170,000 tonnes per annum of municipal solid waste (MSW) from commercial and domestic sources. Jon prepared the Flora and Fauna chapter of the EIS and the Appropriate Assessment Screening Report. He also prepared an invasive species management plan for the proposed development.

- **Knockharley Landfill, Co. Meath**
  The proposed development was for an existing landfill facility where waste disposal and recovery activities are undertaken. Jon both conducted and coordinated ecological surveys (habitats, bats, mammal, birds and water quality), and prepared the Biodiversity chapter of the EIAR and reviewed the Natura Impact Statement.

- **Pairc Ui Chaoimh Redevelopment, Cork City**
  Project ecologist for the redevelopment of Pairc Ui Chaoimh. Jon prepared the Flora and Fauna chapter of the EIS and the Natura Impact Statement. Jon was the expert witness for ecology representing the GAA at the subsequent An Bord Pleanala oral hearing following which the project received full planning.

- **Development of Beamish and Crawford Site, Cork City**
  Heineken Ireland Ltd. and BAM a applied successfully for planning permission to build a multi-purpose development on the site of the old Beamish and Crawford Brewery on South Main Street, Cork City centre. Jon was the project ecologist for the project. He carried out habitat surveys and bat surveys within this urban site and the greater surroundings. He prepared the Ecological Impact Assessment and Appropriate Assessment. Jon was also involved in the consultation process with NPWS and designed a habitat enhancement plan including the installation of green roof as part of the design of the development.

- **Doolin Pier Development Co Clare**
  A new harbour development comprising of a 103 metre pier new pier structure, revetment, bed rock dredging, access road and associated works at Doolin, Co Clare. The new facility offered improved access to the Aran Island from the mainland. Jon was the project ecologist for the EIA. Coordinating and undertaking: Ecological survey (fauna, flora and habitats). Production of an NIS and terrestrial ecology chapter of the EIS. Expert witness at oral hearing for project which received planning.

- **Dairygold Redevelopment, Mallow, Co. Cork (2014)**
  Jon coordinated the Natura Impact Statement and Biodiversity chapter along with ecological surveys at the site for this brownfield site. Surveys undertaken included those for habitats, mammals, bats and water quality (Q sampling/physiochemical). The project subsequently received full planning.

- **Upperchurch Wind Farm, Co Tipperary**
  Jon was the project ecologist for Upperchurch Wind Farm in Tipperary. He both coordinated and conducted bat, mammal, habitat and ornithological surveys within the study area of the 22 turbine Wind Farm. He prepared the Ecological Impact Assessment, Appropriate Assessment and Ecological Management and Habitat Restoration Plan. Jon was also involved in the consultation process with NPWS.

- **'O Grianna Case' Derragh Wind Farm, Co. Cork**
  Jon was the project ecologist for Derragh Wind Farm for the most recent application in 2015. The planning for the previous application had been over turned in the high court in the 'O' Grianna Case' due to lack of consideration for the Grid Route. Jon prepared the Natura Impact Statement and Flora and Fauna Chapter of the EIS for the most recent revised application which received planning from An Bord Pleanala.

Key Projects cont'd.

- **Cork Area Strategic Plan-Strategic Environmental Assessment (SEA).**
  The Cork Area Strategic Plan (CASP), adopted in 2001, provides a framework for the full integration of land use, transportation, social and economic elements for the Cork area up to 2020. Prepared ecology chapter of the SEA.

- **Strategic Area Plans Cork County**
  Prepared the biodiversity, flora and fauna chapter for the Strategic Environmental Assessment for the following towns:
    - Macroom
    - Clonakilty
    - Kinsale
    - Skibbereen
    - Fermoy
    - Mallow

- **Southeast Clare habitat mapping**
  Carried out phase I habitat survey for Clare County Council of all habitat types within a total study area of 400km2. Habitats were classified to level 3 according to a guide to habitats in Ireland (Fossitt, 2000). The information gathered was used to produce a comprehensive habitat map of the region. Among the EU Annex I habitats recorded during the survey was 'depressions on peat substrates of the rhynchosporion (7150)'. This habitat was previously unrecorded within the region and maybe designated as a site of international importance following further investigation.

Other AA Screening Reports and Natura Impact Statements prepared by Jon

- Client: Louis Keating / Clare County Council - Kilrush Marina redevelopment and dredging, Co. Clare (2012)
- Client: GSK - Various projects including a coastal revetment, and several new buildings within the plant, Co. Cork (2010-2015)
- Client: Fenit Harbour Board - Fenit Marina and Harbour Extension Preliminary Ecological Studies & EIA Screening, Co. Kerry (2011)
- Client: The Department of Arts, Heritage and the Gaeltacht - Clifden and Inishbofin Airport Terminals (2011)
- Ardcooney Integrated Tourism Masterplan, Co. Clare
- Client: Scartaglen Wind Farm Ltd - Scartaglen Wind Farm Phases I and II, Co. Kerry (2012 - 2015)
- Client: Castlegregory golf club - Castlegregory golf course club house (2013)
- Client: Ecopower - Glencarbry Wind Farm, Co. Tipperary
- Client: Ecopower - Boolabrien Wind Farm, Co. Waterford
- Client: Ecopower - Knocknamona Wind Farm, Co. Waterford
- Client: Ecopower - Derrynadivva Wind Farm, Co. Mayo
- Client: Ecopower - Killavoy Wind Farm, Co. Cork
- Client: Met Eireann - Valentia Met Eireann Air Monitoring Facility
- Client: Western Power - Knockranny Wind Farm, Co. Galway
- Client: Solar Sense - Cahir Solar Farm, Co. Tipperary
- Client: Solar Sense - Ballyhale Solar Farm, Co. Kilkenny
- Client: Solar Sense - Glenamoy House Solar Farm, Co. Meath
- Client: Kerry County Council - N70 Kilderry road, Co. Kerry

Key skills and experience

- Have applied for, conducted surveys and supervised construction work under the terms of and completed final reports for several derogation licences for bats, badger, otter, pygmy shrew, electrofishing, reptiles, water vole, dormouse and Kerry slug.
- Expert Witness (Project Ecologist): at three An Bord Pleanála Oral Hearings, Cluddaun Wind Farm (Mayo), Pairc Ui Chaoimh (Cork) and Doolin Pier (Clare)
- Phase I habitat surveys, Fossitt (2000), vantage point survey (birds), transect surveys (birds), point count (birds), AnaBat (Bats), Q sampling (kick samples), White clawed crayfish surveys, electrofishing, mammal surveys (Longworth traps, field surveys, dormouse tubes, motion detection cameras).

Elaine Bennett

Ecologist

Elaine Bennett is a Senior Scientist with Fehily Timoney. She has a PhD in Plant Ecology and a BSc in Biological Science from University College Cork and a Diploma in Environmental Impact Assessment. Elaine works in the Environment and Energy Department of FT and is experienced in the co-ordination of Environmental Impact Statements, Environmental Reports, Ecological Assessments and Appropriate Assessments. She is also experienced in habitat assessment and protected species assessments as part of Environmental Impact Statements, Appropriate Assessments and specialist flora and fauna surveys. Elaine has experience in the identification of environmental and engineering constraints and the development of appropriate mitigation.

Qualifications

PhD in Plant Ecology, University College Cork. *"The Status, Ecology and Conservation of Tuberaria guttata (L.) Fourreau in Ireland*

BSc (First Class Honours). Biological Science, University College Cork

Diploma (Environmental Impact Assessment)

Professional Memberships

CIEEM Full member of the Chartered Institute of Ecology and Environmental Management

Employment History

September 2016 – Present
Fehily Timoney & Company, Cork – Senior Scientist

2015-2016
Atkins – Senior Environmental Consultant

2011-2014
EirGrid – Senior Ecologist

2007-2011
Mott McDonald Ireland Ltd – Ecologist/Environmental Scientist

2007
White Young Green Environmental - Ecologist

Key Projects

- **Knockharley Landfill (Knockharley Landfill Ltd.).** Preparation of the Appropriate Assessment to accompany the EIAR and planning application for the existing facility and the proposed development elements comprising the intensification of waste acceptance, storage of incinerator bottom ash (IBA), biological processing of residual municipal solid waste 'fines' and the storage and treatment of leachate.
- **M11 Waste Facilities (M11 EJV) –** Biodiversity assessments and Stage 1 Screening for Appropriate Assessments of five proposed waste facilities in Co. Wexford as part of the M11 scheme.
- **Bandon Waste Water Treatment Plant Upgrade (Irish Water) –** Environmental project manager for the upgrade of Bandon Waste Water Treatment Plant. Responsible for procurement of specialists, co-ordination of assessments and reporting including EIA screening, Screening for Appropriate Assessment, invasive species assessment, landscape and visual, cultural heritage, noise and vibration, air quality and odour.
- **South Kerry Greenway (Kerry County Council).** Project manager for the EIAR/EIS of the 32km proposed greenway in Co. Kerry.
- **Moanvane Wind Farm (Element Power).** Co-ordination of EIS/EIAR for a proposed 12-turbine wind farm in Co. Offaly.
- **Fassaroe Development (Cosgrave Property Group).** Co-ordination of sections of the EIS for the proposed mixed-use development at Fassaroe, Co. Wicklow. One of the main site constraints was the presence of 3 historic landfills within the site, which required detailed assessment and design measures.
- **Derrysallagh Grid Connection (Derrysalllagh Wind Farm Ltd.).** Co-ordination of remedial EIAR/EIS for the partly constructed grid connection works and preparation of planning applications and EIARs/EISs for outstanding grid connection works.
- **Clashavoon Battery Storage Facility (BNRG Neoen Holdings Ltd.).** Co-ordination of planning application including Planning and Environmental Report for a battery storage facility in Clashavoon, Co. Cork.
- **Raragh Cable (Raragh Development Ltd.)** Environmental co-ordinator of EIS and preparation of ecological impact assessment and Stage 1 Screening for Appropriate Assessment of the proposed cable development between the permitted Raragh Wind Farm and the electricity substation at Kingscourt, Co. Cavan.
- **Derragh Substation (Enerco).** Co-ordinator of the planning application with Environmental Report and Stage 1 Screening for Appropriate Assessment of a proposed new substation for Derragh Wind Farm.
- **Center Parcs Feeder Main (Gas Networks Ireland).** Environmental co-ordinator of Environmental Report for the proposed gas pipeline in Co. Longford.
- **Johnstown North Solar Farm (BNRG**). Environmental co-ordinator for the Environmental Report supporting a planning application for a proposed 20MW solar farm in Co. Wicklow.

Key Projects cont'd.

- **Wicklow Local Network Reinforcement (Irish Water)** – Co-ordination of environmental inputs for the replacement of a section of sewer in Wicklow town. Assessments being conducted include EIA Screening, Screening for Appropriate Assessment, Archaeological Screening and Invasive Species assessment.

- **EirSpan - Sligo and Leinster Bridges Maintenance Works (NRA)** – Stage 1 Screening for Appropriate Assessment of maintenance works on bridges in Sligo (51 bridges) and Leinster (8 bridges). Desktop assessment and risk assessment of the proposed works with reference to the qualifying interests and special conservation interests of Natura 2000 sites in proximity to the proposed works.

- **Cork Lower Harbour EIS (80,000PE) (Cork County Council) -** Co-preparation of the EIS for a new 80,000 PE WWTP and pipeline infrastructure. Responsibilities Included the review of sub-consultants technical reports and preparation of the following EIS chapters: Flora and Fauna, Water Quality and preparation of Socio-Economics (Human Beings & Material Assets) chapters. Received consent from An Bord Pleanála under Strategic Infrastructure without the requirement for an Oral Hearing.

- **Coolbane Quarry (Drimoleague Concrete Works Ltd.) –** Stage 1 Screening for Appropriate Assessment for continuance of operations at the quarry site in West Cork.

- **Youghal Main Drainage (Dunn's Park Overflow Pipeline) (Irish Water) –** Stage 1 Screening for Appropriate Assessment of proposed overflow pipeline from Dunn's Park pumping station. Natura 2000 sites of relevance were River Blackwater (Cork/Waterford) SAC and Blackwater Estuary SPA.

- **Stage 1 Appropriate Assessment of Drainage Works (Tipperary County Council**) – Stage 1 Screening for Appropriate Assessment of proposed drainage works in seven areas within Co. Tipperary. The drainage works comprised dredging river channels clear of recent silt deposits, flood debris and fresh vegetation by a tracked excavator working in the direction of flow so as to minimize impacts on the downstream aquatic environment.

- **Sullivan's Quay Re-development EIS (Ascon Property Developments Ltd.) -** Management and preparation of EIS for the redevelopment of a city centre site. Scoping was conducted with the planning authority in order to identify areas of concern with regard to the redevelopment of the site. The environmental impact assessment included archaeology, noise and vibration, air quality, landscape and visual assessment, flora and fauna, soils, geology and hydrogeology. Environmental considerations of particular relevance to this site and development were overshadowing and daylight access due to the height of the new development and proximity to residential and commercial developments. Due to the provision of 3 levels of underground car parking with 201 nr. car park spaces, a transport assessment was also conducted. The Trip Rate Information Computer System (TRICS) was used to assess transport impacts from the new development. Groundwater impacts and impacts on archaeology were of particular concern due to the deep excavations required for the basement car park as the site is within a zone of archaeological potential and in close proximity to the River Lee.

- **Great Island and Tarbert Proposed Combined Cycle Gas Turbines (CCGTs) EIS (Endesa) -** Co-ordination and management of terrestrial ecological surveys – terrestrial habitat, flora and fauna assessments were conducted at two existing brownfield sites as part of EIA. A habitat and flora survey of the site was undertaken and bat, badger and otter surveys were conducted to establish the baseline environment. Mitigation measures were proposed to minimise impacts on birds, bats and badgers. Expert Witness at both Oral Hearings.

- **N11 / N25 Oilgate to Rosslare Constraints and Route Selection Study (Wexford County Council)** - Preparation of various chapters for the constraints study: flora and fauna; water quality; soils, geology and hydrogeology; landscape and visual. Co-ordination of flora and fauna assessments for a route selection report for the 26km N11/N25 Oilgate to Rosslare Road Scheme. Conducted habitat mapping and botanical assessment of the 26km scheme. The scheme will involve a crossing of the Slaney River Valley SAC and the Wexford Harbour and Slobs SPA.

- **N69 Listowel Bypass Route Selection Report (Kerry County Council)** - Ecological surveys and habitat mapping were undertaken along each of five potential route options. Each of the five options involves a crossing of the Lower River Shannon SAC.

- **N21 Adare to Abbeyfeale Route Selection Report (Limerick County Council)** - The project involved detailed consultation with NPWS, which centred upon a number of ecological sensitivities in the study area including the protected lesser horseshoe bat and hen harrier species.

- **Annaghroe and Knockaginny Bridges Appropriate Assessment (Monaghan County Council)** - Conducted an ecological assessment (habitat mapping and botanical assessment) and appropriate assessment for the reinstatement of two cross-border bridges at Annaghroe and Knockaginny. The original bridges, which provided cross-border access across the River Blackwater between Counties Monaghan and Tyrone, were removed in the 1950s and 1970s.

- **Combined Cycle Gas Turbine Power Plant EIS (Bord na Mona)** - As part of an EIA for a proposed power plant and associated pipeline infrastructure, a habitat survey and mapping to level III of Fossitt (2000) was conducted at the site and along the proposed pipeline infrastructure.

- **Owenmore Open Cycle Gas Turbine (OCGT) EIS (Constant Energy)** - A habitat assessment of the site was conducted to level III of the Fossitt (2000) habitat classification system. The survey also included a protected flora survey of the site due to the presence of lowland blanket bog within the site and records for protected species in the vicinity of the site. Otter and badger surveys were also conducted and mitigation developed for the minimisation of impacts on these protected species.

Silvia Garcia Merino

Senior Project Scientist

Silvia works as a Senior Project Scientist with Fehily Timoney & Company. Silvia holds a MSc. in Physics from Complutense University of Madrid(Spain). She is an experienced professional with over 7 years working in energy resource assessments, layout design and environmental impacts of renewable energy projects internationally.

During her professional experience, Silvia has carried out a number of feasibility studies of wind and solar farms and prepare Environmental Impact Statement (EIS) chapters well as coordinate multi-disciplinary teams for the preparation of environmental reports. She has also been project manager for several solar farm planning applications in Ireland.

Since 2015 she also holds an international MSc. in Ecosystem science and Policy from UCD (Ireland) and Giessen University (Germany).

Qualifications

MSc Physics, Climate and geophysics, Basque Country University and Complutense of Madrid (Spain), 2007

MSc Global Change: Ecosystem Science and Policy, UCD and Giessen (Ireland and Germany), 2015

Professional Memberships

EWEA and Solar Energy Network (in Linkedin)

Employment History

2015 – Present
Senior Project Scientist in Fehily Timoney & Company, Cork, Ireland

2008 - 2013
Wind Engineer in Gamesa, Bilbao (Spain)

Key Projects

- **LVIA section for planning applications. 2016-18**
  Responsible for the preparation of the LVIA for Ballyhale Solar Farm, Co. Tipperary and Barnahely Battery Storage in Co. Cork against others and photography work for a number of solar farm applications.

- **Lead of Shadow Flicker and Telecommunication & Aviation Chapters of the Environmental Impact Statement (EIS) of several Wind Farms in the Republic of Ireland. 2015-18**
  Responsible for the modelling and assessment of Shadow Flicker impacts of Wind Farms for inclusion in the Environmental Impact Statement. Shadow flicker analysis carried out for projects including Slaghbooly Wind Farm (WF) in Co. Clare, Cloghboola WF in Co. Kerry, Castletownmoor WF in Co. Meath, Meenwaun and Moanvane WFs in Co. Offaly. Liaison with the modelling software developer to ensure the suitable methodology for the assessment is used.

- **Feasibility studies of Wind and Solar Farms. 2015-18**
  For a variety of clients across a range of Counties including Cork, Kerry, Roscommon, Tipperary and Wexford.

- **Coordination of the EIS and applications for a number of cable routes connecting Wind Farms to the national grid.2016-18**
  Coordination of the EIS for the Raragh Wind Farm Underground 20KV Grid Connection (Co. Cork). Manage and prepare an EIA Screening Report for a Section 5 application for the Underground Grid Connection Derragh Wind Farm (Co Cork). Manage the EIS for the Derrysallagh Wind Farm Overhead Grid Connection (Co. Sligo).

- **Planning application and associated Environmental Report for several Solar Farms in Co. Tipperary, Co. Kilkenny and Co. Cork. 2015-17**
  Project Manager for the Planning Application and FI response of solar farms (5-15MW). Granted permission obtained for Cahir, Carrick-on-Suir and Ballyhale Solar Farms in Co. Tipperary and Kilkenny.

- **Evaluation of noise performance of different turbine models, windfarms in UK and Germany, 2011 - 12**
  Study of the performance of different turbine models in terms of the noise impact that they would have in sensitive acoustic points following the national guidelines. Analysis of different turbine control strategies and the impact on the energy production.

Donna O'Halloran

Project Environmental Scientist

Donna O'Halloran is a Project Ecologist and Environmental Scientist with three years' experience and works on waste, energy and urban planning related projects. Donna has a comprehensive knowledge of air and climate and biodiversity related international and national legislation and international agreements as well as Ecological Impact Assessment and Appropriate Assessment.

Donna's biodiversity skills also include, biodiversity impact appraisal, mitigation measures, enhancement measure design, Invasive Species Management Plans, flora, fauna and habitat identification skills, habitat surveying, botanical surveying, invasive species surveying, water quality surveying, ornithological, terrestrial mammals and bat surveying. Donna's air and climate skills also include impact appraisal and mitigation measures as well as the use of traffic emission models and carbon calculation models.

Qualifications

MSc Ecological Assessment (First Class Hons), UCC, 2014

MSc (Agr.) Environmental Resource Management (First Class Hons), UCD, 2007

BSc (Agr.) Landscape Horticulture (Hons), UCD, 2006

National Diploma in Horticulture, National Botanic Gardens/ITB, Dublin, 2004

Employment History

2015 – Present
Fehily Timoney & Company
Cork

2011-2014
Heronswood Childcare Centre,
Cork

2010-2011
Little Hands Childcare and
Early Learning Centre,
Cork

2007-2008
Mitchell + Associates
Cork

2006
Brady Shipman Martin
Cork

2001-2004
National Botanic Gardens
Dublin

2001-2003
Carewswood Garden Centre
Cork

Key Projects

- **Air and Climate Impact Appraisal as part of Environmental Impact Assessment Report which included traffic emission (DMRB) modelling and calculating carbon (Scottish Government)**
  Undertook air and climate appraisals for windfarms and waste facilities as part of Environmental Impact Assessments. This included calculating carbon release during the manufacturing of turbines, site construction, felling and peat removal. The carbon savings and carbon payback during operation of windfarms was also calculated. Traffic emissions for preconstruction, construction and post construction were also undertaken.
  - Wind farm in the east (2018 – preplanning stage)
  - Ballymanus Wind Farm, Co. Wicklow (2016 & 2017)
  - Slaghbooly Wind Farm, Co. Clare (2015)
  - Castletownmoor Wind Farm, Co. Meath (2015)

- **Air and Climate Impact Appraisal as part of Environmental Impact Assessment Report/Environmental Report which included traffic emission (DMRB) modelling:**
  - Knockharley Landfill, 2018
  - Overhead Line, midlands (2018 - preplanning stage)
  - Solar Farm Co. Wexford (2018 – preplanning stage)
  - Landfill Extension in Leinster (2018 – preplanning stage)
  - Soil Backfill Facility, Co. Limerick (2018 – preplanning stage)
  - Battery Storage Facility, Co. Cork (2018 – preplanning stage)
  - Proposed Waste Transfer and Processing Facility, Co Laois (2015 & 2018 preplanning)
  - Waste Soil Recovery Facility Kilquade, Co Wicklow (2016)
  - Millennium Park Landfill Extension, Co. Dublin (2016)

- **Review of Stage One Appropriate Assessment (AA) Screening Reports and Stage Two Natura Impact Statements (NIS) for Strategic Environmental Assessment (SEA), 2018**
  - Review of multiple AA Screening Reports and NIS for OPW SEA Flood Management for the South Western River Basin

- **Habitat Surveys, Ecological Impact Assessment, AA Screening Reports and/or NIS for solar farms, parks, greenways and waste related developments, 2016-2018**
  - Knockharley Landfill, 2018
  - Waste Facility Licence Renewal, Leinster (preplanning)
  - Soil Recovery Facility on illegal landfill, Leinster (preplanning)
  - Soil Recovery Facility, Munster (preplanning)
  - Battery storage facility on illegal dump, Munster (preplanning)
  - Retention application for decommissioned mine, Leinster (preplanning)
  - Landfill extension Millenium Park, Dublin
  - Gas Pipeline, Co. Longford
  - Overhead power Line, Co. Sligo (on going)
  - Smithstown Solar Farm, Co. Kildare
  - Furryhill Solar Farm, Co. Kildare
  - Ballykereen Solar Farm, Co Wexford
  - Cahir Solar Farm, County Tipperary

Key Work Continued

  - Solar Farm in Co Clare (ongoing)
  - Solar Farm in Co. Cork (ongoing)
  - Carrick-on-Suir Solar Farm, Co. Tipperary
  - Finnis Solar Farm, Co. Cork.
  - Moanvane Wind Farm Co. Offaly
  - Moanaincha Wind Farm, Co. Tipperary
  - Raragh Wind Farm cable route, Co. Cavan
  - Blackwater Estuary, Co. Waterford
  - Ashbourne Linear Park, Dublin

- **Mammal Surveys including badger, red squirrel and pine marten surveys, 2016-2018**
  Mammal surveys generally undertaken as part of habitat surveys. The following projects required derogation licences which are prepared and successfully received:

  - Permitted Meenwaun Windfarm, Co. Offaly –badger and red squirrel.
  - Finnis Solar Farm, Co Cork – badger derogation licence
  - Darthogue Solar Farm, Co Meath – badger derogation licence
  - Preplanning solar farm development in the east – badger
  - Preplanning wind farm in the east of the country – badger

- **Bat Emergence and activity surveys, 2015 - 2017**
  Following on from Habitat Surveys, where a habitat is deemed important for foraging and/or commuting bats an activity survey is required or where potential roosts are observed emergence surveys are required. These surveys have been carried out for:

  - Lee Water Treatment Plant extension (2015)
  - Monaincha Wind Farm, Co Tipperary (part of planning conditions) (2016)
  - A landfill extension in the east of the country (confidential) (2016)
  - A cable route development in the midlands (2016). Have also undertaken the sonogram analysis of calls for the EcIA.

- **Vegetation Surveys, 2016**
  Carried out Vegetation Surveys at Barranafaddock Windfarm, Co. Waterford as part of yearly (for three years) surveys to analyse the recovery of vegetation on bare soil in areas within the development. Surveys undertaken as part of the development's planning conditions.

- **Invasive Species Surveys, Management Plans and Treatment**
  Surveys normally carried out as part of habitat survey.

  - **Invasive Species Management Plan and treatment of an existing windfarm in the midlands (confidential), 2016-2018.**
    Completed survey, analysis and write up of the management plan for the complete removal of Himalayan balsam and I am carrying out treatment.
  - **Outline Invasive Species Management Plan for illegal dump in Cork - 2018**
    Observed invasive species within site during habitat survey, recorded location area size and maturation before completing an outline management plan to be finalised prior to the construction phase. At preplanning stage.

- **Vantage Point Bird (VP) Surveys 2016 - 2018**
  Undertaken VP bird surveys of raptors, wild fowl and wetland birds which include hen harrier, whooper swan and peregrine falcon. Surveys undertaken pre and post planning.

  - Dromada Wind Farm, Co. Limerick.
  - Raragh Wind Farm, Co. Cavan.
  - Wind Farm, Co. Kildare (pre-planning).
  - Monaincha Wind Farm, Co, Tipperary.
  - Barranafaddock Wind Farm, Co. Waterford.
  - Wind Farm (confidential -pre planning stage), Co. Laois

- **Breeding Bird Surveys, 2015-2017**
  Carried out Breeding Bird Surveys Barranafaddock Windfarm, Co. Waterford, as part of yearly (for three years) surveys to analyse the impacts (if any) of the development on its surrounding hedgerow birds. Surveys undertaken as part of the development's planning conditions.

- **Wind Farm Post Construction Bird Collision Surveys 2015-2017**
  Undertake monthly bird collision surveys at Monaincha Windfarm, Co Tipperary and Barranafaddock Windfarm, Co. Waterford. Surveys required as part of planning conditions and undertaken every month for first three years of operation with annual reports drawn up at the end of each year. These surveys monitor the potential impact if any on the developments birds (with any bat findings also recorded).

John Mahon

Senior Acoustic Consultant

Current Position

Senior Acoustic Consultant

Qualifications

PhD in Acoustics & Vibration, Trinity College Dublin (2008)

Vibration Analysis - ISO 18436-2 Certification, Mobius Institute Board of Certification

BA BAI (Hons) Mechanical Engineering, Trinity College Dublin (2004)

Professional Memberships

Member of Engineers Ireland

Member of Institute of Acoustics

Employment History

2016 – Present
Fehily Timoney & Company, Dublin

2008 – 2015
Infrasonic (Acoustics & Vibration Consultancy), Dublin

2008 – 2013
Trinity College Dublin

Publications

Contributed to a Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes. Appendix B – Good Practice Guide for Noise Barrier Design, March 2014

Multiple Academic Journal and Conference publications on Flow Induced Noise & Vibration, Noise Barriers and Noise Source Identification Techniques.

John is a Senior Acoustic Consultant with Fehily Timoney & Company. He has a PhD in Acoustics and Vibration and a BA BAI (Hons) degree in Mechanical Engineering from Trinity College Dublin. He is a member of Engineers Ireland and the Institute of Acoustics.

John has over 13 years' experience in acoustics & vibration and has an extensive knowledge and experience in the measurement, prediction and analysis in the field of acoustics and vibration including excellent knowledge of acoustics and vibration legislation, policy and standards at EU and Irish levels. John's primary experience is in environmental noise including measurement and prediction of industrial noise, wind farm noise and road noise. He has completed noise modelling, measurements and assessments for road schemes, wind farm developments, construction projects and industrial sites. He also has significant experience in assessing the acoustic performance of noise barriers and he sits on the Irish and European Committees for Standardization CEN/TC226/WG 6 (Road traffic noise reducing devices).

Key Projects

- **Multiple Noise Impact Assessments, 2018**
  He was involved in the submission of multiple noise impact assessments ranging from waste transfer facilities, seaweed processing plants to breweries, visitor centres and peat processing plants. These noise impact assessments required attended and unattended baseline measurements as well as carrying operational and construction noise predictions and assessing the predicted noise levels against appropriate noise limits.
- **Noise Impact Assessments for Solar Farms**
  Undertook noise impact assessments for over ten solar farm and battery storage projects including background noise assessments, noise predictions for construction and operational phases and designing mitigation measures. He was also responsible for the preparation of environmental impact statements, technical reports and consultation with county councils.
- **Noise Impact Assessments for Wind Farms, 2008 – 2018**
  Undertook noise impact assessments for wind farm projects including background noise assessments, noise predictions for construction and operational phases, **compliance noise assessments** and noise complaint investigations. He was also responsible for the preparation of environmental impact statements, technical reports and consultation with county councils.

  Meenwaun Wind Farm
  Acres Wind Farm
  Cordal Wind Farm
  Moanvane Wind Farm, Co Meath
  Castletownmoor Wind Farm
  Sigatoka Wind Farm
- **EPA Compliance Noise Surveys**
  Undertook noise monitoring and licence compliance work for EPA licensed landfill and waste facilities, greenfield waste sites and other commercial facilities including data analysis and preparation of technical reports. Carried out reviews of technical reports prepared as part of EPA licensed facilities requirements.
- **Noise Assessments at 42 Above Ground Installations, Gas Networks Ireland, 2017**
  Managed a team who carried out environmental and occupational noise monitoring at 42 above ground installation sites. All sites were assessed against environmental noise limits and occupational noise criteria.
- **M3 Motorway Noise Survey**
  He was responsible for the investigation of a number of noise complaints along the M3 motorway. This involved attended and unattended monitoring at a number of noise sensitive locations and comparing the noise levels against noise limits as per planning conditions. It also required detailed noise modelling of sections of the motorway to determine the noise impact from future traffic growth.
- **Offline Motorway Service Areas – Applegreen Services Area Ltd**
  Noise lead on numerous planning applications for offline motorway service areas. Prepared noise and vibration impact assessments for construction and operational phases. Managed baseline monitoring, modelling of road traffic and industrial noise sources, preparation of technical reports and mitigation design.
- **Aberdeen Western Peripheral Route (AWPR) - Ferrovial Agroman**
  Responsible for evaluating the noise impact of the amendment of the road alignment between the specimen design and conceptual design for the Fastlink section of the Aberdeen Western Peripheral Route. This involved noise modelling in accordance with CRTN of the Fastlink section of the AWPR and incorporating mitigation measures to satisfy Transport Scotlands' design goals.
- **M8 M73 M74 Motorway Improvements – ROD Consulting Engineers**
  Responsible for checking the noise performance parameters of environmental noise barriers to be used in the motorway improvement scheme.

Tom Clayton

Senior Engineer

Tom is a Chartered Engineer with a total of 10 years of experience within the geotechnical sector having developed excellent skills in analytical design and project management. Tom has key expertise in earthworks, slope stability, geotechnical asset management, deep foundations, shaft design and geo-environmental soil classification. Tom has also been responsible for the soils, geology and hydrogeology chapters of multiple environmental impact statements.

Tom currently leads the geotechnical and engineering geology team at Fehily Timoney and is responsible for the day-to-day running of the team and business development.

Qualifications

MEng (Distinction) Civil Engineering (University of Surrey)

Chartered Engineer (CEng)

Professional Memberships

Institution of Civil Engineers (Member)

Employment History

2016 – Present
Fehily Timoney & Company
Cork

2008 – 2016
Arcadis UK (formerly Hyder Consulting)

2004 – 2008
Hyder Consulting (Undergraduate) – including a 1 year industry placement and three 8 week summer placements

Key Projects

- **Project Manager: Dublin Airport North Runway Development – Environmental Assessment (April 2017 – on-going) Estimated Capital Value - €320M**

  Project Manager for this project involving the **procurement and management** of a **comprehensive site investigation program** for the investigation of areas of potential **contamination and unregulated waste disposal** within the development boundary at the Dublin Airport North Runway project. The project included the review of historical site investigation data over the **261-hectare site** and the subsequent application of geophysical survey methods to further investigate potential for areas of unregulated waste. Intrusive investigation comprised a borehole and trial pit based ground investigation on areas of potential contamination identified by the historical data review and geophysical surveys. FT managed and supervised all aspects of the investigations including the selection and scheduling of **appropriate environmental testing suites** including **WAC analysis** to allow for classification of materials present, identify material suitable for reuse and to determine routes for disposal off site where required.

- **Project Manager: Tier 1 & 2 Assessments, Unauthorised Landfill Remediation - Dublin Airport North Runway Development (April – November 2017) Estimated Capital Value - €320M**

  Project Manager for this **Tier 2 Environmental Assessments** of 2 No. areas of **unregulated waste disposal** within an **8.6-hectare site** within the Dublin Airport North Runway development boundary. Areas of unregulated waste were identified during Environmental Assessment works at the project. The project comprised the completion of **Tier 1 Assessment** for the site, completion of additional detailed site investigations to fully delineate the extent of waste deposits. FT were managed and supervised the intrusive site investigation works, environmental sampling of soils and groundwaters, preparation of the **Tier 2 Environmental Risk Assessment** and the development of a **Conceptual Site Model.** FT proposed remedial options for the site which resulted in the excavation and disposal of approximately **12,000 tonnes of Mix Municipal Waste – International Catering Waste** from the sites. FT supervised the remedial works and undertook validation sampling and screening of results against published Soil Guideline Values (SGVs) to ensure no residual remaining risk to receptors at the site remained.

- **Lead Geotechnical Engineer: Timoole Landfill Remediation Tender Design – Priority Construction, Estimated Capital Value - €2M**

  Tom has been the Geotechnical Lead for the design of temporary works associated with the removal of **40,000+m^3 of assorted domestic and commercial waste** materials from a site in Co. Meath. Tom worked closely with the Contractor to develop a work methodology based on the **geotechnical observational method**. Assessing the existing and proposed slopes and ground investigation, Tom developed an ongoing system for assessing the **stability of temporary slopes** on a daily basis with defined mitigation measures, including **sheet piling, construction of berms and use of dewatering** which were to be employed following a set of trigger levels, observations and geologies. The project also involved **both pre- and post- construction structural surveying** of 19 properties and outhouses and a 3.5km section of road to identify any damage caused by the works.

- **Project Manager: Dublin Airport Stockpile Soil Classification – DAA (on behalf of Ramboll), (Dec 17 – Feb. 18) – Estimated Capital Value - €320M**

  Tom was the Project Manager for this Soil Classification project relating to **70,000+m^3 of construction and demolition waste** at Dublin Airport. Tom undertook the management of environmental engineers, site investigation contractors and laboratories in order to produce a **Soil Classification Report** as part of the tender for removal and disposal of these soils as waste materials. The project involved undertaking **50+ waste acceptance criteria (WAC) tests** in **25 trial pits** and across **10 stockpiles** to allow a robust estimation of both the **European Waste Catalogue (EWC**) code and the WAC category for the materials. FT also procured and managed the site investigation contractors and laboratories, including the preparation of **preliminary safety and health plans**. The final report was included in the tender documents to allow the Contractor to estimate the quantity of Non-hazardous and Inert waste on site.

Key Projects

- **Project Manager: BASF Ireland Ltd. Environmental Baseline Assessment, Dunkettle Interchange Improvement Scheme (June 17 – Sept. 17) Estimated Capital Value - €75M**

  Project Manager for this project involving site investigation design and associated preparation **of tender documentation** for site investigation and the completion of a **Baseline Environmental Assessment at a brownfield site** at Little Island, Cork**.** FT were retained by BASF Ireland Ltd. to provide Environmental Services as part of **due diligence** for the purchase of BASF land by Transport Infrastructure Ireland (TII). The scope of works undertaken included the Procurement, Supervision and Management of **Environmental Investigations**. FT designed a site investigation and soil and groundwater quality testing in accordance with guidance on the Investigation and Sampling Strategies for Potentially Contaminated Land. FT managed and supervised the ground investigation at the site consisting of 15 No. trial pits and 3 No. groundwater monitoring wells. FT developed a **Conceptual Site Model based on the Source – Pathway – Receptor (SPR)** Model to identify risks posed to on and off-site receptors. Upon completion of soil and groundwater laboratory analysis a **Generic Quantitative Risk Assessment (GQRA)** was completed for risks posed to receptors at the site.

- **Project Manager: Newhaggard Soil Classification – Fingal County Council, (Nov 17 – Feb 18) – Estimated Capital Value - €1M**

  Tom was the Project Manager for this **Waste Classification** project near Lusk, Co. Dublin. A quantity of waste soils had been deposited previously within the Rogerstown Estuary and the project involved the **classification of these soils for re-use**, both in terms of contaminants and from a **geotechnica**l point of view. Tom managed sub-contractors to carry out site investigation and staff to prepare a Soil Classification Report and provided technical oversight to the project. The project involved the tendering and procurement of ground investigation, **management and supervision** of the ground investigation contractors, the digging of **35 trial pits** and the undertaking of environmental testing, WAC testing and geotechnical testing in accordance with the Specification for Road Works. Using this suite we were able to delineate areas of contamination when assessed against the **LQM guidelines** and the **Dutch List** and identify areas of soil potentially contaminated with Japanese knotweed and also assess the likely category of soil for re-use as general fill and landscaping fill for future road schemes.

- **Centre Parcs Feeder Main – Fingleton White, (Sept. 17 – Present.) – Estimated Capital Value**

  Tom was the Geotechnical / Geology Lead for the preparation of **a Soils, Geology and Hydrogeology chapter** for this new gas main linking Center Parcs into the gas grid. Tom also acted as PSDP for this scheme.

- **Derrysallagh Wind Farm Substitute Consent, Kilronan Wind Farm Ltd., July 2017 – Present**

  Tom was the Geotechnical / Geology Lead for the preparation of a **Soils, Geology and Hydrogeology chapter for a retrospective EIS** relating to the construction of an electrical cable route from Derrysallagh Wind Farm to a nearby electrical sub-station. As part of this assessment, Tom undertook a full desk study, site visit and provided an assessment of potential and cumulative impacts of the development (including with the wind farm development itself) and mitigation measures that could be implemented.

- **Raragh Wind Farm – Mainstream Renewables, July 2016 – Dec. 16**

  Tom was the Geotechnical / Geology Lead for the preparation of a **Soils, Geology and Hydrogeology chapter for an EIS** relating to the construction of an electrical cable route from Raragh Wind Farm to Kingscourt, Co. Cavan. As part of this assessment, Tom undertook a full desk study, site visit and provided an assessment of potential and cumulative impacts of the development and mitigation measures that could be implemented.

- **Wind Farm Planning Application & EIS – Element Power, Oct. 16 – Dec. 16**

  Tom was the Geotechnical / Geology Lead for the preparation of a Peat Stability Assessment for an EIS relating to the construction of this Wind Farm in Co. Donegal which was proposed as an 8 turbine site. Tom oversaw the conducting of peat probing and field visits to the site and the preparation of a peat stability assessment in line with Scottish guidance on the preparation of Peat Stability Assessments

James Dunn

Remediation Geotechnical Engineer

Qualifications

MSc Geology, University College Cork (2014)

BSc Applied Geology: 2:1 (Hons), Staffordshire University (2005)

Professional Memberships

British Geological Society

Engineers Ireland

International Association of Hydrogeologists (IAH)

Employment History

May 2016 – Present
Senior Project Engineer, Fehily Timoney & Company, Cork

January – May 2016
Research Support, University College Cork

March – December 2015
Geologist, Ground Investigations Ireland

September 2014 – March 2015
Environmental Officer – Resource Recovery, Bord na Mona

May 2012 – June 2013
Exploration Geologist, Salva Resources

2010 – 2012
Geologist, Rio Tinto

2005 – 2010
Project Manager/Remediation Engineer, RAW Group

James is a Senior Project Engineer with Fehily Timoney & Company working in the Infrastructure Department. He has a Bachelor of Science in Applied Geology from Staffordshire University and a Masters in Geology from University College Cork. James has 11 years' professional experience in the geo-environmental, remediation and geological engineering sectors in the UK, Ireland and Australia. He has successfully managed geo-environmental, remediation & geotechnical projects ensuring that projects are delivered within budget and within expected timescales.

With roles having been predominantly site based ranging from large commercial and residential development sites, waste facilities and remote mine sites, James has developed sound practical skills in undertaking field based projects. During his career he has been involved in the design, supervision and reporting of a number of environmental and remediation projects using a variety of site assessment techniques.

Key Projects

- **Senior Project Engineer: Dublin Airport North Runway Development – Environmental Assessment (April 2017 – on-going) Estimated Capital Value - €320M**
  Senior Project Engineer responsible for the **procurement and management** of a **comprehensive site investigation program** for the investigation of areas of potential **contamination and unregulated waste disposal** within the development boundary at the Dublin Airport North Runway project. The project included the review of historical site investigation data over the **261-hectare site** and the subsequent application of geophysical survey methods to further investigate potential for areas of unregulated waste. Intrusive investigation comprised a borehole and trial pit based ground investigation on areas of potential contamination identified by the historical data review and geophysical surveys. FT managed and supervised all aspects of the investigations including the selection and scheduling of **appropriate environmental testing suites** including **WAC analysis** to allow for classification of materials present, identify material suitable for reuse and to determine routes for disposal off site where required.
- **Senior Project Engineer: Tier 1 & 2 Assessments, Unauthorised Landfill Remediation - Dublin Airport North Runway Development (April – November 2017) Estimated Capital Value - €320M**
  Senior Project Engineer responsible for the management **Tier 2 Environmental Assessments** of 2 No. areas of **unregulated waste disposal** within an **8.6-hectare site** within the Dublin Airport North Runway development boundary. Areas of unregulated waste were identified during Environmental Assessment works at the project. The project comprised the completion of **Tier 1 Assessment** for the site, completion of additional detailed site investigations to fully delineate the extent of waste deposits. FT were managed and supervised the intrusive site investigation works, environmental sampling of soils and groundwaters, preparation of the **Tier 2 Environmental Risk Assessment** and the development of a **Conceptual Site Model.** FT proposed remedial options for the site which resulted in the excavation and disposal of approximately **12,000 tonnes of Mix Municipal Waste – International Catering Waste** from the sites. FT supervised the remedial works and undertook validation sampling and screening of results against published Soil Guideline Values (SGVs) to ensure no residual remaining risk to receptors at the site remained.
- **Senior Project Engineer: Detailed Quantitative Risk Assessment (DQRA) - Dublin Airport North Runway Development (December 2017 – On-going) Estimated Capital Value - €320M**
  Responsible for the completion of a **DQRA** to assess the potential risk posed to groundwater, surface water and site users from the presence of Polyfluoroalkyl Substances (PFASs) associated with the use of fire extinguishers at a former fire training ground within the Dublin Airport North Runway development boundary. FT undertook a review of historical site investigation data from the site and designed a detailed site investigation program to include the advancement of 17 No. trial pits and 6 No. groundwater monitoring wells. FT undertook research of current best practice and published threshold values for PFAS contamination to develop appropriate sampling and testing program. **A sampling program was developed** in agreement with the Client, the Local Authority and liaison with analytical laboratories to ensure sampling testing targeted potential contaminants of concern. FT undertook and comprehensive groundwater and surface water sampling program, **assessment of aquifer properties and groundwater discharge modelling** and **development** of a **Conceptual Site Model** based on the Source – Pathway – Receptor (SPR) Model to facilitate the completion of the DQRA.
- **Senior Project Engineer: Ballaghveny Landfill Remedial Works, Co. Tipperary (October 2016 – January 2017) Estimated Contract Value - €700k**
  Acting as resident engineer (Employer's Representative) for the **investigation and remediation** of damaged landfill liner and capping and installation of groundwater management infrastructure at a Licenced Landfill Facility. The project involved **non-intrusive and intrusive investigations** to identify pathways for impact to groundwater beneath the site from leachate associated with filled and capped waste cells. Upon identification of remedial works required FT managed and supervised remedial repairs to liner and capping and the installation of groundwater collection and pumping infrastructure to mitigate the risks posed to groundwater beneath the site.

Key Projects cont'd.

- **Senior Project Engineer: BASF Ireland Ltd. Environmental Baseline Assessment, Dunkettle Interchange Improvement Scheme (June 17 – Sept. 17) Estimated Capital Value - €75M**
  Senior Project Engineer responsible for site investigation design and associated preparation **of tender documentation** for site investigation the completion of a **Baseline Environmental Assessment at a brownfield site** at Little Island, Cork**.** FT were retained by BASF Ireland Ltd. to provide Environmental Services as part of **due diligence** for the purchase of BASF land by Transport Infrastructure Ireland (TII). The scope of works undertaken included the Procurement, Supervision and Management of **Environmental Investigations**. The site was historically utilised for the import and placement of excavated Fill from adjacent industrial and pharmaceutical development during the 1980s and 1990s. FT designed a site investigation and soil and groundwater quality testing in accordance with guidance on the Investigation and Sampling Strategies for Potentially Contaminated Land. FT managed and supervised the ground investigation at the site consisting of 15 No. trial pits and 3 No. groundwater monitoring wells. FT developed a **Conceptual Site Model based on the Source – Pathway – Receptor (SPR)** Model to identify risks posed to on and off-site receptors. Upon completion of soil and groundwater laboratory analysis a **Generic Quantitative Risk Assessment (GQRA)** was completed for risks posed to receptors at the site.

- **Senior Project Engineer: Tier 2 Risk Assessments, Groundwater – HSE, Cork (April 2017 – July 2017)**
  Senior Project Engineer responsible for site investigation design and associated preparation **of tender documentation** for site investigation the completion of **Tier 2 Risk Assessments** in accordance with the *EPA Guidance on the Authorisation for Discharges to Groundwater*. This project was undertaken on behalf of the HSE (South) for two regional hospitals in County Cork. The objective of the works was to assess the potential **impact to receptors including groundwater** from discharge activities at the site. The Environmental Assessments completed formed part of a Section 4 Discharge Licence Application to Cork County Council for the proposed extension of the facilities. FT managed and supervised the **procurement** of **site investigation contractors**, supervision of site works and environmental sampling of groundwater and discharge waters. preparation of Tier 2 environmental risk assessments and the development of a **Conceptual Site Model.**

- **Senior Project Engineer: Groundwater Risk Assessment, Basketstown Landfill, Co. Meath (December 2017 – ongoing)**
  Completion of an **Aquifer Assessment and Groundwater Flow Model** for the licenced Basketstown Landfill (Closed) in Co. Meath in line with EPA methodologies on behalf of a local authority client. This project included desk based assessment, review of previous **Groundwater Risk Assessments** and the refinement of the current Conceptual Site Modelling including Source-Pathway-Receptor models for the site. Responsible for the review of the **Groundwater Flow Model** developed using the **USGS MODFLOW** software package including the input of modelled engineered groundwater control options to propose potential mitigation measure associated with the on-going impact to groundwater beneath the site from leachate contamination. The objective of the project is to provide a **cost benefit analysis for proposed remedial options** for the site.

Mary Creedon

Senior Engineer

Mary Creedon works as a Senior Engineer for Fehily Timoney & Company. Mary is a Chartered Engineer and holds a Bachelor of Engineering (Civil) degree. Mary has acquired a wide range of experience since graduating in 1986. She is a Chartered Member of Engineers Ireland (MIEI) and a Member of The Institution of Highways and Transportation (M.I.H.T.). Mary's particular area of expertise includes drainage design using the Micro-Drainage Software Modelling System and flood risk assessment (FRA) using HEC-RAS hydrodynamic river modelling and Culvert Master software systems. Mary has prepared Flood Risk Assessments and Surface Water Management Plans for Development Plans for public and private bodies. She is experienced in the design of SUDS (Sustainable Urban Drainage Systems), to mitigate against flooding and pollution of watercourses. She has prepared hydrological reports for major road projects for the NRA and for Environmental Impact Statements (EIS) for Road Schemes, Industry and Wind Farms. Mary has prepared the preliminary and detailed drainage design for the construction of many major road schemes in Ireland and the UK. She has consulted with environmental groups, statutory authorities and public utility providers at every phase of NRA road scheme development. Mary is experienced in flood estimation techniques and the preparation of Section 50 and Schedule 6 applications for the crossing of rivers and streams. Mary has been involved in the preparation of contract documents for Works Requirements in Ireland and in the UK.

Qualifications

Bachelor of Engineering (Civil)
1986 University College Cork,
National University of Ireland

Professional Memberships

Chartered Member of Engineers Ireland 2006

Member of The Institution of Highways and Transportation (M.I.H.T.)

Employment History

2003 – Present
Fehily Timoney & Company, Cork

1990—1991 & 1995—2003
E.G. Pettit & Company

1988 and 1992
Carraigex Ltd.

1988
McCarthy & Partners

Key Projects

- **Lee Road Water Treatment Plant Scheme, July 2016** Senior Engineer with the responsibility for the Hydrology and Drainage assessment in the Environmental Report for the proposed upgrade, replacement and extension of the existing Lee Road Water Treatment Plant, Lee Road, Cork City with a 40MLD capacity water treatment facility.
- **Strategic Development Report Knockharley – July 2016 Ongoing** Senior Project Engineer with responsibility for Environmental Impact Assessment (EIA) reporting for Hydrology and Drainage for a strategic development planning application at Knockharley Landfill. **Knockharley Waste Treatment EIS– June 2011.** Senior Project Engineer with responsibility for preparing the SWMP, including a hydrological study of the River Nanny, following an RFI from ABP. A hydraulic analysis of the 100-year flow was undertaken for the existing stream using the river modelling software HECRAS, to examine the capacity of the existing structures downstream and the stream channel. The outflow from the attenuation facility and wetland was incorporated into the model of the stream. The study also had regard to the proposals for the management and discharge of groundwater. **Knockharley Landfill Capping Project 2004** – with responsibility for the detailed design for construction of site stormwater drainage, including, a petrol interceptor, attenuation pond with inlet and outlet chambers, an overflow weir and the spillway to a wetland. Also responsible for the detailed design of a stream diversion chamber and associated controls to the attenuation pond, in the event of a contaminated spill upstream.
- **Site Specific Flood Risk Assessment (SSFRA), October 2015**
  Senior Engineer with the responsibility for preparing a SSFRA for a **Proposed Community Health Centre in Carrigaline**, Co. Cork (Tidal and Fluvial) in support of the planning application for the proposed development of a Primary Care Centre and car park. This project required river modelling of an adjacent tributary of the Kilnagleary River and the preparation of flood zone mapping. There were two environmentally designated sites approximately 100m downstream of the proposed development site boundary. These are the Owenboy River, a proposed Natural Heritage Area (pNHA), site code 001990 and Cork Harbour, Special Protection Area (SPA), site code 004030. As part of the SSFRA it was required to assess any potential impacts on these in accordance with the planning guidelines. The SSFRA concluded that the proposed development site is not expected to impact on any environmentally designated sites.
- **Site Specific Flood Risk Assessment (SSFRA), July 2015**
  Senior Engineer with the responsibility for preparing a SSFRA for a Proposed Extension to the **Changing Facilities at Leinster Branch IRFU** in Donnybrook, Dublin (Fluvial). The application site was located within a conservation area, as outlined for the River Dodder and adjacent lands. As part of the SSFRA it was necessary to assess the following: Any potential impact that the proposed development might have on the adjacent zoning along the River Dodder "To preserve provide and improve recreational amenity and open space and green networks"; to establish that the proposed development would not extend into the riparian area on the banks of the River Dodder; that the proposed development would not impede the Dodder Flood Alleviation works currently underway in the form of flood defence walls adjacent to the proposed development and that it would not impact on any plans by DCC to provide a linear walkway along with the flood alleviation works. FT also provided input into the options for the drainage design for the proposed development.

Key Projects cont'd.

- **N5 Ballaghadereen Bypass Road Scheme, Co. Roscommon, €25M Scheme, 2014 – 2015**
Senior Engineer with the role of Drainage Lead, responsible for drainage design using MicroDrainage software modelling, culvert design using Culvert Master software and Section 50 applications as part of the approval process with OPW, hydrological assessment and hydraulic design of River Lung Bridge and the design of watercourse diversions.
- **Site Specific Flood Risk Assessment (SSFRA), December 2014**
Senior Engineer with the responsibility for preparing a SSFRA for the Proposed Phase 6 Production Building and Car Park at Vistakon Ireland, in the National Technology Park, Castletroy, Co. Limerick. Flood Zone mapping for the SSFRA was based on modelling of the River Shannon undertaken by FT in 2009. Flood zone mapping was prepared in accordance with DoEHLG Guidelines and a cumulative assessment was undertaken with neighbouring developments.
- **N21 Killarney Pole to Barnagh Road Phase 2, Co. Limerick, Capital Vaue €3.3M, 2014**
Senior Engineer with the responsibility for reviewing the culvert and watercourse diversion design, to split the flows and provide a sustained water supply for the livestock of a landowner and designing gravity controls to avoid flooding issues.
- **Site Specific Flood Risk Assessment (SSFRA), May 2013**
Senior Engineer with the responsibility for preparing a SSFRA for a proposed **Linear Park at Monahan's Road, Cork City** for Cork City Council (CCC) as part of their Part 8 Planning Application for this interim environmental enhancement scheme development. The proposed linear park development is located to the south of the Lower River Lee Estuary in a flood prone area. The proposed linear park is located in 3.9 ha of existing public parkland in lands running from the intersection with Victoria Road as far as Páirc Uí Chaoimh and the Showgrounds. The lands proposed for the linear park development comprise the provision of a cycle lane and tree planting and lighting along Monahan's Road; the creation /landscaping of a new linear park to provide for both active and passive recreation; New boundary treatment to Kennedy Park; Re-alignment of junction and laneway, re-organisation of parking, entrance and pathway arrangements at the western end of Monahan's Road approaching the junction with Victoria Road; and New kerbing and footpath repairs and associated works. FT also provided input into the SUDS drainage design for the linear park for CCC.
- **Drainage Catchment Analysis, High Street, Kilkenny City, 2012**
Senior Project Engineer with responsibility for procuring a drainage survey and modelling the sewer system in the catchment of High Street in Kilkenny City. A Drainage Catchment Analysis was undertaken to examine the existing capacity of the surface water systems, as part of the proposed pavement improvement in High Street and adjoining roads.
- **Jeddah Environmental Assessment (JEA) and a Jeddah Environmental and Social Masterplan (JESMP) for the Governorate of Jeddah, 2012**
Senior Engineer with the responsibility for preparing a data assessment and analysis report for Surface Water. Rainfall data records were examined at the Metreological Station at Jeddah Airport 41024, for the period 1970 – 2011. The environmental assessment included an assessment of the operational drainage system at the King Abdulaziz International Airport in Jeddah. This included the examination of detention areas for surface water and an artificial channel which was under construction, to divert flood waters from the upper catchment and wadis, around the southern boundary of the airport to three storm water outfalls, two of which discharged into the Red Sea and one into Sharm Ubhur Creek. The potential for the use of surface water to supplement the desalination process for water supply was also assessed. Surface water sampling was undertaken and analysed as part of the JEA. The results of the surface water assessment informed the response plans.
- **Luas Broombridge Scheme Flood Risk Assessment Stage 1—Railway Procurement Agency, 2010**
Senior Project Engineer with responsibility for preparing the Stage 1 Flood Risk Identification report as part of the flood risk assessment process for the EIS and Planning Application for the Luas Broombridge Scheme. The study area passed through the Upper and Lower Liffey Estuary involving identification of the tidal impact on the scheme.
- **Metro West Flood Risk Assessment Stage 1 and 2, Dublin—Railway Procurement Agency, 2010**
Senior Project Engineer with responsibility for preparing the Surface Water Impact Assessment for the EIS and the Stage 1 Flood Risk Identification and Stage 2 Initial Flood Risk Assessment reports as part of the FRA process for the EIS and Planning Application for the Metro West Scheme. The study area passed through the catchments of the Cammock River, River Liffey, Tolka River, Santry River and Mayne River Tributary. The FRA included the assessment of fluvial and pluvial mapping available from the FEM FRAM study.
- **Oldtown Mooretown Local Area Plan, 2010 - 2016 SEA — Fingal County Council, 2010**
Senior Project Engineer with responsibility for preparing the Strategic Flood Risk Assessment (SFRA) for integration into the SEA for a new LAP for the Oldtown Mooretown lands in Swords, in accordance with the Department of Environment, Heritage and Local Government's 'The Planning System and Flood Risk Management - Guidelines for Planning Authorities', November 2009. The SFRA included the assessment of fluvial and pluvial mapping available from the FEM FRAM study. The SFRA informed the SUDS Strategy Plan for zoned lands.
- **Development Strategy Study at National Technology Park, Limerick—Shannon Development, September 2009 - February 2010**
Senior Project Engineer with responsibility for preparing a flood study for the Development Strategy Study Area in the National Technology Park which included modeling of the River Shannon using HEC-RAS software and producing flood zone mapping for 1% and 0.1 % AEP floods, together with validation of the model with historic and recent flood data to inform the application of a Justification Test.
- **Tegral Ltd.—EIS, Cap. Value €100 M, 2007**
Senior Project Engineer with responsibility for the surface water drainage design for two factories. Including the separation of roof water with a recycling system, attenuation and treatment of discharges and fire water retention to eliminate the potential for any contamination of the River Barrow.

Alice Riordan

SENIOR ENGINEER

Alice has an Honours Degree in Civil and Environmental Engineering and has worked with Fehily Timoney & Company since graduating in 2004. Alice has broad experience across the disciplines of Waste, Infrastructure and Energy.

Since graduating, she has gained extensive experience in the preparation of tender and contract documentation and in the assessment of prequalification submissions and tenders for works. Alice has managed the tendering process for contracts using both the IEI Form of Contract (3rd edition) and the new Department of Finance suite of Contracts for Public Works.

Alice currently works in the Waste & Resources Group and has been involved in projects including infrastructure design, including for HWRC & civic amenity sites, material recycling facilities and landfill sites. Alice is a Chartered Member of the Institute of Engineers Ireland and a Chartered Waste Manager with the Chartered Institute of Wastes Management.

Qualifications

Bachelor of Engineering (Civil and Environmental) Honours, University College Cork, National University of Ireland, 2004

Professional Memberships

Chartered Member of Engineers Ireland (MIEI)

Member of the International Association of Hydrogeologists (IAH)

Chartered Environmentalist (CEnv)

Member of the Chartered Institution of Wastes Management (MCIWM)

Chartered Institution of Water and Environmental Management (Graduate Member)

Member of the Environmental Sciences Association of Ireland (ESAI)

Member of the Engineers Ireland Register of Professionally Competent Persons to carry out Landfill Assessments at historical landfill or contaminated sites (the 'Landfill Register')

Employment History

2004 – 2017
Fehily Timoney & Company, Ireland

Publications

A spreadsheet tool to calculate landfill gas flow across a range of control valves or to select appropriate valves based on design flows C.J. Cronin, A. Riordan, N. Menzies, S. Willacy, B. Ward, J. McFeat; ISWA World Congress Vienna 2013.

Key Selected Projects

- **Gorey Civic Amenity, Co. Wexford, 2012-2013**
  Project Manager and design engineer for the design, procurement and construction phases of the Gorey Civic Amenity Development Contract. Responsible for detailed design of drainage, services and overall facility layout, and for preparation of tender drawings and documents. Carried out tender assessments and made recommendations to the client. Involved in ongoing contract management including the issue of change orders to site in line with client requirements, attendance at site meetings, contract administration and preparation of Final account reports. Prepared preliminary cost estimates for the work for submission to the Client.
- **Carrickmacross Civic Amenity, Co. Monaghan, 2008-2010**
  Design engineer with responsibility for design and tender documents for the development. Duties included detailed design of site layout, buildings, drainage systems and onsite services; preparation of pricing document and other tender/contract documents, and ongoing client liaison and engagement.
- **Holmestown Waste Management Facility, Co. Wexford, 2005-2013**
  Senior Project Engineer involved in the design process of a new waste management facility at Holmestown, including design of fully engineered landfill cells (2 no. phases), detailed earthworks balance calculations, surface water management system, landfill gas infrastructure and site layout, including civic amenity/HWRC facility; contract document preparation and assessment of tenders; dealing with ongoing site queries in relation to both construction and operational issues.
- **Dunmore Civic Amenity Site, Kilkenny, 2009**
  Project Manager for the feasibility assessment, design and construction of a civic amenity site extension at Dunmore landfill in Kilkenny. Management of process including scoping study, survey of existing operations, development and distribution of customer satisfaction questionnaire, economic assessment of expansion proposal, preliminary design and capital cost estimates, preparation of grant aid application, procurement of contractor and preparation of all tender documents, and overall site supervision of constriction works.
- **Silliot Hill Waste Management Facility, 2004-2008**
  Project Engineer involved in all aspects of development of the Silliot Hill Waste Management Facility which included design and development of a composting facility for sewage sludge, a pilot composting facility for food waste, a civic amenity (HWRC) waste facility, landfill gas utilisation plant and enclosed landfill gas flare, leachate rising main to connect directly to the local sewerage scheme, closure and capping of the landfill and reserved area for a materials recovery facility. Duties involved preliminary and detailed design, contract documentation preparation and tendering and contract administration.
- **Knockharley Landfill, 2005 – 2017**
  Project engineer for all four construction phases including the supervision of construction and the delivery of the works to the satisfaction of the client, including CQA procedures to ensure compliance with permit and licence constraints. Supported Project Director in the design of fully engineered landfill cells, detailed earthworks balance calculations, surface water management system, landfill gas infrastructure and site layout; contract document preparation and assessment of tenders.
- **Marlinstown Landfill, Co. Westmeath — Phase 2 Capping Contract,**
  Project Manager for the design and tendering phases of Marlinstown Landfill Phase 2 Capping. Responsible for detailed design and drawings of leachate and gas collection infrastructure and preparation of tender documents.

Roads & Traffic

Employee Profile

Relevant Waste Industry Project Experience
(Sample)

(November 2018)

Suite No.5, Gowna Plaza, Bracetown Business Park, Clonee, Co. Dublin
Tel: 01 825 3015 E-mail: info@trafficwise.ie
Internet: trafficwise.ie

NAME: Julian Keenan (Project Lead Specialist)

QUALIFICATIONS: Degree Civil Engineering BE (Hons) University College Galway (1990)
Highways Technology BTech (Highways &Transportation Engineering)
Diploma Quality Assurance to BS5950
MIEI, MCHIT

POSITION: Director

Julian has 28 years engineering experience and began his civil engineering career with West Sussex County Council's Surveyors Department (WSCCSD). Over the period from 1990 to 1994 he progressed in seniority from Graduate Engineer to Senior Assistant Engineer and was responsible for preliminary design and cost estimation on major roads schemes, structures design, detailed roads design and contract preparation and administration. He was also responsible for preparation of accident investigation and prevention schemes together with safety audits.

In 1994 Julian transferred to the Transport Planning & Policy Section of WSCCSD where he was employed as Senior Engineer. Reporting to the Highways Committee, in this role he was responsible for preparing scheme feasibility studies, and various traffic and transportation studies. Julian was responsible for the preparation and development of Local Transport Plans for the Horsham area and for Crawley including the M23 and Gatwick Airport. Julian was also responsible for the management of external consultants employed by the Local Authority from time to time.

In August of 1997 Julian was invited to join The Denis Wilson Partnership as a Principal Engineer responsible for running the Traffic & Transportation Section of Denis Wilson Partnership, Ireland. Julian was appointed Technical Director in early 2000 and was responsible for the day-to-day operation of the Dublin Office and all technical work carried out.

In August 2002 Julian together with the former management and staff of DWP established **Traffic***wise* Ltd.

Traffic*wise* Ltd. is a firm of engineering consultants specialising in the field of Traffic and Transportation Planning. The commissions undertaken by **Traffic***wise* Ltd. involve, for the most part, the assessment, evaluation, and design of highway schemes. Commissions arise in both the public and private sectors. Typical projects include for both the evaluation and preparation of Town Centre Traffic Management Plans, review of the transport aspects of proposed development projects, preparation of Traffic Impact Assessment studies, and geometric roads design. Commissions span planning representation on a single dwelling house, to preparing traffic assessments and roads layout designs serving large Shopping Complexes, and schemes involving the implementation of complete Action Area Plans. **Traffic***wise* Ltd. also regularly commissions Road Safety Audits and Road Traffic Accident Investigations and Accident Reconstructions.

A brief overview of relevant experience with respect to projects involving similar transportation requirements is provided hereunder. Please note that the following does not include current projects and is by no means exhaustive.

All listed project work undertaken by Julian Keenan.

Appendix A

Relevant Project Experience (Sample)

Project **Client** **Status**	**WASTE/ENERGY INDUSTRY PROJECTS** **Brief Description of Commission**
KTK Landfill Site Kilcullen, Co Kildare **Client:** KTK Sand & Gravel / Later Greenstar Ltd. *Permission Granted* *(Operating)*	**Engineered Landfill Development** Preparation of Transport Assessment for EIS. Preparation of Preliminary and Later Detailed Geometric Roads and Access Layouts. Weighbridge/Concrete Slab Design Traffic Management Advice and Adhoc Consultation re: Roads and Traffic Matters during Construction
Knockharley Landfill Site Nr. Kentstown, Co Meath **Client:** Greenstar Ltd *Permission Granted - An Bord Pleanála* *(Operating)*	**Engineered Landfill Development** Preparation of Transport Assessment for EIS. Preparation of Preliminary Geometric Roads and Access Layouts. Preliminary Design of Access Road and Underpass Traffic Management Advice and Adhoc Consultation re: Roads and Traffic Matters during Construction Representation at An Bord Pleanala Orla Hearing
Waste Transfer and Recovery Facility Knockharley, Co Meath **Client:** Panda Waste Limited *Permission Granted* *(Operating)*	**Waste Recovery Facility** Preparation of Transport Assessment for EIS Design of Proposed Access Arrangements and Assessment of Internal Vehicular Operation
Ballynagran Residual Landfill Ballynagran, Coolbeg, Co Wicklow **Client:** Greenstar Ltd. *Permission Granted* *(Operating)*	**Engineered Landfill Development** Preparation of Transport Assessment for EIS Preparation of Preliminary Geometric Roads and Access Layouts. Preliminary Design of Access Road and M11 Overpass/Interchange Traffic Management Advice and Adhoc Consultation re: Roads and Traffic Matters during Construction
Fassaroe Waste Transfer Facility Bray, Co Wicklow Former Noble Waste Management Facility **Client:** Greenstar Ltd. *Permission Granted* *(Operating)*	**Waste Recovery Facility** Preparation of Detailed Geometric Roads, Access and Facility Layouts. Layout of Compactor Access, Design of; Disposal Area, Transfer Buildings, Site Drainage, Car Park, Access Road, Weighbridge, Wheel-Wash and Civic Amenity Bring Centre (Refurbishment of Existing Site)
East Galway Residual Landfill Nr. Kilconnell, Co Galway **Client:** Greenstar Ltd. *Permission Granted – ABP - (Operating)*	**Engineered Landfill Development** Preparation of Transport Assessment for EIS Preparation of Preliminary Geometric Roads and Access Layouts Preparation of Detailed Roads Layout Arrangements Representation at An Bord Pleanala Orla Hearing
Ballycoolin Materials Recovery Facility Cappagh Road, Fingal, Co Dublin **Client:** Panda Waste Limited *Permission Granted - (Operating)*	**Waste Recovery Facility** Preparation of Transport Assessment for EIS. Preparation of Preliminary Geometric Roads and Access Layouts. Facility Layout Design and Vehicle Operations Appraisal
KTK Land Restoration Project (Inert) Ballymore Eustace, Co Kildare **Client:** KTK Sand & Gravel *Permission Granted - (Exhausted)*	**Land Restoration Project (Post Quarry)** Preparation of Transport Assessment for EIS Preparation of Preliminary and Later Detailed Geometric Roads and Access Layouts including Safety Appraisal

Project **Client** **Status**	**WASTE/ENERGY INDUSTRY PROJECTS (Continued)** **Brief Description of Commission**
Millennium Business Park, Ballycoolin **Materials Recovery Facility** Cappagh Road, Fingal, Co Dublin **Client:** Greenstar Limited *Permission Granted - (Operating)*	**Waste Recovery Facility** Preparation of Transport Assessment for EIS. Preparation of Preliminary Geometric Roads and Access Layouts. Facility Layout Design and Vehicle Operations Appraisal
Landfill Development Brownfield, Donard, Co Wicklow **Client:** ERML *Permission Refused*	**Engineered Landfill Development** Preparation of Transport Assessment for EIS Preparation of Detailed Geometric Roads and Access Layouts.
Waste to Energy Facility, Nr Kilworth Project Vale, between Mitchellstown & Kilworth **Client:** Bioverda *Permission Refused*	**Anaerobic Digestion Plant** Preparation of Transport Assessment for EIS. Preparation of Detailed Geometric Roads and Access Layouts. Representation at An Bord Pleanala Oral Hearing
Landfill Development Usk, Kilcullen, Co Kildare **Client:** Greenstar	**Engineered Landfill Development** Preparation of Detailed Geometric Roads and Access Layouts requested by An Bord Pleanala (Designs and proposals accepted by Board). Representation at An Bord Pleanala Orla Hearing No.2
Calf Field Residual Landfill Ballynadrummy, Nr Longwood **Client:** Thornton (later One 5 One) *Permission Refused – An Bord Pleanála*	**Engineered Landfill Development** Did not prepare Transport Assessment for EIS Preparation of Preliminary Geometric Roads and Access Layouts Preparation of Detailed Roads Layout Arrangements Representation at An Bord Pleanala Orla Hearing
Waste to Energy Facility Huntstown Power, Huntstown Quarry **Client:** Energia *Facility Under Construction*	**Anaerobic Digestion Plant** Preparation of Transport Assessment for EIS. Preparation of Detailed Geometric Roads and Access Layouts.
Waste to Energy Facility Little Island Cork **Client:** Stream BioEnergy *Facility Under Construction*	**Anaerobic Digestion Plant** Preparation of Transport Assessment for EIS. Preparation of Detailed Geometric Roads and Access Layouts.
Waste to Energy Facility Ballymena, CO. Antrim **Client:** Stream BioEnergy *Permission Granted - (Operating)*	**Anaerobic Digestion Plant** Preparation of Transport Assessment for EIS. Preparation of Detailed Geometric Roads and Access Layouts.
JV of Various Meat Industry Rosegreen, Nr Cashel **Client:** JV *Permission Refused at ABP*	**Development of Anaerobic Digestion Plant at Existing Rendering Plant adjacent to the Coolmore Stud** Preparation of Transport Assessment for EIS Preparation of Preliminary and Later Detailed Geometric Roads and Access Representation at Oral Hearing
Oweninny Wind Farm Carrickmacross, Mayo **Client:** ESB & Bord Na Mona *Permission Granted – (Under Construction)*	**Wind Farm Development** **Preparation of Scheme and Assessment of Development Impacts** Presentation of Evidence to Oral Hearing Cross-examination of Planning Authority.

Project Client Status	**RETAIL PROJECTS Brief Description of Commission**
Kildare Village Outlet Kildare Town **Client:** Value Retail *Permission Granted 2004 – (Operating)*	**Regional Shopping Centre Development** Preparation of Transport Assessment for EIS. Preparation of Preliminary and Later Detailed Geometric Roads and Access Layouts Traffic Management Advice and Adhoc Consultation re: Roads and Traffic Matters during Construction and Continuing for Operation
Kildare Village Outlet (Phase II) Kildare Town **Client:** Value Retail *Permission Granted 2012*	**Regional Shopping Centre Development** Preparation of Transport Assessment for EIS. Preparation of Preliminary Geometric Roads and Access Layouts Representation at An Bord Pleanala Oral Hearing
Florentine Centre Bray Florentine Road, Bray, Co Wicklow **Client:** Ballymore / Treasury Holdings *Permission Granted – (Not Implemented)*	**Shopping Centre Development** Preparation of Transport Assessment for EIS. Involving a comprehensive assessment of traffic movements and car parking demand in the centre of Bray. Preparation of Preliminary and Later Detailed Geometric Roads and Access Layouts together with internal operation and layout of Multi Storey Car Park
Dunnes Stores Galway Galway City **Client:** Dunnes Strores *Permission Granted – (Operating)*	**Shopping Centre Re-development** Preparation of Preliminary and Later Detailed Geometric Roads and Access Layouts together with Car Park Layout Re-design
Brewery Shopping Centre Waterford **(Later Waterford Shopping Centre)** Waterford City Centre **Client:** KPM *Permission Granted*	**Shopping Centre Development** Preparation of Transport Assessment for large shopping centre development of approximately 1M sq.ft. in the centre of Waterford. Involved SATURN network modelling of town centre and extensive alterations to traffic management around the town. Preparation of Preliminary and Later Detailed Geometric Roads and Access Layouts together with Car Park and Servicing design. Representation to An Bord Pleanala Oral Hearing
Loughrea Shopping Centre Loughrea, Co Galway **Client:** O'Rourke & Sons *Permission Granted – (Operating)*	**Shopping Centre Development** Preparation of Transport Assessment Preparation of Preliminary and Later Detailed Geometric Roads and Access Preparation of detailed parking assessment and redesign of parking layout.

Project **Client** **Status**	**VARIOUS PROJECTS** **Brief Description of Commission**
Keepak Kilbeggan Plant **Client:** Keepak *Permission Granted*	**Construction of New Meat Processing Plant at Kilbeggan** Preparation of Transport Assessment for EIS. Preparation of Preliminary and Later Detailed Geometric Roads and Access Layouts
An Post Coolmine, Co Dublin **Client:** An Post *Permission Granted*	**Development of existing postal distribution centre** Preparation of Transport Assessment for EIS.
LUAS Line Planning Dublin City Centre **Client:** Arnotts & Easons *Design Incorporated into final layout*	**Representation regarding line and configuration of LUAS station and crossings at O'Connell Street.** Included representations to the inspectorate (written and oral) together with preliminary designs for alternative station and crossing layouts (layouts adopted into final LUAS construction).
DIAGEO Dundalk Brewery, Waterford Brewery **Client:** DIAGEO *Current*	**Redevelopment of Existing Brewery Facilities** Preparation of various onsite procedures Preparation of Facility Layout alterations
Edenderry Power Edenderry **Client:** Edenderry Power *Permission Granted*	**Development of Existing Power Facility including change in transport of materials** Preparation of Transport Assessment for EIS
National Roads Authority Maynooth Interchange M4 **Client:** NRA *Assessment*	**Proposed Development South of Interchange** Evaluation of submitted Transport Assessment and assessment of proposed modifications to the M4 Interchange Representation at Oral Hearing
Bewleys Hotel Extension Newlands Cross **Client:** Bewley's. *Permission Granted - (Operating)*	**Extension to Existing Hotel** Preparation of Transport Assessment
Lawlors Hotel Extension Naas, Co Kildare **Client:** Jack Tierney *Permission Granted - (Under Construction)*	**Extension to Existing Hotel** Preparation of Transport Assessment Design of Accesses, Car Park and Servicing Arrangements
N11 Beehive Interchange Nr. Wicklow Town, Co Wicklow **Client:** Celtic Waste Ltd. (Greensatr) *Permission Granted - An Bord Pleanála*	**Redesign of proposed motorway interchange; Alterations required to provide access to then future engineered landfill site at Coolbeg** Preparation of Preliminary Geometric Roads Layout involving the re-design of N11 Motorway Interchange at Beehive Public House
Roadstone Huntstown Huntstown Quarry, North Road (N2), Dublin **Client:** Roadstone *Permission Granted –.(Operating)*	**(1) Planning application for quarry, (2) Planning application for revised/relocated access from old N2, (3) High Court representation on various matters** Preparation of Transport Assessment. Representation at High Court on Various Traffic Related Matters. Preparation of Preliminary and Later Detailed Geometric Roads and Access.

Project **Client** **Status**	**PROFESSIONAL REPRESENTATION** **Brief Description of Commission**
College Green Plaza College Green, Dublin City Centre **Client:** Hanahoe Solicitors *Permission Refused by An Bord Pleanala*	**Objection** Presentation of Evidence to Oral Hearing Cross-examination of Planning Authority.
Slane N2 Bypass Slane, Co Meath **Client:** John Rogers SC *Permission Refused by An Bord Pleanala*	**Objection** Presentation of Evidence to Oral Hearing Cross-examination of Planning Authority.

CURRICULUM VITAE

PROFILE

Professional, highly experienced Senior Archaeologist with excellent project management, report production and client liaising skills. Over 20 years' experience in cultural resource management and Licensed fieldwork.

Name	Dermot Nelis BA ArchOxon AIFA MIAI
Address	36 Fingal Street, Dublin 8
Telephone No.	086 2861020
Email	info@dnarchaeology.com
Date of Birth	July 16 1967
Nationality	Irish

QUALIFICATIONS

1998	Licence Eligible Archaeologist
1996	Member of the Institute of Archaeologists of Ireland (MIAI)
1995	Associate of the Institute for Archaeologists (AIFA)
1992-1993	Post-Graduate Certificate in Field Archaeology. Upper 2(I). The University of Oxford
1986-1989	BA (Hons.) Archaeology, 2 (II). The Queen's University of Belfast

PROFESSIONAL EXPERIENCE

2004 - Present

Dermot Nelis Archaeology. *Principal*

Founder and Principal of Dermot Nelis Archaeology with over 20 years' experience in archaeological consultancy, resource management and fieldwork. Proven experience in liaising on project details and fieldwork strategies with government agencies, local authorities and private developers, as well as the production of over 250 cultural heritage Environmental Impact Assessments and desk-based assessments for sports facilities, wind farms, parks *etc*. Director of over 125 Licensed fieldwork projects.

1998 - 2004

Irish Archaeological Consultancy Ltd. *Company Director*

Founder and Director of a nationwide archaeological consultancy with an annual turnover in excess of €3,000.000 and a staff of 150. Responsible for competitive tendering and management of projects in excess of €1,000.000. Conducted numerous excavations, walkover surveys, testing and monitoring programmes and acted as Senior Archaeologist on several motorway schemes for various County Councils. Directed large-scale test trenching and multi-period excavations associated with those developments.

1996 - 1998 *Margaret Gowen and Co. Ltd. Supervising Archaeologist*
Sixteen months supervision on an Hiberno-Norse excavation in Dublin, including the supervision and management of all aspects of the on-site written record and the production of a detailed recording site manual.

1995 - 1996 *St. Albans District Council*. *Assistant District Archaeologist*
Responsible for a wide range of project work including the execution of monitoring programmes, the preparation of archaeological project designs in advance of fieldwork, assessing planning applications for their archaeological constraints, preparing detailed archaeological assessment reports and archaeology strategy formulation within the District.

1994 - 1995 *Chris Blandford and Associates*. *Archaeological Consultant*
Extensive experience gained as an archaeological consultant in research, analysis and report production for a variety of commissions, including major road developments and the preparation of impact assessments and mitigation strategies. Also specialist contributions to Environmental Statements of commercial and infrastructure developments, client negotiation on report production and fieldwork programmes.

1993 - 1994 *Oxford Archaeological Unit*. *Field Archaeologist*
Archaeologist responsible for excavation and recording on development led evaluations.

1992 - 1993 *The University of Oxford*. *Post-Graduate Student*
Professional expertise gained in archaeological fieldwork, consultancy, management and report production.

Nick Jones, Director/Principal Consultant. Nick Jones is Managing Director and Principal Consultant of Odournet UK Ltd, and an advisor and former board member of the Odournet Group.

He has over twenty-six years of experience in odour and air quality related issues gained initially within the chemical industry (1992 to 1996) and then within the consultancy sector (1996 to present). He has worked as an odour specialist for Odournet UK Ltd since 1998. He holds an Honours Bachelor of Science degree from the University College of North Wales: Bangor, in Marine Biology and Oceanography. He is a qualified Environmental Auditor and his professional memberships include the Composting Association, the International Water Association (IWA) and the Institute of Directors (IoD).

He is an international odour expert and has conducted more than 600 consultancy studies relating to odour assessment and control for private companies, regulatory bodies, government authorities and research institutes. He specialises in the wastewater, waste management, renewable energy, intensive agriculture, and animal by-product sectors, although he has experience with almost all industrial processes which have the potential to generate environmentally relevant odour impacts. Nick is the responsible director and technical lead for Odournet's global projects team which has conducted projects all over the world including UAE, Saudi Arabia, Qatar, Oman, China, Singapore, Korea, India, and South America.

In addition to his extensive consultancy activities, he has project managed and authored a number of research studies aimed at increasing the understanding of the scientific community with regard to odour issues and the development of odour assessment and policy frameworks; and provided specialist input into a range of documents that aim to define best practice for odour control and complaints investigation for a range of industrial sectors.

He regularly provides advice and acts as an expert peer reviewer for guidance, policy and scientific papers relating to odour assessment, management and control on an international basis. This has included for odour guidance prepared by the UK Environment Agency, DEFRA, the Institute of Air Quality Management (IAQM)[1], the Irish EPA and SEPA.

He is an experienced expert witness, and has provided expert testimony to inform legal disputes relating to statutory, private and public nuisance, planning, licencing, contractual disputes, and mediation/arbitration.

Dr Andrew Meacham, Principal Consultant. Andrew holds a BSc and PhD in chemistry and has been employed at Odournet as a specialist environmental odour consultant for 12 years.

Andrew obtained a BSc Honours in Chemistry in 2000 from the University of Bristol, followed by a PhD in Chemistry from the University of Bristol in 2004. Following graduation, he undertook a one year Royal Society of Chemistry Fellowship at the University of Queensland and was then employed as a research proposal writer for PERA International.

He has detailed knowledge of the full range of techniques available for sampling, quantification and assessment of odours, including source and field measurement techniques, sensory and chemical analysis techniques and atmospheric dispersion modelling. Andrew has project managed in excess of 300 projects across a broad range of industries in the UK, Europe and internally. Andrew specialises in the application of dispersion modelling for odour assessment purposes.

Paul Ottley, Principal consultant. Paul holds a Bachelor of Science Honours degree in Environmental Science from the University of Birmingham.

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[1] IAQM Guidance for the assessment of odour for planning. May 2014.

From 1999 to 2003 Paul worked for the Environment Agency in the areas of waste and water regulation and from 2003 to 2004 he worked for South Derbyshire District Council as a Pollution Control Officer in the Environmental Health Department where his principal roles were undertaking the District's Air Quality Review, regulating permitted processes, investigating nuisance complaints and providing responses to planning applications on behalf of the Pollution Control team.

Paul joined Odournet in 2004 and since this time has specialised in environmental odour and air quality issues. Paul has 15 years' experience in environmental odour measurement, assessment and control.

Paul has an in-depth knowledge of the techniques for assessing odorous emissions from a wide range of industrial sectors and specialises in the wastewater treatment sector. He has project managed over 300 studies focussing on assessment of odour impact and odour control, in the UK and overseas.

Paul has acted as expert witness for a number of legal cases/planning appeals relating to wastewater treatment and other odorous industries. His other roles at Odournet include the provision of odour assessment training courses to local authority, private industrial and water company clients.

Paul's qualifications and memberships include: Membership of the Institute of Air Quality Management (IAQM) and Institute of Environmental Science (IES), MCERTS Level 2 LTE3 Odour, IEMA Approved Environmental Auditing.

Adam Dawson holds a bachelor's degree in Meteorology and Atmospheric Science from the University of Leeds and an MSc in Applied Meteorology and Climatology from the University of Birmingham.

Adam was a senior consultant at Odournet for approximately 2 years, during which time he specialised in air quality and odour modelling assessments for a range industrial and local authority clients. His focus was primarily in the waste sector, specifically landfill and municipal and green waste facilities.

Prior to his time at Odournet, Adam was employed by the Environment Agency's Air Quality Modelling and Assessment Unit (AQMAU) for 2 years where his primary role was to audit air quality and odour aspects of environmental impact assessments. These included local authority assessments, assessments of industrial process emissions, waste incinerator emissions assessments, ammonia assessments, habitat assessments and odour assessments.

Adam's specific modelling experience includes all of the key modelling programs in use at the current time (ADMS 5, ADMS-Roads, AERMOD and Calpuff).

Appendix 1.9

List of Planning Application and Permissions in the vicinity of the Proposed Development

App No.	Brief Description	Decision	Date of Grant BY L.A	Distance
AA170888	39 RES UNITS, 4,358sqm open space, 78 carparking space and associated work (abp 301299-18)	appealled: ABP ref: 301299-18	28/02/2018	1.5km
AA170267	4 POULTRY HOUSES, 1 OFFICE, ASSOCIATED SITE WORKS (EIS SUBMITTED)	Appealled: ABP ref: 301384-18	14/03/2018	3km
AA170637	29 GUEST SUITES, GATE LODGE, 107 CAR PARKING SPACES, AND OTHER WORKS	CONDITIONAL	24/01/2018	6.5km
LB180570	SOLAR FARM 3MW AND SUBSTATION AND ASSOCIATED SITE WORK	NEW APPLICATION	DUE 26/-7/2018	2.5km
AA180383	SOLAR FARM 8.7MW ON 10.82 HECTARES	APPEALED: ABP-301990-18	07/06/2018	9.5km
AA161238	SOLAR APP REFUSED BY ABP	APPEALED: ABP-17.248823	08/06/2017	9.9km
AA170706	SOLAR FARM 25.76 HECTARES	CONDITIONAL	14/05/2018	9.8km
LB160898	SOLAR FARM (ABP REF PL17248146) 150.29 HECTARES	APPEALED: abp: PL17.248146	10/02/2017	5km
LB170035	COMMUNITY FACILITY - RECREATION HALL, TRAINING AREAS. ASTRO TURF AREA, 100M SPRINT LANE, CHANGING ROOMS, OFFICE, MEETING ROOM, CARPARK	CONDITIONAL	03/07/2017	6km
LB180687	11 HOUSING UNITS	NEW APPLICATION	DUE: 16/08/2018	6.5km
LB170187	REFURBISHMENT OF PROTECTED STRUCTURE FOR 19 BED HOTEL	CONDITIONAL	21/09/2017	7km
NA160607	218 UNITS, DEMOLITION OF EXISTING OUTBUILDINGS, ANCILLARY WORKS	CONDITIONAL - APPEALED (ABP PL. 17.247839 - DECISION: MODIFIED	20/12/2016	9.3km
NA170997	CONSTRUCTION OF 5 BUILDINGS - CARPARK, APARTMENT BLOCKS, SOLAR PANELS ON ROOF, SUBSTATION AND OTHER ASSOCIATED SITE WORKS - RES / MIXED DEV ABP REF: 300959-18	CONDITIONAL - APPEALED (ABP-300959-18)	25/01/2018	8.5km
NA161219	ADVANCED TECHNOLOGY BUILDING (OTHER APPS FOR BUILDINGS, CARPARK ETC WITHIN THIS AREA / BUSINESS PARK)	CONDITIONAL	20/12/2016	8.5km
AA180145	3MW SOLAR FARM OVER RECLAIMED LANDFILL	CONDITIONAL	21/06/2018	ON SITE
Other applications within 10km radius:	one off housing, agriculture, telecommunication poles and services, retention, small scale aplications related to village / town centres			

Planning App No.	Description	Decision	Co-ords X	Y
AA140523	permission to demolish existing dwelling house and to construct a replacement single storey dwelling house with domestic garage, new wastewater treatment system and percolation area, new well, retention of existing relocated entrance and construction of new entrance to serve replacement dwelling and all associated site development works	conditional	699537	766767
AA140524	retention of alterations to all elevations consisting of alterations to window opes and doors, alterations to roof, alterations to all dormer and velux window sizes and locations, internal alterations consisting of alterations to ground and first floor layouts with increased floor area at first floor level, from that already granted under NA40439 and all associated site development works	conditional	699537	766767
AA140783	development will consist of a storey and a half dwelling with all associated site works	refused	699976	767930
AA141110	development will consist of the demolition of an existing fire damaged dwelling and replacing it with a proposed new dormer dwelling house repositioned on the site, close up existing vehicular entrance and relocate new entrance onto public roadway, replace and upgrade existing septic tank with a proposed new waste water treatment system and percolation area to EPA regulations, existing connection to existing mains water supply and all ancillaries	conditional		
AA150005	EXTENSION OF DURATION OF PLANNING PERMISSION REF. NO. NA/100913 - construction of dwelling			
AA150136	development will consist of demolition of existing two storey dwelling and to construct a replacement two storey dwelling and attached granny flat, remove existing septic tank and provide new sewage treatment system & alter location of existing domestic entrance to public road	conditional	698669	767249
AA150238	development will consist of a single storey dwelling, waste water treatment system & all associated site works	conditional	699978	767930
AA150334	a proposed two storey dwelling, separate domestic garage, connection to existing mains sewerage and mains water, entrance onto public roadway and all ancillaries	conditional	697229	765417
AA150886	the development consists of the retention of alterations to a domestic garage that was granted planning permission under planning register reference AA/140523. The alterations include an increase in height to include a loft storage area, 2 velux roof windows to the front (east elevation), 4 velux roof windows to the rear (west elevation), a ground floor window in the gable wall (south elevation), a change in the orientation of the domestic garage and all associated site works	conditional	699537	766767
AA151165	development will consist of construction of a storey & a half style dwelling with detached domestic garage, install a proprietary sewage treatment system and form new entrance from public road	conditional	695858	767689
AA151182	development will consist of a proposed new canopy over existing petrol pumps on existing forecourt and all ancillaries	conditional	699078	766818
AA160064	construct two storey garage to house applicants vintage car/Vehicle collection. Significant further information/revised plans submitted on this application	conditional	695791	766052
AA160127	the development will consist of the erection of 6 No. floodlights over an existing tennis court	conditional	697913	766157
AA160203	the development will consist of revised house plans to omit attached granny flat to previously approved Planning Permission Ref. No. AA/150136 for demolition of existing two storey dwelling and to construct a replacement two storey dwelling and attached granny flat, remove existing septic tank and provide new sewage treatment System & to alter location of existing domestic entrance to public road	conditional	698669	767249
AA160274	retention permission for existing side and rear extensions, detached domestic garage, existing windows, existing detached domestic garage and domestic store, including all ancillary site works	conditional	700427	767112
AA160390	development will consist of construction of a storey & a half style dwelling with detached domestic garage, install a proprietary sewage treatment system and form new entrance from public road	conditional	696755	765721
AA160420	a new ground floor extension to side of existing dwelling, consisting of new vehicular garage and storage area with internal modifications and associated site works	conditional	697319	65226
AA160892	the development will take place in the townlands of Brownstown and Curraghtown. The development will consist of the construction of a six bay slatted shed, with lie back area, and a walled silage slab	conditional	695938	767397
AA161304	alterations to existing north west classroom, extension of link corridor and relocation of existing heating system structure and to construct new mainstream classroom (80sqm), new wc for assisted users (16sqm) and all ancillary site works	conditional	697602	765831

Planning App No.	Description	Decision	Co-ords X	Y
AA161431	EXTENSION OF DURATION OF PLANNING PERMISSION - 01/5006 - To develop and operate an engineered landfill to accept non-hazardous waste and ancillary facilities as described on the public notices			
AA170002	development will consist of the relocation of dwelling position from previously granted under AA/150238	refused		
AA170481	the development will consist of a single storey extension for use as After-School Childcare Services to side of existing Sessional Pre-School building. Significant Further Information/Revised plans submitted on this application	conditional	697227	765184
AA170877				
AA170938	the development will consist of the construction of a single storey extension to the side of an existing house	conditional	697289	765521
AA170987	the development will consist of the relocation & redesign of dwelling, with amended site boundary from previously granted AA/150238, with a domestic garage	conditional	699978	767930
AA171026	construction of a single storey detached extension to existing school comprising of: classroom (80sqm), wheelchair accessible WC (10.5 sqm) and boiler room (3.2 sqm) to north west (rear) of existing school including all ancillary site works	conditional	697602	765831
AA171457				
AA180022	the development consists of planning permission for a new detached dwelling house to the side of the existing dwelling house and retention permission for works to the existing detached dwelling house, details as follows (A) Planning permission for a part single and part storey and a half detached dwelling. Roof mounted solar panels, new vehicular entrance gateway in lieu of the existing field gate, new proprietary waste water treatment unit and percolation area along with all associated services, service connections, landscape and site development works. (B) Planning permission for a new relocated proprietary waste water treatment unit and percolation for the existing detached dwelling in lieu of the existing septic tank. (C) Planning permission for retention of the ground floor extension to the front of the existing dwelling house created by enclosing the covered area, along with associated elevational changes	conditional	695644	765779
AA180145	the development will consist of: a solar farm to be installed over reclaimed landfill with an export capacity of approximately 3MW comprising photovoltaic panels on ground mounted frames, connection to existing single-storey ESB Sub-Station / switch room building, installation of 3 No. transformers, ducting & underground electrical cabling and all associated ancillary works and services	conditional		
AA180391	retention for a utility room, domestic garage and storage shed to the side of the existing house and all associated site works	conditional		
LB150177	development will consist of extensions to sides of existing dwelling & demolish existing shed and construct new detached domestic garage to rear. To remove existing septic tank and provide new proprietary sewage treatment system & revised site boundaries	conditional	696909	768058
LB150465	development will consist of a proposed agricultural field entrance and all ancillaries	conditional	697662	768102
LB1701135				
LB170162	retention permission of existing 2 bedroom, single storey demountable dwelling unit (circa 50m2) & septic tank, metal sliding gate to entrance and 4 no. of pressed steel storage sheds with associated site works	refused		
LB171308	the development will consist of construction of a storey & a half style dwelling with detached domestic garage, install a Proprietary Sewage Treatment system and form new entrance from public road	conditional	697626	768291
LB180064	retention of existing 2 bedroom, single storey demountable dwelling unit (circa 50m2) & septic tank, metal sliding gate to entrance and 4 no. pressed steel storage sheds with associated site works	incompleted application		
LB180513	retention permission of a one story garage to the rear of the house	incompleted application		
LB180628	retention permission of a one story garage to the rear of the house	new application		

Application and Details - Searched by Address of Townlands
o AA180145 - Starrus LFG Ltd. – Solar Farm within Knockharley Landfill (3.87ha)
o AA150136 - Demolition of 2 storey dwelling and construction of replacement dwelling
o NA130915 – New wastewater treatment system and percolation area
o AA150302 – New dwelling house, new site access and new wastewater treatment system
o AA150500 – Retention of garage
o AA151156 – Alterations to dwelling
o AA151157 – Construction of 2 storey dwelling
o AA151165 – construction of dwelling
o AA160027 - Retention of alterations
o AA160892 – construction of 6 bay slatted shed
o AA160935 – retention of playroom
o DA140449 – Retention of extension
o NA130582 – Construction of dwelling
o RA140563 – Extension of duration for 12 horse stables
o RA150249 – Construction of 4 bay underground slatted tank
o RA160088 – 3 bay barn with underground slatted tank
o RA160530 – Single storey dwelling
o RA160597 – Retention for garage
o RA170507 – Retain and complete a portal frame structure
o RA171537 – 2 storey dwelling
o AA140722 – Dormer dwelling
o AA150835 – One and a half storey dwelling
o AA160390 - One and a half storey dwelling
o AA160686 - One and a half storey dwelling
o AA161080 – Removal of kitchen and garage, construction of extension
o AA161466 – change of house type
o FS17084 – Upgrading the fire safety of an existing dwelling
o AA140895 – retention of shed
o AA141110 – demolition of fire damaged dwelling and replacement with new dormer dwelling
o AA150227 – extension to dwelling
o AA151182 – New canopy over petrol pumps on existing forecourt
o AA160127 – Retention of alterations
o AA161431 – Extension of duration of planning permission – Knockharley landfill
o AA170877 – extension of garage and conversion to granny flat
o AA170901 – 2 grass based soccer pitches with training areas
o RA160565 – single storey dwelling
o AA141042 – Demolition of weaner house and farrowing unit;; construct animal welfare extension to dry sow house and replace demolished buildings with new weaner house and farrowing unit; construct new mill building
o AA141072 – single storey extension
o AA150334 – new 2 storey dwelling
o AA150416 – decommission septic tank and replace with new sewage treatment system
o AA150591 – community sports facilities
o AA150982 – sub-division of an existing commercial unit
o AA160064 – 2 storey garage
o AA160127 – 6 floodlights over existing tennis courts
o AA160319 – single storey extension
o AA160420 – extension
o AA160608 – Lean-to extension

Application and Details - Searched by Address of Townlands
o AA160941 – Storey and a half dwelling
o AA160942 – 2 storey dwelling
o AA160975 – Demolition of existing dwelling and construction of new dwelling
o AA161080 – single storey extension
o AA161153 – dwelling
o AA161304 – alterations to school
o AA170347 – 2 storey dwelling
o AA170404 – storey and a half dwelling
o AA170467 - storey and a half dwelling
o AA170491- storey and a half dwelling and change of use to Childcare services
o AA170635 – Inlet screening chamber and stone/grit trap; storm tank and sump; weir chamber, electrical control kiosks – Kentstown Wastewater Treatment Plant
o AA170888 – 39no. 2 storey houses
o AA170938 – single storey extension
o AA171026 – detached extension to Kentstown National School
o AA180022 – detached dwelling
o AA180248 – extension to dwelling
o FS14012 – alterations to butcher’s shop
o FS16033 – change of use of commercial unit
o FS16133 – Lean-to extension to workshop
o FS17011 – new classroom, WC to Kentstown National School
o FS17082 – lean-to extension to workshop
o FS17084 – upgrading the fire safety of a dwelling
o FS17164 - new classroom, WC to Kentstown National School
o FS17169 – extension to pre-school
o NA130606 – extension of duration for 2 storey farmhouse
o NA130835 – single storey dwelling
o NA1360866 – retention of log cabin
o NA140123 – Extension of duration for demolition of dwelling and construction two 4-bed and six 2-storey with velux
o NA141070 – extension of duration for two 4-bed dwellings
o NA141163 – single storey studio
o NA171515 – replace 2 storey dwelling with 2 two-storey semi-detached dwellings
o NT130048 – change of use from commercial to religious community facility
o NT140006 – change of use of the existing dwelling to childcare with one and a half storey extension
o NT140013 – Partial demolition of garage and construction of 2 storey dwelling.

Appendix 2.0

Outline Construction & Environmental Management Plan (oCEMP)

ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

KNOCKHARLEY LANDFILL LTD.

APPENDIX 2-0 OUTLINE CONSTRUCTION AND ENVIRONMENTAL MANAGEMENT PLAN FOR PROPOSED DEVELOPMENT AT KNOCKHARLEY LANDFILL LTD.

NOVEMBER 2018

Knockharley Landfill Ltd.
Kentstown, Navan,Co.Meath

FEHILY TIMONEY & COMPANY

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1. INTRODUCTION

1.1 General Introduction and Purpose

This document is the Outline Construction and Environmental Management Plan (CEMP) for the proposed development at the existing landfill facility at Knockharley and has been prepared for Knockharley Landfill Ltd to accompany the Environmental Impact Assessment Report (EIAR), Stage 1 Appropriate Assessment (AA) Screening Report and Natura Impact Statement (NIS) for the proposed development.

It sets out the key construction and environmental management issues associated with the proposed development.

This document should be read in conjunction with the Environmental Impact Assessment Report (EIAR) prepared for the proposed development, along with other relevant drawings and documentation. In the case of any ambiguity or contradiction between this Outline CEMP and the EIAR, the EIAR shall take precedence.

This Outline CEMP sets out the key environmental management issues associated with the construction of the proposed development, to ensure that during this phase of the development, the environment is protected and impacts on the environment are minimised.

The document is divided into six sections:

Section 1:	*Introduction:* this section provides details on the existing site and the proposed development.
Section 2:	*Existing Site Environmental Conditions:* this section provides details of the main existing geotechnical, hydrological, ecological and archaeological conditions on site. These conditions are to be considered by Knockharley Landfill Ltd in the construction, operation and decommissioning of this proposed development.
Section 3:	*Overview of Construction Works:* this section provides an overview of the construction works proposed, including drainage and sediment controls to be installed.
Section 4:	*Environmental Management Plan (EMP):* this section outlines the main requirements of the EMP and outlines operational controls for the protection of the environment including soil management, habitat and species, site drainage control, archaeology, construction traffic, site reinstatement and decommissioning, waste management.
Section 5:	*Safety & Health Management Plan:* this section defines the work practices, procedures and management responsibilities relating to the management of safety and health during the design, construction and operation of the proposed facility.
Section 6:	*Outline Emergency Response Plan:* this section contains predetermined guidelines and procedures to ensure the health, safety and welfare of everybody involved in the project and to protect the environment during the construction phase of proposed facility.

1.2 The Applicant

The applicant is Knockharley Landfill Ltd., the owner and operator of the existing landfill facility at Knockharley, Kentstown, Navan, Co Meath.

The facility was developed and previously owned and operated by Greenstar Holding Ltd. (previously known as Celtic Waste Ltd.). The site was acquired by Knockharley Landfill Ltd. in March 2014.

Knockharley Landfill is located approximately 1.5 km north of Kentstown village, Co. Meath in the functional area of Meath County Council.

The existing landfill operates under an Industrial Emission (IE) licence (Licence No: W0146-02) from the Environmental Protection Agency (EPA).

1.3 The Site

The existing facility comprises a landfill facility where waste disposal and recovery activities are undertaken. The landfill opened for waste acceptance in December 2004. The landfill accepts the residual fraction of, household, commercial and industrial wastes together with construction/demolition wastes and incinerator bottom ash (IBA) and is licensed by the EPA with an Industrial Emissions (IE) Licence W0146-02. The site is licensed to operate from 07:30 to 18:30 Monday to Saturday inclusive and is licensed to accept waste between 08:00 and 18:00 (excluding public holidays).

The landfill is accessed via the N2 national primary route which provides direct vehicular access to the national roads network, with access facilitated at a ghost island priority junction on the N2 at the facility entrance. The ghost island provides sheltered access for right turning vehicles travelling from the north.

This is complimented with an auxiliary left turn deceleration lane to facilitate access for vehicles coming from the south. Both turning facilities aid in preserving the flow, speed and therefore the capacity of through traffic on the N2.

The existing facility infrastructure comprises:

- Administration building
- Machinery/maintenance garage
- Four portable cabins for storage
- Weighbridge building
- Two weighbridges
- Inspection slab
- Quarantine slab
- Car parking
- Landfill gas treatment compound
- Leachate lagoon
- Surface water attenuation lagoon and wetland

The facility is located on a 135.2 hectare (333-acre site). The existing landfill footprint is positioned near the centre of the landholding and the current planning permission permits the development of approximately 25 hectares of landfill cells. The landfill is being developed in seven phases. To date, Phases 1-4 (Cell 1 to Cell 16 inclusive) of the seven planned cell phases have been fully constructed. As of November 2018, Cells 13, 14, 15 and 16 are operational.

A permanent cap has been placed on all cells in Phase 1 and Phase 2 (Cells 1-8 inclusive). In relation to Phase 3, Cells 9 and 10 and half of Cells 11 and 12 are fully capped. The permanent lining of the final cap on Cells 11 and 12 is complete, the soil placement will take place in 2019. There is an intermediate cap on the remainder on Cells 13 and 14. The landfill development and waste placement is in a northerly direction. The leachate storage lagoon is located to the south of the administrative buildings and the surface water attenuation pond and wetland is situated to the south of the landfill.

Knockharley Landfill Facility comprises the following development:

- Access road and internal road network
- Buildings, fencing and security
- Environmental monitoring infrastructure
- Existing Utilities
- An engineered lined landfill
- Groundwater management infrastructure
- Leachate management system (comprising collection and storage)

- Surface water management system (comprising collection, attenuation and wetland)
- Landfill gas management system (comprising collection pipework, wells and a landfill gas compound)
- Landfill capping system
- Landfill void
- Existing waste types
- Existing waste activities

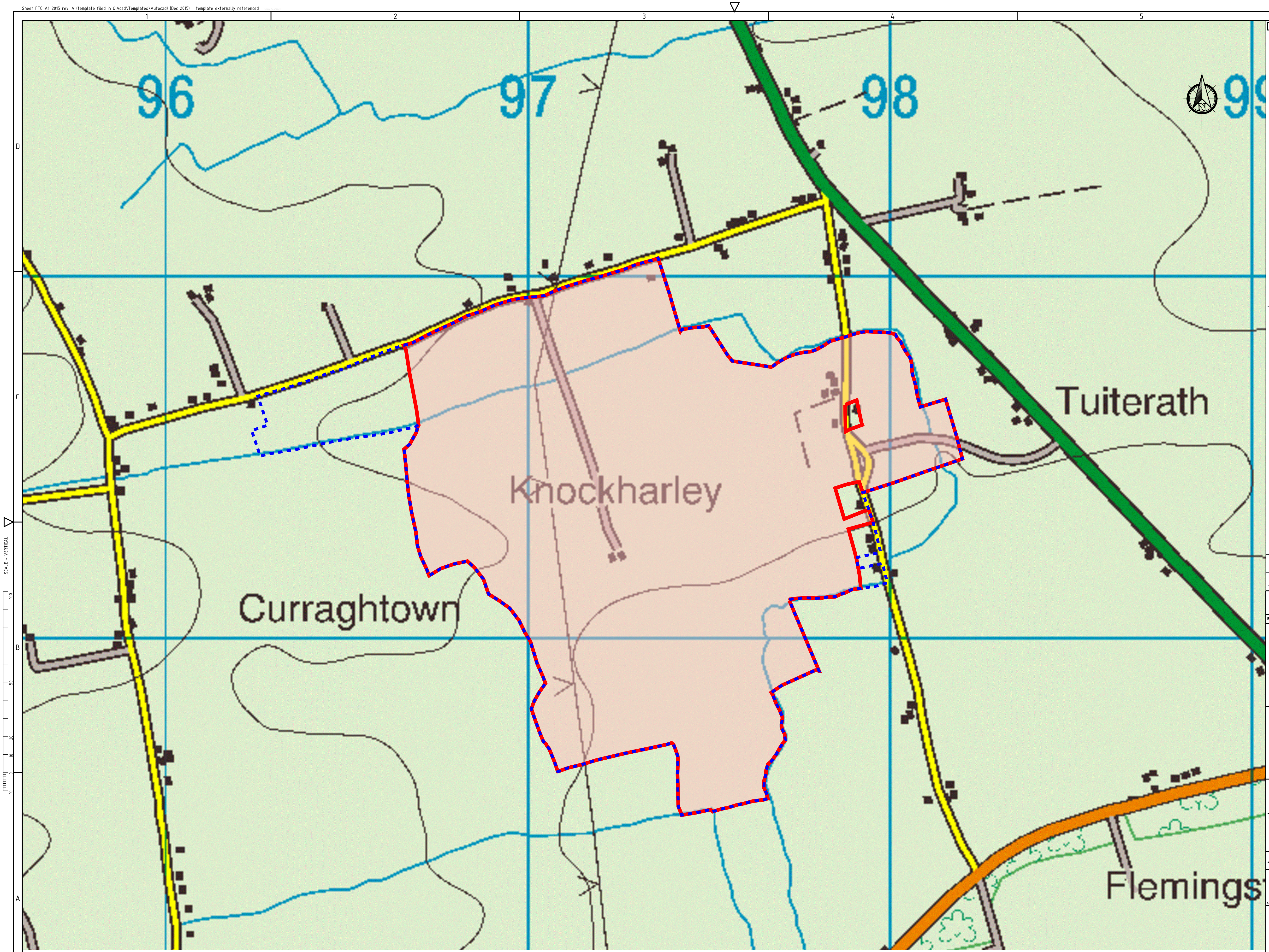
Environmental emissions from the site are limited by a set of emission limit values and trigger values contained in facility licence (W0146-02) and these relate to noise, landfill gas, dust deposition, surface water and groundwater and stack emissions. The licence also sets the standard by which bio-stabilisation of the waste prior to its deposition in the landfill is measured and monitored.

The daily operation of the landfill facility is monitored as required and as a minimum the environmental monitoring schedule and frequency as defined in the IED licence is adhered to. Environmental monitoring programmes specified in the IED licence are for groundwater, surface water, leachate, landfill gas, stack emissions, noise, PM_{10} and dust deposition. In addition, an odour monitoring programme is in operation.

Environmental monitoring results are submitted to the EPA in accordance with the licence.

The facility was designed, constructed and is being operated in accordance with the EU Landfill Directive 1999/31/EC, EPA Industrial Emissions Licence (W0146-02) and EPA manuals on landfill selection, design, operation and monitoring and its relevant planning permissions.

Sheet FTC-A1-2015 rev. A (template filed in O:Acad\Templates\Autocad) (Dec 2015) - template externally referenced (Sean Keohane)

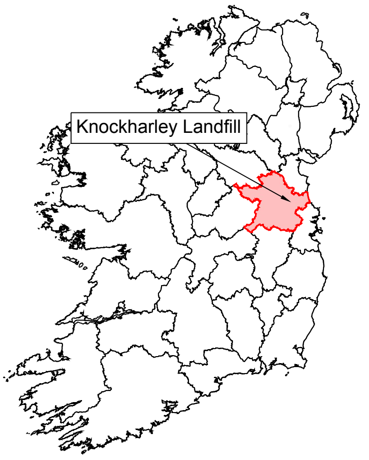


NOT FOR CONSTRUCTION UNLESS SPECIFICALLY STATED OTHERWISE

LEGEND

Plan

🟥	Planning Boundary
▬ ▬ ▬	Ownership Boundary



Rev.	Drawn	Chk'd	App'd	Rev Origin Date	Description
A	SK	CC	BG	Cork 02.03.18	Issue For Planning Application

Revision History A

EIAR/EIS

Name of Client

KNOCKHARLEY LANDFILL LTD.

Name of Job

PROPOSED DEVELOPMENT
AT KNOCKHARLEY LANDFILL

Title of Drawing

1:10,000 REGIONAL SITE LOCATION MAP

Scales Used
1:10017

This Drawing was printed to A3-

Dwg. No.
LW14-821-01-P-0000-001

Rev.
A

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0m 50m 100m 150m 200m 250m 300m 350m 400m 450m 500m

Scale 1:10017

When Applicable : Ordnance Survey Ireland Licence No. EN 0001218 © Ordnance Survey Ireland and Government of Ireland
Discovery Series Sheet 43

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ORIGINAL DRAWING SIZE A1 - (841 x 594)

SCALE HORIZ.

SCALE - VERTICAL

1.4 The Proposed Development

The proposed development comprises:

- The acceptance of up to 435,000 tonnes per annum of non-hazardous wastes, which will comprise up to 150,000 tonnes of incinerator bottom ash (IBA), as well as household, commercial and industrial wastes including residual fines, non-hazardous contaminated soils, construction and demolition (C&D) wastes and baled recyclables. In addition, the acceptance of up to 5,000 tonnes per annum of stable non-reactive hazardous waste is proposed.
- The acceptance and placement within the existing permitted landfill footprint of incoming wastes for recovery or disposal as appropriate; the increase in height of the landfill body from the current permitted post settlement final contour height of 74 mOD to a post settlement contour height of 85 mOD – the proposed height increase will apply from the active landfill phase at the time of permission grant. Permission is sought for the acceptance of waste until the cells are full.
- The construction and operation of a dedicated IBA facility. Permission is sought to store IBA until recovery outlets are identified. Permission is sought for trials to prepare IBA for recovery and removal off site. The IBA facility will consist of 5 no. cells which will be constructed in accordance with the requirements of the Landfill Directive 99/31/EC for non-hazardous wastes. A final post settlement contour height of 85 mOD is proposed. Permission is sought for operation of the IBA facility until the cells are full and subsequent aftercare activities as may be required are complete. The development includes additional perimeter (haul) roads and screening berms.

  The IBA facility will comprise 1 no. portal frame building 76 m x76 m x 15.5 m to facilitate:
    - weathering
    - metals recovery trials
    - crushing and washing to facilitate recovery trials and processing

- The construction and operation of a building for:
    - The biological treatment of the organic fraction of MSW (otherwise known as MSW 'fines' material) and;
    - contingency storage of baled recyclables
    - contingency storage of baled MSW

  This facility shall comprise:
    - a processing building of 108 m in length, 50 m in width and up to 17 m in height, of portal frame construction with 13 no. vehicle roller shutter doors and 7 or more pedestrian access doors (subject to fire certification requirements)
    - internal storage bays as required
    - 12 no. concrete composting tunnels located within the processing building of c. 6 m in width, 25m in length and 5 m in height
    - a covered bio-filtration unit within the overall processing building footprint, with a stack of height of 20 m
    - access from the internal site road with a marshalling yard area with egress from the existing site road to the landfill gas compound
    - all other ancillary and associated works, including leachate storage in a below ground tank, bio-treatment system for sanitary wastewater drainage and fencing.
    - Permission is sought for the continued use of this building post filling of the landfill cells onsite.

- The construction and operation of a leachate management facility comprising:
    - 3 no. additional floating cover leachate storage lagoons (L2, L3 and L4) of c. 3,000 m^2 each
    - 2 no. bunded above ground tanks for raw leachate from IBA cells (S1 and S2) approximately 25 m diameter 6.0 m high.
    - 3 no. bunded above ground tanks:
        - 1 no. tank (S3) for treated leachate from landfill leachate approximately 22m diameter 6.0m high.

        - 1 no, tank for treated leachate from IBA approximately 25 m diameter 6.0 m high (S4).
        - 1 no. tank for leachate concentrate 16 m diameter by 6.0 m high (S5).
    - Modular - typically containerised plant units (C1 through C6), on concrete slab of c. 1,000 m^2 and 1 no. elevated tank 5 m diameter 10 m high (T1) with provision for 2 no. additional low level (<5.0 m high) bunded storage tanks for dosing and other compounds (T2 and T3).
    - Extension to existing loading area to accommodate 2 no. 25 tonne articulated tankers.
    - Loading area for 2 no. 25 tonne articulated tankers.
    - Permission is sought for the continued operation of this plant post filling of the landfill cells to facilitate continued leachate management.

- Construction of screening berms along the western boundary to a maximum of 10 m in height, on the eastern boundary to a maximum height of 10 m and on the northern boundary, to a maximum height of 6 m, with a total berm footprint of c. 11.3 ha. Haul roads for construction will be in or immediately adjacent to berm footprint.

- Construction of surface management infrastructure, with discharge to the adjacent Knockharley Stream to the northern end of the landfilling footprint and the proposed IBA cell development. Key elements will comprise:

    - holding pond for surface water runoff
    - storm water attenuation lagoon to maintain green field surface water discharges to Knockharley stream and to facilitate suspended solids management
    - wetland
    - flood compensation culvert to provide equivalent 1:1000-year flood plain storage
    - permitted stream diversion around permitted development

- Felling of c. 12.5 ha of the existing commercial broadleaf/conifer mix plantations to facilitate:
    - construction of the screening berms along the western boundary and to the north of the proposed IBA area, and
    - development of Phase 7 Cells 27 and 26 and the new northern surface water attenuation pond.
    - Replanting and new planting totalling (c.16.8 ha) will off-set loss of commercial forestry in the proposed development footprint at the following locations:

    - replanting over screening berms
    - new planting on the cap over cells 25, 26, 27 and 28 in what is currently the permitted development

- Relocation of an existing 20 kV overhead ESB powerline that provides power to the existing landfill facility administration buildings, that will be impacted by the development of the screening berm to the east of the proposed IBA cell area.

- Construction of an additional ESB sub-station and new overhead ESB supply to the north-western corner of the currently permitted landfill footprint to facilitate power provision for pumps and other infrastructure.

- Construction of a new ESB sub-station adjacent to the proposed building for biological waste treatment and storage with ESB connection to adjacent 20 kV power lines.

- Extension of existing below ground infrastructure (permitted development) and provision of additional below ground infrastructure. (Power, water, telemetry, leachate rising mains, drainage). Extension of the existing car park for the administration area (760m^2).

More detailed descriptions of the elements of the development are provided in Chapter 2 'Description of the Proposed Development' of Volume 2 of the EIAR.

1.5 Consultation

The scope for the Outline CEMP has been informed by pre-application consultation with An Bord Pleanála, Meath County Council, prescribed bodies and other interested parties as summarised in Chapter 5 of Volume 2 of the EIAR.

This CEMP considers these responses, regarding concerns relating to work practices, environmental management procedures and management responsibilities relating primarily to the construction phase of the proposed development.

The comments expressed in particular by Inland Fisheries Ireland (IFI), Irish Water, Office of Public Works (OPW), the Health Service Executive (HSE), An Taisce, and the Department of Agriculture, Food and the Marine in written consultations received from them as part of the EIA process were considered in the preparation of this Outline CEMP.

2. EXISTING SITE ENVIRONMENTAL CONDITIONS

This section of the Outline CEMP describes the existing site. The information contained in this section is an abridged version of the text contained in the EIAR. The EIAR should be consulted for a more extensive description of the existing site.

2.1 Geological Conditions

The Teagasc online mapping for the site indicates that the soils underlying the site and the surrounding area mainly comprise poorly drained acidic soils consisting of surface water gleys and groundwater gleys. Gley soils are derived from shale and sandstone parent material and are responsible for the poor drainage characteristics evident in this part of County Meath.

The GSI online Quaternary Geology mapping shows that the overburden consists of glacial till predominantly derived from the underlying Namurian shales and sandstones, with the southern part of the site being underlain by tills derived from Carboniferous limestone. Two narrow swathes of alluvium deposits are identified within the southern section of the site and along the northern boundary, with glacial till derived from the Limestone identified to the south of the site.

The site lies regionally within the south-eastern limb of a synclinal axis containing the Namurian aged Balrickard Formation. The dip of the rocks within the syncline are variable. The syncline is bounded to the east and west by two northwest-southeast trending faults.

The 1:100,000 scale bedrock map shows that the site is underlain by Carboniferous aged (Namurian) Balrickard Formation described by the GSI as '*coarse feldspathic micaceous sandstone with shale and argillaceous limestone and fossiliferous shale'*. The Balrickard Formation is underlain by similar strata to the north and south belonging to the Donore Formation and passes up into similar rocks of the Walshstown Formation to the northeast.

The GSI Online Irish Geological Heritage database indicates that the proposed development area is not located in an area of specific geological heritage interest. The nearest site of significant geological heritage features fields of megafluting, located approximately 800 m to the east of the site. This geological feature covers 115 km^2 area and forms part of the largest field of such features in Ireland.

The GSI online Aggregate Potential Mapping database indicates that the site is located within an area of high potential for crushed rock aggregate. No other geological features of economic significance were noted within a 2-km radius of the site. The operational Duleek Quarry is located 5.1 km east of the site.

2.2 Hydrological Conditions

The average annual rainfall (1981 – 2010) in the area of the proposed development is 929 mm[i].

The proposed development site lies within Hydrometric Area HA 08 known as the Catchment of Nanny-Delvin of the Irish River Network and is under the new single River Basin Management Plan for Ireland which is the responsibility of the Water Policy Advisory Committee. The Midlands and Eastern Water and Environment Committee will have responsibility for regional delivery and implementation. The site is situated within the waterbody catchment as defined by the EU Water Framework Directive (WFD - 2000/60/EC) (8), and as shown in Figure 12.1. Waterbody Catchment Map[1]. The risk status and water quality of riverbodies are taken from www,catchments.ie.

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[1] Cycle 1 mapping is used from www.watermaps.wfd.ie as it provides more information on stream order than cycle 2 mapping from catchments.ie.

Under cycle 2, the relevant:

- Catchment is Nanny-Delvin IE_EA_08_352
- Sub catchment is Nanny Meath SC 010,
- Riverbody is Flemingstown 08_010

Under cycle 1, the relevant:

- River Waterbody is Veldonstown IE_EA_08_352EA_Nanny160_NannyTRIB_Veldonstown.

The river body associated with the proposed development is described in more detail below.

The WFD risk status of the Flemingstown riverbody is "review". The water quality is high.

The northern boundary of the landholding within the site boundary is on the boundary of a second waterbody catchment:

- under Cycle 2 the Boyne SC_10 and the riverbody Roughgrange (Main Channel) 010, and
- under Cycle 1, the river body IE_EA_07_583EA_Boyne159Main_BoyneTRIB_Rathdrinagh2_Upper.

The WFD risk status of the Roughgrange riverbody is "review" and the risk score is subject to review (meaning further investigation is required to assign status as "at risk" or "not at risk". The river water quality status is unassigned.

2.3 Ecological Conditions

Ecology is described in more detail in Volume 2 Chapter 10 'Biodiversity' of this EIAR Summary details are presented below.

While the proposed development site is not located within a site designated for environmental conservation, there are three European Sites and twelve pNHAs within 15 km of the site, as detailed in Table 10-3 and illustrated on Figure 10-2. An appraisal of the potential impacts of the proposed development on the constitutive characteristics of European sites within 15km of the proposed development at the Knockharley landfill is set out in the AA Screening Statement and Natura Impact Statement which accompany this application for permission. Accordingly, whilst all fifteen designated sites (European sites and pNHAs) are detailed below, the appraisals for the purposes of Appropriate Assessment are set out in the AA Screening Statement and Natura Impact Statement.

Designated sites within 15km of the proposed development:

- River Boyne and River Blackwater cSAC
- River Boyne and River Blackwater SPA
- Boyne Estuary SPA
- Balrath Woods pNHA
- Thomastown Bog pNHA
- Rossnaree Riverbank pNHA
- Crewbane Marsh pNHA
- Boyne Woods pNHA
- Duleek Commons pNHA
- Slane Riverbank pNHA
- Dowth Wetland pNHA

- King William's Glen pNHA
- Boyne River Islands pNHA
- Cromwell's Bush Fen pNHA
- Melfont Abbey Woods pNHA

The proposed development is not contained within any designated conservation site and, as far as the pNHAs are concerned, there is no potential for direct impacts on any designated conservation site, as there is no ecological link between the sites. There are no NHAs within 15km of the development. There are 12 pNHAs within 15km of the proposed development, however, there is only linkage to Balrath Woods pNHA, as the Knockharley Stream (Flemingstown Stream) flows through part of this site. However, this site is designated for woodland which will not be affected by the proposed development. There is no ecological pathway between the remainder of the pNHAs and the proposed development. The proposed development site is ecologically connected to the River Nanny Estuary and Shore SPA (Site Code: 004158) via a tributary (Flemingstown Stream) of the River Nanny. This SPA is located ca. 21.6km (instream distance) to the east of the proposed development. Again, it should be noted that an AA Screening Statement and Natura Impact Statement accompany this application for permission.

The NPWS website and National Biodiversity Data Centre (NBDC) website were searched for records of protected species from the 10km grid (NPWS data) and for the 2km grid squares in which the proposed development is located (NBDC data). Table 10-4 illustrates the results of the data searches. No records were available on the NPWS website for the 10km Gird N96 and no records of protected fauna or flora were available on the NBDC website for the 2km Grid Square N96T in which the proposed development is located.

The following records of protected species in N96 were identified on site during the surveys:

- West European Hedgehog
- Irish Hare
- European Otter
- Eurasian Badger
- Irish Stoat
- Common Frog
- Eurasian Pygmy Shrew

A total of 11 dominant habitats were recorded on the site during the habitat survey (Fossitt, 2000) conducted in 2010 (FT, 2010) and ground truthed in 2015 and 2016. These are listed below, together with their Fossitt (2000) habitat codes:

- Hedgerow (WL1)
- Treeline (WL2)
- Scrub (WS1)
- Immature Woodland (WS2)
- Improved Agricultural Grassland (GA1)
- Mosaic of Improved Agricultural Grassland and Wet Grassland (GA1/GS4)
- Wet Grassland (GS4)
- Artificial Lakes or ponds (FL8)
- Eroding/Upland River (FW1)
- Reed and Large Sedge Swamps (FS1)
- Buildings and Artificial Surfaces (BL3)

In addition to the above the following habitats were noted as present in March 2015:

- Dry meadows and Grassy Verges (GS2)
- Mixed Broadleaved Woodland (WD1)
- Mixed broadleaved/coniferous woodland (WD2)
- Planted Shrubs (WS3)
- Drainage ditches (FW4)

The habitats on the site have been modified as part of the existing landfill site development. The site surrounding the active landfill site is dominated by mixed broadleaved/coniferous woodland (WD2) which has been planted as part of the development of the site. In the interim since 2010, where some of this woodland had been classified as immature woodland (WS2) has matured and is now classified as mixed broadleaf and conifer woodland (WD2). The trees are largely less than 4-5 m in height. In the immature sections comprise of a mixture of Alder, Silver Birch, Beech and Willow species (among others).

The more mature compartments comprise of trees up to 10m in height though wet conditions underfoot have restricted growth in some locations. The more mature areas are largely in the northwest of the site. The width between planted rows of trees has also allowed the herb layer to remain largely intact with no understorey vegetation visible in compartments visited in March 2015. In the area east of the adjacent forestry compartment, previously classified as immature woodland (WS2) is now best classified as deciduous woodland (WD1) due to the increased canopy height. In some parts of the planted areas Gorse dominates and these areas have been classified as scrub (WS1). In the south of the site a number of screening berms have been constructed. These have been planted with young trees and are included in the immature woodland habitat.

While the mixed broadleaved/coniferous woodland (WD2) and deciduous woodland (WD1) located within the site have been planted and have undergone some improvement, these habitats provide both shelter and foraging habitats for local wildlife and are therefore evaluated as Local Importance (Higher Value).

The remainder of the site which has not been planted is dominated by wet grassland (GS4) and a mosaic of wet grassland and improved agricultural grassland (GS4/GA1). Areas of improved agricultural grassland (GA1) are located around the administration buildings, landfill gas compound and in the northeast area of the site. The wet grassland and mosaics with improved agricultural grassland are evaluated as Local Importance (Higher Value) due to the higher diversity of flora species present. Agricultural grassland is evaluated as Local Importance (lower value) due to it being a monoculture, with limited ecological value.

The field boundaries on the site comprise hedgerows (WL1) predominantly with some treelines (WL2) occurring in the northern and eastern portion of the site. Hedgerow and treelines are relatively unmanaged and contain a number of mature trees. The hedgerows (WL1) and treelines (WL2) within the site are evaluated as Local Importance (Higher Value), as they provide habitat for mammals, birds and invertebrates.

Two artificial ponds (FL8) are located in the south of the site. These comprise a surface water attenuation pond and a constructed wetland. The constructed wetland is surrounded by a Reed and Large Sedge Swamp (FS1). These ponds, while manmade are surrounded by reeds which are of some ecological value and are evaluated as of Local Importance (lower value).

The remainder of the site comprises the active landfill area and associated site tracks and buildings (Buildings and artificial surfaces, BL3). Along the entrance road to the site the sloping embankments on either side of the access road have been planted with ornamental shrubs and are classified as ornamental/ non-native shrubs (WS3). These habitats are evaluated as being of negligible ecological value.

The site is surrounded almost exclusively by improved agricultural grassland and arable fields.

2.4 Archaeological Conditions

Archaeology is described in more detail in Volume 2 Chapter 14 ‘Archaeology, Architecture and Culture’ of this EIAR. Summary details are presented below.

There are no Recorded Monuments within the proposed development area or the 1 km study area (www.archaeology.ie). The closest Recorded Monument (RMP ME026-030) is located approximately 1.3 km west of the landfill site boundary and takes the form of a possible ringfort.

There was no evidence of any archaeological, architectural or cultural heritage features recorded on aerial photographs within the proposed development area or the surrounding landscape.

No archaeological, architectural or cultural heritage features were revealed within the proposed development area or the surrounding landscape as a result of carrying out the walkover survey.

3. OVERVIEW OF CONSTRUCTION WORKS

3.1 Description of the Proposed Development

The proposed development is described in Section 1.4 of this Outline CEMP. There is more detail in Chapter 2 of Volume 2 of the EIAR.

3.2 Site Layout

The proposed site layout is shown in Drawing LW14-821-01-P-0000-003 Proposed Site Layout Plan in Volume 4 of this EIAR. Key elements of the proposed works key are shown in Drawing LW14-821-01-P-050-0005 Proposed Site Layout Plan with Infrastructure Locations in Volume 4 of this EIAR and are described below and the numbering notation is also presented in the above drawing to indicate approximate locations.

1. Proposed waste acceptance types, activities & quantities
    a. Non-stabilised residual including biodegradable
    b. IBA
    c. Non-hazardous and non-biodegradable stabilised and inert
2. Proposed changes to current permitted cell development
    a. Increased profile
    b. Revised cell layout and additional working faces
3. Proposed dedicated IBA cells
    a. Cell layout
    b. IBA road access
    c. IBA wheel wash
    d. Suspended solids management at side risers
    e. Side risers and rising mains
    f. Suspended solids management
    g. Weathering area including weathering building
4. Proposed biological treatment plant
5. Proposed leachate storage and treatment
    a. Bunded storage
    b. Floating cover lagoons
    c. Tanker loading areas
    d. Leachate treatment / conditioning area
6. Proposed surface water/drainage infrastructure
    a. Additional surface water attenuation lagoon
    b. Surface water outfall
    c. Flood compensation lands
    d. Surface water holding pond
7. Earth balance and proposed berms
    a. Cell development
    b. Berm phasing
8. Proposed tree felling & replanting
9. Relocation of ESB powerline

10. Ancillary infrastructure
    a. Additional ESB substation
    b. Additional ESB substation
    c. Additional drainage
    d. New overhead ESB line

An application will also be made to the EPA to facilitate the licensing of the proposed development. The existing facility is licensed to operate by the EPA by IE W0146-02.

3.3 Construction Period and Program of Works

The proposed cell layout and phasing for the permitted and proposed developments are presented in Table 3-1. Drawing LW14-821-01-P-0050-011 Cut and Fill Phasing in Volume 4 of this EIAR shows the proposed construction cut locations and phasing of screening berms associated with key mile stone developments. This drawing should also be read in conjunction with Drawing no. LW14-821-01-P-0050-003 Existing Forestation Proposed Felling and New Planting in Volume 4 of this EIAR as programming was designed to facilitate replanting / new planting within 2 years following felling as may be required.

It is preferable, from a construction viewpoint, that construction of the facility take place during the summer months to take advantage of longer daylight hours and drier weather. However, this is dependent on a number of factors including the implementation of appropriate mitigation measures in relation to the ecology of the development locations (refer to Chapter 11, 'Lands Soils and Geology of Volume 2 of this EIAR).

Upon appointment of a contractor for the works, a programme will be developed taking account of the required mitigation factors.

Table 3-1: Proposed Construction Phasing

Infrastructure	Cell Construction Programme (years post grant of permission)	Screening Berm
Cells 19, 20, 21, 22, 28, 29 and cell weathering area 32	0 through 2	Berms A and B
Advance works, security, felling, suspended solids management, site clearance, haul roads, services	0 through 1	Berm A
Surface water management infrastructure	0 through 1	Berm A
Screening Berms	1 through 8	Berms A through D
Leachate infrastructure	1 through 5	Berms A through D
Miscellaneous infrastructure	1 through 5	Berms A through D
Cells 24, 26 and 27	3 through 4	Berm C
Cells 23. 25 and 30	5 though 6	Berm D
Cells 31 and remainder 32	7 through 8	Berm E
Capping	1 through 8	

Infrastructure provision (access roads, power, telemetry, gas, leachate, surface water) will be developed concurrent with cell construction.

3.4 Construction Working Hours

Construction work will generally be carried out during daylight hours. Construction work will generally be confined to 08:00 to 18:30 Monday to Saturday.

3.5 Overview of the Construction Sequence (Preliminary Only)

The key construction elements are as follows:

1. advance works
2. general earthworks and associated concrete works
3. internal roads
4. deforestation
5. screening berms
6. access Roads
7. IBA storage facility
8. additional above ground and below ground floating cover lagoons to store incoming and treated leachates
9. leachate management facility
10. a weathering / future reprocessing area within the IBA cells
11. an additional wheel wash to clean vehicles leaving the IBA cell development
12. additional leachate rising mains and associated suspended solids management systems tanks
13. additional below ground ducting for water, telemetry and power
14. biological treatment facility
15. upgrading of leachate management facility
16. new underground ESB power supplies and remove existing overhead power supplies

3.5.1 Outline Construction Methodology

3.5.1.1 Advance Works

The key construction related deliverables required prior to development of the proposed Cells and associated Infrastructure will be as follows:

- Establishment of site security, fences and Works compound (s) with appropriate welfare provision.
- Establishment of temporary surface water management measures requiring construction of silt fences and or localised settlement ponds to contain suspended solids associated with dig and deposition areas.
- Site clearance for screening berms.
- Installation of site access roads requiring stripping and stockpiling of topsoil and installation of granular formations atop separation geomembranes.
- Felling in accordance with the Felling Act 2014.
- Relocation / exposing of existing services to facilitate connection to proposed works.

Temporary surface water management

Prior to any earthworks or forestry works taking place, measures to mitigate potential impact on surface water from suspended solids will be implemented. Where permanent measures are not in place temporary settlement ponds and or silt fences will be established to mitigate the risk of suspended solids entering water courses.

Settlement ponds will typically have below ground excavation facilitating gravity flows where possible lined with a synthetic material and a discharge pipe system with appropriate downstream protection in the receiving water using concrete or rip rap to dissipate energy and prevent downstream erosion.

Prior to cell development works taking place, the northern catchment storm water infrastructure will be constructed.

Excavated materials will be removed to screening berms. Clay barrier material won from underlying boulder clays to produce engineered clay will be placed in layers and compacted to 98% maximum dry density.

Thereafter a 2mm textured HPPE liner will installed with welding being monitored by independent CQA.

Inlet and outlet structures and associated protection works will constructed using reinforced concrete.

Construction Compound

A temporary Contractors Compound will be required for the duration of the construction cycles. It will consist of a hardcore area surrounded by secure fencing, comprising site office, canteen, toilet facilities, storeroom and staff parking areas. Fuel/oil storage areas will be bunded in accordance with best practice. The compound will move around site to accommodate the cycles of construction.

Temporary toilet facilities will be required for construction workers. These will consist of temporary 'portaloo' type chemical toilets located within the construction site compound.

3.5.1.2 Earthworks and Associated Concrete Works

The construction element will broadly fall under two categories for earthworks related operations; earthworks and structures.

Bulk dig and construction of stockpiles and screening berms

An earth balance (see Drawing LW14-821-01-P-0050-011 Cut and Fill Phasing in Volume 4 of this EIAR) will define excavation locations and fill (typically screening berms), locations subject to construction program considerations and detailed design.

Prior to earthworks taking place, the advance works described above will require construction of haul roads, silt ponds and installation silt fences to mitigate impact of suspended solids on adjacent watercourses.

Thereafter overburden material will be excavated using tracked 360° excavators and transported in off road dump trucks to screening berm locations where material will be placed, compacted in layers, profiled, top soiled planted with trees and grass seed. In the event that boulder clay (at depth) is encountered it will be stockpiled for reuse as engineered clay in lining systems, see below.

Where ground water is present gravity and or pumped drainage will be provided with outlets via suspended solids pond into receiving surface waters.

In all lagoons engineered clay will be installed in layers and compacted using a sheep's foot roller or similar in layers to ensure compliance with permeability specifications after which 2.00 mm welded HDPE lining materials will be installed.

Production of engineered clay

Following removal of overburden to screening berms or stockpiles, in-situ boulder clay will be excavated, passed through trommels to remove boulders exceeding 50 mm diameter and stockpiled or placed within excavations to form a 1.0 m engineered clay barrier.

Boulders will be used on site as granular fill in haul roads.

Engineered clay (with boulders removed) will be placed and compacted in layers not exceeding 250 mm typically to a proctor maximum dry density of 98% or more subject to permeability testing.

Concrete works

Concrete works will typically require local excavations, drainage and suspended solids management for dig and concrete pours and into which structures will be built requiring placement of blinding, shutters, reinforcement and final concrete pour. Where possible precast concrete (e.g. culvert) to mitigate the risk will be used.

Swales and inlet structures will be excavated, profiled and seeded asap to mitigate development of suspended solids.

A designated concrete wash-down area will be constructed at the temporary compound. Every concrete truck delivering concrete to the site will use this facility prior to leaving the site. A settlement lagoon will be provided to receive all run-off from the concrete wash down area.

3.5.1.3 Internal Roads

Internal roads will comprise:

- Haul roads during construction. These will typically comprise stone aggregate compacted using vibrating rollers on separation membranes.
- Paved roads in the IBA facility constructed using reinforced concrete over IBA formations.
- Asphalt perimeter roads using conventional barber greens, vibrating (granular) and dead rollers (asphalt) for:
  - IBA cells
  - Permitted development.

3.5.1.4 Screening Berms

Screening berms will be constructed on a phased basis concurrent with overburden from cell excavation works. Prior to berm installation, top soil will be stripped back formation compacted and soils as may become available placed and compacted in layers.

Layers will be overfilled and once berms are at the final height is reached will have side slopes profiled receive and allow subsequent placement of topsoil, seeding and tress as required.

To minimise erosion, storm drainage will be installed prior to bulk earth moves and silt fences will be placed around screening berms until a grass cover has become established.

Prior to earthworks taking place temporary haul roads will also be installed.

3.5.1.5 IBA Cells

Overburden will be removed and placed in the screening berms. In-situ boulder clays will be engineered via screening to remove boulders. A ground water drainage system will be installed to accommodate prevailing site conditions upon which the engineered clay barrier will be installed and compacted to 95% maximum dry density.

Thereafter, a 2mm textured HPPE liner will be installed with welding being monitored by an independent CQA. Upon this, a protection geotextile will be placed prior to installation of a 500 mm drainage stone blanket within which will be a HDPE drain pipe network will terminate in HDPE sider risers.

Headwalls and valve chambers associated with leachate pumping will be constructed using reinforced concrete and pipework and telemetry ducts will be constructed using HDPE welded pipework.

3.5.1.6 IBA Weathering Facility

The construction of the IBA Weathering Facility is described as follows:

The storage area will be constructed within the IBA facility footprint in cell 32. Following completion of the cells, a level formation will be established using IBA materials to facilitate acceptance of IBA materials. A single span portal frame building (76 m x 76 m) will be constructed on concrete pad foundations within the IBA weathering footprint.

Initially IBA material will be placed in thin layers above a thermal protection barrier to mitigate elevated temperatures damaging the liner.

To facilitate weathering, once a level platform of weathered IBA is in place, a central access road will be constructed using reinforced concrete.

Clay barrier material will be won from underlying boulder clays excavated to form cells. Boulders within the excavated clay will be removed via screening and engineered clay will be placed in layers and compacted to 96% maximum dry density.

Thereafter a 2mm textured HPPE liner will installed with welding being monitored by independent CQA.

Inlet and outlet structures and associated protection works will be constructed using reinforced concrete.

3.5.1.7 Leachate Management Facility

The primary elements associated with the leachate management facility will comprise:

- Floating cover lagoons excavated below ground and lined with 1.0 m clay barrier. Clay barrier material will be won from underlying boulder clays excavated to form cells. Boulders within the excavated clay will be removed via screening and engineered clay will be placed in layers and compacted to 96% maximum dry density. The floating cover will be constructed using LLDPE.
- Overground tanks constructed using glass lined prefabricated steel tanks founded on a reinforced concrete foundation with reinforced concrete bund walls to facilitate emergency containment.
- Leachate tanker loading facility constructed with reinforced concrete bays and associated HDPE pipe drainage to adjacent tanks to accommodate spills. Pipework from tanks and lagoons will be below ground welded HDPE.
- Reinforced concrete area on granular fill to accommodate containerised treatment modules as may be required for future treatment and or conditioning of leachate road.
- Asphalt surfaced access road on granular formation facilitating access to the facility.

3.5.1.8 Biological Treatment Facility

The biological treatment facility will be a portal frame building surrounded by a concrete working area to facilitate access and egress of vehicles.

Prior to building construction, the topsoil will be stripped back under the footprint of the buildings. Additional excavation will be carried out to the formation level of foundations and underground tanks, where required. The foundations will be ground bearing reinforced concrete pads/strips on a suitable stratum. Once the foundations are poured, rising walls will be constructed. These will be comprised of a mixture of concrete blockwork walls and reinforced concrete retaining “push walls” in material handling areas in the form of tunnels. Push walls will be designed to retain the weight of stockpiled material and pushing forces from loading vehicles. Due to site topography, import of fill material to raise the levels to the underside of floor will be required. Imported fill shall be a granular engineered fill, compacted to provide a suitable subgrade for the building floors. Floors will be steel, or fibre reinforced concrete industrial floors on a suitable depth of compacted granular fill.

The steel frame will be erected on the reinforced concrete substructure. The frame will consist of rolled steel columns and rafters at 5-7m typical spacing. Cold rolled light gauge steel purlins and cladding rails will be fixed to the main columns and rafters.

The frame will be cladded with corrugated coated steel cladding, to match the existing building. Access to the building will be by fast acting industrial roller shutter doors, with personnel access/fire escape doors as required to comply with Fire Regulations.

The walls and roof of the composting tunnels will be entirely of reinforced concrete construction.

External cladding will be affixed to the steel frame when completed.

Roof drainage will consist of gutters and downpipes draining the pitched roofs, the roof of the composting tunnels will be “flat” with a nominal fall. The concrete surface of the tunnel roof will be made waterproofed by means of a bonded membrane system. All roof water will be collected for harvesting.

Proposed Rainwater Harvesting and Storage Systems

Some of the non-potable water requirements of the biological treatment facility along with floor wash-down and vehicle wash-down requirements will be met through utilisation of rain water harvesting.

Two 40 m^3 rain water harvesting tanks (80 m^3 combined capacity) are proposed. Rainwater from the roofs will be collected in a tank and stored for re-use as grey water in the treatment facility, and for supply to a water storage tank as required. This is regarded as a source control technique also. Two systems will be provided, one for each side of the treatment facility, these will be located under the open space area adjacent to the fire tender turning area to the north of the site and the other system will be located under the loading area to the south of the facility. The locations of these systems are shown in Planning Drawings LW14-821-01-P-1700-003 in Volume 4 of the EIAR.

All of the SuDS designs described above will be installed in accordance with the CIRIA guidance. All of the elements of the drainage system are designed to gravitate towards one of the two attenuation ponds.

4. ENVIRONMENTAL MANAGEMENT PLAN

4.1 Introduction

This Environmental Management Plan (EMP) defines the work practices, environmental management procedures and management responsibilities relating primarily to the construction phase of the proposed development at Knockharley Landfill, Kentstown, Navan, Co Meath.

This EMP describes how the Contractor for the main construction works will implement a site Environmental Management System (EMS) on this project to meet the specified contractual, regulatory and statutory requirements and environmental impact assessment report mitigation measures. This plan will be further developed and expanded following the grant of planning permission and appointment of the Contractor for the main construction works. Please note that some items in this plan can only be finalised with appropriate input from the Contractor who will carry out the main construction works and once the planning conditions attached to any grant of planning are known. It is the Contractor's responsibility to implement an effective environmental management system to ensure that Knockharley Landfill Ltd environmental requirements for the construction of this project are met and are in accordance with planning permission and the IE licence.

All site personnel will be required to be familiar with the environmental management plan's requirements as related to their role on site. The plan describes the project organisation, sets out the environmental procedures that will be adopted on site and outlines the key performance indicators for the site.

- The EMP is a controlled document and will be reviewed and revised as necessary.
- A copy of the EMP will be located at the site office.
- All employees, suppliers and Contractors whose work activities cause/could cause impacts on the environment will be made aware of the EMP and its contents.

4.2 Project Obligations

In the construction of the proposed development there are numerous environmental management obligations on the developer and the Contractor. As well as statutory obligations, there are numerous specific obligations set out in the EIAR. These obligations are set out below. When planning is granted, there are also likely to be planning conditions, with which the developer must comply. The Outline CEMP will be updated following the completion of the planning phase to incorporate these obligations. The Contractor and all its sub-Contractors are to be fully aware of and in compliance with these environmental obligations.

4.2.1 EIA Obligations

The EIAR has identified mitigation measures that will be put in place to mitigate the potential environmental impacts arising from construction of the proposed project.

4.2.2 Planning Permission Obligations

Should the proposed development be granted planning permission, the conditions of the planning grant issued will be adhered to.

4.2.3 Industrial Emissions Licence

As outlined in the EIAR, the facility will also require an EPA Industrial Emissions licence for which a separate application will be made. The Industrial Emissions licence that will relate to the proposed development will condition environmental monitoring and reporting.

4.2.4 Other Obligations

The developer and/or contractor for the main construction works will liaise directly with the appropriate persons in relation to securing any necessary permits to allow the works to take place, including for example commencement notice.

4.3 Environmental Management Programme

4.3.1 Noise, Light, Dust and Air Control

Noise Control

Noise will be generated from construction related plant and machinery during the construction works.

The noise impact for construction works traffic will be mitigated by restricting movements along access routes to the standard working hours and exclude Sundays, unless specifically agreed otherwise.

The construction works on-site will be carried out in accordance with the guidance set out in BS 5228:2009+A1:2014, and the noise control measures set out in Appendix 2.0 Construction Environmental Management Plan (CEMP) in Volume 3 of this EIAR.

The hours of construction activity will be limited to avoid unsociable hours. Construction operations shall be restricted to between 08:00 hours and 18:30 hours Monday to Saturday in accordance with the operating hours in the IE licence, unless specifically agreed otherwise.

Mitigation measures shall be implemented to reduce impacts related to construction noise and vibration. BS 5228-1:2009+A1:2014 provides a detailed list of mitigation measures to minimise the noise impact from construction activities and these recommendations should be implemented:

- It is recommended that construction activities shall be carried out during normal working hours;
- A site representative responsible for matters relating to noise should be appointed; and
- Noise monitoring at noise sensitive locations should be performed during critical periods.

There are many general measures that will be taken to reduce noise levels:

- Avoid unnecessary revving of engines and switch off equipment when not required;
- Keep internal haul routes well maintained and avoid steep gradients;
- Select equipment conforming to international standards on noise and vibration;
- Select equipment with quiet and low vibration emissions, and ensure equipment is regularly maintained ensuring it operates in an efficient manner. If possible, all mechanical plant will be fitted with effective exhaust silencers;
- Compressors will be of the "sound reduced" models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers; and
- Locate equipment as far away as noise sensitive receivers as possible within constraints of the site.

Construction noise levels were predicted under Chapter 9 'Noise and Vibration' of Volume 2 of this EIAR, and the predicted noise levels from each activity as well as the cumulative noise level from the construction phase is below the 65 dB $L_{Aeq,1hr}$ noise limit.

Operational noise monitoring will be carried out in compliance with the requirements of the Industrial Emissions licence.

Complaints regarding construction noise will be entered the site complaints log and the relevant site environmental officer will arrange to meet with those affected. The situation will be acted upon immediately and reviewed by the Construction/Environmental Manager. If nuisance is occurring, then the project manager will decide what action is necessary to reduce to acceptable levels or eliminate the disturbance.

Other management practices, in line with the recommendations of the Final Draft BAT Guidance Note for the landfill activities, will be incorporated during facility development:

- Construct a buffer zone between the facility and the external environment.
- Selection of equipment that conforms to EU Noise Standards.
- Limiting activities with noise potential to certain hours.

Lighting Control

In determining the lighting arrangements for the worksite, consideration will be given to residents and other sensitive receptors that may experience a nuisance by the light. Where appropriate, measures will be implemented to reduce obtrusive light (including consideration of hours of lighting, provisions for dimming or switching off light, equipment to be used and lighting position).

Reference to and consideration of the Bat Conservation Trust's best practice guide shall be made (Bats and Lighting in the UK, Bats and the Built Environment Series).

Where possible, a daylight only construction schedule will be adopted to minimise adverse lighting effects as different phases are completed. If construction takes place during winter months, it may be unavoidable that works are carried out during the hours of darkness in consideration of shorter daylight availability.

Where appropriate the following measures will be considered for implementation:

- do not "over" light
- dim or switch off lights
- use specifically designed equipment
- keep glare to a minimum
- position lights sensibly

Dust and Air Quality Control

The principal source of air emissions during the construction phase will be dust, PM_{10} and vehicle emissions.

The amount of dust generated and emitted from the proposed development at the Knockharley landfill facility and the potential impact on surrounding areas will vary according to the following:

- the type and quantity of material and working method
- distance between site activities and sensitive receptors
- climate/local meteorology and topography

An assessment undertaken in the Volume 2 Chapter 7 'Air Quality and Climate' of this EIAR identified with regard to dust (dust soiling) and PM_{10} (human health), the risk from earthworks, construction and trackout activities during the construction phase is deemed to be Low Risk.

The following control measures have been identified and will be implemented during the construction phase:

- The developer in association with the contractor will develop and implement a dust control plan. This plan will address aspects such as excavations, filling activities & temporary stockpiling. The plan will be prepared prior to any construction activities and will be established and maintained through the construction period. Dust controls will be as per the CEMP in Appendix 2.0 of Volume 3 of this EIAR.

The dust control plan will include the following mitigation measures:

  - All vehicles will comply with the onsite speed limit. The speed limit will be reduced appropriately on internal haul routes in extremely dusty environments
  - Stockpiles (soil) during the construction phase will be sprayed during periods of dry weather in order to suppress dust migration from the site.
  - The earthen berms will be replanted in forestry immediately following construction in order to establish vegetated cover to prevent windblown erosion and associated dust emissions.
  - Availability of a water bowser to spray work areas and haul road. The amount of water sprayed will be sufficient to suppress the dust and not be such as to allow any run-off into watercourses.
  - The earthworks foreman will inspect internal haul roads as part of his daily supervision of the site. If dust is causing a problem a water bowser will be engaged.
  - Site roads shall be regularly cleaned and maintained as appropriate. Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic only. Furthermore, any road that has the potential to give rise to fugitive dust shall be regularly watered, as appropriate, during dry and/or windy conditions.
  - Public roads outside the site shall be regularly inspected for cleanliness and cleaned as necessary. Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind. Water misting, or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.
  - Vehicles exiting the site will use the wheel wash at the administration area to mitigate track out onto the public road.
  - All loads which could cause a dust nuisance will be covered to minimise the potential for fugitive emissions

- In the event of dust complaints, they will be recorded and actioned in accordance with the licence for the facility and the complaints procedure.
- A monitoring programme at the site will continue to measure dust and PM_{10} in accordance with the IE licence for the facility. The results of monitoring will inform the licensee of the effectiveness of dust control and mitigation.

Predicted vehicle emissions associated with the proposed development are within the relevant air quality guidelines and therefore will have a neutral impact on ambient air quality. No mitigation measures are therefore required.

4.3.2 Outline Site Drainage Management Plan

As with any civil engineering project of this nature it is vital to ensure that prior to works commencing on site, adequate mitigation measures are put in place. All such mitigation measures as detailed within this Outline CEMP will be implemented by the appointed Civil Works Contractor (CWC) covering the actions required to complete the project in a safe secure manner with respect to the environment. The Project/Site manager representing the CWC is responsible for enforcing the technical and contractual requirements of the project.

This site drainage plan will set out the tasks required to complete the project under a number of headings and outline the mitigation measures proposed to curtail any environment pollution.

Note, this Outline Site Drainage Management Plan should be read in conjunction with Volume 2 Chapter 12 of this EIAR. The Site Drainage Management Plan shall be finalised in accordance with this outline plan following the appointment of the CWC for the main construction works.

3.5.1.9 Sustainable Urban Drainage System

A sustainable urban drainage system (SuDS) approach was applied to storm water management where appropriate and possible within the site, the overall strategy aims to provide an effective system to mitigate the adverse effects of urban storm water runoff on the environment by reducing runoff rates, volumes and frequency, reducing pollutant concentrations in storm water, contributing to amenity, aesthetics and biodiversity enhancement and allow for the maximum collection of rainwater for re-use where possible. In addition, SuDS features will replicate the natural characteristics of rainfall runoff for the site by providing control of run-off at source.

SuDS is a requirement of Meath County Council under the Greater Dublin Regional Code of Practice for Drainage Works (21) and Greater Dublin Strategic Drainage Study (GDSDS) (2). Additionally, these systems are recommended under the new guidelines, The Planning System and Flood Risk Management Guidelines for Planning Authorities (22).

3.5.1.10 Sedimentation and Erosion Control

Suspended solids as a result of earthworks, excavations and temporary storage of excavated materials represents a potential source of impact.

In addition, there is a possibility that pollutants associated with construction equipment could spill/leak, thereby representing a potential source of impact. Mitigation measures relating to fuels, oils and materials are discussed in the following sections.

Control of both erosion and sediment entrainment in runoff will be a key undertaking for the duration of the project. A silt management plan will be implemented onsite utilising silt fences, swales, settlement ponds and diversion drains, as required to remove suspended materials from any surface water runoff within the construction zones. Details of this plan and the measures taken for the control of erosion and sediments are presented in the sections below. The performance of sediment control measures will be assessed through frequent inspections and measurements by the team put in place by the CWC and the Client's Representative. There are a number of SuDS features proposed which have been designed in accordance with CIRIA Design document '*The SUDS Manual C697'*.

Permanent Attenuation Pond & Wetland

In order to avoid an increase in hydrographic peaks due to the proposed development the existing "Southern" attenuation pond (managing surface runoff south of the water shed divide) will be supplemented with a new "Northern" Attenuation Pond. For details of the watershed dividing the site refer to Chapter 12 of Volume 2 of the EIAR.

The attenuation ponds together with adjacent wetlands, will also operate as settlement areas. The efficiency of the attenuation ponds to settle out suspended solids have been estimated to reduce the outflow concentration of suspended solids to less than 25 mg/l. This is below the waste licence limit of 35 mg/l and is within the limits set out in the European Directive 2006/44/EC on the quality of fresh waters needing protection or improvement in order to support fish life. The "Southern" attenuation pond and wetland are already in place at the site. The proposed "Northern" attenuation pond and wetland will be the first element of constuction within the "Northen" catchment. Any disturbance during construction will not increase the suspended solids concentration above the allowable limits. Calculations for attenuation and settlement and the criteria applied are included in Appendix 12-4 of Volume 3 of the EIAR.

Checks on the pond size were undertaken with regard to the efficiency of the removal of pollutants as recommended by CIRIA B14 (23) and GDSDS guidelines (2) and these are included in the pond calculations.

Both attenuation ponds were designed to fully attenuate a 1 in 20-year flow and to contain a 1 in 100-year flow preventing it from overtopping the banks of the pond, in accordance with the GDSDS guidelines (2). An overflow weir in the "Southern" storm water management system is in place to take the flows in excess of the 1 in 20- year flow. An overflow weir in the proposed "Northern" attenuation pond will discharge via a baffled chute structure to the Knockharley stream. Normal outflows from both attenuation ponds (existing and proposed) will gravitate through wetlands before reaching the Knockharley Stream at their respective locations. The normal outflow is controlled to the green field (pre-development) flow rates by an outlet control valve.

It is proposed to adjust the outflow control to cater for the additional volumes associated with the proposed development south of the water shed in the "Southern" storm water attenuation pond. The modifications will not impact on the design philosophy outlined which limits the flows from the ponds to greenfield rates and also provides suspended solids treatment for all the discharges and runoff from paved areas. The proposed "Northern" attenuation pond will employ a floating outflow structure or similar approved to maintain greenfield rates. The ponds and wetland locations are shown on Drawing No. LW14-821-01-P-0000-005 Proposed Site Layout Plan Sheet 2 of 8 in Volume 4 of the EIAR and are also illustrated in Figure 12.9 of Chapter 12 of Volume 2 of the EIAR. Calculations for the design are included in Appendix 12-4 of Volume 3 of this EIAR.

All drainage will be put in place ahead of construction such that any part of the proposed development will have a functioning drainage system in place.

Diversion Drains

To mitigate any impact of the drainage in adjoining lands, the following drainage systems will be employed:

- The maximum depth of excavation is approximately 3m at the location of the proposed new attenuation pond and 7m at the IBA holding facility.
- The excavations will be pumped into the site drainage system (including attenuation ponds), after which permanent *in situ* dewatering will be implemented during operations. As historically there is little evidence of high inflows, it is anticipated that pumped flows from excavations will be very low. Bio-degradable silt bags (or equivalent approved) will be used during dewatering of excavations.

Cross-drainage pipes of 450mm minimum diameter will be provided to prevent a risk of clogging for conveying flows from agricultural drains and forestry drains across the access roads.

A minimum buffer of 10m from watercourses has been adopted for the proposed works.

Details of how uncontaminated surface water runoff will be diverted away from construction areas through the installation of interceptor drains up gradient of construction areas are included in the Volume 4 Figure 12.6 of this EIAR.

Filter strips (vegetated buffers):

These are vegetated strips of land over which flows are treated at low velocities, as shown in the typical details in Figure 2.3 and Figure 2.4. They are appropriate according to The SuDS Manual as pre-treatment devices for SuDS components receiving sheet flow from adjacent impervious areas. The filter strips provided will be wide, gently sloping areas of grass treating runoff from adjacent impermeable areas and roofs, at source, running over its surface. Filter strips also have an attenuating effect on runoff and can allow some infiltration to the ground where the sub-grade is suitable.

These are located adjacent to hard-standing areas. These filter strips will be located post construction where gentle strips are achieved for example adjacent to the existing administration building, as shown in the Figure below.

Figure 4.1: Typical Filter Strip

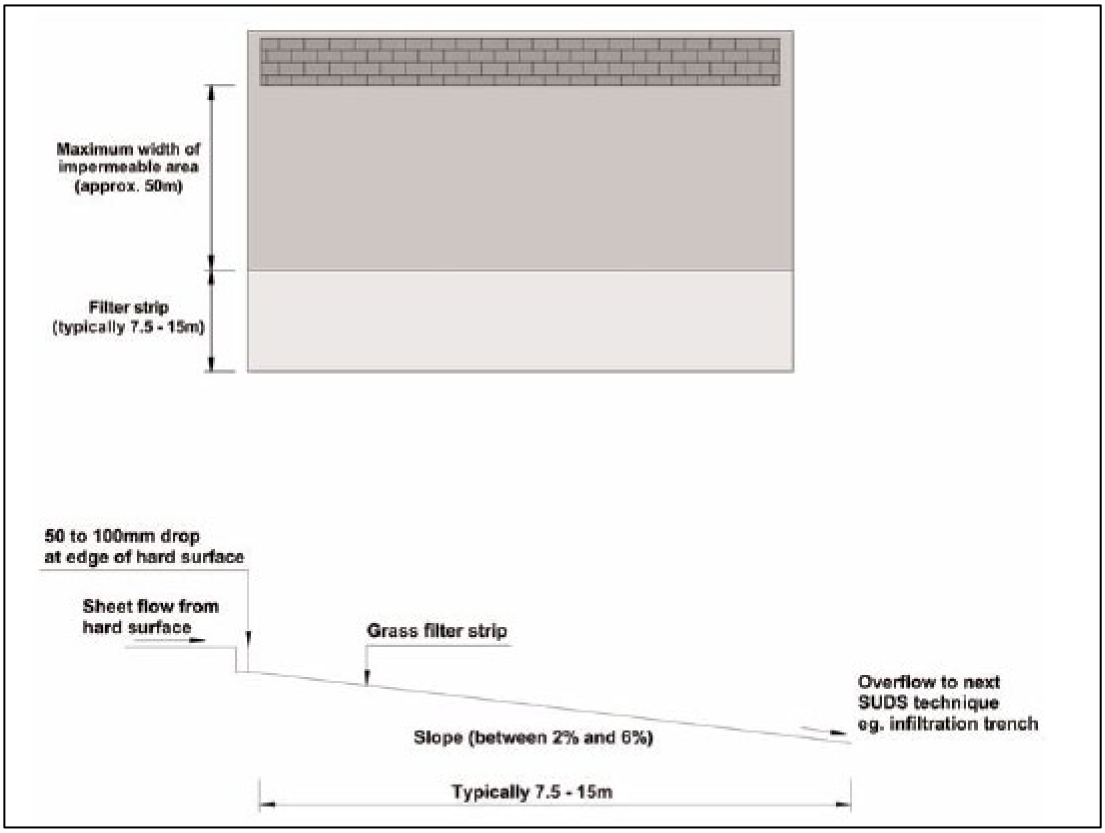

Figure 4.2: Typical Plan and Elevation of Filter Strip

Filter drain:

Filter drains are trenches filled with permeable material with a perforated collection pipe at the invert to collect and convey the water, as shown in Figure 2.5. They may have an optional permeable 'sandy' topsoil at surface. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site. The filter drains can treat, convey and attenuate runoff, at source, and can infiltrate to the ground where the sub-grade is suitable.

These systems will allow some form of storage for small rainfall events and can result in water evaporation and adsorption in small quantities, therefore there will be less run-off from these areas in small rainfall events thus mimicking the natural response for this catchment. The filter drains proposed for this site will be located adjacent to the access road to the loading areas as shown in Drawings LW14-821-01-P-0000-003 to LW14-821-01-P-0000-011 in Volume 4 of the EIAR.

Figure 4.3: Typical Filter Drain

4-Stage Treatment Plan

Details of how drainage waters originating in construction areas will be collected and treated prior to controlled release are included in Volume 4 of this EIAR drawings nos. LW14-821-01-0000-003 through to LW14-821-01-0000-011.

A four-stage treatment train (swale – holding pond - attenuation pond – wetland) will cater for the proposed raised landfill area and will retain and treat the discharges from this area to mitigate any suspended solids that may be released during construction in the surface water run-off. A new swale and "Northern" attenuation lagoon will also drain and provide surface water management of ground and surface water arising from all development in the northern catchment area of the facility including permitted cells and the proposed IBA facility. Refer also to the Outline Surface Water Management Plan in Volume 3, Appendix 12.2 of Volume 3 this EIAR. Drawings showing details of the "Northern" storm water management infrastructure are presented in included Volume 4 of this EIAR drawing LW14-821-01-0500 series.

Swales

Swales leading to an attenuation facility are proposed in the drainage of the development as outlined in Volume 2 Chapter 12 of this EIAR Sections 12.6. These swales are of approximate depth 600 mm with a bottom width of 1000 mm and side slopes at 1 in 3.

The swales will be constructed in accordance with CIRIA C698 Site Handbook for the Construction of SUDS. The attenuation facility will also serve to treat the incoming flows and settle any suspended solids before out falling at restricted rates to the stream which runs through the site. The swale will not be part of the permanent drainage for the development and its location has been chosen based on the site topography.

Silt Fencing

Silt Protection Controls (SPCs) for the proposed development are planned as described above in Volume 2 Chapter 12 of this EIAR and in Volume 4 Drawing LW14-821-01-P-0500-005 of this EIAR and will be put in place in advance as construction progresses across the site and will be regularly maintained during the construction phases. Silt traps and silt fencing are proposed at the location of watercourse crossings and where access roads pass close to watercourses during construction and at stockpiles and or screening bunds during construction. Silt fencing will be used to mitigate any contamination of streams with silt.

The rate of absorption following tree felling, and therefore rate of run-off, is expected to be slightly higher than that of a forested site, however it is expected to develop a vegetation ground cover relatively quickly. Thus, no significant increase in the rate of run-off is anticipated as a result of felling or risk of downstream flooding. Additional silt fencing will be kept on site in case of an emergency break out of silt laden run-off.

All stockpile material will be bunded adequately and protected from heavy rainfall to reduce silt run-off, where necessary. A typical details of a silt fence is also provided below.

Figure 4.4: Typical Silt Fence[2]

Wheel Wash & Concrete Washout Area

There is an existing wheel wash at the entrance to the site which will be used during the construction period.

A designated concrete wash-down area will be constructed at the temporary site compound. Every concrete truck delivering concrete to the site must use this facility prior to leaving the site. A settlement lagoon will be provided to receive all run-off from the concrete wash down area.

A new wheel wash is also proposed at the exit of the IBA facility and this will be used for vehicles leaving the IBA facility during and post construction.

3.5.1.11 Emergency Silt Control and Spillage Response Procedures

To mitigate against impacts from fuel storage and re-fuelling, a single area shall be designated for refuelling and all refuelling shall take place at this location. The refuelling area shall be protected by bunding to contain any potential spillages either from tank rupture or from spillages during re-fuelling.

All personnel working on site will be trained in pollution incident control response. An emergency response plan will be prepared which will ensure that appropriate information will be available on site outlining the spillage response procedure and a contingency plan to contain silt. A regular review of weather forecasts of heavy rainfall is required, and a contingency plan will be prepared, if necessary, for before and after such events.

Emergency drip trays and spill kits will be kept available on site for use in emergencies to ensure that any spills from vehicles are contained and removed off site. Each refuelling station will be fully equipped for a spill response.

3.5.1.12 General Preparation in Advance of Implementing Site Drainage Management Plan

All site personnel will be made aware of their environmental responsibilities at the site induction prior to being allowed to work on site, and through the production of a Method Statement, outlining environmental requirements for sub-contractors (where applicable), which will include environmental emergency response procedures to deal with spillages, should they occur.

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[2] Courtesy Thrace Synthetic

In principle, soil excavation will be undertaken during dry periods. However, it is noted that other factors may affect working timeframes. Therefore, working only during dry weather will not always be practicable or feasible.

Long range weather forecasts should be examined, and the construction phases planned to take cognisance of expected weather conditions. Regular meetings should be held to re-assess construction phases with weather conditions as the project progresses.

Cessation of operations during an extreme rainfall events may be required in areas which are sensitive to silt pollution, and any other areas where silt will be quickly carried into receiving watercourses. Extreme weather conditions will be monitored, and a contingency plan prepared in advance of construction. An extreme rainfall event will be classified as an event that corresponds to the Met Éireann Orange – Weather Alert for rainfall.

3.5.1.13 Personnel Qualifications and Key Contacts

All those carrying out work on site must have a Solas Safe Pass Card. All works must be supervised by a competent supervisor. Workers must be adequately trained in the tasks they are required to carry out. The key contact names and contact details should be supplied to all personnel entering the site. All site staff should be informed of the emergency procedures for the site.

4.3.3 Watercourse Diversion and Construction of Watercourse Crossings

The IFIs '*Guidelines on the Protection of Fisheries During Construction Works in and Adjacent to Waters'* (2015) has been consulted in the preparation of the stream diversion design.

Although the stream running through the site is not fisheries sensitive, cognisance of the sensitivity of watercourses downstream will be taken into account. The precise timing and duration will be discussed with IFI in relation to in-stream works in the Knockharley Stream, including the proposed stream diversion and short sections of culverting which will be required, to define the closed season for in-stream works prior to construction. Generally, in-stream works will only take place during the period **July-September** (IFI, 2015). Any in-stream works will be undertaken in consultation with the Planning Authority and Inland Fisheries Ireland (IFI) and subject to Section 50 approval from the OPW

Box or piped culverts will only be used over very short stretches i.e. at track or berm crossings, to avoid any loss of valuable habitat.

Rock armour will be used to provide bank protection works upstream and downstream of new structures, to ensure no undercutting or destabilisation of either the structure or riparian bank areas occurs.

The new watercourse diversion will maintain the same cross-sectional profile as the existing stream.

The diversion was modelled as part of the flood risk assessment and it was found to be capable of passing the design flow for a 1 in 100-year flood. Details of the sizing of the culverts and the profile of the watercourse diversion are included in the Flood Risk Assessment in Appendix 12.5, EIAR Volume 3.

In order to monitor the proposed development during construction, a system of monitoring and maintenance of the drainage network will be implemented during and after the construction phases. The measure should include but not be limited to the items listed in Section 4.3.4 below.

4.3.4 Maintenance and Monitoring

Facility management as part of licence compliance will implement maintenance and monitoring criteria which will require:

- Inspection and maintenance of the surface water management system including swales, culverts, rainwater harvesting tanks and outfalls will be undertaken regularly, to ensure no blockages have occurred and the system is operating correctly.
- Adequate access will be provided to all swale areas for inspection and maintenance.

- The landfill operator shall have responsibility for ensuring that all the mitigation and maintenance measures included in the surface water management plan are put in place.
- Water quality monitoring will be carried out in accordance with the licence during the construction and operation and aftercare stages.
- An emergency plan which will include the requirement for the shutting off the outfall from the attenuation pond during the construction period, if contamination is detected.

4.3.5 Archaeological Management

Due to fieldwork previously carried out for the phased development of the Knockharley landfill site revealing substantial archaeological remains within the immediate vicinity of the proposed development area, it is proposed that a programme of pre-development licensed geophysical surveying will be carried out in all suitable areas of land take.

It is proposed that a programme of pre-development test trenching will be carried out after the geophysical survey has been completed and within all areas of proposed land take. Test trenching will take in to account the results of the geophysical survey and will be carried out under licence to the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs and the National Museum of Ireland. Further archaeological mitigation measures, which may include preservation in situ or preservation by record, may be made pending the results of the test trenching programme, and in agreement with the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs and the National Museum of Ireland.

There will be no direct or indirect operational impact on the archaeological, architectural or cultural heritage resource. As such there are no operational mitigation measures required.

There will be no residual impacts on archaeological, architectural or cultural heritage remains after mitigation measures have taken place.

There are no Recorded Monuments, Protected Structures, Architectural Conservation Areas, NIAH structures or NIAH historic gardens or designed landscapes within the proposed development area. As a result, there will be no direct or indirect construction impact on the recorded archaeological, architectural or cultural heritage resource.

4.3.6 Outline Construction Waste Management Plan

This Outline Construction Waste Management Plan has been prepared for the proposed development in line with "Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects" (2006) as published by the Department of the Environment, Community and Local Government.

The Construction Waste Management Plan shall be finalised in accordance with this plan following the appointment of the Contractor for the main construction works. This plan should be read in conjunction with the EIAR.

It is an objective of this plan to prevent, reduce, reuse and recover as much of the waste generated on site as practicable and to ensure the appropriate transport and disposal of residual waste off site. This is in line with the relevant National Waste Management Guidelines and the European Waste Management Hierarchy.

Assignment of Responsible Personnel

It will be the responsibility of the Contractor for the main construction works (when appointed) to nominate a suitable site representative such as a Project Manager, Site Manager or Site Engineer as Waste Manager who will have overall responsibility for this waste management plan. The waste manager will have overall responsibility to instruct all site personnel including sub-Contractors to comply with the specifications of this plan.

They will ensure that at an operational level, crew foreman/gangers are assigned direct responsibility for its implementation.

Waste Generated

The wastes/spoils likely to be generated during the construction phase are presented in Table 4-1 below:

Table 4.1: Potential wastes generated during construction phase

Waste	Source
Hardcore, stone, gravel, concrete and plaster	Materials used during construction
Timber	Temporary supports, concrete shuttering and product deliveries
Miscellaneous building materials	Left over from construction of the site buildings
Waste from chemical toilets	Chemical toilets
Plastics	Packaging of material
Lubricating oils, diesel	Unused quantities at end of construction period

All wastes will be collected at the end of the construction phase, taken off site, and reused, recycled and disposed of according to best practice through waste facilities. Lubricating oils and diesel will be removed from the site and disposed of in accordance with the European Communities (Waste Oil) Regulations, 1992. (S.I. No. 399 of 1992).

Waste Reduction

All efforts will be made by site management to minimise the creation of waste throughout the project. This will be done by:

- Materials ordering will be optimised to ensure only the necessary quantities of materials are delivered to site.
- Materials storage areas will be of a suitable design and construction to adequately protect all sorted materials to ensure no unnecessary spoilage of materials occurs which would generate additional waste.
- All plant will be serviced before arriving on site. This will reduce the risk of breakdown and the possible generation of waste oil/hydrocarbons on site.
- Prefabrication of design elements will be used where suitable to eliminate waste generation on site.
- If materials such as concrete are being ordered, great care will be practiced in the calculation of quantities to reduce wastage.

Waste Reuse

When possible (and following appropriate testing), materials shall be re-used on site for other suitable purposes, e.g.

- Re use of excavated materials for screening, berms, etc.
- Re use of excavated materials as suitable fill elsewhere on site for the new site tracks, the hardstanding areas and embankments, where possible.

Waste Recovery

In accordance with national waste policy, source separation of recyclable material will take place. This will include the provision of receptacles for the separation and collection of dry recyclables (paper, cardboard, plastics, etc.), biological waste (canteen waste) and residual waste.

Receptacles will be clearly labelled, signposted and stored in dedicated areas.

The following sourced segregated material containers will be made available on site at a suitable location:

- Timber
- Ferrous Metals
- Aluminium
- Dry Mixed Recyclables
- Packaging Waste
- Food waste

Waste Disposal

Residual waste generated on site will require disposal. This waste will be deposited in dedicated receptacles and collected and transported to waste facilities for disposal. All waste movements will be recorded, of which records will be held by the waste manager on site.

Training

Copies of the waste management plan will be made available to all relevant personnel on site. All site personnel and sub-contractors will be instructed about the objectives of the Project Waste Management Plan and informed of the responsibilities that fall upon them as a consequence of its provisions.

It will be the responsibility of the Contractors' appointed Waste Manager to ensure that all personnel are made aware of their responsibilities under the plan via a toolbox talk or otherwise.

4.3.7 Outline Construction Traffic Management Plan

4.3.7.1 Introduction

The Construction Traffic Management Plan (CTMP) for the proposed development shall be finalised in accordance with this Outline Plan following the appointment of the Contractor for the main construction works.

Please note that some items in this plan can only be finalised with appropriate input from the Contractor who will actually carry out and schedule the works. Furthermore, it is appropriate that the Project Supervisor Construction Stage (PSCS), when appointed, should have an active role in the preparation/review of the Traffic Management Plan. This plan should be read in conjunction with Chapter 8 Roads, Traffic and Transportation of Volume 2 of the EIAR.

The Contractor will be required to prepare the necessary Site-Specific Traffic Management Plans prior to the construction works commencing in accordance with Chapter 8 of the Traffic Signs Manual and subject to load permits. The Contractor will be responsible for the implementation of all requirements of the Roads Authority.

This Outline CTMP deals with the traffic generated during the construction of the proposed development. It concentrates on the traffic arising from each element of the works which includes the site clearance works and the building construction works.

Construction traffic will require regular access to the site at varying times throughout the construction phase. The aim of this Outline CTMP is to put in place procedures to manage traffic effectively on site and in the immediate vicinity of the development, to ensure the continued movement of traffic on the public roads and to minimise disturbance during transportation of materials. The correct implementation of this Outline CTMP will ensure that appropriate procedures are in place to minimise any effects on the safety and movement of the general public.

4.3.7.2 Traffic Impact during Construction

As with any construction development project, the transport of materials onto the site will give rise to increased traffic and associated impacts. However, due to the very nature of construction these impacts will be temporary. The facility's construction will lead to construction-related traffic on the roads in the proximity of the development. It will include:

- Site personnel driving to the work site and site compounds (by car, van and 4x4)
- Delivery of liner materials, tanks, steel, cladding and other construction materials by van and HGV
- Movement of construction equipment and refuelling trucks to and around the site
- Import of fill material and concrete

Public perception of the construction phase will be influenced primarily from the impact of traffic movements. The degree of traffic disturbance caused by the construction phase depends on the volume of material imported/exported, the associated civil engineering requirements and the length of the construction period.

Prior to the commencement of construction, the CTMP will be reviewed by the main Contractor (and any sub-contractors) and will be updated as necessary.

4.3.7.3 Construction Staging

Construction commencement dates are yet to be confirmed at this stage; these will be made known to the Planning Authority by way of a formal Commencement Notice.

In terms of traffic impacts, it is proposed to carry out the project in a number of phases, with an overall construction programme of nine months expected for Phase 1. Subsequent phases are expected to be rolled out in two-year intervals as per Table 3-1, Section

Construction operations shall generally be restricted to between 08:00 to 18:30 Monday to Saturday.

4.3.7.4 Road Improvements, Modifications and Access to/from the National Road Network

The site is situated in the townland of Knockharley, approximately 6km south of Slane on the west side of the N2 National Primary Route. Navan is located approximately 13km to the west of the site via Balrath Cross and the R153 Regional Road.

To the north, the site is bounded by the CR384 County Road running east-west. To the east the site is bounded by the CR384 running north-south between the N2 and R150. The CR384 in this location runs almost parallel to the N2. To the south, the site is bounded by farmland, which is generally located adjacent to the R150 on the Kentstown side of the N2. To the west, the site is bounded by mainly gently sloping farmland, mostly in large fields generally defined by mature hedgerows with some groups of trees.

The N2 has a posted speed limit of 100kph near the site. This road is one of the main traffic arteries in the country and is the primary access route to the site.

Save for the CR384, the general road infrastructure in the immediate vicinity of the development site is of a relatively good standard in terms of road alignment, surfacing and cross-section.

The existing site enjoys direct vehicular access to the national roads network with primary access facilitated at a ghost island priority junction on the N2. The ghost island provides sheltered access for right turning vehicles travelling from the north. This is complimented with an auxiliary left turn deceleration lane to facilitate access for vehicles coming from the south. Both turning facilities aid in preserving the flow, speed and therefore the capacity of through traffic on the N2. The junction has been designed and constructed in accordance with the NRA: Design Manual for Roads and Bridges (DMRB) and has been the subject of Roads Safety Auditing (Stages 1, 2 and 3) in accordance with procedures set out in the relevant NRA guidelines.

The access road to the site runs due west through arable lands, thereafter running under the CR384 County Road.

The entrance proper to the site is located approximately 80 to 100 metres west of the underpass of the CR384. A security gate with closed circuit television is located on the access road. This aids site security staff in preventing unauthorised traffic from entering the site.

The original grant of permission conditioned the site operator to provide a traffic management plan. The traffic management plan includes provisions for prohibiting traffic directly associated with the landfill from travelling along the R150 between its junctions with the N2 and the R153 in Kentstown. After the opening of the landfill site it was found at subsequent planning forums that the traffic management system of prohibiting landfill traffic by means of a contracted arrangement functions successfully and to the satisfaction of the Planning Authority. It should be noted nonetheless that other HGVs including waste industry related vehicles generated by nearby waste treatment facilities are not prohibited from using the R150.

4.3.7.5 Road Cleaning

Public roads shall be kept free of mud, dust, spillages and debris from the construction site, construction plant or haulage vehicles. All vehicle existing the facility will be required to pass through the existing or proposed site wheel washes. Road sweeping vehicles will be used if required to ensure that the public road network remains clean.

4.3.7.6 Construction Plant and Vehicles

The typical construction plant and vehicles accessing the development site may include:

- Site personnel driving to the work site and site compounds (by car, van and 4x4)
- Delivery of plant, materials, structural and re-enforcing steel and other construction materials by van and HGV
- Movement of construction equipment and refuelling trucks to and around the site
- Import of fill material and concrete
- Traffic associated with delivery of ESB Networks equipment

It should be noted however that final selection of construction plant and vehicles may vary depending on suitability, availability, contractor's choice, etc.

Landfill operators will be responsible for the upkeep and maintenance of construction plant and vehicles, ensuring good working order prior to use. Should emergency maintenance need to be carried out on site, this will be carried out at a designated area away from sensitive receptors and it will be ensured that a spill kit is nearby.

Parking for all site staff vehicles during the Construction phase will be provided adjacent to the construction compound. Parking of construction related vehicles (or queuing) will not be permitted outside the facility gate. This will be achieved using a combination of signage, suitable bollards (if required) and enforcement by site management

4.3.7.7 Consultation and Notification

Traffic Management Co-ordinator

The Contractor will appoint a dedicated competent Traffic Management Coordinator for the duration of this project and this person will be the main point of contact for all matters relating to traffic management on the project.

Induction

Prior to the works commencing, the Traffic Management Coordinator will carry out an induction for the materials haulage contractor staff to inform them of the traffic requirements in relation to vehicle movements. Traffic consideration shall form part of the induction process for all site staff also.

An Garda Síochána

Following the appointment of the successful Contractor for the main construction works for this project, this Outline CTMP shall be finalised. The Traffic Management Coordinator will liaise directly with An Garda Síochána in relation to the plan and any concerns/requirements they have will be incorporated in to the plan.

County Council

The Contractor will liaise directly with Meath County Council Roads Department in relation to the plan in the event that any permits are required and if so shall be applied for and obtained from the Roads Department.

4.4 Environmental Management Team – Structure and Responsibility

A preliminary organisation chart is included in Figure 4.2. Revisions to the project organisation chart shall be controlled independently of this plan following the appointment of the Contractor for the main construction works.

The Contractor's Project Manager will be responsible for the delivery of all elements of the Environmental Management Plan.

The Contractor's Project Manager will retain all responsibility for issuing, changing and monitoring the Environmental Management Plan throughout.

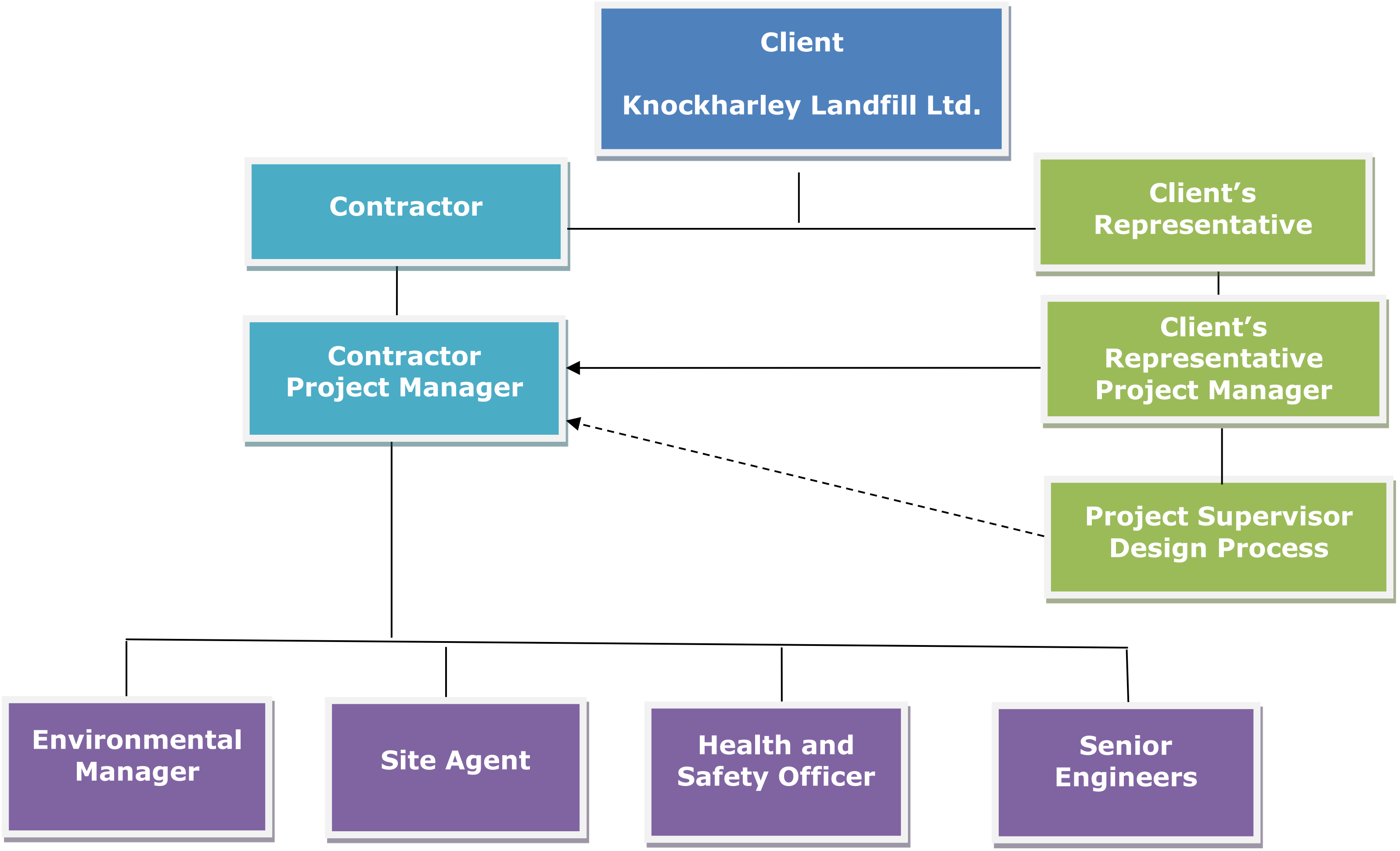

Figure 4.5: Project Management Team Organogram

- **Note – the Contractor PM may fulfil one or all of the sub roles identified**

4.5 Training, Awareness and Competence

All site personnel will receive environmental awareness information as part of their initial site briefing. The detail of the information should be tailored to the scope of their work on site. The Contractor for the main construction works may decide to conduct the environmental awareness training at the same time as health and safety training (often referred to as Site Inductions).

This will ensure that personnel are familiar with the environmental aspects and impacts associated with their activities, the procedures in place to control these impacts and the consequences of departure from these procedures.

The CEMP will be retained in the management office during the project. The environmental performance at the site will be on the agenda of the monthly project management meetings for the project.

Elements of the CEMP will be discussed at these meetings including objectives and targets, the effectiveness of environmental procedures, etc. Two-way communication will be encouraged by inviting all personnel to offer their comments on environmental performance at the site.

4.6 Environmental Policy

The Contractor will be responsible for preparing and maintaining an Environmental Policy for the site. The policy should be appropriate to the project, commit to continuous improvement and compliance with legal requirements and provide a framework for objectives and targets. This will be communicated to all site personnel and will be available on-site notice boards.

4.7 Register of Environmental Aspects

The Contractor will be responsible for preparing and maintaining a *Register of Environmental Aspects* pertaining to the site. This register will identify the environmental aspects associated with activities onsite and determine which aspects have or can have a significant impact on the environment.

4.8 Register of Legislation

The Contractor will be responsible for preparing and maintaining a register of key environmental legislation pertaining to the site. This register will reference all current environmental legislation and will be inspected, reviewed and updated regularly to ensure compliance.

4.9 Objectives and Targets

Objectives and targets will be set by in Contract Documents to ensure that the project will be constructed and operated in full accordance with the EIAR, planning conditions, waste licence and legislative requirements, with minimal impact on the environment.

Environmental objectives are the broad goals that the Contractor must set in order to improve environmental performance. Environmental targets are set performance measurements (key performance indicators or KPI’s) that must be met in order to realise a given objective.

The Contractor will be required to manage objectives based on each significant environmental impact. Key objectives are likely to include the following:

- To ensure that nearby rivers and streams are not negatively impacted by construction works
- To ensure that humans are not negatively impacted by dust generated by construction works
- To ensure that humans are not negatively impacted by noise generated by construction works

- To ensure that impacts to habitats and wildlife are minimised during works
- To ensure that a waste management plan for this site will be fully implemented
- To ensure that the visual impact during the construction work is minimised
- To ensure that the proposed development is constructed in compliance with the EIAR.

Performance in relation to each of these objectives will be reviewed on a regular basis by means of inspections, audits, monitoring programmes, etc.

In addition, the requirement of the Industrial Emissions licence to be applicable to the site will define the specific environmental objectives and targets during the construction phase.

4.10 Non-Conformance, Corrective and Preventative Action

Non-conformance notices will be issued where there is a situation where limits associated with activities on the project are exceeded, or there is an internal/external complaint associated with environmental performance.

Non-conformance is the situation where essential components of the EMS are absent or dysfunctional, or where there is insufficient control of the activities and processes to the extent that the functionality of the EMS in terms of the policy, objectives and management programmes, is compromised. A non-conformance register should be controlled by the Contractor.

The EMS and all its components must conform to the EMP, objectives and targets and the requirements of the ISO 14001 management standard.

In the event of non-conformance with any of the above, the following must be undertaken:

- Investigate cause of the non-compliance;
- Develop a plan for correction of the non-compliance;
- Determine preventive measures and ensure they are effective;
- Verify the effectiveness of the correction of the non-compliance;
- Ensure that any procedures affected by the corrective action taken are revised accordingly.

Responsibility must be designated for the investigation, correction, mitigation and prevention of non-conformance.

4.11 EMS Documentation

The Contractor is required to keep the following documentation in relation to the environmental management of the project (as a minimum):

- Construction Environmental Management Plan for the proposed development
- Register of Environmental Impacts
- Register of Planning Conditions
- Monitoring Records
- Minutes of Meetings
- Training Records
- Audit and Review Records.

All of these documents and records are to be available for inspection in the site office. The documentation shall be up to date and shall be reviewed on a regular basis with revisions controlled in accordance with the site quality plan.

It will be a requirement of the EPA Industrial Emissions licence applicable to the site to develop and maintain an Environmental Management programme for the facility.

4.12 Control of Documents

The Contractor will establish, implement and maintain a procedure to control CEMP documents and records so they are clearly identifiable, organised, current, easily located and revised when necessary.

5. SAFETY & HEALTH MANAGEMENT PLAN

5.1 Introduction

This Safety and Health Management Plan (SHMP) will define the work practices, procedures and management responsibilities relating to the management of health and safety during the design, construction and operation of the proposed materials transfer and processing facility at the Millennium Business Park and shall be read in conjunction with the Preliminary Safety & Health Plan prepared for the project by the Project Supervisor for the Design Process. The Safety and Health Management Plan shall be finalised in accordance with this Outline plan following the appointment of the contractor for the main construction works.

This SHMP will describe how the contractor for the main construction works will implement a site safety management system (SMS) on this project to meet the specified contractual, regulatory and statutory requirements, environmental impact assessment report mitigation measures and planning conditions. It is the contractor’s responsibility to implement an effective safety management system to ensure that the developer’s safety requirements for the construction of this project are met.

All site personnel will be required to be familiar with the requirements of the safety management plan as related to their role on site. The plan describes the project organisation and sets out the health and safety procedures that will be adopted on site.

- The Safety and Health Plan will be a controlled document and will be reviewed and revised as necessary.
- A copy of the Safety and Health Plan will be located on/near the site H&S notice board.
- All employees, suppliers and contractors whose work activities cause/could cause impacts on the environment will be made aware of the SHMP and its contents.

5.2 Project Obligations

The construction of the proposed development will impose numerous safety management obligations on the developer, designer and contractor. As well as statutory obligations, there are a number of specific obligations set out in the EIAR and will be set out in the planning conditions for the proposed development, should it be granted consent. These obligations are set out below. The contractor for the main construction works and all of its sub-contractors will be required to ensure that they are fully aware of and in compliance with these safety obligations.

5.2.1 EIA Obligations

The EIAR for the proposed development identifies mitigation measures that will be put in place to mitigate the potential impacts arising from construction of the project.

5.2.2 Planning Permission Obligations

Should the proposed development be granted consent, the planning conditions will be complied with and should be read in conjunction with this CEMP and other related reports prepared by and on behalf of the developer.

5.2.3 Statutory Obligations

The Safety, Health and Welfare at Work Act 2005 and the Safety, Health and Welfare at Work (Construction) Regulations 2013 place a responsibility on the Developer as the “Client”, the Designer, the Project Supervisors and the Contractor.

The Client must:

- Appoint a competent and adequately resourced Project Supervisor for the Design Phase (PSDP)
- Appoint a competent and adequately resourced Supervisor for the Construction Stage (PSCS)
- Be satisfied that each designer and contractor appointed has adequate training, knowledge, experience and resources for the work to be performed
- Co-operate with the project supervisor and supply necessary information
- Keep and make available the safety file for the completed structure
- Provide a copy of the safety and health plan prepared by the PSDP to every person tendering for the project
- Notify the Authority of the appointment of the PSDP.

Designers must:

- Identify any hazards that their design may present during construction and subsequent maintenance
- Eliminate the hazards or reduce the risk
- Communicate necessary control measures, design assumptions or remaining risks to the PSDP so they can be dealt with in the safety and health plan
- Co-operate with other designers and the PSDP or PSCP
- Take account of any existing safety and health plan or safety file
- Comply with directions issued by the PSDP or PSCS.

The PSDP must:

- Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project
- Where possible, eliminate the hazards or reduce the risks
- Communicate necessary control measure, design assumptions or remaining risks to the PSCS so they can be dealt with in the safety and health plan
- Ensure that the work of designers is coordinated to ensure safety
- Organise co-operation between designers
- Prepare a written safety and health plan for any project and deliver it to the client prior to tender
- Prepare a safety file for the completed structure and give it to the client.

The PSCS must:

- Co-ordinate the identification of hazards, the elimination of the hazards or the reduction of risks during construction
- Develop the Safety and Health Plan initially prepared by the PSDP before construction commences
- Co-ordinate the implementation of the construction regulations by contractors
- Organise cooperation between contractors and the provision of information
- Co-ordinate the reporting of accidents to the Authority
- Notify the Authority before construction commences
- Provide information to the site safety representative
- Co-ordinate the checking of sage working procedures
- Co-ordinate measures to restrict entry on to the site
- Co-ordinate the provision and maintenance of welfare facilities
- Co-ordinate arrangements to ensure that craft, general construction workers and security workers have a Safety Awareness card, e.g. Safe Pass and a Construction Skills card where required

- Co-ordinate the appointment of a site safety representative where there are more than 20 persons on site
- Appoint a safety adviser where there are more than 100 on site
- Provide all necessary safety file information to the PSDP
- Monitor the compliance of contractors and others and take corrective action where necessary;
- Notify the Authority and the client of non-compliance with any written directions issued.

The Contractor must:

- Co-operate with the PSCS
- Promptly provide the PSCS with information required for the safety file
- Comply with directions of the project supervisors
- Report accidents to the Authority and to the PSCS where an employee cannot perform their normal work for more than 3 days
- Comply with site rules and the safety and health plan and ensure that your employees comply
- Identify hazards, eliminate the hazards or reduce risks during construction
- Facilitate the site safety representative
- Ensure that relevant workers have a safety awareness card and a construction skills card where required
- Provide workers with site specific induction
- Appoint a safety officer where there are more than 20 on site or 30 employed
- Consult workers with site specific induction
- Monitor compliance and take corrective action.

Consequently, at all stages of the project there are statutory requirements for the management of safety, health and welfare of all involved in or affected by the development. As previously outlined, this CEMP and specifically the Safety and Health Management Plan addresses key construction management issues associated with the proposed development. This plan will be developed further at the construction stage, on the appointment of the Contractor for the main construction works.

5.2.4 The Management of Health and Safety during the Design Process

Fehily Timoney & Company (FT) has been appointed Project Supervisor for the Design Process (to prepare the Environmental Impact Assessment Report and planning application for the proposed development) and is competent to fulfil this role in accordance with the Safety, Health and Welfare at Work (Construction) Regulations, 2013. Health and safety are a major priority for FT and FT adopts health and safety practices that are an inherent part of a safe and sustainable business. FT's objective is to provide a safe and healthy work environment for all and to meet our duties to clients, contractors and members of the public.

It is FT's policy to comply fully with all health and safety legislation, in particular the Safety, Health and Welfare at Work Act, 2005, Safety, Health and Welfare at Work (General Application) Regulations 2007, and the Safety, Health and Welfare at Work (Construction) Regulations 2013.

FT has developed in-house procedures to ensure, so far as is reasonably practicable, that all projects:

- are designed to be capable of being constructed to be safe/without risk to health;
- can be operated and maintained safely and without risk to health during use; and
- comply in all respects, as appropriate, with the relevant statutory enactments and instruments.

These procedures include effective risk management procedures involving the identification and evaluation of risks and the development of mitigation measures to eliminate (where possible) or reduce those risks during the life-cycle of the project. The FT team is committed to health and safety and shares responsibility for managing risk at all stages of a project.

All work by FT is undertaken in a competent and efficient manner taking account of the general principles of prevention to safeguard the safety, health and welfare of construction & maintenance workers and other third parties.

The FT procedures for the management of safety during the design process are outlined in the in-house procedure PP09 "Health and Safety Requirements in Design Projects" and is adhered to on all design projects.

The purpose of this procedure is to define the requirements for the management of health & safety during design projects, to ensure compliance with The Safety, Health and Welfare at Work (Construction) Regulations 2013.

The procedure includes standard forms which are used to communicate health and safety considerations within the design team and also guidelines which develop the company's health and safety procedure and outline the company's responsibilities for health and safety during the design process.

The procedure addresses health and safety issues at all stages of a project, from the preliminary design through to commissioning and operation. By establishing a chain of responsibility, each party is clear on their role and obligations from a health and safety perspective. Risk assessments are carried out, at preliminary and detailed design stages by every discipline involved in the design. Each risk assessment is prepared by the designers and reviewed by the Health and Safety Facilitator for the project.

Risk assessments are used to identify hazards and assess risk at all stages during the life of the project including the construction & maintenance stages.

A Health and Safety Facilitator for the Design Process (HSF) is appointed on all projects where FT are the Project Supervisor for the Design Process (PSDP). Health & Safety Facilitators are selected from the senior ranks of FT design staff to ensure they have the required knowledge, experience and training to carry out the role.

Meetings will be held between the HSF and relevant design personnel to collate all the risk assessments and other pertinent information and to discuss any issues relating to health and safety and ensure the constructability of the designs. The minutes of these meetings are circulated to the entire design team complete with actions allocated to the designers as appropriate. At such a meeting a "Construction Risk Analysis" form is completed which forms the basis for the Preliminary Safety & Health Plan. This document outlines the particular, significant and residual risks and in addition specific construction methods or sequences assumed during the design. Special requirements for maintenance envisaged at design stage are also included.

A Designers Safety File shall be kept and maintained during the design. All design criteria adopted, and safety & health information required for the Safety File shall be kept in this file which is maintained by the HSF and is the pre-cursor to the Safety File. The information required from the Contractor/PSCS for inclusion in the Safety File is specified at tender stage in the Preliminary Safety and Health Plan.

This information from the PSCS & Contractor(s) and the Designers Safety File is used to compile the Safety File in the latter stages of a contract and formally issued to the Client on completion of the contract.

FTC promotes a collaborative approach to health and safety on site where the Client, PSDP, Designers, Contractors and PSCS co-operate with each other and share information. Joint site safety audits and/or walk-downs are carried out as part of this collaboration and safety is monitored and addressed on site on an ongoing basis. The regular safety meetings are held to document this ongoing co-operation, get an over-view of works currently in hand onsite and about to commence and share information.

5.2.5 The Preliminary Safety and Health Plan

In accordance with the requirements of the Safety, Health & Welfare at Work (Construction) Regulations 2013, a Preliminary Safety & Health Plan will be required as part of the design process. This plan will be further developed by the PSCS on appointment and maintained as a live document during construction and commissioning of the proposed development.

The safety and health plan is required to include the following information:

- a general description of the project;
- details of other work activities taking place on site;
- works involving particular risks;
- the timescale for the project and the basis on which the time frame was established;
- conclusions drawn by designers and the PSDP having taken into account the General Principles of Prevention and any relevant Safety and Health Plan or Safety File;
- the location of electricity, water and sewage connections so as to facilitate early establishment of welfare facilities.

In accordance with the PSDP's procedures, the Preliminary Safety & Health Plan for the proposed development should include the following sections and subsections to ensure that the PSCS is aware of the health and safety issues at tender stage and enable them to price accordingly:

Preamble:

1 General Project Information:
  1.1 Title
  1.2 Description of Project
  1.3 Employer
  1.4 Designers/Other Consultants
  1.5 Project Supervisor Design Process
  1.6 Drawings, Specifications and Other Documents
  1.7 Intended Contract Commencement Date
  1.8 Intended Contract Completion Date
  1.9 Basis for Contract Duration
  1.10 Restrictions on Working Hours
  1.11 Notification of Project
  1.12 Termination of the PSCS Appointment

2 The Existing Environment:
  2.1 Site Location
  2.2 Relevant Adjoining Land Uses
  2.3 Site Restrictions
  2.4 Restrictions on Access
  2.5 Hazardous Area Classification
  2.6 Existing Services
  2.7 Ground Conditions
  2.8 Existing Hazards
  2.9 Liaison with Statutory Bodies

3 Other Work Activities:
  3.1 Other Contracts Which May Affect Work
  3.2 Occupation of Site
  3.3 Building Activities
  3.4 Other Work Activities
  3.5 Emergency Procedures in Place on Site

4 Particular and Residual Risks:
  4.1 Works Which Puts Persons at Work at Risk
  4.2 Work Which Puts Persons at Risk from Chemical or Biological Substances
  4.3 Work with Ionising Radiation

- 4.4 Work near High Voltage Power Lines
- 4.5 Work Exposing Persons at Work to the Risk of Drowning
- 4.6 Work on Wells, Underground Earthworks and Tunnels
- 4.7 Work Carried Out by Divers at Work Having a System of Air Supply
- 4.8 Work Carried Out in a Caisson with a Compressed Air Atmosphere
- 4.9 Work Involving the Use of Explosives
- 4.10 Work Involving the Assembly or Dismantling of Heavy Prefabricated Components
- 4.11 Work Involving Hazardous Material
- 4.12 Residual Risks

5 Additional Information:
- 5.1 Existing Documents
- 5.2 Site Possession
- 5.3 Site Rules
- 5.4 Site Specific Safety Objectives
- 5.5 Phasing of Works
- 5.6 Permits/Authorisation Required
- 5.7 Maintenance
- 5.8 Continuing Liaison
- 5.9 Specific Recommendations

6 Information Required for Safety File:
- 6.1 Information Required for Safety File from PSCS

5.2.6 The Management of Health and Safety during the Construction Phase

The selection criteria for the Contractor for the works will be based on the ability to construct the works in a manner that will not endanger the safety, health and welfare of any parties and competence to fulfil the role of PSCS.

The contract will be awarded on the basis of assessment of the candidates against relevant health and safety criteria including experience of similar projects, knowledge of the construction processes involved and training of their management and staff who will be involved in carrying out the works.

5.2.7 The Construction Stage Safety and Health Plan

In accordance with the requirements of the Safety, Health & Welfare at Work (Construction) Regulations 2013, the preliminary Safety & Health Plan prepared by the PSDP will be further developed by the PSCS before the commencement of the construction work and updated on a regular basis during the construction phase of the project.

The document will include the following sections and subsections to ensure the management of health and safety during the construction phase of the project:

1. Description of Project:
    - project description and programme details
    - details of client, PSDP and PSCS, designers
    - main contractor and other consultants
    - extent and location of existing records and plans
    - arrangements for communicating with Contractors, PSDP and others as appropriate

2. Communication and Management of the Work:
    - management structure and responsibilities
    - safety and health goals for the project and arrangements for monitoring and review of safety and health performance

- arrangements for:
    - regular liaison between parties on site
    - consultation with the workforce
    - the exchange of design information between the Client, Designers, Project Supervisor for the Design Process, Project Supervisor Construction Stage and Contractors on site
    - handling design changes during the project
    - the selection and control of contractors
    - the exchange of safety and health information between contractors
    - security, site induction, and on-site training
    - welfare facilities and first aid
    - the production and approval of risk assessments and method statements
    - the reporting and investigation of accidents and other incidents (including near misses)
- site rules
- fire and emergency procedures

3. Arrangements for Controlling Significant Site Risks:

- safety risks
    - services, including temporary electrical installations
    - preventing falls
    - work with or near fragile materials
    - control of lifting operations
    - dealing with services (water, electricity and gas)
    - the maintenance of plant and equipment
    - poor ground conditions
    - traffic routes and segregation of vehicles and pedestrians
    - storage of hazardous materials
    - dealing with existing unstable structures
    - accommodating adjacent land use
    - other significant safety risks

- health risks:

    - dealing with contaminated land
    - manual handling
    - use of hazardous substances
    - reducing noise and vibration
    - other significant health risks

The construction stage safety and health plan will be maintained on site by the PSCS and will be communicated to all relevant parties on an ongoing basis through inductions, site safety meetings and tool box talks etc. as required.

6. OUTLINE EMERGENCY RESPONSE PLAN

6.1 Introduction

This chapter of the Outline CEMP presents an Outline Emergency Response Plan for the contractor during the construction phase proposed Knockharley Landfill development. The Emergency Response Plan shall be finalised in accordance with this Outline plan following the appointment of the contractor for the main construction works and following detailed design development. There is an existing Emergency Response Plan for the operational licensed facility as approved by the EPA.

This Outline Emergency Response Plan contains predetermined guidelines and procedures to ensure the safety, health and welfare of everybody involved in the project and to protect the environment during the construction phase of the proposed development. This outlines the immediate response to an emergency or disaster situation and will be developed by the main construction works contractor and PSCS as part of their construction stage Safety and Health Plan.

An emergency is any disruptive or harmful event that endangers people, environment, property or assets. Emergencies can be small, as in a fire contained by employees using firefighting equipment or large, as in a disaster resulting from a storm.

In the context of the proposed development at the Knockharley Landfill, examples of Emergency Response Plan emergency events are:

- medical emergency
- explosion
- overheated equipment
- chemical and fuel spill
- fire
- loss of power
- vehicle incidents

Example sources of emergency or disaster events are:

- unstable/inappropriate stockpiles on site
- faulty or incorrect use of equipment
- falls from height
- smoking
- storm/adverse weather
- power failure
- fuel spill
- road failure
- serious vehicle collisions or overturning

6.2 Emergency Response Plan

An emergency response plan deals with the immediate physical effects of a disaster and outlines the initial response.

6.2.1 Emergency Response Liaison

The contractor/PSCS will designate an individual to serve as the Emergency Response Liaison for this project. The emergency response liaison will coordinate the emergency response for the duration of any emergency at or nearby the project site.

Meath County Council, An Garda Síochána and the HSE Ambulance Co-ordinator will be provided with the construction programme and the onsite contact information from the Emergency Response Liaison prior to construction.

The Emergency Response Liaison will be immediately reachable at all times during project construction. The Liaison will coordinate with the above agencies to establish emergency procedures for access to and within the site in the event of an emergency.

6.2.2 Reporting Emergencies

In the event of fire, storm, flood, serious injury or other emergency, contact:

ALL ON SITE EMERGENCIES DIAL 999

6.2.3 Designated Responder

A map depicting the location with the emergency meeting point will be furnished to Meath County Fire & Rescue Service and HSE ambulance co-ordinators.

Upon arrival on the scene, the senior EMS Officer will set up the incident command structure. The Emergency Response Liaison and all contractor's personnel will cooperate with directions of the incident commander and assist as directed.

The nearest emergency services, ambulance and Accident & Emergency (A&E) facilities are:

Service:	Contact Details:	
Accident & Emergency (A&E)	Our Lady of Lourdes Hospital, Drogheda	041 983 7601
Ambulance Service	Dial 112 or 999	
Fire Services	Dial 112 or 999	
Garda Station	Slane Garda Station	041 982 4202

Each member of the contractor's site team who are First-Aid and Cardiopulmonary Resuscitation (CPR) trained personnel will be identifiable with a hard hat sticker indicating their training.

6.2.4 Emergency Alarm

The emergency alarm will be raised on site as soon as an emergency situation is detected, the alarm will be identified (contractor to check those that apply):

Air Horn		**Radio**		**Voice**		**Hand Signals**		**Siren**	

6.2.5 Emergency Reporting

In the event of an emergency the nearest supervisor with radio equipment/mobile phone will be notified. The degree of emergency will be reported to the Emergency Response Liaison who will contact the Emergency Services and request the appropriate emergency service.

6.2.6 Medical Protocol

In the event of a major medical emergency, the emergency centre (999) will be notified and an ambulance and emergency medical team will respond to the scene. All major medical cases require professional (ambulance) transportation. In the event of a minor medical case, the affected employee can be transported via company vehicle in the escort of a foreman or site engineer (with first aid training).

6.2.7 Emergency Response

Upon notification, the Emergency Response Liaison will respond to the emergency scene and manage emergency operations:

1. Assess hazards and make the area safe – If you cannot enter the area without risking your safety, don’t do it, call the Emergency Services immediately and wait for them. If you think you can safely enter the area, look around the emergency scene for anything that can be dangerous or hazardous to you, the casualty, or anyone else at the scene. Bystanders can help with making the area safe. First aid kits will be available on site. Operators that have been first aid/CPR/AED trained will be listed on site and easily identifiable by a hard hat sticker.

2. Take charge of the situation – if you are the first-aid provider on the scene act fast. If someone is already in charge, briefly introduce yourself and see if that person needs any help. If there is any chance the casualty could have a head or spinal injury, tell them not to move.

3. Get Consent – always identify yourself as a first-aid provider and offer to help. Always ask for consent before touching a conscious adult casualty and always ask for consent from a parent or guardian before touching an unconscious or conscious child or infant. With an unconscious adult casualty consent is implied as it is generally accepted that most people want to live. Remember to protect yourself first by wearing gloves and eye protection.

4. Assess Responsiveness – is the casualty conscious or unconscious? Note their response while you are asking them for their consent. If they respond, continue with the primary survey, and if they don’t respond, be aware that an unconscious casualty is or has the potential of being a breathing emergency.

5. Call out for help – this will attract bystanders. Help is always useful in an emergency situation. Someone can be called over the phone for medical help. Others can bring blankets if needed, get water, etc. A bystander can help with any of the following:

- Make the area safe.
- Find all the casualties.
- Find the first aid kit, or any useful medical supplies.
- Control the crowd.
- Call for medical help.

- Help give first aid, under your direction.
- Gather and protect the casualty's belongings.
- Take notes, gather information, be a witness.
- Reassure the casualty's relatives.
- Lead the ambulance attendants to the scene of the emergency.
- Notify Emergency Services as soon as you can. Either send a bystander or call yourself.

In the event of a major medical emergency, the Emergency Response Liaison, as the person-in-charge of the emergency scene, will dispatch someone to the site access point nearest the emergency scene to direct and lead arriving outside responders to the emergency scene.

The designated meeting point will be agreed prior to the commencement of construction. Emergency personnel will be met at this meeting point which has been communicated by management during the 999 call. The emergency personnel escort will use the hazard lights on their vehicle so they are easily identified.

6.2.8 Escape and Evacuation Procedure

Dependent upon the degree of the emergency and if safe to do so, employees will evacuate to the designated assembly area where the designated wardens shall account for all employees and determine if anyone still remains within the emergency scene.

Should a wild land fire or peat slippage occur, and the designated assembly area is compromised, other locations will be designated as secondary assembly areas.

6.2.9 Prevention of Illness/Injury due to Weather/Elements

1. All employees will have access to shelter and heat in the event of inclement weather.
2. Employees will have access to at least a litre of water at all times.
3. Weather forecast will be discussed every morning with the crews. Weather conditions and forecast will be monitored regularly by management.
4. No Employee will work alone. A buddy system will be used so employees can contact a supervisor in case of an emergency.

6.2.10 Environmental Emergency Procedure

An emergency preparedness and response procedure is required to prevent environmental pollution incidents. Emergency Silt Control and Spillage Response Procedures are included in Section 4.3.2 of this Outline CEMP.

Suitable spill kits and absorbent material for dealing with oil spills will be maintained on site. In the event of pollution or potential risk of pollution, the Local Authority should be informed immediately.

6.2.11 Emergency Response Plan – Haul Routes

Emergency Response Procedure relating to transportation of plant, equipment and materials to the site will be developed by the main contractor during the construction phase of the development.

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[i] www.met.ie

Appendix 2.1

Glossary of Terms

Appendix 2.1 Glossary of Terms

Acid Scrubber is an air-stream pollution control device which uses liquid spray to remove solid and liquid particulate matter (which washes out) and gaseous pollutants (which are either absorbed or chemically neutralized), in particular acidic off gases.

Aerobic A condition in which elementary oxygen is available and utilised in the free form by bacteria.

Anaerobic condition in which oxygen is not available in the form of dissolved oxygen or nitrate/nitrite.

Anchor Trench a trench where the ends of geosynthetic materials are embedded and suitably backfilled.

Aftercare Any measures that are necessary to be taken in relation to the facility for the purposes of preventing environmental pollution following the cessation of the activity in question at a facility.

Basal Lining the lining at the base of a cell.

Biodegradable In the context of waste, this means waste that is capable of undergoing anaerobic or aerobic biological decomposition, such as food and garden waste, paper and cardboard.

Bio-filtration is a technique for pollution control using living organisms such as bacteria to capture and biologically degrade pollutants.

Biological Processing or Treatment means composting, anaerobic digestion, mechanical-biological treatment or any other biological treatment process for stabilising and sanitising biodegradable waste, including pre-treatment processes. See waste stabilisation.

Bio-stabilised Waste/Stabilised Waste Residual biodegradable municipal waste that has been treated to achieve an EPA approved biodegradability stability standard prior to landfilling or alternative agreed use. See Waste Stabilisation.

Bund / Bunded a structure designed to contain the contents of a tank or container within the bund in the event of a spill or leak.

Capping is the covering of a landfill, usually with low permeability material (Landfill cap).

Composting The autothermic and thermophilic biological decomposition of separately collected biowaste in the presence of oxygen in order to produce compost.

Condensate Knock-out Pot A pot to facilitate removal of liquid condensate which forms when warm landfill gas cools during transport or processing (such as compression).

C&D Construction and Demolition Waste All waste that arises from construction and demolition activities (including excavated soil from contaminated sites). These wastes are listed in chapter 17 of the European waste catalogue (EWC).

C&D Soil and Stones are non-hazardous soils and stones arising from construction and demolition related sources.

Daily Cover (in the context of landfilling) is the term used to describe material (about 150 mm if soil cover is used) spread over deposited waste at the end of each working day. Appropriate synthetic materials may also be used.

EX Rated equipment refers to equipment that has been classified as safe for use in hazardous, potentially flammable or explosive areas, which are often referred to as "Ex areas.".

Final Capping Refers to the provision of a permanent capping system across the top of deposited waste to act as a barrier and restoration layer between the waste body and the external environment. The design details of any final capping system should be in accordance with published EPA Guidance and any specific requirements outlined in an EPA licence.

Fines Refers to the small-sized fraction of waste that is mechanically separated from a mixed-sized waste stream by means of passing it through a screen (such as a trommel) during a waste processing activity. Fines are typically segregated from a mixed waste stream after an initial shredding, agitation or crushing pre-step. There is no set or uniform screen size used by all operators to generate fines. Depending on the origin or nature of the waste from which the fines are generated, they may be specifically described by the operator as organic fines, C&D fines, inert fines or by some other name.

Flare a device used for the combustion of landfill gas thereby converting its methane content to carbon dioxide.

Geocomposite a composite material used as a geomembrane.

Geomembrane is a flexible membrane liner.

Geotextile a textile material used as a geomembrane.

Hermetic Seal is a seal which is air tight.

Incinerator Bottom Ash (IBA) is the non-hazardous ash produced in incineration facilities following the combustion process.

Industrial Emissions (IE) Licence a licence to carry out an industrial emissions directive (2010/75/EU) activity. Issued by the EPA.

Inert Waste Waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in any way likely to give rise to environmental pollution or harm human health.

Intermediate Capping is temporary synthetic low-permeability covers

Landfill Directive A Directive which aims, by means of stringent operational and technical requirements on the landfilling of waste, to implement measures, procedures and guidance to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, ground water, soil and air, and on the global environment, including the greenhouse effect, as well as any resulting risk to human health, during the whole life cycle of the landfill.

Landfill Gas (LFG) All gases generated from the landfilled waste.

Landfill Liner a low permeability barrier installed to impede the flow of leachate, groundwater and landfill gas.

Leachate Any liquid percolating through the deposited waste and emitted from or contained within a landfill as defined in Section 5(1) of the WMA.

LLDPE linear low-density polyethylene

'Monofill' the filling of a landfill cell with only one type of waste.

Municipal Solid Waste (MSW) Household waste as well as commercial and other waste that, because of its nature or composition, is similar to household waste. It excludes municipal sludges and effluents. In the context of this report municipal waste consists of three main elements – household, commercial (including non–process industrial waste), and street cleansing waste (street sweepings, street bins and municipal parks and cemeteries maintenance waste, litter campaign material).

Municipal Solid Waste 'fines' (MSW fines) see Fines derived from MSW

Organic Waste Biodegradable food, garden and landscaping waste, and where the context permits, will also include industrial organic sludges (e.g. from the food and drink production sector).

Residual Municipal Waste The fraction of municipal waste remaining after the source separation of municipal waste fractions, such as food and garden waste, packaging, paper and paperboard, metals and glass, which is usually unsuitable for recovery or recycling.

Residual Non-stabilised Waste is residual MSW material with a biodegradable fraction, originating from household, commercial and industrial waste collections

Residual Waste The fraction of collected waste remaining after treatment and/or diversion steps, which generally requires further treatment or disposal.

Stable Non-Reactive Hazardous Waste(SNRHW) certain hazardous waste is suitable for disposal in non-hazardous landfills: so called SNRHW. Article 6(c)(iii) of Council Directive 1999/31/EC on the landfill of waste specifies those wastes which may be accepted in a non-hazardous landfill and allows for certain hazardous wastes to be deposited provided they are stable and non-reactive.

> *(c) [a] landfill for non-hazardous waste may be used for:*
>
> *(i) municipal waste;*
>
> *(ii) non-hazardous waste of any other origin, which fulfil the criteria for the acceptance of waste at landfill for non-hazardous waste set out in accordance with Annex II;*
>
> *(iii) stable, non-reactive hazardous wastes (e.g. solidified, vitrified), with leaching behaviour equivalent to those of the non-hazardous wastes referred to in point (ii), which fulfil the relevant acceptance criteria set out in accordance with Annex II. These hazardous wastes shall not be deposited in cells destined for biodegradable non-hazardous waste,*

Surface Impoundment the treatment, storage or disposal of wastes within a topographic depression.

Surface Water Attenuation Pond

Swales are vegetated channels over which flows are conveyed at low non-erosive velocities.

Waste Defined as any substance or object which the holder discards, intends to discard or is required to discard, by the Waste Framework Directive (2008/98/EC).

Waste Cell The compartment within a landfill in which waste is deposited: The cell has physical boundaries, which may be a low permeability base, a bund wall and a low permeability cover.

Waste Stabilisation means the reduction of the decomposition properties of the biodegradable fraction of waste to such an extent that offensive odours are minimised and that the Respiration Activity after four days (AT4) is <7 mg O_2 /g DM thereafter

Weathering (in the context of IBA processing) an exothermic process whereby silica, calcium, aluminium and sulphate minerals along with heavy metals in the presence of carbon dioxide and water undergo complex physio chemical carbonation (and other) processes.

APPENDIX 5.1

Records of Consultation Documentation and Responses - October 2016

FEHILY
TIMONEY
& COMPANY

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

IRELAND **UNITED KINGDOM** **POLAND** **SAUDI ARABIA**

Our Ref: LW14/821/01/ConLet/DFM/CF

Mr. Eoin McDonnell
Planning & Environmental Department
Failte Ireland
88-95 Amiens Street
Dublin 1

25 October 2016

RE: Proposed development at Knockharley Landfill, Kentstown, Co. Meath

Dear Mr. McDonnell,

Knockharley Landfill Ltd. is applying to An Bord Pleanála (ABP), under the Strategic Infrastructure provisions of the 2000 Planning & Development Act, as amended, for permission to intensify waste acceptance at the existing landfill facility (ABP File ref: PL17.PC0223).

You may have received correspondence relating to previously proposed development at this facility in 2015 – these development applications did not proceed at the time.

Knockharley Landfill is located approximately 1.5 km north of Kentstown village, Co. Meath in the functional area of Meath County Council. The existing landfill facility operates under an Industrial Emission Licence (Ref. No. W0146-02) from the Environmental Protection Agency.

Knockharley Landfill Ltd. has appointed Fehily Timoney and Company to prepare an Environmental Impact Statement (EIS) for the proposed development. This letter is being issued to you as part of the scoping process for the EIS.

A scoping document describing the proposed development and the approach being taken to the preparation of the EIS is enclosed.

As part of the consultation process, we would be interested in receiving any comments you may have on the proposed development, relevant to your area of expertise, within two weeks of the date of this letter.

If you have no comments to make, we would be grateful if you would please acknowledge receipt of this letter.

Comments or acknowledgements can be sent via email to knockharleylandfillscoping@ftco.ie.

Yours sincerely,

Derek Milton
for and on behalf of **Fehily Timoney & Company**

ACEI
Association of Consulting Engineers of Ireland
Cumann Innealtóirí Comhairle na hÉireann

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Gerry O'Sullivan John Nolan Sarah Toal Stephen Byrne Tina Raleigh
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KNOCKHARLEY LANDFILL

ENVIRONMENTAL IMPACT STATEMENT - SCOPING REPORT FOR PROPOSED DEVELOPMENT

OCTOBER 2016

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1 INTRODUCTION

1.1 Applicant

The applicant is Knockharley Landfill Limited who is the owner and operator of the facility located in County Meath. The facility was developed and previously owned and operated by Greenstar North East Limited. The site was acquired by Knockharley Landfill Limited in March 2014.

1.2 The Development in Summary

Knockharley Landfill is located approximately 1.5 km north of Kentstown village, Co. Meath in the functional area of Meath County Council. The existing landfill operates under an Industrial Emissions Licence (Licence reference no. W0146-02) from the Environmental Protection Agency which permits the acceptance of up to 200,000 tonnes per annum (tpa) of waste, of which 175,000 tonnes is disposal capacity and 25,000 tonnes is recovery. Condition 3 of the planning consent (PL17.220331), restricted the disposal capacity at the facility to 132,000 tonnes per annum until December 2010, thereafter reducing to 88,000 tonnes per annum.

It is proposed to apply for consent to increase waste intake at Knockharley Landfill to up to 440,000 tpa for recovery and disposal. The development proposal includes the following recovery and disposal activities:

1. landfilling of residual non-hazardous waste and non-hazardous soils
2. storage of incinerator bottom ash (IBA) to facilitate future recovery

The proposal will require the development of a dedicated storage area for IBA, in addition to the existing permitted landfill footprint. The proposed layout of the storage activity is shown on Figure 1: Drawing INFO-001. No changes are proposed to the current permitted landfill footprint. In order to increase the void capacity within the existing landfill footprint, it is proposed to raise the final profile of the landfill by up to 10-12 m.

In addition, the footprint of the existing leachate management area, which comprises a covered lagoon, will be increased to facilitate installation of a leachate treatment plant for pre-treatment of leachate generated from the landfill, prior to its removal offsite, as currently occurs.

To facilitate soils management onsite, as well as to mitigate potential impacts associated with noise and visual impact, it is also proposed to create a number of screening berms at a number of locations on the facility perimeter.

It is proposed to construct a 40 m^2 building on site to facilitate the short term storage of baled waste and/or the recovery of metals from ash.

1.3 Planning Process for the Proposed Development

1.3.1 Strategic Infrastructure

The Planning and Development Act 2000 was amended in 2006 to require applications for planning permission for major infrastructure projects to be made directly to An Bord Pleanála rather than to the local planning authority, as would have previously been the case.

In order to fall within the Strategic Infrastructure provisions of the 2000 Act, as amended, a proposed development must be, *inter alia*, of a class specified in the Seventh Schedule to the Act and satisfy one or more of the conditions of Section 37A (2) of the Act. The applicable class in this case is in Part 3 of the Seventh Schedule, as amended, which specifies, *inter alia*, the following class of development:

- *"An installation for the disposal, treatment or recovery of waste with a capacity for an annual intake greater than 100,000 tonnes."*

The conditions in Section 37A (2) are that:

> 37A (2) “*following consultations under Section 37B, the Board serves on the prospective applicant a notice in writing under that section stating that, in the opinion of the Board, the proposed development would, if carried out, fall within one or more of the following paragraphs, namely—*
>
> *(a) the development would be of strategic economic or social importance to the State or the region in which it would be situate,*
>
> *(b) the development would contribute substantially to the fulfilment of any of the objectives in the National Spatial Strategy or in any regional spatial and economic strategy in force in respect of the area or areas in which it would be situate,*
>
> *(c) the development would have a significant effect on the area of more than one planning authority.”*

In July 2016, Knockharley Landfill Limited wrote to An Bord Pleanála to formally request a pre-application consultation meeting under Section 37B of the Planning and Development Act 2000, as amended, in respect of their existing development in County Meath. This pre-application consultation process is being undertaken under reference PL17.PC0223.

Under Section 37E of the Act, a planning application for a development which comes within the scope of Section 37A must be accompanied by an Environmental Impact Statement (EIS). Fehily Timoney & Company has been commissioned to prepare the EIS. This scoping document has been prepared to inform the preparation of the EIS.

Screening will be undertaken to determine if an Appropriate Assessment (AA) of the proposed development at Knockharley Landfill is required. If the screening assessment indicates that an AA is required, a Natura Impact Statement will be prepared and submitted to accompany the planning application and EIS.

1.4 Environmental Impact Assessment and the Function of the EIS

The European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, requires member states to ensure that a competent authority carries out an appraisal of the environmental impacts of certain types of project, as listed in the Directive, prior to development consent being given for the project. Knockharley Landfill is such a project. The environmental impact assessment of the proposed development at Knockharley Landfill will be undertaken by An Bord Pleanála, should the project be deemed as strategic infrastructure.

The EIS, to be submitted with the planning application for the development, will provide information on the possible environmental impacts of the project and propose mitigation measures to reduce the residual impacts. Thus the function of the EIS is to provide information for the environmental impact assessment.

1.5 Purpose of Scoping

The purpose of the EIS scoping process is to identify the issues which are likely to be important during the environmental impact assessment and to eliminate those that are not. The scoping process will identify the sources or causes of potential environmental effects, the pathways by which the effects can happen, and the sensitive receptors which are likely to be affected. The issues identified in the scoping process will be examined in the EIS, any potential impacts will be quantified, mitigation measures proposed as required, and residual impacts described. The scoping process will also identify the appropriate level of detail for the information to be provided in the EIS.

There is provision in the legislation for formal scoping of an EIS. The person preparing the EIS can request the competent authority, in this case An Bord Pleanála, to provide a written opinion on the information to be contained in the EIS. The applicant must provide sufficient information on the project to allow informed opinions to be given. The competent authority can request additional information from the applicant.

When sufficient information has been obtained, the competent authority seeks a written opinion from the statutory consultees. Upon receipt of these opinions, the competent authority issues its formal opinion to the applicant. Giving a formal scoping opinion does not preclude the competent authority from requiring further information at a later stage.

The alternative to formal scoping is informal scoping. This can be undertaken by the authors of the EIS by direct consultation with the relevant statutory and non-statutory consultees. Informal scoping is proposed for the EIS for Knockharley Landfill.

1.6 Consultation

A consultation process is being undertaken by Knockharley Landfill Limited and the EIS team. This will include liaising with relevant departments of the local planning authority, Meath County Council.

It is also the intention of the applicant to undertake public consultation and details of this consultation will be included in the EIS.

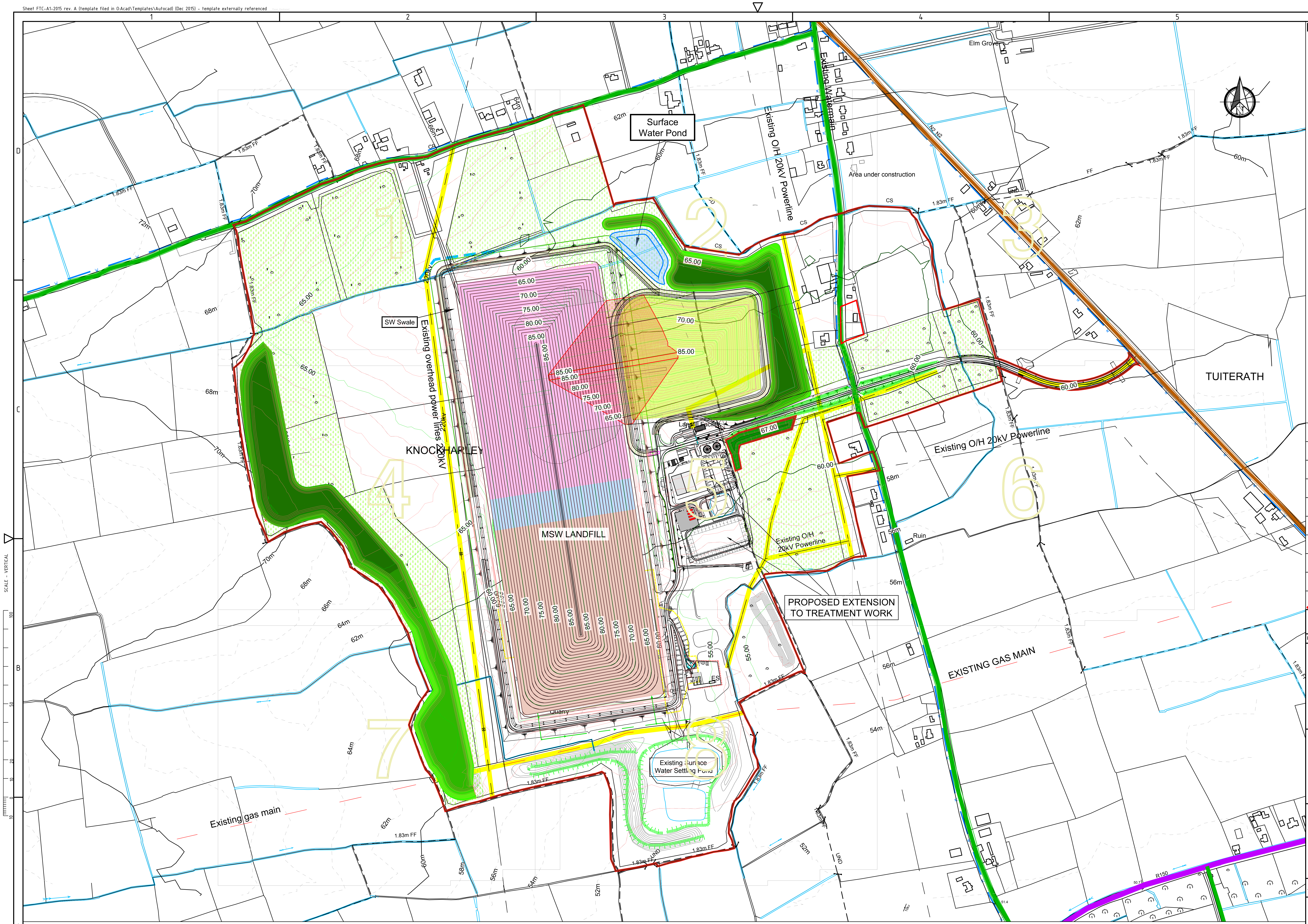
Article 28 of the Planning and Development Regulations (as amended) requires that certain bodies are contacted depending on the nature of the potential impacts of a development. Consequently, consultation letters will be sent to the relevant prescribed bodies (as defined in Article 28 of the Planning and Development Regulations as amended) as well as non-governmental organisations (NGOs) and local stakeholders.

This scoping document will be sent to the organisations listed below:

- Meath County Council – Planning
- Meath County Council – Environment
- An Taisce
- Failte Ireland
- Teagasc
- The Heritage Council
- Dublin Airport Authority
- Development Application Unit, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs
- Inland Fisheries Ireland – Eastern River Basin District
- Irish Wild Life Trust
- Transport Infrastructure Ireland
- Irish Geological Heritage Programme
- Environmental Health Department,
- Eastern & Midlands Regional Assembly
- Irish Water
- Office of Public Works (OPW)
- Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs –National Parks and Wildlife Service
- An Chomhairle Ealaíon
- Department of Communications, Climate Action and Environment
- Department of Agriculture, Food & Marine
- National Transport Authority
- Meath County Development Board
- Eastern-Midlands Region Waste Management Office
- Environmental Protection Agency
- Kentstown Village Project
- Knockharley and Districts Residents Association
- Knockharley Landfill Liaison Committee
- Department of Housing, Planning, Community and Local Government

Comments on the scope of the EIS can be submitted by email to knockharleylandfillscoping@ftco.ie

Sheet FTC-A1-2015 rev. A (template filed in O:Acad\Templates\Autocad) (Dec 2015) - template externally referenced



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LEGEND

🟥	Planning Boundary
🟨	Existing Wayleave
— — —	Finished Ground Contour
🟧	National Primary Route
🟪	National Regional Route
🟩	National County Route
🟦	Landfill Cells currently being filled
▨	Constructed Landfill Cells
▨	Proposed Future Landfill Cells
▨	Proposed Screening Berms
▨	Existing Watercourse
▨	Existing Forested Areas

Rev.	Drawn	Chk'd	App'd	Rev Origin / Date	Description
A	AR	CC		Cork	Issue For Planning Application

Revision History A

PLANNING + EIS

Name of Client

KNOCKHARLEY LANDFILL LTD.

Name of Job

PROPOSED DEVELOPMENT AT KNOCKHARLEY LANDFILL

Title of Drawing

PROPOSED SITE LAYOUT PLAN

Scales Used
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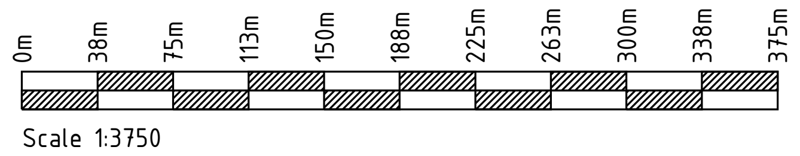

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ORIGINAL DRAWING SIZE A1 - (841 x 594)

2 PROJECT DESCRIPTION

2.1 Existing Development

The existing facility comprises a non-hazardous disposal site (landfill). It is located on a 135 hectare land holding with the existing landfill footprint positioned near its centre. The current planning permission (PL17.220331) permits the development of approximately 25 ha of landfill cells in seven phases. To date, four of the seven planned phases have been constructed. Phase 1 has been permanently capped. Phase 2 and 3 has part permanent and part intermediate capping (temporary). Phase 4 is partly filled and has both daily and intermediate capping. Permanent capping of the remainder of Phase 2 and part of Phase 3 has commenced and is due to be completed by year end.

The facility was designed, constructed and is being operated in accordance with the EU Landfill Directive 1999/31/EC, EPA Industrial Emissions Licence (W0146-02) and EPA manuals on landfill selection, design, operation and monitoring and its relevant planning permissions.

The landfill opened in December 2004 and accepts residual household, commercial and industrial wastes together with construction & demolition (C&D) wastes and incineration bottom ash (IBA). The site is licensed to operate from 07:30 to 18:30 Monday to Saturday inclusive and is licensed to accept waste between 08:00 and 18:00 (excluding public holidays).

The existing buildings on the site comprise an administration building, two weighbridges, inspection slab, quarantine slab, machinery/maintenance garage, car parking and other facilities. These are located within the buildings area to the east of the landfill cells.

The landfill is connected to the national primary route, the N2, by a private dedicated access road via an underpass under the regional road CR384. Waste arriving at the facility enters the site via this private dedicated access road.

The daily operation of the landfill facility is monitored as required under the Industrial Emissions Licence and consists of a number of monitoring programmes that address groundwater and surface water quality, leachate and landfill gas management, air emissions, VOC, noise, odour and dust deposition. The frequency of monitoring of the different environmental parameters is set out in the licence with a requirement to submit all the monitoring data from the facility to the EPA. Environmental monitoring data is reported to the EPA on a biannual and annual basis. Any non-compliances, incidents or complaints are reported by the next working day following occurrence.

Environmental management facilities on-site include:

- Leachate management system
- Landfill gas management system
- Surface water management system

2.1.1 Leachate Management System

Leachate that gathers in the base of filled cells is collected via a system of pipework, laid in a 'herringbone' fashion within the granular material laid on the cell floors. Electricity- powered leachate pumps are located in the low points of the cells, and leachate is pumped from here to the on-site leachate storage lagoon. The lagoon itself is covered with a floating cover to minimise water ingress and odour emissions. Leachate is tankered from this lagoon to an off-site waste-water treatment facility.

2.1.2 Landfill Gas Management System

Landfill gas is extracted from all active and filled cells via vertical and horizontal gas wells and pipework. Gas extraction commences from each cell once sufficient waste has been placed to prevent air infiltration into the gas extraction system. In addition, temporary extraction pipes are installed at the landfill working face to further enhance gas collection. A slotted horizontal gas collection pipe is also installed at the top of the cell side-slopes to intercept any gas travelling up the cell embankments.

Landfill gas is fed from the cells to the utilisation compound just east of the landfill footprint and north of the surface water lagoon. This compound contains three enclosed flares and four landfill gas engines. The latter generate electricity for export to the Irish national grid. The landfill gas utilisation plant is operated by Bioverda Power Systems Ltd., under contract from Knockharley Landfill Ltd. There is a flare dedicated to the management of poor quality landfill gas generated in the active area.

2.1.3 Surface Water Management System

Drainage from adjoining lands onto the site is directed around the property and flows into the local drainage network at the southern boundary of the facility.

Surface water from the landfill is drained via the main landfill swale to a purpose-built storm water attenuation pond and constructed wetland. The storm water attenuation pond is lined with an engineered lining system, comprising a HDPE membrane (permeability 1 x 10^{-9}m/s) and a layer of engineered clay to the same specification as the landfill cells. The constructed wetland comprises a shallow clay-lined pond both naturally colonised and planted with appropriate species. The outflow from the constructed wetland flows into the Knockharley Stream local drainage network at the south-eastern corner of the site.

Surface water arising from all roads and hardstandings is diverted to the main surface water sewer. This surface water sewer discharges to the surface water pond via a full retention oil interceptor and stilling chamber.

2.1.4 Cell Lining System

The deposited waste is fully contained through the use of a 1m thick clay basal liner with a permeability of 1 x 10^{-9}m/s and a composite high-density polyethylene (HDPE) membrane, complying with both the EU Landfill Directive and with the licence conditions. Placed waste is compacted immediately and covered daily to limit wind-borne litter and other nuisances.

The clay component of the basal lining system is won from material excavated during the construction of the cells. The clay is screened and subsequently placed and compacted in layers, to achieve the required degree of permeability, in compliance with the licence. The cells are then lined with a 2 mm thick HDPE geomembrane. The liner is textured on the side-slopes and smooth on the cell floors. The cell floors fall to low points equipped with leachate pumps. The composite barrier layer is protected against mechanical damage using a protective geotextile overlain by drainage stone on the floor and using a protective geotextile on the side slopes. The construction of the landfill liner system is subject to independent quality assurance testing and controls approved by the EPA.

2.1.5 Landfill Capping System

As part of ongoing operations at the site, the active area of the landfill is covered with daily cover. Near-horizontal areas of the working face are covered with soil and woodchip, the slope of the working face is covered with synthetic cover sheets at the end of each working day. Temporary low-permeability cover is installed as areas of the landfill reaches full height.

Phase 1 final capping at Knockharley Landfill consisted of 12,500m^2 of capping predominantly over Cells 1 and 2 and was undertaken in 2008/2009.

Phase 2 final capping consisted of 16,500m^2 of capping over the remaining areas above Cells 1, 2, 3 and 4. This work was undertaken during 2012.

Phase 3 capping at Knockharley Landfill consisted of final capping of 26,500m^2 over Cells 5 and 6. It also extended over part of Cells 7 and 8. This work was undertaken during 2013. Phase 4 capping is underway consisting of final capping over Cells 7 to 10.

The fully engineered final cap comprise a gas collection layer, a 1 mm fully welded linear low-density polyethylene (LLDPE) liner, sub-surface drainage layer, subsoil layer and topsoil layer. The overall thickness of the soil layers is 1 m in accordance with the requirements of the waste licence.

2.2 Proposed Development

It is proposed to increase the waste intake at the facility to up to 440,000 tpa for disposal and recovery, comprising the following waste management processes:

1. Landfilling of residual non-hazardous waste and non-hazardous soils
2. Storage of incinerator bottom ash (IBA) to facilitate future recovery

2.2.1 Landfilling of residual non-hazardous waste and non-hazardous soils

Landfilling of residual non-hazardous waste and non-hazardous soils is currently undertaken at the facility and the proposed development will see an increase in tonnage of these materials to be accepted for disposal and recovery at the site. This increase will be accommodated within the current permitted landfill footprint, and proposed to raise the final profile by up to 10-12 m.

2.2.2 Storage of IBA

It is proposed to develop a dedicated area for the storage of incinerator bottom ash (IBA). This area will be developed as a 'land raise' concept and will comprise shallow cells constructed in accordance with the requirements of the Landfill Directive, as well as leachate collection and gas venting infrastructure, site access roads, covered leachate lagoon and all ancillary and associated works.

The indicative footprint of this area is shown in Figure 1.

2.2.3 Building

It is proposed to develop a 40 m^2 building to facilitate the following activities:

- temporary storage of baled non-hazardous residual waste
- recovery of metals from IBA

The temporary storage of baled waste is proposed in response to a market identified requirement for capacity of this nature, as it provides contingency in terms of scheduling baled waste export shipments, as well as providing contingency during maintenance or unforeseen downtime experienced at energy from waste facilities.

2.2.4 Tonnages for acceptance

Up to 440,000 tonnes of material may be accepted at the facility per annum. Table 2.1 identifies potential tonnages of input materials and means of management of same.

Table 2.1: Potential Tonnages for acceptance

Waste Type	Input tonnage	Means of Management
Non-hazardous residual waste and non-hazardous soils	up to 290,000 tpa	Disposal within existing footprint & recovery through approved means e.g. daily and intermediate cover etc., temporary baled waste storage
Incinerator Bottom Ash	up to 150,000 tpa	Recovery/disposal through storage within dedicated area

2.2.5 Leachate treatment infrastructure

It is also proposed to augment the existing leachate storage lagoon through the installation of leachate pre-treatment/conditioning plant in order to reduce the concentration and volume of leachate being consigned from site for treatment at offsite wastewater treatment facilities.

Specialised plant (likely to be membrane bioreactor or reverse osmosis technology) will be installed within housed, enclosed containerised systems on a concrete plinth, with 1-2 further covered lagoons installed to store the separated leachate fractions. Final detail of these systems will be presented in the EIS.

2.2.6 Screening Berm development & and Ancillary development

In order to facilitate the management of soils onsite, won from the development of the IBA storage area as well as the future development of the currently permitted landfill cells, it is proposed to develop a number of berms at certain locations along the facility perimeter. The installation of these berm will also serve a purpose in terms of mitigation of potential noise impacts and visual impacts. Indicative locations of these berms are shown on Figure 1.

In addition, a second surface_water attenuation lagoon will be installed to the north of the IBA storage area, to facilitate surface_water management from this area, which will discharge to the existing stream.

3 STRUCTURE AND SCOPE OF THE EIS

3.1 Contents of the EIS - Statutory Requirements

The EIS must be prepared in accordance with the Planning and Development Regulations 2001, as amended, which set out the contents of an EIS.

Schedule 6 of the Regulations specifies the information to be contained in an EIS, including the following:

- *"A description of the proposed development comprising information on the site, design and size of the proposed development*
- *A description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects*
- *The data required to identify and assess the main effects which the proposed development is likely to have on the environment, and*
- *An outline of the main alternatives studied by the developer and an indication of the main reasons for his or her choice, taking into account the effects on the environment."*

Information is also required on the following matters:

- *A description of the physical characteristics of the whole proposed development and the land-use requirements during the construction and operational phases*
- *A description of the main characteristics of the production processes, for instance, nature and quantity of the materials used, and*
- *An estimate, by type and quantity, of expected residues and emissions (including water, air and soil pollution, noise, vibration, light, heat and radiation) resulting from the operation of the proposed development."*

Aspects of the environment likely to be significantly affected by the proposed development are also to be described, including in particular:

- *"Human beings, fauna and flora Soil, water, air, climatic factors and the landscape*
- *Material assets, including the architectural and archaeological heritage, and the cultural heritage, and*
- *The inter-relationship between the above factors*."

A description is required of the likely significant effects (including direct, indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative) of the proposed development on the environment resulting from:

- *"The existence of the proposed development,*
- *The use of natural resources, and*
- *The emission of pollutants, the creation of nuisances and the elimination of waste*"

A description is required of the methods used to assess the effects on the environment. A summary in non-technical language of this information is also to be included.

Finally, any difficulties encountered by the developer in compiling the required information should be indicated.

3.2 EIS Methodology

3.2.1 General

The EPA published guidelines on the preparation of environmental impact statements. These are contained in '*Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)*', published in 2003 and '*Guidelines on the Information to be contained in Environmental Impact Statements*' published in 2002. The EIS team will have regard to these guidelines in the preparation of the EIS, as well as the draft revised versions of these guidelines, published for consultation in 2015. The team will also have regard to best practice guidance for individual environmental topics and available Best Available Technique (BAT) conclusion notes.

3.2.2 Mitigation Measures

The central purpose of the EIS is to identify potentially significant adverse impacts at the pre-application stage and to propose measures to mitigate these impacts. The primary mitigation will be by avoidance. Where potential adverse impacts are identified, the element of the proposed development giving rise to the adverse impact will be modified if feasible, to avoid the impact. If impacts cannot be avoided, measures will be incorporated into the project to reduce the adverse impacts to as low as is practicable. Where adverse impacts cannot be prevented, measures will be taken to restore the environment to an approximation of its previous condition or to a new equilibrium.

3.2.3 EIS Structure

There are two different EIS structures which are commonly used and which the EPA guidelines accept as equally valid. The structure, which the EIS team proposes to use for the EIS for the proposed development, is the grouped format structure.

Using this structure there is a separate chapter for each topic, e.g. air and climate, ecology, hydrology. The description of the existing environment, the proposed development and the potential impacts, mitigation measures and residual impacts are grouped in the chapter. The grouped format makes it easy to investigate topics of interest and facilitates cross-reference to specialist studies.

Each of the environmental topics will generally be presented under the following headings:

- Introduction
- Methodology
- Receiving Environment
- Potential Impacts
    - Construction
    - Operation
    - Decommissioning
- Mitigation Measures
    - Construction
    - Operation
    - Decommissioning
- Residual Impacts
- References

The structure proposed for the EIS is as follows:

Volume 1 – Non-Technical Summary (including figures)
Volume 2 - Main EIS
Volume 3 – Appendices for the EIS

4 ENVIRONMENTAL ISSUES TO BE ADDRESSED IN THE EIS

4.1 Background to the Project

The EIS will summarise the nature of the existing development, the planning history associated with the development site, the consultation processes undertaken and the format and structure being followed in the EIS preparation.

4.2 The Need for the Development

The specific need for the proposed development will be outlined identifying the legislative and policy aspects relevant to the wastes proposed for acceptance, the current and likely future generation and capacity demand profiles, as well as alternative management options.

Based on this assessment, the need for the proposed development will be established.

4.3 Alternatives Considered

The alternatives in relation to the proposed development will be considered under the following headings:

- Alternative site layout
- Alternative treatment technologies
- ‘Do-nothing’ alternative

The reasons, including environmental considerations, for choosing the proposed alternatives will be explained.

4.4 Technical Difficulties

Any technical difficulties encountered during the preparation of the EIS will be outlined.

4.5 Scheme Description

A description of all elements of the proposed development will be provided including:

- Construction methods and programmes of work
- Operations
- Restoration and aftercare
- Monitoring, maintenance and reporting.

4.6 Planning and Policy Context

The European, national, regional and local planning and policy context for the project will be addressed with reference to relevant county development and other plans or policies, regional planning guidelines and Government and waste management policy statements including (but not limited to):

- Council Directive 1999/31/EC on the Landfilling of Waste
- Council Directive 2008/98/EC on waste (and repealing certain Directives)
- European Communities (Waste Directive) Regulations 2011
- Waste Management: Changing Our Ways – 1998
- Preventing and Recycling Waste – Delivering Change – a Policy Statement – 2002
- A Resource Opportunity – Waste Management Policy in Ireland – 2012

- Eastern Midlands Region Waste Management Plan 2015 – 2021
- Southern Region Waste Management Plan 2015 – 2021
- Connacht Ulster Region Waste Management Plan 2015 - 2021
- National Spatial Strategy 2020-2020
- The National Development Plan 2007-2013 (revised in 2010 to 2016)
- Regional Planning Guidelines for the Greater Dublin Area 2010-2022
- Meath County Development Plan 2013 – 2019.

The relevant objectives within each of these documents will be summarised and put in context in relation to the proposed development.

4.7 Consultation Programme

Stakeholders, including national and local regulatory bodies, Government agencies, environmental non-governmental organisations (NGOs) and the general public will be provided with information on the project and asked for their comments and concerns. A list will be provided in the EIS of the bodies consulted and a summary will be provided of the queries and concerns expressed.

4.8 Human Environment – Socio Economic, Land Use and Amenity

The main areas that will be examined in this section with respect to the potential effects of the proposed development on the human environment in the area are:

- Settlements & population
- Land use
- Local employment and economic activity
- Transportation network
- Utilities
- Amenity
- Tourism

4.8.1 Assessment Methodology

Data from the Central Statistics Office will be used to define the socio-economic baseline of the surrounding environment. The potential positive and negative impacts of the project on population, tourism and recreation, employment and economic activity both directly and indirectly, will be assessed. This includes a review of the economic benefits to the surrounding community arising from the community contribution fund.

4.8.2 Existing Environment

The facility is located in a rural area approximately 1.5 km north of Kentstown village. The village of Slane is located 7 km north of the site, the town of Duleek 7 km to the east and the town of Navan 10 km to the west. There are a number of farmsteads and residences located along the local road network surrounding the site with a number of these situated within 1 km of the existing facility.

Community facilities in the immediate area, are primarily focused in Kentstown Village and include schools, a community hall, pubs and shops. The Kentstown Local Area Plan promotes tourism by encouraging and facilitating the development of sustainable tourism in through the conservation, protection and enhancement of the built and natural heritage, in order to maximise upon the economic benefits arising from the industry.

4.8.3 Potential Impacts

The continued operation of the Knockharley has significant economic benefits for the local community through the continued contributions from the community contribution fund.

4.9 Noise and Vibration

4.9.1 Aspects to be Addressed

The chapter will address noise and vibration impacts arising from the development and operation of the IBA storage area, the operation of the existing landfill, the installation of the leachate conditioning plant, screening berms installation and the impact of traffic associated with increased waste acceptance activities at the site.

4.9.2 Assessment Methodology

A noise assessment will be carried out for the construction and operational phases of the proposed development. This will include characterising the existing background noise environment through the review of monitoring data conducted as part of licence compliance.

A site specific noise prediction assessment will be conducted using prediction modelling software which will assess the cumulative impacts from operations within the existing landfill footprint, the construction and operation of the proposed IBA storage area, the installation of screening berms and increased traffic movements on sensitive receptors in the vicinity of the site.

4.9.3 Potential Impacts

The main potential construction phase impacts may arise during the construction of the IBA storage area, which could coincide with the development of future cells within the main landfill footprint, as well as screening berm installation. Construction related impacts related to the use of plant and machinery in the development of these area will be considered.

Operational noise impacts may arise from the acceptance and placement of IBA, residual waste and soils within their respective locations, as well as potential future winning of IBA from the storage area and its movement offsite.

4.10 Traffic and Transportation

4.10.1 Aspects to be Addressed

The traffic impact assessment will address the traffic impacts on the local road network from the construction of IBA storage area and operation of the overall facility at the maximum input of 440,000 tpa.

4.10.2 Assessment Methodology

A traffic impact assessment will be conducted in accordance with the National Roads Authority (NRA) Traffic and Transport Assessment (TTA) Guidelines, May 2014. Data collected from road traffic surveys at the junction to the facility from the N2 will be used in the assessment.

The methodology for the traffic impact assessment will include a review of the traffic volumes and impacts which will be generated by the construction and operation of the facility. The type and nature of waste loads will be characterised to calculate vehicle trips to and from the facility. Baseline traffic volumes will be established for the receiving environment and an assessment of the increases in traffic volumes undertaken. Recommendations will be made to mitigate any potential traffic impacts where required.

4.10.3 Existing Environment

The site is approximately 7 km south of Slane on the west side of the N2 National Primary Road. Navan is located approximately 10 km to the west of the site via the R153 Regional Road.

To the north, the site is bounded by the County Road CR384 running east-west. To the east the site is bounded by the CR384 running north-south between the N2 and R150. To the south, the site is bounded by farmland, which in general is located adjacent to the R150 over the section between the N2 National Primary Road and Kentstown.

The site has direct vehicular access to the national road network with access facilitated at a ghost island priority junction on the N2. The ghost island provides easy access for right-turning vehicles travelling from the north. This is complimented with an auxiliary left turn deceleration lane to facilitate access for vehicles coming from the south. The junction has been designed and constructed in accordance with the NRA: Design Manual for Roads and Bridges (DMRB).

The private access road to the site runs due west through arable lands, thereafter running under the CR384 County Road. The primary controlled site entrance (a security gate with closed circuit television) is located approximately 80 to 100 m west of the underpass of the CR384. Vehicles arriving at the facility enter the site via this private dedicated access road, through the site entrance to the weighbridge facility.

4.10.4 Potential Impacts

It is anticipated that the traffic volumes arising from the construction of any new infrastructure will be minor when considered in context with traffic volumes associated with the operation of the facility. The increase in waste acceptance activities at the facility has the potential to give rise to traffic congestion and capacity issues, such as queuing, in the event of there being inadequate access infrastructure. However, given that works have taken place to upgrade the junction with the N2 along a dedicated private road, the impact arising from increase traffic volumes will be reduced. Nonetheless these potential impacts will be assessed as part of the traffic impact assessment.

4.11 Air and Climate Change

4.11.1 Aspects to be Addressed

The assessment will address the potential impacts on air quality due to construction activities and emissions from traffic and material placement activities associated with the operation of the overall facility.

The climate in the immediate local area of a proposed development is known as the micro-climate whereas the climate of a large geographical area (global) is the macro-climate. The potential impacts of Knockharley Landfill on micro-climate and macro-climate will be addressed.

Odour modelling will be undertaken, which will be informed by baseline field assessment and other information sources, to determine the potential impact of increased waste acceptance at the facility.

4.11.2 Assessment Methodology

Air quality monitoring conducted by the EPA at a number of locations in the vicinity of the site, as well as dust and volatile organic compound (VOC) monitoring conducted on-site, will be reviewed and levels compared with the air quality standards.

To assess the impacts of construction dust emissions, the approach and assessment criteria outline in the *National Roads Authority (NRA) Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes* (2011) and the *Institute of Air Quality Management (IAQM) publications, Guidance on the assessment of dust from demolition and construction & Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance* will be used.

Potential vehicle emissions arising from the operation of the facility at 440,000 tpa will be assessed using the NRA Guidelines. For the purposes of assessing the impact on air quality of emissions generated by operation traffic, the methodology described in the Design Manual for Roads (DMRB) (Volume 11, Section 3 Air Quality, May 2007) and published by the UK Highways Agency will be used. The DMRB model predicts vehicle emissions for NO_x, NO_2 and $PM_{10,}$ carbon monoxide, benzene and 1,3-butadiene.

The potential for the generation of operational dust, odour and other emissions will be evaluated and mitigation measures proposed, where necessary.

The potential micro-climatic impacts of the Knockharley facility will be assessed in relation to the micro-climatic baseline, the scale of the elements of the project and the nature of use of the surrounding environment.

The data collected during baseline assessments will be used to construct a baseline odour dispersion model of the site. The model will define estimates of the current emissions generated from the site, and the odour exposure levels that are predicted to occur around the site under the range of meteorological conditions that occur over a typical meteorological year. Modelling will be conducted using the AERMOD dispersion model in accordance with relevant guidance issued by the US EPA and Irish EPA. The potential levels of exposure experienced around the site will be presented in the form of concentration isopleths. This model will then be used as a foundation from which to investigate the effect of the proposed development at various points in time during its development.

4.11.3 Existing Environment

Knockharley landfill is located in a rural area, corresponding to air quality zone D under the Air Quality Regulations, SI 180 of 2011, as amended. The air quality is expected to be good.

Existing air emissions from the site include landfill gas which is actively managed and utilised to generate electricity for export to the national grid. There have been odour issues associated with the operation of the landfill and the operators have been actively engaged with the EPA in relation to the implementation of processes and regimes to significantly mitigate these issues.

4.11.4 Potential Impacts

The construction phase of the IBA storage area has the potential to generate dust emissions, which could give rise to nuisance for local residents. Construction plant and equipment, and the traffic generated by the construction process, have the potential to give rise to emissions of oxides of nitrogen, benzene and particulates, which could impact on local air quality in the short term.

Potential air quality impacts arising from the operation of the IBA storage area include dust emissions arising from the placement and/or winning of IBA, while potential emissions from increased landfilling rates includes odour and landfill gas.

4.12 Ecology

4.12.1 Aspects to be Addressed

This chapter of the EIS will address the habitats and species, including those of conservation concern in and in close proximity to the facility.

4.12.2 Assessment Methodology

The assessment will focus on:

- Natura 2000 sites i.e. Special Areas of Conservation designated under the EU Habitats Directive (Council Directive 92/43/EEC) and Special Protection Areas designated under the EU Birds Directive (Directive 2009/147 EC), within 15 km of the proposed sites and routes
- Other designated sites such as Natural Heritage Areas, Nature Reserves and Refuges for Fauna or Flora
- Habitats listed in Annex I of the Habitats Directive
- Birds listed in Annex I of the Birds Directive
- Species protected under the Wildlife Acts including protected flora
- Habitats that can be considered as corridors for the purposes of Article 10 of the Habitats Directive
- Red data book species
- and biodiversity in general.

Desk studies will be undertaken in which ecological databases, such as those of the NPWS and EPA will be consulted. The NPWS (including the local conservation ranger), Inland Fisheries Ireland and the main environmental non-governmental organisations will be consulted.

A flora and fauna assessment for the proposed development will be conducted in accordance with Fossitt (2000) "*A Guide to Habitats in Ireland*", following best practice guidelines in Smith *et al.* (2011) "*Best Practice Guidance for Habitat Survey and Mapping*". The aquatic habitats in the Knockharley Stream and the River Nanny are evaluated based on biological monitoring conducted as part of licence compliance. The results of this assessment will be presented in the EIS using GIS mapping.

Some vegetation and tree removal will be required for the development of the IBA storage area and the screening berms installation and relevant assessments for these areas will be included in the EIS.

4.12.3 Existing Environment

To the north and the east of the existing landfill footprint and within the site boundary is agricultural land which is predominantly managed forestry. The site itself, while relatively flat, rises gradually northwards and westward from approximately 50 mOD at the south-east corner to almost 70 mOD at the western boundary.

There are a number of designated sites located in the vicinity of Knockharley landfill. These include:

- Balrath Woods pNHA (001579)
- Thomastown Bog pNHA (001593)
- Rossnaree Riverbank pNHA (001589)
- River Boyne and River Blackwater SAC (002299)
- Duleek Commons pNHA (001578)

While there will be no direct impact on any of these site, indirect impacts may occur. These include the potential impacts from a discharge of contaminated run-off from the Knockharley site. The local Knockharley Stream, to which surface_water discharges from the site, is within the River Nanny catchment, which discharges to the River Nanny Estuary and Shore SPA, which is located c. 20 km from the site.

Screening will be undertaken to determine if an Appropriate Assessment (AA) of the proposed development at Knockharley Landfill is required. If the screening assessment indicates that an AA is required, a Natura Impact Statement will be prepared and submitted to accompany the planning application and EIS.

4.12.4 Potential Impacts

Potential impacts from the construction and operation of the proposed development on flora and fauna include:

- Direct loss of habitat
- Damage to adjacent habitats during construction
- Impacts on water quality due to polluted run-off emanating from the site
- Disturbance to local wildlife, including loss of habitat for, or displacement from, known foraging or breeding areas of mammals, birds, bats etc.
- The introduction of alien invasive species during construction
- Impact on water quality or aquatic habitats resulting from the stream diversion
- Cumulative impacts which may affect the conservation status of any given species, in particular Annex species
- Impacts on the conservation status of Natura 2000 sites.

4.13 Soils, Geology & Hydrogeology

4.13.1 Aspects to be Addressed

The assessment will address soils, bedrock and aquifer underlying the site.

4.13.2 Assessment Methodology

The methodology for the soils and geology assessment will be in accordance with the guidelines published by the Institute of Geologists of Ireland (2013) *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements*.

The existing geology will be described in terms of the bedrock geology, overburden geology and hydrogeology. It will be prepared using available published literature for the site area which includes:

1. Groundwater Protection Scheme for County Meath (on GSI website)
2. Geology of Meath - Sheet 13 (McConnell, B et al., 2001)
3. General Soil Map of Ireland - Second Edition 1980 (Gardiner, M.J and Radford, T, 1980)

As part of the assessment the following will be conducted:

- A review of the characteristics of the entire site (ground conditions, topography, vegetation cover/condition)
- Identification of past and present land use on the site (grazing, forestry etc.) and their current impact on the existing ground conditions
- Review and interpretation of data collected during site investigations carried out in July and August 2016

4.13.3 Existing Environment

Site investigations previously undertaken at the site during the phased development of the landfill to-date indicate that the overburden at the site is glacial till which varies in thickness from 12 to 21.5 m, from east to west across the site. The till comprises cobbles and boulders in a silty clay matrix with minor sand content. The till has a low permeability in the range of 1 x 10^{-9} m/sec to 4.6 x 10^{-11} m/sec.

Bedrock recovered from boreholes on-site indicate fine grained light coloured sandstone and darker coloured siltstone /mudstone. The elevation of the bedrock surface varies from 40 to 50 mOD, falling away towards the south, following the slope of the topography. The GSI website classifies this bedrock (Namurian rocks) in County Meath as a Poor Aquifer (Pl) which would generally be unproductive except in localised zones. The vulnerability of the aquifer is also classified as low.

4.13.4 Potential Impacts

The impact on soils/geology of the site is limited to any excavations required for the development of the proposed IBA storage area, the expanded leachate storage lagoons and the development of screening berms, in terms of slope stability.

Excavated material will be used in screening berm development and/or as temporary landfill cap. Once operational, the management of clean surface water run-off and/or leachate from the site will be integrated into the existing management systems on-site, through installation of newly required infrastructure. As no alterations are required to the consented landfill footprint to accommodate the proposed intensification of landfilling, it is anticipated that there will be no impacts from increased landfilling activities on the soil/ geology or groundwater. A hydrogeological risk assessment will be prepared in relation to the development of the landfill cells associated with the IBA storage.

Groundwater monitoring conducted as part of licence compliance to date indicates no impact on water quality. Therefore, it is anticipated that the continued employment of the groundwater protection measures in accordance with the Landfill Directive and site operations will result in no degradation of groundwater quality at the site.

4.14 Hydrology & Water Quality

4.14.1 Aspects to be Addressed

The assessment will address water quality impacts on surface water. The impact of the project on the hydrological regime of the receiving environment, including flood risk, will be addressed.

4.14.2 Assessment Methodology

The objectives of the relevant River Basin Management Plan in relation to water quality will be considered. The review will include the County Development Plans for Meath and will consider the policies and objectives of the Plan in relation to surface water and flooding. The assessment will be prepared in accordance with the EPA and Office Public Works (OPW) guidance. Any concerns expressed by consultees relating to hydrology, drainage and/or flooding will be addressed, where appropriate.

The review will have regard to the baseline data and the studies undertaken for the assessment of impacts on terrestrial and fresh water ecology, geology and hydrogeology in relation to environmentally protected areas, receiving waters and soil conditions. Baseline monitoring data collected on a quarterly basis as part of licence compliance will be reviewed and used to characterise the impact, if any, on receiving waterbodies.

Preliminary drainage design, using Sustainable Drainage Systems (SuDs), for the proposed development will be conducted to ensure that additional surface water run-off is incorporated into the existing drainage system design, where possible.

The impact of the proposed stream diversion will be assessed to determine any potential impact on flooding as part of a standalone Flood Risk Assessment report. The design of the second standalone surface_water attenuation facility will ensure sufficient capacity for the flows resulting from the IBA storage area development.

4.14.3 Existing Environment

The site is drained by Knockharley Stream which lies in the Veldonstown waterbody (EA_Nanny160_NannyTRIB_Veldonstown) within the Eastern River Basin District (ERBD). The stream enters to the site from the west and flows eastwards towards the eastern boundary of the site before travelling southwards to Veldonstown Stream, which in turn drains to the River Nanny. The outlet from the existing onsite surface water management system discharges into tributaries of the River Nanny.

4.14.4 Potential Impacts

The main impact from the construction phase of the proposed development will be rainfall run-off containing silt that could potentially lead to siltation and consequently physical effects on flora and fauna in aquatic habitats.

Sediment has the potential to arise from:

- Vegetation removal could lead to an increase in sediment in the surface water run-off
- Temporary spoil heaps from the excavation of foundations of the proposed facilities
- Silt carried on the wheels of vehicles leaving the site could be carried onto the public road.

In addition, potential impacts on water quality and flooding may result from the diversion of the Knockharley Stream.

The potential impacts on hydrology and drainage that may arise from the operation of the facility includes impacts on localised flooding patterns and downstream structures arising from increase run-off/discharge rates as well as cumulative hydrological impacts with neighbouring developments.

4.15 Archaeology, Architecture and Cultural Heritage

4.15.1 Aspects to be Addressed

The assessment will address features and sites of archaeological, architectural and cultural heritage significance.

4.15.2 Assessment Methodology

Archaeological, architectural and cultural heritage assessments of the Knockharley site were conducted for previous applications. In addition, archaeological monitoring was conducted at the site during the previous excavation for the various phases of the landfill footprint. These records will be reviewed and presented in the EIS. Subsequently a walkover of the site, with particular focus on the previously undisturbed area proposed for the development of the IBA storage area, and screening berms will be conducted by an archaeologist.

An impact assessment and mitigation strategy will be prepared. This will outline potential adverse impacts that the proposed development may have on the archaeological, architectural or cultural heritage resource, while the mitigation strategy is designed to avoid, reduce or offset such impacts.

Consultation will take place with a number of bodies including the Heritage Officer and/or Conservation Officer in Meath County Council.

4.15.3 Existing Environment

A number of archaeological features have been recorded within the Knockharley site. Geophysical surveying of targeted areas undertaken in 2003 (Licence Number 03R010) identified potential areas which were subject to pre-development testing. This testing resulted in the identification of a possible well and a posthole feature which were archaeologically resolved. In 2004, nine archaeological features were encountered in the course of pre-development testing and archaeological monitoring. Two of these sites, a deer trap and a well, were excavated and preserved by record.

In 2006, further monitoring was conducted (Licence 04E0788 extension) resulting in five separate areas/features of archaeological significance were uncovered in the course of monitoring.

In 2009, monitoring of the removal of topsoil for the development of the on-site gas utilisation compound in the south eastern portion of the landfill site was conducted. The archaeological monitoring found no evidence of archaeological layers or features. The stratigraphy consisted of topsoil overlying natural layers. Occasional modern debris indicated the area had been disturbed in the recent past.

4.15.4 Potential Impacts

The potential impacts of the proposed development will be the loss or interference with a previously unrecorded site or features of archaeological, architectural and cultural heritage significance caused by excavations. Once construction of the proposed development has been completed, the potential for a negative impact on archaeological, architectural and cultural heritage from the development will be minimal.

4.16 Landscape and Visual Impact

4.16.1 Aspects to be Addressed

The potential impacts from the proposed development within the context of the existing waste management facility will be assessed.

4.16.2 Assessment Methodology

A desktop study will be undertaken to determine the existing landscape of the area and visual envelope of the Knockharley development within that area. Landscape values such as amenity areas, designated views and prospects, and historical archaeological and architectural heritage will be identified from the Meath County Development Plan.

A number of viewpoints illustrating the existing views of the facility and in particular the landfill body itself will be included. An assessment of the impacts of the IBA storage area and in particular the proposed increased landfill height will be conducted with representations of the dimensions and scale of these elements of the development produced and included in the assessment.

4.16.3 Existing Environment

The landscape of the existing facility and the surrounding area is characterised by extensive hedgerow bound fields interspersed with areas of woodland cover and mature trees. Relatively gentle undulations in landform combine with vegetation to generally constrain views across the landscape with the exception of localised vantage points or clearances in vegetation. The existing facility and in particular, the landfill body, is a visible feature in the surrounding landscape.

4.16.4 Potential Impacts

It is anticipated that the potential impacts arising from the IBA storage area development and the increased landfill height will be mitigated by the installation of the screening berms such that impacts will be related to the scale and form of overall development with respect to the visual character of the surrounding area.

5 CUMULATIVE IMPACTS, INDIRECT IMPACTS AND INTERACTION OF EFFECTS

5.1.1 Aspects to be Addressed

The cumulative impacts of the proposed development at Knockharley Landfill with other projects, existing or which have received planning permission but have not yet been built, or for which there is information in the public domain, at a sufficient level of detail to allow assessment, will be addressed. Indirect effects and effects in different environmental media will be addressed.

5.1.2 Assessment Methodology

The assessment methodology will be based on the EPA guidance and the EU guidelines, *'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions'*, published by the Office for Official Publications of the European Communities in May 1999.

As part of scoping the studies required to assess the impacts of the development in the different environmental media, the potential for significant cumulative and indirect impacts and interactions will be examined and any such potential impacts will be identified. Where the potential for significant cumulative and indirect impacts and interactions is identified, such impacts and interaction of impacts will be included in the scope and addressed in the baseline and impact assessment studies for each of the relevant environmental media and aspects of the project. The cumulative and indirect impacts and interaction of impacts will be presented in the chapters of the EIS which address the most relevant environmental media.

The matrix and expert opinion approaches, as outlined in the EU Guidelines, will be used in the identification of the potential for significant cumulative and indirect impacts and interactions. A matrix of potential interactions will be prepared. Modelling and carrying out of capacity analyses will be used to evaluate impacts.

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Éire

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www.water.ie

Derek Milton
Fehily, Timoney and Company
Core House,
Pouladuff Road,
Cork

04/11/2016

RE: Proposed Development at Knockharley Landfill, Kentstown, Co. Meath

Dear Mr Milton,

Irish Water (IW) acknowledges receipt of your letter dated 25th October regarding the Environmental Impact Statement (EIS) scoping for the above development. On an initial review, Irish Water does not have objections to the proposed development.

We do however note where the proposed extension to treatment works is within close proximity to Irish Water assets, specifically water mains contiguous to the eastern boundary. We suggest a site investigation be carried out prior to the beginning of construction and proposals outlined for dealing with situations where the works would interfere with existing water services infrastructure (watermains, service connections, rising mains, foul and surface water sewers, culverts, etc.).

Please also see attached our suggested scope in relation to Water Services.

Yours Sincerely,

Suzanne Dempsey

Suzanne Dempsey
Spatial Planning Strategy Specialist

Response to EIS Scoping Report Requests

IW currently does not have the capacity to advise on scoping of individual projects. However, in general we would like the following aspects of Water Services to be considered in the scope of an EIS where relevant;

a) Impacts of the development on the capacity of water services (do existing water services have the capacity to cater for the new development if required).
b) Any up-grading of water services infrastructure that would be required to accommodate the development.
c) In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an IW collection network
d) In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks & potential measures to minimise/stop surface waters from combined sewers
e) Any physical impact on IW assets – reservoir, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets
f) Any potential impacts on the assimilative capacity of receiving waters in relation to IW discharge outfalls including changes in dispersion /circulation characterises
g) Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development (and resultant potential impact on the capacity of the source) or the potential of the development to influence/ present a risk to the quality of the water abstracted by IW for public supply.
h) Where a development proposes to connect to an IW network and that network either abstracts water from or discharges waste water to a "protected"/sensitive area, consideration as to whether the integrity of the site/conservation objectives of the site would be compromised.
i) Mitigation measures in relation to any of the above

This is not an exhaustive list.

Please note

- If a development will require a connection to either a public water supply or sewage collection system the developer is advised to contact Irish Water's Connections and Developer Services Team prior to applying for planning permission. The contact in the Eastern Region is Oliver Fogarty ; olfogarty@water.ie
- For Information on Irish Water assets please send a query to DataRequests@water.ie
- Irish Water will not normally accept new surface water discharges to combined sewer networks

An Taisce
The National Trust for Ireland

20162610-FTC-KTLF

Fehily Timoney & Company
J5 Plaza
North Park Business Park
North Road
Dublin 11

Sent by email to:
info@ftco.ie

26.10.16

Ref: **LW14/821/01/ConLet/DFM/CF**
For: **Proposed development at Knickharley Landfill, Kentstown, Co. Meath**

Dear Sir/Madam,

Thank you for your letter dated 25th October 2016.

It is noted that the subject proposal relates to an increase in the quantum of waste intake at Knockarley Landfill of up to 440,000 tpa. The current facility permits the acceptance of up to 200,000 tba.

Due to the large volume of waste intake being proposed at this facility, all environmental considerations need to be adequately assessed.

Under Section 4.8 (Socio Economic, Land Use and Amenity) it is stated that '*there are a number of farmsteads and residences located along the local road network surrounding the site with a number of these situated within 1km of the existing facility*'. An Taisce note that under 'Potential Impacts' [4.8.3] it is stated that '*the continued operation of the Knockharley has significant economic benefits for the local community through the continued contributions from the community contribution fund*'. Due to the proximity of the facility to dwellings, the assessment of 'Potential Impacts' should outline any negative impacts that may occur as a result of increased waste intake (odours etc). Appropriate mitigation measures should be identified.

Section 4.10.4 of the Scoping Report states that "*The increase in waste acceptance activities at the facility has the potential to give rise to traffic congestion and capacity issues, such as queuing*". The application needs to demonstrate that the subject proposal, during construction and operation of this facility will not be prejudicial to public health and safety.

An Taisce is a membership-based charity. Join at www.antaisce.org/membership
An Taisce – The National Trust for Ireland | Tailors' Hall, Back Lane, Dublin, D08 X2A3, Ireland | www.antaisce.org
Company 12469 | Charity CHY 4741 | Charity Regulator No. 20006358 | +353 1 454 1786 | info@antaisce.org |
Directors: J Leahy, M Mehigan, D Murphy, B Rickwood (UK), C Stanley Smith (UK), A Uí Bhroin, P Kearney, J Sweeney

Section 4.12.3 identifies a number of designated sites in the vicinity of Knockharley landfill. These include: Balrath Woods pNHA (001579), Thomastown Bog pNHA (001593), Rossnaree Riverbank pNHA (001589), River Boyne and River Blackwater SAC (002299), Duleek Common pNHA (001578). The application needs to demonstrate that it is consistent with the provision of Article 6(3) of the Habitats Directive. Best practice suggests that sites lying within 15-20km radius of the plan area should be included.

All water quality issues need to be adequately addressed. Leachate management needs to be outlined. It should be demonstrated that the subject proposal will not have an impact on water quality. All downstream impacts need to be addressed. Appropriate mitigation measures need to be identified.

Landscape designations, views and prospects, archaeological features and architectural heritage all need to be assessed.

Yours faithfully,

Ian Lumley,

Built Environment Office
An Taisce – The National Trust for Ireland

daa cuideachta phoiblí theoranta
Príomhoifig: Aerfort Átha Cliath,
Co.Bhaile Átha Cliath, Éire

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F. 353-1-814-4120
www.daa.ie

daa public limited company
Head Office: Dublin Airport,
Co Dublin, Ireland

Fehily Timoney & Company
J5 Plaza
North Park Business Park
North Road
Dublin 11

Date: 07th November 2016

Ref No: 01.3.006
Your Ref: LW14/821/01/ConLet/DFM/CF

Dear Mr. Milton,

Re: EIA Scoping: Proposed development at Knockharley Landfill, Kentstown, Co. Meath

Further to your letter of 25th of October, daa Plc, Head Office, Dublin Airport, Co. Dublin have no comment to make at the current time with regard to the EIA Scoping for a proposed development to intensify waste acceptance at the existing landfill facility at Knockharley Landfill, Kentsown, Co. Meath.

Yours faithfully,

Jane Roche

Jane Roche
Planning Department

From: Manager Dau <Manager.Dau@ahg.gov.ie>
Sent: 27 October 2016 15:57
To: knockharley landfill scoping
Cc: Reception
Subject: DAU Ref: G Pre00334/2016 Re Proposed development at Knockharley Landfill, Kentstown, Co. Meath

Your Ref: **LW14/821/01/ConLet/DFM/CF**
Our Ref: **G Pre00334/2016** (Please quote in all related correspondence)

A Chara,

On behalf of the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, I acknowledge receipt of your recent consultation from Derek Milton of Fehily, Timoney and Company Consultants in Engineering & Environmental Sciences.

In the event of observations, you will receive a co-ordinated heritage-related response by email from Development Applications Unit (DAU) on behalf of the Department.

The normal target turnaround for pre-planning and other general consultations is six weeks from date of receipt. In relation to general consultations from public bodies under the European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004 to 2011, the Department endeavours to meet deadline dates, where requested.

If you have not heard from DAU and wish to receive an update, please telephone the direct line number below or email manager.dau@ahg.gov.ie .

Le meas
Sinéad O' Brien

Development Applications Unit,
Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs
Newtown Road,
Wexford,
Y35 AP90
(053) 911 7528

Derek Milton

From: Yvonne Jackson <Yvonne.Jackson@failteireland.ie>
Sent: 04 November 2016 11:10
To: knockharley landfill scoping
Subject: Proposed Development at Knockharley Landfill
Attachments: EIS &Tourism Guidelines.pdf

Dear Derek,

I wish to acknowledge receipt of your recent letter to Fáilte Ireland in relation to the **proposed development at Knockharley, Kentstown, Co. Meath**
I have attach a copy of the Fáilte Ireland's Guidelines for the treatment of tourism in an EIS, which we recommend should be taken into account in preparing the EIS.

Yours sincerely,

Yvonne

Yvonne Jackson
Investment and Innnovation | Fáilte Ireland | Áras Fáilte | 88/95 Amiens Street | Dublin 1
T: 01 8847224
W: www.failteireland.ie

From: Noel McGloin <Noel.McGloin@fisheriesireland.ie>
Sent: 07 November 2016 16:53
To: knockharley landfill scoping
Subject: Derek Milton RE: EIS for a proposed development at Knockharley Landfill, Kentstown, Co. Meath
Attachments: Guidelines Report 2016.pdf

Dear Mr. Milton

We are in receipt of your correspondence dated 25th October, 2016.

Inland Fisheries Ireland (IFI) is a Statutory Body established on the 1st July 2010 .Under section 7(1) of the Inland Fisheries Act 2010 (No. 10 of 2010) *the principal function of IFI is the protection, management and conservation of the inland fisheries resource. Under section 7(3) of the IFI Act it is stated that without prejudice to subsection (1), IFI shall in the performance of its functions have regard to(g) the requirements of the European Communities (Natural Habitats) Regulations 1997 (S.I. No. 94 of 1997) and the need for the sustainable development of the inland fisheries resource (including the conservation of fish and other species of fauna and flora habitats and the biodiversity of inland water ecosystems),(h) as far as possible, ensure that its activities are carried out so as to protect the national heritage (within the meaning of the Heritage Act 1995).*

The EU Water Framework Directive (2000/60/EC) entered into force in December 2000 requires the protection of the ecological status of river catchments – this encompasses water quality and requires the conservation of habitats for ecological communities. One of the primary objectives of the Directive is to establish a framework which prevents further deterioration and protects and enhances the status of aquatic ecosystems. Protection of aquatic ecosystems requires that river systems be protected on a catchment basis.

Article 5 of the 2009 Surface Water Regulations requires that a public authority, in performance of its functions, shall not undertake those functions in a manner that knowingly causes or allows deterioration in the chemical or ecological status of a body of surface water. Also article 28(2) of the said Regulations states that a surface water body whose status is determined to be less than good shall be restored to at least good status not later than the end of 2015. This application is in close proximity to the Veldonstown tributary of the Nanny River whose status is *poor* and has to be restored to *good* status .

Having examined this proposal as it stands IFI is concerned about the potential generation of suspended solids, hydrocarbons and other related deleterious matter that may flow to waters. We are also concerned about the potential blocking of any waters and any proposed new channel diversions.

The Nanny River is a tributary of the River Boyne and has significant stocks of Brown Trout and lamprey.

We attach a copy of our updated Guidelines in relation to construction works.

We look forward to a copy of your EIS in due course.

Yours sincerely

Noel McGloin
Senior Fisheries Environmental Officer
Inland Fisheries Ireland - Dublin

Iascach Intire Eireann
Inland Fisheries Ireland

Telephone: +353 (0) 1 8842688

EMail: noel.mcgloin@fisheriesireland.ie
Web: www.fisheriesireland.ie

3044 Lake Drive, City West, Dublin 24, IRELAND.

Help Protect Ireland's Inland Fisheries

Call 1890 34 74 24 to report illegal fishing, water pollution or invasive species.

Comhairle Chontae na Mí
Roinn Pleanáil,
Teach Buvinda, Bóthar Átha Cliath,
An Uaimh, Contae na Mí, C15 Y291
Fón: 046 – 9097500/Fax: 046 – 9097001
R-phost: planning@meathcoco.ie
Web: www.meath.ie
Uimhir: 00172770

Meath County Council
Planning Department
Buvinda House, Dublin Road,
Navan, Co. Meath, C15 Y291
Tel: 046 – 9097500/Fax: 046 – 9097001
E-mail: planning@meathcoco.ie
Web: www.meath.ie
Council Registration Number: 00172770

Our Ref: MG/LM

Planning Section

8th November, 2016

Derek Milton,
Fehily Timoney & Co.,
Unit 16, North Park Offices,
North Road,
Dublin 11

Re: Proposed Development at Knockharley Landfill Kentstown Co. Meath.

Dear Mr. Milton,

I refer to your invitation to comment on the preparation of an Environmental Impact Statement for the proposed "intensification of waste acceptance at Knockharley landfill facility for recovery and disposal."

Meath County Council acknowledges receipt of your letter and confirms that it has no comments to make in respect of the scoping report.

Yours sincerely,

Michael Griffin,
Senior Executive Officer,
Planning Department.

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

LW14-821-01

Mr. Derek Milton
Fehiley Timoney and Company
J5 Plaza
North Park Business Park
North Road
Dublin 11

Dáta | Date	Ár dTag | Our Ref.	Bhur dTag | Your Ref.
10 November 2016	**TII16-95955**	**LW14/821/01/ConLet/DFM/CF**

RE: Proposed Development at Knockharley Landfill, Kentstown, Co. Meath

Dear Mr. Milton,

The Authority wishes to advise that it is not in a position to engage directly with planning applicants in respect to proposed developments. The Authority will endeavour to consider and respond to planning applications referred to it given its status and duties as a statutory consultee under the Planning Acts. The approach to be adopted by the Authority in making such submissions or comments will seek to uphold official policy and guidelines as outlined in the Spatial Planning and National Roads Guidelines for Planning Authorities (DoECLG, 2012). Regard should also be had to other relevant guidance available at www.tii.ie.

The issuing of this correspondence is provided as best practice guidance only and does not prejudice TII's statutory right to make any observations, requests for further information, objections or appeals following the examination of any valid planning application referred.

With respect to access to the proposed operations, it is noted that previous EIS Scoping documentation referred indicates that the site is accessed via a direct private road access to the N2, national primary road. This implies that any proposed development or intensification of use at the landfill will rely on the direct private access to the N2, national primary road.

In that regard, the applicant/developer should be aware that official policy concerning access to national roads seeks to avoid the creation of additional access points from new development or the generation of increased traffic from existing accesses (i.e. non-public road access) to national roads, to which speed limits greater than 50 kph apply.

The developer/applicant should consult the Meath County Development Plan, 2013 – 2019, Section 6.10.8 to ensure proposals are brought forward consistent with the provisions of the adopted plan and the foregoing official policy.
It is also noted that the EIS Scoping document referred makes reference to Figure 1: Drawing INFO-001 (Section 1.2) and Figure 1 (Section 2.2.2) but these do not appear to have accompanied the EIS Scoping Report, therefore, the applicant/developer should be aware that further issues not identified may arise.

With respect to EIS scoping issues, the recommendations indicated below provide only general guidance for the preparation of EIS, which may affect the National Roads Network.

The developer should have regard, *inter alia*, to the following;

- Consultations should be had with the relevant Local Authority/National Roads Design Office with regard to locations of existing and future national road schemes; Leinster Orbital Route (LOR),
- The Authority would be specifically concerned as to potential significant impacts the development would have on any national roads (and junctions with national roads) in the proximity of the proposed development; N2,
- The developer should assess visual impacts from existing national roads,
- The developer should have regard to any Environmental Impact Statement and all conditions and/or modifications imposed by An Bord Pleanála regarding road schemes in the area. The developer should in particular have regard to any potential cumulative impacts,
- The developer, in conducting Environmental Impact Assessment, should have regard to TII Publications (formerly NRA DMRB and the NRA Manual of Contract Documents for Road Works),
- The developer, in conducting Environmental Impact Assessment, should have regard to TII's Environmental Assessment and Construction Guidelines, including the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (National Roads Authority, 2006),
- The EIS should consider the Environmental Noise Regulations 2006 (SI 140 of 2006) and, in particular, how the development will affect future action plans by the relevant competent authority. The developer may need to consider the incorporation of noise barriers to reduce noise impacts (see *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (1st Rev., National Roads Authority, 2004)),
- It would be important that, where appropriate, subject to meeting the appropriate thresholds and criteria and having regard to best practice, a Traffic and Transport Assessment be carried out in accordance with relevant guidelines, noting traffic volumes attending the site and traffic routes to/from the site with reference to impacts on the national road network and junctions of lower category roads with national roads. The Authority's Traffic and Transport Assessment Guidelines (2014) should be referred to in this regard. The scheme promoter is also advised to have regard to Section 2.2 of the TII TTA Guidelines which addresses requirements for sub-threshold TTA,
- The designers are asked to consult TII Publications to determine whether a Road Safety Audit is required,
- In the interests of maintaining the safety and standard of the national road network, the EIS should identify the methods/techniques proposed for any works traversing/in proximity to the national road network,
- In relation to haul route identification, the applicant/developer should clearly identify any haul routes proposed (construction and operation) and fully assess the network to be traversed. Separate structure approvals/permits and other licences may be required in connection with the proposed haul route and all structures on the haul route should be checked by the applicant/developer to confirm their capacity to accommodate any abnormal load proposed.

Notwithstanding, any of the above, the developer should be aware that this list is non-exhaustive, thus site and development specific issues should be addressed in accordance with best practise.

I hope that the above comments are of use in your scoping process.

Yours sincerely,

M Byrne

Mark Byrne
Regulatory & Administration Unit

OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

Ceann Oifig
Sráid Jonathan Swift
Baile Átha Troim
Co. na Mí
C15 NX36

Head Office
Jonathan Swift Street
Trim
Co Meath
C15 NX36

Fón/Phone: (0761) 10 6000
(046) 942 6000
Facs/Fax: (046) 948 1793
Íosghlao/LoCall 1890 213414
Suíomh gréasáin/website: www.opw.ie

Mr. Derek Milton
Fehily Timoney & Company
Consultants in Engineering & Environmental Sciences
J5 Plaza
North Park Business Park
North Road
Dublin 11

Our Ref: 873 – 2016
Your Ref: LW14/821/01/ConLet/DFM/CF
Re: Proposed Development at Knockharley Landfill, Kentstown, Co Meath

Dear Mr Milton,

I refer to your correspondence dated 25th October 2016 regarding the above.

I have attached a map showing any of the channels maintained by the Office of Public Works and the Drainage Districts (DD) channels maintained by the Local Authority along with any benefitting land in the vicinity of the site. Benefitting land is land which would have benefitted from the construction of an Arterial Drainage Scheme but which could in extreme weather events be liable to flooding. The channels maintained by the OPW are coloured blue, the channels maintained by the Local Authority are coloured red and the benefitting lands are outlined in black with a green hatch.

OPW Drainage channels require a 10m maintenance strip along the edge of the channel measured out from the top bank edge of the channel. This strip should not be planted or paved in any way which would prevent access for maintenance. This requirement should be applied for all drainage channels where possible to assist in the prevention of flooding.

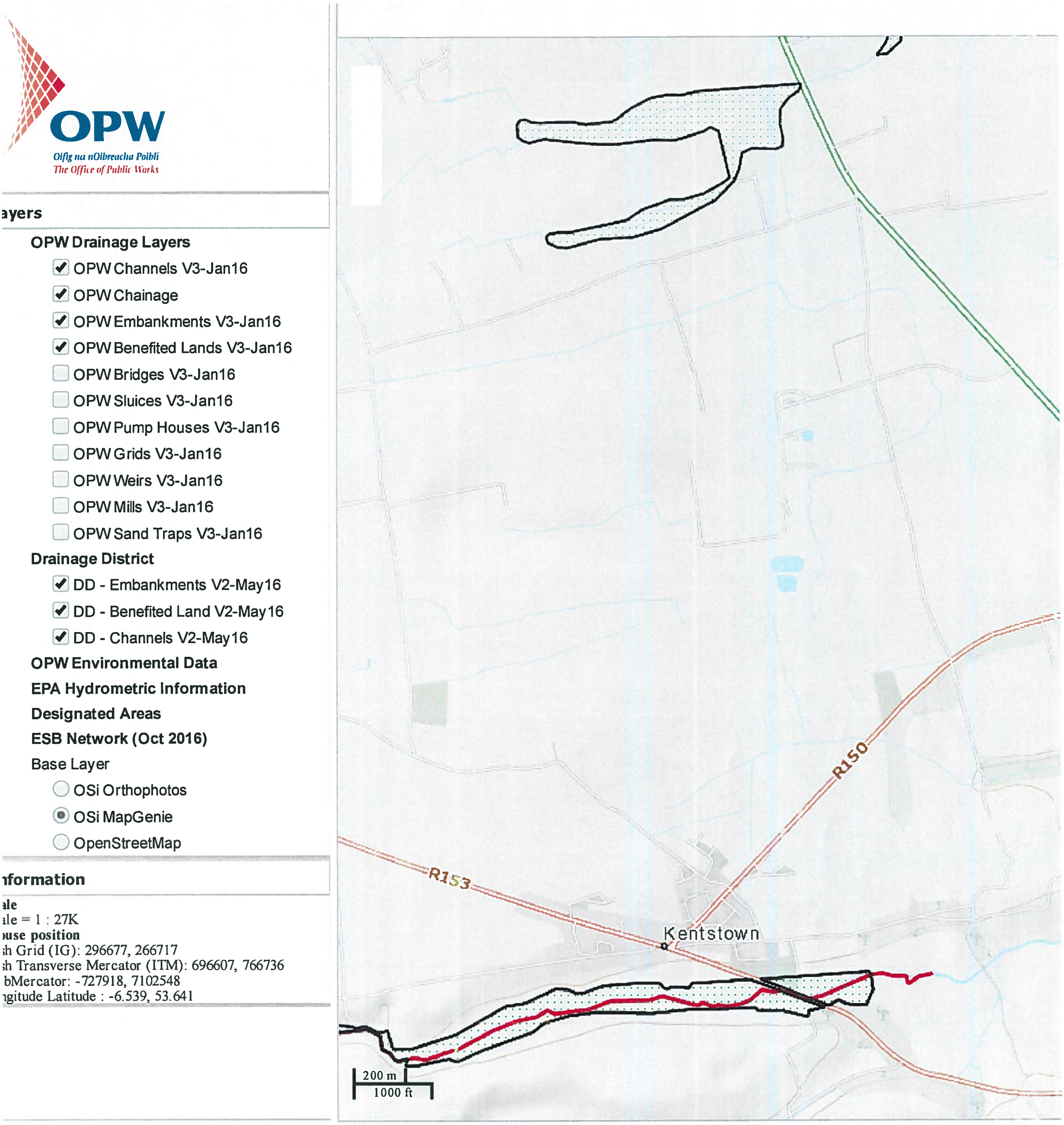
New culverts/bridges on any watercourse or changes to existing structures or watercourses will require Section 50 consent from the Office of Public Works.

The Office of Public Works website; www.floodmap.ie has information on past flood events in Ireland. This data is obtained by searching for a specific location. Links are provided to the relevant information (reports, photos etc). The map has information on hydrometric stations, rivers lakes, river catchment areas, land commission embankments, drainage districts and benefitting lands.

Yours sincerely

Karen Donovan
Engineering Services Administration Unit
17th November 2016

Oifig Bhaile Átha Cliath/Dublin Office (01) 647 6000
Oifig Chlár Chlainne Mhuiris/Claremorris Office (01) 647 6000
Oifig Chill Chainnigh/Kilkenny Office (056) 777 2600



OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

ayers

OPW Drainage Layers
- ☑ OPW Channels V3-Jan16
- ☑ OPW Chainage
- ☑ OPW Embankments V3-Jan16
- ☑ OPW Benefited Lands V3-Jan16
- ☐ OPW Bridges V3-Jan16
- ☐ OPW Sluices V3-Jan16
- ☐ OPW Pump Houses V3-Jan16
- ☐ OPW Grids V3-Jan16
- ☐ OPW Weirs V3-Jan16
- ☐ OPW Mills V3-Jan16
- ☐ OPW Sand Traps V3-Jan16

Drainage District
- ☑ DD - Embankments V2-May16
- ☑ DD - Benefited Land V2-May16
- ☑ DD - Channels V2-May16

OPW Environmental Data

EPA Hydrometric Information

Designated Areas

ESB Network (Oct 2016)

Base Layer
- ○ OSi Orthophotos
- ● OSi MapGenie
- ○ OpenStreetMap

nformation

ale
ale = 1 : 27K
use position
sh Grid (IG): 296677, 266717
sh Transverse Mercator (ITM): 696607, 766736
bMercator: -727918, 7102548
ngitude Latitude : -6.539, 53.641

From: Sarah Lacey <Sarah.Lacey@teagasc.ie>
Sent: 18 November 2016 09:12
To: knockharley landfill scoping
Cc: Paddy Browne
Subject: Proposed development at Knockharley Landfill

REF: LW14/821/01/ConLet/DFM/CF

Thank you for your letter of 25th October 2016 regarding proposed development at Knockharley Landfill, Kentstown, Co Meath. We have no comments.

Kind Regards

Sarah Lacey

Pp Paddy Browne
Head CELUP
Teagasc
Johnstown Castle
Wexford

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Environmental Health Service
HSE Dublin North East
Co. Clinic
Navan
Co. Meath
Telephone: 046-9021595/9098729
Fax: 046 9022818

Mr. Derek Milton
Fehily Timoney & Company
Core House
Pouladuff Road
Cork
Co. Cork

8th November 2017

ID Number:	0531
Proposed Development:	Proposed intensification of waste acceptance at Knockharley Landfill facility, Kentstown, Co. Meath for recovery and disposal.

Dear Sir,

Please find attached the HSE scoping report in relation to the above proposal.

The following HSE departments were made aware of the consultation request for the proposed development on 01-11-2017

- HSE Emergency Planning
- HSE Estates
- HSE Health Protection

Environmental Health Report
The EH service response to the proposal is in the attached report. The HSE is keen to ensure the EIA process adequately identifies and assesses impacts of the proposed development on humans and health.

- The assessment is based solely on an assessment of documentation submitted to this office on 28/10/2017.
- This report refers only to those sections of the documents which are relevant to the HSE.
- We have made observations and submissions under the following specific areas ;

> ***Description of the project, Later consents required, Consideration of Alternatives, Public Consultation, Noise, Water, Dust,Odour, Pest Control, Litter, Complaints Procedure, Cumulative Impact, Decommissioning.***

All correspondence or any queries with regard to this report including acknowledgement of this report should be forwarded to Elish O'Reilly, Principal Environmental Health Officer.

Yours Sincerely,

Elish O Reilly

Elish O'Reilly
Principal Environmental Health Officer

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Environmental Health Service
HSE Dublin North East
Co. Clinic
Navan
Co. Meath
Telephone: 046-9021595/9098729
Fax: 046 9022818

HSE EIS SCOPING REPORT

Environmental Health Service Consultation Report

(as a Statutory Consultee (Planning and Development Acts 2000,
& Regs made thereunder).

Date:	**7th November 2016**
Type of consultation:	**Scoping**
Planning Authority:	**An Bord Pleanala**
Reference Number:	**LW14/821/01ConLet/DFM/CF**
EHIS Reference:	**0531**
Applicant:	**Knockharley Landfill Limited**
Proposed Development:	**Proposed intensification of waste acceptance at Knockharley Landfill facility, Kentstown, Co. Meath for recovery and disposal.**

This report only comments on Environmental Health impacts of the proposed development. I have made observations on the following specific areas:

Description of the Project:
This proposal is a change from previous proposals outlined in scoping reports submitted to this department in both February and May 2016. Clarification should be provided if this is the final proposal for this waste facility or will permission for new waste management processes be looked for in the immediate future.

The scoping report does not fully describe all processes outlined in the proposal. It is stated a new building shall be developed to facilitate the recovery of metals from incinerator bottom ash. Further details should be provided of this process in the EIS. It is also proposed that a dedicated area for the storage of incinerator bottom ash will be developed. The proposed length of storage, the future recovery or final disposal options for IBA should be addressed in the EIS.

The EIS should also describe the waste acceptance criteria and identify the characteristics and volumes of the waste streams to be accepted on site. Clarification shall be provided if hazardous waste is to be handled on site.

With regard to the construction phase of the project all potential impacts should be identified and assessed. Proposed mitigation measure should be fully described. A comprehensive construction management plan outlining specific control measures should be provided in the EIS.

Later Consents Required:
Information on possible future monitoring requirements for the operation of the landfill should be included in the EIS.

Consideration of Alternatives:
The EIS should fully describe and consider any alternatives to this project. The reasons for choosing the proposed treatment and disposal processes shall be outlined.

Public Consultation:
Meaningful public consultation with the local community should be carried out. It is stated that the general public will be provided with information about the project and a summary will be provided of the queries and concerns expressed. All legitimate concerns from the public shall be fully addressed and evaluated. The EIS should clearly demonstrate how the outcome of consultation with the public influenced decision making within the EIA. This development, if not managed correctly, has the potential to generate nuisance for local residents so it is essential that thorough and robust public consultation is carried out with regards to this proposal.

Noise:
A noise survey must be carried out to assess the impact of noise from both the construction and operational phase of the proposed development on the residents living in the vicinity. Up to date baseline monitoring shall be carried out to establish the existing noise environment. All noise sensitive receptors in the vicinity of the landfill shall be identified. Appropriate noise assessment modelling should be carried out to accurately predict the change in the noise environment. This information should be outlined and clearly displayed in the EIS. The significance of the predicted change in the noise environment should be fully assessed.

The potential cumulative effects of other industry in the vicinity of the development should also be assessed as part of the noise survey. All mitigation measures for the control of noise shall be described.

Water:
All drinking water sources, both surface and groundwater (including individual private wells) shall be identified. Any potential impacts to these drinking water sources shall be assessed. Details of bedrock, overburden, vulnerability, groundwater flows and gradients, inner and outer zones of protection and catchment areas should all be considered when assessing potential impacts and possible mitigation measures. The EHS would recommend that all information is gathered by means of a site survey as desktop studies do not always accurately reflect the current use of water resources.

Potential impacts of surface water runoff should be assessed and mitigation measures detailed. Site drainage, increased rainfall and the possibility of flooding should all be considered when identifying possible impacts and mitigation measures.

Dust:
The impact of dust generation from construction and operation of the proposed development should be assessed. A dust minimisation plan or similar mitigation measures should be included within the EIS.

Odour:
The potential impacts of air emissions and odour generation should be clearly assessed in the EIA. Proposals for the capture, containment and treatment of odorous air shall be outlined. The development proposes to dramatically increase the volume of waste intake at the facility. Appropriate odour modelling must be carried out to accurately predict the change in odour emissions from the facility. The impact of the intensified odour emissions on the local community must be full assessed. It is stated in the scoping document there have been odour issues associated with the operation of the landfill. A full and rigorous assessment of all previous odour complaints should be carried out as part of the EIA process to uncover any information which could assist with control measures for odour on site.

Pest Control
The proposal for the new development will result in previously undisturbed land being utilised for earthworks and construction. There is a very real threat of existing rodent habitats being disrupted and destroyed. The EIS should include a description of measures to be put in place to control rodent activity.

Litter
The increased waste streams proposed to be accepted on site have the potential to cause nuisance problems with regards to litter. An assessment of the impact of litter

should be included in the EIS and control measures outlined to prevent problems with litter arising.

Complaints procedure:
The EIS should include proposals for dealing with issues of odour or nuisance from members of the public should they arise. A comprehensive operational management plan outlining working procedures on site and control measures should be provided. Details of a procedure to fully follow up and investigate complaints along with specific contact details for members of the public should also be included.

Cumulative Impacts:
In line with the EPA Guidelines on the information to be contained in Environmental Impact Statements (2002) and their Advice Notes on Current Practise in the preparation of Environmental Impact Statements (2003) the EIA should include the assessment of cumulative impacts of any other industrial or energy developments in the area e.g. quarrying, heavy industry, wind farms, composting facilities etc.

Decommissioning:
The EIS should describe proposals for decommissioning the facility at the end of life of the project. The residual impact of the development on the environment must be fully assessed.

Lisa Maguire
Lisa Maguire
Environmental Health Officer

All correspondence or any queries with regard to this report including acknowledgement of this report should be forwarded to:

Elish O'Reilly
Principal Environmental Health Officer
Environmental Health Department
Co. Clinic
Navan
Co. Meath

Appendix 5.2

Consultation with OPW and IFI

Mary Molloy

From:	Noel McGloin <Noel.McGloin@fisheriesireland.ie>
Sent:	11 October 2017 09:19
To:	Derek Milton
Cc:	Francis Carolan; Kevin O'Brien
Subject:	RE: Derek Milton RE: EIS for a proposed development at Knockharley Landfill, Kentstown, Co. Meath
Attachments:	Guidelines Report 2016.pdf

Dear Mr. Milton

Apologies for the delay in reverting to you on this.

Inland Fisheries Ireland (IFI) is a Statutory Body established on the 1st July 2010 .Under section 7(1) of the Inland Fisheries Act 2010 (No. 10 of 2010) *the principal function of IFI is the protection, management and conservation of the inland fisheries resource. Under section 7(3) of the IFI Act it is stated that without prejudice to subsection (1), IFI shall in the performance of its functions have regard to(g) the requirements of the European Communities (Natural Habitats) Regulations 1997 (S.I. No. 94 of 1997) and the need for the sustainable development of the inland fisheries resource (including the conservation of fish and other species of fauna and flora habitats and the biodiversity of inland water ecosystems),(h) as far as possible, ensure that its activities are carried out so as to protect the national heritage (within the meaning of the Heritage Act 1995).*

The EU Water Framework Directive (2000/60/EC) entered into force in December 2000 requires the protection of the ecological status of river catchments – this encompasses water quality and requires the conservation of habitats for ecological communities. One of the primary objectives of the Directive is to establish a framework which prevents further deterioration and protects and enhances the status of aquatic ecosystems. Protection of aquatic ecosystems requires that river systems be protected on a catchment basis.

Article 5 of the 2009 Surface Water Regulations requires that a public authority, in performance of its functions, shall not undertake those functions in a manner that knowingly causes or allows deterioration in the chemical or ecological status of a body of surface water. Also article 28(2) of the said Regulations states that a surface water body whose status is determined to be less than good shall be restored to at least good status not later than the end of 2015. This application is in close proximity to the Veldonstown tributary of the Nanny River whose status is *poor* and has to be restored to *good* status .

Having examined this proposal as it stands IFI is concerned about the potential generation of suspended solids, hydrocarbons and other related deleterious matter that may flow to waters. We are also concerned about the potential blocking of any waters.

The Nanny River is a tributary of the River Boyne and has significant stocks of Brown Trout and lamprey.

We attach a copy of our Guidelines(updated since last communication in 2015) in relation to construction works.

We look forward to a copy of your EIS in due course.

Yours sincerely

Noel McGloin
Senior Fisheries Environmental Officer
Inland Fisheries Ireland - Dublin

Iascach Intire Eireann
Inland Fisheries Ireland

Telephone: +353 (0) 1 8842688

EMail: noel.mcgloin@fisheriesireland.ie
Web: www.fisheriesireland.ie

3044 Lake Drive, City West, Dublin 24, IRELAND. **D24 Y265**

Help Protect Ireland's Inland Fisheries

Call 1890 34 74 24 to report illegal fishing, water pollution or invasive species.

From: Derek Milton [mailto:derek.milton@FTCO.IE]
Sent: 10 October 2017 17:19
To: Noel McGloin
Cc: Chris Cronin
Subject: FW: Derek Milton RE: EIS for a proposed development at Knockharley Landfill, Kentstown, Co. Meath

Dear Mr. McGloin,

I am following up on the email below from July to see if the IFI had any further comment in relation to the attached – it would be appreciated if you could revert at your convenience, should this be the case,

Best Regards,

Derek Milton

From: knockharley landfill scoping
Sent: 17 July 2017 15:32
To: 'Noel McGloin' <Noel.McGloin@fisheriesireland.ie>
Subject: RE: Derek Milton RE: EIS for a proposed development at Knockharley Landfill, Kentstown, Co. Meath

Dear Mr. McGloin,

Further to previous communication in relation to proposed development at Knockharley Landfill, attached (along with previous scoping report issued October 2016) is a further scoping document relating to drainage for the proposed development. It would be much appreciated if this could be reviewed to see if it raises any further comments from Inland Fisheries Ireland in relation to the proposed development, in addition to those provided in your correspondence below.

Please reply to this email with any further comments, if possible by 11th August,

Thanking you in advance,

Derek Milton

From: Noel McGloin [mailto:Noel.McGloin@fisheriesireland.ie]
Sent: 07 November 2016 16:53
To: knockharley landfill scoping <knockharleylandfillscoping@ftco.ie>
Subject: Derek Milton RE: EIS for a proposed development at Knockharley Landfill, Kentstown, Co. Meath

Dear Mr. Milton

We are in receipt of your correspondence dated 25th October, 2016.

Inland Fisheries Ireland (IFI) is a Statutory Body established on the 1st July 2010 .Under section 7(1) of the Inland Fisheries Act 2010 (No. 10 of 2010) *the principal function of IFI is the protection, management and conservation of the inland fisheries resource. Under section 7(3) of the IFI Act it is stated that without prejudice to subsection (1), IFI shall in the performance of its functions have regard to(g) the requirements of the European Communities (Natural Habitats) Regulations 1997 (S.I. No. 94 of 1997) and the need for the sustainable development of the inland fisheries resource (including the conservation of fish and other species of fauna and flora habitats and the biodiversity of inland water ecosystems),(h) as far as possible, ensure that its activities are carried out so as to protect the national heritage (within the meaning of the Heritage Act 1995).*

The EU Water Framework Directive (2000/60/EC) entered into force in December 2000 requires the protection of the ecological status of river catchments – this encompasses water quality and requires the conservation of habitats for ecological communities. One of the primary objectives of the Directive is to establish a framework which prevents further deterioration and protects and enhances the status of aquatic ecosystems. Protection of aquatic ecosystems requires that river systems be protected on a catchment basis.

Article 5 of the 2009 Surface Water Regulations requires that a public authority, in performance of its functions, shall not undertake those functions in a manner that knowingly causes or allows deterioration in the chemical or ecological status of a body of surface water. Also article 28(2) of the said Regulations states that a surface water body whose status is determined to be less than good shall be restored to at least good status not later than the end of 2015. This application is in close proximity to the Veldonstown tributary of the Nanny River whose status is *poor* and has to be restored to *good* status .

Having examined this proposal as it stands IFI is concerned about the potential generation of suspended solids, hydrocarbons and other related deleterious matter that may flow to waters. We are also concerned about the potential blocking of any waters and any proposed new channel diversions.

The Nanny River is a tributary of the River Boyne and has significant stocks of Brown Trout and lamprey.

We attach a copy of our updated Guidelines in relation to construction works.

We look forward to a copy of your EIS in due course.

Yours sincerely

Noel McGloin
Senior Fisheries Environmental Officer
Inland Fisheries Ireland - Dublin

Iascach Intire Eireann

Inland Fisheries Ireland

Telephone: +353 (0) 1 8842688

EMail: noel.mcgloin@fisheriesireland.ie
Web: www.fisheriesireland.ie

3044 Lake Drive, City West, Dublin 24, IRELAND.

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Bernie Guinan

From: Karen Donovan <karen.donovan@opw.ie>
Sent: 20 October 2017 14:32
To: Derek Milton
Subject: Re: FW: Office of Public Works Comments
Attachments: Map.pdf; OPW Comments.pdf

Derek,

Apologies for delay in replying.

This office have no further comment to make in relation to this development apart from to highlight that *New culverts/bridges on any watercourse or changes to existing structures or watercourses will require Section 50 consent from the Office of Public Works*.

Original comments made by OPW in November 2016 are attached.

Regards

Karen

On 10/10/2017 17:18, Derek Milton wrote:

> Dear Ms. Lynch,
>
> I am following up on the email below from July to see if the OPW had any further comment in relation to the attached – it would be appreciated if you could revert at your convenience, should this be the case,
>
> Best Regards,
>
> Derek Milton
>
> **From:** knockharley landfill scoping
> **Sent:** 17 July 2017 15:51
> **To:** 'maryt.lynch@opw.ie' <maryt.lynch@opw.ie>
> **Subject:** FW: Office of Public Works Comments
>
> Dear Ms. Lynch,
>
> I received an out of office response to an email reply to Karen Donovan of your office, in relation to correspondence below.
>
> Further to this previous communication in relation to proposed development at Knockharley Landfill, attached (along with previous scoping report issued October 2016) is a further scoping document relating to drainage for the proposed development. It would be much appreciated if this could be reviewed to see if it raises any further comments from OPW in relation to the proposed development, in addition to those provided in your correspondence below.
>
> Please reply to email with any further comments, if possible by 11th August,

OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

Ceann Oifig
Sráid Jonathan Swift
Baile Átha Troim
Co. na Mí
C15 NX36

Head Office
Jonathan Swift Street
Trim
Co Meath
C15 NX36

Fón/Phone: (0761) 10 6000
(046) 942 6000
Facs/Fax: (046) 948 1793
Íosghlao/LoCall 1890 213414
Suíomh gréasáin/website: www.opw.ie

Mr. Derek Milton
Fehily Timoney & Company
Consultants in Engineering & Environmental Sciences
J5 Plaza
North Park Business Park
North Road
Dublin 11

Our Ref: 873 – 2016
Your Ref: LW14/821/01/ConLet/DFM/CF
Re: Proposed Development at Knockharley Landfill, Kentstown, Co Meath

Dear Mr Milton,

I refer to your correspondence dated 25th October 2016 regarding the above.

I have attached a map showing any of the channels maintained by the Office of Public Works and the Drainage Districts (DD) channels maintained by the Local Authority along with any benefitting land in the vicinity of the site. Benefitting land is land which would have benefitted from the construction of an Arterial Drainage Scheme but which could in extreme weather events be liable to flooding. The channels maintained by the OPW are coloured blue, the channels maintained by the Local Authority are coloured red and the benefitting lands are outlined in black with a green hatch.

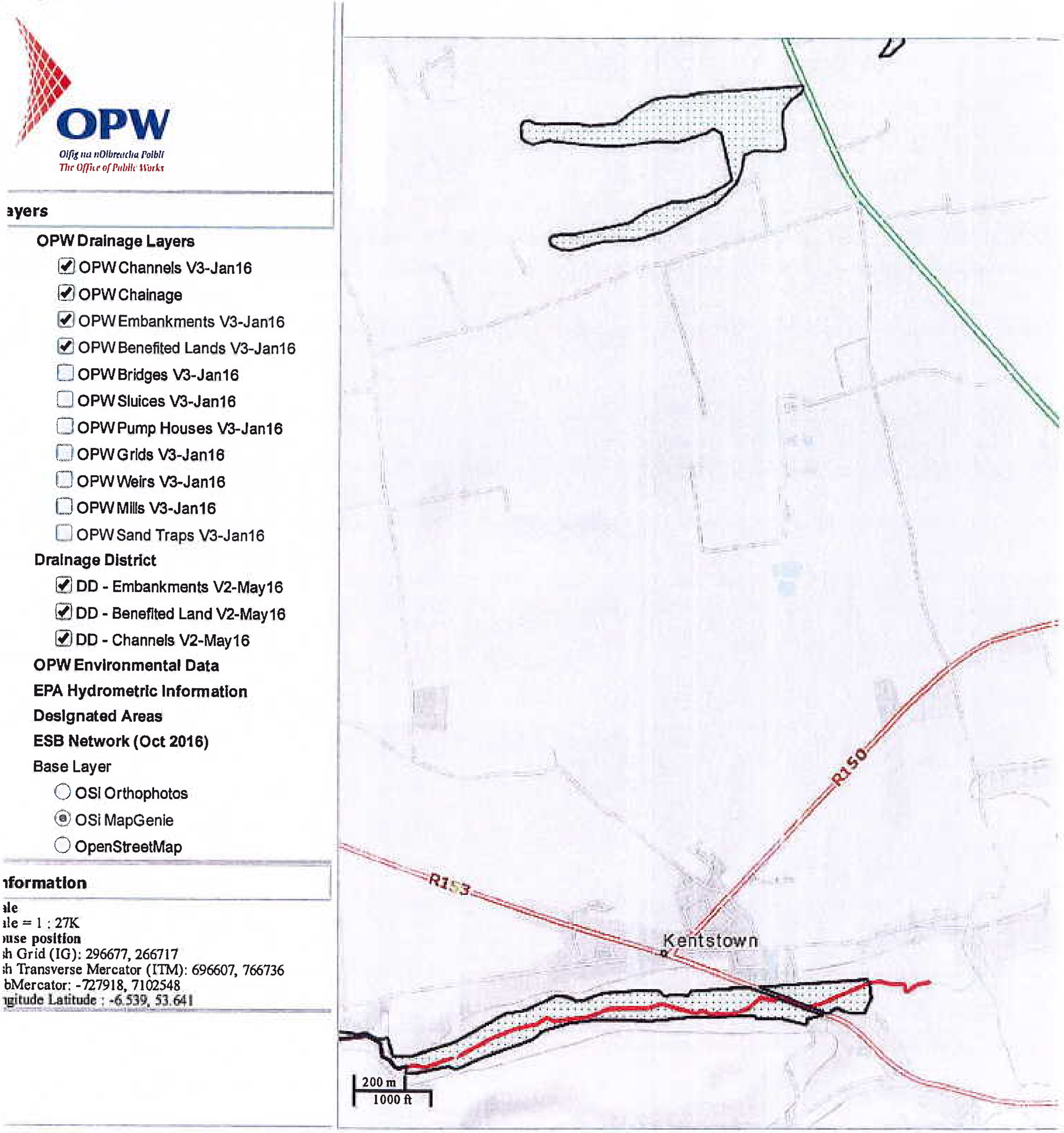
OPW Drainage channels require a 10m maintenance strip along the edge of the channel measured out from the top bank edge of the channel. This strip should not be planted or paved in any way which would prevent access for maintenance. This requirement should be applied for all drainage channels where possible to assist in the prevention of flooding.

New culverts/bridges on any watercourse or changes to existing structures or watercourses will require Section 50 consent from the Office of Public Works.

The Office of Public Works website; www.floodmap.ie has information on past flood events in Ireland. This data is obtained by searching for a specific location. Links are provided to the relevant information (reports, photos etc). The map has information on hydrometric stations, rivers lakes, river catchment areas, land commission embankments, drainage districts and benefitting lands.

Yours sincerely

Karen Donovan
Engineering Services Administration Unit
17th November 2016



OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

ayers

OPW Drainage Layers

☑ OPW Channels V3-Jan16
☑ OPW Chainage
☑ OPW Embankments V3-Jan16
☑ OPW Benefited Lands V3-Jan16
☐ OPW Bridges V3-Jan16
☐ OPW Sluices V3-Jan16
☐ OPW Pump Houses V3-Jan16
☐ OPW Grids V3-Jan16
☐ OPW Weirs V3-Jan16
☐ OPW Mills V3-Jan16
☐ OPW Sand Traps V3-Jan16

Drainage District

☑ DD - Embankments V2-May16
☑ DD - Benefited Land V2-May16
☑ DD - Channels V2-May16

OPW Environmental Data

EPA Hydrometric Information

Designated Areas

ESB Network (Oct 2016)

Base Layer

○ OSi Orthophotos
● OSi MapGenie
○ OpenStreetMap

nformation

ale
ale = 1 : 27K
use position
h Grid (IG): 296677, 266717
h Transverse Mercator (ITM): 696607, 766736
bMercator: -727918, 7102548
gitude Latitude : -6.539, 53.641

Thanking you in advance,

Derek Milton

From: Karen Donovan [mailto:karen.donovan@opw.ie]
Sent: 17 November 2016 16:42
To: knockharley landfill scoping <knockharleylandfillscoping@ftco.ie>
Subject: Office of Public Works Comments

Please find attached OPW Comments on the **Proposed Development at Kncokharley Landfill, Kentstown, Co Meath.**

The original has been issued to Mr.Derek Milton, Fehily Timoney & Company, North Road, Dublin 11.

Regards

Karen Donovan

--
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Karen Donovan,
Engineering Services Administration Unit,
Office of Public Works,
OPW Headquarters,
Jonathan Swift St.,
Trim, Co. Meath,
Ireland.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
email: karen.donovan@opw.ie
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

OPW - Ag féachaint don am atá le teacht - Ag caomhnú ón am atá thart
OPW - Looking to the future - Caring for the past

Bí Ullamh Don Gheimreadh
Be Winter Ready
Follow @emergencyIE
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

--
~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Karen Donovan,
Engineering Services Administration Unit,
Office of Public Works,
OPW Headquarters,
Jonathan Swift St.,
Trim, Co. Meath,
Ireland.
C15 NX36

Phone: 046 9426403
~~~~~~~~~~~~~~~~~~~~~~~~~~~~
email: karen.donovan@opw.ie
~~~~~~~~~~~~~~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Appendix 5.3

Records of Consultation Documentation and Responses - March 2018

FEHILY TIMONEY & COMPANY

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

Our Ref: LW14/821/01/ConLet/TR/MG

Ms. Noelle Carroll
Department of Communications, Climate Action & Environment
29 - 31 Adelaide Road
Dublin
D02 X285

noellecarroll@dcae.gov.ie

29 March 2018

RE: Proposed development at Knockharley Landfill, Kentstown, Co. Meath

Dear Ms. Carroll,

Knockharley Landfill Ltd. is applying to An Bord Pleanála (ABP), under the Strategic Infrastructure provisions of the 2000 Planning & Development Act, as amended, for permission to intensify waste acceptance at the existing landfill facility (ABP File ref: PL17.PC0223). The pre-application consultation with ABP has now closed and ABP has determined the proposed development is strategic infrastructure development.

Knockharley Landfill is located approximately 1.5 km north of Kentstown village, Co. Meath in the functional area of Meath County Council. The existing landfill facility operates under an Industrial Emission Licence (Ref. No. W0146-02) from the Environmental Protection Agency.

Knockharley Landfill Ltd. has appointed Fehily Timoney and Company to prepare an Environmental Impact Assessment Report/ Environmental Impact Statement (EIAR/EIS) for the proposed development. This letter is being issued to you as part of the scoping process for the EIAR/EIS.

You will have received correspondence relating to previously proposed development at this facility in October 2016. This correspondence related included a scoping document describing the proposed development and the approach being taken to the preparation of the EIAR/EIS. The core elements of the proposal are unchanged. It is proposed to increase the rate of waste acceptance at the site to 440,000 tonnes per annum for disposal and recovery comprising (1) the landfilling of residual non-hazardous waste and non-hazardous soils and (2) the storage of incinerator bottom ash (IBA) to facilitate future recovery. The original proposal included the development of a 40 m^2 building to facilitate the following activities:

- temporary storage of baled non-hazardous residual waste
- recovery of metals from IBA

It is now proposed to develop the following facilities:

- a 76 m^2 portal frame building in the IBA facility to facilitate:
    - weathering
    - metals recovery trials
    - crushing and washing to facilitate recovery trials
- a 73.5 m^2 building for:
    - biological treatment of residual MSW ‘fines’ material and;
    - contingency storage of recyclable bales

Cont’d...

J5 PLAZA, NORTH PARK BUSINESS PARK, NORTH ROAD, DUBLIN 11
T: Tel:+353 1 658 3500 **F:** +353 1 658 3501 **E:** info@ftco.ie **W:** www.fehilytimoney.ie
Directors: Eamon Timoney David McHugh Bernadette Guinan Beren De Hora
Company Secretary: Sinead Timoney
Registered in Ireland, Fehily Timoney & Company Ltd. Number 180497
Registered Office: Core House, Pouladuff Road, Cork. VAT Registration Number: IE6580497D

The construction of the screening berms and other infrastructure on site will require:

- Relocation of an existing 20 kVa overhead ESB powerline that provides power to the existing landfill facility administration buildings
- Felling of c. 12.5 ha of the existing conifer plantations
- Re-planting and compensation planting totalling (c.16.8 ha) will off-set loss of forestry in the proposed development footprint at the following locations:
    - replanting over screening berms
    - compensation planting on the cap over cells 25, 26, 27 and 28 in what is currently the permitted development

A drawing of the proposed development is included as an attachment to this letter.

As part of the consultation process for the EIAR/EIS, we would welcome any comments you may have on the proposed development, relevant to your area of expertise, within three weeks of the date of this letter.

If you have no comments to make, we would be grateful if you would please acknowledge receipt of this letter.

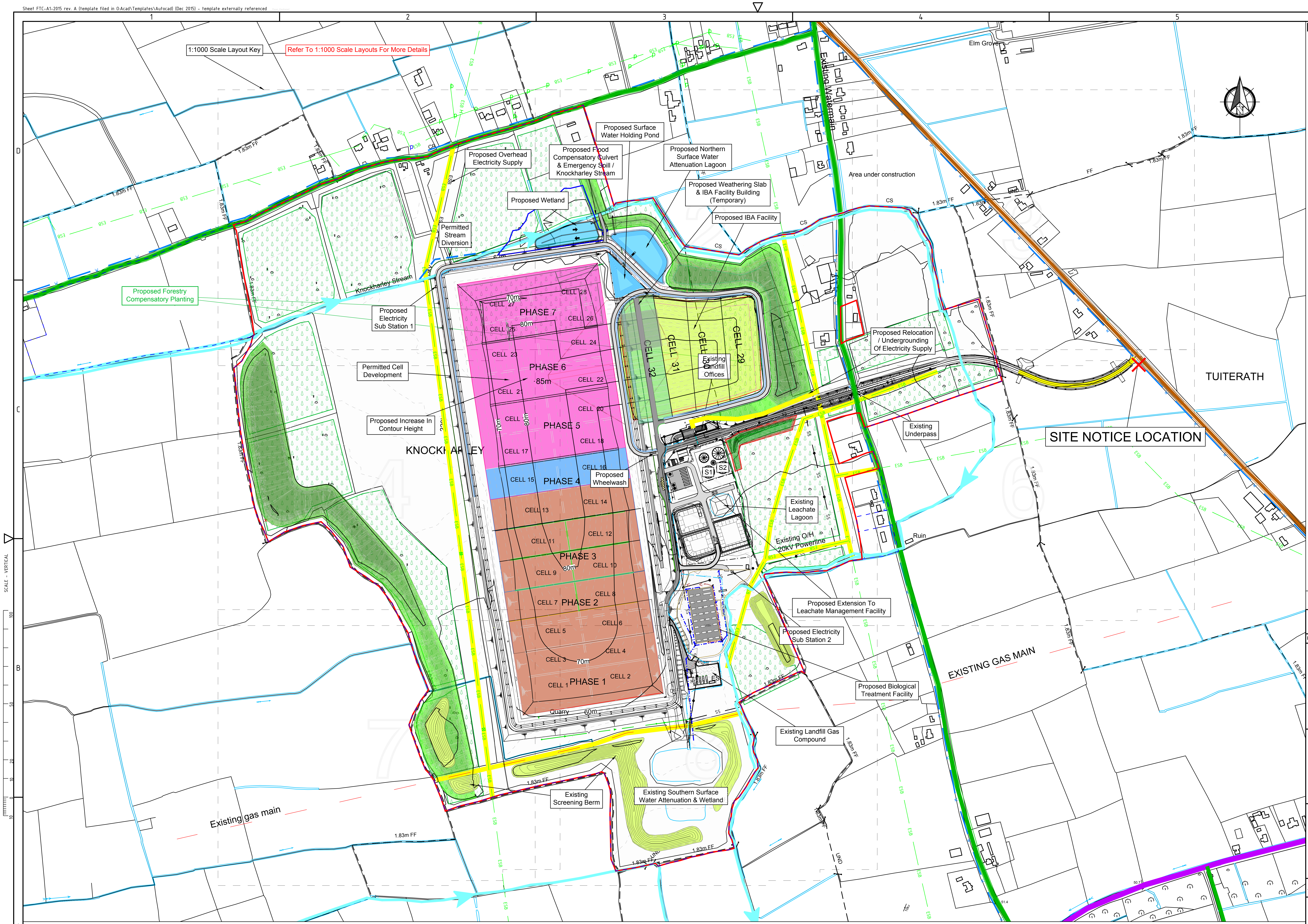
Comments or acknowledgements can be sent via email to knockharleylandfillscoping@ftco.ie.

Yours sincerely,

Bernie Guinan
for and on behalf of **Fehily Timoney & Company**

Encl.

Sheet FTC-A1-2015 rev. A (template filed in O:\Acad\Templates\Autocad) (Dec 2015) - template externally referenced



0m 38m 75m 113m 150m 188m 225m 263m 300m 338m 375m

Scale 1:3750

When Applicable : Ordnance Survey Ireland Licence No. EN 0001218 © Ordnance Survey Ireland and Government of Ireland
Ordnance Survey Sheet 2441, 2509, 2509c and 2509d

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LEGEND
Plan

—	Planning Boundary
- - -	Ownership Boundary
—	Existing Wayleave
- - —	Ground Contours
—	National Primary Route
—	National Regional Route
—	National County Route
=	Existing Watercourse
■	Landfill Cells currently being filled (2017/ '18)
■	Constructed Landfill Cells
▲	Final Forested Areas
■	Permitted Landfill Cells, To Be Constructed
■	IBA Facility
IBA	IBA, Cell 33 (Outline Only Shown For Calrity)
■	Proposed Screening Berms with Forestry Replanting
- - -	Proposed Stream Diversion

EXISTING SERVICES LEGEND
ESB Power lines — ESB — ESB — ESB —
Water Supply Pipes — W — W — W —
Storm Sewer — SS — SS — SS — SS — SS —
Telemetry & Power — T+P — T+P — T+P —
Leachate Rising Main — LR — LR — LR —
Groundwater Drainage
Leachate Collection

PROPOSED SERVICES LEGEND
Power, Telemetry & Gas
Leachate Collection
Surface Water Drain
Water Supply — WATER — WATER — WATER —
Foul Sewer gravity pumped

A	SK	CC	BG	Cork 02.03.18	Issue For Planning Application
Rev.	Drawn	Chk'd	App'd	Rev Origin Date	Description

Revision History A

EIAR/EIS

Name of Client

KNOCKHARLEY LANDFILL LTD.

Name of Job

PROPOSED DEVELOPMENT AT KNOCKHARLEY LANDFILL

Title of Drawing

PROPOSED SITE LAYOUT PLAN

Scales Used
1:3750

This Drawing was printed to A1-

Dwg. No.
LW14-821-01-P-0000-003

Rev.
A

O:\ACAD\2014\LW14\821\01\PLANNING APPLICATION\LW14-821-01-P-0000-003

FEHILY TIMONEY & COMPANY

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

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J5 Plaza, North Park Business Park,
North Road, Dublin 11, Ireland
T:+353-1-6583500, F:+353-1-6583501

ORIGINAL DRAWING SIZE A1 - (841 x 594)

SCALE HORIZ.

SCALE - VERTICAL

Meath County Council comments on Scoping Report dated October 2016

Proposal

It is proposed to apply for consent to increase waste intake at Knockharley Landfill to up to 440,000 tpa for recovery and disposal. The development proposal includes the following recovery and disposal activities:

1. landfilling of residual non-hazardous waste and non-hazardous soils
2. storage of incinerator bottom ash (IBA) to facilitate future recovery

The proposal will require the development of a dedicated storage area for IBA, in addition to the existing permitted landfill footprint. In order to increase the void capacity within the existing landfill footprint, it is proposed to raise the final profile of the landfill by up to 10-12 m.

In addition, the footprint of the existing leachate management area, which comprises a covered lagoon, will be increased to facilitate installation of a leachate treatment plant for pre-treatment of leachate generated from the landfill, prior to its removal offsite, as currently occurs.

To facilitate soils management onsite, as well as to mitigate potential impacts associated with noise and visual impact, it is also proposed to create a number of screening berms at a number of locations on the facility perimeter.
It is proposed to construct a 40 m2 building on site to facilitate the short term storage of baled waste and/or the recovery of metals from ash.

Introduction

Detailed below are Meath County Council's comments on the Scoping Report dated October 2016. Since the preparation of the Scoping Document in 2016 the EIA Directive (2014/52/EU) has been transposed into Irish Law. The Environmental Impact Assessment Report (EIA Report) should follow the requirements of EIA Directive (2014/52/EU) and have regard to original EIA Directive. The EIA should be carried out in compliance with the requirements of the relevant Directive at the time of application to An Bord Pleanala.

EIAR Sections

1. Alternatives Considered

This section should include specific reasoning for the site chosen as well as the proposed landfill design and increase in height of same and the alternatives considered. It is also important to detail the need for the increase in waste tonnage at the facility and the need for a facility for the storage of incinerator bottom ash.

2. Human Environment – Socio economic, Land Use & Amenity

The potential positive and negative impacts of the project on the local population, tourism and recreation, employment and economic activity both directly and indirectly, will need to be assessed in this Section. The current and proposed number of employees at the facility should be detailed as well as the indirect employment from the facility. This section should also assess the visual impact and impact on Protected Views given the increase in the landfill height. A full assessment of impact from odour on the local area should also be carried out given the proposed increase in the height of the landfill.

3. Noise and Vibration

A map detailing the noise monitoring locations should be provided to ensure that the noise monitoring is indicative of actual potential noise nuisance. The number of noise monitoring stations should reflect the increase in the landfill height and additional onsite ancillary facilities proposed. The noise and vibration from the consequent additional traffic movements and the potential increase in operational noise impacts from the increased height of the landfill area and the construction of the IBA storage area should be clearly assessed. It is noted that additional screening berms are mentioned to mitigate noise, details of other measures such as additional planting and noise reduction equipment, should also be clearly assessed and proposed.

4. Traffic and Transportation

Details of traffic associated with the existing, approved and proposed development should be included in the EIAR as follows:

a) The hours of operation of the facility – daily and weekly;
b) The type and frequency of vehicle used to deliver the waste to the development per day, per week and per month;
c) The details of the origin of the waste and the haul routes of the material to the site;
d) The proposed output of materials, leachate, etc. from the site daily, weekly and monthly and the haul routes of this material;
e) Details of the traffic associated with the construction phase;
f) Staff numbers associated with the existing, approved and proposed development and traffic movements generated by same;
g) Any increase in traffic as a result of the proposed development

The EIAR should also assess the carrying capacity of the adjoining road network to cater for the level of traffic anticipated and the suitability of the existing site access. The increase in waste acceptance activities at the facility has the potential to give rise to traffic congestion and capacity issues which the EIAR will need to assess.

5. Air Quality and Climate

This section needs to reference the source of waste material and the potential impacts from same as well as the dusts generated by the additional traffic movements from same. The applicant should pay attention to Meath County Council's Draft Climate Action Strategy (CAS) document that will go on public display in early May. The CAS covers 8 thematic areas which encompass 139 specific actions some of which may be of relevance to the proposed development.

6. Ecology

There are a number of designated sites located in the vicinity of Knockharley landfill. These include:

- Balrath Woods pNHA (001579)
- Thomastown Bog pNHA (001593)
- Rossnaree Riverbank pNHA (001589)
- River Boyne and River Blackwater SAC (002299)
- Duleek Commons pNHA (001578)

While there may not be direct impacts on any of these sites, indirect impacts may occur. These include the potential impacts from a discharge of contaminated run-off from the Knockharley site. Screening will have to be undertaken to determine if an Appropriate Assessment (AA) of the proposed development at Knockharley Landfill is required. If the screening assessment indicates that an AA is required, a Natura Impact Statement will be prepared and submitted to accompany the planning application and EIAR.

An Ecological Assessment should be carried out with areas of each habitat onsite provided and an evaluation of relative importance of each habitat. The potential impacts on each habitat and any protected plant and animal species should be assessed. Mitigation proposals should be clearly stated in the EIAR. The NPWS should be consulted with regard to likely impacts on designated sites, and protected plant and animal species.

7. Soils, Geology & Hydrogeology

The impact on soils/geology of the site will mainly relate to excavations required for the development of the proposed IBA storage area, the expanded leachate storage lagoons and the development of screening berms, in terms of slope stability. Current groundwater protection measures and any additional measures required should be clearly identified. Groundwater monitoring locations should be clearly shown.

8. Hydrology & Water Quality

The EIAR should assess the impact and change in run-off rates from the proposed increase in the height of the landfill area. The impact of the proposed additional berms and the felling and replanting of trees should also be assessed.

9. Landscape and Visual Impact

In order to increase the void capacity within the existing landfill footprint, it is proposed to raise the final profile of the landfill by up to 10-12 m. This chapter of the EIAR should include an appraisal of the development in the context of the Landscape Character Assessment which forms Appendix 7 of the County Development Plan 2013-2019. The views and prospects and the amenity of places and features of natural beauty or interest listed in Appendix 12 and shown on Map 9.5.1 of the County Development Plan 2013-2019 are to be considered. Photomontages should be submitted where relevant. A visual assessment from Bru Na Boinne, the Hill of Tara, the Hill of Slane and any other important archaeological sites should form part of this assessment. The visual impact from the N2 National Roadway as well as the local roadways surrounding the site should also be assessed. The current visual impact, visual impact for the lifetime of the proposed permission and the long-term site restoration impact should be clearly shown. Updated site restoration proposals, plans and photomontages will be required.

11. Archaeology, Architecture and Cultural Heritage

Research should include all archaeological, historical buildings including protected structures, and monuments or places subject to statutory protection within the study area and should include an assessment of the potential impacts, if any, arising from the development. Visual assessments from Bru Na Boinne, the Hill of Tara, the Hill of Slane and any other important archaeological sites should form part of this chapter.

____

Padraig Maguire,
Senior Executive Planner,
Meath County Council

18th April 2018

knockharley landfill scoping

From:	Caroline Corrigan <caroline.corrigan@meathcoco.ie>
Sent:	09 April 2018 13:23
To:	knockharley landfill scoping
Cc:	Larry Whelan; Patrick Gallagher; Padraig Maguire; Sean Clarke
Subject:	Proposed SID development at Knockharley Landfill

Good afternoon Bernie,

I acknowledge receipt of your correspondence dated 29th March 2018. Presently we have no comments in relation to the scoping of the proposed development. I would however like to draw your attention to our draft Climate Action Strategy (CAS) document that will go on public display in early May, the CAS covers 8 thematic areas which encompass 139 specific actions some of which may be of relevance to the proposed development. Once the document is ready for the consultation period I will forward a copy of same.

Regards,

Caroline

Caroline Corrigan, BEng(Hons) CEng MIEI
Senior Executive Engineer | Environment | Meath County Council
Buvinda House | Dublin Road | Navan | Co. Meath | C15Y291
Tel: 046-9097200 | Fax: 046-9097001

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Meath County Council?s new corporate headquarters are:
Buvinda House,
Dublin Road,
Navan,
Co. Meath, C15 Y291

Roinn Cumarsáide, Gníomhaithe
ar son na hAeráide & Comhshaoil
Department of Communications,
Climate Action & Environment

Ms Bernie Guinan,
Fehily Timoney & Company,
J5 Plaza,
North Park Business Park,
North Road,
Dublin 11.

3rd April, 2018

Re: Proposed development at Knockarley Landfill, Kentstown, Co Meath

Dear Ms Guinan,

On behalf of Department of Communications, Climate Action & Environment, I wish to acknowledge receipt of your correspondence.

The contents of your correspondence will be brought to the attention of the appropriate officials.

Yours sincerely,

Majella Dowling

Fáiltítear roimh comhfhreagras i nGaeilge

An Roinn Tithíochta,
Pleanála agus Rialtais Áitiúil
Department of Housing,
Planning and Local Government

Oifig an Aire
Office of the Minister

3 April, 2018.

Bernie Guinan
Fehily Timoney & Company
J5 Plaza
North Park Business Park
North Road
Dublin 11

Re: Proposed development at Knockharley Landfill, Kentstown, Co. Meath

Dear Ms Guinan,

I have been asked by Mr. Eoghan, T.D. Minister for Housing, Planning, and Local Government, to acknowledge receipt of your recent letter, regarding the proposed development at Knockharley Landfill, in Kentstown, Co. Meath.

The contents have been noted, and have been referred to the relevant Section in the Department for information.

Kind regards,

PP

Niamh Redmond
Private Secretary

An Roinn Tithíochta, Pleanála agus Rialtais Áitiúil, Teach an Chustaim, Baile Átha Cliath D01 W6X0
Department of Housing, Planning and Local Government, Custom House, Dublin D01 W6X0
Teil/Tel: 353 1 888 2000 Facs/Fax: 353 1 878 8640
Ríomhphost/e-Mail: minister@housing.gov.ie
www.tithiocht.gov.ie www.housing.gov.ie

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knockharley landfill scoping

From: Donncha O'Sullivan <Donncha.OSullivan@gasnetworks.ie>
Sent: 10 April 2018 16:03
To: knockharley landfill scoping
Cc: Peter Keegan; Graham Canty; Tom Considine; Jim Brohan (James); Chris Dillon (C)
Subject: Knockharley Landfill - Attn: Bernie Guinan
Attachments: GNI-DLE-4429.pdf; Code of Practice 2015.pdf

Bernie,

You recently contacted Gas Networks Ireland and requested information on its infrastructure in the vicinity of your forthcoming works. The 14m wide GNI Wayleave about the Gas Transmission Pipeline in the general area of interest to you is shown, in **RED**, on the drawing attached. Please treat all Gas Networks Ireland Drawings as 'indicative' only.

To verify the *in situ* position of the Gas Transmission Pipeline please contact Chris Dillon, 087-927 9284, chris.dillon@gasnetworks.ie. All work in the vicinity of a Gas Transmission Pipeline must be completed in compliance with the attached 'Code of Practice 2015'.

The Gas Transmission Pipeline exists within Gas Networks Ireland Wayleaves. No excavation may take place within any such Wayleave unless consent, in the form of a valid Excavation Permit, has been granted by Gas Networks Ireland. For further advice in regard to such Wayleaves please contact our Tom Considine, Tom.Considine@gasnetworks.ie.

Regards,

Donncha

Donncha Ó Sullivan BE CEng MIEI MIGEM
Development Liaison Engineer

Gas Networks Ireland
P.O. Box 51,Gasworks Road, Cork, Ireland

T +353 21 453 4613 | **M** +353 87 982 2437
E donncha.osullivan@gasnetworks.ie

gasnetworks.ie | Find us on Twitter

You are reminded that all work in the vicinity of Gas Networks Ireland Pipelines and Installations must be completed to comply fully with the relevant guidelines to be found in the current editions of the Health & Safety Authority publications, 'Code Of Practice For Avoiding Danger From Underground Services' and 'Guide To Safety In Excavations'. Both documents are available free of charge from The Health And Safety Authority. www.hsa.ie, 1890-28 93 89.

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scaipeadh den fhaisnéis, aon athbhreithniú ar nó aon úsáid eile a bhaint as, nó aon ghníomh a dhéantar ag brath ar an bhfaisnéis seo ag daoine nó ag eintitis nach dóibh siúd an fhaisnéis seo, toirimiscthe agus féadfar é a bheith neamhdhleathach. Níl Líonraí Gáis Éireann faoi dhliteanas maidir le seachadadh iomlán agus ceart na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Ní ghlacann Líonraí Gáis Éireann le haon dliteanas faoi ghnímh nó faoi iarmhairtí bunaithe ar úsáid thoirmiscthe na faisnéise seo. Níl Líonraí Gáis Éireann faoi dhliteanas maidir le seachadadh ceart agus iomlán na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Má fuair tú an teachtaireacht seo in earráid, más é do thoil é, déan teagmháil leis an seoltóir agus scrios an t-ábhar ó gach aon ríomhaire.
Féadfar ríomhphost a bheith soghabhálach i leith truaillithe, idircheaptha agus i leith leasaithe neamhúdaraithe. Ní ghlacann Líonraí Gáis Éireann le haon fhreagracht as athruithe nó as idircheapadh a rinneadh ar an ríomhphost seo i ndiaidh é a sheoladh nó as aon dochar do chórais na bhfaighteoirí déanta ag an teachtaireacht seo nó ag a ceangaltáin. Más é do thoil é, tabhair faoi deara chomh maith go bhféadfar monatóireacht a dhéanamh ar theachtaireachtaí chuig nó ó Líonraí Gáis Éireann chun comhlíonadh le polasaithe agus le caighdeáin Líonraí Gáis Éireann a chinntiú agus chun ár ngnó a chosaint. Líonraí Gáis Éireann cuideachta ghníomhaíochta ainmnithe, faoi theorainn scaireanna, atá corpraithe in Éirinn leis an uimhir chláraithe 555744 agus a tá hoifig chláraithe ag Bóthar na nOibreacha Gáis, Corcaigh, T12 RX96.

Go raibh maith agat as d’aird a thabhairt.

The information transmitted is intended only for the person or entity to which it is addressed and may contain confidential, commercially sensitive and/or privileged material. Any review, retransmission, dissemination or other use of, or taking of any action in reliance upon, this information by persons or entities other than the intended recipient is prohibited and may be unlawful. Gas Networks Ireland accepts no liability for actions or effects based on the prohibited usage of this information . Gas Networks Ireland is neither liable for the proper and complete transmission of the information contained in this communication nor for any delay in its receipt. If you received this in error, please contact the sender and delete the material from any computer.
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Thank you for your attention.

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Environmental Health Service
HSE Dublin North East
Co. Clinic
Navan
Co. Meath
Telephone: 046-9021595/9098729
Fax: 046 9022818

HSE EIS SCOPING REPORT

Environmental Health Service Consultation Report

(as a Statutory Consultee (Planning and Development Acts 2000,
& Regs made thereunder).

Date:	**26th April 2018**
Type of consultation:	**Scoping**
Planning Authority:	**Environmental Protection Agency**
Reference Number:	**2085**
EHIS Reference:	**0748**
Applicant:	**Knockharley Landfill Ltd**
Proposed Development:	**Permission to intensify waste acceptance at the existing landfill facility to 440,000 tonnes per annum for disposal and recovery comprising (1) the landfilling of residual non-hazardous waste and non-hazardous soils and (2) the storage of incinerator bottom ash to facilitate future recovery. A 76m^2 portal frame building in the IBA facility to facilitate weathering, metals recovery trials and crushing and washing to facilitate recovery trials. A 73.5m^2 building for biological treatment of residual MSW 'fines' material and contingency storage of recyclable bales. Construction of screening berms and other infrastructure, relocation of existing 20kVa overhead ESB powerline, felling 12.5 ha of existing conifer plantations, replanting 16.8 ha at Knockharley Landfill, Kentstown, Co. Meath.**

This report only comments on Environmental Health impacts of the proposed development.

Introduction

The following documents should be considered when preparing the Environmental Impact Statement:

- Guidelines on the information to be contained in EIS (2002), 187kb
- Advice Notes on Current Practice in the preparation of EIS (2003), 435kb
- Guidelines for Planning Authorities and An Bord Pleanala on carrying out Environmental Impact Assessment http://www.housing.gov.ie/sites/default/files/migrated-files/en/Publications/DevelopmentandHousing/Planning/FileDownLoad%2C32720%2Cen.pdf

Adoption of the Directive (2014/52/EU) in April 2014 initiated a review of the above guidelines. The draft new guidelines can be seen at: http://www.epa.ie/pubs/consultation/reviewofdrafteisguidelinesadvicenotes/ (Please note that the original Guidelines and Advice Notes are still applicable until such date as the final revision of the Guidelines are published.

Generally the Environmental Impact Assessment should examine all potentially significant impacts and provide the following information for each:

a) Description of the receiving environment;
b) The nature and scale of the impact;
c) An assessment of the significance of the impact;
d) Proposed mitigation measures;
e) Residual impacts.

Directive 2014/52/EU has an increased requirement to assess potential significant impacts on Population and Human Health. In the experience of the Environmental Health Service (EHS) impacts on human health are generally inadequately assessed in EIA in Ireland. It is recommended that the wider determinants of health and wellbeing are considered. Guidance on determinants of health can be found at www.publichealth.ie

In addition to the above, the following information should be included in the EIAR:

Description of the Project:

Clarification should be provided if this is the final proposal for this waste facility or will permission for new waste management processes be looked for in the immediate future.

The scoping report does not fully describe all processes outlined in the proposal. Further details should be provided of the process of recovering metal from IBA and of the biological treatment process of residual MSW 'fines' material. The proposed length of storage, the future recovery or final disposal options for IBA should be addressed in the EIAR.

The EIAR should also describe the waste acceptance criteria and identify the characteristics and volumes of the waste streams to be accepted on site. Clarification shall be provided if hazardous waste is to be handled on site.

With regard to the construction phase of the project all potential impacts should be identified and assessed. Proposed mitigation measure should be fully described. A comprehensive construction management plan outlining specific control measures should be provided in the EIAR.

Later Consents Required:
Information on possible future monitoring requirements for the operation of the landfill should be included in the EIAR.

Consideration of Alternatives:
The EIAR should fully describe and consider any alternatives to this project. The reasons for choosing the proposed treatment and disposal processes shall be outlined.

Public Consultation:
Meaningful public consultation with the local community should be carried out. It is stated that the general public will be provided with information about the project and a summary will be provided of the queries and concerns expressed. All legitimate concerns from the public shall be fully addressed and evaluated. The EIAR should clearly demonstrate how the outcome of consultation with the public influenced decision making within the EIA. This development, if not managed correctly, has the potential to generate nuisance for local residents so it is essential that thorough and robust public consultation is carried out with regards to this proposal.

Noise:
A noise survey must be carried out to assess the impact of noise from both the construction and operational phase of the proposed development on the residents living in the vicinity. Up to date baseline monitoring shall be carried out to establish the existing noise environment. All noise sensitive receptors in the vicinity of the landfill shall be identified. Appropriate noise assessment modelling should be carried out to accurately predict the change in the noise environment. This information should be

outlined and clearly displayed in the EIAR. The significance of the predicted change in the noise environment should be fully assessed and the criteria for the evaluation of the significance clearly identified.

The potential cumulative effects of other industry in the vicinity of the development should also be assessed as part of the noise survey. All mitigation measures for the control of noise shall be described.

Water:

All drinking water sources, both surface and groundwater (including individual private wells) shall be identified. Any potential impacts to these drinking water sources shall be assessed. Details of bedrock, overburden, vulnerability, groundwater flows and gradients, inner and outer zones of protection and catchment areas should all be considered when assessing potential impacts and possible mitigation measures. The EHS would recommend that all information is gathered by means of a site survey as desktop studies do not always accurately reflect the current use of water resources.

Potential impacts of surface water runoff should be assessed and mitigation measures detailed. Site drainage, increased rainfall and the possibility of flooding should all be considered when identifying possible impacts and mitigation measures.

Dust:

The impact of dust generation from construction and operation of the proposed development should be assessed. A dust minimisation plan or similar mitigation measures should be included within the EIAR.

Odour:

The potential impacts of air emissions and odour generation should be clearly assessed in the EIA. Proposals for the capture, containment and treatment of odorous air shall be outlined. The development proposes to significantly increase the volume of waste intake at the facility. Appropriate odour modelling must be carried out to accurately predict the change in odour emissions from the facility. The impact of the intensified odour emissions on the local community must be full assessed. It is stated in the scoping document there have been odour issues associated with the operation of the landfill. A full and rigorous assessment of all previous odour complaints should be carried out as part of the EIA process to uncover any information which could assist with control measures for odour on site.

Pest Control

The proposal for the new development will result in previously undisturbed land being utilised for earthworks and construction. There is a very real threat of existing rodent habitats being disrupted and destroyed. The EIAR should include a description of measures to be put in place to control rodent activity.

Litter

The increased volumes of waste proposed to be accepted on site have the potential to cause nuisance problems with regards to litter. An assessment of the impact of litter should be included in the EIAR and control measures outlined to prevent problems with litter arising.

Complaints procedure:

The EIAR should include proposals for dealing with issues of odour or nuisance from members of the public should they arise. A comprehensive operational management plan outlining working procedures on site and control measures should be provided. Details of a procedure to fully follow up and investigate complaints along with specific contact details for members of the public should also be included.

Cumulative Impacts:

In line with the EPA Guidelines on the information to be contained in Environmental Impact Statements (2002) and their Advice Notes on Current Practise in the preparation of Environmental Impact Statements (2003) the EIA should include the assessment of cumulative impacts of any other industrial or energy developments in the area e.g. quarrying, heavy industry, wind farms, composting facilities etc.

Decommissioning:

The EIAR should describe proposals for decommissioning the facility at the end of life of the project. The residual impact of the development on the environment must be fully assessed.

Lisa Maguire

Lisa Maguire
Environmental Health Officer

All correspondence or any queries with regard to this report including acknowledgement of this report should be forwarded to:

Elish O'Reilly
Principal Environmental Health Officer
Environmental Health Department
Co. Clinic
Navan
Co. Meath

UISCE
ÉIREANN : IRISH
WATER

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F: +353 1 89 25001
www.water.ie

Bernie Guinan
Fehily Timoney & Company
J5 Plaza, North Park Business Park
North Road
Dublin 11

09/04/2018

Re: Proposed Development at Knockharley Landfill, Kentstown, Co Meath

Dear Ms Guinan,

Irish Water (IW) acknowledges receipt of your letter dated 29th March regarding the Environmental Impact Assessment Report (EIAR) scoping for the above development.

In accordance with the 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' Irish Water believes that further information is required in order to scope any impacts to our assets including –

- Information on the nature, location and volume of any groundwater development for dewatering.
- Location of Aquifers, showing groundwater abstractions and any related protection zones and discharges to groundwater.
- Outline of the proposed site and demonstration of how the proposed development relates spatially to conservation sites, aquifers and groundwater abstractions.
- A geological cross section where a conservation site, groundwater abstraction or a discharge location is located within 2km of the proposed development site.

We also suggest a site investigation be carried out prior to the beginning of construction and proposals outlined for dealing with situations where works would interfere with existing water services infrastructure (watermains, service connections, rising mains, foul and surface water sewers, culverts, etc.). Irish Water notes that this development has been determined as strategic infrastructure development by ABP and is open for further discussion in relation to water services. Please also see attached our suggested scope in relation to water services.

Yours Sincerely,

P.P

Suzanne Dempsey
Spatial Planning Strategy Specialist

Response to EIAR Scoping Report Requests

IW currently does not have the capacity to advise on scoping of individual projects. However, in general we would like the following aspects of Water Services to be considered in the scope of an EIAR where relevant;

a) Impacts of the development on the capacity of water services (do existing water services have the capacity to cater for the new development if required).
b) Any up-grading of water services infrastructure that would be required to accommodate the development.
c) In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an IW collection network
d) In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks & potential measures to minimise/stop surface waters from combined sewers
e) Any physical impact on IW assets – reservoir, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets
f) Any potential impacts on the assimilative capacity of receiving waters in relation to IW discharge outfalls including changes in dispersion /circulation characterises
g) Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development (and resultant potential impact on the capacity of the source) or the potential of the development to influence/ present a risk to the quality of the water abstracted by IW for public supply.
h) Where a development proposes to connect to an IW network and that network either abstracts water from or discharges waste water to a "protected"/sensitive area, consideration as to whether the integrity of the site/conservation objectives of the site would be compromised.
i) Mitigation measures in relation to any of the above

This is not an exhaustive list.

Please note

- If a development will require a connection to either a public water supply or sewage collection system the developer is advised to contact Irish Water's Connections and Developer Services Team prior to applying for planning permission. The contact in the Eastern region is Chris Smith chsmith@water.ie
- For Information on Irish Water assets please send a query to DataRequests@water.ie

Irish Water will not normally accept new surface water discharges to combined sewer networks.

knockharley landfill scoping

From:	John Spink <John.Spink@teagasc.ie>
Sent:	09 April 2018 14:13
To:	knockharley landfill scoping
Subject:	FW: knockharley

John Spink
Head of Crop Science Dept.
Teagasc Crops, Environment and Land Use Programme
Oak Park Crops Research Centre
Carlow Ireland

D. Dial +353 (0) 599170250
Mobile +353 (0) 872043892

www.Teagasc.ie

From: John Spink
Sent: 09 April 2018 14:11
To: 'knockhartleylandfillscoping@ftco.ie'
Subject: knockharley

Your letter to Noel Culleton has been passed on to me as Noel retired in 2012. I'm afraid it's contents fall out of any area in which I would have the expertise to comment.

John Spink
Head of Crop Science Dept.
Teagasc Crops, Environment and Land Use Programme
Oak Park Crops Research Centre
Carlow Ireland

D. Dial +353 (0) 599170250
Mobile +353 (0) 872043892

www.Teagasc.ie

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Environmental Health Service
HSE Dublin North East
Co. Clinic
Navan
Co. Meath
Telephone: 046-9021595/9098729
Fax: 046 9022818

HSE EIS SCOPING REPORT

Environmental Health Service Consultation Report

(as a Statutory Consultee (Planning and Development Acts 2000, & Regs made thereunder).

Date:	**17th April 2018**
Type of consultation:	**Scoping**
Planning Authority:	**An Bord Pleanala**
Reference Number:	**LW14/821/01/ConLet/TR/MG**
EHIS Reference:	**0748**
Applicant:	**Knockharley Landfill Ltd**
Proposed Development:	**Permission to intensify waste acceptance at the existing landfill facility to 440,000 tonnes per annum for disposal and recovery comprising (1) the landfilling of residual non-hazardous waste and non-hazardous soils and (2) the storage of incinerator bottom ash to facilitate future recovery. A 76m^2 portal frame building in the IBA facility to facilitate weathering, metals recovery trials and crushing and washing to facilitate recovery trials. A 73.5m^2 building for biological treatment of residual MSW 'fines' material and contingency storage of recyclable bales. Construction of screening berms and other infrastructure, relocation of existing 20kVa overhead ESB powerline, felling 12.5 ha of existing conifer plantations, replanting 16.8 ha at Knockharley Landfill, Kentstown, Co. Meath.**

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Later Consents Required:
Information on possible future monitoring requirements for the operation of the landfill should be included in the EIAR.

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outlined and clearly displayed in the EIAR. The significance of the predicted change in the noise environment should be fully assessed and the criteria for the evaluation of the significance clearly identified.

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All drinking water sources, both surface and groundwater (including individual private wells) shall be identified. Any potential impacts to these drinking water sources shall be assessed. Details of bedrock, overburden, vulnerability, groundwater flows and gradients, inner and outer zones of protection and catchment areas should all be considered when assessing potential impacts and possible mitigation measures. The EHS would recommend that all information is gathered by means of a site survey as desktop studies do not always accurately reflect the current use of water resources.

Potential impacts of surface water runoff should be assessed and mitigation measures detailed. Site drainage, increased rainfall and the possibility of flooding should all be considered when identifying possible impacts and mitigation measures.

Dust:

The impact of dust generation from construction and operation of the proposed development should be assessed. A dust minimisation plan or similar mitigation measures should be included within the EIAR.

Odour:

The potential impacts of air emissions and odour generation should be clearly assessed in the EIA. Proposals for the capture, containment and treatment of odorous air shall be outlined. The development proposes to significantly increase the volume of waste intake at the facility. Appropriate odour modelling must be carried out to accurately predict the change in odour emissions from the facility. The impact of the intensified odour emissions on the local community must be full assessed. It is stated in the scoping document there have been odour issues associated with the operation of the landfill. A full and rigorous assessment of all previous odour complaints should be carried out as part of the EIA process to uncover any information which could assist with control measures for odour on site.

Pest Control

The proposal for the new development will result in previously undisturbed land being utilised for earthworks and construction. There is a very real threat of existing rodent habitats being disrupted and destroyed. The EIAR should include a description of measures to be put in place to control rodent activity.

Litter

The increased volumes of waste proposed to be accepted on site have the potential to cause nuisance problems with regards to litter. An assessment of the impact of litter should be included in the EIAR and control measures outlined to prevent problems with litter arising.

Complaints procedure:

The EIAR should include proposals for dealing with issues of odour or nuisance from members of the public should they arise. A comprehensive operational management plan outlining working procedures on site and control measures should be provided. Details of a procedure to fully follow up and investigate complaints along with specific contact details for members of the public should also be included.

Cumulative Impacts:

In line with the EPA Guidelines on the information to be contained in Environmental Impact Statements (2002) and their Advice Notes on Current Practise in the preparation of Environmental Impact Statements (2003) the EIA should include the assessment of cumulative impacts of any other industrial or energy developments in the area e.g. quarrying, heavy industry, wind farms, composting facilities etc.

Decommissioning:

The EIAR should describe proposals for decommissioning the facility at the end of life of the project. The residual impact of the development on the environment must be fully assessed.

Lisa Maguire

Lisa Maguire
Environmental Health Officer

All correspondence or any queries with regard to this report including acknowledgement of this report should be forwarded to:

Elish O'Reilly
Principal Environmental Health Officer
Environmental Health Department
Co. Clinic
Navan
Co. Meath

knockharley landfill scoping

From:	Environmental Co-ordination (Inbox) <Environmental_Co-ordination@agriculture.gov.ie>
Sent:	16 April 2018 14:09
To:	knockharley landfill scoping
Subject:	Knockharley Landfill proposed development at Kentstown, Co. Meath

Dear Bernadette,

I refer to your recent correspondence concerning the above.

If the proposed development will involve the felling or removal of any trees, the developer must obtain a Felling License from this Department before trees are felled or removed. A Felling Licence application form can be obtained from **Felling Section, Department of Agriculture, Food and the Marine, Johnstown Castle Estate, Co. Wexford**. Tel: 076-1064459, Web https://www.agriculture.gov.ie/forestservice/treefelling/treefelling/

A Felling Licence granted by the Minister for Agriculture, Food and the Marine provides authority under the Forestry Act 2014 to fell or otherwise remove a tree or trees and/or to thin a forest for silvicultural reasons. The Act prescribes the functions of the Minister and details the requirements, rights and obligations in relation to felling licences. The principal set of regulations giving further effect to the Forestry Act 2014 are the Forestry Regulations 2017 (S.I. No. 191 of 2017).

The developer should take note of the contents of **Felling and Reforestation Policy** document which provide a consolidated source of information on the legal and regulatory framework relating to tree felling. The policy document is available at:
https://www.agriculture.gov.ie/media/migration/forestry/treefelling/FellingReforestationPolicy240517.pdf .

In order to ensure regulated forestry operations in Ireland accord with the principles of sustainable forest management (SFM) , as well as fulfilling the requirements of other relevant environmental protection laws, the Department (acting through its Forest Service division) must undertake particular consultations and give certain matters full consideration during the assessment of individual Felling Licence applications. This includes consultation with relevant bodies, the application of various protocols and procedures (e.g. Forest Service Appropriate Assessment Procedure), and the requirement for applicants on occasion to provide further information (e.g. a Natura Impact Statement).

Consequently, when the Forest Service is considering an application to fell trees, the following applies:

1. The interaction of these proposed works with the environment locally and more widely, in addition to potential direct and indirect impacts on designated sites and water, is assessed. Consultation with relevant environmental and planning authorities may be required where specific sensitivities arise (e.g. local authorities, National Parks & Wildlife Service, Inland Fisheries Ireland, and the National Monuments Service);

2. Where a tree Felling Licence application is received, the Department will publish a notice of the application before making a decision on the matter. The notice shall state that any person may make a submission to the Department within 30 days from the date of the notice. The notices for 2018 are published online at:

https://www.agriculture.gov.ie/forestservice/publicconsultation/environmentalimpactassessmenteiapublicconsultationforafforestationforestroadconstructionandfellinglicenses2018/

3. Third parties that make a submission or observation will be informed of the decision to grant or refuse the licence and on request details of the conditions attached to the licence, the main reasons and considerations on which the decision to grant or refuse the licence was based, and where conditions are attached to any licence, the reasons for the conditions. Both third parties and applicants will be also informed of their right to appeal any decision within 28 days to the Forestry Appeals Committee. Felling Licence decisions for 2018 are published online at: https://www.agriculture.gov.ie/forestservice/publicconsultation/environmentalimpactassessment-2018registerofdecisions/

Yours sincerely,

Liz McDonnell

Liz McDonnell | *Executive Officer,**An tAonad um Chomhordú Timpeallachta, An Rannóg um Athrú Aeráide agus Beartas Bithfhuinnimh,***
Environmental Co-ordination Unit |Climate Change & Bioenergy Policy Division | environmentalco-ordination@agriculture.gov.ie
An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine
Lárionad Gnó Grattan, Bóthar Bhaile Átha Cliath, Port Laoise, Co Laoise, R32 K857
Grattan Business Centre, Dublin Road, Portlaoise, Co. Laoise, R32 K857
T +353 (0)57 868 9915
www.agriculture.gov.ie

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Ms. Bernie Guinan
Fehily Timoney & Company
J5 Plaza
North Park Business Park
North Road
Dublin 11

Dáta | Date	Ár dTag | Our Ref.	Bhur dTag | Your Ref.
18 April 2018	**TII18-101318**	

Re: EIS Scoping; proposed development at Knockharley Landfill, Kentstown, Co. Meath

Dear Ms. Guinan,

I refer to your letter of 29 March 2018 regarding the above.

TII wishes to advise that it is not in a position to engage directly with planning applicants in respect to proposed developments. TII will endeavour to consider and respond to planning applications referred to it given its status and duties as a statutory consultee under the Planning Acts. The approach to be adopted by TII in making such submissions or comments will seek to uphold official policy and guidelines as outlined in the Spatial Planning and National Roads Guidelines for Planning Authorities (DoECLG, 2012). Regard should also be had to other relevant guidance available at www.tii.ie.

The issuing of this correspondence is provided as best practice guidance only and does not prejudice TII's statutory right to make any observations, requests for further information, objections or appeals following the examination of any valid planning application referred.

With respect to access to the proposed operations, it is noted that previous EIS Scoping documentation referred indicates that the site is accessed via a direct private road access to the N2 national primary road. This implies that any proposed development or intensification of use at the landfill will rely on the direct private access to the N2 national primary road.

In that regard, the applicant/developer should be aware that official policy concerning access to national roads seeks to avoid the creation of additional access points from new development or the generation of increased traffic from existing accesses (i.e. non-public road access) to national roads, to which speed limits greater than 50 km/h apply.

The developer/applicant should consult the Meath County Development Plan, 2013 – 2019, Section 6.10.8 to ensure proposals are brought forward consistent with the provisions of the adopted plan and the foregoing official policy.

Próiseálann BIÉ sonraí pearsanta a sholáthraítear dó i gcomhréir lena Fhógra ar Chosaint Sonraí atá ar fáil ag www.tii.ie.
TII processes personal data in accordance with its Data Protection Notice available at www.tii.ie.

Bonneagar Iompair Éireann
Ionad Gnó Gheata na Páirce
Sráid Gheata na Páirce
Baile Átha Cliath 8
Éire, D08 DK10

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With respect to EIAR scoping issues, the recommendations indicated below provide only general guidance for the preparation of EIAR, which may affect the national roads network.

The developer should have regard, *inter alia*, to the following;

- Consultations should be had with the relevant local authority/National Roads Design Office with regard to locations of existing and future national road schemes; Leinster Orbital Route (LOR),
- TII would be specifically concerned as to potential significant impacts the development would have on any national roads (and junctions with national roads) in the proximity of the proposed development; N2,
- The developer should assess visual impacts from existing national roads,
- The developer should have regard to any Environmental Impact Statement (EIS) and all conditions and/or modifications imposed by An Bord Pleanála regarding road schemes in the area. The developer should in particular have regard to any potential cumulative impacts,
- The developer, in conducting EIAR, should have regard to TII Publications (formerly NRA DMRB and the NRA Manual of Contract Documents for Road Works),
- The developer, in conducting EIAR, should have regard to TII's Environmental Assessment and Construction Guidelines, including the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (National Roads Authority, 2006),
- The EIAR should consider the Environmental Noise Regulations 2006 (SI 140 of 2006) and, in particular, how the development will affect future action plans by the relevant competent authority. The developer may need to consider the incorporation of noise barriers to reduce noise impacts (see *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (1st Rev., National Roads Authority, 2004)),
- It would be important that, where appropriate, subject to meeting the appropriate thresholds and criteria and having regard to best practice, a Traffic and Transport Assessment (TTA) be carried out in accordance with relevant guidelines, noting traffic volumes attending the site and traffic routes to/from the site with reference to impacts on the national road network and junctions of lower category roads with national roads. TII's TTA Guidelines (2014) should be referred to in this regard. The scheme promoter is also advised to have regard to Section 2.2 of the TII TTA Guidelines which addresses requirements for sub-threshold TTA,
- The designers are asked to consult TII Publications to determine whether a Road Safety Audit is required,
- In the interests of maintaining the safety and standard of the national road network, the EIAR should identify the methods/techniques proposed for any works traversing/in proximity to the national road network,
- In relation to haul route identification, the applicant/developer should clearly identify any haul routes proposed (construction and operation) and fully assess the network to be traversed. Separate structure approvals/permits and other licences may be required in connection with the proposed haul route and all structures on the haul route should be checked by the applicant/developer to confirm their capacity to accommodate any abnormal load proposed.

Notwithstanding, any of the above, the developer should be aware that this list is non-exhaustive, thus site and development specific issues should be addressed in accordance with best practise.

I trust that the above comments are of use in your scoping process.

Yours sincerely,

pp **Michael McCormack**
Senior Land Use Planner

knockharley landfill scoping

From: Yvonne Jackson <Yvonne.Jackson@failteireland.ie>
Sent: 10 April 2018 12:14
To: knockharley landfill scoping
Subject: Proposed development at Knockharley, Kentstown, Co. Meath
Attachments: EIS &Tourism Guidelines.pdf

Hello Bernie,

I wish to acknowledge receipt of your recent letter to Fáilte Ireland in relation to the **proposed development at Knockharley, Kentstown, Co. Meath**
I have attach a copy of the Fáilte Ireland's Guidelines for the treatment of tourism in an EIS, which we recommend should be taken into account in preparing the EIS.

Yours sincerely,

Yvonne

Yvonne Jackson
Product Development-Activities | Fáilte Ireland | Áras Fáilte | 88/95 Amiens Street | Dublin 1
T: 01 8847224
W: www.failteireland.ie

Appendix 5.4

Pre-Application Consultation with An Bord Pleanála

An
Bord
Pleanála

Recording of Meeting
17.PC0223 1st meeting

Case Reference / Description	17.PC0223 Increased acceptance of non-hazardous waste for recovery and disposal, Co. Meath.		
Case Type	Pre-application consultation		
1st / 2nd / 3rd Meeting	1st		
Date	04/08/16	**Start Time**	11a.m.
Location	Conference Room	**End Time**	12.05p.m.
Chairperson	Philip Green	**Executive Officer**	Kieran Somers

Attendees		
Representing An Bord Pleanála		
Staff Member	**Email Address**	**Phone**
Philip Green, Assistant Director of Planning		
Pauline Fitzpatrick, Senior Planning Inspector		
Diarmuid Collins, Senior Administrative Officer		
Kieran Somers, Executive Officer	k.somers@pleanala.ie	01-8737107

Representing the Prospective Applicant		
Derek Milton, Fehily Timoney and Company		
Tim Hodnett, Knockharley Landfill Ltd		
John O'Malley, Kiaran O'Malley and Co Ltd		

The meeting commenced at 11a.m.

Introduction:

The Board referred to the letter received from the prospective applicant dated the 8th July, 2016 formally requesting pre-application consultations with the Board.

The Board advised the prospective applicant that the instant meeting essentially constituted an information-gathering exercise for the Board; it also invited the prospective applicant to outline the nature of the proposed development and to highlight any matters it wished to receive advice on from the Board.

The Board mentioned general procedures in relation to the pre-application consultation process as follows:

- The Board will keep a record of this meeting and any other meetings, if held. Such records will form part of the file which will be made available publicly at the conclusion of the process.
- The Board will serve formal notice at the conclusion of the process as to whether or not the proposed development is SID. It may form a preliminary view at an early stage in the process as to whether the proposed development would likely constitute strategic infrastructure.
- A further meeting or meetings may be held in respect of the proposed development.
- Further information may be requested by the Board and public consultations may also be directed by the Board.
- The Board may hold consultations in respect of the proposed development with other bodies.
- The holding of consultations does not prejudice the Board in any way and cannot be relied upon in the formal planning process or any legal proceedings.

Presentation by the prospective applicant:

The prospective applicant began by outlining the main issues it intended to address by way of the instant meeting. These were as follows:

- Development proposal
- Site location
- Existing development
- Elements of the proposed development
- Need for the proposed development
- Why the proposed development is considered to be strategic
- Intended submission programme

Development Proposal:

The prospective applicant stated that the proposed development is intended to facilitate the increased need for landfilling of non-hazardous municipal solid waste (MSW); the recovery, through long-term storage, of non-hazardous incinerator bottom ash (IBA); and the development of a leachate treatment/conditioning plant. The prospective applicant noted that this is a smaller scale development in the context of its previous proposal which was the subject of a pre-application consultation process under case reference number 17.PC0210.

Site Location:

With respect to the location of the subject site, the prospective applicant said that it is strategically located off the N2, has direct access to the Greater Dublin Area, and is the closest landfill facility to Carranstown and Poolbeg Waste to Energy Facilities. In terms of road access, there is a dedicated junction on the N2 leading to the facility, as well as a private access road.

Existing Development:

The prospective applicant said that the current facility, and operations as they exist are covered by an EPA Industrial Emissions Licence. This licence permits the acceptance of up to 200,000 tonnes per annum (which is constituted of 175,000 tonnes of MSW and the recovery of 25,000 tonnes of construction and demolition material). The prospective applicant referred to planning permission received from the Board under appeal case reference number PL 17.220331 which restricted disposal at the facility to 132,000 tonnes per annum until the end of 2010, and 88,000 tonnes per annum thereafter.

Elements of the Proposed Development:

The prospective applicant gave an indicative layout of the proposed development and outlined the constituent elements of this. The proposed development would have proposed inputted tonnages of up to 290,000 tonnes per annum of non-hazardous MSW and non-hazardous soils for disposal, and up to 150,000 tonnes for the recovery of incinerator bottom ash.

As regards the first element of this (non-hazardous MSW and non-hazardous soils for disposal), the proposed development would provide for:

- Additional capacity to be incorporated within the existing permitted landfill facility footprint.
- A proposal to increase the existing height profile of the landfill body.
- Additional annual capacity to provide replacement MSW capacity for closed and closing landfills, as well as contingency capacity.
- An increase in demand for non-hazardous soils capacity.

As regards the second element (recovery of incinerator bottom ash), the prospective applicant said that the proposed development would provide for:

- The recovery of IBA which is currently accepted at Knockharley from the Indaver Carranstown facility.
- The construction of a dedicated IBA storage area to facilitate the future reclamation of such material should markets be developed for this.
- The sourcing of IBA material at the existing Carranstown and Poolbeg facilities and other similar facilities should they be developed.

In response to the Board's query, the prospective applicant said that the IBA material proposed to be stored in a dedicated area on site would be kept separate from MSW. This will enable the IBA material to be re-used in the future if a market for it develops.

As regards the third element (development of a leachate conditioning plant), the prospective applicant said that this would result in a reduction of the quantity of leachate for treatment at an off-site wastewater treatment plant, and could also entail processes such as reverse osmosis, sequential batch reactors and membrane bioreactors.

Responding to the Board's query, the prospective applicant said that a dedicated lagoon would be installed for the capture of leachate arising from IBA. It added that the amount of leachate arising from this material would not be particularly high. In a general context, the prospective applicant noted that there are very limited outlets for leachate at the present time and this informs its decision to include a leachate conditioning plant as part of the overall proposal.

Need for the Proposed Development:

The prospective applicant said there is a clear need for the proposed development having regard to the following considerations:

- Providing a facility for an increased level of MSW and soils acceptance having regard to reducing national landfill capacity generally, as well as the need to manage MSW and soils disposal in the most effective possible way.

- Providing IBA management capacity having regard to the significant waste stream requiring management and to ensure the potential for future sustainable re-use opportunity, if such an opportunity arises.

- Providing for leachate treatment having regard to the need for a reduction in cost and volume, and a requirement in the reduction of loading on wastewater treatment plants.

Why the Proposed Development is considered to be Strategic:

The prospective applicant said that the proposed development clearly comes under the remit of the Seventh Schedule of the Planning and Development Act 2000, as amended, under the following category:

- An installation for the disposal, treatment or recovery of waste with a capacity for an annual intake greater than 100,000 tonnes.

Having regard also to the criteria as set out under 37A(2) of the Planning and Development Act 2000, as amended, the prospective applicant said that the proposed development would constitute strategic infrastructure in that it would have both regional and national importance, would have significance pertaining to the regional spatial and economic strategy, and would have significant effects on the functional area of more than one planning authority.

Intended Submission Programme:

The prospective applicant indicated to the Board that its intention is to lodge a formal application for the proposed development some time in the fourth quarter of 2016.

Board comments/queries:

Having regard to the previous pre-application case which was before it (case reference number 17.PC0210), the Board enquired as to why there are material changes between this and the instant pre-application case. Noting that elements such as the proposed biological waste treatment facility and the development of a hazardous waste landfill have been omitted, the prospective applicant said that these decisions were based primarily on commercial considerations.

The prospective applicant advised the Board that the Indaver Carranstown facility primarily accounts for the IBA material currently being accepted at the existing facility equating to approximately 45,000 tonnes per annum. Responding to the Board's query, the prospective applicant said that the Poolbeg facility, once operational, would likely generate 120,000 to 130,000 tonnes per annum. Taking this figure in conjunction with the amount currently being accepted from Indaver Carranstown, the prospective applicant said that there would be provision for 90% acceptance of tonnage from these two facilities. It added that this overall figure would be subject to commercial arrangements.

The prospective applicant said that there are no current proposals for the acceptance of IBA material from other jurisdictions.

With respect to the proposed intake of up to 290,000 tonnes per annum figure in relation to non-hazardous MSW and non-hazardous soils, the Board enquired as to how that figure was arrived at.. The prospective applicant replied that the figure in question is premised on striking a balance between operational and engineering capacity at the facility and what is reasonably to be expected in terms of throughput, as well as contingency factors. If the throughput of 290,000 tonnes was reached on a per annum basis, the prospective applicant said that the lifespan of the facility would likely end circa 2025-2026. The prospective applicant added that in recent times local authorities have had to invoke the provisions of section 56 of the Waste Management Act 1996 in response to capacity issues in waste disposal.

In respect of the proposal to increase the existing height profile of the landfill body, the prospective applicant advised the Board that this would be in the order of between seven to twelve metres in terms of additional height.

The Board enquired as to whether IBA material changes in any way when it is placed in storage over time, as is proposed as part of the subject development. The prospective applicant replied that there is no chemical change, but that a certain degree of solidification occurs. In respect of this material generally, the prospective applicant reiterated that it remains to be seen if a market demand for it emerges.

Responding to the Board's query, the prospective applicant said that there would be low levels of contamination in respect of soils accepted for disposal at the facility. It added that these would not be hazardous. It also noted that there has been a general increase in the demand for the disposal of soils.

In response to the Board's query, the prospective applicant confirmed that the facility is currently operating under the permission obtained under appeal case reference number PL 17.220331. There have been no further permissions.

The Board enquired as to whether there have been any discussions yet between the prospective applicant and the relevant regional authorities and local authority. The prospective applicant advised that there have not been but that there will be soon. It also said that a public consultation event is planned within the next four to six weeks. Noting this, the Board said that it may seek meetings with relevant prescribed bodies as part of the pre-application consultation process.

Conclusion:

It was agreed that, following its initial round of consultations, the prospective applicant will then revert to the Board seeking a further meeting. This request will likely be made circa mid-September, 2016. At that point the prospective applicant will give the Board feedback on its consultations and also expects to have a design for the proposed development finalised. The Board's representatives indicated to the prospective applicant that, in the meantime, they may seek a meeting with the relevant waste management body.

The meeting concluded at 12.05p.m.

P. Fitzpatrick

cc.

Philip Green

Assistant Director of Planning

An
Bord
Pleanála

Recording of Meeting
17.PC0223 2nd meeting

Case Reference / Description	17.PC0223 Increased acceptance of non-hazardous waste for recovery and disposal, Co. Meath.		
Case Type	Pre-application consultation		
1st / 2nd / 3rd Meeting	2nd		
Date	25/10/16	**Start Time**	11a.m.
Location	Conference Room	**End Time**	12.10p.m.
Chairperson	Philip Green	**Executive Officer**	Kieran Somers

Attendees

Representing An Bord Pleanála

Staff Member	**Email Address**	**Phone**
Philip Green, Assistant Director of Planning		
Pauline Fitzpatrick, Senior Planning Inspector		
Marcella Doyle, Senior Executive Officer		
Kieran Somers, Executive Officer	k.somers@pleanala.ie	01-8737107

Representing the Prospective Applicant		
Derek Milton, Fehily Timoney and Company		
Dee Stevenson, Knockharley Landfill Ltd		
John O'Malley, Kiaran O'Malley and Co Ltd		

The meeting commenced at 11a.m.

The Board referred to the previous meeting which took place on the 4th August, 2016 and asked the prospective applicant if it wished to make any comments on the record of this meeting. The prospective applicant replied that it had no comments to make.

The Board noted that this may be the final meeting in this particular pre-application consultation case. Notwithstanding this, it recommended that the prospective applicant keep the process open until it deems it necessary to close the consultations.

Presentation by the prospective applicant:

The prospective applicant began by providing an update on the project. It noted that since the time of the previous meeting with the Board, there have been some minor revisions to the proposed development. In particular, the prospective applicant drew the Board's attention to the inclusion of a facility processing building for Incinerator Bottom Ash (IBA) processing or temporary baled Municipal Solid Waste (MSW) storage. The prospective applicant said that the dimensions of the building will be 40 metres by 40 metres comparable to a typical industrial type building. The prospective applicant also noted some revisions to the proposed development layout as previously presented to the Board. These include the omission of the proposed stream diversion and the consolidation of the proposed bottom ash area.

With respect to consultations since the time of the previous meeting, the prospective applicant provided the Board with the following updates:

EPA: The prospective applicant said that a formal meeting took place with the Agency on the 29th August, 2016. Matters discussed included the potential for increased odour generation and the requirement to demonstrate appropriate means of mitigation. The prospective applicant said that the Agency enquired as to the means of classification of activities being proposed and the extent of Appropriate Assessment to be carried out (Stage 1 or Stage 2). It also wished to have more details regarding proposals related to future winning of IBA material and the requirement for indoor containment of IBA processing were it to occur. Specific licensing procedural issues were also discussed at this meeting.

Meath County Council: The prospective applicant said that a formal meeting took place with representatives from the local authority on the 7th September, 2016. Matters discussed included the nature and scale of the proposed development compared to previous developments on site and the potential for IBA or bale storage element within the proposed facility building. The prospective applicant said that the local authority's main concerns related to visual impact and odour effects on the environment. It suggested to the prospective applicant that it include elevated areas in its visual assessment and clear odour management proposals. The local authority also queried the extent of Appropriate Assessment to be carried out and emphasised the importance of public consultations.

Eastern Midlands Waste Regional Office: The prospective applicant said that a formal meeting with the EMWRO took place on the 12th September, 2016. Matters discussed included the nature and scale of the proposed development compared to previous developments on site and the breakdown of proposed input tonnages. The EMWRO also enquired as to the potential for the IBA or bale storage element within the proposed facility building. Other matters discussed included the extent of Appropriate Assessment to be carried out and any potential environmental impacts arising from the proposed development.

As regard consultations with the general public, the prospective applicant said that it has scheduled an event to take place on Monday 14th November, 2016. It intends to present information relating to the proposed development at this event and invite feedback from members of the public attending.

The prospective applicant asked the Board's advice regarding the scale of drawings to accompany the planning application. It said that it would wish to provide the best visual representation of the proposed development and remarked that drawings of a typical scale of 1:200 or 1:500 might not be adequate in this regard. The Board agreed that it would be looking for a scale of drawing which would give a proper representation of the extent of the proposed development, including technical and structural detail such as sections through the proposed landfill. It invited the prospective applicant to forward examples of drawings for its advice prior to the lodgement of any planning application. Following this, it is the intention of the prospective applicant to formally close the pre-application consultation process and request a formal SID determination from the Board.

Board comments/queries:

The Board enquired as to any policy context discussion regarding the proposed development which may have taken place between the prospective applicant and the EMWRO. The prospective applicant replied that such a discussion took place at a relatively high level. It said the view of the EMWRO is that the proposed development would be supported in a policy context. Noting this, the Board recommended that the proposed development be firmly put into a policy context in any subsequent planning application.

The Board posed the scenario of two similar facilities being potentially applied for and operational at the same time and queried how such a scenario might be considered. The prospective applicant said that it would seek to establish a price per tonne of IBA as well as securing the amount of annual storage. The producers of IBA looks for security of disposal with five year contracts, minimum, the norm. It noted that commercial and market conditions would be a matter for the EMWRO. Responding to the Board, it said it is not foreseen that material will come from the North.

The Board enquired as to the extent of Appropriate Assessment and asked if a Stage 2 (submission of a Natura Impact Statement with the planning application) is likely. The prospective applicant noted that the River Nanny Estuary and Shore SPA is approximately 25 kilometres from the proposed development. It intends to apply a precautionary approach as regards AA and that the production of an NIS is quite likely. Noting this, the Board also advised the prospective applicant to consider any indirect effects arising from the proposed development. As regards AA generally, the Board noted that it is the competent authority and that it can screen in European Sites as well as screen them out.

The potential re-use and storage of IBA material was raised by the Board. It enquired as to whether any chemical alteration or other reaction occurs when this material is in storage that might hinder its re-use. The prospective applicant replied by saying that a stabilisation/solidification process does take place in respect of the material in such storage. It added that the material in question would be stored/stockpiled in such a way as to facilitate easy access and/or reclamation. Noting this, the Board said it would be important for any planning application to formally state that the proposed method of disposal would not be prejudicial to the potential re-use of this material. The prospective applicant said that it is satisfied that the material in question would not be sufficiently altered in storage and that there would be no risks of cross-contamination in respect of other waste types. It added that its intention is to clearly outline how the IBA material will be stored and, potentially, reclaimed for use. It also confirmed that the environmental considerations of such a re-use will be included in the EIS to accompany the planning application.

Procedures:

Procedures in relation to the making of a formal planning application to it were given by the Board as follows:

- An application can only be lodged after formal notice has been received by the prospective applicant from the Board.

- The application must be made by way of full completion of an application form to the Board.

- The Board requires as a minimum that the public notice of the application would be in two newspapers circulating in the area to which the proposed development relates, one of which should be a national newspaper (A sample public notice is attached). A site notice in accordance with the protocols set out in the Planning and Development Regulations, 2001-2011 must also be erected. The date of the erection of the site notice is to be inserted; otherwise it should contain the same information as the newspaper notices and should remain in place for the duration of the period during which the public can make submissions to the Board.

- The documentation relating to the application is to be available for public inspection at the offices of the relevant planning authority and the offices of An Bord Pleanála. In this regard the requirements in terms of the number of copies of the documentation to be lodged with the relevant planning authority and the Board is as follows:

  - Planning Authority – 5 hard copies and 2 electronic copies.

  - An Bord Pleanála – 3 hard copies and 7 electronic copies.

- The Board also requires the prospective applicant to provide a stand-alone website containing all of the application documentation. The address of this website is to be included in the public notice.

- The public notice of the application is to indicate that the application documentation will be available for public inspection after the elapsment of at least 5 working days from the date of the publication of the notice so as to ensure that the documentation is in place for such inspection.

- The time period for the making of submissions by the public is to be at least seven weeks from the date the documents become available for inspection (not from the date of publication of the public notices). The Board requires that the public notice must indicate the deadline time and date for the making of submissions to the Board. It was agreed that the prospective applicant would advise the Board's administrative personnel in advance of the details of its proposed public notice and that any further definitive advice on same including confirmation of dates/times could be communicated at that stage.

- The service of notice of the application on any prescribed bodies must include a clear statement that the person served can make submissions to the Board by the same deadline as specified in the public notice.

- The service letter on the planning authority with the necessary copies of the documents should be addressed to the Chief Executive and should also alert the authority to the Board's requirement that the application documentation be made available for public inspection/purchase by the planning authority in accordance with the terms of the public notice (copies of any newspaper/site notices should be provided to the planning authority). It is the Board's intention that all of the application documentation will remain available for public inspection during the currency of the application.

- The depositing of the application documentation and the making of the application to the Board should take place immediately after the publication of the notice and the completion of the service requirements. It should not await the elapsment of the period for the public to make submissions. The application documentation should include a copy of all letters serving notice of the application on prescribed bodies and the local authority, copies of the actual newspaper notices as published and the site notice.

- The fee for lodging an application is €100,000. The fee for making a submission in respect of an application is €50 (except for certain prescribed bodies which are exempt from this fee). There is an existing provision enabling the Board to recover its costs for processing any application from the applicant. In addition, it was pointed out that the legislation also enables the Board direct payment of costs or a contribution towards same to the planning authority and third parties.

- The prospective applicant was also informed that the Board is in the process of updating its ICT system. In this regard, the prospective applicant was requested to submit the site location map in shape file format.

The sequencing of the making of the application was summarised as follows:

1. Publish newspaper notices.

2. Serve copy of relevant documents on bodies/persons required to be notified of the application. Deposit required number of copies with relevant planning authority.

3. Deposit required number of copies of application documentation with An Bord Pleanála and make an application to it.

The prospective applicant indicated its current intention to submit a formal planning application to the Board prior to the end of 2016.

Responding to the prospective applicant's query on the matter, the Board said that, typically, a two to four-week time period should be expected between the formal closure of the pre-application consultation process and the Board issuing its formal SID determination. This time period allows for the completion of the Inspector's report also.

With respect to public notices for the proposed development, the Board said that reference should be made for any application to the EPA for an Industrial Emissions Licence. This would also be the case if the site is a Seveso Site.

As regards the time period for members of the public to make written submissions/observations to the Board, the Board reminded the prospective applicant that the Christmas time period which is excluded under the legislation may have to be factored in in such calculations.

The Board said advice regarding GIS and shape files can be provided by it.

Conclusion:

Responding to the Board's query, the prospective applicant confirmed that it will be submitting a Traffic Impact Assessment (TIA) as part of the planning application. This, it said, will be informed by operational experience at the existing facility. In relation to the acceptance of IBA material at the proposed development, the prospective applicant said this would be in accordance with the existing facility's operating hours. Noting this, the Board said that any increase in traffic volumes related to the proposed development would need to be clearly set out and explained.

The Board enquired as to whether the prospective applicant has received any comments from the National Parks and Wildlife Service (NPWS) in relation to AA screening. The prospective applicant replied that it has written to the NPWS, but has to check if any response was received. The Board recommended that the prospective applicant liaise closely with the NPWS in this regard.

The Board said that a list of prescribed bodies to be formally notified of the application will be provided by it in its formal SID determination letter.

The Board also noted that it has discretion to hold an oral hearing in such cases; however, it reminded the prospective applicant not to rely on the holding of an oral hearing, particularly to expand on its case or for the submissions of any further information.

It was agreed that the prospective applicant will revert to the Board in respect of the matter of scale of drawings and comments, if any, that it wishes to make on the record of this meeting. Following this, it will be a matter for the prospective applicant to indicate if it requires a further meeting or a formal closure to the pre-application consultation process.

The meeting concluded at 12.10p.m.

Philip Green

Assistant Director of Planning

Our Ref: 17.PC0223
P.A.Reg.Ref:

Your Ref: Knockharley Landfill Limited

An
Bord
Pleanála

Private and Confidential
Derek Milton
Fehily Timoney & Company,
J5 Plaza,
North Park Business Park,
North Road,
Finglas, Dublin 11.

2nd October 2017

Re: Increased acceptance of non-hazardous wastes for recovery and disposal.
Knockharley Landfill, Co. Meath

Dear Sir,

I have been asked by An Bord Pleanála to refer further to the above-mentioned pre-application consultation request.

Please find enclosed a copy of the written record of the meeting of the 14th September, 2017 which is marked 'Private and Confidential'.

If you have any queries in relation to the matter please contact the undersigned officer of the Board.

Please quote the above-mentioned An Bord Pleanála reference number in any correspondence or telephone contact with the Board.

Yours faithfully,

Muiríosa Cassells
Muiriosa Cassells
Executive Officer
Direct Line:01-8737247

Tel (01) 858 8100
LoCall 1890 275 175
Fax (01) 872 2684
Website www.pleanala.ie
Email bord@pleanala.ie

64 Marlborough Street
Dublin 1
D01 V902

Knockharley landfill

An Bord Pleanála

Recording of Meeting 17.PC0223 3rd meeting

Case Reference / Description	17.PC0223 Increased acceptance of non-hazardous waste for recovery and disposal, leachate plant and biological treatment facility Knockharley Landfill, Co. Meath.		
Case Type	Pre-application consultation		
1st / 2nd Meeting	3rd		
Date	14th September, 2017	**Start Time**	2.30 p.m
Location	Meeting room 3	**End Time**	3.30 p.m.
Chairperson	Philip Green	**Executive Officer**	Muiríosa Cassells

Attendees		
Representing An Bord Pleanála		
Staff Member	**Email Address**	**Phone**
Philip Green, Assistant Director of Planning		
Pauline Fitzpatrick, Senior Planning Inspector		
David Curran, Senior Executive Officer	d.curran@pleanala.ie	01-8737264

Muiríosa Cassells, Executive Officer	m.cassells@pleanala.ie	01-8737247
Representing the Prospective Applicant		
Derek Milton, Fehily Timoney and Company		
John O'Malley, Kiaran O'Malley and Co Ltd		

The meeting commenced at 2.30pm

The Board referred to the previous meeting which took place on the 25th October 2016 and asked the prospective applicant if it wished to make any comments on the record of this meeting. The prospective applicant replied that it had no comments to make.
The Board noted that revised drawings were submitted to the Board on the 16th and 20th February, 2017 (hard copy) for perusal by the Board. A request to close the pre app process was received on the 31st March, 2017. A report was then prepared by the Board's reporting inspector on the 12th April, 2017. A Board Direction then followed on the 5th May, 2017 instructing the reporting team to meet with the EPA and the Eastern-Midlands Regional Waste Office
On the 13th June, 2017 the prospective applicant issued a letter to the Board withdrawing their request for a Determination.

The Records of the Board's meeting with the EPA and the EMRWO were given to the prospective applicants. They had no comments to make.

Presentation by the prospective applicant: (See Document attached)

The prospective applicant began by providing an update on the status of the project involving increased landfilling of non-hazardous municipal solid waste (MSW recovery through long term storage of non hazardous incinerator bottom ash (IBA) and the development of leachate treatment/conditioning plant. It is also now proposed to provide for a 25,0000 tpa biological treatment (composting) facility for treatment of organic residual 'fines' . The development of a facility processing building for IBA processing or temporary baled MSW storage is not now being proposed. The 25,000 tpa capacity is not additional and will be from the 290,000 tpa capacity identified for the increased landfilling.

The prospective applicants stated there is a need for the biological treatment facility due to the increased market demand for treatment of organic fines produced from recovered fuel production and further demand expected as evidenced by a number of developments proposing increased recovered fuel consumptions. Regard is had to the continued Landfill Directive implementation. The proposal supports EMWMP 2015 – 2021 Policy E15a, where further thermal capacity to be provided may relate to recovered fuel production.

Comments

A discussion ensued regarding the Board's meeting's with the EPA and the EMRWO.

The prospective applicant was advised that the Board directed it's reporting team to examine in more detail the planning and environmental authorisations for the permitted energy from waste facilities at Carranstown and Poolbeg in respect of the proposed development and requirements for recovery or disposal of the bottom ash residues.

It also asked its representatives to meet with the EPA to discuss their perspective on strategic management of this waste stream in Ireland and whether any relevant considerations arise in terms of the IED licences for the above mentioned EFW facilities

The Boards reporting team met with the EPA via conference call on the 29th May 2017 regarding the above Direction. The EPA informed the Board that it is not aware of any specific plans or obligations at national or European level vis-à-vis the use or re-use of IBA but is cognisant generally of the Governments support for recycling. It is also stated that economics and economies of scale may be an important factor in the considerations of how viable re-use is.

A meeting was held with the Eastern Midlands Regional Waste Office on the 20th July, 2017. The Regional Waste Office noted that the regional plans make reference to the exploration of alternative uses for waste streams generally. It noted that a collective approach is needed with respect to the development of the market for IBA re-use but that there was no certainty at present as to how or where the market would develop. It said that the prudent strategy might be to allow for further re-appraisal with respect to the disposal of bottom ash, should re-use in Ireland become a viable option.

The Board acknowledged that there may need to be a policy making considerations from the relevant stakeholders (e.g. Gov/NRA/NSAI etc).

The prospective applicant was advised that the waste streams and sources and figures for such should be clearly stated and robustly supported and that alternative re-use /use of waste streams should be fully assessed.

The Board made reference to the Department of Housing, Planning, Community and Local Governments Circular letter which advises on the interim Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive) which is soon to be transposed into Irish law.

Conclusion:

The Board asked the prospective applicant if it considered this to be the final meeting in this particular pre-application case or if they had any further consultations to undertake. The prospective applicant said that it had no further consultations and it believed that this would be the final meeting. The prospective applicant noted this and indicated a planning application would be lodged by it at the end of the year.

The meeting concluded at 3.30 p.m.

Philip Green

Philip Green
Assistant Director of Planning

29/9/17

An Bord Pleanála

Record of Meeting 17.PC0223

Case Reference / Description	17.PC0223 Increased acceptance of non-hazardous waste for recovery and disposal, Knockharley Landfill, Co. Meath.		
Case Type	Pre-application consultation		
Meeting	Meeting with Eastern-Midlands Regional Waste Office		
Date	20/07/17	**Start Time**	11 a.m.
Location	Offices of EMRWO	**End Time**	11.45 a.m.
Chairperson	Philip Green	**Executive Officer**	Kieran Somers

Attendees

Representing An Bord Pleanála

Staff Member	**Email Address**	**Phone**
Philip Green, Assistant Director of Planning		
Pauline Fitzpatrick, Senior Planning Inspector		
Kieran Somers, Executive Officer	k.somers@pleanala.ie	01-8737107

Representing the EPA		
Hugh Coughlan		
Emma Cassin		

The meeting commenced at 11 a.m.

The Board said that the instant meeting with the EMRWO was an information-gathering exercise from its point of view pursuant to section 37C(4) of the Planning and Development Act 2000, as amended, whereby the Board can consult with any person it considers may have information relevant to the purposes of the consultation under section 37B. A record of the meeting would be taken which would be made public at the closure of the pre application consultation process. A copy of the instant record would be forwarded to the EMRWO.

The Board noted that the function of pre-application consultations generally is to determine whether or not a proposed development would constitute strategic infrastructure, to advise on procedural issues and any other matters pertaining to proper planning and sustainable development which, in the opinion of the Board, might have a bearing on any decision.

The Board set out the progress of pre-application consultations to date. It advised the EMRWO that two meetings have been held with the prospective applicant in relation to PC0223.

With respect to the Knockharley Landfill, the Board set out the constituent elements of the proposed development as follows:

- Increased landfilling of non-hazardous municipal solid waste up to 290,000 tonnes per annum.
- Recovery through long term storage of non-hazardous incinerator bottom ash up to 150,000 tonnes per annum.
- Facility processing building for incinerator bottom ash (IBA) processing or temporary baled municipal solid waste (MSW) storage.
- Leachate treatment/conditioning plant.

The EMRWO was also informed that the prospective applicant had sought formal closure to the pre-application consultation processes. The Inspector's report had been received by the Board, but, by Board Direction dated the 5th May, 2017, the Board had deferred consideration of the case and requested the pre-application consultation team to examine in more detail the planning and environmental authorisations for the permitted Carranstown and Poolbeg Energy from Waste facilities in respect of proposals and requirements for the recovery or disposal of bottom ash; to meet with representatives from the EPA and the EMRWO to discuss their perspective on strategic management of this waste stream in Ireland and as to whether any relevant considerations arise in terms of the IED licences for the Poolbeg or Carranstown facilities.

As regards bottom ash, the Board noted that the prospective applicant in this pre-application consultation case proposes recovery by way of a dedicated storage area (where it will be stored and available subject to future market conditions).

The representatives from the EMRWO noted that they recently had a meeting with representatives of the prospective applicant.

Noting this, the Board's representatives said that a key area in relation to the need for the proposed development related to dealing with incinerator bottom ash. It was stated that the Board is seeking clarity in this area generally and as to whether there are any existing mechanisms in existence or being proposed for the potential recovery or reuse of this material. The Board noted for the record that it also recently had a meeting with representatives from the EPA in this regard.

With regard to regional plans, the Board enquired as to whether there are any specific references to the potential re-use of this waste stream at present or in the future. The EMRWO replied that the relevant plan does refer to exploring alternatives generally and does broadly support such an approach.

The Board asked if there are any policies at European level which are pertinent. The EMRWO noted that bottom ash has been used abroad with respect to building materials and as aggregate.

The representatives of the EMRWO noted that an end-of-waste status might have to be obtained with respect to such facilities; it added that such a process could potentially be lengthy and would involve a number of stakeholders. It also noted that in the absence of either End of Waste status or technical standards there is currently no substantive opportunity in Ireland for re-use of this material at present.

The Board's representatives asked the EMRWO if it had any opinion on the proposed use of bottom ash at Knockharley (i.e. storage and segregation). The EMRWO said that the viability of any proposed re-use of this material would be dependent on a variety of matters as outlined previously. The EMRWO said that a collective approach would be needed with respect to the development of this particular market. It added that there was no real certainty at present as to how or when the market would develop.

In a general context, it noted that alternative uses and approaches with regard to waste are coming on stream as time progresses.

The EMRWO noted that there are still a number of waste streams, including bottom ash, which currently do not have any alternative uses in Ireland other than export or landfill.

The Board's representatives said that any application consequent to this pre-application consultation process would have to be very clear with regard to volumes of waste and the categories of same which are included in a planning application. The EMRWO agreed with this.

Conclusion:

It was agreed that a copy of the record would be forwarded to the EMRWO. The record will be made available to the prospective applicant and will be on the public record when the pre-application consultation case is formally concluded. The EMRWO also agreed to forward on information relating to bottom ash.

The meeting concluded at 11.45 a.m.

Philip Green

Assistant Director of Planning

An
Bord
Pleanála

Record of Meeting
17.PC0223

Case Reference / Description	17.PC0223 Increased acceptance of non-hazardous waste for recovery and disposal, Knockharley Landfill, Co. Meath.		
Case Type	Pre-application consultation		
Meeting	Meeting with EPA via video conference		
Date	29/05/17	**Start Time**	3 p.m.
Location	Various incl. Offices of An Bord Pleanála	**End Time**	3.40 p.m.
Chairperson	Pauline Fitzpatrick	**Executive Officer**	Kieran Somers

Attendees

Representing An Bord Pleanála

Staff Member	**Email Address**	**Phone**
Pauline Fitzpatrick, Senior Planning Inspector		
Kieran Somers, Executive Officer	k.somers@pleanala.ie	01-8737107

Representing the EPA

Brian Meaney	Environmental Licensing Programme	

Patrick Byrne	Office of Environmental Enforcement, Dublin	
Carol O' Sullivan	Office of Environmental Enforcement, Dublin	
Mary Frances Rochford	Office of Environmental Enforcement, South East	
Damien Masterson	Office of Environmental Enforcement, South East	

The meeting commenced via video conference at 3 p.m.

The Board said that the instant meeting with the EPA was an information-gathering exercise from its point of view pursuant to section 37C(4) of the Act whereby the Board can consult with any person it considers may have information relevant to the purposes of the consultation under section 37B. A record of the meeting would be taken which would be made public at the closure of the pre application consultation process. A copy of the record will be forwarded to the Agency.

The Board noted that the function of pre-application consultations generally is to determine whether or not a proposed development would constitute strategic infrastructure, to advise on procedural issues and any other matters pertaining to proper planning and sustainable development which, in the opinion of the Board, might have a bearing on any decision.

The Board set out the progress of pre-application consultations to date. It advised the Agency that two meetings have been held with the prospective applicant in relation to PC0223.

The Board set out the constituent elements of the proposed development as follows:

- Increased landfilling of non-hazardous municipal solid waste up to 290,000 tonnes per annum.
- Recovery through long term storage of non-hazardous incinerator bottom ash up to 150,000 tonnes per annum.
- Facility processing building for incinerator bottom ash (IBA) processing or temporary baled municipal solid waste (MSW) storage.
- Leachate treatment/conditioning plant.

The EPA was also informed that the prospective applicant had sought formal closure to the pre-application consultation process. The Inspector's report had been received by the Board, but, by Board Direction dated the 5th May, 2017, the Board had deferred consideration of the case and requested the pre-application consultation team to examine in more detail the planning and environmental authorisations for the permitted Carranstown and Poolbeg Energy from Waste facilities in respect of proposals and requirements for the recovery or disposal of bottom ash; and to meet with representatives from the Agency to discuss their perspective on strategic management of this waste stream in Ireland and in a European context and as to whether any relevant considerations arise in terms of the IED licences for the Poolbeg or Carranstown facilities, or for the licensing regime for Knockharley Landfill.

As regards bottom ash, the Board noted that the prospective applicant in this pre-application consultation case proposes recovery by way of a dedicated storage area (where it will be stored and available subject to future market conditions).

The Board said that it was seeking to ascertain if the Agency is aware of any future plans at National or European level vis-à-vis the use or re-use of IBA. The Agency replied saying that it is not aware of any specific plans or obligations, but is cognisant generally of the Government's support for recycling; it added that economics and economies of scale may be an important factor in the consideration of how viable such re-use is.

The Agency referred to two applications which are before it for changes to existing licences to enable the acceptance of non-hazardous IBA. These are in respect of the Nurendale facility in County Meath and the Starrus Eco Holding Ltd facility in the Millennium Business Park. Recycling options are referred to in the licence applications

At a European level, the Agency said it was not aware of any specific plans as regards IBA. It noted for the record that the Industrial Emissions Directive (2010/75/EU) is the pertinent EU instrument in this regard. The Agency also drew the Board's attention to the revised Waste Incineration BREF which is currently at first draft stage.

Noting that the prospective applicant has advised of liaison with the Agency, the Board enquired as to the role of the Agency with respect to any future market development or requirement for IBA. The Agency stated that its remit is with regard to the end of waste criteria and that it is required to ensure that any waste residue has no environmental effects; the processes involved prior to this are a matter for the owner and operator of the facility in question.

With respect to the licensing of both the Carranstown and Poolbeg facilities, the Board enquired as to whether there are any conditions attached to these licences which would have an impact on the waste stream into the future. The Agency replied that there is a general requirement on the operators to reduce the quantity of waste; it added that this requires the operators to consider options with regard to use and re-use. Noting this, the Board asked how operators of facilities demonstrate compliance with this. The Agency replied that there is nothing specific in this latter regard, but that there would be a general requirement as part of an Environmental Management Programme. It also noted that the Carranstown facility has some metal removal involved. It also exports some of its bottom ash for backfilling of a mine in Northern Ireland. Poolbeg will not have metal removal and the material will be exported in its raw state.

why Poolbeg only?

initial
> to be assessed
pretty quickly

* In respect of the recently operational Waste-to-Energy plant at Poolbeg, the Agency noted that bottom ash produced will be presumed to be hazardous until such time as * the operator can prove otherwise.

With regard to any differing opinions on the re-use of IBA, the Board asked if the Agency itself had any views on this. The Agency considered that any divergence may be explained by different economic analyses which have been carried out.

With regard to figures proposed as part of pre-application consultations on the existing facility, the Board said that it had sought to impress upon the prospective applicant the absolute need for clarity with regard to tonnages and the waste stream.

Conclusion:

A copy of the record will be forwarded to the Agency. The record will be made available to the prospective applicant and will be on the public record when the pre-application consultation case is formally concluded.

The meeting concluded at 3. 40 p.m.

Pauline Fitzpatrick

Senior Planning Inspector

Appendix 5.5

Public Consultation

Knockharley Landfill Ltd

NOTICE OF PUBLIC CONSULTATION EVENT

Knockharley Landfill Ltd., (Waste Licence W0146-02)

is holding a public consultation event on:

MONDAY, 14TH NOVEMBER FROM 3PM-6PM

at the **KNOCKHARLEY LANDFILL FACILITY,**

KENTSTOWN, NAVAN, CO. MEATH

to advise of its submission of a planning application

for development at the landfill facility.

All welcome.

Comment Card

Name (optional) Elizabeth Mc Ardle

Comment:

Thank you for your time

1) You have forgotten that this process omits the most important element of all – the earth. To be healthy we need a healthy earth. This proposal does not take this into account.

2) Do you ~~[illegible]~~ propose reduction of packaging to reduce waste, so this process would not be needed.

Date:

3) Would you trade places with a local person and live here. If the answer is no, You have to think again

Knockharley Landfill
Kentstown

LW14-821-01

Visitor Sign in Sheet Knockharley

	Date	Name	Time in	Time out
1	Nov. 14/11/	Mary Morgan	3·00.	
2	No 14/11	Marian Kelly	3:00	
3	Nov 14/11/16	Theresa Clarke	3.00	
4	Nov 14/11/10	[illegible] mc Comes	3:35	
5	"	John & Elizabeth Hoverney	3.50 pM	041-9825294
6	"	Elizabeth Mc Ardle	4:40	
7	"	Aidan Lawlor	5·00	
8	"	Sean Mc Govern	5 00.	
9	"	Angela Murray	5,25	
10		[illegible] Murray		
11	"	Peter Connell	5.25	
12	14/11/16	[illegible] K. Finegan	5.30	
13		[illegible]	?	
14		Joseph K.LMARTIN	5·30	
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APPENDIX 7.1

Odour Impact Assessment

sensory experts since 1980

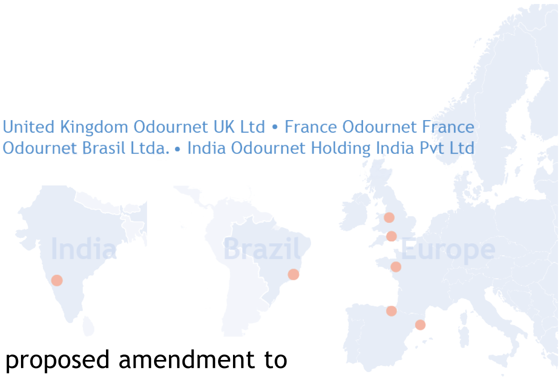
Report

Odour impact assessment of a proposed amendment to operations at Knockharley Landfill

Client: Fehily Timoney & Co.
Core House
Pouladuff Road

Report number: Appendix 7.1 OIA
Project code: FETI18A

Date: 14 August 2018 (August 2018)



title: Odour impact assessment of a proposed amendment to operations at Knockharley Landfill

report number: Appendix 7.1 OIA

project code: FETI18A

key words:

client: Fehily Timoney & Co.
Core House
Pouladuff Road
Cork
T12 D773

contact: Tanya Ruddy

contractor: Odournet UK Ltd
Unit 7 Anglo Business Park
Bristol
BS15 1NT
01225 868869 phone
Companies House Cardiff 2900894

uk@odournet.com

authors: Andrew Meacham, Nick Jones

approved: on behalf of Odournet UK Ltd by

Mr. Nick Jones, director

date: 14 August 2018

Executive Summary

This report presents the results of an odour impact assessment of the proposed development of Knockharley landfill site, County Meath. The study was conducted by Odournet UK Ltd under instruction from Fehily Timoney and Company Ltd. on behalf of Knockharley Landfill Ltd.

The overall objective of the study was to assess whether and how the odour emissions and exposure generated from the landfill facility are likely to change as a result of the proposed development at the site.

The development involves an increase in the volume of waste which will be accepted by the site from the current level of 88,000 (for disposal) to 440,000 tonnes per annum.

Table 1: Summary of operations

Summary of changes to operational conditions	Current planning	Proposed development
Biodegradable municipal waste and fines (tpa)	40,000	65,000
Biological treatment facility in operation (tpa)	no	25,000
Filling of stabilised, inert waste and MSW* (tpa)	48,000	225,000
Acceptance of incinerator bottom ash (tpa)	yes**	150,000

*non-biodegradable fraction
**IBA tonnage included in stabilised and inert fraction

The proposed development will include:

- Construction of a biological waste treatment facility to process municipal solid waste fines (MSW fines).
- Intensification of the existing permitted landfill by increasing the final height profile. The height increase is proposed to be 11 m to take it to a height of 85 m OD. The intensification if sought is for future landfilling operations only.
- Construction of an incinerator bottom ash (IBA) facility to the north of the site office to accept up to 150,000 tonnes per annum of IBA. This will include the construction of dedicated cells for the acceptance, placement and storage of IBA until a market is identified for the recovery of IBA.
- Modification of landfill operations so that stabilised waste from biological waste treatment and other inert wastes will be placed from cells 27/28 and move south. Non-stabilised waste will not be placed north of cells 21. The progressive filling of MSW will continue in a northerly direction up to cell 21. The proposed filling schedule therefore limits the proximity of activities associated with waste handling and landfill gas generating areas with respect to local receptors.
- The construction and operation of a leachate management facility which includes plans to add 2 no. additional leachate lagoons and several leachate tanks to handle the increased leachate from the expansion of the landfill and the operation of the IBA facility.
- Enhancement of the intermediate capping system from stitched geo-multicover and recovered soils and construction and demolition waste to hermetically sealed geo-multicovers, to provide tighter control of potential fugitive landfill gas emissions and increase the volume of gas extracted to the landfill gas generation plant.

The specific objectives of the study are as follows:

1. To estimate the magnitude of odour emissions that are likely to be generated from the site under current and proposed operational (baseline) conditions and gain an understanding of the main contributors to such emissions.
2. To assess the odour exposure levels that are likely to occur around the site under baseline conditions.
3. To assess how emissions from the site are likely to change in the future if the proposed development (including an increase in amount of waste accepted) is implemented; and assess the implications of these changes on odour exposure and impact risk.

The study was conducted using odour impact assessment techniques that comply with the requirements of the Irish EPA AG4 guidance note[1] and guidance published by the UK Environment Agency[2] and UK Institute of Air Quality Management[3], and involved development of an odour dispersion model for the site which was used to assess predicted offsite odour exposure and impact risk. The model was developed using source emission data that was defined in terms of European odour units, which were calculated using a combination of site specific odour survey data, data contained within the Odournet UK Ltd odour emission library, and gas emission estimates derived from a landfill gas production model of the site provided by Fehily Timoney and Company. A cross check of the plausibility of the emission estimates defined in the model was also undertaken for current operational conditions using field assessment techniques based on the European standard EN 16841-2:2016[4].

In order to assess the implications of the landfill over its operational life in comparison to the situation which would occur if the development did not go ahead (do nothing), the following operational scenarios were considered:

- Scenario 0: Baseline conditions in 2018.
- Scenario 1: Year 4 ‘do nothing’. The situation which is likely to occur in the final active deposition stages of the landfill if it continues to operate in line with current planning and licence conditions (i.e. the development does not go ahead).
- Scenario 2: Year 4 of proposed development.
- Scenario 3: Year 6 of proposed development. The situation which will occur in the final stages of the landfill if the development proceeds.

In order to compare the scenarios and assess the implications of the development in terms of odour impact risk, the following criteria were selected to assess the threshold at which a potentially significant impact could occur in EIA terms based on a review of relevant Irish and UK guidance:

- Landfilling operations (high offensive odours) threshold: $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$.
- Biological treatment facility emissions (moderately offensive odour) threshold: $C_{98,\ 1\text{-hour}} \geq 3\ ou_E/m^3$.

The key findings of the study are summarised as follows:

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[1] Irish EPA (2010). Air Dispersion Modelling from Industrial Installations Guidance Note (AG4). Irish EPA

[2] IPPC H4 Technical Guidance Note “H4 Odour Management”, Environment Agency (England), March 2011.

[3] Guidance on the assessment of odour for planning, Version 1.1 - July 2018, Institute of Air Quality Management, UK

[4] BS EN 16841-2:2016, Ambient air — Determination of odour in ambient air by using field inspection.

1. The total odour emissions generated from landfilling activities are predicted to decrease as a result of the proposed development in comparison to current baseline levels and the emissions that would occur if the proposal did not go ahead (2022). This is due to the enhancement in capping proposed as part of the development and the fact that the majority of additional waste which will be accepted by the landfill is stabilised, inert or non-biodegradable and hence has a low odour generation potential. Additional emissions will be generated from the biological waste facility, however, such emissions will be treated in an odour control system prior to release through a 20 m stack which will enhance dilution and dispersion.
2. The odour exposure levels that are predicted to occur around the site as a result of landfilling operations are predicted to be lower than the current baseline and the 'do nothing' situation for the first 4 years, if the development goes ahead. The development is therefore predicted to have a beneficial effect on odour exposure and impact risk during this period. The number of houses exposed to odour levels that exceed the threshold where a potentially significant risk of odour impact could develop falls from twelve no. under baseline conditions and ten no. in year 4 of 'do nothing', to four no. in year 4 of the development.
3. A risk of impact will remain whilst the landfill is operating beyond year 4 which is predicted to be at its highest in the final year of the landfill (year 6). Under this scenario, six no. properties are predicted to be exposed to odour levels that exceed the threshold where a potentially significant risk of odour impact could develop.
4. The emissions from the biological treatment facility are not predicted to pose any risk of impact at any area within or outside the facility.
5. The overall conclusion of the study is that the development will have a beneficial effect on odour exposure and impact risk in comparison to the do-nothing scenario in the next four years. A residual risk of impact will remain to up to four no. properties during this period and up to six no. properties until the landfill is completed, based on application of the precautionary indicative odour impact criteria applied in the study.

Table of Contents

1 Introduction and scope

1.1 Introduction and scope

This report presents the results of an odour impact assessment of the proposed development (including a proposed increase in amount of waste accepted) at Knockharley landfill, County Meath. The study was conducted by Odournet UK Ltd under instruction from Fehily Timoney and Company Ltd., on behalf of Knockharley Landfill Ltd.

The overall objective of the study was to assess how the odour emissions and exposure generated from the facility are likely to change as a result of the proposed development and associated changes to operations at the site.

The specific objectives of the study are as follows:

1. To estimate the magnitude of odour emissions that are likely to be generated from the site under current operational (baseline) conditions and gain an understanding of the main contributors to such emissions.
2. To assess the odour exposure levels that are likely to occur around the site under baseline conditions.
3. To assess how emissions from the site are likely to change at selected times in the future if the proposed development (including an increase in amount of waste is accepted) is implemented; and assess the implications of these changes on odour exposure and impact risk.

This report describes the approach, results and conclusions of the study.

1.2 Structure of report

The report is structured as follows:

- Section 2 provides an overview of the study area and an introduction to the proposed development.
- Section 3 describes the methodology applied to conduct the impact assessment adopted for the study.
- Section 4 identified the activities that have the potential to generate odour associated with the existing site and proposed development and explains how emission estimates were derived.
- Section 5 describes the results of an odour impact assessment for current and baseline conditions using odour dispersion modelling to assess predicted odour exposure levels.
- Section 6 summarises the conclusions of the study.

Supporting information is provided in the Annex.

1.3 Quality Control and Assurance

Odournet's odour measurement, assessment and consultancy services are conducted to the highest possible quality criteria by highly trained and experienced specialist staff. All activities are conducted in accordance with quality management procedures that are certified to ISO9001 (Certificate No. A13725).

All sensory odour analysis and odour sampling services are undertaken using UKAS accredited procedures (UKAS Testing Laboratory No. 2430) which comply fully with the requirements of the international quality standard ISO 17025: 2005 and the European standard for olfactometry EN13725: 2003. Where

required, Odournet is accredited to conduct odour sampling from stacks and ducts in accordance to ISO 17025: 2005 and EN13725: 2003 under the MCERTS scheme. Odournet is the only company in the UK to have secured UKAS accreditation for all elements of the odour measurement and analysis procedure.

The Odournet laboratory is recognised as one of the foremost laboratories in Europe, consistently outperforming the requirements of the British Standard for Olfactometry in terms of accuracy and repeatability of analysis results.

2 Overview of study area

2.1 Site location and overview of odour complaints

Knockharley landfill is located near Kentstown in County Meath, Ireland. The site lies to the west of the N2 national primary road and to the north of the regional road R150 in a rural location.

The location of the site in relation to nearby residential properties is illustrated in Figure 1 below.

Figure 1: Location of site

Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Selected nearby residential properties presented as blue stars

The site has been linked to a number of historic odour complaints as illustrated in Table 2 below:

Table 2: Historical odour complaints

Year	No. of odour complaints	No. of locations
2016	140	27
2017	21	8
2018 (to April)	5	4

Review of the table indicates that 140 complaints were reported in 2016 from 27 locations. This compares to 21 complaints from 8 no. locations in 2016 and 5 no. complaints from 4 locations in 2018[5] (as of April 2018). It is understood that during 2016 the landfill accepted additional waste under Section 56 of the Waste Management Act and in response to the level of odour complaints at the facility, the EPA carried out 62 sensory assessments of ambient odour levels around the site and issued a non-compliance in relation to odour nuisance pertaining to 3 of those 62 assessments.

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[5] Including one anonymous location

Figure 2: General location of odour complaints in 2017/18

Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Approximate locations from which complaints are understood to be generated are indicated by orange stars.

2.2 Description of site activities

2.2.1 Current operational conditions.

The existing landfill currently has permission to accept 88,000 tonnes per annum (tpa) of domestic, commercial, industrial and construction wastes. The facility is licensed to accept waste between the hours of 08:00 to 18:00 Monday to Saturday inclusive.

The landfill is made up of 7 No. phases, with each phase segregated into 4 No. cells. As of April 2018, Cells 15/16 of Phase 4 were the active cells, with cells 1 to 10 complete and permanently capped. Cells 11 and 12 have been completed with application of the final cap partially applied to each of these cells.

Incoming waste is transported to the site by road. Waste lorries enter the site via the access road from the N2 and waste is conveyed and deposited directly into the active filling area. Following deposition, the waste is compacted by front-end loader to form waste lifts approximately 2.5 m high. As part of the existing site licence, the depositional area is restricted to an area of 625 m^2. Outside of operating hours a daily cover is applied to the active cell. Once filling of a cell is complete, intermediate caps are scheduled to be constructed 6 months after completion. A permanent cap is then applied the following year. 2 No. cells are normally worked on in parallel; the depositional area is still restricted to an area of 625 m^2.

The construction and development of each filling cell incorporates measures to allow collection of leachate and landfill gas that is generated within the waste mass.

Landfill gas extracted by these systems is directed to 4 No. gas engines for energy generation, or to enclosed flares for combustion. The combined capacity of the gas engines is 3,600 m^3/hr. Three enclosed flares give a combined capacity of 5,500 m^3/hr. The gas compound is situated to the east of Phase 1 of the landfill. A 500 m^3/hr open flare is also present for odour control by flaring of landfill gas within the active cell. In accordance with the licence, stack emissions monitoring is carried out annually and the results are reported to the EPA.

Leachate is collected through a leachate drainage layer and is then pumped to a covered leachate lagoon located to the east of the landfill area from which it is periodically loaded to tankers. Displaced air during filling is passed through a carbon filter to minimise odorous emissions and exported offsite.

2.2.2 Description of proposed development (including increase in waste accepted)

The proposed development is for the acceptance of 440,000 tonnes per annum of wastes, which will comprise up to 150,000 tonnes of incinerator bottom ash (IBA), as well as household, commercial and industrial wastes including residual fines, non-hazardous contaminated soils, construction and demolition (C&D) wastes and baled recyclables.

A summary of the waste that will be accepted is presented in table below:

Table 3: Summary of quantities of each waste type received per annum

Year	Biodegradable municipal waste and fines [tonnes]	Stabilised and inert waste and MSW* [tonnes]	Incinerator bottom Ash [tonnes]	Total waste accepted [tonnes]
Year 1-5	65,000	225,000	150,000	440,000

* non-biodegradable fraction

The proposed development will include the following aspects:

- Construction of a biological waste treatment facility to process 25,000 tpa municipal waste fines (MSW fines). (This tonnage is included in the stabilised fraction in Table 3.)
- Intensification of the existing permitted landfill by increasing the final height profile. The height increase is proposed to be 11 m to take it to a height of 85 m AOD. The intensification if sought for future landfilling operations only.
- Construction of an incinerator bottom ash (IBA) facility to the north of the site office to accept up to 150,000 tonnes per annum of IBA. This will include the construction of dedicated cells for the acceptance, placement and storage of IBA until a market is identified for the recovery of IBA.
- Modification in the filling schedule so that stabilised waste from biological waste treatment and other inert wastes will start filling at cells 27/28 and move south. Non-stabilised MSW will not be stored above cells 21. It will continue to be landfilled in a northerly direction.
- The construction and operation of a leachate management facility which includes plans to add 2 No. additional leachate lagoons and several leachate tanks to handle the increased leachate from the expansion of the landfill and the operation of the IBA facility.
- Enhancement of the intermediate capping system from stitched geo-multicover and recovered soils and construction and demolition waste to hermetically sealed geo-multicovers, to provide tighter control of potential fugitive landfill gas emissions and increase the volume of gas extracted to the landfill gas generation plant.

The proposed biological waste treatment facility will allow the treatment of biodegradable MSW fines by maturation/composting in concrete tunnels. Operations will take place in a sealed building operating under negative pressure thus minimising the risk of fugitive odorous emissions.

The biological waste treatment facility will stabilise MSW fines prior to deposition within the landfill. This waste, along with other stabilised waste from other biological treatment facilities and inert wastes such as soil and stone, bulky waste and street sweepings etc. will be filled from the most northern cells (27/28), with filling moving south to join the filling of the non-stabilised waste at cell 21 so as maintain landfill gas generating waste as far away from receptors on the northern boundary as possible.

Permission is also sought to store IBA until recovery outlets are identified and conduct trials to prepare IBA for recovery and removal off site. The IBA facility will consist of 5 no. cells which will be constructed in accordance with the requirements of the Landfill Directive 99/31/EC for non-hazardous wastes. A final post settlement contour height of 85 AOD is proposed. The facility (cells 29-32) will be created to the north of the weighbridge and east of cells 20-26. The 5th cell will be constructed in the wedge between the landfill and the IBA facility. This will be used to store the 150,000 tonnes per annum of incinerator bottom ash (IBA). If the facility attracts waste at the maximum rate, the landfill is expected to run out of void during year 6. At that point both the IBA facility and the biological treatment facility will continue to operate.

3 Methodology applied for the odour impact assessment

3.1 Operational scenarios identified for consideration

The objective of the study was to evaluate the implications of the proposed developments and changes to the site licence in terms of offsite odour emission exposure and impact risk during the lifetime of the site.

In order to achieve this objective, the study assessed the odour emissions and exposure levels under the following operational scenarios:

- Scenario 0: Baseline conditions in 2018.
- Scenario 1: Year 4 ‘do nothing’. The situation which is likely to occur in the final active deposition stages of the landfill if it continues to operate in line with current planning and licence conditions (i.e. the development does not go ahead).
- Scenario 2: Year 4 of proposed development.
- Scenario 3: Year 6 of proposed development. The situation which will occur in the final stages of the landfill if the development is accepted.

The assumed waste inputs into the site under these scenarios are summarised in the table below.

Table 4: Summary of waste inputs for each modelled scenario

Summary of changes to operational conditions	Current operations (2018)	Future operations		
		Scenario 1: Do nothing Year 4 + active deposition	Scenario 2: Proposed development Year 4	Scenario 3: Proposed development Year 6
Biodegradable municipal waste and fines (tpa)	40,000	40,000	65,000	65,000
Biological treatment facility in operation (tpa)	no	no	25,000	25,000
Total landfill gas generation potential (m^3/hour)	1,620	1,438	2,059	2,150
Filling of stabilised, inert waste and MSW* (tpa)	48,000	48,000	225,000***	225,000***
Acceptance of incinerator bottom ash (tpa)	yes**	yes**	150,000	150,000

*non-biodegradable fraction
**IBA tonnage included in stabilised and inert fraction
***inclusive of 25,000 tpa stabilised in biological treatment facility

3.2 Estimation of odour emissions

For each operational scenario, the odour emissions generated from the landfill were estimated in terms of European odour units by development of a ‘site emission model’ using on-site odour measurements of the waste and landfill gas, operational details of the site supplied by the client and estimation of gas leakage using a landfill gas production model (current and future operating scenario).

In order to assess the veracity of this model and how it is likely to compare to real world conditions, a series of field assessments were also conducted under the current baseline conditions. This dual approach for assessment is consistent with current best practice.[6]

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[6] Guidance on the assessment of odour for planning, Version 1.1 - July 2018, Institute of Air Quality Management, UK

Further details of these techniques are presented below.

3.2.1 Development of a site emission model.

The site emission model was developed using the following data:

1. On site odour emission measurements of freshly deposited waste and the surface of the intermediate capping and odour concentration measurements of the site landfill gas. These measurements were conducted using standardised odour sampling and analysis techniques in accordance with Odournet's UKAS accredited source sampling procedures (UKAS laboratory number 2430) which complied fully with EN13725:2003.
2. Emission estimates from other landfills collated by Odournet during the last 25 years.
3. Landfill gas generation and leakage estimates derived from a calibrated Landgem gas model of the site prepared by Fehily Timoney and Company Ltd.

Further details of this data are provided in this report.

3.2.2 Logic check by offsite field survey (baseline only)

Offsite field surveys (dynamic odour plume tracking assessments) were conducted to provide an assessment of the landfill emissions under current operating conditions, to evaluate whether the estimates derived from the emission model approach described above were reasonable and thereby validate the emission prediction approach required to define emission estimates for the landfill under future operational conditions.

The field assessments were conducted using a method that was drawn from the European standard EN 16841-2:2016[7]. The specific method applied during this study involves determination of the extent of the odour plume(s) generated from the odour source under defined meteorological conditions by continuously traversing the plume(s) using a team of trained observers.

The observations of plume extent are used alongside meteorological data at the time of the assessments to estimate the magnitude of emissions using air dispersion modelling software (AERMOD). Further information is provided in Annex C.

3.3 Odour dispersion modelling and impact assessment

3.3.1 General approach

The emission estimates using the process described above were then input into a dispersion model which was applied to assess the level of exposure to odour that is likely to occur around the site under the full range of meteorological conditions representative of the area. The outputs of the model were then compared against published odour impact criteria (see below) to assess how the risk of odour impact is likely to change as a result of the development.

The model was constructed using the AERMOD atmospheric dispersion model published by the US Environmental Protection Agency (US EPA), with meteorological data sourced from Dublin airport. Impact risk was assessed on the basis of the worst case meteorological year from a 5 year data set of sequential hourly average data. Further details of the dispersion model and the reasons for selecting this model are presented in Annex B

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[7] EN16841-2:2016, 2016 Ambient air — Determination of odour in ambient air by using field inspection.

The model was constructed and applied in accordance with guidance published by the model developer (the US EPA) and relevant guidance published by the Irish EPA[8], the UK Environment Agency[9] and the Institute of Air Quality Management (IAQM)[10].

Further details of the assumptions applied to develop and apply the model are presented later in this report.

3.3.2 Odour exposure criteria

In general terms, odour impact is recognised as a symptom that develops because of intermittent but regular exposure to odours that are recognisable and have an offensive character. The key factors that contribute to the development of odour annoyance can be usefully summarised by the acronym FIDOL:

- **F**requency of exposure
- **I**ntensity or strength of exposure
- **D**uration of exposure
- **O**ffensiveness
- **L**ocation sensitivity

In acknowledgement of these factors, odour impact assessment techniques have been developed in Europe and internationally that involve the application of atmospheric dispersion models and indicative odour impact criteria. These criteria are generally defined in terms of a minimum concentration of odour (reflecting the intensity/strength element of FIDOL) that occurs for a defined minimum period of time (reflecting duration and frequency element of FIDOL) over a typical meteorological year. The concentration element of these criteria can be increased or lowered to reflect variations in the offensiveness of the odours released from a specific type of facility, and the sensitivity of nearby sensitive locations.

The unit used to express exposure concentration in these criteria is the European odour unit (ou_E), which is further described in Annex A.[11]

In the UK and Ireland, the most commonly applied odour impact criteria are derived from research conducted by the UK Environmental Agency which were originally published in the UK guidance note H4. These criteria are also referenced in more recent guidance note AG4[12] published by the Irish Environmental Protection Agency. The criteria define odours in three offensiveness brackets as indicated in the table below and have been designed for application to permanent residential properties which are considered to be the most sensitive from an impact risk perspective.

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[8] Irish EPA (2010). Air Dispersion Modelling from Industrial Installations Guidance Note (AG4). Irish EPA

[9] IPPC H4 Technical Guidance Note “H4 Odour Management”, Environment Agency (England), March 2011.

[10] Guidance on the assessment of odour for planning, Version 1.1 - July 2018, Institute of Air Quality Management, UK

[11] EN13725: 2003. Air Quality: Determination of odour concentration by dynamic olfactometry

[12] Air Dispersion Modelling from Industrial Installations Guidance Note 4 (AG4), Environment Protection Agency.

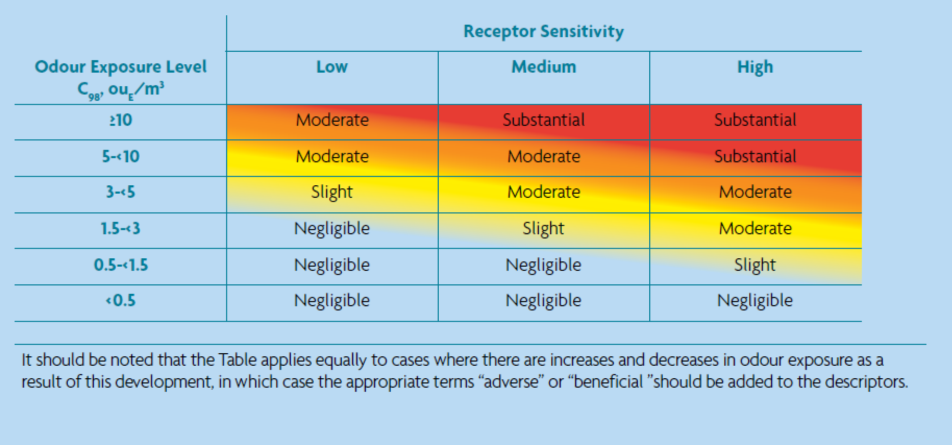
Table 5: Impact criteria defined in H4 and AG4

Exposure level	Relative offensiveness of odour	Example industrial sectors
$C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$	High (or most offensive)	Rendering, Fish Processing, Oil Refining, Creamery, WWTP, Fat & Grease Processing, biological landfill odours.
$C_{98,\ 1\text{-hour}} \geq 3\ ou_E/m^3$	Medium	Intensive Livestock Rearing, Food Processing (Fat Frying), Paint-spraying Operations, Asphalt Manufacture
$C_{98,\ 1\text{-hour}} \geq 6\ ou_E/m^3$	Low (or least offensive)	Brewery, Coffee Roasting, Bakery, Chocolate Manufacturing, Fragrance & Flavouring

It is important to note that whilst examples are provided of the industries which may generate odours that fall into each offensiveness category, the guidance does not specify specific criteria for all industrial sectors. It is also important to note that the criteria are intended as indicative benchmarks for development of odour impact *risk*, but are not absolute standards and may vary due to local factors such as population density, complaint behaviour, receptor sensitivity etc. Selection of an appropriate criteria is therefore a matter of specialist judgement.

In terms of planning, further informative guidance has been published by the UK Institute of Air Quality Management (IAQM)[13]. This guidance states that based on the current evidence available to the authors, odour annoyance can develop at odour exposure levels of between $C_{98,\ 1\text{-hour}} = 1\ ou_E/m^3$ to $C_{98,\ 1\text{-hour}} = 10\ ou_E/m^3$ depending upon the offensiveness of the odour and local conditions. Two matrices are then provided which outline the possible effect of odour exposure on receptors with different sensitivities (i.e. odours that are classified as 'most offensive' and 'moderately offensive') as indicated in the figures below. In these matrices, the likely effect is considered at different exposure levels and receptor sensitivities, ranging from negligible to substantial. Where the effect is above 'slight', it is likely to be considered significant in EIA terms.

Figure 3: Proposed odour effect descriptors for impacts predicted by modelling- 'Most offensive' odours (Source: IAQM[12])



Odour Exposure Level C_{98}, ou_E/m^3	Receptor Sensitivity		
	Low	Medium	High
≥10	Moderate	Substantial	Substantial
5-<10	Moderate	Moderate	Substantial
3-<5	Slight	Moderate	Moderate
1.5-<3	Negligible	Slight	Moderate
0.5-<1.5	Negligible	Negligible	Slight
<0.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are increases and decreases in odour exposure as a result of this development, in which case the appropriate terms "adverse" or "beneficial "should be added to the descriptors.

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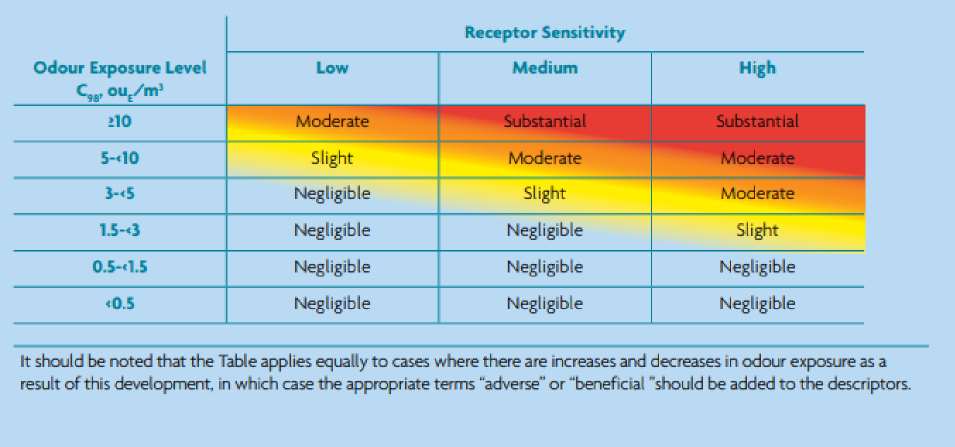
[13] Guidance on the assessment of odour for planning, published by IAQM: July 2018

Figure 4: Proposed odour effect descriptors for impacts predicted by modelling- 'Moderately' offensive odours (Source: IAQM[12])



Odour Exposure Level C_{98}, ou_E/m^3	Receptor Sensitivity		
	Low	Medium	High
≥10	Moderate	Substantial	Substantial
5-<10	Slight	Moderate	Moderate
3-<5	Negligible	Slight	Moderate
1.5-<3	Negligible	Negligible	Slight
0.5-<1.5	Negligible	Negligible	Negligible
<0.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are increases and decreases in odour exposure as a result of this development, in which case the appropriate terms "adverse" or "beneficial "should be added to the descriptors.

Review of the figures indicate that for odours that fall into the 'most offensive' category, the threshold for development of a risk of significant impact from an EIA perspective occurs at exposure levels of $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$ for highly sensitive receptors (e.g. residential property), whilst for an odour that is considered to be moderately offensive, the threshold is $C_{98,\ 1\text{-hour}} \geq 3\ ou_E/m^3$. As exposure levels increase above these threshold levels, the probability of a significant impact occurring also increases.

Bearing in mind that odorous emissions from landfilling operations generally comprise a mixture of landfill gas and waste odour which fall into the high (or most) offensive category, these thresholds are generally consistent with Odournet's experience, which indicates that it is possible for a significant adverse odour impact to develop at exposure levels as low as $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$. However, it should be noted that such instances are relatively rare and hence the thresholds should be considered precautionary. This position also appears to be supported by research published by SNIFFER[14] in a study that was co-funded by the Environmental Protection Agency (EPA), which states: 'for odour from landfill sites an impact criterion of $C_{98,\ 1\text{-hour}} = 3\ ou_E/m^3$ or less is usually applied in the UK and the Republic of Ireland for purposes of assessment and regulation'.

For the purposes of comparing the impact risk between the various operational scenarios studied in this case and evaluating the potential significance of impact in EIA terms, the following criteria for assessing potential have been applied:

- Landfilling operations (high offensive odours) threshold: $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$.
- Biological treatment facility emissions (moderately offensive odour) threshold: $C_{98,\ 1\text{-hour}} \geq 3\ ou_E/m^{3\cdot}$

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[14] SNIFFER, Odour Monitoring and Control on Landfill Sites, ER31, February 2013; and Odour Management Plan Reports for Landfills, ER31, February 2013

4 Identification of odour sources and estimation of emissions

4.1 Identification of potential odour sources

The generation of odour is an inevitable consequence of landfilling operations and is associated with the release of a variety of odorous volatile organic compounds (VOCs), which are generated as a result of the biological breakdown of the organic constituents of the waste. These compounds vary but can include organic alcohols, aldehydes, ketones, organic acids, amines, ammonia and reduced sulphur compounds (e.g. hydrogen sulphide, dimethyl sulphide and mercaptans).

The process that leads to the generation of these odorous compounds commences as soon as the waste is generated at its original source and continues once it has been deposited into the landfill and anaerobic conditions take hold within the main body of the landfill to generate landfill gas.

The characteristics of the odour generated from the landfill process, in terms of intensity and offensiveness, will ultimately depend upon the age, type and quality of waste received (e.g. to what extent anaerobic biological breakdown of the material has commenced prior to delivery), and the procedures in place for waste reception, deposition, landfill gas and leachate management.

The main activities that generate odour at landfills can be broadly characterised as follows:

1. Emissions from the operational filling area (i.e. waste deposition, compaction at the working face, and emissions from the general active cell).
2. Emissions from landfill gas (i.e. gas flux through the landfill cap; other fugitive gas emissions).
3. Emissions from leachate storage and handling.
4. Any ancillary activities undertaken at the site (e.g. biological waste treatment and storage).

Review of the current and proposed site operations have identified a range of odour sources that are likely to be relevant from an impact assessment perspective as summarised in Table 6 below:

Table 6: Odour sources associated with current and proposed operations

Area of landfill	Odour source	Nature of odour	Intensity and offensiveness of odours released	Frequency and duration
Non-stabilised biodegradable waste to landfill (current and proposed site activities)	Filling face	Waste	Moderate/high intensity; Moderate/high offensiveness	Semi-continuous during operational hours
	Active cell	Landfill gas	Moderate intensity; moderate/high offensiveness	Variable depending upon atmospheric conditions
Deposition of inert, stabilised and non-biodegradable wastes (current and proposed site activities)	Filling face	Earthy/compost like	Low/moderate intensity; Low/moderate offensiveness	Semi-continuous during operational hours
Intermediate and final capped cells (current and proposed site activities)	Gas flux through capping	Landfill gas	Low to high intensity; Low to high offensiveness	Variable depending upon containment effectiveness and atmospheric conditions
Biological treatment (proposed activities only).	Odour control plant	Residual odour from the biofilter	Low intensity; moderate offensiveness	Continuous

It important to note that whilst the proposed development will increase the amount of non-biodegradable waste that will be landfilled, such waste has a low odour potential and will not contribute to landfill gas generation. Furthermore, the proposed IBA facility has not been considered as an odour source since the material has a negligible odour potential.

4.2 Estimation of odour emissions

The assumptions applied to derive these emission estimates are detailed below:

4.2.1 Emissions from the operational areas

On the basis of Odournet's experience, the odour emissions generated from the operational area are influenced by the following:

- The quantity and type of waste actively deposited during the working day.
- The type of cover applied at the end of the working day.
- The underlying age of the waste in the active cell, and hence potential for generation and flux of landfill gas.

For the operational areas receiving MSW waste under the current and proposed operational scenarios of the landfill site, the emissions from the active cell were calculated using the emissions data summarised in Table 7 below which were collected at the site in 2010 and 2018. This data is generally comparable to data Odournet has collected at other operational landfills in the UK and northern Europe, with broadly similar waste compositions and cell designs as Knockharley. On this basis and considering the design and operation of the operational cells has not changed significantly since 2010, the data is considered to present a reasonable basis from which to derive emissions under current and future operational conditions.

Table 7: Emission estimates derived from onsite monitoring data area sources during Odournet's study.

Source	Date of sampling	Geomean odour emission rate ($ou_E/m^2/s$)
Freshly tipped waste	02/10/2010	15.5
	14/10/2010	5.7
	11/04/2018	9.2
	Geomean of results	**9.3**
Daily cover applied	02/10/2010	1.3
	14/10/2010	1.0
	11/04/2018	0.8
	Geomean of results	**1.0**

For activities involving the active deposition of waste from trucks the odour emission rate is typically linked to the odour potential of the waste expressed in ou$_E$/tonne. For the types of wastes received at Knockharley, an emission rate of 200,000 ou$_E$/tonne has been assumed.[15]

The emission estimates for each scenario are therefore summarised as follows.

Table 8: Emission estimates from the operational area under each operational scenario

Operational scenario	Source	Area odour emission rate [ou$_E$/m^2/s]	Total area [m^2]	Operating hours	Odour emission rate [x10^3 ou$_E$/s]
Sc0	Temporary capped area[16]	1.0	17860	Continuous	17.9
	Working face	10	625	08:00 - 18:00	6.3
	Fresh waste tipping	28.4[17]	25	08:00 - 18:00	0.7
	Total				**24.9**
Sc1	Temporary capped area	1.0	8930	Continuous	8.9
	Working face	10	625	08:00 - 18:00	6.3
	Fresh waste tipping	28.4	25	08:00 - 18:00	0.7
	Total				**15.9**
Sc2&3	Temporary capped area	1.0	17860	Continuous	17.9
	Biodegradable waste Working face	10	625	08:00 - 18:00	6.3
	Fresh waste tipping	46.2	25	08:00 - 18:00	1.2
	Stabilised & inert waste working face	1.0	625	08:00 - 18:00	0.6
	Stabilised & inert waste tipping	8.0	25	08:00 - 18:00	0.2
	Total				**26.2**

4.2.2 Estimation of emissions of landfill gas

Landfill gas emissions generally represent the highest potential contributor to odours from landfills and can exhibit significant variations from site-to-site and over time depending upon the rate of production of the gas from the underlying waste, the containment effectiveness of the cap, and the odour potential of the gas.

For the purposes of this study, an estimate of the rate of generated under current conditions was derived using data from the calibrated LandGem model provided by Fehily Timoney (see Annex D for further details). An estimate of the odour leakage rate per cell was then derived assuming the following gas containment and concentration assumptions:

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[15] Emssions during movement of biodegradable municipal waste per kg (ou$_E$/kg) are expected to be in the region of 20 times the magnitude of surface emissions per metre squared (ou$_E$/m^2/s) measured from MSW.

[16] The measured emission from overnight capped areas has conservatively been applied to temporary capped areas.

[17] A waste deposition rate was estimated from the total waste received per annum and then multiplied by a typical odour emission rate of 200,000 odour units per tonne[17].

Table 9: estimation of emissions of landfill gas

Scenario	Containment offered by permanent capping (%)	Containment offered by intermediate capping (%)	Concentration of landfill gas (ou_E/m^3)
Scenario 0	98	90	2.3 million
Scenario 1	98	95	2.3 million
Scenario 2	98	95	2.3 million
Scenario 3	98	95	2.3 million

A summary of the derived emission estimates for each landfill cell is presented in Annex D.

4.2.3 Biological treatment facility.

The proposed biological waste treatment facility will involve a range of activities that have the potential to generate odour emissions which include the reception of MSW fines and composting activities. However, a range of odour control measures will be incorporated into the design to mitigate such potential emissions. These include:

- All waste imports will be carried out within a ventilated building which will be extracted to a biofilter odour control system. The building will operate under negative pressure with an active ventilation system achieving approximately 3 air changes per hour. Ventilation pipework installed in the headspace of the building will be connected to a high-volume medium-pressure blower that will draw off the warm, buoyant building air that will be generated by a combination of emissions from the input materials in the intake area and from emissions from the movement of the material between composting tunnels.
- The main entrance to the building will be fitted with a fast-acting roller shutter doors. A closed-door management strategy will be enforced. Rapid response roller shutter doors will be installed at vehicle entry and exit points.
- Aerobic exhaust from the composting tunnels is subjected will be treated through an odour control system.
- Treated emissions from the biofilter will be discharged via a 20 m stack to enhance dispersion.
- Vehicles exiting the facility through the roller shutter door on the western flank will be subjected to cleaning procedures in accordance with the DAFM Conditions Document[18] in a designated cleaning area located outside of this door.

As a result, the only significant odour source associated with the proposed biological treatment facility from an offsite exposure perspective is the biofilter stack.[19]

It is understood that the biofilter will be designed to achieve a maximum odour concentration at the outlet of 1,200 ou_E/m^3. On the basis of an estimated air flow rate for the system of 240,000 m^3/hr, the maximum emission from the stack will be no more than 80,000 ou_E/s.

These emissions will be directed through a 2.4 m diameter 20 m tall stack with an efflux velocity of 15 m/s.

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[18] Conditions for Approval and Operation of a 'Type 8' Composting/Biogas plant transforming Category 3 catering waste", Department Agriculture Food and the Marine 2014

[19] Any fugitive releases of odour are expected to be short lived, of low to moderate intensity and only likely to be detectable in the immediate vicinity.

4.2.4 Estimation of overall site emissions by field survey

The emission estimates derived through the field assessment are presented below:

Table 10: Estimated odour emission rate of landfill operations by back calculation

Survey ref	Date	Time	Onsite conditions	Estimated odour emission rate (10^3 ou_E/s)
Survey 1	10/04/2018	09:00-11:00	Receiving waste and landfill gas treatment in engines and enclosed flare(s)	62.9
Survey 2		11:00-13:00		115.5
Survey 3		14:00-17:00		93.4
Survey 4	11/04/2018	08:00-10:00		65.1
Survey 5		13:00-14:00		155.4
Survey 6		14:00-16:00		117.9
Survey 7		16:00-17:00		89.0
Average				99.9

The variation in estimated emissions noted by the field panel assessments are an expected result given the nature of emissions from the site, the influence weather conditions have on landfill gas release and the uncertainties in the assessment technique. The average emission rate from the site as a whole was 99.9 x 10^3 ou_E/s.

4.3 Summary of emission estimates for each operational condition

A summary of the odour emissions estimated for each operational condition are presented in Table 11 below:

Table 11: Estimated emissions for each operational scenario

Area of site	Source	Time weighted emission [x 10^3 ou_E/s]			
		Scenario 0	Scenario 1	Scenario 2	Scenario 3
Landfilling	Active cell operations	24.9	15.9	26.1	26.1
	Gas flux/leakage from intermediate and final capping	73.4	62.4	39.2	41.8
	Subtotal	98.3	78.3	65.3	67.9
Biological treatment	Odour control plant	n/a	n/a	80.0	80.0
	Total	**98.3**	**78.3**	**145.3**	**147.9**

Review of the table above indicates that the following:

1. Under the baseline conditions (Scenario 0), emissions from landfilling activities are predicted to be higher than for the future operational scenario (year 4) under current licence conditions (Scenario 1). This is linked to the current gas generation rates and number of cells currently with intermediate capping in place. Going forwards, it is assumed that all cells will have permanent capping applied within a year of filling thus reducing potential fugitive emissions released to atmosphere.
2. The total emissions generated from the landfilling operations are predicted to decrease as a result of the development in comparison to the current operational scenario (Scenario 0) and

year 4 operation if the development does not go ahead (Scenario 1). This is due to the enhanced containment of landfill gas emissions which will be achieved by the development.

3. In overall terms the emissions from the development is predicted to increase due to the inclusion of a new biological treatment facility (Scenario 2 and 3). However, odour control techniques provisions will be provided to ensure any odours from this facility are treated prior to release through an elevated stack which will serve to disperse residual odours in the atmosphere. The offensiveness of the odours released will also be lower due to the nature of the treatment process and treatment of the air prior to release in a biofilter.

5 Assessment of odour exposure and impact risk

5.1 Modelling scenarios

In order to assess the impact of the operational scenarios, a dispersion model was applied to assess the likely levels of odour exposure for the worst meteorological year and evaluate odour impact risk.

Since the odours from the biological treatment of waste had a different character and offensiveness rating to the landfill odours, these emissions were modelled separately. The modelled scenarios were therefore as follows:

Table 12: Modelled scenarios

Odour type	Model Scenario	Corresponding operational scenario
Landfilling	1	Scenario 0
	2	Scenario 1 (landfill activities only)
	3	Scenario 2 (landfill activities only)
	4	Scenario 3 (landfill activities only)
Treated odours from biological treatment	5	Scenario 2&3 (biological treatment only)

5.2 Modelling assumptions

The assumptions applied in the dispersion modelling for the baseline scenario were as follows:

- The emission rates described in the preceding chapter where used to define the sources in each scenario.
- Data describing the topography of the area surrounding the works was obtained from Ordnance Survey Ireland for the area surrounding the proposed facility. A receptor grid of 3.7 km by 3.7 km (50 m resolution), centred on the site, was utilised in the model. The height of the receptor is set at 1.5 m which represents the breathing level of humans.
- The study area was defined as rural, in line with land use classification techniques described in the AERMOD User Guide issued by the US EPA.
- Meteorological data applied was derived from 5 years of recent sequential hourly average data obtained from Dublin Airport (2012 to 2016). This complies with Irish EPA AG4 guidance that states that the last year of meteorological data used must be within 10 years of the assessment year. Dublin Airport is located approximately 30 km to the south-east of the site and the estimated annual mean windspeed at the site is between 4-6 m/s from the Met Eireann website. The annual wind speed of the data between 2012-2016 from Dublin airport is 5.6 m/s therefore is within the expected range for this area of Ireland. The meteorological data was adjusted to reflect the surface characteristics of the meteorological site in accordance with the guidelines in the Implementation Guide[20]. Each year was processed to establish the worst-case year, in terms of highest predicted odour exposure at local receptors, which was determined to be 2012.[21]

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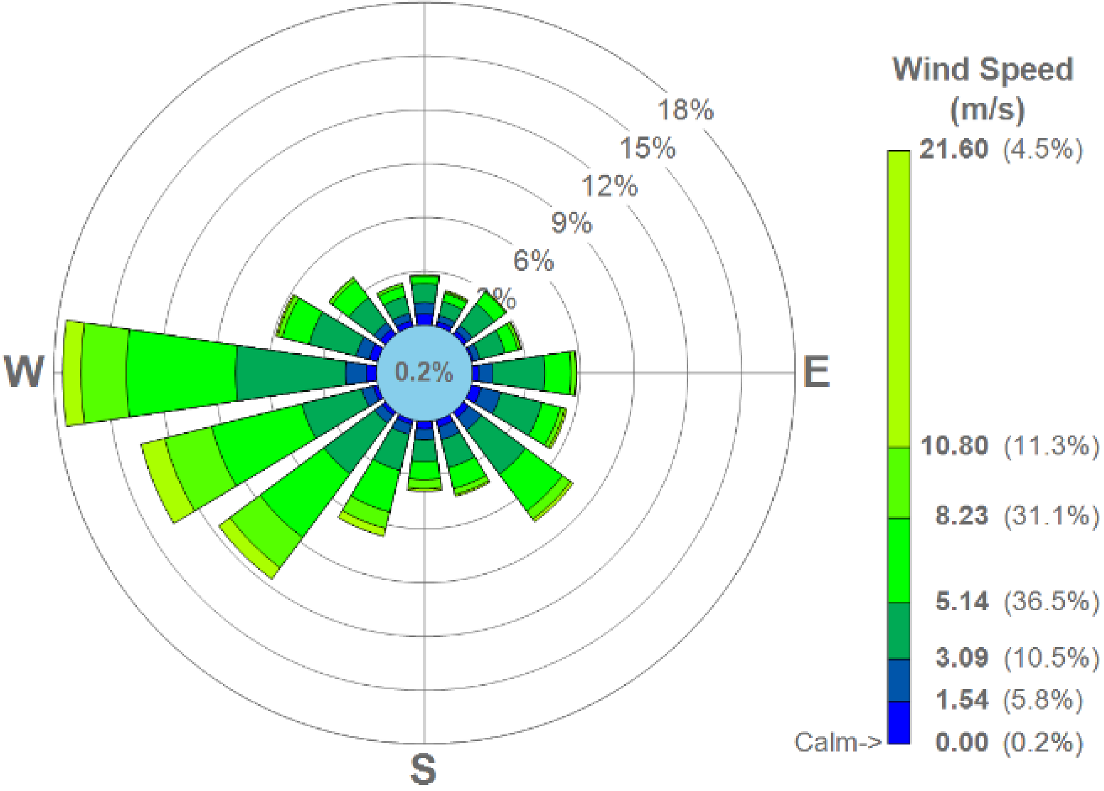
[20] AERMOD Implementation Guide, Published by the US EPA: March 2009

[21] The worst case meteorological year has been defined on the basis of highest predicted odour exposure at a residential property in any of the future operational scenarios.

Figure 5: A wind-rose for the combined meteorological dataset (2012-2016)



- The capped cells have been modelled as volume sources to represent diffuse fugitive landfill gas release from the capped cells rather than the top of the landfill; the temporary capped cells have been modelled as area sources.
- Building dimensions for the biotreatment facility were input into the model. The model software Building Profile Input Parameters (BPIPRPIME) was run to calculate the potential for building downwash on each emission source in each of the 36 wind direction sectors (10° width/sector). This model also calculates GEP heights where the effect of building downwash is eliminated. This data is then used in AERMOD to calculate plume downwash (i.e. adjusted plume centreline due to building wake affects). The effect of building downwash is only considered for point sources.
- The receptors presented in Figure 6 were also included within the dispersion model, to allow a comparison of predicted odour exposure levels between the modelled scenarios.

Figure 6: Discrete receptors included within dispersion model

Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Discrete receptors considered within the dispersion model are presented as blue stars.

- The model only considered emissions generated under the normal running conditions for the facility.

5.3 Significance criteria

The following significance criteria were applied as discussed in section 3.3.2:

- Landfilling operations: $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$.
- Biological treatment facility emissions: $C_{98,\ 1\text{-hour}} \geq 3\ ou_E/m^{3.}$

5.4 Discussion of dispersion modelling results

5.4.1 Odour impact of landfilling operations.

The outputs of the dispersion modelling are presented below for each modelled scenario. The figures present isopleths defining the area where the predicted odour exposure level is equal to $C_{98,\ 1\text{-hour}} = 1.5\ ou_E/m^3$ and $C_{98,\ 1\text{-hour}} = 3\ ou_E/m^3$.

The plots present results from the 2012 meteorological data, the worst-case year of the dataset (2012-2016).[22] Annex C presents an overview of the sensitivity of predicted odour impacts for different meteorological years (2012-2016).

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[22] The worst case meteorological year has been defined on the basis of highest predicted odour exposure at a residential property in any of the future operational scenarios.

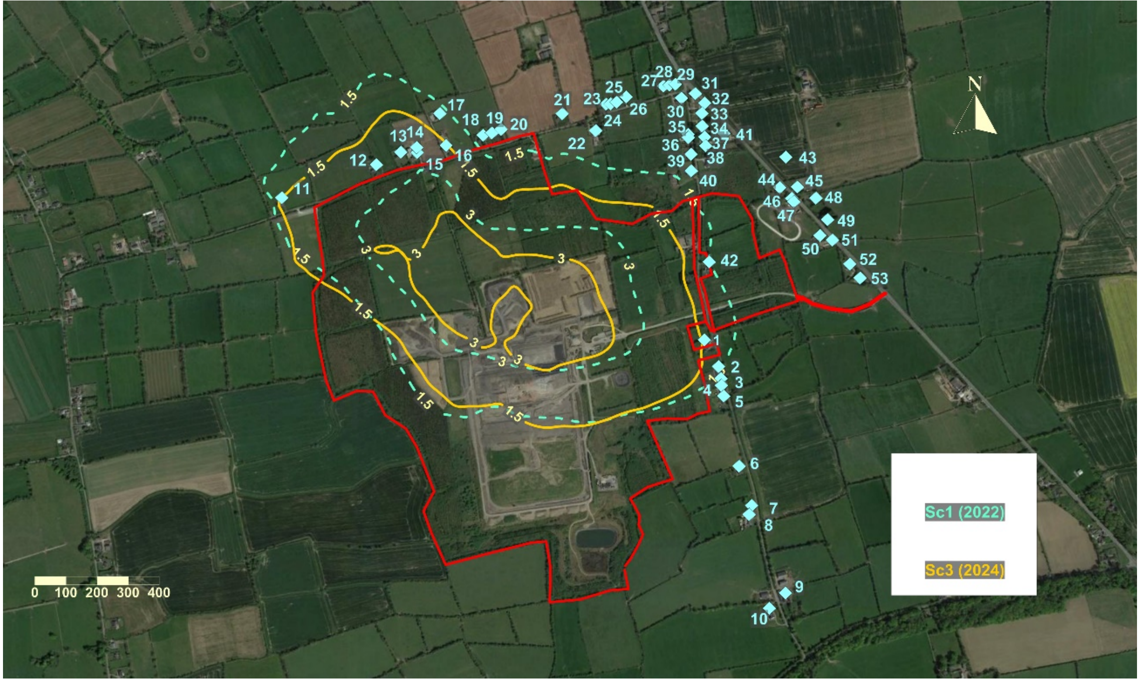
Figure 7: Predicted odour exposure levels from landfilling operations for Scenario 0 and Scenario 1 (Year 4 ‘do nothing’)

Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Residential properties are presented as blue stars.

Figure 8: Predicted odour exposure levels for landfill operations for Scenario 1 (Year 4 do nothing) & Scenario 2 (year 4 development)

Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Residential properties are presented as blue stars.

Figure 9: Predicted odour exposure levels for landfill operation for Scenario 1 (Year 4 do nothing) & Scenario 3 (year 6 development)



Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Residential properties are presented as blue stars.

Table 14 presents a summary of the area of land predicted to be exposed to $C_{98,\ 1\text{-hour}} \geq 3.0\ ou_E/m^3$ for each model scenario.

Table 13: Predicted odour exposure ($C_{98,\ 1\text{-hour}}$) at modelled discreet receptor locations

Receptor	Maximum $C_{98,\ 1\text{-hour}}$				Predicted change in odour exposure in comparison to Sc0		Predicted change in odour exposure in comparison to Sc1	
	Sc0: Baseline	Sc1: Yr 4 do nothing	Sc2: Yr 4 development	Sc3: Yr 6 development	Sc2 Yr 4	Sc3 Yr 6	Sc2 Yr 4	Sc3 Yr 6
1	2.15	1.77	1.37	1.46	-36%	-32%	-22%	-17%
5	2.14	1.32	1.30	1.19	-39%	-44%	-1%	-10%
6	1.68	0.81	0.89	0.77	-47%	-54%	+11%	-4%
11	1.74	1.81	1.29	1.56	-26%	-10%	-29%	-14%
12	1.91	2.46	1.43	1.76	-25%	-7%	-42%	-28%
15	2.07	2.58	1.65	2.03	-20%	-2%	-36%	-21%
16	1.49	2.22	1.27	1.53	-15%	+4%	-43%	-30%
18	1.09	1.20	0.76	0.81	-30%	-26%	-37%	-33%
22	0.93	1.14	0.67	0.88	-28%	-6%	-41%	-23%
40	0.98	1.33	0.78	0.95	-21%	-2%	-42%	-28%
42	2.00	1.57	1.27	1.31	-36%	-34%	-19%	-16%

Table 14: Area encompassed within $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$ isopleth and $C_{98,\ 1\text{-hour}} \geq 3.0\ ou_E/m^3$ isopleth

Scenario	$C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$ isopleth		$C_{98,\ 1\text{-hour}} \geq 3.0\ ou_E/m^3$ isopleth area	
	Area of land exposed (km^2)	Percentage reduction relative to baseline	Area of land exposed (km^2)	Percentage reduction relative to baseline
Sc0: Baseline (2018)	1.47	-	0.53	-
Sc1: Year 4 do nothing	1.09	26%	0.36	32%
Sc2: Year 4 development	0.81	45%	0.14	74%
Sc3: Year 6 development	0.85	42%	0.18	66%

Review of the model outputs prompts the following observations:

- Review of the current baseline impact isopleths (Sc0 - Figure 7) indicate that the area of land that is exposed to odours above the risk threshold of $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$ is approx. 1.47 km^2, and includes 12 no. properties located to the north and east of the site.

- Comparison of Sc0 (current baseline) and Sc1 (year 4 do-nothing) (Figure 7) indicates that odour exposure levels around the site are generally predicted to reduce, leading to a reduction in the land exposed to odour levels above the impact threshold by 26%. The development of the landfill to the north does however push the exposure isopleths northwards and leads to an increase in predicted odour exposure at the properties located to the north of the site in comparison to current baseline conditions. A corresponding reduction in odour exposure is predicted to the east of the site. The number of properties potentially at risk of significant odour impact is 10.

- Comparison of Sc1 (year 4 do nothing) with Sc2 (year 4 with development) (Figure 8) indicates that the development has a beneficial effect on offsite exposure in comparison to the do-nothing scenario. In this scenario, the area of land potentially exposed to odours above the risk threshold reduces by 47% in comparison to the current baseline. The number of properties at risk of potentially significant impact reduces to 4, all of which are located to the north.

- Comparison of Sc3 (year 6 with development) and Sc2 (year 4 with development) indicates a slight increase in odour exposure during the final years of the landfill although the number of properties at risk of potentially significant impact is 6. This risk is likely to persist until the operational cells are closed and permanent capping is installed.

It is therefore evident that the development will lead to an overall reduction in offsite odour exposure and impact risk in comparison to the baseline and the 'do nothing' situation, up until 2022, when the existing planning approval expires. A potentially significant risk of odour impact will remain to a handful of properties to the north of the site during the remaining life of active deposition and subsequent completion of permanent capping which is estimated to be in the order of 2 no. years.

5.4.2 Biological treatment facility

The model output for the biotreatment facility is presented in Table 15 below:

Table 15: Predicted odour exposure ($C_{98,\ 1\text{-hour}}$) at modelled discreet receptor locations

Receptor	Maximum $C_{98,\ 1\text{-hour}}$
	Biological treatment facility
1	1.54
5	1.14
6	1.14
11	0.37
12	0.42
15	0.46
16	0.47
18	0.43
22	0.15
40	0.35
42	0.78

Review of the predicted exposure levels indicates that the odour exposure at all modelled receptors fall below the levels at which a significance impact is predicted. The predicted odour exposure is below $C_{98,\ 1\text{-hour}}$ = 3 ou_E/m^3 across the entire model domain. As a result, the impact risk posed by this element of the development is considered to be negligible.

6 Conclusions

The conclusions of the study are summarised as follows:

1. The total odour emissions generated from landfilling activities are predicted to decrease as a result of the proposed development in comparison to current baseline levels and the emissions that would occur if the proposal did not go ahead (2022). This is due to the enhancement in capping proposed as part of the development and the fact that the majority of additional waste which will be accepted by the landfill is stabilised, inert or non-biodegradable and hence has a low odour generation potential. Additional emissions will be generated from the biological waste facility, however, such emissions will be treated in an odour control system prior to release through a 20 m stack which will enhance dilution and dispersion.

2. The odour exposure levels that are predicted to occur around the site as a result of landfilling operations are predicted to be lower than the current baseline and the 'do nothing' situation for the first 4 years, if the development goes ahead. The development is therefore predicted to have a beneficial effect on odour exposure and impact risk during this period. The number of houses exposed to odour levels that exceed the threshold where a potentially significant risk of odour impact could develop falls from twelve no. under baseline conditions and ten no. in year 4 of 'do nothing', to four no. in year 4 of the development.

3. A risk of impact will remain whilst the landfill is operating beyond year 4 which is predicted to be at its highest in the final year of the landfill (year 6). Under this scenario, six no. properties are predicted to be exposed to odour levels that exceed the threshold where a potentially significant risk of odour impact could develop.

4. The emissions from the biological treatment facility are not predicted to pose any risk of impact at any area within or outside the facility.

5. The overall conclusion of the study is that the development will have a beneficial effect on odour exposure and impact risk in comparison to the do-nothing scenario in the next four years. A residual risk of impact will remain to up to four no. properties during this period and up to six no. properties until the landfill is completed, based on application of the precautionary indicative odour impact criteria applied in the study.

Annex A Odour sampling and analysis techniques.

A.1 Collection of odour samples from sources with no measurable flow.

Collection of samples from area sources where there is no measurable flow were conducted using a ventilated canopy known as a ‘Lindvall hood’. The canopy was placed on the odorous material and ventilated at a known rate with clean odourless air. A sample of odour was collected from the outlet port of the hood using the Lung principle.

The rate of air injected into the hood was monitored for each sample and used to calculate a specific odour emission rate per unit area per second (E_{sp}) as follows:

$$E_{sp} = C_{hood} \text{ x } L \text{ x } V$$

Where,

> C_{hood} is the odour concentration measured from the sample bag.
>
> L is the hood factor, which is equal to the path length (m^2) of the hood divided by the covered area (m^2).
>
> V is the velocity (m/s) of air presented to the hood.

A.2 Measurement of odour concentration using olfactometry

Odour measurement is aimed at characterising environmental odours, relevant to human beings. As no methods exist at present that simulates and predict the responses of our sense of smell satisfactorily, the human nose is the most suitable ‘sensor’. Objective methods have been developed to establish odour concentration, using human assessors. A British standard applies to odour concentration measurement:

- BSEN 13725:2003, *Air quality - Determination of odour concentration by dynamic olfactometry*.

The odour concentration of a gaseous sample of odorants is determined by presenting a panel of selected and screened human subjects with that sample, in varying dilutions with neutral gas, in order to determine the dilution factor at the 50% detection threshold (D_{50}). The odour concentration of the examined sample is then expressed as multiples of one European Odour Unit per cubic meter [ou_E/m^3] at standard conditions.

A European Odour Unit is defined that amount of odorant(s) that, when evaporated into 1 cubic metre of neutral gas at standard conditions, elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one European Reference Odour Mass (EROM), evaporated in one cubic metre of neutral gas at standard conditions. One EROM is equivalent to 123 mg n-butanol (CAS-Nr. 71-36-3). Evaporated in 1 cubic metre of neutral gas this produces a concentration of 0,040 mmol/mol.

A.3 Summary of source odour measurement data

Olfactometry samples were collected between the 2nd September and 14th September 2010 and 10th and 11th April 2018 using Odournet UKAS accredited source sampling and analysis procedures which are accredited by UKAS (UKAS laboratory number 2430) and comply fully with BSEN13725: 2003. The results of the measurements are summarised in Table 18below.

Table 16: Surface odour emission measurements

Source	Date of sampling	Area odour emission rate [$ou_E/m^2/s$]			
		Geomean	Sample 1	Sample 2	Sample 3
Freshly tipped waste	02/10/2010	15.5	11.1	21.5	-
Freshly tipped waste	14/10/2010	5.7	6.8	4.9	-
Freshly tipped waste	11/04/2018	9.2	9.0	10.0	8.5
Daily cover applied	02/10/2010	1.3	0.9	1.8	-
Daily cover applied	14/10/2010	1.0	1.0	1.1	-
Daily cover applied	11/04/2018	0.8	0.7	0.8	1.1

Table 17: Landfill gas odour concentration measurements

Source	Date of sampling	Odour concentration [ou_E/m^3]		
		Geomean	Sample 1	Sample 2
Landfill gas	02/10/2010	2,330,158	2,444,108	2,221,614

Annex B Selection of dispersion model

B.1 Description of dispersion model

AERMOD is a steady-state Gaussian plume model which is designed to assess short-range (up to 50 kilometres) dispersion of air pollutant emissions. The AERMOD dispersion model was developed by the US Environment Protection Agency and the American Meteorological Society and is routinely used by environmental impact assessment practitioners in the UK to assess the likely dispersion of pollutants, including odour.

Algorithms within the model consider a number of elements when assessing how pollutants will disperse, including the following:

- Dispersion in both the convective and stable boundary layers;
- Plume rise and buoyancy;
- Plume penetration into elevated inversions;
- Computation of vertical profiles of wind, turbulence, and temperature;
- The urban night-time boundary layer;
- The treatment of building wake effects;
- The treatment of plume meander.

The model has two important pre-processors, AERMET and BPIPPRIME. AERMET is a meteorological data pre-processor that calculates the atmospheric parameters needed by the dispersion model, such as atmospheric turbulence characteristics, mixing heights, friction velocity, Monin-Obukov length and surface heat flux. Unlike with earlier, more basic dispersion models, vertical profiles of wind, turbulence and temperature are created.

BPIPPRIME is a dispersion algorithm used in AERMOD to factor in the effect of turbulence in the wake regions of buildings. PPRIME calculates turbulent intensity and wind fields as a function of the building dimension, these are then used in AERMOD to alter the downwind plume.

This model is appropriate for this assessment as in the region of the site there are no complex terrain features in the region of the site which would significantly alter meteorological conditions. Also, due to the low source stack height in this assessment, pollutant concentrations over long distances are not considered significant. Therefore, the prediction of pollutant concentrations within 10 km of the source is sufficient. The site location is not in close proximity to a coastline therefore the impacts of coastal fumigation do not need to be modelled in this assessment.

Based on guidance issued by the Irish EPA (AG4) it is considered that AERMOD is appropriate for the assessment of impacts of pollutant emissions from this facility.

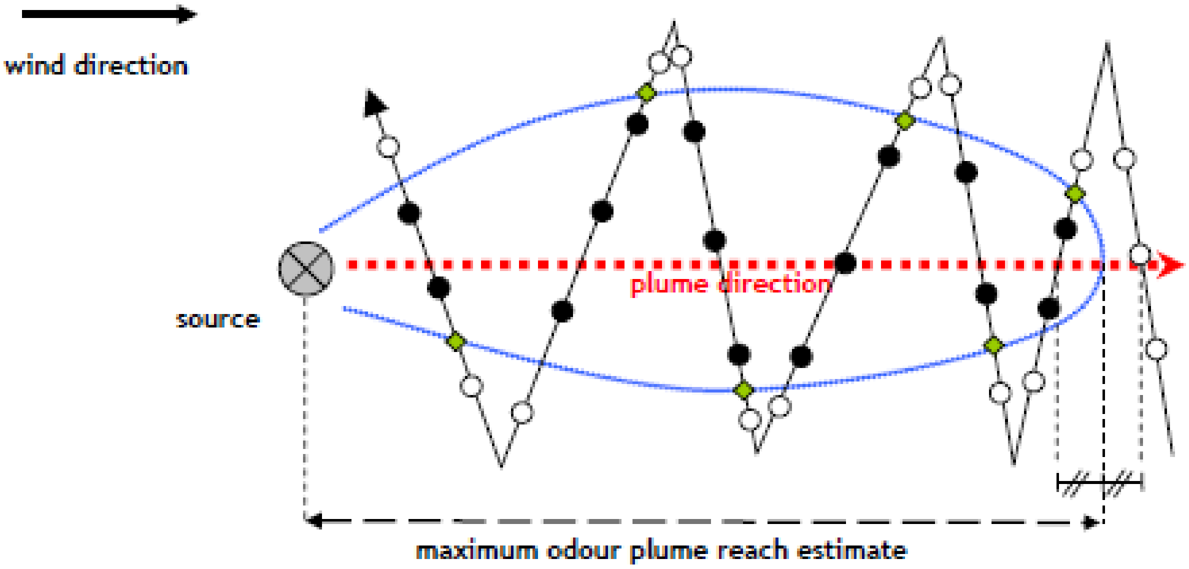
Annex C Offsite field survey - plume tracking assessment

C.1 Summary of methodology

The specific approach applied is summarised as follows:

1. On each day of the assessment 2 No. trained assessors, whose acuity to odour has been assessed using the procedures presented in the British Standard for Olfactometry BSEN13725: 2003, assessed the extent of the odour plumes from each of the key sources identified during the onsite walkover. Prior to the assessment, the key odour producing activities onsite were observed to provide an insight into the odours experienced during the plume tracking assessment.
2. The assessment of the odour plume extent and width was undertaken by repeatedly traversing the plume and noting locations of 'odour presence' and 'odour absence', as indicated in Figure 10 below. Extent of plumes are recorded on entering the plume to avoid the risk of adaptation to the odour.
3. During the assessments the predominant meteorological conditions were noted and recorded, including the wind speed which was measured using calibrated airflow measurement equipment. Further to measurements taken onsite, data was also taken from a Dunsany automatic weather station located approximately 11 km to the east of the landfill.

Figure 10: Dynamic plume measurement



The boundaries of the detectable odour plume and meteorological data recorded during the field surveys were input into a dispersion model, to enable calculations of dispersion from the site under the conditions which prevailed during each survey. The model was established using a GIS system which was integrated within the AERMOD atmospheric dispersion model published by the US Environmental Protection Agency (US EPA).

Odour emission estimates from the site as a whole were calculated using reverse modelling, using techniques described in Annex G of BS EN 16841-2:2016.

- Receptors were allocated to the coordinates of the plume extents within the model.

- Volume emission sources were defined across the active and temporary capped cells, representative of the most significant area of odour emissions at the facility.
- A nominal emission rate (e.g. 100,000 ou_E/s) was set for the odour sources onsite, and the odour concentration predictions for the plume extent receptors calculated by AERMOD for the dispersion conditions prevalent at the time of the assessment.
- The modelled emission rate is then divided by the average predicted concentration at plume extent receptors, to define an emission estimate from the site for the conditions of the assessment.

The output of each survey was an estimate of the total odour emission rate generated by the landfilling activities, expressed in odour (sniffing) units per second. Observations were also made of the character and potential offensiveness of the odours detected to gain an insight into their likely origin.

A total of 7 no. field assessment surveys were conducted by Odournet UK staff between the 10th and 11th April 2018. The surveys were conducted when waste deposition activities were in operation to provide a clear picture of the overall odour generation from the site.

The methodology applied during the study was reduced in scope in comparison to the full requirements of BS EN 16841-2:2016, which details that a minimum of 10 assessments should be conducted. The assessment was used as a logic check to the onsite measurements and the number of assessments undertaken is deemed to be proportionate to the study objective, in that the results are being used to confirm suitability of approach, rather than derive an absolute emission rate for the future modelling scenarios.

C.2 Model assumptions reverse modelling to define emissions from field assessments

- Modelling was undertaken using the US EPA AERMOD dispersion modelling suite.
- Data describing the topography of the area surrounding the works was obtained from Ordnance Survey Ireland for the area surrounding the proposed facility. A receptor grid of 2.5 km by 2.5 km (50 m resolution), centred on the site, was utilised in the model. The height of the receptor is set at 1.5 m which represents the breathing level of humans. Additionally, discrete receptors were included at the plume extents for each field assessment.
- The study area was defined as rural, in line with land use classification techniques described in the AERMOD User Guide issued by the US EPA.
- Meteorological data applied was taken from a Dunsany automatic weather station located approximately 11 km to the east of the landfill. Hourly average data was calculated from spot readings recorded at 15-minute intervals. The meteorological data was adjusted to reflect the surface characteristics of the meteorological site in accordance with the guidelines in the Implementation Guide.[23]
- Four volume sources spaced across the intermediate capped areas and active cells were defined in the model.

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[23] AERMOD Implementation Guide, Published by the US EPA: March 2009

C.3 Summary of plume tracking data

Field assessments were conducted on the 10th and 11th April 2018. The observations made during the surveys are summarised in Table 18 below.

Table 18: Summary of observations

Survey reference	Date	Time of survey	Onsite conditions	Extent of odour plume (from active face) [m]	Width of plume extent [m]	Nature of predominant site odour
Survey 1	10/04/2018	09:00-11:00	Receiving waste and treatment of landfill gas in engines and enclosed flares	470	100	Mixed waste/ landfill gas
Survey 2		11:00-13:00		550	190	
Survey 3		14:00-17:00		500	150	
Survey 4	11/04/2018	08:00-10:00		540	150	
Survey 5		13:00-14:00		580	190	
Survey 6		14:00-16:00		600	200	
Survey 7		16:00-17:00		570	180	

The predominant character of the odour plume identified during all the field surveys was that of waste/landfill gas.

Odours were also detectable in the vicinity of the gas compound area during the field surveys. These odours were distinctly detectable as originating from a combustion process and only detectable across a localised area around the gas compound onsite.

No odour was detected around the leachate lagoon.

The weather conditions during the surveys are summarised in Table 19 below:

Table 19: Summary of meteorological conditions

Survey reference	Date	Wind speed (m/s)	Average wind direction (degrees from north)	Precipitation (mm)	Temp (ºC)	Cloud cover (eighths)
Survey 1	10/04/2018	2.3-3.9	40-50	0	8	7
Survey 2		3.0-5.8	40-50	0	8	6
Survey 3		3.3-6.3	40-60	0	8	5
Survey 4	11/04/2018	3.0-5.4	38-49	0	7	7
Survey 5		4.3-4.9	42-49	0	9	6
Survey 6		4.0-4.9	42-51	0	9	6
Survey 7		3.2-4.1	48-52	0	8	6

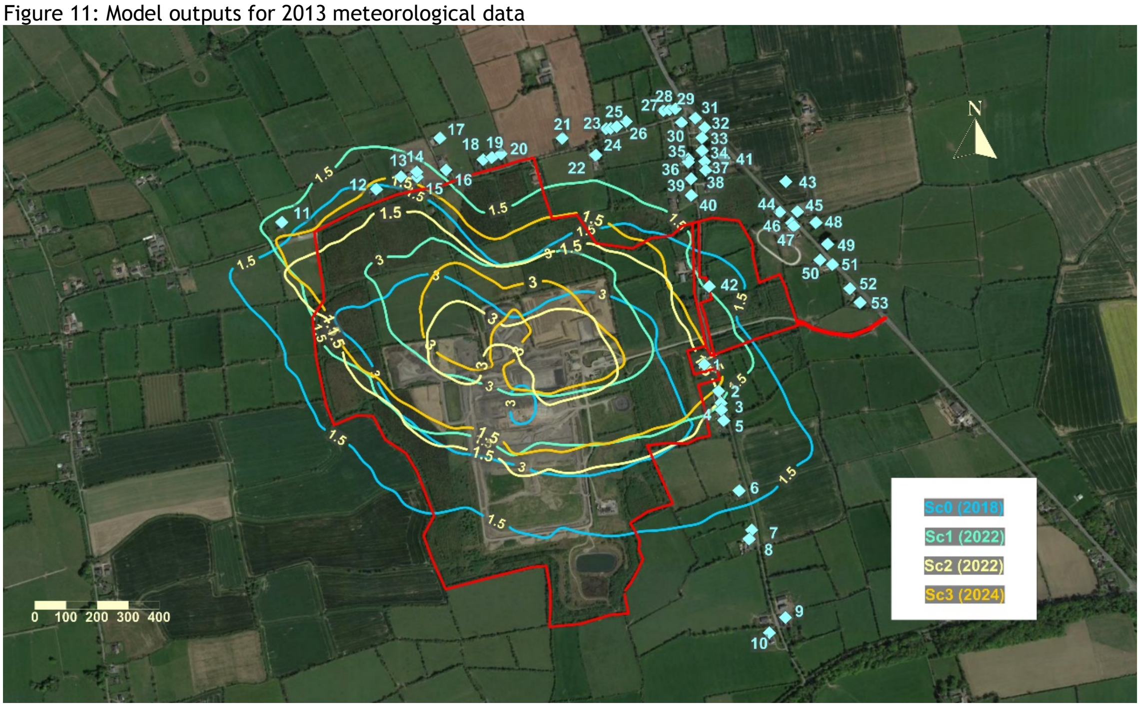
The magnitude of emissions monitored during the surveys has been estimated via reverse dispersion modelling for each of the surveys as presented in Table 20 below.

Table 20: Estimated odour emission rate of waste handling operations by back calculation

Survey reference	Date	Time of survey	Onsite conditions	Estimated odour emission rate [x 10^3 ou$_E$/s]
Survey 1	10/04/2018	09:00-11:00	Receiving waste and treatment of landfill gas in engines and enclosed flares	62.9
Survey 2		11:00-13:00		115.5
Survey 3		14:00-17:00		93.4
Survey 4	11/04/2018	08:00-10:00		65.1
Survey 5		13:00-14:00		155.4
Survey 6		14:00-16:00		117.9
Survey 7		16:00-17:00		89.0
Average				99.9

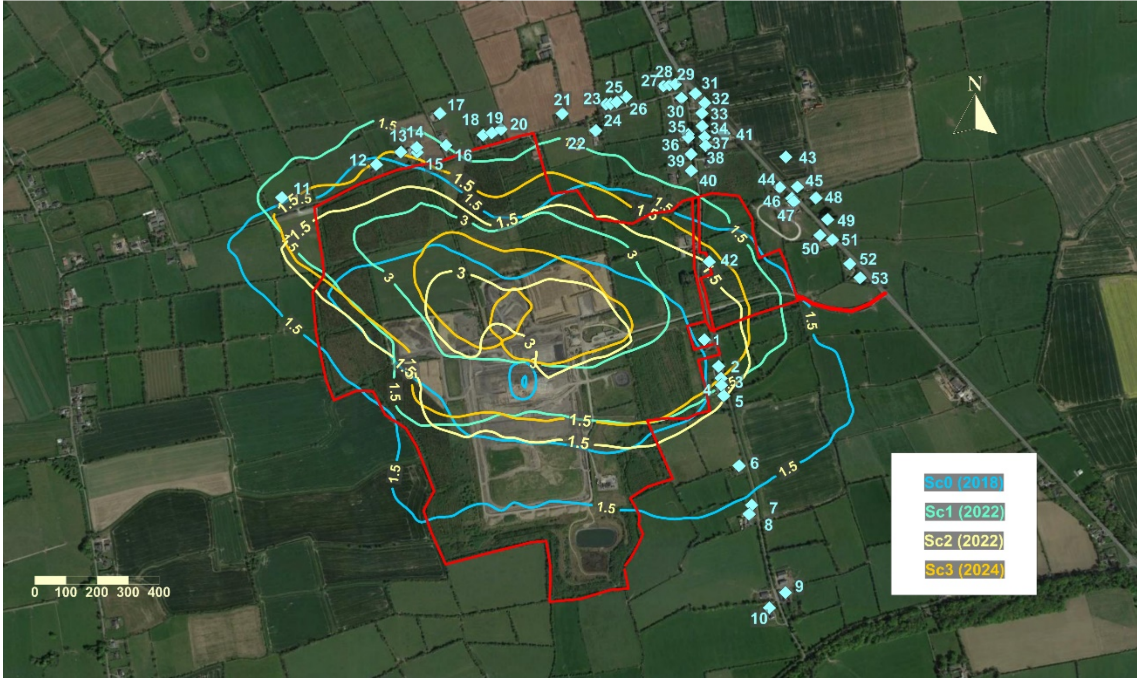
Annex D Sensitivity of modelled odour exposure against meteorological data year

Figure 11: Model outputs for 2013 meteorological data



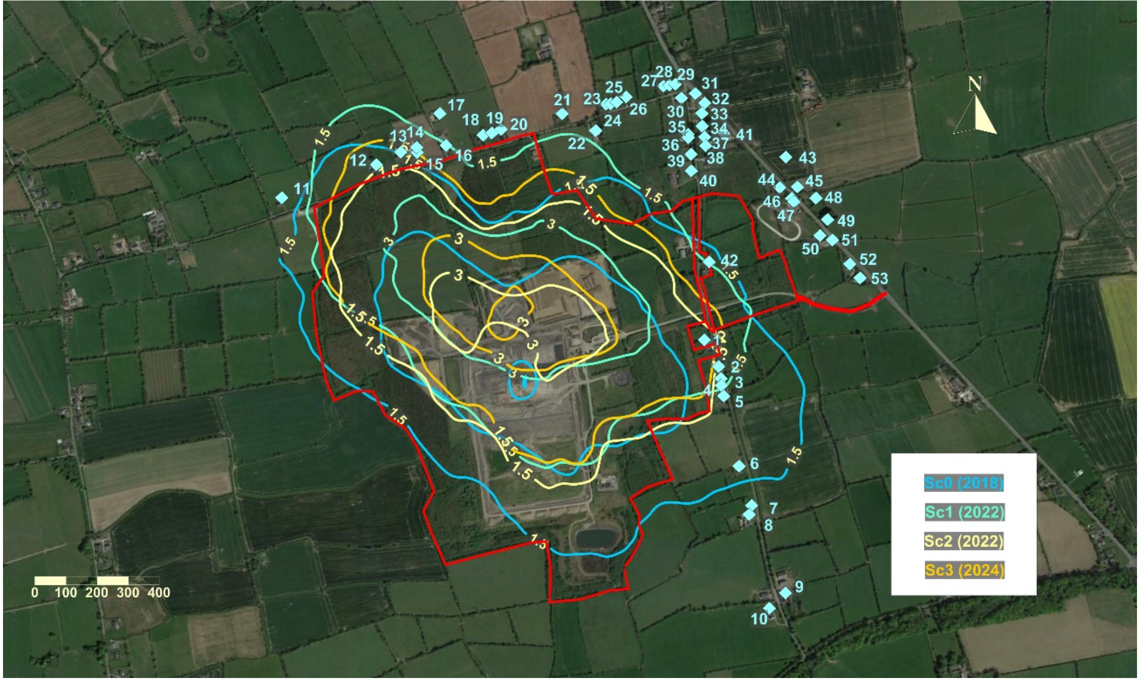
Map imagery: Google Earth. Local residential properties are presented as blue stars

Figure 12: Model outputs for 2014 meteorological data



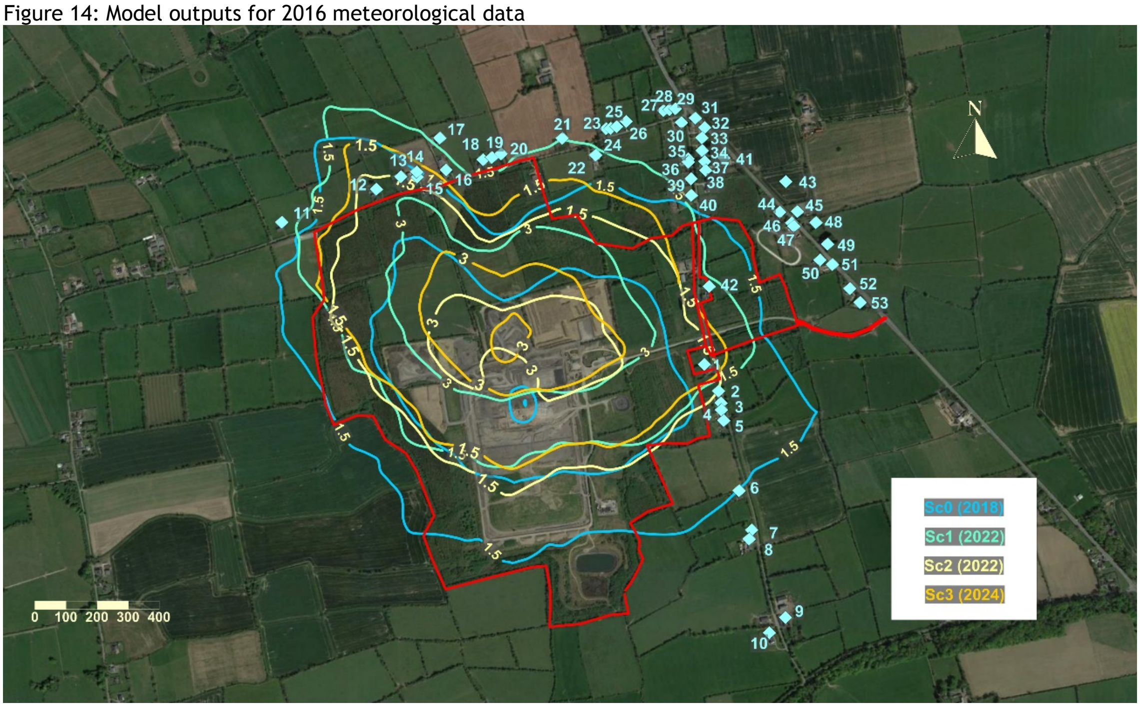
Map imagery: Google Earth. Local residential properties are presented as blue stars

Figure 13: Model outputs for 2015 meteorological data



Map imagery: Google Earth. Local residential properties are presented as blue stars

Figure 14: Model outputs for 2016 meteorological data



Map imagery: Google Earth. Local residential properties are presented as blue stars

Annex E Landfill gas production and containment estimates

The estimated gas production and containment rates for each cell under each of the scenarios studied are presented in the tables below. The magnitude of landfill gas generated is influenced by the age of the waste within each cell, and has been estimated using LandGem landfill gas modelling tool, calibrated against historic data for Knockharley by Fehily Timoney and Co. The estimated landfill gas production data were processed alongside waste deposition rates per year to estimate the landfill gas production for each cell. The table below presents these emission estimates.

Table 21 Odour emissions associated with LFG residual flux – Sc0

Source	Scenario 0 - 2018			
	Predicted methane production [m^3/annum]	Total landfill gas production* [m^3 per hour]	Capping containment assumption	Odour emission [ou$_E$/s]
cell 1	97,600	22	98%	288
cell 2	113,845	26	98%	336
cell 3	129,819	30	98%	384
cell 4	179,232	41	98%	530
cell 5	210,457	48	98%	622
cell 6	245,581	56	98%	726
cell 7	251,568	57	98%	744
cell 8	347,197	79	98%	1,026
cell 9	444,186	101	98%	1,313
cell 10	638,560	146	98%	1,887
cell 11	1,109,215	253	90%	16,392
cell 12	1,109,215	253	90%	16,392
cell 13	1,109,215	253	90%	16,392
cell 14	1,109,215	253	90%	16,392
Total	7,094,905	1,620	-	73,423

* Assumes 50% methane content

Table 22: Odour emissions associated with LFG residual flux – Sc1

Source	Scenario 1 – 2022 (year 4)			
	Predicted methane production [m^3/annum]	Total landfill gas production* [m^3 per hour]	Capping containment assumption	Odour emission [ou$_E$/s]
cell 1	10,998	3	98%	33
cell 2	10,891	2	98%	32
cell 3	14,762	3	98%	44
cell 4	15,744	4	98%	47
cell 5	21,541	5	98%	64
cell 6	22,394	5	98%	66
cell 7	30,344	7	98%	90
cell 8	32,619	7	98%	96
cell 9	34,029	8	98%	101
cell 10	34,029	8	98%	101
cell 11	57,335	13	98%	169
cell 12	63,269	14	98%	187
cell 13	83,276	19	98%	246
cell 14	131,084	30	98%	387
cell 15	266,301	61	98%	787
cell 16	296,452	68	98%	876
cell 17	318,209	73	98%	940
cell 18	427,054	98	98%	1,262
cell 19	729,212	166	98%	2,155
cell 20	1,427,236	326	90%	21,091
cell 21	2,273,180	519	90%	33,593
Total	6,299,960	1,438		62,367

* Assumes 50% methane content

Table 23: Odour emissions associated with LFG residual flux – Sc2

Source	Scenario 2 – 2022 (year 4)			
	Predicted methane production [m^3/annum]	Total landfill gas production* [m^3 per hour]	Capping containment assumption	Odour emission [ou$_E$/s]
cell 1	31,165	7	98%	92
cell 2	36,606	8	98%	108
cell 3	92,222	21	98%	273
cell 4	94,976	22	98%	281
cell 5	79,870	18	98%	236
cell 6	92,770	21	98%	274
cell 7	136,369	31	98%	403
cell 8	180,832	41	98%	534
cell 9	273,302	62	98%	808
cell 10	468,735	107	98%	1,385
cell 11	523,074	119	98%	1,546
cell 12	1,277,365	292	98%	3,775
cell 13	816,504	186	98%	2,413
cell 14	944,559	216	98%	2,792
cell 15	1,140,171	260	98%	3,370
cell 16	1,420,343	324	95%	10,495
cell 17	1,410,814	322	95%	10,424
Total	9,019,678	2,059		39,210

* Assumes 50% methane content

Table 24: Odour emissions associated with LFG residual flux – Sc3 Yr 6

Source	Scenario 3 – 2024 (year 6)			
	Predicted methane production [m³/annum]	Total landfill gas production* [m³ per hour]	Capping containment assumption	Odour emission [ouE/s]
cell 1	17,003	4	98%	50
cell 2	20,090	5	98%	59
cell 3	50,613	12	98%	150
cell 4	52,124	12	98%	154
cell 5	43,834	10	98%	130
cell 6	50,913	12	98%	150
cell 7	74,841	17	98%	221
cell 8	99,243	23	98%	293
cell 9	149,991	34	98%	443
cell 10	257,247	59	98%	760
cell 11	287,069	66	98%	848
cell 12	701,033	160	98%	2,072
cell 13	448,107	102	98%	1,324
cell 14	518,385	118	98%	1,532
cell 15	625,739	143	98%	1,849
cell 16	779,501	178	98%	2,304
cell 17	869,286	198	98%	2,569
cell 18	1,197,180	273	98%	3,538
cell 19	1,454,580	332	95%	10,748
cell 20	1,718,629	392	95%	12,699
Total	9,415,406	2,150		41,896

* Assumes 50% methane content

APPENDIX 7.2

Landfill Gas Prediction Model

Calibrated Landfill Gas Prediction Model for Knockharley Landfill - Option 2A

Revision: 0 ***Date:*** ***15 November 2018***

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Cork : Tel 021-4964133 Fax 021-4964464	**JOB NUMBER:**	**LW14-821-01**		
	CALC NUMBER:	**C-08 Option 2A**		

PROJECT:	**Strategic Development Knockharley**	**FILE:**	C:\Users\tanyar\Documents\workingfiles\uss.ftco.ie\Calc Set 08 Calibrated Gas Model KNK Option 2A 65.xls
DESCRIPTION:	**Calibrated LFG prediciton model - Option 2A**	**SHEET:**	Calc cover

Rev	Date	Purpose and Description	Prepared	Checked	Approved
0	15/11/2018	Issue for EIAR Appendix	TR	TR	TR
		www.fehilytimoney.ie			

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES **Cork : Tel 021-4964133 Fax 021-4964464**	**DESIGNED:**	TR	**CHECKED:**	TR
	DATE:	4/5/18	**REVISION:**	0
	JOB NUMBER:	**LW14-821-01**		
	NUMBER:	**C-08 Option 2A**		

PROJECT:	**Strategic Development Knockharley**	**FILE**	C:\Users\tanyar\Documents\workingfiles\uss.ftco.ie\Calc Set 08 Calibrated Gas Model KNK Option 2A 65.xls
DESCRIPTION:	**Calibrated LFG prediciton model - Option 2A**	**SHEET**	Design Report

Ref. Output

i. References

1 A management and auditing model for balancing landfill gas extraction. C. J. Cronin, P. Kelly, E. Hanley, T. Ruddy, J. Smith Proceedings Waste 2008

2 A spread sheet tool to calibrate LANDGEM gas modelling balancing landfill gas extraction. C. J. Cronin, P. Kelly, T. Ruddy, D. Smyth, S. Myler. Proceedings Sardinia 2011.

3 http://www.epa.gov/ttncatc1/products.html#software

4 IED Licence W0146-02 avilable online at http://www.epa.ie/licences/lic_eDMS/090151b2804db14f.pdf

5 Planning permission, Planning Register Reference No. 01/5006, An Bord Pleanala Decision 2002

6 Phasing Plan (inlcudes details of available void) https://uss.ftco.ie/DMS/view_document.aspx?ID=127536&Latest=true

7 Waste In-Situ - Historic AERs and 2015 AER - available online at http://www.epa.ie/licsearchdownload/CombinedFileView.aspx?regno=W0146-02%20%20&classification=Enforcement. See more detail in Section 3.Waste breakdown to determine gas potential taken from NWD reports 2005-2008 and from AERs thereafter.

8 Project Waste Volumes - Table of Projected waste inputs as per email correspondance FT and Client https://uss.ftco.ie/DMS/view_document.aspx?ID=147368&Latest=true. See more detail in Section 3. Project waste breaskdowns agreed with Client prior to modelling.

9 Weighbrige waste inputs for year. Incoming from AGB 09-01-17 https://uss.ftco.ie/DMS/view_document.aspx?ID=194446&Latest=true

10 Bioverda data Email incoming 06-02-17 (DOC to TR) on gas capture rates at KNK for 2016 https://uss.ftco.ie/DMS/view_document.aspx?ID=194407&Latest=true

11 2017 tonnages (email in from TF on 12-01-18 to TR). Tonnages in filename '2017 draft tonnages.xls' (draft as not signed off yet) https://uss.ftco.ie/DMS/view_document.aspx?ID=305713&Latest=true

12 2017 average gas extraction rates, in email in from TF to TR on 10-01-17 vic BPS Ltd. DOC. Saved as https://uss.ftco.ie/DMS/view_document.aspx?ID=305715&Latest=true

13 Phasing Calculations - estimates of how waste will be placed in the landfill - void utilisation. 'KNH-projected waste flow and allocation -DFM edit.xls https://uss.ftco.ie/DMS/view_document.aspx?ID=304545&Latest=true

ii. Contents

Output Sheets

LandGEM Calibration Curve
8.1A Database Calcs
The outputs will be sent to Odournet for use in odour modelling.
This is included in the Option 2A workbook

1.0 Introduction & Purpose

1.1 Overview of Gas Calibration Tool

Ref 1 This landfill gas calibration tool is one of a suite of programs developed by FTC designed to facilitate balancing of landfill gas extraction.

This tool was developed because historical audits of sites invariably show significant differences between audit results and the theoretical gas prediction curve developed for the facility.

This software tool is designed as a validation check when using theoretical gas prediction models. Following inputs of MSW waste and historical gas extraction audit results, algorithms develop a locus of curves using the LandGEM software for respective k and L_o selections.

Thereafter the five curves that provide the closest match to the gas extraction flow rate observation at the specified audit date (Table 1.3) are selected and presented graphically in Figure 1.1.

These graphs (Figure 1.1) present prediction model outputs against audit flow records and allow inputs also from one other prediction curve (GasSim or other).

Thereafter the best fit curve from the 5 generated LandGEM curves can be selected (Table 1.7) and the k and L_o values determined for the best fit curve.

Ref 2 The algorithms used to develop the spreadsheet are documented in Ref 2.

1.2. Landfill Gas Prediction Model Limitations

Ref 3 The model requires representative audit results over an extended period and on the basis of such produces a best fit curve using LandGEM algorithms.

The model make no allowance for waste compositions that differ from average US conditions. Adjustments are therefore required if waste composition of the subject landfill differs from US historical averages. This calibration tool is not suited to residual waste where organic content of the waste may be very low.

The model applies a best fit result for the target date and only selects the five closest curves to that date. The selection does not by default represent the most appropriate curve.

Users when entering flow data must make allowance for fugitive emissions.

1.3 LandGEM Software Support

The gas prediction tool uses spreadsheets developed by the US Environmental Protection Agency. The manual and software of LandGEM version 3.02 can be obtained from the following web addresses respectively:

http://www.epa.gov/ttncatc1/dir1/landgem-v302-guide.pdf
http://www.epa.gov/ttncatc1/products.html#software

1.4. Example Design Report

Attached is an example of a typical audit report generated by the FTC as balancing software tool

Typical Audit Report

1.5 Database calculations

The curves are created using waste inputs and different factors for k and L_o. These calculations are carried out in the background but if the user wishes to view them they can be unhidden.

Some worksheets are also password protected to prevent inadvertent errors with macros, should the user want to unprotect them the password is 1234

2.0. Financial Analysis

The purpose of the model calibration is to facilitate financial and infrastructure conceptual planning for the facility in relation to flaring and utilisation.

Basic financial computations have been developed to facilitate financial planning using a calibrated gas prediction tool.

The models have not been developed for investment purposes. The purpose of the financial model is to facilitate present value comparisons of respective options based on a calibrated gas prediction curves.

The curve selection in Table 1.7 forms the basis of all financial analysis.

The proposed flare and utilisation infrastructure should be entered into Table 2.1.

Thereafter financial information should be entered into Tables 2.2 and 2.4.

Table 2.5 should be used to assess the start and end date for financial analysis.

3.0. Liability

The software tool is an academic tool only and Fehily Timoney & Co accept no responsibility for model errors as may be present or any liability associated with or arising from its use.

3.0. References

The information contained in this calc sheet was obtained from the following sources:

Info	**Source**
Waste Tonnages 2004-2015	2010-2017 AERs online at www.epa.ie
Waste Tonnages 2016 to date	Email in 09-01-17 IMC to CJC with file: https://uss.ftco.ie/DMS/view_document.aspx?ID=194444&Latest=true. Used this file to update the file of waste categories, saved at https://uss.ftco.ie/DMS/view_document.aspx?ID=194508&Latest=true
Quantity of landfill gas captured 2010	from 2010 AER online
Quantity of landfill gas captured 2011	T:\DublinArchive\Dublin-Jobs\2011\LW11\172\03\Incoming
Quantity of landfill gas captured 2012	T:\DublinArchive\Dublin-Jobs\2012\LW12\172\01\Incoming
Quantity of landfill gas captured 2013	T:\DublinArchive\Dublin-Jobs\2014\LW14\172\03\Incoming
Quantity of landfill gas captured 2014	T:\RCP (Q Drive)\2015\LW15\821\04\iNCOMING
Quantity of landfill gas captured 2015	https://uss.ftco.ie/DMS/view_document.aspx?ID=70186&Latest=true
Quantity of landfill gas captured 2016	Email in link is included in referenes above, file reference is included here:https://uss.ftco.ie/DMS/view_document.aspx?ID=194424&Latest=true
Quantity of landfill gas captured 2017	https://uss.ftco.ie/DMS/view_document.aspx?ID=305715&Latest=true
Landfill Gas Model and Calibration Exercise in 2010 for EIS/Licence app	T:\Archive2015 (E Drive)\RCP\2010\LW10\172\02\Calculations\Calc Set 03 Gas Model\Rev 6
Planning History	Chapter 1 of EIS
Quantity of landfill gas captured 2015	https://uss.ftco.ie/DMS/view_document.aspx?ID=305715&Latest=true
Waste tonnages 2017	https://uss.ftco.ie/DMS/view_document.aspx?ID=305713&Latest=true
Phasing Calculations - estimates of how waste will be placed in the landfill - void utilisation.	https://uss.ftco.ie/DMS/view_document.aspx?ID=304545&Latest=true

5.0. Options

The followingscenarios were modelled in order to establish gas generation predictions.

Option 1 - No change. The facility remains in operation in line with current planning permission and IED licence.

Option 2A- The facility is approved to accept 440,000 tpa of waste of which a proportion is BMW or landfill gas generating.

5.1 Option 2A

The proposed development obtains consent for acceptance of 290,000 tonnes of waste per annum (plus an additional 150,000 t IBA to the IBA facility).

Option 2

Waste Inputs 2004-2017

The model inputs only include historic waste placed in the landfill for disposal with an assumption about the gas

Historic data records are included in Appendix - Waste Inputs

Waste Inputs 2018 and onwards

Option	2018	2019	2020	2021	2022	2023 & 2024
2A	65,000	65,000	65,000	65,000	65,000	54,000

Assumptions

The estimates of waste inputs for disposal are based on the data in the Waste Inputs tab. There is no certainty regarding future waste inputs and particularly the type of waste material and the landifll gas generating potential of that waste. Therefore conservative assumptions have been made regarding waste types. The waste breakdown was agreed with the Client prior to modelling. This model has been generated in order to inform odour dispersion modelling. Void runs out for waste with a gas generation potential in mid 2024 in this Scenario 2A.

It has been assumed that all waste with a gas generation potential will be placed together. Inert and stabilised waste will be be placed separately.

FT used the same K and Lo values for each of the scenarios, the K and Lo values chosen were those that were most representative of historic landfill gas generation in the landfill across the scenarios.

6.0 Landill Gas Generation Prediction

Go to 8.1A Database Calcs for predicted landfill gas generation rates.

In this Option 2A, peak gas is in 2024 at 2,155 m^3/hr

Gas generation continues within the same range for one more year but as waste inputs are to cease in 2024, gas drops off very quickly post closure.

Table 8.1A.1 Model Parameters	Model Parameters:		
	k =	0.300	year $^{-1}$
	L_o =	150	m^3/Mg

Please note that the printed pdf version of this file does not show the entire file output for compiling reasons. Predicted landfill gas emissions are 150 m3/hr in 2034 and 0 m3/hr in 2061.

	Year		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Table 8.1A.2 Waste Inputs	User Waste Acceptance Inputs	*(Mg/year)*	910	136,121	133,119	136,154	124,507	104,880	94,694	54,968	55,520	21,609	4,578	35,427	67,582	35,528	66,365	65,000	65,000	65,000	65,000	65,000	54,000	0
	User Waste-In-Place	*(Mg)*	0	910	137,031	270,150	406,304	530,811	635,691	730,385	785,353	840,873	862,481	867,060	902,486	970,069	1,005,596	1,071,961	1,136,961	1,201,961	1,266,961	1,331,961	1,396,961	1,450,961

	Year		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Table 8.1A.3 LandGEM Results	Methane Emissions	*(m^3/year)*	35,893	5,398,390	9,252,565	12,227,560	13,971,862	14,489,525	14,471,035	12,889,629	11,739,867	9,549,851	7,255,379	6,772,978	7,684,563	7,094,904	7,875,019	8,399,075	8,787,305	9,074,913	9,287,978	9,445,821	9,128,656	6,762,675
	Avg. Methane Emission	*(m^3/hour)*	4.09	615.83	1,055.51	1,394.88	1,593.87	1,652.92	1,650.81	1,470.41	1,339.25	1,089.42	827.67	772.64	876.63	809.37	898.36	958.14	1,002.43	1,035.24	1,059.55	1,077.55	1,041.37	771.47
	Avg. Total LFG Emission	*(m^3/hour)*	8.2	1,231.7	2,111.0	2,789.8	3,187.7	3,305.8	3,301.6	2,940.8	2,678.5	2,178.8	1,655.3	1,545.3	1,753.3	1,618.7	1,796.7	1,916.3	2,004.9	2,070.5	2,119.1	2,155.1	2,082.7	1,542.9
	WASTE ADDED IN YEAR 1	YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
		WASTE	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910
		EMISSIONS	35,893	26,591	19,699	14,593	10,811	8,009	5,933	4,395	3,256	2,412	1,787	1,324	981	727	538	399	295	219	162	120	89	66
	WASTE ADDED IN YEAR 2	YEAR		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		WASTE		136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121
		EMISSIONS		5,371,799	3,979,527	2,948,106	2,184,010	1,617,955	1,198,610	887,952	657,811	487,319	361,015	267,446	198,129	146,778	108,735	80,553	59,675	44,209	32,750	24,262	17,974	13,315
	WASTE ADDED IN YEAR 3	YEAR			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		WASTE			133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119
		EMISSIONS			5,253,340	3,891,770	2,883,094	2,135,848	1,582,275	1,172,178	868,371	643,305	476,572	353,053	261,548	193,760	143,541	106,338	78,777	58,359	43,234	32,028	23,727	17,577
	WASTE ADDED IN YEAR 4	YEAR				0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		WASTE				136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154
		EMISSIONS				5,373,092	3,980,484	2,948,815	2,184,536	1,618,344	1,198,899	888,166	657,970	487,436	361,101	267,510	198,177	146,813	108,762	80,573	59,690	44,219	32,758	24,268
	WASTE ADDED IN YEAR 5	YEAR					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		WASTE					124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507
		EMISSIONS					4,913,462	3,639,982	2,696,565	1,997,665	1,479,906	1,096,342	812,190	601,685	445,739	330,212	244,627	181,224	134,254	99,458	73,680	54,584	40,437	29,956
	WASTE ADDED IN YEAR 6	YEAR						0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		WASTE						104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880
		EMISSIONS						4,138,915	3,066,184	2,271,485	1,682,757	1,246,617	923,517	684,158	506,837	375,474	278,158	206,064	152,656	113,091	83,780	62,065	45,979	34,062
	WASTE ADDED IN YEAR 7	YEAR							0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		WASTE							94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694
		EMISSIONS							3,736,931	2,768,386	2,050,871	1,519,323	1,125,542	833,822	617,711	457,611	339,007	251,142	186,051	137,830	102,107	75,643	56,037	41,514
	WASTE ADDED IN YEAR 8	YEAR								0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		WASTE								54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968
		EMISSIONS								2,169,223	1,607,000	1,190,495	881,940	653,357	484,019	358,570	265,635	196,787	145,784	107,999	80,008	59,271	43,909	32,529
	WASTE ADDED IN YEAR 9	YEAR									0	1	2	3	4	5	6	7	8	9	10	11	12	13
		WASTE									55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520
		EMISSIONS									2,190,994	1,623,129	1,202,443	890,792	659,915	488,877	362,169	268,301	198,763	147,247	109,083	80,811	59,866	44,350
	WASTE ADDED IN YEAR 10	YEAR										0	1	2	3	4	5	6	7	8	9	10	11	12
		WASTE										21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609
		EMISSIONS										852,744	631,728	467,996	346,700	256,842	190,273	140,958	104,424	77,359	57,309	42,456	31,452	23,300
	WASTE ADDED IN YEAR 11	YEAR											0	1	2	3	4	5	6	7	8	9	10	11
		WASTE											4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578
		EMISSIONS											180,675	133,847	99,157	73,457	54,418	40,314	29,865	22,125	16,390	12,142	8,995	6,664
	WASTE ADDED IN YEAR 12	YEAR												0	1	2	3	4	5	6	7	8	9	10
		WASTE												35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427
		EMISSIONS												1,398,061	1,035,709	767,272	568,409	421,088	311,950	231,098	171,202	126,829	93,957	69,605
	WASTE ADDED IN YEAR 13	YEAR													0	1	2	3	4	5	6	7	8	9
		WASTE													67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582
		EMISSIONS													2,667,018	1,975,776	1,463,691	1,084,329	803,290	595,092	440,855	326,594	241,946	179,238
	WASTE ADDED IN YEAR 14	YEAR														0	1	2	3	4	5	6	7	8
		WASTE														35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528
		EMISSIONS														1,402,040	1,038,657	769,456	570,027	422,286	312,837	231,756	171,689	127,190
	WASTE ADDED IN YEAR 15	YEAR															0	1	2	3	4	5	6	7
		WASTE															66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365
		EMISSIONS															2,618,985	1,940,192	1,437,329	1,064,800	788,823	584,374	432,915	320,712
	WASTE ADDED IN YEAR 16	YEAR																0	1	2	3	4	5	6
		WASTE																65,000	65,000	65,000	65,000	65,000	65,000	65,000
		EMISSIONS																2,565,117	1,900,286	1,407,766	1,042,899	772,598	572,355	424,011
	WASTE ADDED IN YEAR 17	YEAR																	0	1	2	3	4	5
		WASTE																	65,000	65,000	65,000	65,000	65,000	65,000
		EMISSIONS																	2,565,117	1,900,286	1,407,766	1,042,899	772,598	572,355
	WASTE ADDED IN YEAR 18	YEAR																		0	1	2	3	4
		WASTE																		65,000	65,000	65,000	65,000	65,000
		EMISSIONS																		2,565,117	1,900,286	1,407,766	1,042,899	772,598
	WASTE ADDED IN YEAR 19	YEAR																			0	1	2	3
		WASTE																			65,000	65,000	65,000	65,000
		EMISSIONS																			2,565,117	1,900,286	1,407,766	1,042,899
	WASTE ADDED IN YEAR 20	YEAR																				0	1	2
		WASTE																				65,000	65,000	65,000
		EMISSIONS																				2,565,117	1,900,286	1,407,766
	WASTE ADDED IN YEAR 21	YEAR																					0	1
		WASTE																					54,000	54,000
		EMISSIONS																					2,131,020	1,578,699
	WASTE ADDED IN YEAR 22	YEAR																						0
		WASTE																						0
		EMISSIONS																						0

2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961

2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054
5,009,913	3,711,435	2,749,498	2,036,879	1,508,957	1,117,863	828,133	613,496	454,489	336,694	249,429	184,781	136,889	101,410	75,127	55,655	41,230	30,544	22,628	16,763	12,418	9,200	6,815	5,049	3,740	2,771	2,053	1,521
571.52	423.39	313.65	232.36	172.14	127.52	94.47	69.99	51.85	38.41	28.45	21.08	15.62	11.57	8.57	6.35	4.70	3.48	2.58	1.91	1.42	1.05	0.78	0.58	0.43	0.32	0.23	0.17
1,143.0	846.8	627.3	464.7	344.3	255.0	188.9	140.0	103.7	76.8	56.9	42.2	31.2	23.1	17.1	12.7	9.4	7.0	5.2	3.8	2.8	2.1	1.6	1.2	0.9	0.6	0.5	0.3
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910
49	36	27	20	15	11	8	6	4	3	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121
9,864	7,308	5,414	4,011	2,971	2,201	1,631	1,208	895	663	491	364	270	200	148	110	81	60	45	33	24	18	13	10	7	5	4	3
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119
13,022	9,647	7,146	5,294	3,922	2,906	2,152	1,595	1,181	875	648	480	356	264	195	145	107	79	59	44	32	24	18	13	10	7	5	4
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154
17,978	13,319	9,867	7,309	5,415	4,011	2,972	2,202	1,631	1,208	895	663	491	364	270	200	148	110	81	60	45	33	24	18	13	10	7	5
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507
22,192	16,440	12,179	9,023	6,684	4,952	3,668	2,718	2,013	1,491	1,105	819	606	449	333	247	183	135	100	74	55	41	30	22	17	12	9	7
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880
25,234	18,694	13,849	10,259	7,600	5,630	4,171	3,090	2,289	1,696	1,256	931	689	511	378	280	208	154	114	84	63	46	34	25	19	14	10	8
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694
30,754	22,783	16,878	12,504	9,263	6,862	5,084	3,766	2,790	2,067	1,531	1,134	840	623	461	342	253	187	139	103	76	56	42	31	23	17	13	9
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968
24,098	17,852	13,225	9,797	7,258	5,377	3,983	2,951	2,186	1,620	1,200	889	658	488	361	268	198	147	109	81	60	44	33	24	18	13	10	7
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520
32,855	24,340	18,031	13,358	9,896	7,331	5,431	4,023	2,981	2,208	1,636	1,212	898	665	493	365	270	200	148	110	81	60	45	33	25	18	13	10
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609
17,261	12,787	9,473	7,018	5,199	3,851	2,853	2,114	1,566	1,160	859	637	472	349	259	192	142	105	78	58	43	32	23	17	13	10	7	5
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578
4,937	3,657	2,709	2,007	1,487	1,102	816	605	448	332	246	182	135	100	74	55	41	30	22	17	12	9	7	5	4	3	2	1
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427
51,565	38,200	28,299	20,965	15,531	11,506	8,524	6,314	4,678	3,465	2,567	1,902	1,409	1,044	773	573	424	314	233	173	128	95	70	52	38	29	21	16
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582
132,783	98,368	72,873	53,986	39,993	29,628	21,949	16,260	12,046	8,924	6,611	4,897	3,628	2,688	1,991	1,475	1,093	810	600	444	329	244	181	134	99	73	54	40
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528
94,225	69,803	51,712	38,309	28,380	21,024	15,575	11,538	8,548	6,332	4,691	3,475	2,575	1,907	1,413	1,047	775	574	426	315	234	173	128	95	70	52	39	29
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365
237,589	176,010	130,392	96,596	71,560	53,013	39,273	29,094	21,554	15,967	11,829	8,763	6,492	4,809	3,563	2,639	1,955	1,449	1,073	795	589	436	323	239	177	131	97	72
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
314,115	232,702	172,390	127,710	94,610	70,089	51,923	38,465	28,496	21,110	15,639	11,586	8,583	6,358	4,710	3,490	2,585	1,915	1,419	1,051	779	577	427	317	235	174	129	95
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
424,011	314,115	232,702	172,390	127,710	94,610	70,089	51,923	38,465	28,496	21,110	15,639	11,586	8,583	6,358	4,710	3,490	2,585	1,915	1,419	1,051	779	577	427	317	235	174	129
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
572,355	424,011	314,115	232,702	172,390	127,710	94,610	70,089	51,923	38,465	28,496	21,110	15,639	11,586	8,583	6,358	4,710	3,490	2,585	1,915	1,419	1,051	779	577	427	317	235	174
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
772,598	572,355	424,011	314,115	232,702	172,390	127,710	94,610	70,089	51,923	38,465	28,496	21,110	15,639	11,586	8,583	6,358	4,710	3,490	2,585	1,915	1,419	1,051	779	577	427	317	235
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
1,042,899	772,598	572,355	424,011	314,115	232,702	172,390	127,710	94,610	70,089	51,923	38,465	28,496	21,110	15,639	11,586	8,583	6,358	4,710	3,490	2,585	1,915	1,419	1,051	779	577	427	317
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000
1,169,529	866,408	641,851	475,495	352,255	260,957	193,322	143,216	106,097	78,599	58,227	43,136	31,956	23,673	17,538	12,992	9,625	7,130	5,282	3,913	2,899	2,148	1,591	1,179	873	647	479	355
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
0	0	0	0	0	0																						
1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961	1,450,961

2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082
1,127	835	618	458	339	251	186	138	102	76	56	42	31	23	17	13	9	7	5	4	3	2	2	1	1	1	0	0
0.13	0.10	0.07	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.3	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77
910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121	136,121
2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119	133,119
3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154	136,154
4	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73
124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507	124,507
5	4	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880	104,880
6	4	3	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694	94,694
7	5	4	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968	54,968
5	4	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520	55,520
7	5	4	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609	21,609
4	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578	4,578
1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427	35,427
12	9	6	5	3	3	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582	67,582
30	22	16	12	9	7	5	4	3	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528	35,528
21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365	66,365
53	40	29	22	16	12	9	7	5	4	3	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
71	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
95	71	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
129	95	71	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	0	0	0	0	0	0
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
174	129	95	71	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	0	0	0	0	0
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
235	174	129	95	71	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	0	0	0	0
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000
263	195	144	107	79	59	43	32	24	18	13	10	7	5	4	3	2	2	1	1	1	0	0	0	0	0	0	0
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Waste	
Year	Imported Waste
	t
2004	910
2005	136,121
2006	133,119
2007	136,154
2008	124,507
2009	104,880
2010	94,694
2011	54,968
2012	55,520
2013	21,609
2014	4,578
2015	35,427
2016	67,582
2017	35,528
2018	66,365
2019	65,000
2020	65,000
2021	65,000
2022	65,000
2023	65,000
2024	54,000
2025	
2026	
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Table 1.2 - Hist. LFG Details				
Year	Adjusted Gas Prediction Flow rate	Other Gas Prediction model	Capture Factor	Historical gas flow
	m^3/hr	m^3/hr		m^3/hr
2004	0		75%	0
2005			75%	0
2006			75%	0
2007	1,080		75%	810
2008	1,350		80%	1,080
2009	1,828		90%	1,645
2010	3,178		90%	2,860
2011	3,184		100%	3,184
2012	2,135		85%	1,815
2013	2,772		90%	2,495
2014	1,579		95%	1,500
2015	1,592		90%	1,433
2016	1,710		90%	1,539
2017	1,768		95%	1,680
2018			75%	0
2019			75%	0
2020			75%	0
2021			60%	0
2022			60%	0
2023			70%	0
2024			80%	0
2025			80%	0
2026			80%	0
2027			80%	0
2028			80%	0
2029			80%	0
2030			80%	0
2031			80%	0
2032			80%	0
2033			80%	0
2034			80%	0
2035			80%	0
2036			80%	0
2037			80%	0
2038			80%	0
2039			80%	0
2040			80%	0
2041			80%	0
2042			80%	0
2043			80%	0
2044			80%	0
2045			80%	0
2046			80%	0
2047			80%	0
2048			80%	0
2049			80%	0
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2059				

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INSTRUCTIONS:

NOTE: default data inserted please insert relevant data as instructed below

1. Enter Imported Waste tonnage and years in Table 1.1.
2. Enter Historical Landfill Gas Flow totals for years up to current year in Table 1.2 **including allowance for fugitive emissions**.
3. Enter details of the measured Landfill Gas Flow to engines and/or flares for current year in Table 1.3.(Table 1.5 adjusts for fugitive emissions).
4. Enter average methane content of landfill gas at the engines in Table 1.4.
5. Enter landfill gas capture estimate for respective years using tool in Table 1.5.
6. Select Update Calibration Curve to update analysis for model curve selection
7. Blue text denotes where inputs are required.
8. Select best-fit prediction curve from Fig.1.1 and enter best fit in Table 1.7. This model number curve will be used for PV analysis.
9. Table 1.8 allows manual selection of k and Lo.

NOTE Default year settings on x axis of Fig 1.1. If dates outside these years are required reformatting of the axis is required

PV Analysis Cover

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Cork, Ireland

Table 1.7 - Model Selection	
Enter Model No:	
k=	0
Lo=	0

Table 1.8 - Manual K and Lo Selection	
k=	0.30
Lo=	150

IMPORTANT NOTE:
This model is only accurate for methane concentrations between 40 and 60 percent. Using LandGEM at landfills that have methane content outside the range of 40 to 60 percent is not recommended. The first-order decomposition rate equation used by LandGEM to determine emissions may not be valid outside of this range.
Note also that LandGEM uses waste stream composition based on average of US sites

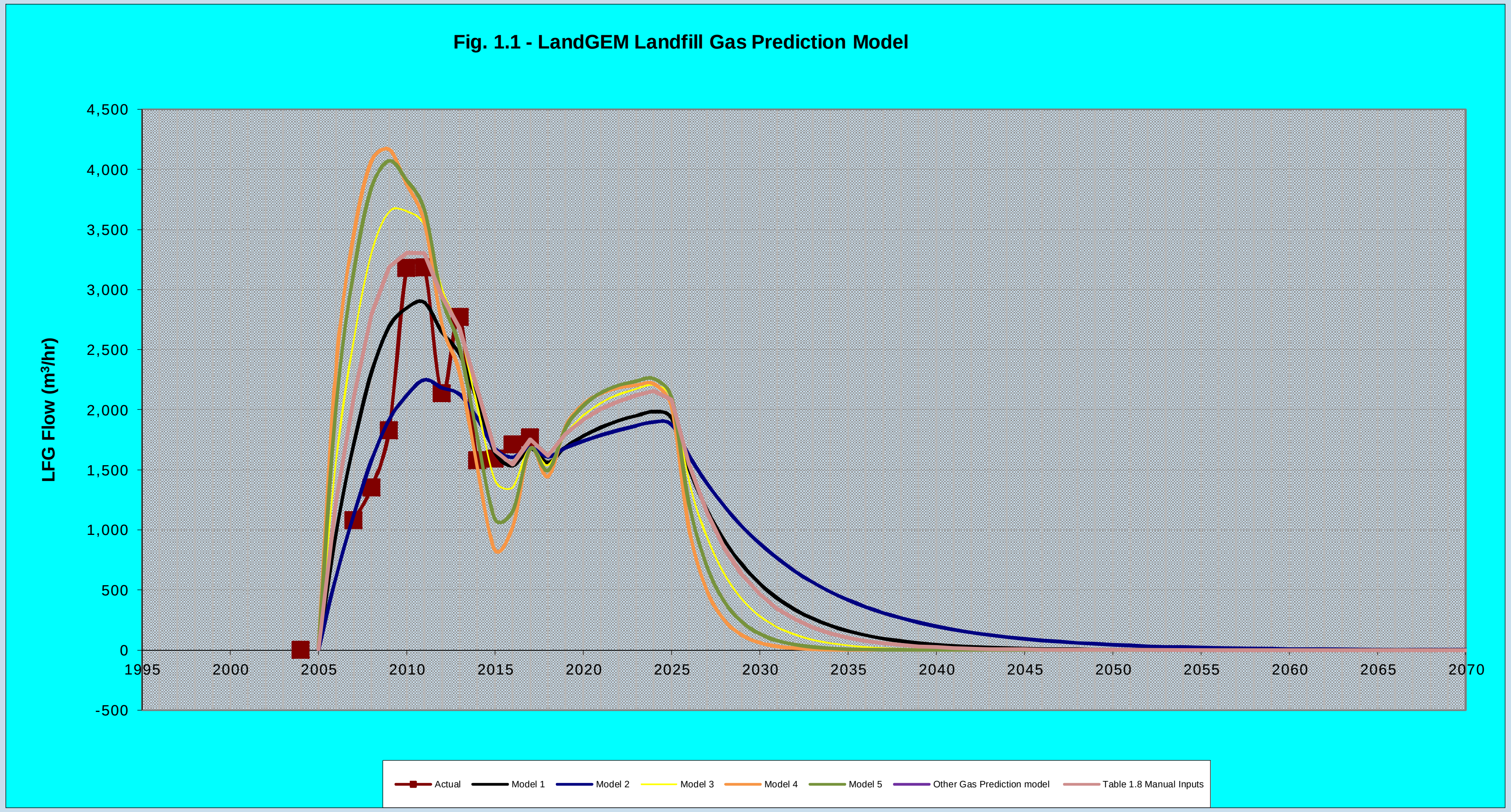
Fig. 1.1 - LandGEM Landfill Gas Prediction Model

Table 1.3 - Actual LFG Flow at Flares & Engines	
Enter Year	2017
Enter Actual Gas Production (m^3/hr)	1,680
Tolerance (m^3/yr)	200

Table 1.4 - Avg. CH_4 Conc. at Engines	
Enter CH_4 (%v/v)	50%

Table 1.5 - LFG Capture Estimate	
% of Landfill Open	2%
Open Landfill Capture Eff.	80%
% of Landfill Capped	98%
Capped Landfill Capture Eff.	95%
Overall Capture Efficiency	95%

Table 1.6 - K and Lo for models 1-5		
	k (year^{-1})	L_o (m^3/Mg)
Model 1	0.25	140
Model 2	0.15	140
Model 3	0.4	150
Model 4	0.7	145
Model 5	0.55	150

7 **Waste In-Situ**

	tonnes	tonnes
	Disposal	waste disposed with a gas generation potential (see table below for calculations)
2004	910	910
2005	136,121	136,121
2006	133,119	133,119
2007	136,182	136,182
2008	133,759	133,759
2009	134,073	134,073
2010	135,929	135,929
2011	89,577	89,577
2012	88,488	88,488
2013	30,618	30,618
2014	6,648	6,648
2015	71,564	71,564
2016	159,512	159,512
2017	86,184	86,184
total	1,342,684	1,342,684

Estimate of quantity of biodegradable waste disposed annually. Assumed all waste recovered was inert or stabilised.

7 AER data used for each year

Year	fines disposed	MSW disposed	bio fraction	
2007	92,009	44,145	136,154	
2008	101,381	23,126	124,507	
2009	92,304	12,576	104,880	
2010	75,117	26,635	94,694	
2011	38,887	34,215	54,968	in compliance with licence condition 1.13.1 (i)
2012	44,878	22,642	55,520	in compliance with licence condition 1.13.1 (i)
2013	17,787	9,926	21,609	in compliance with licence condition 1.13.1 (i) and 1.13.1.(ii)
2014	3,774	2,681	4,578	in compliance with licence condition 1.13.1 (i) and 1.13.1.(ii)
2015	21,873	45,181	35,427	in compliance with licence condition 1.13.1 (i) and 1.13.1.(ii)
2016	42,398	111,931	42,398	in compliance with licence condition 1.13.1 (ii) and 1.13.1.(iii)
2017	27,645	52,551	35,528	in compliance with licence condition 1.13.1.(iii)

5, 6 & 8 **Projected Waste Aceptance - Option 1 No Change**

Planning Reference AA1161431 granted an extension of planning for 5 years from Jan 2017. Previous revisions had assumed a 2026 planning closure date.

	tonnes	tonnes	tonnes
	Disposal	Recovery	Total
2018	88,000		88,000
2019	88,000		88,000
2020	88,000		88,000
2021	88,000		88,000

Total tonnage to be accepted post 2018, has been calucatated based on:

a) planning restriction of a max of 88,000tpa (ref 5)

b) waste input discussions with the client (ref 8)

c) available void (ref 6) which sees the facility accept waste at a rate of 440,000 tonnes per annum.

The table below is an estimate of predicted waste inputs and breakdown by type.

It is applicable to Option 2A

8

	Incoming material type	2019	2020	2021	2022	2023	2024	2025
1	IBA	150,000	150,000	150,000	150,000	150,000	150,000	150,000
2	contam soil, residual MSW, bulky, fines, cleaning grit	285,000	285,000	285,000	285,000	285,000	285,000	285,000
3	SNRHW	5,000	5,000	5,000	5,000	5,000	5,000	5,000
		435,000	**435,000**	**435,000**	**435,000**	**435,000**	**435,000**	**435,000**

0

Option 2A Waste with a gas generation potential						
Assumption that all non-hazardous waste accepted at the facility was MSW, of which 15% allowable BMW fraction (existing licence condition)	**65,250**	**65,250**	**65,250**	**65,250**	**65,250**	**65,250**
	65,000	**65,000**	**65,000**	**65,000**	**65,000**	**54,000**

Say

65,000 tonnes per annum

Calibrated Landfill Gas Prediction Model for Knockharely Landfill - Option 1A

Revision: 0 ***Date: 15 November 2018***

Prepared by:

Fehily Timoney & Co.
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Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: TR **CHECKED:** TR
DATE: 15/11/18 **REVISION:** 0
JOB NUMBER: LW14-821-01
CALC NUMBER: C-08

PROJECT: Strategic Development Knockharley
DESCRIPTION: Calibrated Landfill Gas model Option 1A
FILE: C:\Users\tanyar\Documents\workingfiles\uss.ftco.ie\Calc Set 08 Calibrated Gas model KNK Option 1A.xls
SHEET: Calc cover

Rev	Date	Purpose and Description	Prepared	Checked	Approved
0	15-Nov-18	Issue for EIAR Appendix	TR	TR	TR
		www.fehilytimoney.ie			

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	DATE:	15.11.18	**REVISION:**	0
	JOB NUMBER:	**LW14-821-01** **C-08**		

PROJECT:	**Strategic Development Knockharley**	**FILE**	C:\Users\tanyar\Documents\workingfiles\uss.ftco.ie\Calc Set 08 Calibrated Gas model KNK Option 1A.xls
DESCRIPTION	**Calibrated Landfill Gas model Option 1A**	**SHEET**	Design Report

Ref. Output

i. References

1 A management and auditing model for balancing landfill gas extraction. C. J. Cronin, P. Kelly, E. Hanley, T. Ruddy, J. Smith Proceedings Waste 2008

2 A spread sheet tool to calibrate LANDGEM gas modelling balancing landfill gas extraction. C. J. Cronin, P. Kelly, T. Ruddy, D. Smyth, S. Myler. Proceedings Sardinia 2011.

3 http://www.epa.gov/ttncatc1/products.html#software

4 IED Licence W0146-02 avilable online at http://www.epa.ie/licences/lic_eDMS/090151b2804db14f.pdf

5 Planning permission, Planning Register Reference No. 01/5006, An Bord Pleanala Decision 2002

6 Phasing Plan (inlcudes details of available void) https://uss.ftco.ie/DMS/view_document.aspx?ID=127536&Latest=true

7 Waste In-Situ - Historic AERs and 2015 AER - available online at http://www.epa.ie/licsearchdownload/CombinedFileView.aspx?regno=W0146-02%20%20&classification=Enforcement. See more detail in Section 3. Breakdown of waste inputs in 2005-2008 NWD reports, to determine potential gas producing fraction of the waste.

8 Project Waste Volumes - Table of Projected waste inputs as per email correspondance FT and Client https://uss.ftco.ie/DMS/view_document.aspx?ID=147368&Latest=true. See more detail in Section 3. These tonnages were agreed with the Client prior to modelling.

9 Weighbrige waste inputs for year. Incoming from AGB 09-01-17 https://uss.ftco.ie/DMS/view_document.aspx?ID=194446&Latest=true

10 Bioverda data Email incoming 06-02-17 (DOC to TR) on gas capture rates at KNK for 2016 https://uss.ftco.ie/DMS/view_document.aspx?ID=194407&Latest=true

11 2017 tonnages (email in from TF on 12-01-18 to TR). Tonnages in filename '2017 draft tonnages.xls' (draft as not signed off yet) https://uss.ftco.ie/DMS/view_document.aspx?ID=305713&Latest=true

12 2017 average gas extraction rates, in email in from TF to TR on 10-01-17 vic BPS Ltd. DOC. Saved as https://uss.ftco.ie/DMS/view_document.aspx?ID=305715&Latest=true

13 Phasing Calculations - estimates of how waste will be placed in the landfill - void utilisation. KNH-projected waste flow and allocation -DFM edit.xls https://uss.ftco.ie/DMS/view_document.aspx?ID=304545&Latest=true

ii. Contents

1.0 Introduction & Purpose

1.1 Overview of Gas Calibration Tool

Ref 1 This landfill gas calibration tool is one of a suite of programs developed by FTC designed to facilitate balancing of landfill gas extraction.

This tool was developed because historical audits of sites invariably show significant differences between audit results and the theoretical gas prediction curve developed for the facility.

This software tool is designed as a validation check when using theoretical gas prediction models. Following inputs of MSW waste and historical gas extraction audit results, algorithms develop a locus of curves using the LandGEM software for respective k and L_o selections.

Thereafter the five curves that provide the closest match to the gas extraction flow rate observation at the specified audit date (Table 1.3) are selected and presented graphically in Figure 1.1.

These graphs (Figure 1.1) present prediction model outputs against audit flow records and allow inputs also from one other prediction curve (GasSim or other).

Thereafter the best fit curve from the 5 generated LandGEM curves can be selected (Table 1.7) and the k and L_o values determined for the best fit curve.

Ref 2 The algorithms used to develop the spreadsheet are documented in Ref 2.

1.2. Landfill Gas Prediction Model Limitations

The model requires representative audit results over an extended period and on the basis of such produces a
Ref 3 best fit curve using LandGEM algorithms.

The model make no allowance for waste compositions that differ from average US conditions. Adjustments are therefore required if waste composition of the subject landfill differs from US historical averages. This calibration tool is not suited to residual waste where organic content of the waste may be very low.

The model applies a best fit result for the target date and only selects the five closest curves to that date. The selection does not by default represent the most appropriate curve.

Users when entering flow data must make allowance for fugitive emissions.

1.3 LandGEM Software Support

The gas prediction tool uses spreadsheets developed by the US Environmental Protection Agency. The manual and software of LandGEM version 3.02 can be obtained from the following web addresses respectively:

http://www.epa.gov/ttncatc1/dir1/landgem-v302-guide.pdf
http://www.epa.gov/ttncatc1/products.html#software

1.4. Example Design Report

Attached is an example of a typical audit report generated by the FTC as balancing software tool

Typical Audit Report

1.5 Database calculations

The curves are created using waste inputs and different factors for k and L_o. These calculations are carried out in the background but if the user wishes to view them they can be unhidden.

Some worksheets are also password protected to prevent inadvertent errors with macros, should the user want to unprotect them the password is 1234

2.0. Financial Analysis

The purpose of the model calibration is to facilitate financial and infrastructure conceptual planning for the facility in relation to flaring and utilisation.

Basic financial computations have been developed to facilitate financial planning using a calibrated gas prediction tool.

The models have not been developed for investment purposes. The purpose of the financial model is to facilitate present value comparisons of respective options based on a calibrated gas prediction curves.

The curve selection in Table 1.7 forms the basis of all financial analysis.

The proposed flare and utilisation infrastructure should be entered into Table 2.1.

Thereafter financial information should be entered into Tables 2.2 and 2.4.

Table 2.5 should be used to assess the start and end date for financial analysis.

3.0. Liability

The software tool is an academic tool only and Fehily Timoney & Co accept no responsibility for model errors as may be present or any liability associated with or arising from its use.

4.0. References

The information contained in this calc sheet was obtained from the following sources:

Info	**Source**
Waste Tonnages 2004-2017	2010-2017 AERs online at www.epa.ie
Waste Tonnages 2016 to date (waste inputs)	Email in 09-01-17 IMC to CJC with file: https://uss.ftco.ie/DMS/view_document.aspx?ID=194444&Latest=true. Used this file to update the file of waste categories, saved at
Quantity of landfill gas captured 2010	from 2010 AER online
Quantity of landfill gas captured 2011	T:\DublinArchive\Dublin-Jobs\2011\LW11\172\03\Incoming
Quantity of landfill gas captured 2012	T:\DublinArchive\Dublin-Jobs\2012\LW12\172\01\Incoming
Quantity of landfill gas captured 2013	T:\DublinArchive\Dublin-Jobs\2014\LW14\172\03\Incoming
Quantity of landfill gas captured 2014	T:\RCP (Q Drive)\2015\LW15\821\04\iNCOMING
Quantity of landfill gas captured 2015	https://uss.ftco.ie/DMS/view_document.aspx?ID=70186&Latest=true
Quantity of landfill gas captured 2016	Email in link is included in references above, file reference is included here: https://uss.ftco.ie/DMS/view_document.aspx?ID=194424&Latest=true
Quantity of landfill gas captured 2017	https://uss.ftco.ie/DMS/view_document.aspx?ID=305715&Latest=true
Landfill Gas Model and Calibration Exercise in 2010 for EIS/Licence app	T:\Archive2015 (E Drive)\RCP\2010\LW10\172\02\Calculations\Calc Set 03 Gas Model\Rev 6
Planning History and current permissions	Chapter 1 of EIS https://uss.ftco.ie/DMS/view_document.aspx?ID=223592&Latest=true
Quantity of landfill gas captured 2015	https://uss.ftco.ie/DMS/view_document.aspx?ID=305715&Latest=true
Waste tonnages 2017	https://uss.ftco.ie/DMS/view_document.aspx?ID=305713&Latest=true
Phasing Calculations - estimates of how waste will be placed in the landfill - void utilisation.	https://uss.ftco.ie/DMS/view_document.aspx?ID=304545&Latest=true

5.0. Options Modelled

The following three scenarios were modelled in order to establish a range of gas generation predictions.
Option 1 - No change. The facility remains in operation in line with current planning permission and IED
Option 1A - assumption that not all waste accepted for disposal will have a gas generation potential.
The projected inputs were reduced see Sheet Waste Inputs
Option 2 - The proposed development obtains consent to landfill 290,000 tonnes of waste per annum.
Option 2A - The best estimate of the volume of waste for disposal with gas generation potential.

5.1 Option 1
No change, the facility remains open as per current licence and planning
permission, which is 88,000 tpa and open until 2021

Estimate of the gas generation potential of waste in the years 2018 to close.
9 Option 1A - assumption that not all waste accepted for disposal will have a gas generation potential
10 Option 2A - assumption that not all waste acepted for disposal will have a gas generation potential
Refer Appendix - Waste Inputs for calculations

Option 1A -Waste Inputs (tonnes for disposal)

2018	40,000
2019	40,000
2020	40,000
2021	40,000

2022	0
2023	0
2024	0
2025	0
2026	0

Assumptions

The estimates of waste inputs for disposal are based on the data in the Waste Inputs tab. There is no certainty regarding future waste inputs and particularly the type of waste material and the landifll gas generating potential of that waste. Therefore conservative assumptions have been made regarding waste types. The waste breakdown was agreed with the Client prior to modelling. This model has been generated in order to inform odour dispersion modelling.

FT used the same K and Lo values for each of the 4 scenarios, the K and Lo values chosen were those that were most representative of historic landfill gas generation in the landfill across the 4 scenarios.

6.0 Predicted Landfill Gas Generation

Go to 8.1A Database Calcs for predicted landfill gas generation rates.
In this Option 1A, peak gas is in 2018 at 1,573 m^3/hr
Gas generation drops off after 2018 as waste inputs decrease.

Waste	
Year	Imported Waste
	t
2004	910
2005	136,121
2006	133,119
2007	136,154
2008	124,507
2009	104,880
2010	94,694
2011	54,968
2012	55,520
2013	21,609
2014	4,578
2015	35,427
2016	67,582
2017	35,528
2018	40,000
2019	40,000
2020	40,000
2021	40,000
2022	
2023	
2024	
2025	
2026	
2027	
2028	
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2059	

Table 1.2 - Hist. LFG Details				
Year	Adjusted Gas Prediction Flow rate	Other Gas Prediction model	Capture Factor	Historical gas flow
	m^3 / hr	m^3 / hr		m^3 / hr
2004			75%	0
2005			75%	0
2006			75%	0
2007	1,080		75%	810
2008	1,350		80%	1,080
2009	1,828		90%	1,645
2010	3,178		90%	2,860
2011	3,184		100%	3,184
2012	2,135		85%	1,815
2013	2,772		90%	2,495
2014	1,579		95%	1,500
2015	1,592		90%	1,433
2016	1,711		90%	1,540
2017	1,768		95%	1,680
2018			90%	0
2019			90%	0
2020			90%	0
2021			90%	0
2022			90%	0
2023			90%	0
2024			90%	0
2025			90%	0
2026			90%	0
2027			95%	0
2028			95%	0
2029			95%	0
2030			80%	0
2031			80%	0
2032			80%	0
2033			80%	0
2034			80%	0
2035			80%	0
2036			80%	0
2037			80%	0
2038			80%	0
2039			80%	0
2040			80%	0
2041			80%	0
2042			80%	0
2043			80%	0
2044			80%	0
2045			80%	0
2046			80%	0
2047			80%	0
2048			80%	0
2049			80%	0
2050				
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2059				

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INSTRUCTIONS:

NOTE: default data inserted please insert relevant data as instructed below

1. Enter Imported Waste tonnage and years in Table 1.1.
2. Enter Historical Landfill Gas Flow totals for years up to current year in Table 1.2 **including allowance for fugitive emissions**.
3. Enter details of the measured Landfill Gas Flow to engines and/or flares for current year in Table 1.3.(Table 1.5 adjusts for fugitive emissions).
4. Enter average methane content of landfill gas at the engines in Table 1.4.
5. Enter landfill gas capture estimate for respective years using tool in Table 1.5.
6. Select Update Calibration Curve to update analysis for model curve selection
7. Blue text denotes where inputs are required.
8. Select best-fit prediction curve from Fig.1.1 and enter best fit in Table 1.7. This model number curve will be used for PV analysis.
9. Table 1.8 allows manual selection of k and Lo.

NOTE Default year settings on x axis of Fig 1.1. If dates outside these years are required reformatting of the axis is required

PV Analysis Cover

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Table 1.7 - Model Selection	
Enter Model No:	
k=	**0**
Lo=	**0**

Table 1.8 - Manual K and Lo Selection	
k=	**0.35**
Lo=	**150**

IMPORTANT NOTE:
This model is only accurate for methane concentrations between 40 and 60 percent. Using LandGEM at landfills that have methane content outside the range of 40 to 60 percent is not recommended. The first-order decomposition rate equation used by LandGEM to determine emissions may not be valid outside of this range.
Note also that LandGEM uses waste stream composition based on average of US sites

Fig. 1.1 - LandGEM Landfill Gas Prediction Model

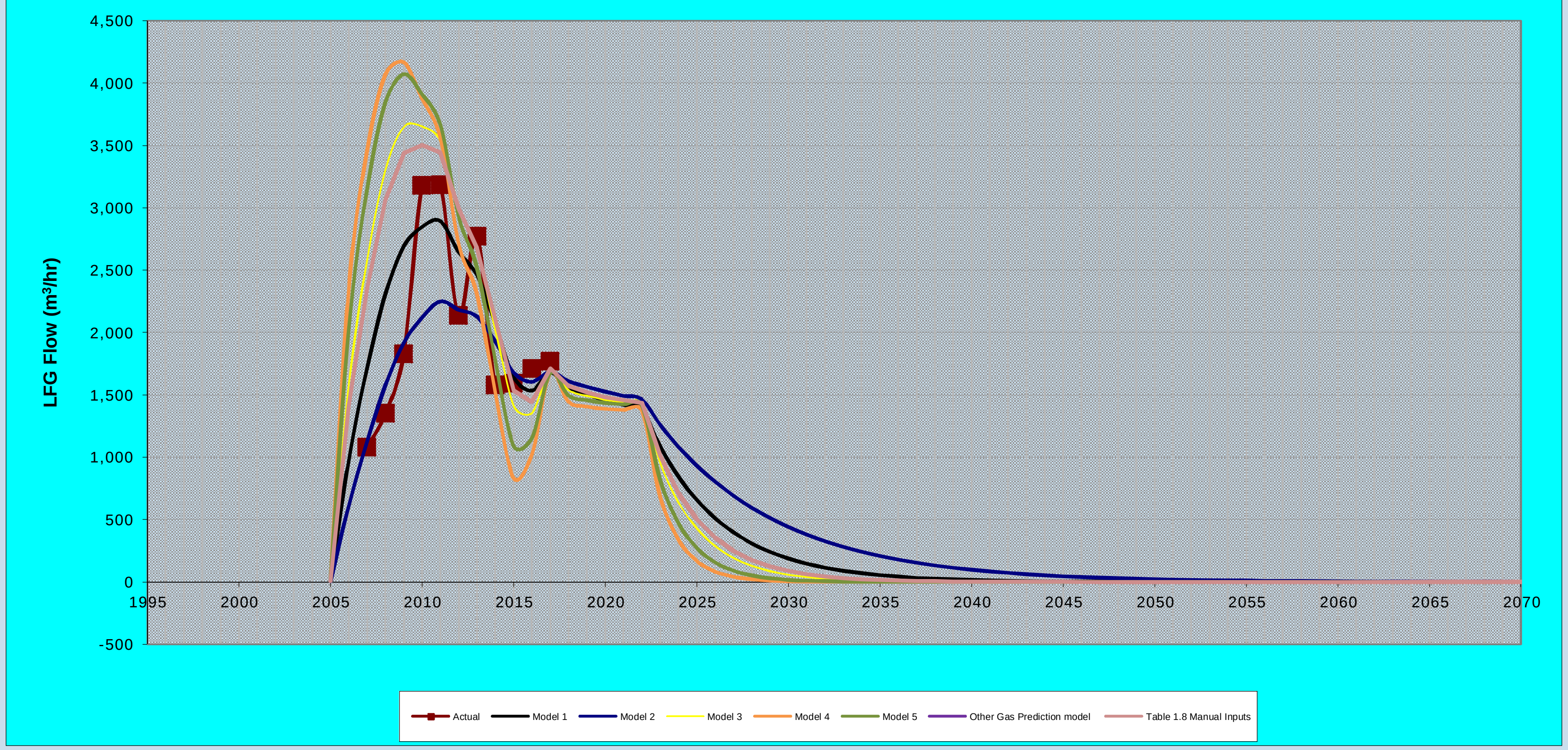


Table 1.3 - Actual LFG Flow at Flares & Engines	
Enter Year	**2017**
Enter Actual Gas Production (m^3/hr)	**1,680**
Tolerance (m^3/yr)	**200**

Table 1.4 - Avg. CH_4 Conc. at Engines	
Enter CH_4 (%v/v)	**50%**

Table 1.5 - LFG Capture Estimate	
% of Landfill Open	**2%**
Open Landfill Capture Eff.	**80%**
% of Landfill Capped	**98%**
Capped Landfill Capture Eff.	**95%**
Overall Capture Efficiency	95%

Table 1.6 - K and Lo for models 1-5		
	k (year^{-1})	**L_o (m^3/Mg)**
Model 1	0.25	140
Model 2	0.15	140
Model 3	0.4	150
Model 4	0.7	145
Model 5	0.55	150

Option 1A (No change, disposal of 88,000 tonnes of waste per annum with reduced gas generation potential)

Table 8.1A.1 Model Parameters

Model Parameters:
k = 0.350 year $^{-1}$
L_o = 150 m^3/Mg

Table 8.1A.2 Waste Inputs

Year		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
User Waste Acceptance Inputs	(Mg/year)	910	136,121	133,119	136,154	124,507	104,880	94,694	54,968	55,520	21,609	4,578	35,427	67,582	35,528	40,000	40,000	40,000	40,000	0	0
User Waste-In-Place	(Mg)	0	910	137,031	270,151	406,305	530,812	635,692	730,385	785,353	840,873	862,482	867,060	902,487	970,069	1,005,597	1,045,597	1,085,597	1,125,597	1,165,597	1,165,597

Year		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
User Waste Acceptance Inputs	(Mg/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
User Waste-In-Place	(Mg)	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597

Year		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
User Waste Acceptance Inputs	(Mg/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
User Waste-In-Place	(Mg)	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597

Year		2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083
User Waste Acceptance Inputs	(Mg/year)																				
User Waste-In-Place	(Mg)	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597	1,165,597

Table 8.1A.3 LandGEM Results

Year		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Methane Emissions	(m^3/year)	41,020	6,164,775	10,344,804	13,427,206	15,074,333	15,350,326	15,085,654	13,108,448	11,740,003	9,247,076	6,722,678	6,334,321	7,510,088	6,893,732	6,660,991	6,496,981	6,381,405	6,299,960	4,439,507	3,128,468
Avg. Methane Emission	(m^3/hour)	4.68	703.26	1,180.11	1,531.74	1,719.64	1,751.12	1,720.93	1,495.37	1,339.27	1,054.88	766.90	722.60	856.73	786.42	759.87	741.16	727.97	718.68	506.45	356.89
Avg. Total LFG Emission	(m^3/hour)	9.4	1,406.5	2,360.2	3,063.5	3,439.3	3,502.2	3,441.9	2,990.7	2,678.5	2,109.8	1,533.8	1,445.2	1,713.5	1,572.8	1,519.7	1,482.3	1,455.9	1,437.4	1,012.9	713.8

Year		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Methane Emissions	(m^3/year)	2,204,594	1,553,551	1,094,769	771,471	543,646	383,101	269,967	190,242	134,061	94,472	66,573	46,913	33,059	23,296	16,417	11,569	8,152	5,745	4,048	2,853
Avg. Methane Emission	(m^3/hour)	251.49	177.22	124.89	88.01	62.02	43.70	30.80	21.70	15.29	10.78	7.59	5.35	3.77	2.66	1.87	1.32	0.93	0.66	0.46	0.33
Avg. Total LFG Emission	(m^3/hour)	503.0	354.4	249.8	176.0	124.0	87.4	61.6	43.4	30.6	21.6	15.2	10.7	7.5	5.3	3.7	2.6	1.9	1.3	0.9	0.7

Year		2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
Methane Emissions	(m^3/year)	2,010	1,417	998	703	496	349	246	173	122	86	61	43	30	21	15	11	7	5	4	3
Avg. Methane Emission	(m^3/hour)	0.23	0.16	0.11	0.08	0.06	0.04	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg. Total LFG Emission	(m^3/hour)	0.5	0.3	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Year		2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084
Methane Emissions	(m^3/year)	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg. Methane Emission	(m^3/hour)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg. Total LFG Emission	(m^3/hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Year		2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104
Methane Emissions	(m^3/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg. Methane Emission	(m^3/hour)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg. Total LFG Emission	(m^3/hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Year		2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124
Methane Emissions	(m^3/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg. Methane Emission	(m^3/hour)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg. Total LFG Emission	(m^3/hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Year		2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144
Methane Emissions	(m^3/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg. Methane Emission	(m^3/hour)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg. Total LFG Emission	(m^3/hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 8.1A.4 Target Values

Year	2017	
Target Gas Production	1680	m^3/hour
Tolerance	100	m^3/hr

Table 8.1A.5 Data Input Table

	k																				
1,713	0.02	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
5	19	38	55	60	61	60	58	57	56	56	56	56	56	57	58	59	60	61	62	63	64
10	38	77	109	120	122	120	117	114	112	111	111	112	112	114	115	117	119	121	123	125	127
15	57	115	164	180	183	180	175	171	169	167	167	167	169	171	173	176	179	182	185	188	191
20	76	153	218	241	244	240	234	228	225	223	222	223	225	228	231	235	238	242	247	251	255
25	95	191	273	301	305	300	292	286	281	278	278	279	281	285	289	293	298	303	308	313	319
30	114	230	327	361	366	360	350	343	337	334	333	335	337	341	346	352	358	364	370	376	382
35	133	268	382	421	427	420	409	400	393	390	389	390	394	398	404	410	417	424	432	439	446
40	152	306	436	481	488	479	468	457	449	445	444	446	450	455	462	469	477	485	493	502	510
45	171	345	491	541	549	539	526	514	506	501	500	502	506	512	520	528	536	546	555	564	574
50	190	383	546	601	610	599	584	571	562	557	556	558	562	569	577	586	596	606	617	627	637
55	209	421	600	662	671	659	643	628	618	612	611	613	619	626	635	645	656	667	678	690	701
60	228	459	654	722	732	719	701	685	674	668	667	669	675	683	693	704	715	727	740	752	765
65	247	498	709	782	793	779	760	742	730	724	722	725	731	740	750	762	775	788	802	815	828
70	267	536	764	842	854	839	818	800	786	779	778	780	787	797	808	821	835	849	863	878	892
75	286	574	818	902	914	899	877	857	843	835	833	837	844	854	866	880	894	909	925	940	956
80	305	613	873	962	975	959	935	914	899	891	889	892	900	911	924	938	954	970	987	1,003	1,020
85	324	651	927	1,022	1,036	1,019	994	971	955	946	944	948	956	968	981	997	1,013	1,031	1,048	1,066	1,083
90	343	689	982	1,083	1,097	1,079	1,052	1,028	1,011	1,002	1,000	1,004	1,012	1,024	1,039	1,055	1,073	1,091	1,110	1,128	1,147
95	362	727	1,036	1,143	1,158	1,139	1,110	1,085	1,067	1,058	1,056	1,060	1,069	1,081	1,097	1,114	1,133	1,152	1,171	1,191	1,211
100	381	766	1,091	1,203	1,219	1,199	1,169	1,142	1,124	1,113	1,111	1,115	1,125	1,138	1,155	1,173	1,192	1,212	1,233	1,254	1,274
105	400	804	1,145	1,263	1,280	1,259	1,227	1,199	1,180	1,169	1,167	1,171	1,181	1,195	1,212	1,231	1,252	1,273	1,295	1,317	1,338
110	419	842	1,200	1,323	1,341	1,318	1,286	1,257	1,236	1,225	1,222	1,227	1,237	1,252	1,270	1,290	1,311	1,334	1,356	1,379	1,402
115	438	881	1,254	1,383	1,402	1,378	1,344	1,314	1,292	1,280	1,278	1,283	1,294	1,309	1,328	1,349	1,371	1,394	1,418	1,442	1,466
120	457	919	1,309	1,443	1,463	1,438	1,403	1,371	1,348	1,336	1,333	1,339	1,350	1,366	1,385	1,407	1,431	1,455	1,480	1,505	1,529
125	476	957	1,363	1,504	1,524	1,498	1,461	1,428	1,404	1,392	1,389	1,394	1,406	1,423	1,443	1,466	1,490	1,516	1,541	1,567	1,593
130	495	995	1,418	1,564	1,585	1,558	1,519	1,485	1,461	1,447	1,444	1,450	1,462	1,480	1,501	1,525	1,550	1,576	1,603	1,630	1,657
135	514	1,034	1,472	1,624	1,646	1,618	1,578	1,542	1,517	1,503	1,500	1,506	1,519	1,537	1,559	1,583	1,609	1,637	1,665	1,693	1,721
140	533	1,072	1,527	1,684	1,707	1,678	1,636	1,599	1,573	1,559	1,556	1,562	1,575	1,594	1,616	1,642	1,669	1,697	1,726	1,755	1,784
145	552	1,110	1,582	1,744	1,768	1,738	1,695	1,656	1,629	1,614	1,611	1,617	1,631	1,651	1,674	1,700	1,729	1,758	1,788	1,818	1,848
150	571	1,149	1,636	1,804	1,829	1,798	1,753	1,713	1,685	1,670	1,667	1,673	1,687	1,707	1,732	1,759	1,788	1,819	1,850	1,881	1,912
155	590	1,187	1,691	1,864	1,890	1,858	1,812	1,771	1,741	1,726	1,722	1,729	1,744	1,764	1,789	1,818	1,848	1,879	1,911	1,944	1,975
160	609	1,225	1,745	1,925	1,951	1,918	1,870	1,828	1,798	1,781	1,778	1,785	1,800	1,821	1,847	1,876	1,908	1,940	1,973	2,006	2,039
165	628	1,263	1,800	1,985	2,012	1,978	1,929	1,885	1,854	1,837	1,833	1,840	1,856	1,878	1,905	1,935	1,967	2,001	2,035	2,069	2,103
170	647	1,302	1,854	2,045	2,073	2,038	1,987	1,942	1,910	1,893	1,889	1,896	1,912	1,935	1,963	1,994	2,027	2,061	2,096	2,132	2,167
175	666	1,340	1,909	2,105	2,134	2,098	2,045	1,999	1,966	1,948	1,945	1,952	1,969	1,992	2,020	2,052	2,086	2,122	2,158	2,194	2,230
180	685	1,378	1,963	2,165	2,195	2,158	2,104	2,056	2,022	2,004	2,000	2,008	2,025	2,049	2,078	2,111	2,146	2,182	2,220	2,257	2,294
185	704	1,417	2,018	2,226	2,256	2,217	2,162	2,113	2,079	2,060	2,056	2,064	2,081	2,106	2,136	2,170	2,206	2,243	2,281	2,320	2,358
190	723	1,455	2,072	2,286	2,317	2,277	2,221	2,170	2,135	2,115	2,111	2,119	2,137	2,163	2,194	2,228	2,265	2,304	2,343	2,382	2,422
195	742	1,493	2,127	2,346	2,378	2,337	2,279	2,227	2,191	2,171	2,167	2,175	2,194	2,220	2,251	2,287	2,325	2,364	2,405	2,445	2,486
200	762	1,531	2,181	2,406	2,439	2,397	2,338	2,285	2,247	2,227	2,222	2,231	2,250	2,277	2,309	2,345	2,384	2,425	2,466	2,508	2,549

Table 8.1A.6 Closest Model Calculation

Closest match to target	762	1,531	1,691	1,684	1,707	1,678	1,695	1,656	1,685	1,670	1,667	1,673	1,687	1,707	1,674	1,700	1,669	1,697	1,665	1,693	1,657
Diff between target & closest ma	918	149	11	4	27	2	15	24	5	10	13	7	7	27	6	20	11	17	15	13	23
2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
k	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lo	0	0	0	0	0	140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
k	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lo	0	0	0	140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
k	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lo	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	0	0
k	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00
Lo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	0	0	0	0	0	0
k	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lo	0	0	0	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0

Table 8.1A.7 Results

	1	2	3	4	5
k	0.25	0.15	0.40	0.70	0.55
L_o	140	140	150	145	150

Ref

Appendix - Waste Inputs

7, 9, 10, 11 **Waste In-Situ**

	tonnes		tonnes disposal with methane generating potential
	Disposal	Average Recovery	
2004	910		910
2005	136,121		136,121
2006	133,119		133,119
2007	136,182		136,154
2008	133,759		124,507
2009	134,073		104,880
2010	135,929		94,694
2011	89,577		54,968
2012	88,488		55,520
2013	30,618		21,609
2014	6,648		4,578
2015	71,564		35,427
2016	159,512		42,398
2017	83,328		35,528

Estimate of quantity of biodegradable waste disposed annually. Assumed all waste recovered was inert or stabilised.

7 AER data used for each year

Year	fines disposed	bio fraction	Biowaste fraction calculated from
2007	92,009	136,154	
2008	101,381	124,507	
2009	92,304	104,880	
2010	75,117	94,694	in compliance with licence condition 1.13.1 (i)
2011	38,887	54,968	in compliance with licence condition 1.13.1 (i)
2012	44,878	55,520	in compliance with licence condition 1.13.1 (i)
2013	17,787	21,609	in compliance with licence condition 1.13.1 (i) and 1.13.1 (ii)
2014	3,774	4,578	in compliance with licence condition 1.13.1 (i) and 1.3.1 (ii)
2015	21,873	35,427	in compliance with licence condition 1.13.1 (i) and 1.13.1 (ii)
2016	42,398	42,398	in compliance with licence condition 1.13.1 (ii) and 1.13.1 (iii)
2017	27,645	35,528	in compliance with licence condition 1.13.1.(iii)

5, 6 & 8 **Projected Waste Aceptance - Option 1 No Change**

Planning Reference AA1161431 granted an extension of planning for 5 years from Jan 2017.

	tonnes Disposal	tonnes Total	tonnes gas potential
2017	88,000	88,000	40,000
2018	88,000	88,000	40,000
2019	88,000	88,000	40,000
2020	88,000	88,000	40,000
2021	88,000	88,000	40,000

Estimation of Gas Generation Potential of 88,000 tpa for disposal.

Total tonnage to be accepted post 2016, has been calucatated based on:
a) planning restriction of a max of 88,000tpa (ref 5)
b) waste input discussions with the client (ref 8)
c) available void (ref 6)

The table below is an estimate of predicted waste inputs and breakdown by type. Table generated by DFM, FT and shared with Client for review.

It is applicable to Options 2 and 2 a.

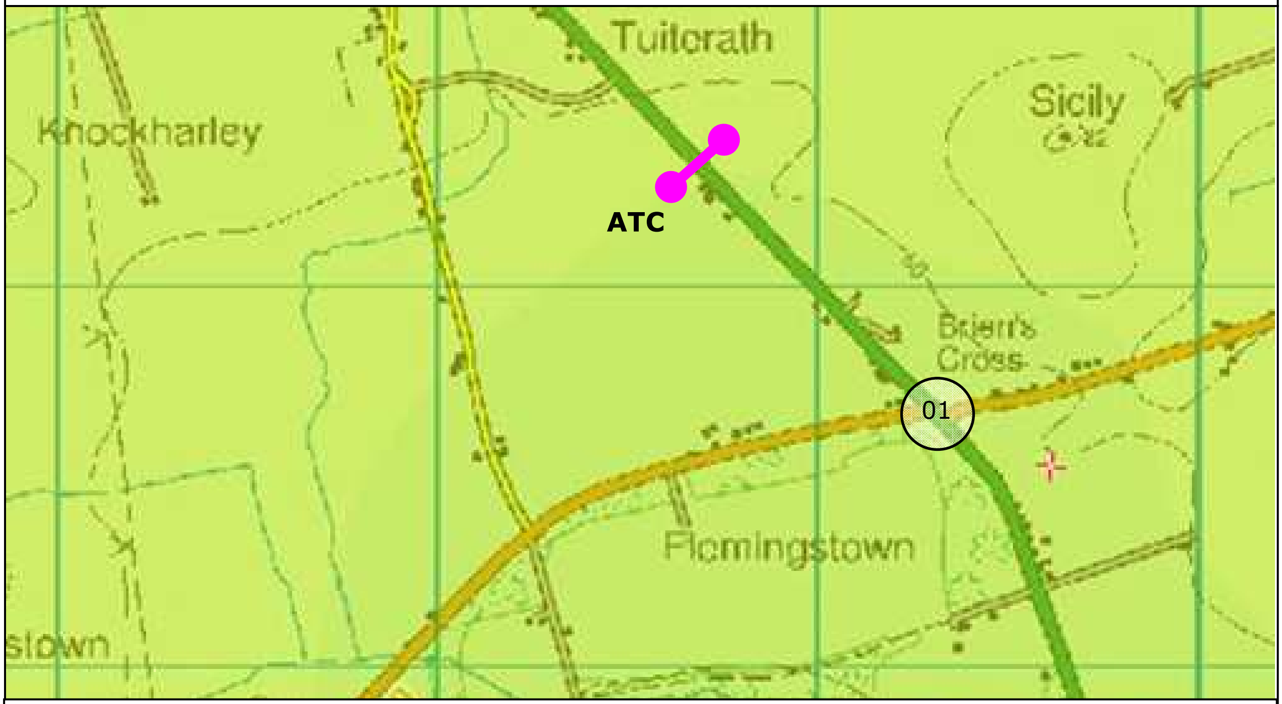
8

	Incoming material type	2019	2020	2021	2022	2023	2024	2025	2026
1	IBA	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
	Non Hazardous Residual Waste' *comprising*	285,000	285,000	285,000	285,000	285,000	285,000	285,000	285,000
	SNRHW	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
		440,000	**440,000**	**440,000**	**440,000**	**440,000**	**440,000**	**440,000**	**440,000**
		440,000	440,000	440,000	440,000	440,000	440,000	440,000	440,000

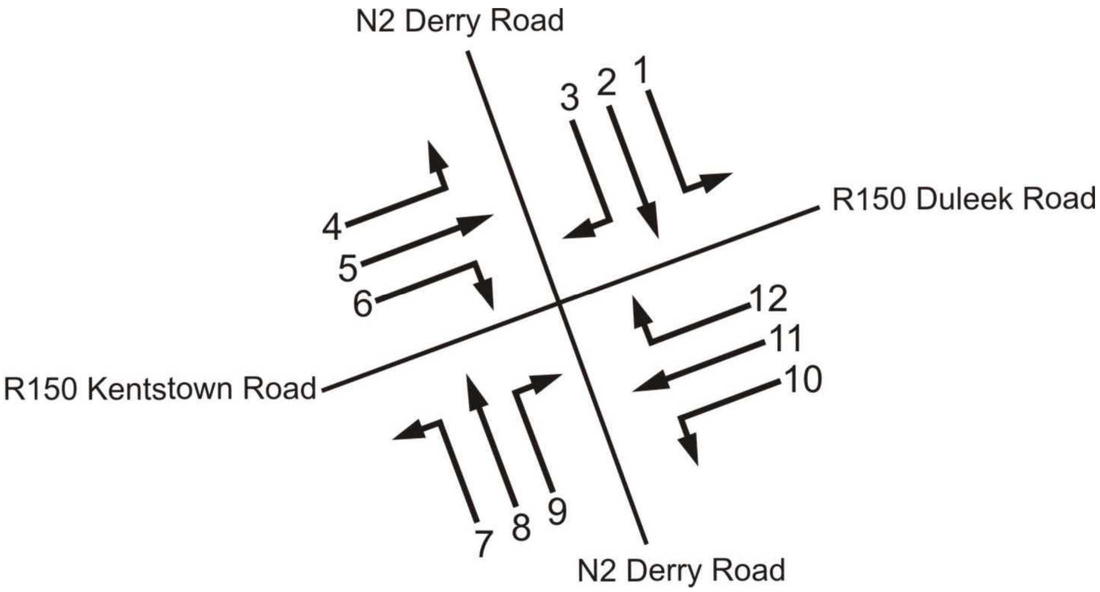
Appendix 8.1

Traffic Survey Data 2010, 2015 and 2016

Site Location



Movement Numbering



Job number: ATH/16/084	Job date: 5st September 2016	Drawing No: ATH/16/084-01
Client: FTCO	Job day: Tuesday	Author: SPW

abacus
Transportation Surveys

ABACUS TRANSPORTATION SURVEYS

KENTSTOWN TRAFFIC COUNTS **SEPTEMBER 2016**
MANUAL CLASSIFIED JUNCTION TURNING COUNT **ATH/16/084**

SITE: 01 DATE: 6th September 2016

LOCATION: N2 Derry Road/R150 DAY: Tuesday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
07:00	4	2	0	0	0	6	6	77	41	4	5	1	128	138	1	0	0	0	0	1	1
07:15	7	3	1	2	0	13	16	78	29	5	7	1	120	133	1	0	0	0	0	1	1
07:30	11	1	1	1	0	14	16	78	28	2	8	2	118	131	1	0	0	0	0	1	1
07:45	5	2	1	1	1	10	13	83	33	3	3	1	123	129	2	0	0	0	1	3	4
H/TOT	27	8	3	4	1	43	51	316	131	14	23	5	489	531	5	0	0	0	1	6	7
08:00	7	1	1	0	0	9	10	87	17	1	7	0	112	122	3	1	0	0	0	4	4
08:15	14	5	0	3	0	22	26	101	17	2	13	0	133	151	1	0	1	0	0	2	3
08:30	14	2	0	4	1	21	27	68	17	5	8	1	99	113	3	3	0	0	0	6	6
08:45	8	1	0	0	0	9	9	69	11	1	9	1	91	104	2	0	0	0	0	2	2
H/TOT	43	9	1	7	1	61	72	325	62	9	37	2	435	490	9	4	1	0	0	14	15
09:00	4	1	1	2	0	8	11	48	7	5	7	0	67	79	4	0	0	0	0	4	4
09:15	9	5	2	1	0	17	19	36	12	2	3	0	53	58	2	0	0	0	1	3	4
09:30	10	1	1	4	0	16	22	58	14	5	14	0	91	112	2	0	0	0	0	2	2
09:45	4	0	0	0	0	4	4	44	10	4	10	3	71	89	4	2	0	0	0	6	6
H/TOT	27	7	4	7	0	45	56	186	43	16	34	3	282	337	12	2	0	0	1	15	16
10:00	7	1	0	0	0	8	8	33	9	2	3	1	48	54	2	0	0	0	0	2	2
10:15	4	1	0	1	0	6	7	34	9	6	7	0	56	68	1	0	1	0	0	2	3
10:30	4	0	0	0	0	4	4	32	6	3	7	0	48	59	0	0	0	0	0	0	0
10:45	6	1	0	1	0	8	9	31	8	2	14	0	55	74	3	0	0	0	0	3	3
H/TOT	21	3	0	2	0	26	29	130	32	13	31	1	207	255	6	0	1	0	0	7	8
11:00	2	1	0	2	0	5	8	29	8	5	14	0	56	77	2	0	0	0	0	2	2
11:15	2	1	1	1	0	5	7	23	9	4	7	0	43	54	1	0	0	0	0	1	1
11:30	2	2	2	0	0	6	7	20	7	4	5	0	36	45	1	0	0	0	0	1	1
11:45	3	3	1	1	0	8	10	22	9	3	13	1	48	67	4	0	0	1	0	5	6
H/TOT	9	7	4	4	0	24	31	94	33	16	39	1	183	243	8	0	0	1	0	9	10
12:00	5	0	0	2	0	7	10	24	4	4	10	1	43	59	1	0	0	0	0	1	1
12:15	14	0	0	2	0	16	19	16	5	3	10	0	34	49	3	0	0	1	0	4	5
12:30	1	1	1	0	0	3	4	36	8	5	7	0	56	68	4	1	0	0	0	5	5
12:45	2	1	0	0	0	3	3	29	2	1	7	0	39	49	3	0	0	0	0	3	3
H/TOT	22	2	1	4	0	29	35	105	19	13	34	1	172	224	11	1	0	1	0	13	14

ABACUS TRANSPORTATION SURVEYS

KENTSTOWN TRAFFIC COUNTS **SEPTEMBER 2016**
MANUAL CLASSIFIED JUNCTION TURNING COUNT **ATH/16/084**

SITE: 01 DATE: 6th September 2016

LOCATION: N2 Derry Road/R150 DAY: Tuesday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	2	2	0	0	0	4	4	32	5	3	12	0	52	69	2	1	1	1	0	5	7
13:15	4	0	0	1	0	5	6	24	5	2	5	0	36	44	1	0	1	0	0	2	3
13:30	2	1	0	2	0	5	8	21	6	2	12	0	41	58	3	0	0	0	0	3	3
13:45	6	0	1	0	0	7	8	24	8	4	7	2	45	58	1	0	0	0	0	1	1
H/TOT	14	3	1	3	0	21	25	101	24	11	36	2	174	228	7	1	2	1	0	11	13
14:00	10	2	1	2	0	15	18	25	4	3	8	0	40	52	0	1	1	0	0	2	3
14:15	1	0	1	1	0	3	5	20	6	6	12	0	44	63	1	0	1	0	0	2	3
14:30	6	2	0	2	0	10	13	37	6	1	11	0	55	70	1	0	1	0	0	2	3
14:45	3	2	1	4	0	10	16	20	6	2	5	0	33	41	0	1	0	0	0	1	1
H/TOT	20	6	3	9	0	38	51	102	22	12	36	0	172	225	2	2	3	0	0	7	9
15:00	2	1	0	1	0	4	5	21	4	6	6	1	38	50	1	0	0	1	0	2	3
15:15	6	4	0	2	0	12	15	20	7	6	4	2	39	49	6	0	0	0	0	6	6
15:30	4	1	0	1	0	6	7	32	10	1	5	0	48	55	2	1	0	0	0	3	3
15:45	9	2	2	2	0	15	19	19	4	5	7	0	35	47	3	0	1	0	0	4	5
H/TOT	21	8	2	6	0	37	46	92	25	18	22	3	160	201	12	1	1	1	0	15	17
16:00	6	1	0	1	0	8	9	27	10	0	6	0	43	51	1	0	0	0	0	1	1
16:15	1	1	0	1	0	3	4	32	6	2	5	0	45	53	3	0	0	0	0	3	3
16:30	6	1	0	1	0	8	9	29	5	2	7	0	43	53	1	0	0	0	0	1	1
16:45	7	1	1	0	0	9	10	24	3	1	6	1	35	44	1	0	0	0	1	2	3
H/TOT	20	4	1	3	0	28	32	112	24	5	24	1	166	201	6	0	0	0	1	7	8
17:00	9	0	1	2	0	12	15	45	5	0	3	0	53	57	1	1	0	1	0	3	4
17:15	10	1	1	1	0	13	15	33	3	2	6	1	45	55	3	1	0	0	0	4	4
17:30	5	0	0	0	0	5	5	38	6	3	2	1	50	55	3	0	0	0	0	3	3
17:45	6	0	0	0	0	6	6	29	8	2	5	0	44	52	6	1	0	0	0	7	7
H/TOT	30	1	2	3	0	36	41	145	22	7	16	2	192	218	13	3	0	1	0	17	18
18:00	10	7	0	0	0	17	17	33	4	4	2	0	43	48	1	0	0	0	0	1	1
18:15	13	1	1	1	0	16	18	35	8	2	3	0	48	53	2	1	0	0	0	3	3
18:30	10	4	0	0	0	14	14	26	8	2	4	0	40	46	3	1	0	0	0	4	4
18:45	5	3	0	0	0	8	8	26	6	1	5	0	38	45	0	0	0	0	0	0	0
H/TOT	38	15	1	1	0	55	57	120	26	9	14	0	169	192	6	2	0	0	0	8	8
P/TOT	292	73	23	53	2	443	525	1828	463	143	346	21	2801	3343	97	16	8	5	3	129	143

ABACUS TRANSPORTATION SURVEYS

KENTSTOWN TRAFFIC COUNTS **SEPTEMBER 2016**
MANUAL CLASSIFIED JUNCTION TURNING COUNT **ATH/16/084**

SITE: 01 DATE: 6th September 2016

LOCATION: N2 Derry Road/R150 DAY: Tuesday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	0	0	0	0	0	0	0	16	4	0	0	0	20	20	6	1	0	0	0	7	7
07:15	0	0	0	0	0	0	0	21	5	1	1	0	28	30	4	0	0	0	0	4	4
07:30	1	0	0	0	1	2	3	18	9	1	1	1	30	33	4	1	0	0	0	5	5
07:45	2	0	0	0	0	2	2	29	4	1	3	0	37	41	6	0	0	0	0	6	6
H/TOT	3	0	0	0	1	4	5	84	22	3	5	1	115	124	20	2	0	0	0	22	22
08:00	1	0	1	0	0	2	3	21	9	1	6	1	38	47	4	0	0	1	0	5	6
08:15	0	1	0	0	0	1	1	25	3	1	1	1	31	34	7	0	0	0	0	7	7
08:30	3	0	0	1	0	4	5	21	8	1	1	0	31	33	4	0	0	0	0	4	4
08:45	2	1	0	0	0	3	3	15	5	1	2	0	23	26	8	1	0	0	0	9	9
H/TOT	6	2	1	1	0	10	12	82	25	4	10	2	123	140	23	1	0	1	0	25	26
09:00	8	2	0	0	0	10	10	19	1	1	2	0	23	26	7	1	0	0	0	8	8
09:15	3	0	0	0	0	3	3	11	3	0	0	2	16	18	5	0	0	0	0	5	5
09:30	1	1	0	0	0	2	2	11	5	0	3	1	20	25	3	1	0	0	0	4	4
09:45	0	1	0	0	0	1	1	7	1	2	2	1	13	18	0	0	0	0	0	0	0
H/TOT	12	4	0	0	0	16	16	48	10	3	7	4	72	87	15	2	0	0	0	17	17
10:00	2	0	0	0	0	2	2	11	2	0	2	0	15	18	1	0	0	0	0	1	1
10:15	2	1	0	1	0	4	5	5	1	0	2	0	8	11	1	1	0	0	0	2	2
10:30	2	0	0	0	0	2	2	14	1	0	2	1	18	22	1	0	0	0	0	1	1
10:45	1	0	1	0	0	2	3	8	2	1	0	0	11	12	1	0	0	0	0	1	1
H/TOT	7	1	1	1	0	10	12	38	6	1	6	1	52	61	4	1	0	0	0	5	5
11:00	3	1	0	0	0	4	4	14	0	2	3	0	19	24	3	0	0	0	0	3	3
11:15	5	2	0	1	0	8	9	6	3	1	5	0	15	22	1	0	1	0	0	2	3
11:30	0	0	0	0	0	0	0	8	5	1	0	1	15	17	1	0	0	0	0	1	1
11:45	2	0	0	1	0	3	4	8	2	2	4	0	16	22	0	0	0	0	0	0	0
H/TOT	10	3	0	2	0	15	18	36	10	6	12	1	65	85	5	0	1	0	0	6	7
12:00	6	0	0	0	0	6	6	15	4	0	1	0	20	21	4	1	0	0	0	5	5
12:15	4	1	1	0	1	7	9	9	4	0	0	0	13	13	3	0	0	0	0	3	3
12:30	4	1	0	0	0	5	5	8	1	1	1	0	11	13	0	0	0	0	0	0	0
12:45	4	1	0	0	0	5	5	7	2	0	0	1	10	11	1	0	0	0	0	1	1
H/TOT	18	3	1	0	1	23	25	39	11	1	2	1	54	58	8	1	0	0	0	9	9

ABACUS TRANSPORTATION SURVEYS

KENTSTOWN TRAFFIC COUNTS **SEPTEMBER 2016**
MANUAL CLASSIFIED JUNCTION TURNING COUNT **ATH/16/084**

SITE: 01 DATE: 6th September 2016

LOCATION: N2 Derry Road/R150 DAY: Tuesday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	2	0	0	0	0	2	2	8	0	2	4	0	14	20	5	1	0	0	0	6	6
13:15	0	0	0	0	0	0	0	10	2	0	0	0	12	12	0	0	0	0	0	0	0
13:30	2	1	0	0	0	3	3	9	1	1	1	1	13	16	0	0	0	0	0	0	0
13:45	3	0	0	1	0	4	5	5	1	0	3	0	9	13	3	0	0	0	0	3	3
H/TOT	7	1	0	1	0	9	10	32	4	3	8	1	48	61	8	1	0	0	0	9	9
14:00	4	1	0	0	0	5	5	11	2	0	0	1	14	15	2	0	0	0	0	2	2
14:15	5	0	0	0	0	5	5	13	3	2	2	0	20	24	2	0	0	0	0	2	2
14:30	0	0	0	0	1	1	2	11	1	0	0	2	14	16	4	1	0	0	1	6	7
14:45	3	1	0	1	0	5	6	15	1	1	2	1	20	24	5	2	0	0	0	7	7
H/TOT	12	2	0	1	1	16	18	50	7	3	4	4	68	79	13	3	0	0	1	17	18
15:00	1	1	0	0	0	2	2	16	1	0	1	1	19	21	1	0	0	0	0	1	1
15:15	4	0	0	1	0	5	6	18	5	0	2	0	25	28	0	0	0	0	0	0	0
15:30	2	0	0	0	0	2	2	12	5	1	1	2	21	25	3	0	0	0	1	4	5
15:45	0	0	0	0	0	0	0	5	4	0	0	0	9	9	2	1	0	0	0	3	3
H/TOT	7	1	0	1	0	9	10	51	15	1	4	3	74	83	6	1	0	0	1	8	9
16:00	2	0	0	1	0	3	4	17	1	0	1	0	19	20	4	1	0	0	0	5	5
16:15	6	0	0	0	0	6	6	10	2	0	2	0	14	17	1	0	0	0	0	1	1
16:30	0	0	1	0	1	2	4	22	5	1	0	1	29	31	1	0	0	0	1	2	3
16:45	1	1	1	0	0	3	4	23	5	1	1	0	30	32	0	0	0	0	0	0	0
H/TOT	9	1	2	1	1	14	17	72	13	2	4	1	92	99	6	1	0	0	1	8	9
17:00	2	0	0	0	0	2	2	23	3	0	1	0	27	28	2	1	0	0	0	3	3
17:15	3	0	0	0	0	3	3	36	2	0	1	0	39	40	4	0	0	0	0	4	4
17:30	2	0	0	0	0	2	2	20	7	0	0	0	27	27	1	0	0	0	0	1	1
17:45	2	0	0	0	0	2	2	28	4	1	1	1	35	38	4	1	0	0	0	5	5
H/TOT	9	0	0	0	0	9	9	107	16	1	3	1	128	133	11	2	0	0	0	13	13
18:00	3	2	1	0	0	6	7	21	2	0	0	0	23	23	0	0	0	0	0	0	0
18:15	2	0	0	1	0	3	4	15	3	1	0	0	19	20	4	0	0	0	0	4	4
18:30	1	2	0	0	0	3	3	23	1	0	2	0	26	29	4	0	0	0	0	4	4
18:45	2	0	0	0	0	2	2	15	2	0	0	1	18	19	4	0	0	0	0	4	4
H/TOT	8	4	1	1	0	14	16	74	8	1	2	1	86	90	12	0	0	0	0	12	12
P/TOT	108	22	6	9	4	149	168	713	147	29	67	21	977	1100	131	15	1	1	3	151	156

ABACUS TRANSPORTATION SURVEYS

KENTSTOWN TRAFFIC COUNTS **SEPTEMBER 2016**
MANUAL CLASSIFIED JUNCTION TURNING COUNT **ATH/16/084**

SITE: 01 DATE: 6th September 2016

LOCATION: N2 Derry Road/R150 DAY: Tuesday

	MOVEMENT 7							MOVEMENT 8							MOVEMENT 9						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	0	0	0	0	0	0	0	9	4	1	5	0	19	26	2	1	0	0	0	3	3
07:15	0	0	0	0	0	0	0	23	6	3	5	0	37	45	4	2	0	0	0	6	6
07:30	3	0	0	0	0	3	3	25	7	2	7	0	41	51	6	1	0	0	0	7	7
07:45	1	0	0	0	1	2	3	23	7	4	10	0	44	59	3	1	0	0	0	4	4
H/TOT	4	0	0	0	1	5	6	80	24	10	27	0	141	181	15	5	0	0	0	20	20
08:00	0	0	0	0	0	0	0	22	5	4	9	1	41	56	5	0	0	0	0	5	5
08:15	4	0	0	0	0	4	4	20	9	0	11	0	40	54	6	2	0	0	0	8	8
08:30	2	0	0	0	0	2	2	21	9	4	4	0	38	45	4	0	0	0	0	4	4
08:45	4	0	0	0	0	4	4	29	5	4	4	0	42	49	5	1	0	0	0	6	6
H/TOT	10	0	0	0	0	10	10	92	28	12	28	1	161	204	20	3	0	0	0	23	23
09:00	1	0	0	0	0	1	1	25	3	4	7	0	39	50	3	1	1	2	0	7	10
09:15	0	0	0	0	0	0	0	19	3	2	6	0	30	39	7	0	0	0	0	7	7
09:30	0	0	0	0	0	0	0	24	5	4	6	0	39	49	3	1	0	0	0	4	4
09:45	2	0	0	0	0	2	2	14	4	1	11	0	30	45	4	1	0	0	0	5	5
H/TOT	3	0	0	0	0	3	3	82	15	11	30	0	138	183	17	3	1	2	0	23	26
10:00	1	0	0	0	0	1	1	21	9	1	6	0	37	45	2	0	0	1	0	3	4
10:15	1	1	0	0	0	2	2	15	6	1	18	0	40	64	3	0	0	0	0	3	3
10:30	0	0	0	0	0	0	0	23	4	1	8	1	37	49	1	0	0	0	0	1	1
10:45	2	0	0	0	0	2	2	16	4	3	8	1	32	45	4	0	0	0	0	4	4
H/TOT	4	1	0	0	0	5	5	75	23	6	40	2	146	203	10	0	0	1	0	11	12
11:00	1	0	0	0	0	1	1	21	1	3	4	0	29	36	4	1	0	0	0	5	5
11:15	1	0	0	0	0	1	1	22	6	3	12	0	43	60	5	0	0	0	0	5	5
11:30	1	0	0	0	0	1	1	27	6	5	11	1	50	68	4	1	0	0	0	5	5
11:45	2	0	0	0	0	2	2	17	9	2	6	1	35	45	5	1	1	0	0	7	8
H/TOT	5	0	0	0	0	5	5	87	22	13	33	2	157	208	18	3	1	0	0	22	23
12:00	2	1	0	0	0	3	3	27	6	3	9	0	45	58	2	0	0	0	0	2	2
12:15	1	0	0	0	0	1	1	32	5	2	11	0	50	65	3	1	0	0	0	4	4
12:30	0	0	0	0	0	0	0	27	5	2	9	1	44	58	1	2	0	0	0	3	3
12:45	2	0	0	0	0	2	2	14	10	4	7	0	35	46	5	1	2	0	0	8	9
H/TOT	5	1	0	0	0	6	6	100	26	11	36	1	174	227	11	4	2	0	0	17	18

ABACUS TRANSPORTATION SURVEYS

KENTSTOWN TRAFFIC COUNTS **SEPTEMBER 2016**
MANUAL CLASSIFIED JUNCTION TURNING COUNT **ATH/16/084**

SITE: 01 DATE: 6th September 2016

LOCATION: N2 Derry Road/R150 DAY: Tuesday

	MOVEMENT 7							MOVEMENT 8							MOVEMENT 9						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	0	0	0	0	0	0	0	27	6	1	12	1	47	64	5	0	0	0	0	5	5
13:15	2	0	0	0	0	2	2	25	5	7	16	0	53	77	1	0	0	0	0	1	1
13:30	4	0	0	0	0	4	4	23	8	2	12	0	45	62	4	1	0	0	0	5	5
13:45	3	0	0	0	0	3	3	27	6	3	8	1	45	58	2	1	0	0	0	3	3
H/TOT	9	0	0	0	0	9	9	102	25	13	48	2	190	261	12	2	0	0	0	14	14
14:00	0	0	0	0	0	0	0	30	10	1	2	0	43	46	4	2	0	1	0	7	8
14:15	2	1	0	0	0	3	3	33	8	2	6	0	49	58	5	0	0	0	0	5	5
14:30	6	1	0	0	0	7	7	29	7	1	9	0	46	58	2	0	0	0	0	2	2
14:45	2	0	0	0	0	2	2	45	7	3	8	0	63	75	0	1	0	1	0	2	3
H/TOT	10	2	0	0	0	12	12	137	32	7	25	0	201	237	11	3	0	2	0	16	19
15:00	3	0	1	0	0	4	5	29	14	9	7	1	60	75	7	1	0	0	0	8	8
15:15	3	0	0	0	0	3	3	35	13	3	13	1	65	84	7	0	1	0	0	8	9
15:30	2	0	0	0	0	2	2	52	10	4	8	0	74	86	4	1	0	0	0	5	5
15:45	2	0	0	0	0	2	2	48	10	2	6	0	66	75	3	0	0	0	0	3	3
H/TOT	10	0	1	0	0	11	12	164	47	18	34	2	265	320	21	2	1	0	0	24	25
16:00	4	0	0	0	0	4	4	43	7	3	10	0	63	78	6	2	1	0	0	9	10
16:15	1	1	0	0	0	2	2	68	20	4	11	0	103	119	4	2	1	0	0	7	8
16:30	3	1	0	0	0	4	4	64	22	3	13	0	102	120	4	5	1	0	0	10	11
16:45	1	0	0	0	0	1	1	75	24	5	3	1	108	115	6	0	0	0	0	6	6
H/TOT	9	2	0	0	0	11	11	250	73	15	37	1	376	433	20	9	3	0	0	32	34
17:00	4	0	0	0	0	4	4	84	39	5	11	0	139	156	7	3	0	0	0	10	10
17:15	2	1	1	0	0	4	5	103	30	2	8	0	143	154	13	2	0	0	0	15	15
17:30	0	0	0	0	0	0	0	103	37	6	3	1	150	158	17	2	1	0	0	20	21
17:45	4	1	0	0	0	5	5	104	26	3	5	0	138	146	5	0	2	0	0	7	8
H/TOT	10	2	1	0	0	13	14	394	132	16	27	1	570	614	42	7	3	0	0	52	54
18:00	5	0	0	0	0	5	5	91	16	5	3	0	115	121	6	0	0	0	0	6	6
18:15	2	1	0	0	0	3	3	83	34	6	6	2	131	144	8	2	0	0	0	10	10
18:30	1	0	0	0	0	1	1	75	15	3	9	0	102	115	12	1	0	0	0	13	13
18:45	6	1	0	0	0	7	7	54	17	5	5	2	83	94	11	2	1	0	0	14	15
H/TOT	14	2	0	0	0	16	16	303	82	19	23	4	431	474	37	5	1	0	0	43	44
P/TOT	93	10	2	0	1	106	108	1866	529	151	388	16	2950	3546	234	46	12	5	0	297	310

SITE: 01 DATE: 6th September 2016

LOCATION: N2 Derry Road/R150 DAY: Tuesday

	MOVEMENT 10							MOVEMENT 11							MOVEMENT 12						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	10	1	1	0	0	12	13	8	6	0	0	0	14	14	0	2	0	0	0	2	172
07:15	17	2	0	0	0	19	19	23	1	0	0	0	24	24	4	3	0	0	0	7	7
07:30	16	3	0	0	0	19	19	23	7	2	1	0	33	35	5	1	0	0	0	6	6
07:45	14	1	0	0	0	15	15	19	11	3	1	1	35	39	5	3	0	1	0	9	10
H/TOT	57	7	1	0	0	65	66	73	25	5	2	1	106	112	14	9	0	1	0	24	195
08:00	15	3	0	0	0	18	18	26	4	1	0	0	31	32	0	0	4	0	0	4	6
08:15	6	1	0	0	0	7	7	24	3	0	1	0	28	29	0	0	0	1	0	1	2
08:30	4	2	1	1	0	8	10	29	1	0	3	0	33	37	5	4	2	0	0	11	12
08:45	5	2	0	0	0	7	7	20	1	0	4	1	26	32	5	1	0	3	0	9	13
H/TOT	30	8	1	1	0	40	42	99	9	1	8	1	118	130	10	5	6	4	0	25	33
09:00	7	0	0	0	0	7	7	14	3	0	2	0	19	22	12	2	1	0	0	15	16
09:15	4	1	1	0	0	6	7	14	2	0	1	0	17	18	4	0	0	0	0	4	4
09:30	4	0	0	0	0	4	4	20	3	1	2	0	26	29	2	1	1	3	0	7	11
09:45	3	0	0	0	0	3	3	7	3	0	1	2	13	16	4	2	0	2	0	8	11
H/TOT	18	1	1	0	0	20	21	55	11	1	6	2	75	85	22	5	2	5	0	34	42
10:00	3	1	0	0	0	4	4	9	2	1	1	1	14	17	3	1	0	3	0	7	11
10:15	3	2	0	0	0	5	5	13	3	1	0	0	17	18	4	0	0	1	0	5	6
10:30	7	1	0	0	0	8	8	9	2	2	3	1	17	23	4	3	2	0	0	9	10
10:45	5	0	0	0	0	5	5	11	1	0	0	1	13	14	4	3	1	2	0	10	13
H/TOT	18	4	0	0	0	22	22	42	8	4	4	3	61	71	15	7	3	6	0	31	40
11:00	1	0	0	0	0	1	1	11	3	1	2	0	17	20	8	1	0	0	0	9	9
11:15	4	0	0	0	0	4	4	6	4	0	3	0	13	17	3	1	0	1	0	5	6
11:30	5	0	1	0	0	6	7	11	0	1	0	0	12	13	2	1	0	2	0	5	8
11:45	5	1	0	0	0	6	6	12	2	0	1	1	16	18	3	1	0	0	0	4	4
H/TOT	15	1	1	0	0	17	18	40	9	2	6	1	58	68	16	4	0	3	0	23	27
12:00	0	0	0	1	0	1	2	5	0	0	1	0	6	7	3	1	0	0	0	4	4
12:15	6	0	1	0	0	7	8	11	3	0	3	0	17	21	3	1	1	2	0	7	10
12:30	3	1	0	0	0	4	4	9	0	0	2	0	11	14	1	1	2	3	0	7	12
12:45	5	2	0	0	0	7	7	10	3	0	0	1	14	15	2	0	1	1	0	4	6
H/TOT	14	3	1	1	0	19	21	35	6	0	6	1	48	57	9	3	4	6	0	22	32

ABACUS TRANSPORTATION SURVEYS

KENTSTOWN TRAFFIC COUNTS **SEPTEMBER 2016**

MANUAL CLASSIFIED JUNCTION TURNING COUNT **ATH/16/084**

SITE: 01 DATE: 6th September 2016

LOCATION: N2 Derry Road/R150 DAY: Tuesday

	MOVEMENT 10							MOVEMENT 11							MOVEMENT 12						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	5	1	0	0	0	6	6	10	1	2	2	0	15	19	5	0	1	2	0	8	11
13:15	1	3	0	0	0	4	4	11	2	0	1	0	14	15	4	4	1	0	0	9	10
13:30	3	0	0	0	0	3	3	7	2	0	2	0	11	14	6	0	0	1	0	7	8
13:45	1	1	0	0	0	2	2	14	1	1	2	2	20	25	2	2	0	1	0	5	6
H/TOT	10	5	0	0	0	15	15	42	6	3	7	2	60	73	17	6	2	4	0	29	35
14:00	4	0	1	0	0	5	6	13	1	0	0	0	14	14	1	2	1	4	0	8	14
14:15	2	0	0	0	0	2	2	13	1	3	1	0	18	21	5	2	0	1	0	8	9
14:30	2	1	0	0	0	3	3	10	5	0	0	0	15	15	6	1	0	2	0	9	12
14:45	7	0	0	0	0	7	7	8	1	1	4	0	14	20	5	1	2	4	0	12	18
H/TOT	15	1	1	0	0	17	18	44	8	4	5	0	61	70	17	6	3	11	0	37	53
15:00	6	0	0	0	0	6	6	13	5	1	0	1	20	22	7	3	2	2	0	14	18
15:15	7	0	0	0	0	7	7	21	2	1	1	0	25	27	3	2	0	3	0	8	12
15:30	4	1	0	0	0	5	5	19	1	1	0	1	22	24	8	2	0	1	0	11	12
15:45	0	0	1	0	0	1	2	20	2	2	1	1	26	29	6	1	3	1	0	11	14
H/TOT	17	1	1	0	0	19	20	73	10	5	2	3	93	101	24	8	5	7	0	44	56
16:00	4	0	1	0	0	5	6	22	3	3	2	0	30	34	7	2	2	2	0	13	17
16:15	3	0	0	0	0	3	3	30	5	1	1	0	37	39	5	2	1	3	1	12	17
16:30	6	0	0	0	0	6	6	21	6	0	1	0	28	29	9	1	2	1	0	13	15
16:45	6	0	0	0	0	6	6	17	5	1	3	1	27	32	5	5	1	1	0	12	14
H/TOT	19	0	1	0	0	20	21	90	19	5	7	1	122	135	26	10	6	7	1	50	63
17:00	8	1	0	0	0	9	9	22	7	2	0	0	31	32	3	2	0	1	0	6	7
17:15	4	3	0	0	0	7	7	26	5	1	1	0	33	35	12	5	2	0	0	19	20
17:30	5	1	1	0	0	7	8	31	5	0	0	0	36	36	12	5	0	1	0	18	19
17:45	8	4	0	0	0	12	12	23	5	1	1	1	31	34	10	4	0	1	0	15	16
H/TOT	25	9	1	0	0	35	36	102	22	4	2	1	131	137	37	16	2	3	0	58	63
18:00	4	0	1	0	0	5	6	18	7	0	0	0	25	25	9	1	1	0	0	11	12
18:15	4	0	0	0	0	4	4	18	2	1	0	0	21	22	5	2	1	0	0	8	9
18:30	3	0	0	0	0	3	3	8	0	2	0	0	10	11	8	5	0	0	0	13	13
18:45	4	0	0	0	0	4	4	9	1	0	1	1	12	14	0	1	0	0	0	1	1
H/TOT	15	0	1	0	0	16	17	53	10	3	1	1	68	72	22	9	2	0	0	33	34
P/TOT	253	40	10	2	0	305	313	748	143	37	56	17	1001	1109	229	88	35	57	1	410	672

N2/R150 Kentstown Traffic Survey **Summary** **Week Comm: Saturday 3 September 2016**
Automatic Traffic Count **Ath/16/084**

Site 01

Location North of N2/R150 Crossroads (@ Goolgle Earth Ref: 52.38'47.38" N,-6.30'29.94" W)

Speed Survey Summary

Northbound	85% Speed = 102.6 km/h, 95% Speed = 112.0 km/h, Median = 90.7 km/h	Maximum = 177.7 km/h, Minimum = 19.5 km/h, Mean = 91.7 km/h
Southbound	85% Speed = 104.8 km/h, 95% Speed = 115.6 km/h, Median = 92.5 km/h	Maximum = 178.4 km/h, Minimum = 16.2 km/h, Mean = 93.7 km/h

Volumetric Vehicle Counts:

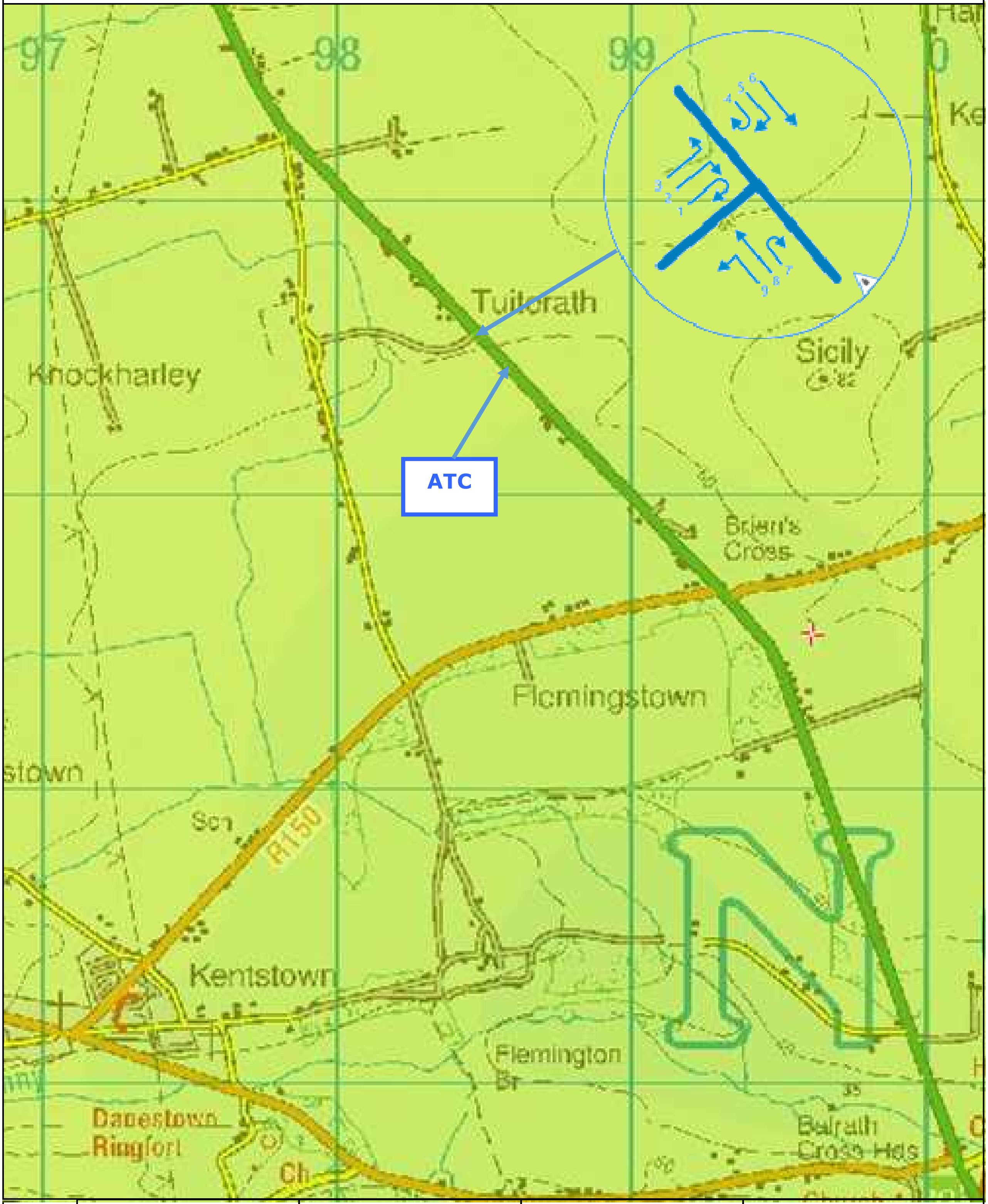
Direction	Time	Saturday 3 September 2016	Sunday 4 September 2016	Monday 5 September 2016	Tuesday 6 September 2016	Wednesday 7 September 2016	Thursday 8 September 2016	Friday 9 September 2016	No. Vehicles	7 day Mean
Northbound	**07-19**	2261	2107	3649	3741	3874	3739	3964	23335	3334
Southbound	**07-19**	2290	2227	3551	3814	3826	3811	3716	23235	3319
Northbound	**00-00**	2974	2783	4549	4717	4942	4827	4978	29770	4253
Southbound	**00-00**	2881	2939	4745	5025	5054	5057	4941	30642	4377

Peak Flows Summary

Peak	AM	IP	PM
Most Frequent Peak Hour	0900	1400	1700
Average Vehicles per Peak Hour	208	292	502

Abacus Transportation Surveys Ltd for
FTCO Consulting Engineers

Site Locations/Movement Directions



Job number: ATH/15/017	ATC: W/C 6th February 2015	Drawing No: ATH/15/017-1	abacus Transportation Surveys
Client: FTCO	JTC: Tuesday 10th February 2015	Author: SPW	

ABACUS TRANSPORTATION SURVEYS LTD

REF: Ath/15/017 Knockharley

SITE: 01

DAY: Tuesday
DATE: 10th February 2015

LOCATION: N2/Knockharley Greenstar Access

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
9:00	0	0	0	0	0	0	0	1	0	0	1	0	2	3	0	0	0	0	0	0	0
9:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	1	0	0	1	0	2	3	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:15	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0
10:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
11:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	0	1	1
12:00	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0
12:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
H/TOT	0	0	0	0	0	0	0	0	0	0	1	0	1	2	1	0	0	0	0	1	1
13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0
14:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:15	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	1	1	0	0	0	2	2	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
H/TOT	0	0	0	0	0	0	0	1	2	0	0	0	3	3	1	0	0	0	0	1	1
17:00	0	0	0	0	0	0	0	3	1	0	0	0	4	4	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	4	1	0	0	0	5	5	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 TOT	0	0	0	0	0	0	0	7	3	2	3	0	15	20	4	0	0	0	0	4	4

ABACUS TRANSPORTATION SURVEYS LTD

REF: Ath/15/017 Knockharley

SITE: 01

DAY: Tuesday
DATE: 10th February 2015

LOCATION: N2/Knockharley Greenstar Access

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	118	1	6	0	0	125	128
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	5	8	4	2	111	122
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108	17	14	1	2	142	152
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	22	6	6	3	123	137
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	404	45	34	11	7	501	539
8:00	0	0	0	0	0	0	0	1	0	0	0	0	1	1	80	23	10	1	0	114	120
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	16	4	3	0	125	131
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	16	5	0	2	93	98
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68	20	9	4	0	101	111
H/TOT	0	0	0	0	0	0	0	1	0	0	0	0	1	1	320	75	28	8	2	433	459
9:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	11	2	5	0	68	76
9:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47	8	9	7	0	71	85
9:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	12	12	2	0	76	85
9:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	4	10	2	1	48	57
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	178	35	33	16	1	263	301
10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	7	9	3	0	51	59
10:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	8	15	1	0	57	66
10:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	9	13	0	0	54	61
10:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	9	7	3	0	40	47
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	118	33	44	7	0	202	233
11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	9	7	2	1	57	64
11:15	0	0	0	0	0	0	0	1	0	0	0	0	1	1	19	5	6	0	0	30	33
11:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	5	10	1	0	39	45
11:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	7	6	2	1	44	51
H/TOT	0	0	0	0	0	0	0	1	0	0	0	0	1	1	108	26	29	5	2	170	193
12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	2	10	1	0	37	43
12:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	4	6	3	0	41	48
12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	4	6	4	0	42	50
12:45	0	0	0	0	0	0	0	1	0	0	0	0	1	1	21	5	5	2	0	33	38
H/TOT	0	0	0	0	0	0	0	1	0	0	0	0	1	1	101	15	27	10	0	153	180
13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	4	6	2	0	47	53
13:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	7	0	9	0	40	52
13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	4	7	6	0	45	56
13:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	4	6	7	1	48	61
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	19	19	24	1	180	222
14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	8	5	8	0	50	63
14:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	12	7	3	0	56	63
14:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	8	4	3	1	43	50
14:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	5	6	6	0	39	50
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	112	33	22	20	1	188	226
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	10	4	5	1	46	56
15:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	4	2	2	0	34	38
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	4	5	6	2	49	61
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	3	3	4	0	39	46
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	113	21	14	17	3	168	200
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	7	4	5	0	43	52
16:15	0	1	0	0	0	1	1	0	0	0	0	0	0	0	40	5	1	4	0	50	56
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	9	4	3	1	47	54
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	9	2	4	0	50	56
H/TOT	0	1	0	0	0	1	1	0	0	0	0	0	0	0	132	30	11	16	1	190	217
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	8	2	5	2	51	61
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	9	7	7	0	66	79
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	2	3	11	0	46	62
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	1	3	2	0	40	44
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	20	15	25	2	203	245
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	4	2	3	0	38	43
18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	2	0	4	0	46	51
18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	1	4	2	0	41	46
18:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	3	4	1	0	34	37
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	129	10	10	10	0	159	177
12 TOT	0	1	0	0	0	1	1	3	0	0	0	0	3	3	1973	362	286	169	20	2810	3193

ABACUS TRANSPORTATION SURVEYS LTD

REF: Ath/15/017 Knockharley

SITE: 01

DAY: Tuesday
DATE: 10th February 2015

LOCATION: N2/Knockharley Greenstar Access

	MOVEMENT 7							MOVEMENT 8							MOVEMENT 9						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
7:00	0	0	0	0	0	0	0	16	0	6	2	0	24	30	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	23	2	6	3	0	34	41	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	25	7	3	1	0	36	39	1	0	0	0	0	1	1
7:45	0	0	0	0	0	0	0	39	4	9	2	0	54	61	2	2	0	0	0	4	4
H/TOT	0	0	0	0	0	0	0	103	13	24	8	0	148	170	3	2	0	0	0	5	5
8:00	0	0	0	0	0	0	0	28	3	4	0	0	35	37	2	0	0	0	0	2	2
8:15	0	0	0	0	0	0	0	31	10	6	1	0	48	52	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	25	5	5	1	0	36	40	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	33	12	6	2	0	53	59	1	0	0	1	0	2	3
H/TOT	0	0	0	0	0	0	0	117	30	21	4	0	172	188	3	0	0	1	0	4	5
9:00	0	0	0	0	0	0	0	36	10	6	7	0	59	71	0	0	0	0	0	0	0
9:15	0	0	0	0	0	0	0	29	7	9	2	0	47	54	0	0	0	0	0	0	0
9:30	0	0	0	0	0	0	0	16	2	3	1	0	22	25	1	0	0	0	0	1	1
9:45	0	0	0	0	0	0	0	33	8	11	2	0	54	62	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	114	27	29	12	0	182	212	1	0	0	0	0	1	1
10:00	0	0	0	0	0	0	0	16	4	9	5	0	34	45	0	0	0	1	0	1	2
10:15	0	0	0	0	0	0	0	22	4	6	2	0	34	40	0	0	1	0	0	1	2
10:30	0	0	0	0	0	0	0	23	7	10	1	0	41	47	0	0	1	0	0	1	2
10:45	0	0	0	0	0	0	0	20	5	6	3	0	34	41	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	81	20	31	11	0	143	173	0	0	2	1	0	3	5
11:00	0	0	0	0	0	0	0	23	8	8	6	0	45	57	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	20	5	7	1	0	33	38	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	20	8	3	4	1	36	44	0	0	0	1	0	1	2
11:45	0	0	0	0	0	0	0	18	5	7	8	0	38	52	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	81	26	25	19	1	152	190	0	0	0	1	0	1	2
12:00	0	0	0	0	0	0	0	28	3	5	1	0	37	41	0	0	0	0	0	0	0
12:15	0	0	0	0	0	0	0	23	4	9	0	0	36	41	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	27	6	9	3	0	45	53	0	0	0	0	0	0	0
12:45	0	0	0	0	0	0	0	24	11	11	4	0	50	61	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	102	24	34	8	0	168	195	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	29	6	6	3	0	44	51	0	0	0	0	0	0	0
13:15	0	0	0	0	0	0	0	27	6	2	5	0	40	48	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	31	10	4	3	1	49	56	0	0	0	0	0	0	0
13:45	0	0	0	0	0	0	0	30	9	6	4	1	50	59	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	117	31	18	15	2	183	214	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	24	10	4	3	0	41	47	0	0	0	0	0	0	0
14:15	0	0	0	0	0	0	0	27	8	7	6	0	48	59	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	42	13	7	8	0	70	84	0	1	0	0	0	1	1
14:45	0	0	0	0	0	0	0	36	7	12	4	0	59	70	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	129	38	30	21	0	218	260	0	1	0	0	0	1	1
15:00	0	0	0	0	0	0	0	28	6	9	6	0	49	61	0	0	0	0	0	0	0
15:15	0	0	0	0	0	0	0	45	6	10	4	1	66	77	0	0	0	0	0	0	0
15:30	0	0	0	0	0	0	0	52	9	6	5	0	72	82	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	48	11	4	8	0	71	83	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	173	32	29	23	1	258	303	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	53	10	10	8	0	81	96	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	56	12	11	5	1	85	98	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	67	18	6	4	1	96	105	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	74	13	5	0	2	94	99	1	0	0	0	0	1	1
H/TOT	0	0	0	0	0	0	0	250	53	32	17	4	356	398	1	0	0	0	0	1	1
17:00	0	0	0	0	0	0	0	81	15	8	6	0	110	122	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	82	18	5	1	0	106	110	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	82	31	6	3	1	123	131	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	103	10	4	3	0	120	126	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	348	74	23	13	1	459	488	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	89	3	3	2	0	97	101	0	0	0	0	0	0	0
18:15	0	0	0	0	0	0	0	94	0	4	4	1	103	111	0	0	0	0	0	0	0
18:30	0	0	0	0	0	0	0	90	1	7	2	0	100	106	0	0	0	0	0	0	0
18:45	0	0	0	0	0	0	0	83	2	6	4	0	95	103	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	356	6	20	12	1	395	422	0	0	0	0	0	0	0
12 TOT	0	0	0	0	0	0	0	1971	374	316	163	10	2834	3214	8	3	2	3	0	16	21

ABACUS TRANSPORTATION SURVEYS

Greenstar Knockharley Traffic Count **Summary** **Week Comm:** **Friday 6 February 2015**
Automatic Traffic Count **Ath/15/017**

Site 01

Location N2 Derry Road, South of Greenstar Access, Knockharley

Speed Survey Summary

Northbound	85% Speed = 101.2 km/h, 95% Speed = 109.4 km/h, Median = 91.1 km/h	Maximum = 160.9 km/h, Minimum = 17.7 km/h, Mean = 91.5 km/h
Southbound	85% Speed = 103.0 km/h, 95% Speed = 112.7 km/h, Median = 91.1 km/h	Maximum = 169.3 km/h, Minimum = 24.5 km/h, Mean = 92.3 km/h

Volumetric Vehicle Counts:

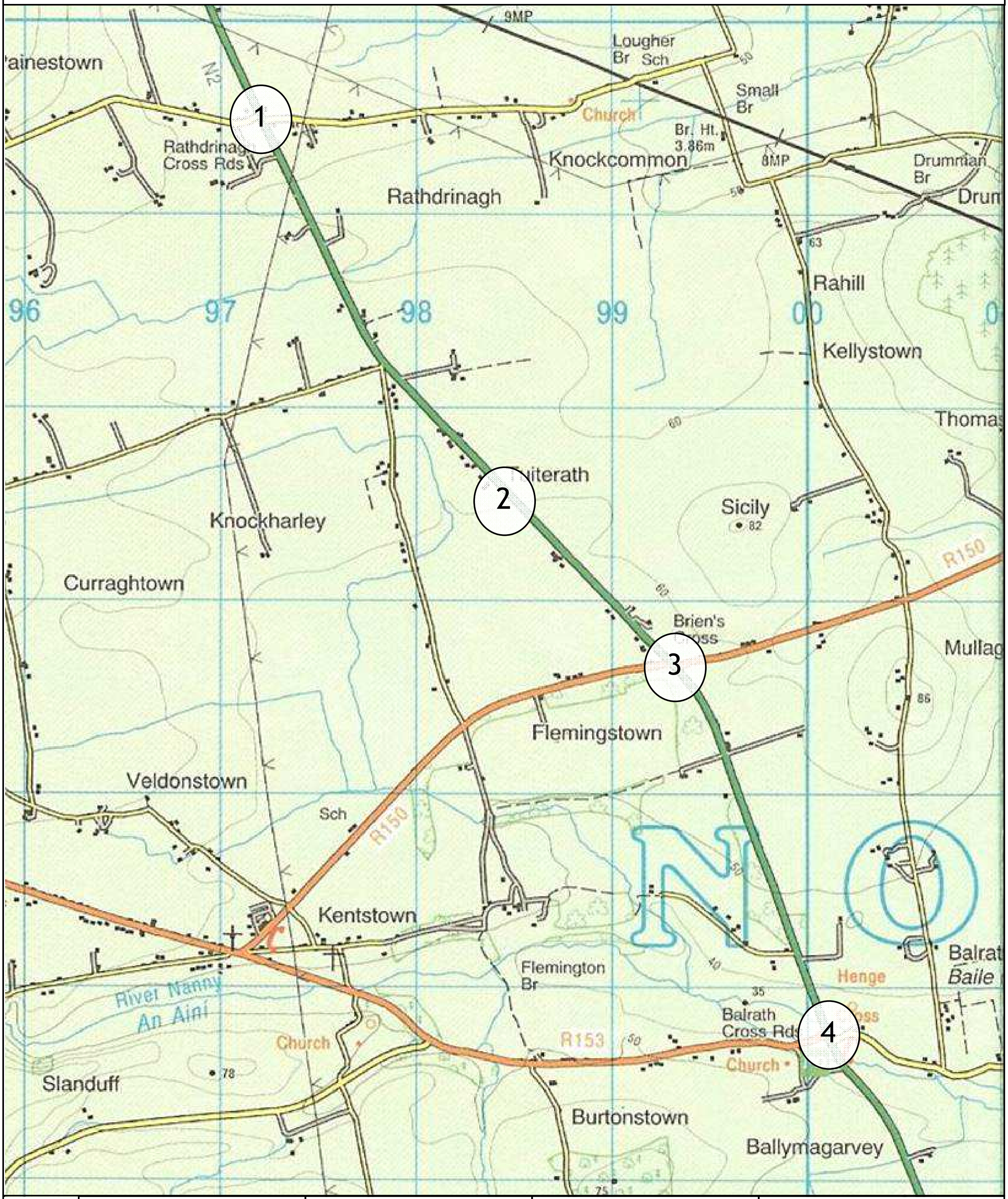
Direction	Time	Friday 6 February 2015	Saturday 7 February 2015	Sunday 8 February 2015	Monday 9 February 2015	Tuesday 10 February 2015	Wednesday 11 February 2015	Thursday 12 February 2015	No. Vehicles	7 day Mean
Northbound	07-19	3072	2107	1957	2669	2757	2690	2721	17973	2568
Southbound	07-19	2820	2321	2343	2904	2867	2889	2898	19042	2720
Northbound	00-00	3898	2715	2529	3387	3508	3510	3515	23062	3295
Southbound	00-00	3846	2923	3046	3968	3855	3908	3897	25443	3635

Peak Flows Summary

Peak	AM	IP	PM
Most Frequent Peak Hour	0800	1400	1800
Average Vehicles per Peak Hour	155	224	366

Abacus Transportation Surveys Ltd for
FTCO

Site Locations



Job number: ATH/10/051	Job date: 20th May 2010	Drawing No: ATH/10/051-1
Client: Traffic Wise	Job day: Thursday	Author: ITK

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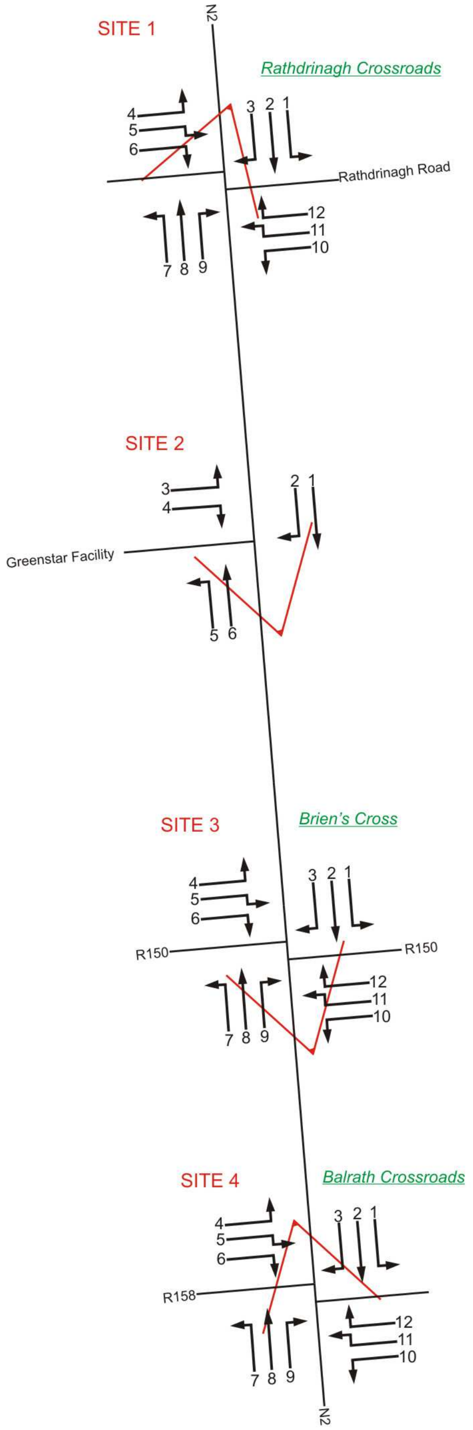
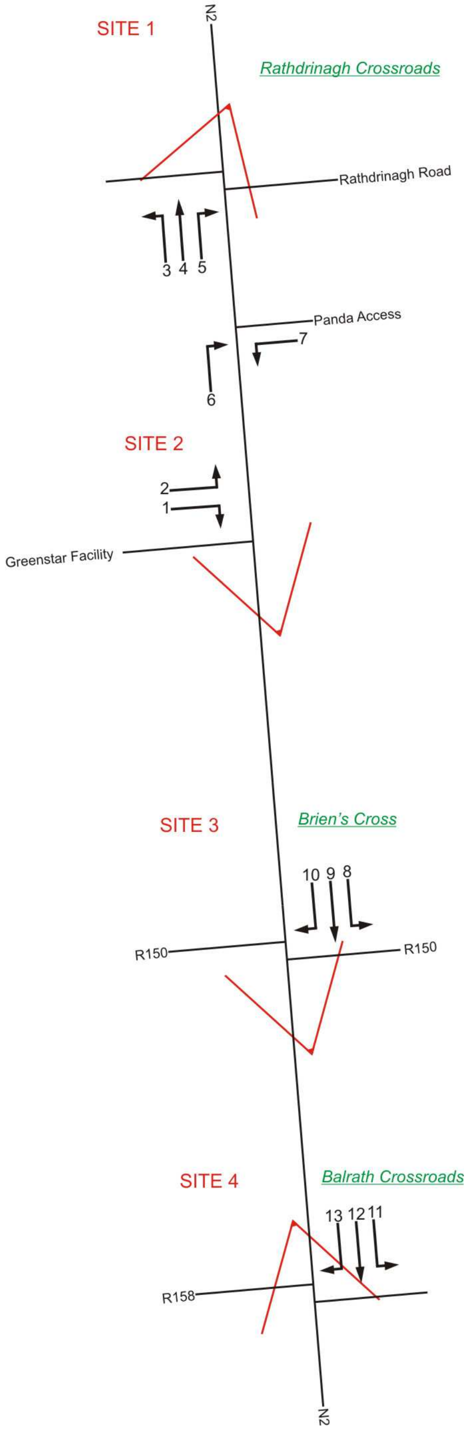
Junction Count Movement Diagram



Vehicles Exiting the Greenstar Facility Movement Diagram



Job number: ATH/10/051	Job date: 20th May 2010	Drawing No: ATH/10/051-2
Client: Traffic Wise	Job day: Thursday	Author: ITK

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ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01 DATE: 20th May 2010

LOCATION: Rathdrinagh Crossroads DAY: Thursday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	4	0	0	0	0	4	4	62	31	6	5	0	104	114	1	0	0	0	0	1	1
07:15	2	1	0	0	0	3	3	89	38	3	6	2	138	149	0	1	0	0	0	1	1
07:30	2	1	0	0	0	3	3	99	38	11	14	1	163	188	2	1	0	0	0	3	3
07:45	2	1	0	0	0	3	3	91	30	8	4	1	134	144	3	0	0	1	0	4	5
H/TOT	10	3	0	0	0	13	13	341	137	28	29	4	539	595	6	2	0	1	0	9	10
08:00	5	0	0	0	0	5	5	76	23	4	4	2	109	118	4	1	0	0	0	5	5
08:15	4	0	0	0	0	4	4	74	21	5	7	0	107	119	2	0	0	1	0	3	4
08:30	5	0	0	0	0	5	5	77	12	5	4	1	99	108	3	1	1	0	0	5	6
08:45	7	0	0	0	0	7	7	67	19	6	8	1	101	115	8	1	0	0	0	9	9
H/TOT	21	0	0	0	0	21	21	294	75	20	23	4	416	460	17	3	1	1	0	22	24
09:00	7	0	0	0	0	7	7	73	20	4	6	1	104	115	4	2	0	0	0	6	6
09:15	3	0	0	0	0	3	3	45	8	5	6	0	64	74	1	1	0	0	0	2	2
09:30	2	0	2	0	0	4	5	37	9	3	2	1	52	57	2	2	1	0	0	5	6
09:45	5	0	0	0	0	5	5	45	15	4	6	3	73	86	1	0	1	0	0	2	3
H/TOT	17	0	2	0	0	19	20	200	52	16	20	5	293	332	8	5	2	0	0	15	16
10:00	2	0	0	0	0	2	2	33	6	6	6	0	51	62	0	0	0	0	0	0	0
10:15	1	0	0	0	0	1	1	22	8	4	5	0	39	48	2	0	0	0	0	2	2
10:30	1	1	0	0	0	2	2	38	4	1	3	0	46	50	3	0	0	0	0	3	3
10:45	2	1	0	0	0	3	3	29	10	5	6	0	50	60	1	2	0	1	0	4	5
H/TOT	6	2	0	0	0	8	8	122	28	16	20	0	186	220	6	2	0	1	0	9	10
11:00	2	0	0	0	0	2	2	30	5	3	8	0	46	58	1	1	0	0	0	2	2
11:15	0	1	0	1	0	2	3	23	3	5	7	1	39	52	1	1	0	0	0	2	2
11:30	2	1	2	0	0	5	6	34	8	8	8	0	58	72	2	0	0	0	0	2	2
11:45	1	1	1	0	0	3	4	33	4	7	10	2	56	75	6	0	0	1	0	7	8
H/TOT	5	3	3	1	0	12	15	120	20	23	33	3	199	256	10	2	0	1	0	13	14
12:00	0	0	0	0	0	0	0	17	6	5	4	0	32	40	2	0	0	0	0	2	2
12:15	1	0	0	1	0	2	3	27	11	3	5	0	46	54	2	1	0	0	0	3	3
12:30	3	1	0	2	0	6	9	31	6	8	9	0	54	70	1	0	0	2	0	3	6
12:45	0	0	0	0	0	0	0	26	4	4	7	0	41	52	4	0	0	0	0	4	4
H/TOT	4	1	0	3	0	8	12	101	27	20	25	0	173	216	9	1	0	2	0	12	15

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01 DATE: 20th May 2010

LOCATION: Rathdrinagh Crossroads DAY: Thursday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	5	0	0	0	0	5	5	38	6	6	7	0	57	69	2	0	1	0	0	3	4
13:15	1	2	0	1	0	4	5	20	4	4	6	1	35	46	5	0	0	1	0	6	7
13:30	1	1	1	0	0	3	4	24	4	1	5	0	34	41	3	1	0	2	0	6	9
13:45	1	0	0	0	0	1	1	19	7	4	6	3	39	52	3	0	0	1	0	4	5
H/TOT	8	3	1	1	0	13	15	101	21	15	24	4	165	208	13	1	1	4	0	19	25
14:00	5	0	0	2	0	7	10	24	7	4	5	0	40	49	2	1	0	0	0	3	3
14:15	0	1	0	0	0	1	1	37	4	6	7	0	54	66	3	1	1	1	0	6	8
14:30	1	0	0	0	0	1	1	24	4	5	2	0	35	40	1	0	0	1	0	2	3
14:45	4	1	0	0	0	5	5	24	5	1	2	2	34	39	3	2	0	0	0	5	5
H/TOT	10	2	0	2	0	14	17	109	20	16	16	2	163	194	9	4	1	2	0	16	19
15:00	2	0	0	1	0	3	4	33	11	3	3	1	51	57	3	1	0	0	0	4	4
15:15	0	0	0	0	0	0	0	28	2	5	6	1	42	53	1	0	0	1	0	2	3
15:30	0	0	1	0	0	1	2	32	4	3	5	3	47	58	0	1	0	2	0	3	6
15:45	1	0	2	0	0	3	4	38	8	6	3	1	56	64	3	1	0	2	0	6	9
H/TOT	3	0	3	1	0	7	10	131	25	17	17	6	196	233	7	3	0	5	0	15	22
16:00	1	0	1	1	0	3	5	27	9	6	5	0	47	57	2	1	0	0	0	3	3
16:15	1	0	0	0	0	1	1	35	5	5	4	0	49	57	1	0	0	0	0	1	1
16:30	0	0	0	0	0	0	0	45	12	2	2	0	61	65	3	0	0	2	1	6	10
16:45	1	0	0	0	0	1	1	29	7	4	4	0	44	51	7	2	1	2	0	12	15
H/TOT	3	0	1	1	0	5	7	136	33	17	15	0	201	229	13	3	1	4	1	22	29
17:00	2	0	1	0	0	3	4	33	9	4	2	1	49	55	5	0	0	0	0	5	5
17:15	1	0	0	0	0	1	1	42	9	0	1	1	53	55	1	1	2	0	0	4	5
17:30	2	0	0	0	0	2	2	50	10	4	4	0	68	75	5	0	0	0	0	5	5
17:45	3	1	0	0	0	4	4	43	5	3	1	0	52	55	2	1	0	0	0	3	3
H/TOT	8	1	1	0	0	10	11	168	33	11	8	2	222	240	13	2	2	0	0	17	18
18:00	1	0	0	0	0	1	1	38	11	2	1	0	52	54	2	1	0	0	0	3	3
18:15	0	0	0	0	0	0	0	48	5	0	3	0	56	60	10	0	0	1	0	11	12
18:30	1	0	0	0	0	1	1	30	5	0	2	0	37	40	5	0	0	0	0	5	5
18:45	1	0	0	0	0	1	1	22	3	1	1	2	29	33	5	0	0	0	0	5	5
H/TOT	3	0	0	0	0	3	3	138	24	3	7	2	174	187	22	1	0	1	0	24	25
P/TOT	98	15	11	9	0	133	150	1961	495	202	237	32	2927	3368	133	29	8	22	1	193	227

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01 DATE: 20th May 2010

LOCATION: Rathdrinagh Crossroads DAY: Thursday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
07:00	2	1	1	0	0	4	5	0	0	0	2	0	2	5	6	3	0	0	0	9	9
07:15	3	0	1	0	0	4	5	0	0	0	1	0	1	2	8	0	0	0	1	9	10
07:30	2	1	0	0	0	3	3	0	0	0	0	0	0	0	8	4	0	0	0	12	12
07:45	4	0	2	0	1	7	9	5	1	0	0	0	6	6	6	1	1	0	0	8	9
H/TOT	11	2	4	0	1	18	21	5	1	0	3	0	9	13	28	8	1	0	1	38	40
08:00	6	0	1	1	0	8	10	2	1	0	0	0	3	3	8	1	2	0	0	11	12
08:15	2	2	0	0	0	4	4	3	0	1	1	0	5	7	5	0	1	0	0	6	7
08:30	6	0	1	0	0	7	8	2	1	1	0	0	4	5	11	1	1	0	0	13	14
08:45	7	0	0	0	0	7	7	6	0	0	0	0	6	6	11	2	0	0	0	13	13
H/TOT	21	2	2	1	0	26	28	13	2	2	1	0	18	20	35	4	4	0	0	43	45
09:00	4	0	0	0	0	4	4	3	0	0	0	0	3	3	9	4	1	0	0	14	15
09:15	4	1	0	0	0	5	5	2	2	0	0	0	4	4	12	4	1	0	1	18	20
09:30	4	0	0	1	0	5	6	3	0	0	1	0	4	5	5	2	0	0	0	7	7
09:45	2	0	0	0	0	2	2	1	0	0	1	0	2	3	10	1	0	0	0	11	11
H/TOT	14	1	0	1	0	16	17	9	2	0	2	0	13	16	36	11	2	0	1	50	52
10:00	1	2	0	1	0	4	5	3	0	0	1	0	4	5	6	0	2	0	0	8	9
10:15	5	0	0	0	0	5	5	1	3	0	1	0	5	6	9	2	1	0	0	12	13
10:30	1	0	1	0	0	2	3	0	0	0	0	0	0	0	2	2	1	0	0	5	6
10:45	2	0	0	0	0	2	2	2	0	0	1	0	3	4	2	0	1	0	0	3	4
H/TOT	9	2	1	1	0	13	15	6	3	0	3	0	12	16	19	4	5	0	0	28	31
11:00	4	0	0	0	0	4	4	3	0	0	0	0	3	3	4	1	1	0	0	6	7
11:15	2	2	0	1	0	5	6	0	0	0	0	0	0	0	3	0	1	0	0	4	5
11:30	2	0	0	0	0	2	2	1	0	0	0	0	1	1	2	0	0	0	0	2	2
11:45	3	0	0	0	0	3	3	2	1	0	1	0	4	5	8	1	0	0	0	9	9
H/TOT	11	2	0	1	0	14	15	6	1	0	1	0	8	9	17	2	2	0	0	21	22
12:00	1	1	0	0	0	2	2	1	1	0	1	0	3	4	3	2	0	0	0	5	5
12:15	4	1	0	1	0	6	7	1	1	0	0	0	2	2	3	1	0	0	0	4	4
12:30	0	0	0	0	0	0	0	2	0	0	0	0	2	2	3	0	1	0	0	4	5
12:45	3	0	0	2	0	5	8	3	2	0	0	0	5	5	2	0	0	0	0	2	2
H/TOT	8	2	0	3	0	13	17	7	4	0	1	0	12	13	11	3	1	0	0	15	16

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01 DATE: 20th May 2010

LOCATION: Rathdrinagh Crossroads DAY: Thursday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	1	0	0	1	0	2	3	3	2	0	0	0	5	5	6	1	1	0	0	8	9
13:15	2	0	0	1	0	3	4	3	0	0	0	0	3	3	10	0	0	0	0	10	10
13:30	3	1	0	0	0	4	4	2	1	0	0	0	3	3	4	2	0	0	0	6	6
13:45	0	0	0	1	0	1	2	3	0	1	0	0	4	5	5	2	0	0	0	7	7
H/TOT	6	1	0	3	0	10	14	11	3	1	0	0	15	16	25	5	1	0	0	31	32
14:00	2	1	0	2	0	5	8	2	2	0	0	0	4	4	7	1	0	0	0	8	8
14:15	4	1	0	0	0	5	5	3	0	0	0	0	3	3	3	0	0	0	1	4	5
14:30	4	2	0	0	0	6	6	1	1	0	0	0	2	2	6	0	1	0	0	7	8
14:45	3	1	0	2	0	6	9	2	1	2	0	0	5	6	5	0	0	1	0	6	7
H/TOT	13	5	0	4	0	22	27	8	4	2	0	0	14	15	21	1	1	1	1	25	28
15:00	4	0	0	0	0	4	4	1	1	0	1	0	3	4	3	0	0	0	0	3	3
15:15	2	2	0	0	0	4	4	1	1	0	0	0	2	2	7	0	0	0	0	7	7
15:30	4	0	0	0	0	4	4	0	0	0	0	0	0	0	6	0	0	0	0	6	6
15:45	4	0	1	0	0	5	6	2	0	0	2	0	4	7	3	0	0	0	0	3	3
H/TOT	14	2	1	0	0	17	18	4	2	0	3	0	9	13	19	0	0	0	0	19	19
16:00	4	0	1	0	0	5	6	1	0	1	1	0	3	5	6	0	0	0	0	6	6
16:15	1	0	1	0	0	2	3	2	1	0	0	0	3	3	7	1	0	0	0	8	8
16:30	1	2	0	0	0	3	3	5	2	0	2	0	9	12	4	2	0	0	0	6	6
16:45	5	0	0	1	0	6	7	4	0	0	1	0	5	6	8	1	0	0	0	9	9
H/TOT	11	2	2	1	0	16	18	12	3	1	4	0	20	26	25	4	0	0	0	29	29
17:00	3	0	0	1	0	4	5	1	0	0	1	0	2	3	5	2	0	0	0	7	7
17:15	2	2	0	1	0	5	6	3	1	1	2	0	7	10	4	1	1	0	0	6	7
17:30	4	1	0	2	0	7	10	0	0	0	0	0	0	0	5	3	0	1	0	9	10
17:45	5	0	0	0	0	5	5	6	2	0	0	0	8	8	6	2	0	0	0	8	8
H/TOT	14	3	0	4	0	21	26	10	3	1	3	0	17	21	20	8	1	1	0	30	32
18:00	4	0	0	0	0	4	4	4	0	0	0	0	4	4	1	1	0	0	0	2	2
18:15	5	0	0	0	0	5	5	1	1	0	0	0	2	2	4	0	0	0	0	4	4
18:30	2	1	0	0	0	3	3	2	0	0	0	0	2	2	5	1	2	0	0	8	9
18:45	2	1	0	1	0	4	5	9	2	0	0	0	11	11	4	4	1	0	0	9	10
H/TOT	13	2	0	1	0	16	17	16	3	0	0	0	19	19	14	6	3	0	0	23	25
P/TOT	145	26	10	20	1	202	234	107	31	7	21	0	166	197	270	56	21	2	3	352	368

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01 DATE: 20th May 2010

LOCATION: Rathdrinagh Crossroads DAY: Thursday

	MOVEMENT 7							MOVEMENT 8							MOVEMENT 9						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	7	0	0	0	0	7	7	8	5	4	3	0	20	26	2	0	0	2	0	4	7
07:15	6	2	0	0	0	8	8	16	9	4	4	0	33	40	2	1	0	0	0	3	3
07:30	1	6	1	0	0	8	9	26	7	0	4	0	37	42	1	1	0	1	0	3	4
07:45	6	2	1	0	0	9	10	27	7	1	3	0	38	42	3	0	1	0	0	4	5
H/TOT	20	10	2	0	0	32	33	77	28	9	14	0	128	151	8	2	1	3	0	14	18
08:00	4	0	0	0	0	4	4	28	3	7	7	1	46	60	5	1	0	4	0	10	15
08:15	4	0	0	0	0	4	4	21	5	4	6	0	36	46	3	1	0	2	0	6	9
08:30	3	1	1	0	0	5	6	34	6	3	4	0	47	54	3	0	0	4	0	7	12
08:45	6	2	0	0	0	8	8	33	6	1	2	0	42	45	5	1	1	1	0	8	10
H/TOT	17	3	1	0	0	21	22	116	20	15	19	1	171	204	16	3	1	11	0	31	46
09:00	8	2	1	0	0	11	12	28	8	1	7	0	44	54	11	1	0	0	0	12	12
09:15	3	0	0	0	0	3	3	25	7	5	11	0	48	65	5	1	2	0	0	8	9
09:30	3	4	0	0	1	8	9	25	9	4	6	0	44	54	3	2	1	1	0	7	9
09:45	4	0	2	0	0	6	7	22	8	7	5	2	44	56	2	1	0	2	0	5	8
H/TOT	18	6	3	0	1	28	31	100	32	17	29	2	180	228	21	5	3	3	0	32	37
10:00	4	0	1	0	0	5	6	26	5	7	6	2	46	59	2	0	0	0	0	2	2
10:15	4	0	0	0	0	4	4	29	6	6	4	0	45	53	4	0	0	4	0	8	13
10:30	3	2	0	0	0	5	5	13	6	5	12	0	36	54	2	2	1	2	0	7	10
10:45	1	0	0	0	0	1	1	22	6	5	7	0	40	52	3	1	0	1	0	5	6
H/TOT	12	2	1	0	0	15	16	90	23	23	29	2	167	218	11	3	1	7	0	22	32
11:00	1	0	0	0	0	1	1	25	6	2	8	0	41	52	0	0	0	1	0	1	2
11:15	3	1	0	0	0	4	4	33	8	6	6	0	53	64	5	1	0	1	0	7	8
11:30	3	2	1	1	0	7	9	23	3	5	5	0	36	45	1	0	0	3	0	4	8
11:45	1	0	0	0	0	1	1	43	7	7	8	2	67	83	0	2	0	3	0	5	9
H/TOT	8	3	1	1	0	13	15	124	24	20	27	2	197	244	6	3	0	8	0	17	27
12:00	4	1	1	0	0	6	7	32	5	1	4	1	43	50	2	1	0	2	0	5	8
12:15	4	2	1	0	0	7	8	27	6	2	8	2	45	58	5	0	0	1	0	6	7
12:30	2	0	1	0	0	3	4	33	7	5	10	0	55	71	4	1	0	2	0	7	10
12:45	5	3	0	0	0	8	8	42	8	2	3	0	55	60	3	0	2	6	0	11	20
H/TOT	15	6	3	0	0	24	26	134	26	10	25	3	198	239	14	2	2	11	0	29	44

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01 DATE: 20th May 2010

LOCATION: Rathdrinagh Crossroads DAY: Thursday

	MOVEMENT 7							MOVEMENT 8							MOVEMENT 9						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	4	1	0	0	0	5	5	32	5	6	10	1	54	71	3	1	2	2	0	8	12
13:15	11	1	0	1	0	13	14	22	5	7	9	0	43	58	1	1	1	2	0	5	8
13:30	4	2	1	0	0	7	8	29	8	2	7	2	48	60	3	0	2	3	0	8	13
13:45	2	2	0	0	0	4	4	33	6	3	14	1	57	78	4	1	0	1	0	6	7
H/TOT	21	6	1	1	0	29	31	116	24	18	40	4	202	267	11	3	5	8	0	27	40
14:00	4	3	0	0	0	7	7	46	6	3	7	1	63	75	4	0	0	0	0	4	4
14:15	4	3	2	0	0	9	10	29	11	1	9	1	51	64	4	0	0	1	0	5	6
14:30	8	0	0	0	0	8	8	39	11	3	8	1	62	75	1	0	1	4	0	6	12
14:45	11	0	1	0	0	12	13	48	9	3	10	2	72	89	4	2	0	1	0	7	8
H/TOT	27	6	3	0	0	36	38	162	37	10	34	5	248	302	13	2	1	6	0	22	30
15:00	5	0	0	0	1	6	7	39	10	8	10	0	67	84	4	1	0	1	0	6	7
15:15	12	2	0	0	0	14	14	39	11	8	5	0	63	74	2	0	0	2	0	4	7
15:30	9	0	0	0	0	9	9	64	13	3	12	1	93	111	1	2	1	3	0	7	11
15:45	8	3	0	0	0	11	11	54	17	7	8	0	86	100	2	0	1	1	0	4	6
H/TOT	34	5	0	0	1	40	41	196	51	26	35	1	309	369	9	3	2	7	0	21	31
16:00	7	0	0	0	0	7	7	60	19	3	7	0	89	100	3	0	1	4	0	8	14
16:15	3	0	0	0	0	3	3	74	15	4	11	0	104	120	2	0	0	2	0	4	7
16:30	4	0	0	0	0	4	4	74	20	2	10	1	107	122	1	1	0	4	0	6	11
16:45	8	1	0	0	0	9	9	58	27	3	11	2	101	119	1	1	1	2	0	5	8
H/TOT	22	1	0	0	0	23	23	266	81	12	39	3	401	461	7	2	2	12	0	23	40
17:00	15	2	1	0	0	18	19	80	29	8	2	0	119	126	5	2	0	2	0	9	12
17:15	9	3	0	1	0	13	14	93	28	4	3	1	129	136	3	2	1	0	0	6	7
17:30	5	4	1	0	0	10	11	99	26	4	4	1	134	142	2	0	0	0	0	2	2
17:45	7	4	0	0	0	11	11	112	23	3	2	0	140	144	2	1	1	2	0	6	9
H/TOT	36	13	2	1	0	52	54	384	106	19	11	2	522	548	12	5	2	4	0	23	29
18:00	13	2	0	0	0	15	15	83	10	4	7	0	104	115	1	0	0	0	0	1	1
18:15	3	0	0	0	0	3	3	82	18	3	7	1	111	123	4	0	0	0	0	4	4
18:30	10	2	0	0	0	12	12	107	15	3	7	2	134	147	3	1	0	0	0	4	4
18:45	8	1	0	0	0	9	9	65	9	4	6	0	84	94	1	0	0	1	0	2	3
H/TOT	34	5	0	0	0	39	39	337	52	14	27	3	433	478	9	1	0	1	0	11	12
P/TOT	264	66	17	3	2	352	366	2102	504	193	329	28	3156	3708	137	34	20	81	0	272	387

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01 DATE: 20th May 2010

LOCATION: Rathdrinagh Crossroads DAY: Thursday

	MOVEMENT 10							MOVEMENT 11							MOVEMENT 12						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	6	3	0	6	0	15	23	0	1	0	0	0	1	1	1	0	0	1	0	2	3
07:15	1	1	3	0	0	5	7	1	1	0	0	0	2	2	1	0	0	0	0	1	1
07:30	3	2	1	1	0	7	9	2	0	0	1	0	3	4	2	0	0	1	0	3	4
07:45	3	1	0	1	0	5	6	1	2	0	1	0	4	5	1	0	0	1	0	2	3
H/TOT	13	7	4	8	0	32	44	4	4	0	2	0	10	13	5	0	0	3	0	8	12
08:00	6	3	0	0	0	9	9	5	0	0	0	0	5	5	1	0	0	0	0	1	1
08:15	3	1	0	2	0	6	9	1	0	1	0	0	2	3	0	0	1	0	0	1	2
08:30	3	2	0	1	0	6	7	2	0	0	2	0	4	7	2	0	1	0	0	3	4
08:45	2	0	1	1	0	4	6	1	3	0	0	0	4	4	1	1	0	0	0	2	2
H/TOT	14	6	1	4	0	25	31	9	3	1	2	0	15	18	4	1	2	0	0	7	8
09:00	5	0	1	4	0	10	16	3	0	1	1	0	5	7	5	0	0	0	0	5	5
09:15	8	2	1	2	0	13	16	4	1	0	0	0	5	5	2	0	0	0	0	2	2
09:30	3	0	2	0	0	5	6	2	0	0	0	0	2	2	0	0	1	0	0	1	2
09:45	5	2	1	1	0	9	11	1	0	0	0	0	1	1	0	0	0	0	0	0	0
H/TOT	21	4	5	7	0	37	49	10	1	1	1	0	13	15	7	0	1	0	0	8	9
10:00	2	0	0	1	0	3	4	1	0	0	0	0	1	1	1	0	0	1	0	2	3
10:15	1	1	1	3	0	6	10	1	0	0	2	0	3	6	1	1	1	1	0	4	6
10:30	3	1	2	2	0	8	12	0	1	0	0	0	1	1	1	2	0	1	0	4	5
10:45	2	0	0	3	0	5	9	0	0	0	0	0	0	0	2	1	2	0	0	5	6
H/TOT	8	2	3	9	0	22	35	2	1	0	2	0	5	8	5	4	3	3	0	15	20
11:00	1	1	0	0	0	2	2	1	1	0	0	0	2	2	2	0	0	1	0	3	4
11:15	9	1	1	1	0	12	14	1	0	0	0	0	1	1	2	1	0	0	0	3	3
11:30	1	0	0	1	0	2	3	3	1	0	0	0	4	4	1	1	0	0	0	2	2
11:45	2	1	0	3	0	6	10	0	1	1	0	0	2	3	2	1	0	2	0	5	8
H/TOT	13	3	1	5	0	22	29	5	3	1	0	0	9	10	7	3	0	3	0	13	17
12:00	3	2	0	1	0	6	7	1	3	0	0	1	5	6	1	0	0	0	0	1	1
12:15	1	1	1	2	0	5	8	4	0	0	0	0	4	4	0	0	0	0	0	0	0
12:30	3	1	0	3	0	7	11	4	0	0	0	0	4	4	0	1	0	2	0	3	6
12:45	0	1	0	2	0	3	6	2	0	0	0	0	2	2	1	0	0	0	0	1	1
H/TOT	7	5	1	8	0	21	32	11	3	0	0	1	15	16	2	1	0	2	0	5	8

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01 DATE: 20th May 2010

LOCATION: Rathdrinagh Crossroads DAY: Thursday

	MOVEMENT 10							MOVEMENT 11							MOVEMENT 12						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	6	0	0	1	0	7	8	0	1	1	1	0	3	5	0	1	0	1	0	2	3
13:15	1	0	1	3	0	5	9	2	1	0	2	0	5	8	0	0	0	0	0	0	0
13:30	1	1	1	4	0	7	13	1	0	0	0	0	1	1	2	0	0	0	0	2	2
13:45	2	1	0	2	0	5	8	2	0	1	0	0	3	4	1	0	0	0	0	1	1
H/TOT	10	2	2	10	0	24	38	5	2	2	3	0	12	17	3	1	0	1	0	5	6
14:00	8	1	3	2	0	14	18	4	0	0	0	0	4	4	1	0	0	0	0	1	1
14:15	5	0	2	3	0	10	15	2	0	0	0	0	2	2	1	0	0	1	0	2	3
14:30	2	0	1	1	0	4	6	5	1	0	0	0	6	6	5	1	0	2	0	8	11
14:45	4	0	0	0	0	4	4	2	1	1	1	0	5	7	2	1	0	0	0	3	3
H/TOT	19	1	6	6	0	32	43	13	2	1	1	0	17	19	9	2	0	3	0	14	18
15:00	4	1	0	1	0	6	7	1	0	1	0	0	2	3	1	0	0	0	0	1	1
15:15	6	0	0	2	0	8	11	5	0	0	1	0	6	7	5	0	0	1	0	6	7
15:30	2	2	0	1	0	5	6	3	1	1	0	0	5	6	1	0	0	0	0	1	1
15:45	3	1	0	0	0	4	4	1	1	0	1	0	3	4	4	1	1	0	0	6	7
H/TOT	15	4	0	4	0	23	28	10	2	2	2	0	16	20	11	1	1	1	0	14	16
16:00	5	1	1	0	0	7	8	1	1	0	0	0	2	2	3	0	0	0	0	3	3
16:15	1	1	0	0	0	2	2	4	0	0	0	0	4	4	3	1	1	0	0	5	6
16:30	5	1	0	1	0	7	8	2	0	0	0	0	2	2	3	0	0	1	0	4	5
16:45	3	1	0	2	0	6	9	1	0	0	1	0	2	3	0	1	0	0	0	1	1
H/TOT	14	4	1	3	0	22	26	8	1	0	1	0	10	11	9	2	1	1	0	13	15
17:00	8	1	0	1	0	10	11	6	1	0	0	0	7	7	6	0	0	0	0	6	6
17:15	5	1	0	1	0	7	8	3	1	0	0	0	4	4	4	1	0	0	0	5	5
17:30	3	1	2	2	0	8	12	1	0	0	0	0	1	1	1	2	2	0	0	5	6
17:45	5	0	0	0	0	5	5	2	1	0	0	0	3	3	0	0	0	0	0	0	0
H/TOT	21	3	2	4	0	30	36	12	3	0	0	0	15	15	11	3	2	0	0	16	17
18:00	4	0	0	0	0	4	4	2	0	0	0	0	2	2	1	1	0	0	0	2	2
18:15	0	0	0	0	0	0	0	3	2	0	0	0	5	5	2	0	0	0	0	2	2
18:30	4	1	0	0	0	5	5	0	0	0	0	0	0	0	2	0	0	0	0	2	2
18:45	5	0	0	0	0	5	5	1	1	0	0	0	2	2	3	0	0	0	0	3	3
H/TOT	13	1	0	0	0	14	14	6	3	0	0	0	9	9	8	1	0	0	0	9	9
P/TOT	168	42	26	68	0	304	405	95	28	8	14	1	146	169	81	19	10	17	0	127	154

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 02 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility DAY: Thursday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	0	0	0	0	0	0	0	82	40	7	8	1	138	153	0	0	0	0	0	0	0
07:15	0	0	0	0	0	0	0	91	39	7	5	0	142	152	0	0	0	0	0	0	0
07:30	1	0	0	0	0	1	1	105	32	10	14	3	164	190	0	0	0	0	0	0	0
07:45	1	1	1	0	0	3	4	102	31	6	8	1	148	162	0	0	0	0	0	0	0
H/TOT	2	1	1	0	0	4	5	380	142	30	35	5	592	658	0	0	0	0	0	0	0
08:00	0	0	0	1	0	1	2	91	24	5	4	2	126	136	0	0	0	0	0	0	0
08:15	1	0	0	0	0	1	1	86	23	6	6	1	122	134	1	0	0	0	0	1	1
08:30	0	0	0	0	0	0	0	85	18	7	4	1	115	125	0	0	0	1	0	1	2
08:45	0	0	0	0	0	0	0	76	22	8	10	1	117	135	0	0	0	0	0	0	0
H/TOT	1	0	0	1	0	2	3	338	87	26	24	5	480	529	1	0	0	1	0	2	3
09:00	0	0	0	0	0	0	0	81	29	6	9	0	125	140	0	0	0	0	0	0	0
09:15	0	0	0	1	0	1	2	63	7	6	4	2	82	92	0	0	0	0	0	0	0
09:30	0	0	0	0	0	0	0	50	14	5	6	0	75	85	0	0	1	0	0	1	2
09:45	1	0	0	0	0	1	1	54	14	3	8	2	81	95	0	0	0	1	0	1	2
H/TOT	1	0	0	1	0	2	3	248	64	20	27	4	363	412	0	0	1	1	0	2	4
10:00	0	0	0	0	0	0	0	40	12	7	10	1	70	88	0	0	0	0	0	0	0
10:15	0	0	0	0	0	0	0	36	10	3	6	0	55	64	1	0	0	0	0	1	1
10:30	0	0	0	0	0	0	0	46	9	4	4	0	63	70	0	1	0	0	0	1	1
10:45	0	0	0	0	0	0	0	34	12	3	10	1	60	76	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	156	43	17	30	2	248	298	1	1	0	0	0	2	2
11:00	0	0	0	1	0	1	2	33	5	6	6	0	50	61	0	0	0	0	0	0	0
11:15	0	0	0	1	0	1	2	45	8	8	6	1	68	81	0	0	0	0	0	0	0
11:30	0	0	1	0	0	1	2	34	6	5	9	0	54	68	0	0	0	2	0	2	5
11:45	0	0	0	2	0	2	5	44	6	7	10	2	69	88	0	0	1	0	0	1	2
H/TOT	0	0	1	4	0	5	11	156	25	26	31	3	241	297	0	0	1	2	0	3	6
12:00	0	0	0	0	0	0	0	23	12	7	8	0	50	64	0	0	0	1	0	1	2
12:15	0	0	0	0	0	0	0	25	13	3	4	0	45	52	0	0	0	1	0	1	2
12:30	0	0	0	3	0	3	7	31	11	9	10	0	61	79	0	0	0	0	0	0	0
12:45	0	0	0	0	0	0	0	32	7	3	11	0	53	69	0	0	0	2	0	2	5
H/TOT	0	0	0	3	0	3	7	111	43	22	33	0	209	263	0	0	0	4	0	4	9

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 02 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility DAY: Thursday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
13:00	0	0	0	1	0	1	2	30	9	6	9	0	54	69	0	0	0	1	0	1	2
13:15	0	0	0	1	0	1	2	32	4	4	6	1	47	58	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	29	5	2	7	0	43	53	0	0	0	2	0	2	5
13:45	0	0	0	0	0	0	0	23	8	5	8	2	46	61	0	0	0	0	0	0	0
H/TOT	0	0	0	2	0	2	5	114	26	17	30	3	190	241	0	0	0	3	0	3	7
14:00	0	0	0	0	0	0	0	36	6	7	7	1	57	71	0	0	0	0	0	0	0
14:15	0	0	0	1	0	1	2	34	7	9	13	1	64	86	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	46	6	5	4	0	61	69	0	0	0	1	0	1	2
14:45	0	0	0	1	0	1	2	25	5	2	2	0	34	38	0	0	0	0	0	0	0
H/TOT	0	0	0	2	0	2	5	141	24	23	26	2	216	263	0	0	0	1	0	1	2
15:00	0	0	0	1	0	1	2	38	13	4	2	2	59	66	0	0	0	0	0	0	0
15:15	0	0	0	1	0	1	2	27	4	7	6	1	45	57	0	0	0	2	0	2	5
15:30	0	0	0	1	0	1	2	36	3	4	6	2	51	63	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	38	10	3	2	2	55	61	0	0	0	1	0	1	2
H/TOT	0	0	0	3	0	3	7	139	30	18	16	7	210	247	0	0	0	3	0	3	7
16:00	0	0	0	0	0	0	0	40	11	5	5	0	61	70	0	0	0	2	0	2	5
16:15	0	0	0	0	0	0	0	46	8	3	5	0	62	70	0	0	0	1	0	1	2
16:30	0	0	0	0	0	0	0	46	10	5	5	1	67	77	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	36	8	4	6	0	54	64	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	168	37	17	21	1	244	281	0	0	0	3	0	3	7
17:00	0	1	0	0	0	1	1	37	9	5	2	1	54	60	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	48	8	3	1	1	61	65	1	0	0	0	0	1	1
17:30	0	0	0	0	0	0	0	56	10	7	6	0	79	90	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	49	7	3	2	0	61	65	1	1	0	0	0	2	2
H/TOT	0	1	0	0	0	1	1	190	34	18	11	2	255	280	2	1	0	0	0	3	3
18:00	0	0	0	0	0	0	0	50	13	2	1	0	66	68	0	0	0	0	0	0	0
18:15	0	0	0	0	0	0	0	47	3	2	3	0	55	60	0	0	0	0	0	0	0
18:30	0	0	0	0	0	0	0	44	4	1	2	0	51	54	0	0	0	0	0	0	0
18:45	0	0	0	0	0	0	0	34	4	1	1	1	41	44	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	175	24	6	7	1	213	226	0	0	0	0	0	0	0
P/TOT	4	2	2	16	0	24	46	2316	579	240	291	35	3461	3994	4	2	2	18	0	26	50

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 02 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility DAY: Thursday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	0	0	0	0	0	0	0	0	1	0	0	0	1	1	13	5	5	4	0	27	35
07:15	0	0	0	0	0	0	0	1	0	0	0	0	1	1	18	11	2	7	0	38	48
07:30	1	0	0	0	0	1	1	0	0	0	0	0	0	0	28	3	1	3	0	35	39
07:45	0	0	0	0	0	0	0	1	0	0	0	0	1	1	39	8	1	5	1	54	62
H/TOT	1	0	0	0	0	1	1	2	1	0	0	0	3	3	98	27	9	19	1	154	184
08:00	1	0	1	0	0	2	3	1	0	1	0	0	2	3	27	5	9	10	0	51	69
08:15	0	0	1	0	0	1	2	0	0	0	0	0	0	0	25	7	2	8	0	42	53
08:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	6	5	6	0	54	64
08:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	11	1	3	0	50	54
H/TOT	1	0	2	0	0	3	4	1	0	1	0	0	2	3	124	29	17	27	0	197	241
09:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	6	6	5	0	59	69
09:15	0	0	0	0	0	0	0	0	0	0	1	0	1	2	26	9	6	12	1	54	74
09:30	0	0	1	1	0	2	4	0	0	1	0	0	1	2	29	14	5	8	0	56	69
09:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	9	6	8	3	50	66
H/TOT	0	0	1	1	0	2	4	0	0	1	1	0	2	4	121	38	23	33	4	219	277
10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	4	4	6	1	48	59
10:15	0	0	0	0	0	0	0	1	0	0	0	0	1	1	33	10	7	11	0	61	79
10:30	0	0	0	0	0	0	0	0	0	0	1	0	1	2	18	4	5	12	0	39	57
10:45	0	0	0	0	0	0	0	0	0	1	0	0	1	2	27	5	3	5	0	40	48
H/TOT	0	0	0	0	0	0	0	1	0	1	1	0	3	5	111	23	19	34	1	188	243
11:00	0	0	0	0	0	0	0	1	0	0	0	0	1	1	33	4	3	10	0	50	65
11:15	0	0	0	0	0	0	0	0	0	0	1	0	1	2	33	7	4	7	1	52	64
11:30	0	0	0	0	0	0	0	0	0	1	1	0	2	4	30	11	3	8	1	53	66
11:45	0	0	0	3	0	3	7	0	0	0	1	0	1	2	40	9	6	8	1	64	78
H/TOT	0	0	0	3	0	3	7	1	0	1	3	0	5	9	136	31	16	33	3	219	273
12:00	1	0	0	1	0	2	3	0	0	0	0	0	0	0	45	6	4	6	1	62	73
12:15	0	0	1	0	0	1	2	1	0	0	0	0	1	1	26	7	2	8	2	45	58
12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	9	9	8	0	72	87
12:45	0	0	1	0	0	1	2	0	0	0	1	0	1	2	45	9	6	9	0	69	84
H/TOT	1	0	2	1	0	4	6	1	0	0	1	0	2	3	162	31	21	31	3	248	302

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 02 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility DAY: Thursday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	0	0	0	1	0	1	2	0	0	0	1	0	1	2	35	9	5	15	1	65	88
13:15	0	0	0	0	0	0	0	0	0	0	1	0	1	2	29	5	5	11	0	50	67
13:30	0	0	0	2	0	2	5	0	1	0	0	0	1	1	37	6	6	5	2	56	68
13:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	6	3	13	2	69	89
H/TOT	0	0	0	3	0	3	7	0	1	0	2	0	3	6	146	26	19	44	5	240	312
14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	8	4	9	1	65	80
14:15	0	0	0	0	0	0	0	0	0	0	1	0	1	2	45	11	4	12	0	72	90
14:30	0	0	0	1	0	1	2	0	0	0	1	0	1	2	40	7	2	9	1	59	73
14:45	0	0	0	1	0	1	2	0	0	1	0	0	1	2	55	9	10	10	1	85	104
H/TOT	0	0	0	2	0	2	5	0	0	1	2	0	3	6	183	35	20	40	3	281	346
15:00	0	0	1	0	0	1	2	0	0	0	1	0	1	2	43	8	5	10	1	67	84
15:15	0	0	0	1	0	1	2	0	0	0	0	0	0	0	51	11	7	8	0	77	91
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	19	6	14	1	120	142
15:45	0	0	0	0	0	0	0	0	0	0	1	0	1	2	61	16	5	9	0	91	105
H/TOT	0	0	1	1	0	2	4	0	0	0	2	0	2	5	235	54	23	41	2	355	422
16:00	0	0	0	0	0	0	0	0	0	0	1	0	1	2	72	20	5	11	0	108	125
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	10	4	10	0	103	118
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	22	4	14	2	115	137
16:45	0	0	0	0	0	0	0	1	0	0	0	0	1	1	92	21	5	8	1	127	141
H/TOT	0	0	0	0	0	0	0	1	0	0	1	0	2	3	316	73	18	43	3	453	521
17:00	1	2	0	0	0	3	3	0	0	0	0	0	0	0	92	26	10	7	0	135	149
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	34	4	3	1	123	130
17:30	1	0	0	0	0	1	1	0	0	0	0	0	0	0	124	33	5	4	1	167	176
17:45	0	1	0	0	0	1	1	0	0	0	0	0	0	0	93	25	5	4	0	127	135
H/TOT	2	3	0	0	0	5	5	0	0	0	0	0	0	0	390	118	24	18	2	552	589
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	16	5	7	0	112	124
18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	20	2	7	1	114	125
18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	104	17	5	8	2	136	151
18:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72	17	4	6	0	99	109
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	344	70	16	28	3	461	508
P/TOT	5	3	6	11	0	25	42	7	2	5	13	0	27	46	2366	555	225	391	30	3567	4218

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 03 DATE: 20th May 2010

LOCATION: Brien's Cross Roads DAY: Thursday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	3	2	1	1	0	7	9	79	38	6	7	1	131	144	0	0	0	0	0	0	0
07:15	5	3	1	0	0	9	10	85	36	6	5	0	132	142	1	0	0	0	0	1	1
07:30	3	5	0	3	0	11	15	101	27	10	11	3	152	174	2	0	0	0	0	2	2
07:45	7	1	1	1	0	10	12	94	29	4	7	1	135	147	1	1	1	0	0	3	4
H/TOT	18	11	3	5	0	37	45	359	130	26	30	5	550	607	4	1	1	0	0	6	7
08:00	9	1	1	0	1	12	14	81	22	5	4	0	112	120	2	1	0	0	1	4	5
08:15	3	2	4	0	1	10	13	81	21	3	6	0	111	120	2	0	0	0	0	2	2
08:30	9	2	2	2	0	15	19	75	16	5	2	1	99	105	1	0	0	0	0	1	1
08:45	9	6	2	0	1	18	20	62	12	6	10	0	90	106	5	4	0	0	0	9	9
H/TOT	30	11	9	2	3	55	65	299	71	19	22	1	412	451	10	5	0	0	1	16	17
09:00	10	1	0	0	0	11	11	67	25	6	9	0	107	122	4	3	0	0	0	7	7
09:15	7	1	2	0	0	10	11	52	6	4	4	2	68	77	4	0	0	0	0	4	4
09:30	4	2	2	0	0	8	9	45	11	3	7	0	66	77	1	1	1	0	0	3	4
09:45	7	0	0	0	1	8	9	46	14	3	8	1	72	85	1	0	0	0	0	1	1
H/TOT	28	4	4	0	1	37	40	210	56	16	28	3	313	360	10	4	1	0	0	15	16
10:00	3	1	0	0	0	4	4	33	11	6	10	1	61	78	4	0	1	0	0	5	6
10:15	6	2	1	0	0	9	10	29	8	2	6	0	45	54	1	0	0	0	0	1	1
10:30	5	3	2	0	0	10	11	41	4	2	4	0	51	57	0	2	0	0	0	2	2
10:45	6	1	0	2	0	9	12	28	10	3	8	0	49	61	0	1	0	0	1	2	3
H/TOT	20	7	3	2	0	32	36	131	33	13	28	1	206	250	5	3	1	0	1	10	12
11:00	5	0	1	0	0	6	7	25	5	5	5	0	40	49	3	0	0	1	0	4	5
11:15	5	2	0	1	0	8	9	38	6	8	5	1	58	70	2	0	0	0	0	2	2
11:30	2	0	0	0	0	2	2	29	6	5	9	0	49	63	3	0	0	0	0	3	3
11:45	8	0	2	1	1	12	15	35	6	5	12	1	59	78	1	0	0	0	0	1	1
H/TOT	20	2	3	2	1	28	33	127	23	23	31	2	206	260	9	0	0	1	0	10	11
12:00	4	0	2	0	0	6	7	18	12	5	9	0	44	58	2	0	0	0	0	2	2
12:15	2	1	1	1	0	5	7	22	11	3	3	0	39	44	1	1	0	0	0	2	2
12:30	7	3	2	0	0	12	13	22	8	7	10	0	47	64	2	0	0	0	0	2	2
12:45	6	2	2	3	0	13	18	23	5	2	8	0	38	49	3	0	0	0	0	3	3
H/TOT	19	6	7	4	0	36	45	85	36	17	30	0	168	216	8	1	0	0	0	9	9

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**

MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 03 DATE: 20th May 2010

LOCATION: Brien's Cross Roads DAY: Thursday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
13:00	5	0	1	1	0	7	9	21	8	5	9	0	43	57	4	1	0	0	0	5	5
13:15	7	0	0	0	0	7	7	23	4	4	6	1	38	49	2	0	0	0	0	2	2
13:30	1	0	1	1	0	3	5	26	5	1	8	0	40	51	2	0	0	0	0	2	2
13:45	4	0	1	3	1	9	14	16	7	4	5	1	33	43	3	1	0	0	0	4	4
H/TOT	17	0	3	5	1	26	35	86	24	14	28	2	154	199	11	2	0	0	0	13	13
14:00	5	2	1	1	0	9	11	29	4	6	6	1	46	58	2	0	0	0	0	2	2
14:15	4	2	1	2	0	9	12	29	5	8	11	1	54	73	1	0	0	0	0	1	1
14:30	3	1	0	1	0	5	6	39	5	5	4	0	53	61	4	0	0	0	0	4	4
14:45	2	0	0	0	0	2	2	23	5	2	3	0	33	38	0	0	0	0	0	0	0
H/TOT	14	5	2	4	0	25	31	120	19	21	24	2	186	230	7	0	0	0	0	7	7
15:00	4	2	1	0	0	7	8	31	11	4	2	1	49	55	3	0	0	0	1	4	5
15:15	0	0	0	0	0	0	0	26	4	7	7	1	45	59	1	0	0	0	0	1	1
15:30	4	1	0	0	0	5	5	32	2	4	6	2	46	58	0	0	0	0	0	0	0
15:45	4	2	0	0	1	7	8	32	7	3	2	1	45	50	2	1	0	0	0	3	3
H/TOT	12	5	1	0	1	19	21	121	24	18	17	5	185	221	6	1	0	0	1	8	9
16:00	12	0	0	0	0	12	12	27	11	5	5	0	48	57	1	0	0	0	0	1	1
16:15	2	1	1	0	0	4	5	39	7	2	5	0	53	61	5	0	0	0	0	5	5
16:30	5	1	0	0	0	6	6	40	8	3	4	0	55	62	1	1	2	1	1	6	9
16:45	3	0	0	0	0	3	3	30	8	4	6	0	48	58	3	0	0	0	0	3	3
H/TOT	22	2	1	0	0	25	26	136	34	14	20	0	204	237	10	1	2	1	1	15	18
17:00	9	4	0	0	1	14	15	28	6	5	2	0	41	46	1	1	0	0	0	2	2
17:15	15	1	2	0	0	18	19	30	7	0	1	1	39	41	3	0	1	0	0	4	5
17:30	11	3	1	0	0	15	16	44	6	6	6	0	62	73	2	1	0	0	0	3	3
17:45	7	1	0	0	0	8	8	40	6	3	2	0	51	55	2	1	0	0	0	3	3
H/TOT	42	9	3	0	1	55	58	142	25	14	11	1	193	215	8	3	1	0	0	12	13
18:00	7	2	0	0	0	9	9	41	11	1	1	0	54	56	2	0	1	0	0	3	4
18:15	4	0	0	1	0	5	6	39	3	2	2	0	46	50	4	0	0	0	0	4	4
18:30	7	0	0	0	0	7	7	35	3	1	2	0	41	44	2	1	0	0	0	3	3
18:45	6	1	0	0	1	8	9	28	3	1	1	0	33	35	0	0	0	0	0	0	0
H/TOT	24	3	0	1	1	29	31	143	20	5	6	0	174	184	8	1	1	0	0	10	11
P/TOT	266	65	39	25	9	404	465	1959	495	200	275	22	2951	3431	96	22	7	2	4	131	141

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**

MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 03 DATE: 20th May 2010

LOCATION: Brien's Cross Roads DAY: Thursday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	2	3	0	0	0	5	5	4	2	0	0	0	6	6	22	4	0	0	0	26	26
07:15	4	0	0	0	0	4	4	17	6	0	1	0	24	25	14	4	0	0	0	18	18
07:30	0	0	0	1	0	1	2	15	8	0	0	0	23	23	16	1	0	0	0	17	17
07:45	3	2	0	0	0	5	5	19	9	1	1	0	30	32	10	1	0	0	0	11	11
H/TOT	9	5	0	1	0	15	16	55	25	1	2	0	83	86	62	10	0	0	0	72	72
08:00	0	0	0	0	0	0	0	17	4	0	0	0	21	21	4	0	0	0	0	4	4
08:15	2	0	0	1	0	3	4	30	4	1	2	0	37	40	11	0	0	0	0	11	11
08:30	3	1	0	0	0	4	4	23	5	0	0	0	28	28	8	0	0	0	0	8	8
08:45	3	1	0	0	0	4	4	18	4	2	0	0	24	25	14	3	0	0	0	17	17
H/TOT	8	2	0	1	0	11	12	88	17	3	2	0	110	114	37	3	0	0	0	40	40
09:00	8	1	0	0	0	9	9	14	2	2	2	0	20	24	14	0	0	0	0	14	14
09:15	4	2	0	0	0	6	6	8	2	1	0	0	11	12	9	0	0	0	1	10	11
09:30	4	1	0	0	0	5	5	5	3	1	2	0	11	14	2	1	0	1	0	4	5
09:45	1	0	0	0	0	1	1	16	2	1	0	0	19	20	0	0	0	0	0	0	0
H/TOT	17	4	0	0	0	21	21	43	9	5	4	0	61	69	25	1	0	1	1	28	30
10:00	3	0	0	0	0	3	3	5	3	0	1	0	9	10	2	1	0	0	0	3	3
10:15	1	1	1	0	0	3	4	12	5	1	0	0	18	19	2	0	0	0	0	2	2
10:30	4	1	0	1	0	6	7	8	3	0	3	0	14	18	1	0	0	0	0	1	1
10:45	4	0	0	0	0	4	4	11	2	0	1	0	14	15	1	1	0	0	0	2	2
H/TOT	12	2	1	1	0	16	18	36	13	1	5	0	55	62	6	2	0	0	0	8	8
11:00	1	0	0	0	0	1	1	16	0	1	0	0	17	18	1	0	1	0	0	2	3
11:15	2	1	1	0	0	4	5	10	6	1	1	0	18	20	1	0	0	0	0	1	1
11:30	4	1	0	0	0	5	5	12	5	0	2	0	19	22	0	0	0	0	0	0	0
11:45	3	1	0	0	0	4	4	11	5	0	2	0	18	21	2	0	0	0	0	2	2
H/TOT	10	3	1	0	0	14	15	49	16	2	5	0	72	80	4	0	1	0	0	5	6
12:00	7	1	0	0	0	8	8	15	5	1	3	0	24	28	3	0	1	0	0	4	5
12:15	4	1	0	0	0	5	5	10	0	0	0	0	10	10	6	1	0	0	0	7	7
12:30	5	0	0	0	0	5	5	15	4	1	2	0	22	25	5	1	0	0	0	6	6
12:45	1	0	0	1	0	2	3	12	0	0	1	0	13	14	3	1	3	0	0	7	9
H/TOT	17	2	0	1	0	20	21	52	9	2	6	0	69	78	17	3	4	0	0	24	26

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**

MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 03 DATE: 20th May 2010

LOCATION: Brien's Cross Roads DAY: Thursday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
13:00	3	0	0	0	1	4	5	11	1	0	1	0	13	14	6	0	0	0	0	6	6
13:15	1	0	0	0	0	1	1	13	2	0	1	0	16	17	2	0	0	0	0	2	2
13:30	2	0	0	0	0	2	2	9	3	2	1	0	15	17	4	0	0	0	0	4	4
13:45	2	0	0	0	0	2	2	18	3	3	0	0	24	26	2	1	0	0	0	3	3
H/TOT	8	0	0	0	1	9	10	51	9	5	3	0	68	74	14	1	0	0	0	15	15
14:00	3	0	0	0	1	4	5	7	1	0	1	0	9	10	4	0	0	0	0	4	4
14:15	3	0	0	0	0	3	3	16	2	0	0	0	18	18	3	0	0	0	0	3	3
14:30	2	0	0	0	0	2	2	11	2	1	0	0	14	15	3	2	0	0	0	5	5
14:45	2	0	1	0	0	3	4	18	2	0	2	0	22	25	6	1	0	0	0	7	7
H/TOT	10	0	1	0	1	12	14	52	7	1	3	0	63	67	16	3	0	0	0	19	19
15:00	5	1	1	0	0	7	8	10	1	0	0	0	11	11	0	0	0	0	0	0	0
15:15	1	0	0	0	0	1	1	13	3	0	1	0	17	18	3	0	0	0	0	3	3
15:30	2	2	1	0	0	5	6	19	1	3	0	1	24	27	2	1	0	0	0	3	3
15:45	4	0	0	0	0	4	4	14	1	0	1	1	17	19	2	0	0	0	0	2	2
H/TOT	12	3	2	0	0	17	18	56	6	3	2	2	69	75	7	1	0	0	0	8	8
16:00	3	0	0	0	0	3	3	15	1	0	0	0	16	16	1	0	0	0	0	1	1
16:15	6	0	0	1	0	7	8	17	4	2	2	0	25	29	3	0	0	0	0	3	3
16:30	1	1	0	0	0	2	2	14	2	0	2	0	18	21	1	1	0	0	0	2	2
16:45	3	1	0	0	0	4	4	19	4	1	1	0	25	27	2	0	0	0	0	2	2
H/TOT	13	2	0	1	0	16	17	65	11	3	5	0	84	92	7	1	0	0	0	8	8
17:00	0	1	1	0	0	2	3	11	4	1	0	0	16	17	4	0	0	0	0	4	4
17:15	1	1	0	0	0	2	2	32	0	2	1	0	35	37	0	0	0	1	0	1	2
17:30	5	0	0	0	0	5	5	17	5	0	3	0	25	29	6	0	0	0	0	6	6
17:45	3	0	0	0	0	3	3	27	2	2	1	0	32	34	1	1	0	0	0	2	2
H/TOT	9	2	1	0	0	12	13	87	11	5	5	0	108	117	11	1	0	1	0	13	14
18:00	3	0	0	1	0	4	5	17	5	1	0	0	23	24	1	0	0	0	0	1	1
18:15	1	0	0	0	0	1	1	16	0	0	2	0	18	21	0	0	0	0	0	0	0
18:30	3	1	0	0	0	4	4	17	3	0	0	0	20	20	3	0	0	0	0	3	3
18:45	1	0	0	0	0	1	1	16	1	0	0	0	17	17	0	1	0	0	0	1	1
H/TOT	8	1	0	1	0	10	11	66	9	1	2	0	78	81	4	1	0	0	0	5	5
P/TOT	133	26	6	6	2	173	186	700	142	32	44	2	920	995	210	27	5	2	1	245	251

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 03 DATE: 20th May 2010

LOCATION: Brien's Cross Roads DAY: Thursday

	MOVEMENT 7							MOVEMENT 8							MOVEMENT 9						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
07:00	0	0	0	0	0	0	0	8	2	5	4	0	19	27	0	0	0	0	0	0	0
07:15	0	0	0	0	0	0	0	11	8	1	7	0	27	37	2	0	0	0	0	2	2
07:30	2	0	0	0	0	2	2	27	3	1	2	0	33	36	2	2	0	0	0	4	4
07:45	0	0	1	0	0	1	2	30	6	1	5	0	42	49	0	2	0	0	0	2	2
H/TOT	2	0	1	0	0	3	4	76	19	8	18	0	121	148	4	4	0	0	0	8	8
08:00	0	0	0	0	1	1	2	24	4	10	10	0	48	66	3	1	0	0	0	4	4
08:15	1	1	2	0	0	4	5	20	6	2	5	0	33	41	1	1	0	0	0	2	2
08:30	3	1	0	0	0	4	4	26	5	3	5	0	39	47	1	2	0	0	0	3	3
08:45	3	2	0	0	1	6	7	25	10	0	3	0	38	42	1	0	0	1	0	2	3
H/TOT	7	4	2	0	2	15	18	95	25	15	23	0	158	195	6	4	0	1	0	11	12
09:00	4	1	1	0	0	6	7	30	5	4	4	0	43	50	1	0	0	0	0	1	1
09:15	3	0	0	0	0	3	3	19	7	5	12	1	44	63	1	0	0	0	0	1	1
09:30	2	1	0	0	0	3	3	20	9	3	7	0	39	50	2	2	0	0	0	4	4
09:45	0	1	0	0	0	1	1	19	8	5	8	2	42	57	2	1	0	0	0	3	3
H/TOT	9	3	1	0	0	13	14	88	29	17	31	3	168	220	6	3	0	0	0	9	9
10:00	2	0	0	0	0	2	2	25	2	4	5	1	37	47	4	1	0	0	0	5	5
10:15	0	0	0	0	0	0	0	28	9	3	10	0	50	65	2	2	3	0	0	7	9
10:30	0	0	1	0	0	1	2	13	3	4	9	0	29	43	1	2	0	0	0	3	3
10:45	1	0	0	0	0	1	1	20	4	3	5	0	32	40	1	0	0	0	0	1	1
H/TOT	3	0	1	0	0	4	5	86	18	14	29	1	148	194	8	5	3	0	0	16	18
11:00	3	1	1	0	0	5	6	27	2	2	10	0	41	55	2	1	0	1	0	4	5
11:15	2	0	0	0	0	2	2	26	5	1	8	1	41	53	1	0	0	0	0	1	1
11:30	2	0	1	0	0	3	4	24	8	3	6	1	42	52	3	0	0	1	0	4	5
11:45	3	1	0	0	0	4	4	33	8	4	9	1	55	70	1	0	0	0	0	1	1
H/TOT	10	2	2	0	0	14	15	110	23	10	33	3	179	230	7	1	0	2	0	10	13
12:00	5	2	0	0	0	7	7	29	4	2	5	0	40	48	6	0	1	0	0	7	8
12:15	0	1	2	0	0	3	4	17	5	2	8	2	34	47	2	0	0	0	0	2	2
12:30	4	0	0	0	0	4	4	34	8	8	8	0	58	72	5	0	0	0	0	5	5
12:45	3	0	0	0	0	3	3	40	9	5	6	0	60	70	3	2	0	0	0	5	5
H/TOT	12	3	2	0	0	17	18	120	26	17	27	2	192	238	16	2	1	0	0	19	20

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 03 DATE: 20th May 2010

LOCATION: Brien's Cross Roads DAY: Thursday

	MOVEMENT 7							MOVEMENT 8							MOVEMENT 9						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	1	0	0	0	0	1	1	29	7	5	16	0	57	80	2	0	1	0	0	3	4
13:15	2	0	0	0	0	2	2	23	3	4	11	0	41	57	3	0	0	0	0	3	3
13:30	5	1	0	0	0	6	6	29	6	6	5	1	47	58	1	0	0	0	0	1	1
13:45	1	0	0	0	0	1	1	40	6	2	11	1	60	76	0	2	0	0	0	2	2
H/TOT	9	1	0	0	0	10	10	121	22	17	43	2	205	271	6	2	1	0	0	9	10
14:00	3	0	0	0	0	3	3	37	7	2	9	0	55	68	8	1	0	0	0	9	9
14:15	6	0	0	1	0	7	8	38	9	4	12	0	63	81	1	0	0	0	0	1	1
14:30	5	0	0	0	0	5	5	29	7	1	9	1	47	60	3	0	0	0	0	3	3
14:45	4	0	0	0	0	4	4	47	7	9	9	0	72	88	4	1	0	0	0	5	5
H/TOT	18	0	0	1	0	19	20	151	30	16	39	1	237	297	16	2	0	0	0	18	18
15:00	6	0	0	0	0	6	6	35	7	4	10	1	57	73	3	2	0	0	0	5	5
15:15	1	1	0	0	0	2	2	46	9	6	8	0	69	82	7	3	0	0	0	10	10
15:30	3	1	0	0	0	4	4	70	15	3	12	1	101	119	6	0	0	0	0	6	6
15:45	2	1	1	0	0	4	5	53	13	5	9	0	80	94	4	0	1	0	0	5	6
H/TOT	12	3	1	0	0	16	17	204	44	18	39	2	307	369	20	5	1	0	0	26	27
16:00	3	1	0	0	1	5	6	64	16	5	11	0	96	113	3	1	1	0	0	5	6
16:15	2	3	0	0	0	5	5	71	9	3	9	0	92	105	3	1	0	0	0	4	4
16:30	5	1	0	0	0	6	6	67	18	4	14	1	104	125	7	1	0	0	0	8	8
16:45	4	1	0	0	0	5	5	83	18	5	8	0	114	127	7	1	0	0	0	8	8
H/TOT	14	6	0	0	1	21	22	285	61	17	42	1	406	470	20	4	1	0	0	25	26
17:00	6	1	0	0	0	7	7	80	25	7	7	0	119	132	6	0	0	1	0	7	8
17:15	6	0	1	0	0	7	8	71	29	3	3	1	107	113	6	0	0	0	0	6	6
17:30	1	0	0	0	0	1	1	106	26	3	4	1	140	148	9	1	0	0	0	10	10
17:45	7	0	0	0	0	7	7	74	21	5	2	0	102	107	7	3	0	0	0	10	10
H/TOT	20	1	1	0	0	22	23	331	101	18	16	2	468	500	28	4	0	1	0	33	34
18:00	6	0	0	0	0	6	6	74	16	5	6	0	101	111	5	1	0	0	0	6	6
18:15	8	0	0	0	0	8	8	78	17	2	7	1	105	116	7	1	0	0	0	8	8
18:30	4	0	0	0	0	4	4	92	16	4	8	1	121	134	9	0	0	0	0	9	9
18:45	11	0	0	0	0	11	11	64	15	4	6	0	89	99	6	1	0	0	0	7	7
H/TOT	29	0	0	0	0	29	29	308	64	15	27	2	416	461	27	3	0	0	0	30	30
P/TOT	145	23	11	1	3	183	193	1975	462	182	367	19	3005	3592	164	39	7	4	0	214	223

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 03 DATE: 20th May 2010

LOCATION: Brien's Cross Roads DAY: Thursday

	MOVEMENT 10							MOVEMENT 11							MOVEMENT 12						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	10	4	0	0	0	14	14	5	3	1	1	0	10	12	3	1	0	0	0	4	4
07:15	16	1	0	0	0	17	17	7	2	2	0	0	11	12	4	3	1	0	0	8	9
07:30	4	2	0	0	0	6	6	15	2	0	2	0	19	22	1	0	0	0	0	1	1
07:45	8	1	1	0	0	10	11	12	2	0	0	1	15	16	7	0	0	0	1	8	9
H/TOT	38	8	1	0	0	47	48	39	9	3	3	1	55	61	15	4	1	0	1	21	23
08:00	8	0	0	0	0	8	8	27	1	2	1	0	31	33	4	1	0	0	0	5	5
08:15	4	1	0	0	0	5	5	18	2	0	1	0	21	22	3	1	0	2	0	6	9
08:30	3	0	0	1	0	4	5	23	2	0	0	0	25	25	8	0	2	1	0	11	13
08:45	7	1	0	0	0	8	8	21	3	0	0	0	24	24	7	0	1	0	0	8	9
H/TOT	22	2	0	1	0	25	26	89	8	2	2	0	101	105	22	2	3	3	0	30	35
09:00	8	1	0	0	0	9	9	16	2	0	1	0	19	20	4	0	2	1	0	7	9
09:15	4	0	0	0	0	4	4	12	2	2	2	0	18	22	3	0	1	1	0	5	7
09:30	0	1	0	0	0	1	1	17	4	1	2	0	24	27	5	4	3	1	0	13	16
09:45	3	0	0	0	0	3	3	18	1	0	2	1	22	26	4	1	1	0	1	7	9
H/TOT	15	2	0	0	0	17	17	63	9	3	7	1	83	95	16	5	7	3	1	32	40
10:00	5	2	3	0	0	10	12	16	1	2	1	0	20	22	5	2	0	1	0	8	9
10:15	5	0	1	0	0	6	7	12	2	0	2	0	16	19	5	0	3	1	0	9	12
10:30	5	1	0	0	0	6	6	9	2	1	3	0	15	19	1	0	1	3	0	5	9
10:45	3	0	0	0	0	3	3	11	1	1	1	0	14	16	3	1	1	0	0	5	6
H/TOT	18	3	4	0	0	25	27	48	6	4	7	0	65	76	14	3	5	5	0	27	36
11:00	5	0	0	0	0	5	5	12	4	1	3	0	20	24	6	2	1	0	0	9	10
11:15	4	0	0	0	0	4	4	14	3	0	2	0	19	22	5	1	2	0	0	8	9
11:30	2	1	0	0	0	3	3	8	0	0	0	0	8	8	2	2	1	3	0	8	12
11:45	1	1	1	0	0	3	4	17	3	2	0	0	22	23	4	0	2	0	0	6	7
H/TOT	12	2	1	0	0	15	16	51	10	3	5	0	69	77	17	5	6	3	0	31	38
12:00	3	0	1	0	0	4	5	4	1	1	4	0	10	16	9	1	2	1	1	14	17
12:15	2	0	1	0	0	3	4	6	2	2	3	0	13	18	6	1	0	0	0	7	7
12:30	6	1	0	0	0	7	7	14	2	0	2	0	18	21	7	1	1	0	0	9	10
12:45	2	0	0	0	0	2	2	12	2	0	2	0	16	19	4	0	1	3	0	8	12
H/TOT	13	1	2	0	0	16	17	36	7	3	11	0	57	73	26	3	4	4	1	38	46

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 03 DATE: 20th May 2010

LOCATION: Brien's Cross Roads DAY: Thursday

	MOVEMENT 10							MOVEMENT 11							MOVEMENT 12						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	3	0	0	0	0	3	3	23	5	0	3	0	31	35	3	2	0	0	0	5	5
13:15	2	1	0	0	0	3	3	10	2	1	2	0	15	18	5	2	1	1	0	9	11
13:30	3	1	0	1	0	5	6	17	1	1	1	0	20	22	6	1	0	0	1	8	9
13:45	3	0	0	0	0	3	3	11	2	1	0	0	14	15	3	0	1	2	1	7	11
H/TOT	11	2	0	1	0	14	15	61	10	3	6	0	80	89	17	5	2	3	2	29	36
14:00	4	0	0	0	0	4	4	7	1	1	2	0	11	14	3	1	2	0	0	6	7
14:15	3	0	1	0	0	4	5	18	1	2	2	0	23	27	4	2	0	1	0	7	8
14:30	1	0	0	0	0	1	1	13	2	1	0	0	16	17	9	0	1	1	0	11	13
14:45	2	1	1	0	0	4	5	12	1	0	2	0	15	18	6	2	1	1	1	11	14
H/TOT	10	1	2	0	0	13	14	50	5	4	6	0	65	75	22	5	4	3	1	35	42
15:00	1	0	0	0	0	1	1	8	4	0	1	0	13	14	3	0	0	1	0	4	5
15:15	4	1	0	1	0	6	7	16	1	1	0	0	18	19	4	2	1	0	0	7	8
15:30	2	1	0	0	0	3	3	12	0	1	0	0	13	14	8	2	2	2	0	14	18
15:45	1	2	0	0	0	3	3	16	2	2	2	0	22	26	4	3	0	1	0	8	9
H/TOT	8	4	0	1	0	13	14	52	7	4	3	0	66	72	19	7	3	4	0	33	40
16:00	3	0	0	0	0	3	3	15	1	0	1	0	17	18	5	4	0	1	0	10	11
16:15	3	1	0	1	0	5	6	13	5	1	1	0	20	22	2	1	1	0	0	4	5
16:30	6	2	0	0	0	8	8	21	4	1	0	0	26	27	5	3	0	0	1	9	10
16:45	3	0	0	0	0	3	3	25	6	1	0	0	32	33	7	2	0	0	1	10	11
H/TOT	15	3	0	1	0	19	20	74	16	3	2	0	95	99	19	10	1	1	2	33	37
17:00	9	1	0	0	0	10	10	21	7	1	2	0	31	34	12	0	2	0	0	14	15
17:15	7	2	0	0	0	9	9	25	5	0	2	0	32	35	9	4	1	0	0	14	15
17:30	4	0	0	0	0	4	4	18	5	1	0	0	24	25	13	7	2	0	0	22	23
17:45	6	0	0	0	0	6	6	25	7	0	0	0	32	32	16	4	0	2	0	22	25
H/TOT	26	3	0	0	0	29	29	89	24	2	4	0	119	125	50	15	5	2	0	72	77
18:00	2	0	0	0	0	2	2	16	5	1	1	0	23	25	7	0	0	0	0	7	7
18:15	5	3	0	0	0	8	8	20	2	1	0	0	23	24	5	3	0	0	0	8	8
18:30	4	0	0	0	0	4	4	13	2	2	1	0	18	20	9	0	1	0	1	11	13
18:45	7	0	0	0	0	7	7	14	2	1	0	0	17	18	7	2	0	0	0	9	9
H/TOT	18	3	0	0	0	21	21	63	11	5	2	0	81	86	28	5	1	0	1	35	37
P/TOT	206	34	10	4	0	254	264	715	122	39	58	2	936	1033	265	69	42	31	9	416	486

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 04 DATE: 20th May 2010

LOCATION: Balrath Cross Roads DAY: Thursday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
07:00	0	0	0	0	0	0	0	110	46	6	7	1	170	183	1	0	0	0	0	1	1
07:15	0	0	0	0	0	0	0	113	39	6	5	0	163	173	2	2	0	0	0	4	4
07:30	1	1	0	0	0	2	2	120	28	10	11	3	172	194	0	1	0	0	0	1	1
07:45	3	2	0	0	0	5	5	108	28	5	7	1	149	162	1	1	0	0	0	2	2
H/TOT	4	3	0	0	0	7	7	451	141	27	30	5	654	712	4	4	0	0	0	8	8
08:00	3	1	0	0	0	4	4	88	21	5	4	0	118	126	2	0	0	0	0	2	2
08:15	2	0	0	0	0	2	2	93	21	3	6	0	123	132	1	1	0	0	0	2	2
08:30	2	1	0	0	0	3	3	83	15	5	2	1	106	112	1	0	0	1	0	2	3
08:45	3	1	0	0	0	4	4	78	14	6	10	0	108	124	2	1	0	0	0	3	3
H/TOT	10	3	0	0	0	13	13	342	71	19	22	1	455	494	6	2	0	1	0	9	10
09:00	1	1	0	0	0	2	2	80	25	6	9	0	120	135	8	0	0	0	0	8	8
09:15	1	0	0	0	0	1	1	60	6	3	4	3	76	86	4	0	1	0	0	5	6
09:30	2	0	1	0	0	3	4	42	13	2	8	0	65	76	3	0	0	0	0	3	3
09:45	0	1	0	1	0	2	3	47	13	3	6	1	70	80	2	0	0	1	0	3	4
H/TOT	4	2	1	1	0	8	10	229	57	14	27	4	331	377	17	0	1	1	0	19	21
10:00	1	0	0	1	0	2	3	38	14	9	9	1	71	88	1	0	0	0	0	1	1
10:15	0	0	1	0	0	1	2	35	8	2	6	0	51	60	1	0	0	0	0	1	1
10:30	4	1	0	0	0	5	5	40	4	2	4	0	50	56	3	0	0	0	0	3	3
10:45	1	0	1	0	0	2	3	29	9	2	8	0	48	59	2	2	0	0	0	4	4
H/TOT	6	1	2	1	0	10	12	142	35	15	27	1	220	264	7	2	0	0	0	9	9
11:00	0	0	0	0	0	0	0	28	4	4	5	0	41	50	3	1	2	0	0	6	7
11:15	2	0	1	0	0	3	4	36	5	6	5	1	53	64	5	1	1	0	0	7	8
11:30	3	0	0	1	0	4	5	25	7	5	8	0	45	58	3	0	0	0	0	3	3
11:45	0	0	0	0	0	0	0	34	4	5	12	1	56	75	4	3	1	0	0	8	9
H/TOT	5	0	1	1	0	7	9	123	20	20	30	2	195	246	15	5	4	0	0	24	26
12:00	1	0	0	0	0	1	1	23	11	7	8	0	49	63	0	1	0	1	0	2	3
12:15	2	0	0	0	0	2	2	26	11	3	3	0	43	48	2	1	1	0	0	4	5
12:30	1	1	0	0	0	2	2	29	9	7	10	0	55	72	3	0	0	0	0	3	3
12:45	0	0	0	0	0	0	0	27	6	5	8	0	46	59	1	0	0	0	0	1	1
H/TOT	4	1	0	0	0	5	5	105	37	22	29	0	193	242	6	2	1	1	0	10	12

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 04 DATE: 20th May 2010

LOCATION: Balrath Cross Roads DAY: Thursday

	MOVEMENT 1							MOVEMENT 2							MOVEMENT 3						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
13:00	0	0	0	0	0	0	0	28	8	5	9	0	50	64	2	0	0	0	0	2	2
13:15	0	1	0	0	0	1	1	26	4	4	6	1	41	52	1	0	0	0	0	1	1
13:30	3	1	0	0	0	4	4	28	5	0	9	0	42	54	2	0	1	0	0	3	4
13:45	2	0	0	0	0	2	2	15	8	4	5	1	33	43	4	0	0	0	0	4	4
H/TOT	5	2	0	0	0	7	7	97	25	13	29	2	166	212	9	0	1	0	0	10	11
14:00	4	0	0	0	0	4	4	28	4	5	6	1	44	55	5	0	1	0	0	6	7
14:15	0	0	0	1	0	1	2	32	5	9	10	1	57	76	3	0	0	0	0	3	3
14:30	2	1	1	0	0	4	5	40	6	4	4	0	54	61	1	0	0	0	0	1	1
14:45	2	1	1	0	0	4	5	29	6	2	3	0	40	45	0	0	0	0	0	0	0
H/TOT	8	2	2	1	0	13	15	129	21	20	23	2	195	237	9	0	1	0	0	10	11
15:00	1	0	0	0	0	1	1	28	11	4	2	1	46	52	3	0	0	0	0	3	3
15:15	6	0	0	0	0	6	6	27	5	7	8	1	48	63	0	0	0	0	0	0	0
15:30	2	0	0	0	0	2	2	31	4	4	6	2	47	59	3	0	0	0	0	3	3
15:45	3	0	0	0	0	3	3	32	9	3	2	1	47	52	0	0	0	0	0	0	0
H/TOT	12	0	0	0	0	12	12	118	29	18	18	5	188	225	6	0	0	0	0	6	6
16:00	1	0	0	0	0	1	1	29	11	5	5	0	50	59	1	0	0	0	0	1	1
16:15	2	0	0	0	0	2	2	41	8	2	5	0	56	64	2	0	0	1	0	3	4
16:30	1	1	0	0	0	2	2	46	9	3	4	0	62	69	0	1	0	0	0	1	1
16:45	4	0	0	0	0	4	4	27	8	4	6	0	45	55	4	0	0	0	0	4	4
H/TOT	8	1	0	0	0	9	9	143	36	14	20	0	213	246	7	1	0	1	0	9	10
17:00	0	1	0	0	0	1	1	37	5	4	2	0	48	53	4	1	1	0	0	6	7
17:15	1	2	0	0	0	3	3	32	7	0	2	1	42	46	4	0	0	0	0	4	4
17:30	2	1	0	0	0	3	3	51	5	4	6	0	66	76	1	0	2	0	0	3	4
17:45	1	1	0	0	0	2	2	45	5	3	2	0	55	59	1	1	0	0	0	2	2
H/TOT	4	5	0	0	0	9	9	165	22	11	12	1	211	233	10	2	3	0	0	15	17
18:00	3	0	0	0	0	3	3	37	10	1	1	0	49	51	4	1	0	0	0	5	5
18:15	3	1	0	0	0	4	4	41	5	2	2	0	50	54	0	0	0	0	0	0	0
18:30	3	0	1	0	0	4	5	38	3	0	2	0	43	46	1	0	0	0	0	1	1
18:45	3	1	0	0	0	4	4	29	3	1	1	0	34	36	3	0	0	0	0	3	3
H/TOT	12	2	1	0	0	15	16	145	21	4	6	0	176	186	8	1	0	0	0	9	9
P/TOT	82	22	7	4	0	115	124	2189	515	197	273	23	3197	3673	104	19	11	4	0	138	149

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 04 DATE: 20th May 2010

LOCATION: Balrath Cross Roads DAY: Thursday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
07:00	0	0	0	0	0	0	0	6	3	0	0	0	9	9	71	12	0	1	1	85	87
07:15	1	0	0	0	0	1	1	6	4	0	1	0	11	12	50	21	2	2	0	75	79
07:30	2	0	0	0	0	2	2	6	2	0	1	0	9	10	60	11	2	1	0	74	76
07:45	0	1	0	0	0	1	1	5	2	1	0	0	8	9	48	8	0	2	1	59	63
H/TOT	3	1	0	0	0	4	4	23	11	1	2	0	37	40	229	52	4	6	2	293	305
08:00	1	0	0	0	0	1	1	7	4	0	0	0	11	11	67	14	0	5	0	86	93
08:15	1	0	0	0	0	1	1	7	4	1	0	0	12	13	55	5	2	3	0	65	70
08:30	3	0	0	0	0	3	3	10	2	1	0	0	13	14	53	8	2	0	0	63	64
08:45	0	1	0	0	0	1	1	10	3	1	0	0	14	15	48	6	3	0	0	57	59
H/TOT	5	1	0	0	0	6	6	34	13	3	0	0	50	52	223	33	7	8	0	271	285
09:00	2	2	0	0	0	4	4	8	1	1	1	0	11	13	38	6	1	0	1	46	48
09:15	4	0	0	0	0	4	4	3	0	2	0	0	5	6	43	4	2	2	0	51	55
09:30	4	0	0	0	0	4	4	9	1	0	0	0	10	10	44	5	1	2	0	52	55
09:45	2	1	0	0	0	3	3	5	2	0	0	0	7	7	38	4	1	4	0	47	53
H/TOT	12	3	0	0	0	15	15	25	4	3	1	0	33	36	163	19	5	8	1	196	210
10:00	3	3	0	0	0	6	6	3	0	0	0	0	3	3	42	8	1	2	0	53	56
10:15	2	0	0	0	0	2	2	10	0	1	0	0	11	12	40	1	3	2	0	46	50
10:30	2	1	0	0	0	3	3	6	0	2	0	0	8	9	21	4	1	1	1	28	31
10:45	2	0	0	0	0	2	2	8	1	1	0	0	10	11	25	3	1	0	0	29	30
H/TOT	9	4	0	0	0	13	13	27	1	4	0	0	32	34	128	16	6	5	1	156	167
11:00	6	1	0	0	0	7	7	5	0	0	2	0	7	10	29	4	1	5	0	39	46
11:15	3	0	0	0	0	3	3	6	2	2	0	0	10	11	28	3	2	2	0	35	39
11:30	5	0	0	0	0	5	5	6	1	2	1	0	10	12	25	5	2	3	0	35	40
11:45	2	4	0	0	0	6	6	3	5	2	1	0	11	13	22	0	2	2	0	26	30
H/TOT	16	5	0	0	0	21	21	20	8	6	4	0	38	46	104	12	7	12	0	135	154
12:00	2	0	0	0	0	2	2	4	1	1	0	0	6	7	27	2	1	1	0	31	33
12:15	0	0	0	0	0	0	0	5	2	1	0	0	8	9	28	6	0	4	1	39	45
12:30	9	1	0	0	0	10	10	9	2	0	0	0	11	11	25	3	2	1	1	32	35
12:45	4	1	0	0	0	5	5	5	0	0	0	0	5	5	32	2	1	3	1	39	44
H/TOT	15	2	0	0	0	17	17	23	5	2	0	0	30	31	112	13	4	9	3	141	158

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 04 DATE: 20th May 2010

LOCATION: Balrath Cross Roads DAY: Thursday

	MOVEMENT 4							MOVEMENT 5							MOVEMENT 6						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	0	1	2	0	0	3	4	4	0	0	0	1	5	6	24	2	1	1	0	28	30
13:15	0	0	0	0	0	0	0	10	1	1	1	0	13	15	28	4	0	4	0	36	41
13:30	2	0	0	0	0	2	2	7	2	1	0	0	10	11	34	7	0	5	1	47	55
13:45	2	0	1	0	0	3	4	4	1	0	0	0	5	5	23	1	1	2	0	27	30
H/TOT	4	1	3	0	0	8	10	25	4	2	1	1	33	36	109	14	2	12	1	138	156
14:00	2	0	0	0	0	2	2	7	1	1	0	0	9	10	25	1	2	3	0	31	36
14:15	2	1	0	0	0	3	3	5	0	1	0	0	6	7	38	2	3	4	0	47	54
14:30	4	0	0	0	0	4	4	3	1	0	0	0	4	4	30	3	3	0	1	37	40
14:45	3	0	1	0	0	4	5	3	1	2	1	0	7	9	30	1	1	2	0	34	37
H/TOT	11	1	1	0	0	13	14	18	3	4	1	0	26	29	123	7	9	9	1	149	166
15:00	4	0	0	0	0	4	4	9	0	0	0	0	9	9	30	3	1	2	1	37	41
15:15	2	1	0	0	0	3	3	6	2	0	1	0	9	10	32	7	0	0	1	40	41
15:30	5	1	0	0	0	6	6	7	1	1	1	0	10	12	22	3	2	2	0	29	33
15:45	5	3	2	0	0	10	11	7	1	0	0	0	8	8	25	5	0	2	1	33	37
H/TOT	16	5	2	0	0	23	24	29	4	1	2	0	36	39	109	18	3	6	3	139	151
16:00	6	1	1	0	0	8	9	4	3	1	0	0	8	9	23	3	2	2	0	30	34
16:15	4	1	0	0	0	5	5	2	1	0	0	0	3	3	18	3	2	0	0	23	24
16:30	5	1	0	0	0	6	6	11	3	0	1	0	15	16	35	4	2	1	1	43	46
16:45	4	0	0	0	0	4	4	5	1	1	0	0	7	8	38	2	0	4	0	44	49
H/TOT	19	3	1	0	0	23	24	22	8	2	1	0	33	35	114	12	6	7	1	140	153
17:00	4	2	0	0	0	6	6	11	2	1	0	0	14	15	26	2	0	2	0	30	33
17:15	3	2	0	0	0	5	5	6	2	0	1	0	9	10	38	2	0	3	0	43	47
17:30	0	0	0	0	0	0	0	9	4	1	0	0	14	15	38	4	4	1	0	47	50
17:45	5	0	0	0	0	5	5	11	4	0	0	0	15	15	32	6	0	3	0	41	45
H/TOT	12	4	0	0	0	16	16	37	12	2	1	0	52	54	134	14	4	9	0	161	175
18:00	5	0	0	0	0	5	5	6	1	0	0	0	7	7	34	2	0	1	0	37	38
18:15	2	0	0	0	0	2	2	15	1	1	0	0	17	18	36	5	0	1	1	43	45
18:30	5	1	0	0	0	6	6	9	2	1	0	0	12	13	28	1	2	1	0	32	34
18:45	3	1	0	0	0	4	4	11	1	1	0	0	13	14	28	2	0	1	1	32	34
H/TOT	15	2	0	0	0	17	17	41	5	3	0	0	49	51	126	10	2	4	2	144	152
P/TOT	137	32	7	0	0	176	180	324	78	33	13	1	449	483	1674	220	59	95	15	2063	2231

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 04 DATE: 20th May 2010

LOCATION: Balrath Cross Roads DAY: Thursday

	MOVEMENT 7							MOVEMENT 8							MOVEMENT 9						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
07:00	12	1	0	0	0	13	13	8	2	5	4	0	19	27	0	0	0	0	0	0	0
07:15	7	2	1	2	0	12	15	12	7	1	7	0	27	37	0	0	0	0	0	0	0
07:30	30	3	0	2	0	35	38	28	5	1	2	0	36	39	1	0	0	0	0	1	1
07:45	15	0	1	2	1	19	23	27	7	2	5	0	41	49	1	0	0	0	0	1	1
H/TOT	64	6	2	6	1	79	89	75	21	9	18	0	123	151	2	0	0	0	0	2	2
08:00	25	3	1	5	0	34	41	25	5	10	10	1	51	70	2	0	0	0	0	2	2
08:15	27	1	1	3	1	33	38	20	8	4	5	0	37	46	0	0	0	0	0	0	0
08:30	24	1	0	1	0	26	27	26	8	3	5	0	42	50	0	0	0	0	0	0	0
08:45	21	6	1	0	0	28	29	28	11	0	4	0	43	48	0	0	1	0	0	1	2
H/TOT	97	11	3	9	1	121	135	99	32	17	24	1	173	214	2	0	1	0	0	3	4
09:00	20	3	3	3	0	29	34	32	4	5	4	0	45	53	0	0	0	0	0	0	0
09:15	32	3	4	3	0	42	48	16	7	5	12	1	41	60	1	0	0	0	0	1	1
09:30	22	6	1	5	0	34	41	19	11	3	7	0	40	51	1	0	1	0	0	2	3
09:45	18	4	1	2	0	25	28	19	9	4	8	2	42	56	0	0	0	0	0	0	0
H/TOT	92	16	9	13	0	130	151	86	31	17	31	3	168	220	2	0	1	0	0	3	4
10:00	24	5	3	4	0	36	43	27	0	4	5	1	37	47	1	0	0	0	0	1	1
10:15	24	6	2	1	0	33	35	25	11	6	10	0	52	68	0	0	0	0	0	0	0
10:30	18	3	0	2	0	23	26	10	4	5	8	0	27	40	1	1	0	0	0	2	2
10:45	22	1	0	2	0	25	28	20	4	3	5	0	32	40	0	0	0	0	0	0	0
H/TOT	88	15	5	9	0	117	131	82	19	18	28	1	148	194	2	1	0	0	0	3	3
11:00	26	2	0	5	1	34	42	25	3	2	11	0	41	56	0	0	0	0	0	0	0
11:15	25	3	4	4	0	36	43	24	4	1	8	1	38	50	0	0	0	0	0	0	0
11:30	26	5	3	3	0	37	42	22	7	3	7	1	40	52	0	0	0	0	0	0	0
11:45	20	2	0	3	2	27	33	34	4	4	8	1	51	64	1	0	0	0	0	1	1
H/TOT	97	12	7	15	3	134	160	105	18	10	34	3	170	222	1	0	0	0	0	1	1
12:00	29	1	0	2	0	32	35	38	6	3	5	0	52	60	0	0	1	0	0	1	2
12:15	27	1	1	1	0	30	32	18	6	4	8	2	38	52	0	0	0	0	0	0	0
12:30	25	2	1	4	1	33	40	32	7	7	8	0	54	68	1	1	1	0	0	3	4
12:45	18	3	1	5	0	27	34	41	10	4	6	0	61	71	2	0	0	0	0	2	2
H/TOT	99	7	3	12	1	122	140	129	29	18	27	2	205	251	3	1	2	0	0	6	7

SITE: 04 DATE: 20th May 2010

LOCATION: Balrath Cross Roads DAY: Thursday

	MOVEMENT 7							MOVEMENT 8							MOVEMENT 9						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	26	5	0	6	0	37	45	31	6	4	16	0	57	80	1	0	1	0	0	2	3
13:15	30	5	2	1	0	38	40	28	3	4	11	0	46	62	1	0	1	0	0	2	3
13:30	33	4	1	0	0	38	39	32	7	6	5	1	51	62	0	0	0	0	0	0	0
13:45	45	3	1	2	0	51	54	35	8	1	11	1	56	72	0	0	1	0	0	1	2
H/TOT	134	17	4	9	0	164	178	126	24	15	43	2	210	275	2	0	3	0	0	5	7
14:00	22	1	0	2	1	26	30	44	8	1	9	0	62	74	1	0	0	0	0	1	1
14:15	32	5	2	2	0	41	45	43	8	4	13	0	68	87	2	0	0	0	0	2	2
14:30	45	7	0	3	0	55	59	32	7	1	8	1	49	61	0	0	0	0	0	0	0
14:45	41	4	0	1	0	46	47	51	7	8	9	0	75	91	0	0	0	0	0	0	0
H/TOT	140	17	2	8	1	168	180	170	30	14	39	1	254	313	3	0	0	0	0	3	3
15:00	36	8	2	0	0	46	47	39	9	4	9	1	62	77	0	0	0	0	0	0	0
15:15	48	9	0	2	0	59	62	49	12	6	8	0	75	88	2	0	0	0	0	2	2
15:30	37	7	1	5	0	50	57	73	15	3	12	1	104	122	0	0	0	0	0	0	0
15:45	41	10	2	4	1	58	65	54	11	5	9	0	79	93	0	0	0	0	0	0	0
H/TOT	162	34	5	11	1	213	231	215	47	18	38	2	320	380	2	0	0	0	0	2	2
16:00	60	8	1	3	0	72	76	61	16	4	11	1	93	110	1	0	0	0	0	1	1
16:15	58	15	0	3	0	76	80	69	11	3	9	0	92	105	0	1	0	0	0	1	1
16:30	90	17	1	1	0	109	111	71	19	4	14	1	109	130	1	0	0	0	0	1	1
16:45	65	11	1	0	1	78	80	89	18	4	8	0	119	131	0	0	0	0	0	0	0
H/TOT	273	51	3	7	1	335	347	290	64	15	42	2	413	477	2	1	0	0	0	3	3
17:00	65	12	1	2	0	80	83	88	23	7	8	0	126	140	1	0	0	0	0	1	1
17:15	71	16	2	3	0	92	97	79	26	4	3	1	113	120	0	0	0	0	0	0	0
17:30	76	13	0	2	0	91	94	115	25	3	4	1	148	156	0	0	0	0	0	0	0
17:45	52	8	2	2	0	64	68	80	24	5	2	0	111	116	2	0	0	0	0	2	2
H/TOT	264	49	5	9	0	327	341	362	98	19	17	2	498	532	3	0	0	0	0	3	3
18:00	90	10	0	1	1	102	104	78	17	5	6	0	106	116	1	0	0	0	0	1	1
18:15	59	8	2	0	0	69	70	90	18	2	7	1	118	129	1	1	0	0	0	2	2
18:30	79	12	0	3	0	94	98	96	15	4	8	1	124	137	1	0	0	0	0	1	1
18:45	97	6	0	2	0	105	108	74	15	4	6	0	99	109	1	2	0	0	0	3	3
H/TOT	325	36	2	6	1	370	380	338	65	15	27	2	447	492	4	3	0	0	0	7	7
P/TOT	1835	271	50	114	10	2280	2463	2077	478	185	368	21	3129	3721	28	6	7	0	0	41	45

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 04 DATE: 20th May 2010

LOCATION: Balrath Cross Roads DAY: Thursday

	MOVEMENT 10							MOVEMENT 11							MOVEMENT 12						
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	BUS	TOT	PCU
07:00	0	0	0	0	0	0	0	2	2	1	0	0	5	6	0	0	0	0	0	0	0
07:15	4	0	1	0	0	5	6	3	1	0	0	0	4	4	0	1	0	0	0	1	1
07:30	2	0	0	0	0	2	2	5	1	0	0	0	6	6	1	0	0	0	0	1	1
07:45	4	1	0	0	0	5	5	2	0	0	0	0	2	2	3	0	0	0	0	3	3
H/TOT	10	1	1	0	0	12	13	12	4	1	0	0	17	18	4	1	0	0	0	5	5
08:00	2	0	1	0	0	3	4	8	0	0	0	0	8	8	1	0	0	0	0	1	1
08:15	1	0	0	0	0	1	1	10	2	0	1	0	13	14	1	0	0	0	0	1	1
08:30	4	1	0	0	0	5	5	9	2	2	0	0	13	14	1	0	0	0	0	1	1
08:45	1	1	1	0	0	3	4	13	0	0	0	0	13	13	1	0	0	0	1	2	3
H/TOT	8	2	2	0	0	12	13	40	4	2	1	0	47	49	4	0	0	0	1	5	6
09:00	3	1	0	0	0	4	4	13	0	1	0	0	14	15	1	0	0	0	0	1	1
09:15	2	0	0	0	0	2	2	8	2	1	0	0	11	12	3	0	0	0	0	3	3
09:30	3	0	0	0	0	3	3	9	0	2	1	0	12	14	1	1	0	0	0	2	2
09:45	2	0	0	0	0	2	2	7	0	0	0	0	7	7	0	0	1	0	0	1	2
H/TOT	10	1	0	0	0	11	11	37	2	4	1	0	44	47	5	1	1	0	0	7	8
10:00	1	0	1	0	0	2	3	3	0	1	0	0	4	5	1	0	0	0	0	1	1
10:15	2	0	0	0	0	2	2	4	1	1	0	0	6	7	3	0	0	0	0	3	3
10:30	2	0	0	0	0	2	2	4	0	0	0	0	4	4	2	0	0	1	0	3	4
10:45	1	0	0	0	1	2	3	7	4	1	0	0	12	13	0	0	0	0	0	0	0
H/TOT	6	0	1	0	1	8	10	18	5	3	0	0	26	28	6	0	0	1	0	7	8
11:00	1	0	0	0	0	1	1	5	0	2	0	0	7	8	1	0	1	0	0	2	3
11:15	2	0	0	0	0	2	2	4	1	1	1	0	7	9	2	1	0	0	0	3	3
11:30	0	0	0	0	0	0	0	2	2	2	0	0	6	7	2	1	1	0	0	4	5
11:45	1	1	0	0	0	2	2	5	1	1	0	0	7	8	1	1	0	1	0	3	4
H/TOT	4	1	0	0	0	5	5	16	4	6	1	0	27	31	6	3	2	1	0	12	14
12:00	0	0	0	0	0	0	0	8	0	0	0	0	8	8	0	0	0	0	0	0	0
12:15	0	0	1	0	0	1	2	4	0	0	0	0	4	4	1	0	0	0	0	1	1
12:30	0	0	0	0	0	0	0	4	3	2	1	0	10	12	2	0	1	0	0	3	4
12:45	1	0	0	0	0	1	1	3	0	2	1	0	6	8	1	0	1	0	0	2	3
H/TOT	1	0	1	0	0	2	3	19	3	4	2	0	28	33	4	0	2	0	0	6	7

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 04 DATE: 20th May 2010

LOCATION: Balrath Cross Roads DAY: Thursday

	MOVEMENT 10							MOVEMENT 11							MOVEMENT 12						
TIME	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**	**CAR**	**LGV**	**OGV1**	**OGV2**	**BUS**	**TOT**	**PCU**
13:00	0	1	0	0	0	1	1	9	0	0	0	0	9	9	1	0	0	0	0	1	1
13:15	0	0	0	0	0	0	0	7	0	1	0	0	8	9	0	0	0	0	0	0	0
13:30	0	1	0	0	0	1	1	6	0	0	1	0	7	8	1	0	0	0	0	1	1
13:45	2	0	0	0	0	2	2	6	1	0	2	0	9	12	4	0	0	0	0	4	4
H/TOT	2	2	0	0	0	4	4	28	1	1	3	0	33	37	6	0	0	0	0	6	6
14:00	0	0	0	0	0	0	0	3	1	1	0	0	5	6	2	0	1	0	0	3	4
14:15	0	0	0	0	0	0	0	5	2	0	1	0	8	9	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	3	3	2	1	0	9	11	1	0	0	1	0	2	3
14:45	0	0	0	0	0	0	0	9	1	1	0	0	11	12	1	1	0	0	0	2	2
H/TOT	0	0	0	0	0	0	0	20	7	4	2	0	33	38	4	1	1	1	0	7	9
15:00	4	0	0	0	0	4	4	7	1	0	0	0	8	8	1	0	0	1	0	2	3
15:15	0	0	0	0	0	0	0	7	2	0	0	0	9	9	3	0	0	0	0	3	3
15:30	1	0	0	0	0	1	1	7	1	1	0	0	9	10	1	0	0	0	0	1	1
15:45	2	0	0	0	0	2	2	3	1	0	0	0	4	4	0	0	0	0	0	0	0
H/TOT	7	0	0	0	0	7	7	24	5	1	0	0	30	31	5	0	0	1	0	6	7
16:00	0	0	0	0	0	0	0	5	0	1	1	0	7	9	3	1	1	0	0	5	6
16:15	2	0	0	0	0	2	2	4	1	0	1	0	6	7	3	1	0	0	0	4	4
16:30	0	0	0	0	0	0	0	8	2	0	0	0	10	10	3	0	0	0	0	3	3
16:45	1	0	0	0	0	1	1	7	3	0	0	0	10	10	1	2	1	0	0	4	5
H/TOT	3	0	0	0	0	3	3	24	6	1	2	0	33	36	10	4	2	0	0	16	17
17:00	2	0	0	0	0	2	2	5	6	0	1	0	12	13	0	1	0	0	0	1	1
17:15	2	0	0	0	0	2	2	5	0	1	0	0	6	7	1	1	0	0	0	2	2
17:30	0	0	0	0	0	0	0	8	2	1	0	0	11	12	1	2	0	0	0	3	3
17:45	5	0	0	0	0	5	5	10	4	0	0	0	14	14	3	0	0	0	0	3	3
H/TOT	9	0	0	0	0	9	9	28	12	2	1	0	43	45	5	4	0	0	0	9	9
18:00	2	0	0	0	0	2	2	12	1	1	0	0	14	15	2	0	0	0	0	2	2
18:15	5	0	0	0	0	5	5	12	3	2	0	0	17	18	1	0	0	0	0	1	1
18:30	1	0	0	0	0	1	1	8	1	0	0	0	9	9	4	0	0	0	0	4	4
18:45	0	0	0	0	0	0	0	4	2	0	0	0	6	6	4	0	0	0	0	4	4
H/TOT	8	0	0	0	0	8	8	36	7	3	0	0	46	48	11	0	0	0	0	11	11
P/TOT	68	7	5	0	1	81	85	302	60	32	13	0	407	440	70	14	8	4	1	97	107

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01,02,03, & 04 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility, Rathdrinagh Crossroads,
Brien's Cross, & Balarath Crossroads DAY: Thursday

	MVT 01				MVT 02				MVT 03				MVT 04				MVT 05				MVT 06			
TIME	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT
07:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
08:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	1	0	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
09:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:30	1	0	0	1	1	1	0	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
09:45	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
H/TOT	1	1	0	2	1	1	0	2	0	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30	0	2	0	2	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0
11:45	1	0	0	1	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
H/TOT	1	2	0	3	0	3	0	3	0	1	0	1	0	0	0	0	0	1	0	1	1	0	0	1
12:00	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
12:15	0	0	1	1	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0
H/TOT	0	1	1	2	2	1	0	3	0	0	0	0	0	0	1	1	0	3	0	3	0	0	0	0

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01,02,03, & 04 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility, Rathdrinagh Crossroads, Brien's Cross, & Balarath Crossroads DAY: Thursday

	MVT 01				MVT 02				MVT 03				MVT 04				MVT 05				MVT 06			
TIME	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT
13:00	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
13:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:30	0	1	1	2	0	2	0	2	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0
13:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	1	1	2	0	3	0	3	0	0	0	0	0	1	1	2	0	1	0	1	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:30	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
14:45	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	1	0	1	0	2	0	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
15:00	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:15	0	2	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
15:45	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
H/TOT	0	2	1	3	0	2	0	2	0	0	0	0	0	1	0	1	0	1	1	2	0	0	0	0
16:00	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
16:15	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P/TOT	2	12	3	17	4	12	1	17	0	1	0	1	1	2	2	5	0	12	1	13	1	0	0	1

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01,02,03, & 04 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility, Rathdrinagh Crossroads,
Brien's Cross, & Balarath Crossroads DAY: Thursday

	MVT 07				MVT 08				MVT 09				MVT 10			
TIME	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT
07:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
08:15	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
08:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0
09:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:30	0	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0
09:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
12:15	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	2	0	0	2	0	1	0	1	0	0	0	0

ABACUS TRANSPORTATION SURVEYS

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01,02,03, & 04 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility, Rathdrinagh Crossroads,
Brien's Cross, & Balarath Crossroads DAY: Thursday

	MVT 07				MVT 08				MVT 09				MVT 10			
TIME	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT
13:00	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
13:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0
13:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
14:45	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
15:15	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P/TOT	0	0	0	0	2	0	1	3	2	12	0	14	0	0	0	0

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01,02,03, & 04 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility, Rathdrinagh Crossroads,
Brien's Cross, & Balarath Crossroads DAY: Thursday

	MVT 11				MVT 12				MVT 13			
TIME	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT
07:00	0	0	0	0	0	0	0	0	0	0	0	0
07:15	0	0	0	0	0	0	0	0	0	0	0	0
07:30	0	0	0	0	0	0	0	0	0	0	0	0
07:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0
08:00	0	0	0	0	0	0	0	0	0	0	0	0
08:15	0	0	0	0	1	0	0	1	0	0	0	0
08:30	0	0	0	0	0	0	0	0	0	0	0	0
08:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	1	0	0	1	0	0	0	0
09:00	0	0	0	0	0	0	0	0	0	0	0	0
09:15	0	0	0	0	0	0	0	0	0	0	0	0
09:30	0	0	0	0	1	1	0	2	0	0	0	0
09:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	1	1	0	2	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0	0	0
10:15	0	0	0	0	0	0	0	0	0	0	0	0
10:30	0	0	0	0	0	0	0	0	0	0	0	0
10:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	0
11:45	0	0	0	0	0	3	0	3	0	0	0	0
H/TOT	0	0	0	0	0	3	0	3	0	0	0	0
12:00	0	0	0	0	0	1	0	1	0	0	0	0
12:15	0	0	0	0	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0	0	0	0
12:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	1	0	1	0	0	0	0

KNOCKHARLEY TRAFFIC COUNTS **MAY 2010**
MANUAL CLASSIFIED JUNCTION COUNTS **ATH/10/051**

SITE: 01,02,03, & 04 DATE: 20th May 2010

LOCATION: N2/Greenstar Facility, Rathdrinagh Crossroads, Brien's Cross, & Balarath Crossroads DAY: Thursday

	MVT 11				MVT 12				MVT 13			
TIME	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT	NON- WASTE HGV	WASTE HGV	TANKER	TOT
13:00	0	0	0	0	0	1	0	1	0	0	0	0
13:15	0	0	0	0	0	0	0	0	0	0	0	0
13:30	0	0	0	0	0	2	0	2	0	0	0	0
13:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	3	0	3	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0	0	0
14:15	0	0	0	0	0	0	0	0	0	0	0	0
14:30	0	0	0	0	0	1	0	1	0	0	0	0
14:45	0	0	0	0	0	1	0	1	0	0	0	0
H/TOT	0	0	0	0	0	2	0	2	0	0	0	0
15:00	0	0	0	0	0	1	0	1	0	0	0	0
15:15	0	0	0	0	0	1	0	1	0	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	2	0	2	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0
18:15	0	0	0	0	0	0	0	0	0	0	0	0
18:30	0	0	0	0	0	0	0	0	0	0	0	0
18:45	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0
P/TOT	0	0	0	0	2	12	0	14	0	0	0	0

Appendix 8.2

Traffic Flow Analysis

Appendix 8.2

Traffic Survey Data Analysis

Total Traffic Flow & HGV Traffic Flow

Appendix 8.2

N2 Traffic Flow Data

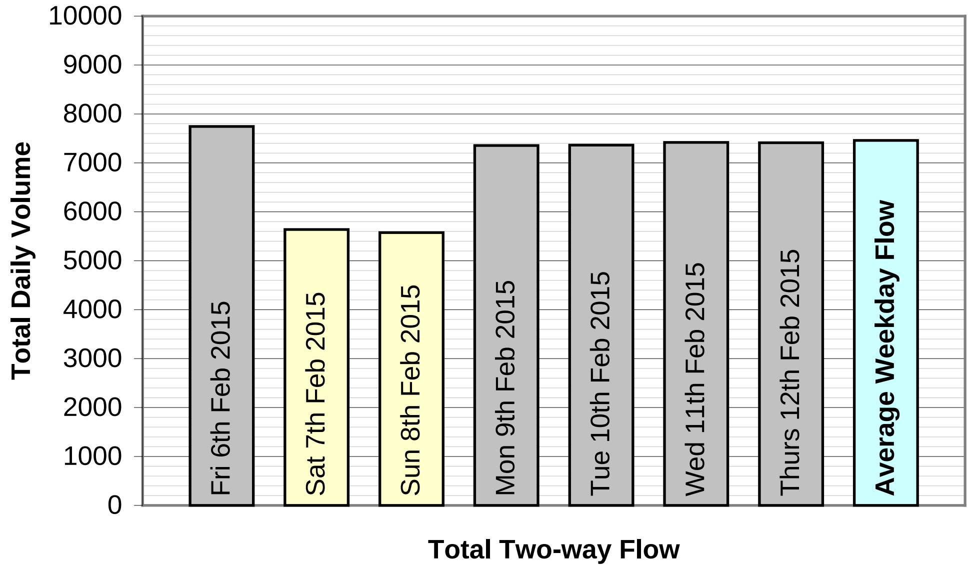


Figure 1 Total & Average Daily Two-way Traffic Flows 2015

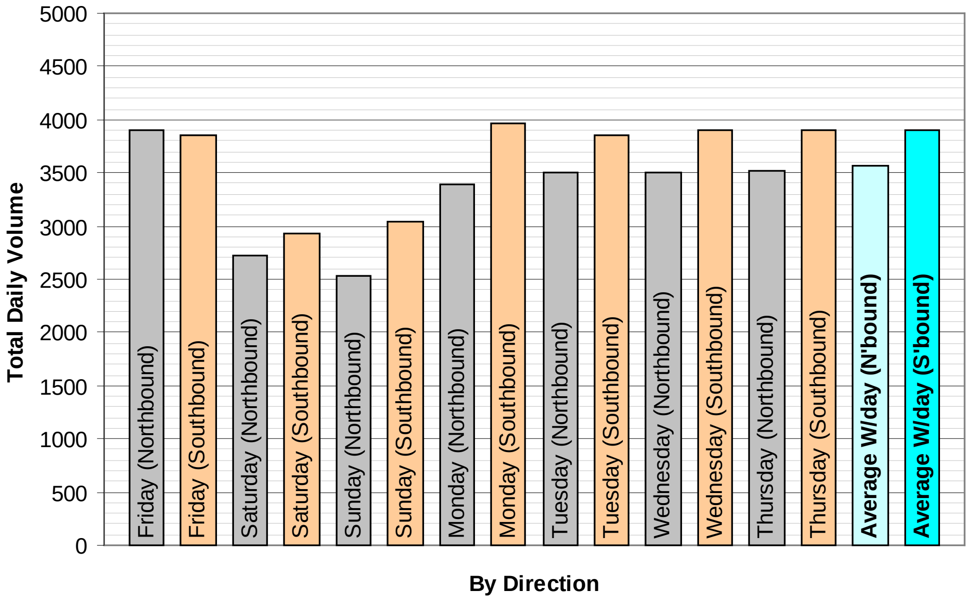


Figure 2 Total & Average Daily Traffic Flows by Direction 2015

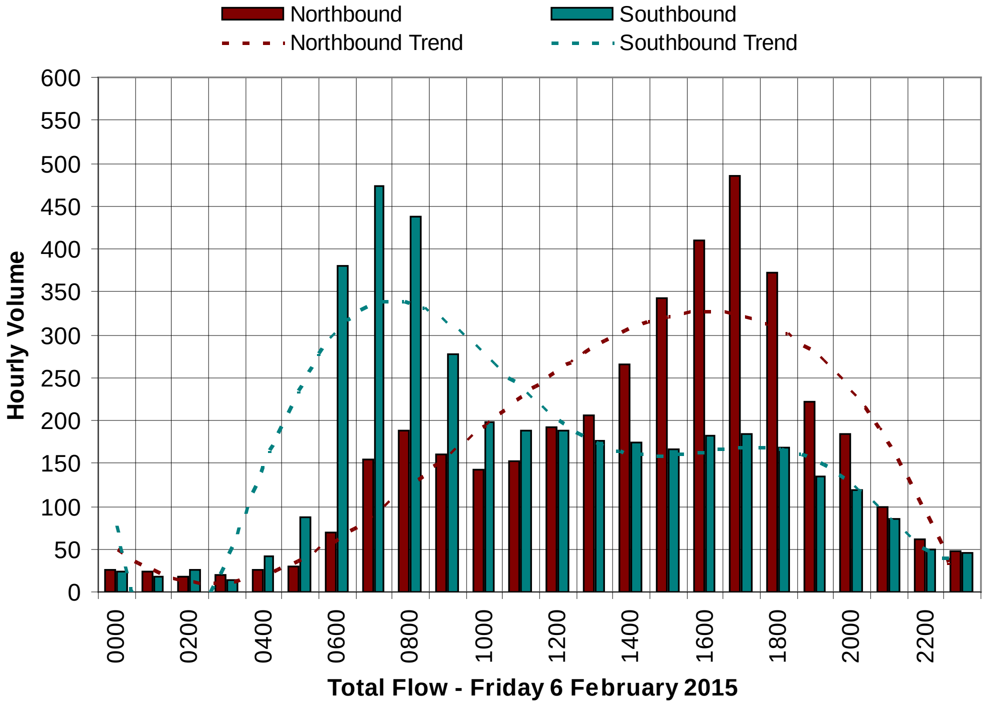


Figure 3 Hourly Traffic Flow - Friday 6 February 2015

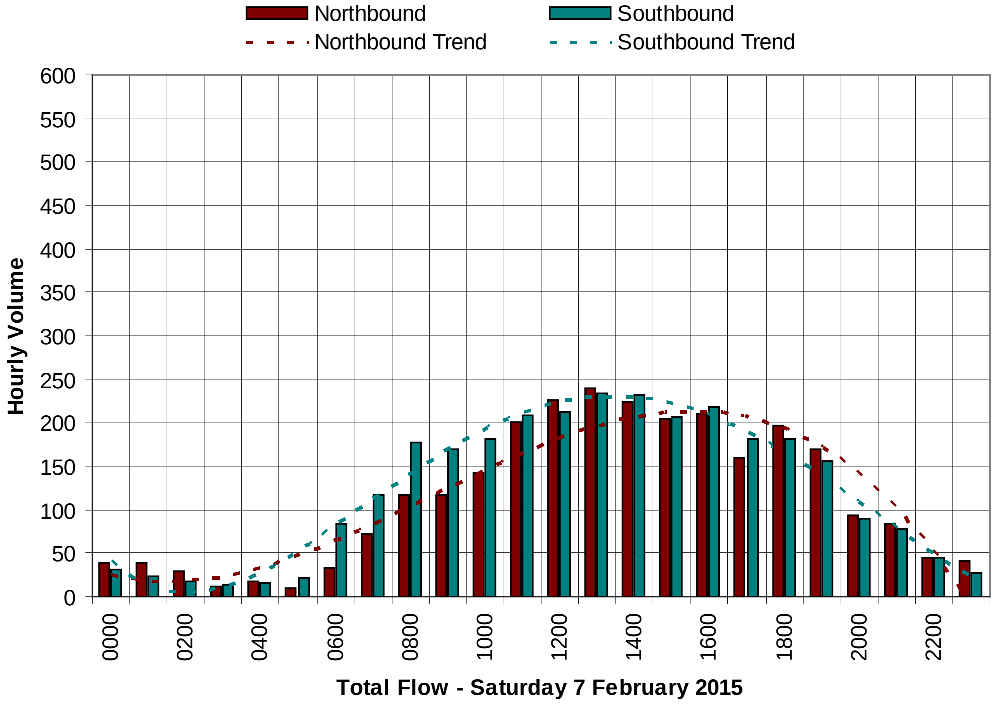


Figure 4 Hourly Traffic Flow - Saturday 7 February 2015

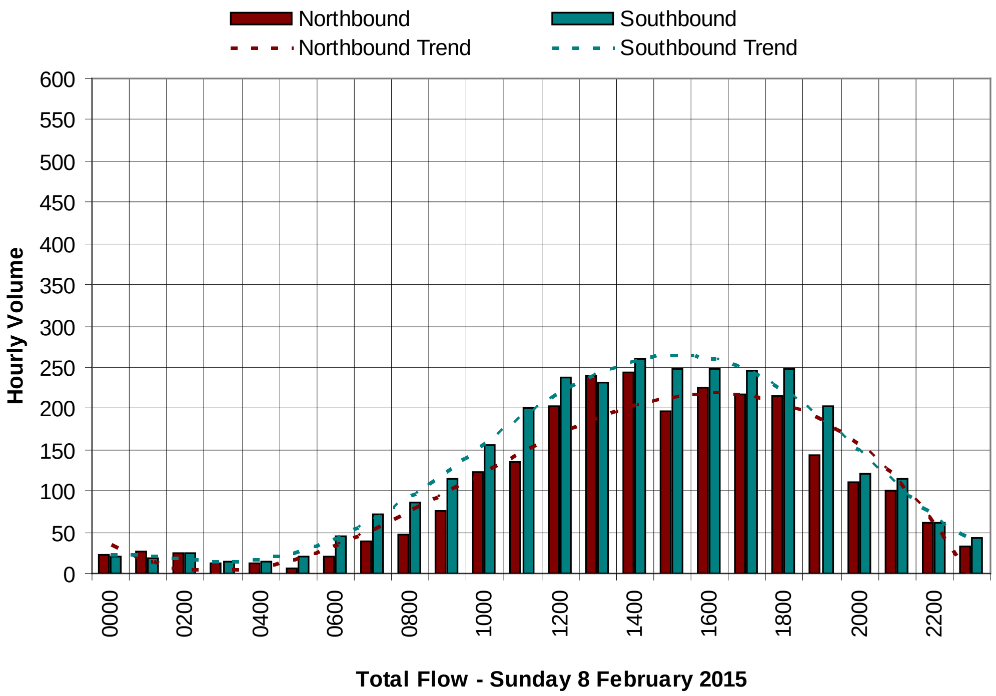


Figure 5 Hourly Traffic Flow - Sunday 8 February 2015

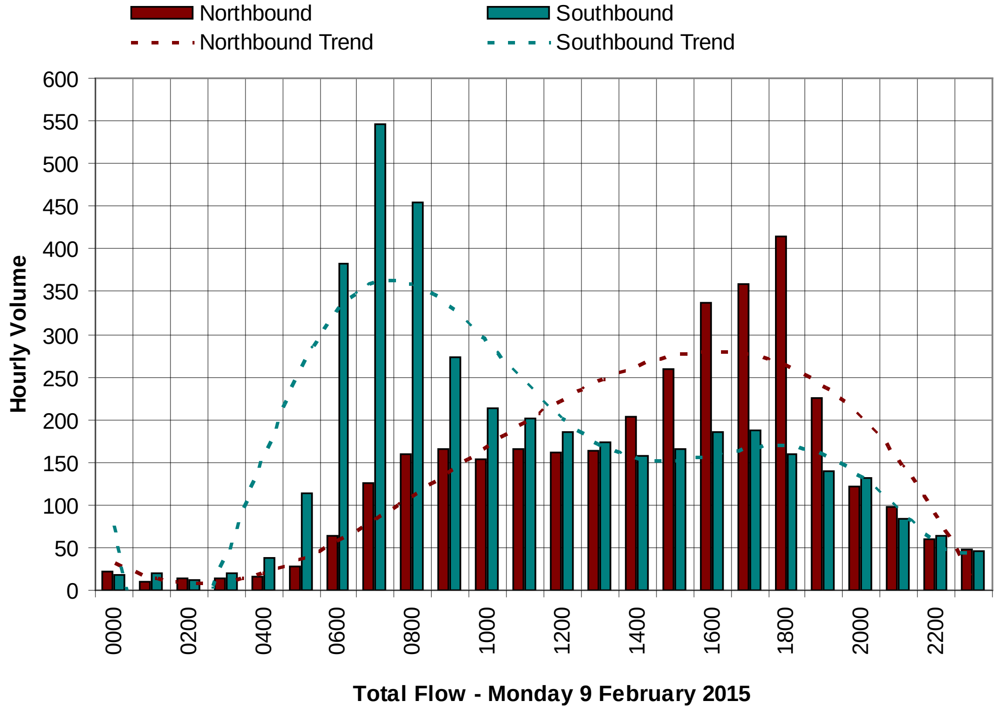


Figure 6 Hourly Traffic Flow - Monday 9 February 2015

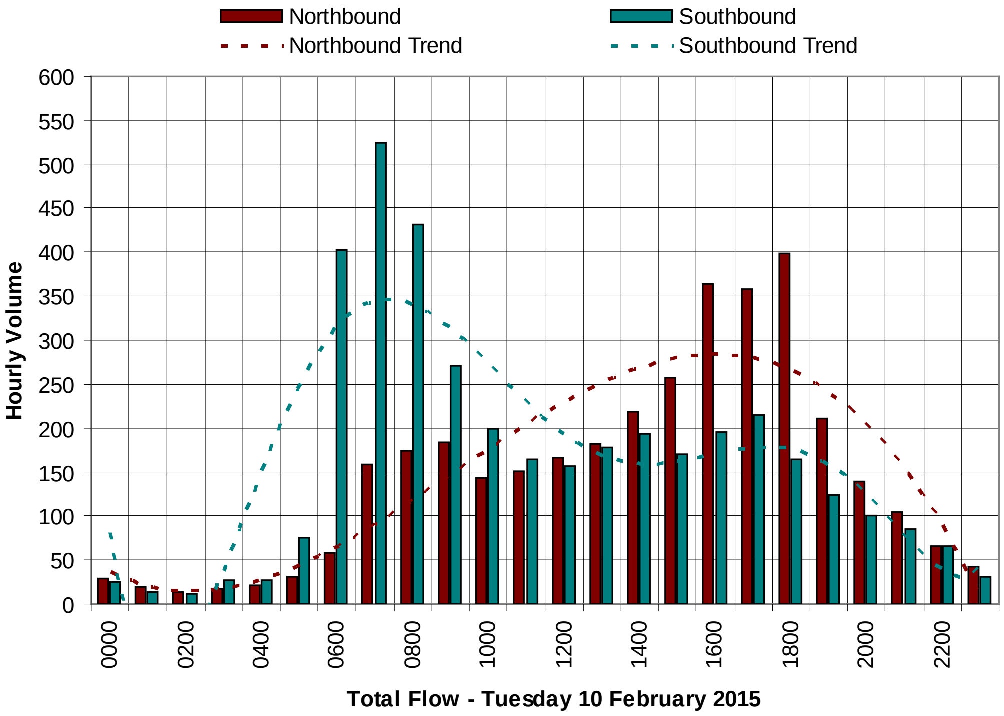


Figure 7 Hourly Traffic Flow - Tuesday 10 February 2015

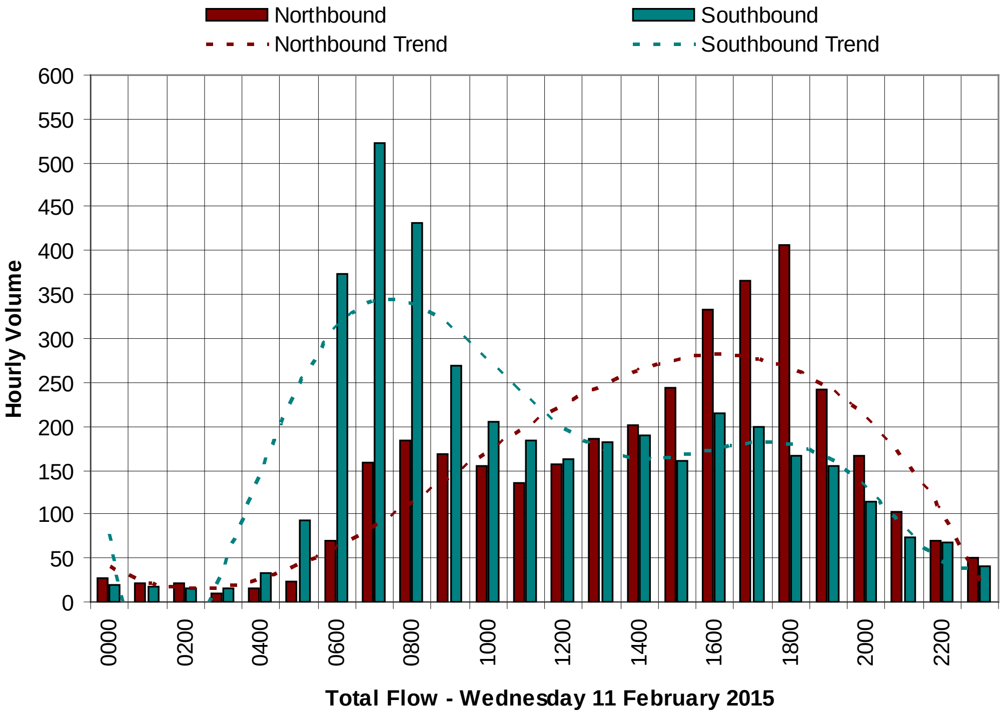


Figure 8 Hourly Traffic Flow - Wednesday 11 February 2015

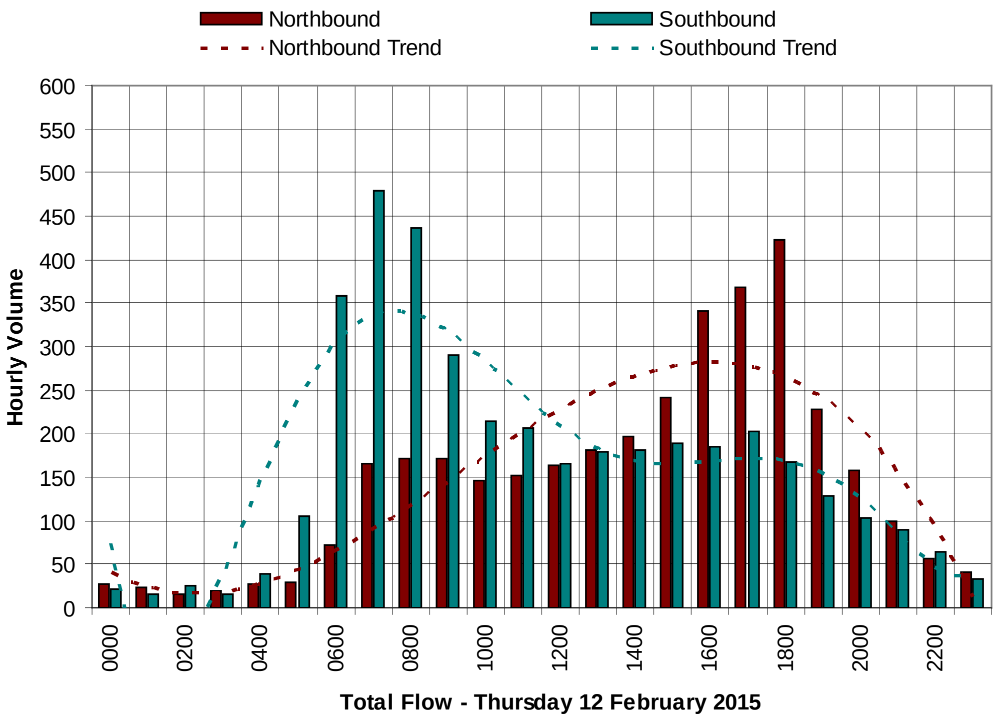


Figure 9 Hourly Traffic Flow - Thursday 12 February 2015

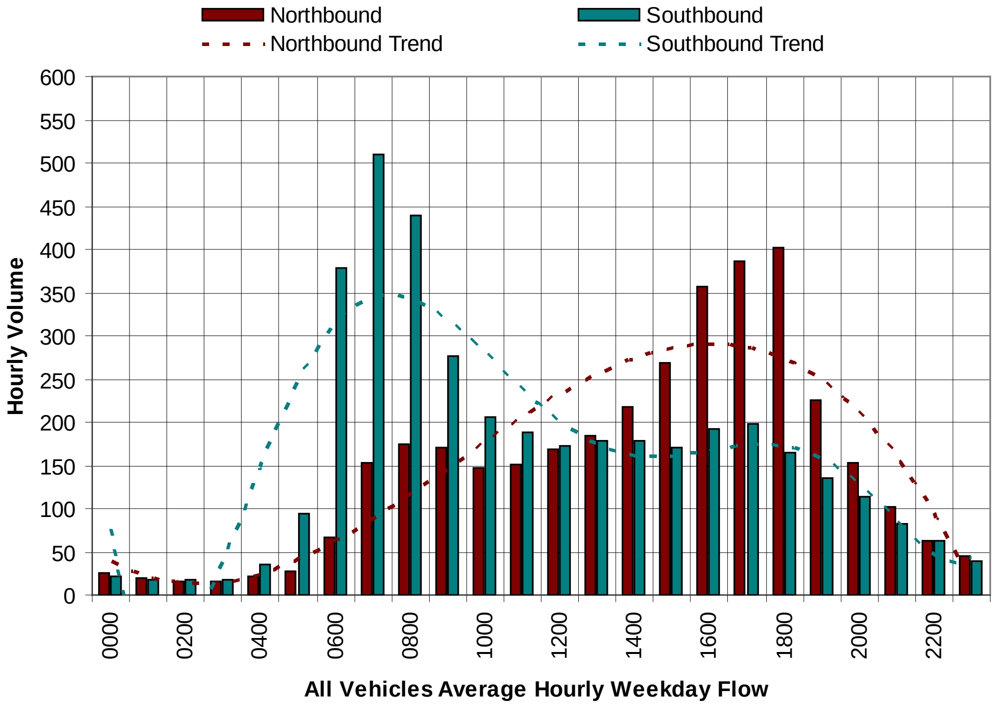


Figure 10 Average Weekday Hourly Traffic Flow 2015

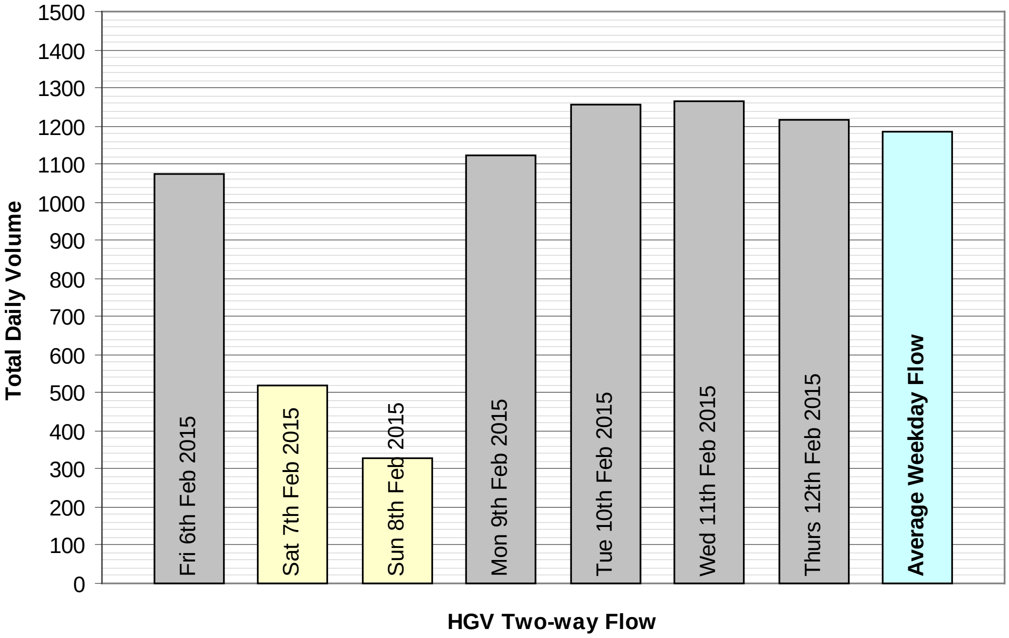


Figure 11 Total & Average Daily Two-way HGV Traffic Flows 2015

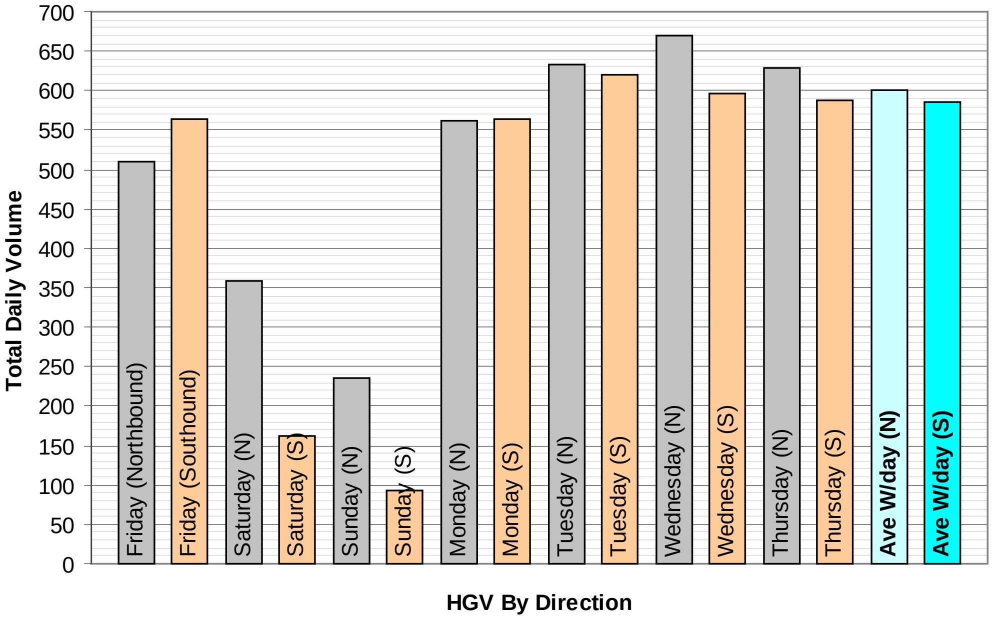


Figure 12 Total & Average Daily HGV Traffic Flows by Direction 2015

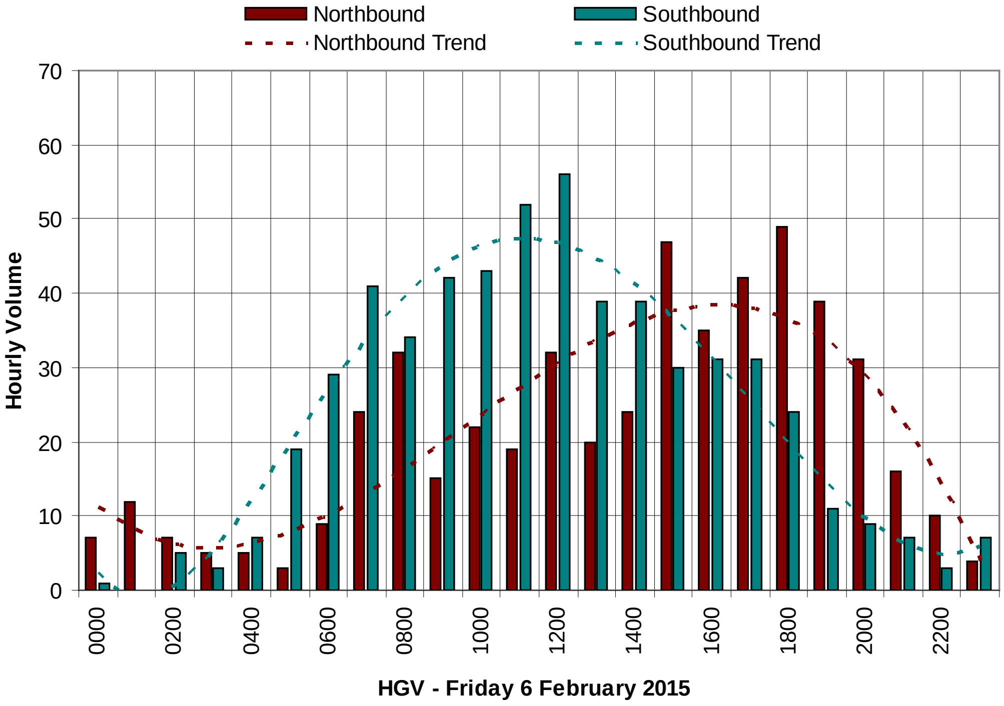


Figure 13 Hourly HGV Traffic Flow - Friday 6 February 2015

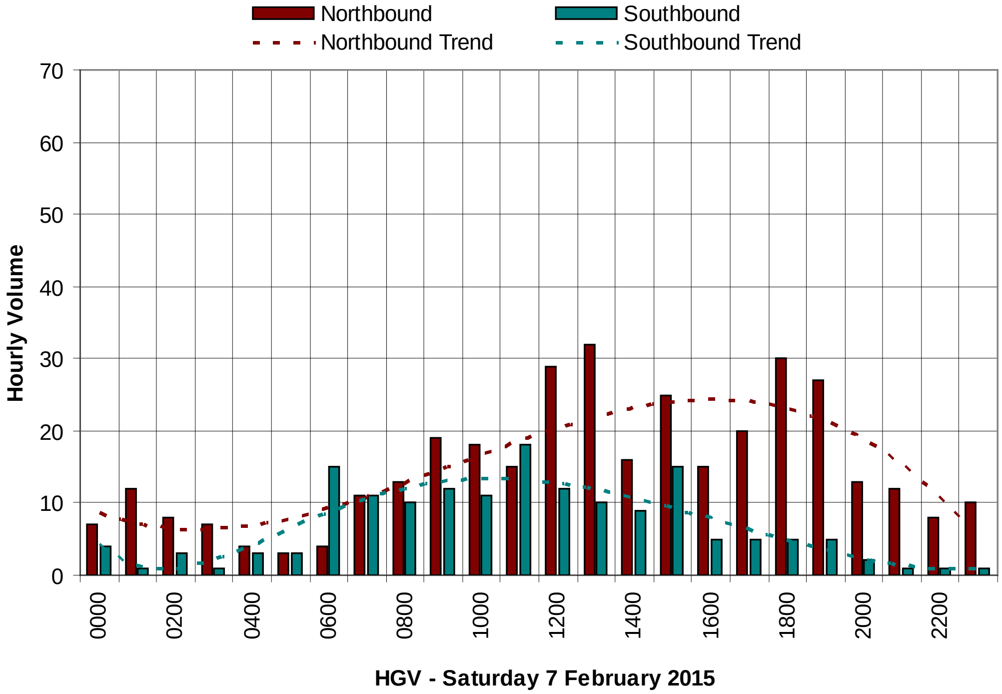


Figure 14 Hourly HGV Traffic Flow - Saturday 7 February 2015

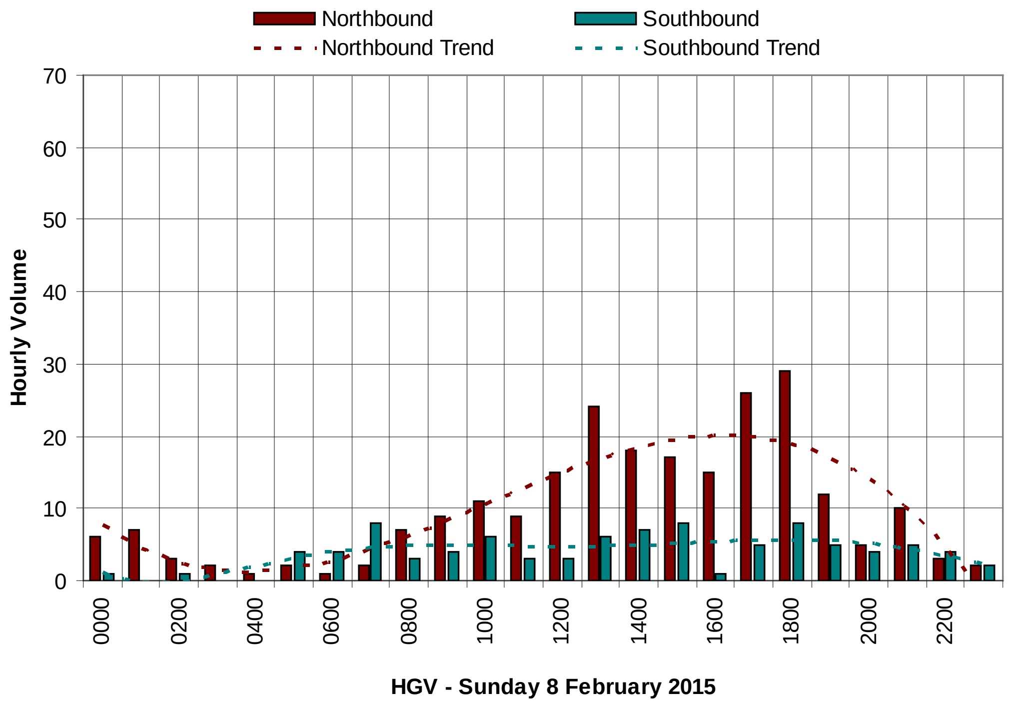


Figure 15 Hourly HGV Traffic Flow - Sunday 8 February 2015

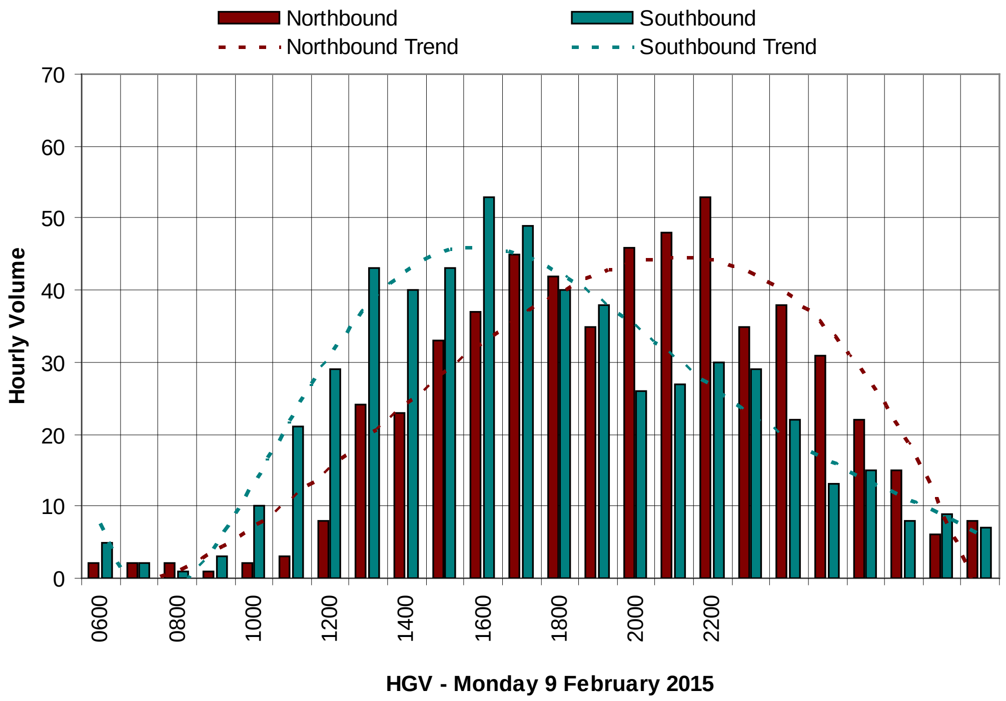


Figure 16 Hourly HGV Traffic Flow - Monday 9 February 2015

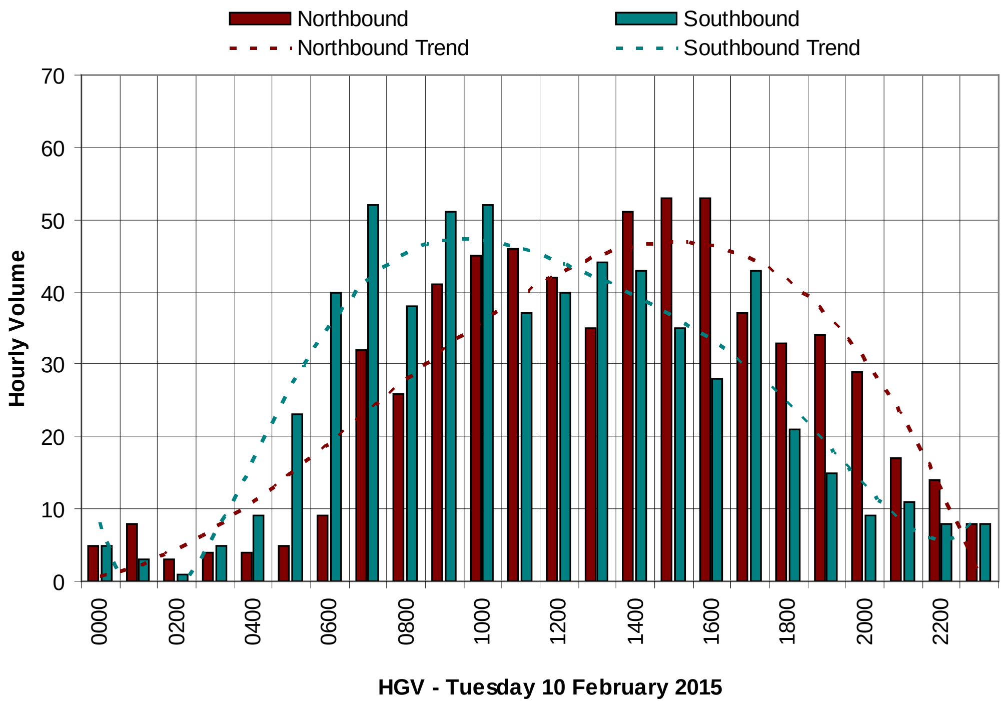


Figure 17 Hourly HGV Traffic Flow - Tuesday 10 February

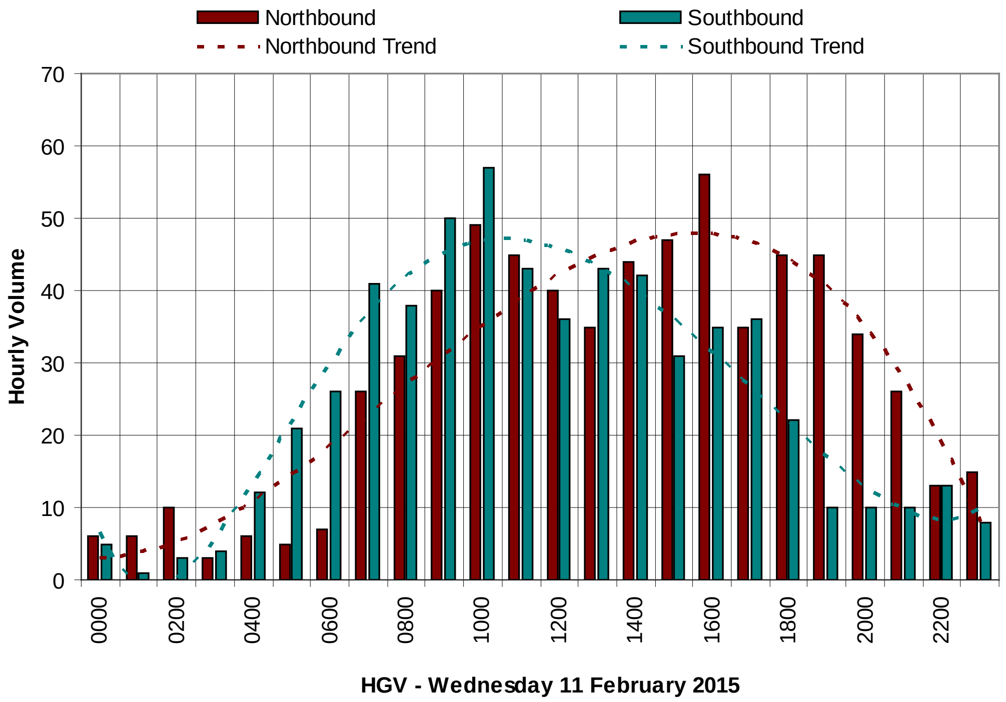


Figure 18 Hourly HGV Traffic Flow - Wednesday 11 February 2015

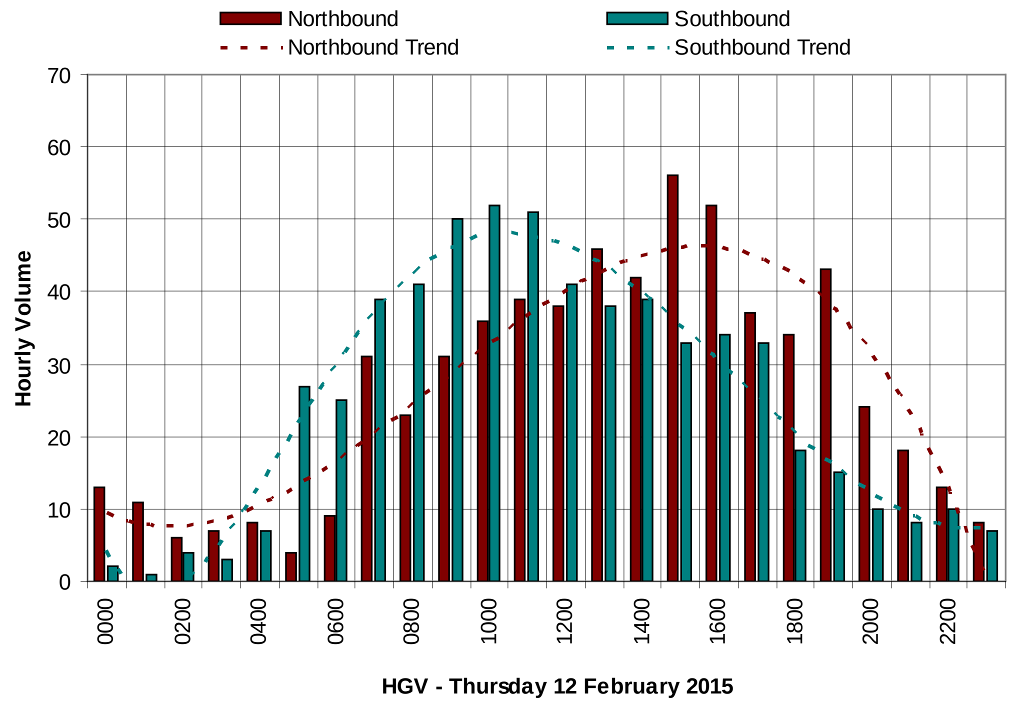


Figure 19 Hourly HGV Traffic Flow - Thursday 12 February 2015

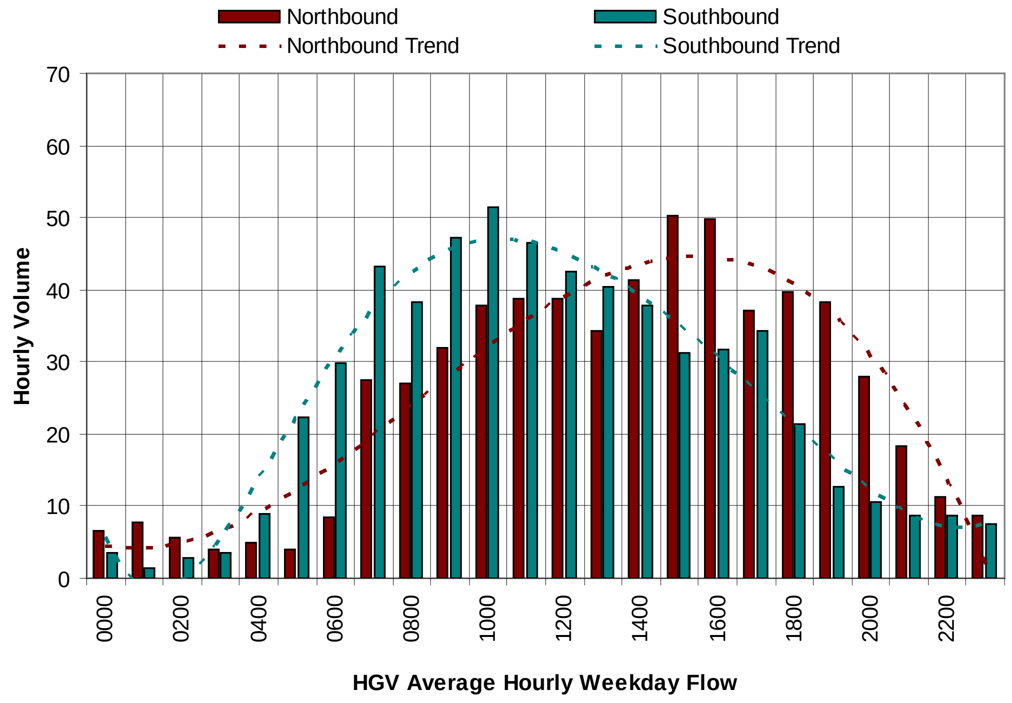


Figure 20 Average Weekday Hourly HGV Traffic Flow 2015

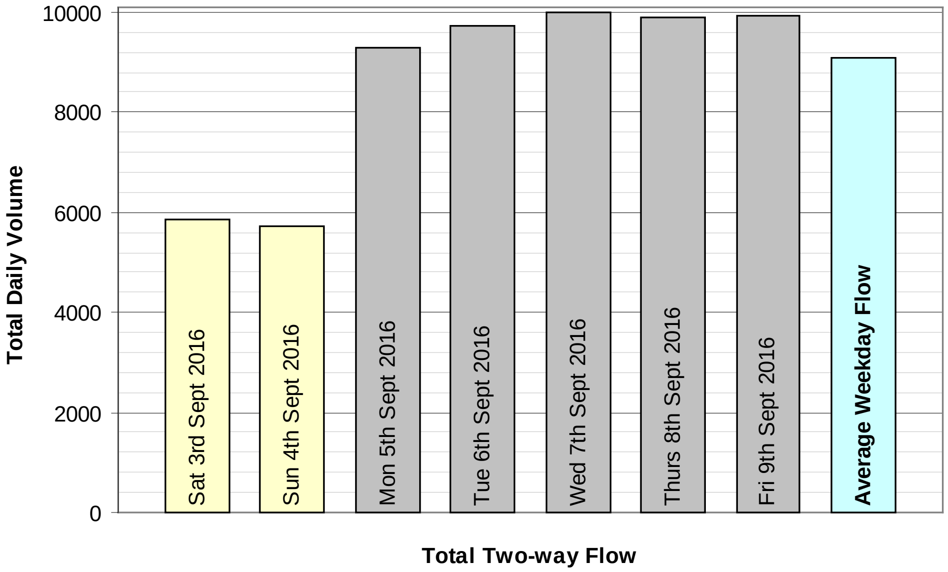


Figure 21 Total & Average Daily Two-way Traffic Flows 2016

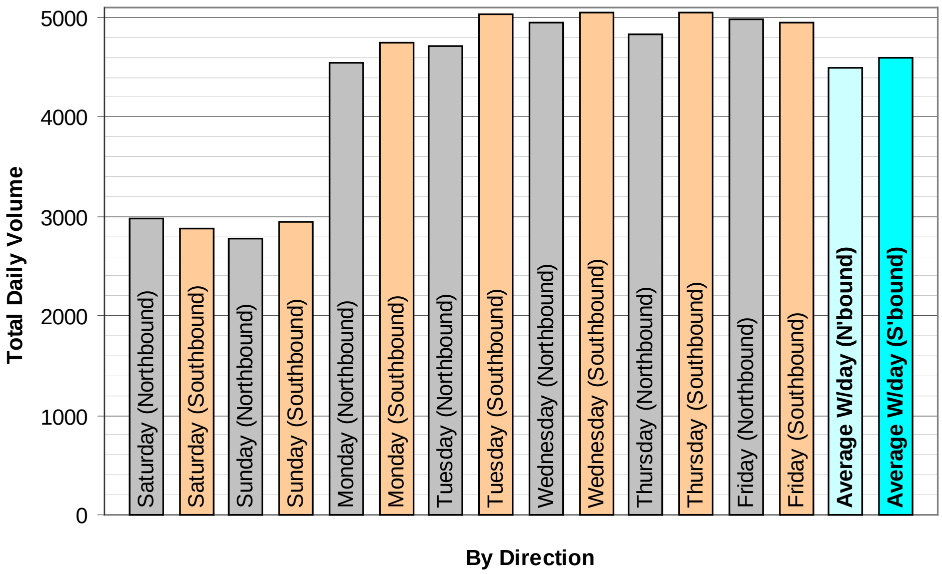


Figure 22 Total & Average Daily Traffic Flows by Direction 2016

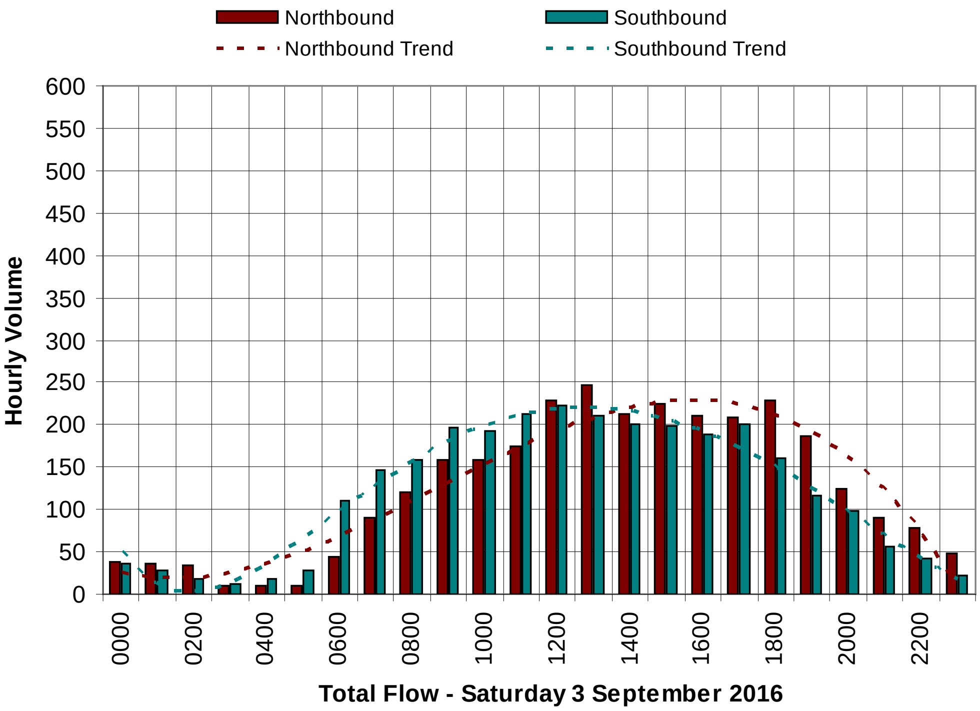


Figure 23 Hourly Traffic Flow – Saturday 3 September 2016

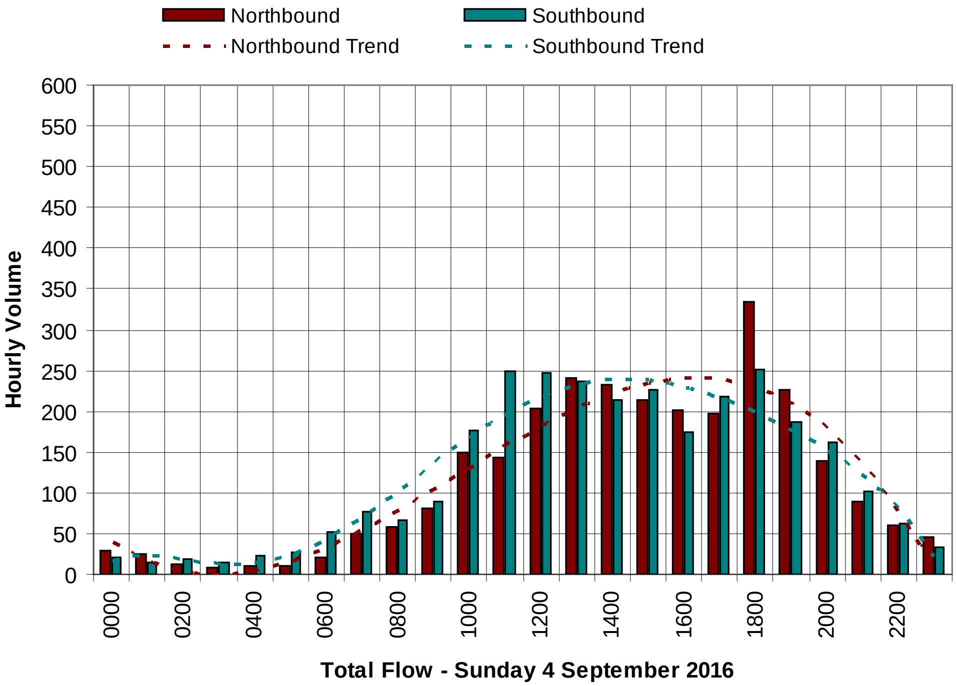


Figure 24 Hourly Traffic Flow – Sunday 4 September 2016

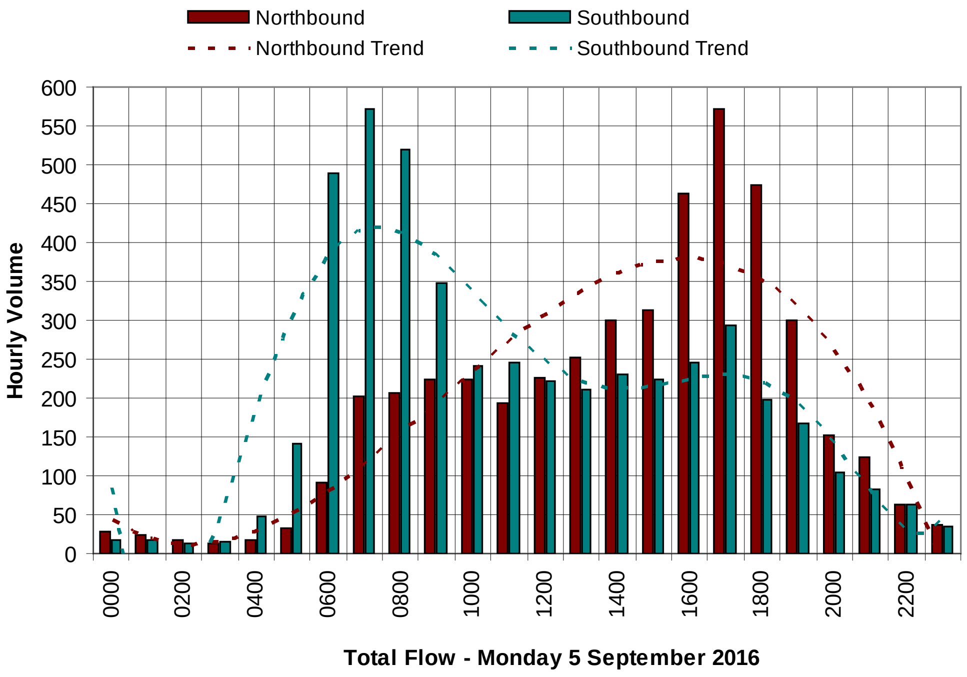


Figure 25 Hourly Traffic Flow - Monday 5 September 2016

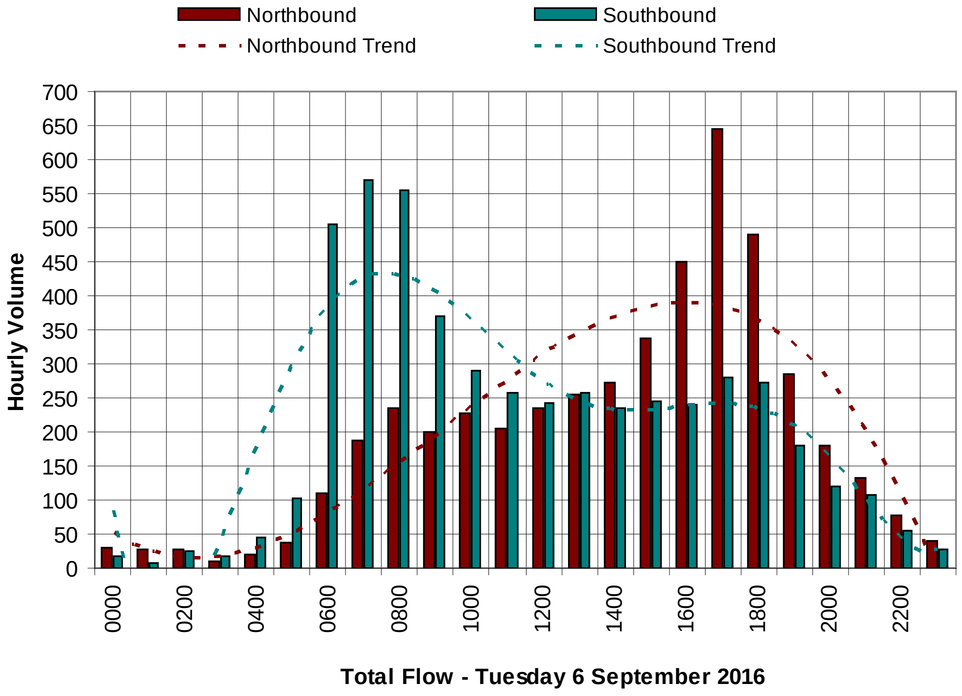


Figure 26 Hourly Traffic Flow - Tuesday 6 September 2016

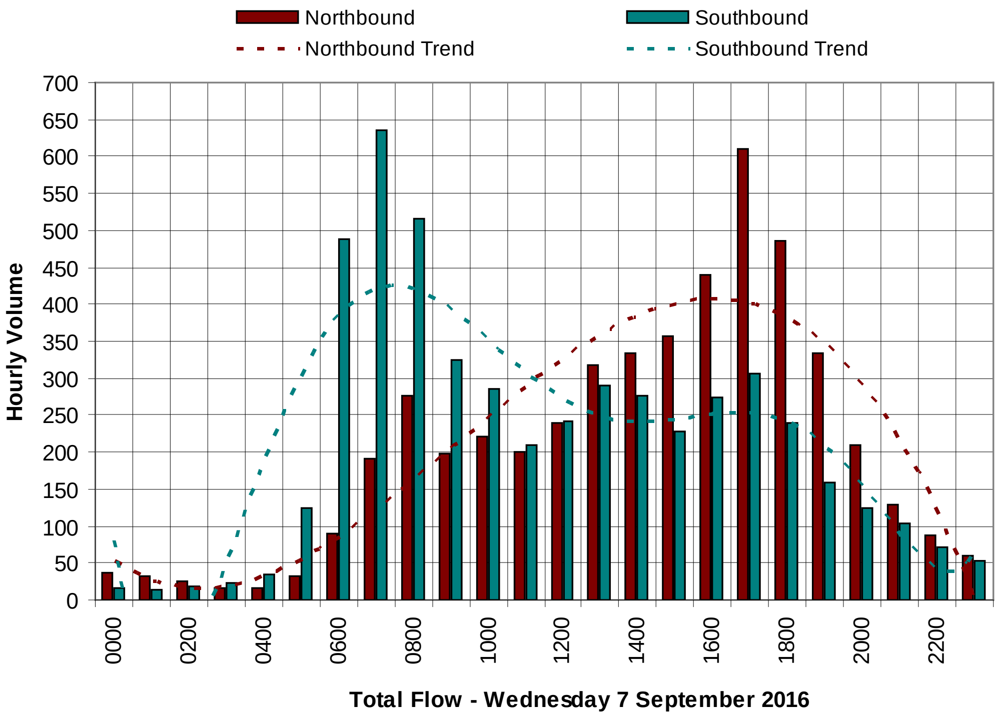


Figure 27 Hourly Traffic Flow - Wednesday 7 September 2016

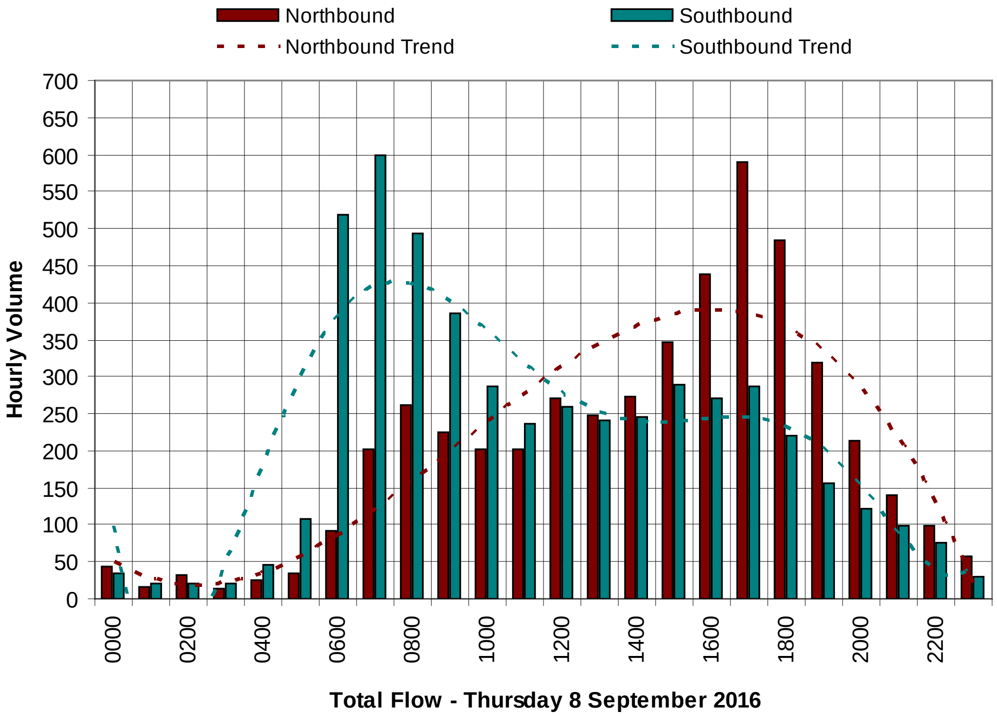


Figure 28 Hourly Traffic Flow - Thursday 8 September 2016

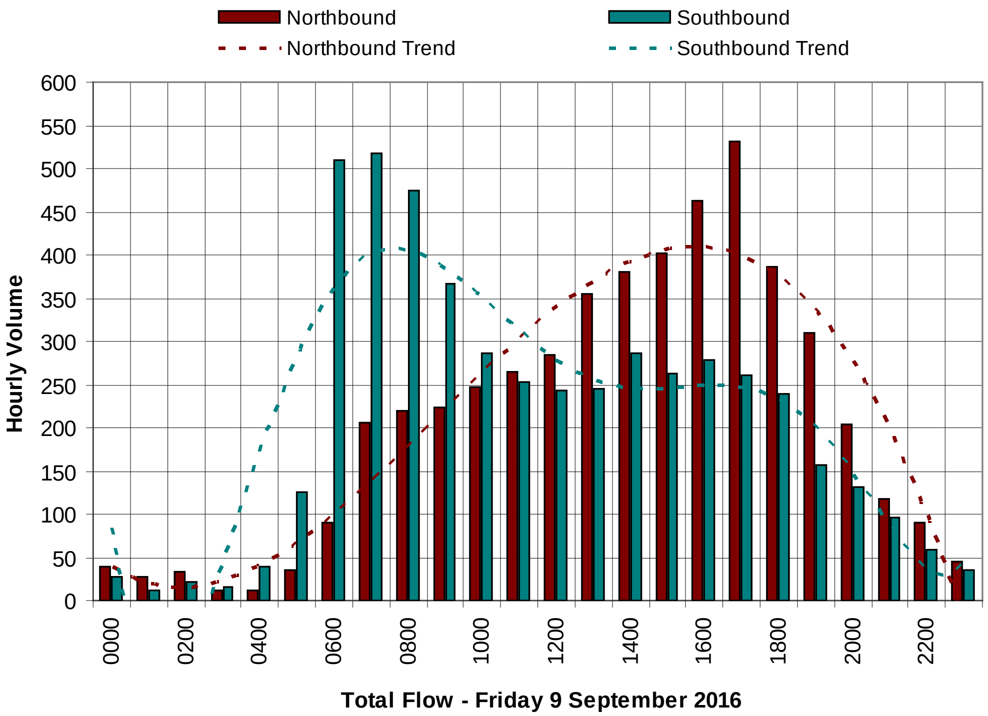


Figure 29 Hourly Traffic Flow - Friday 9 September 2016

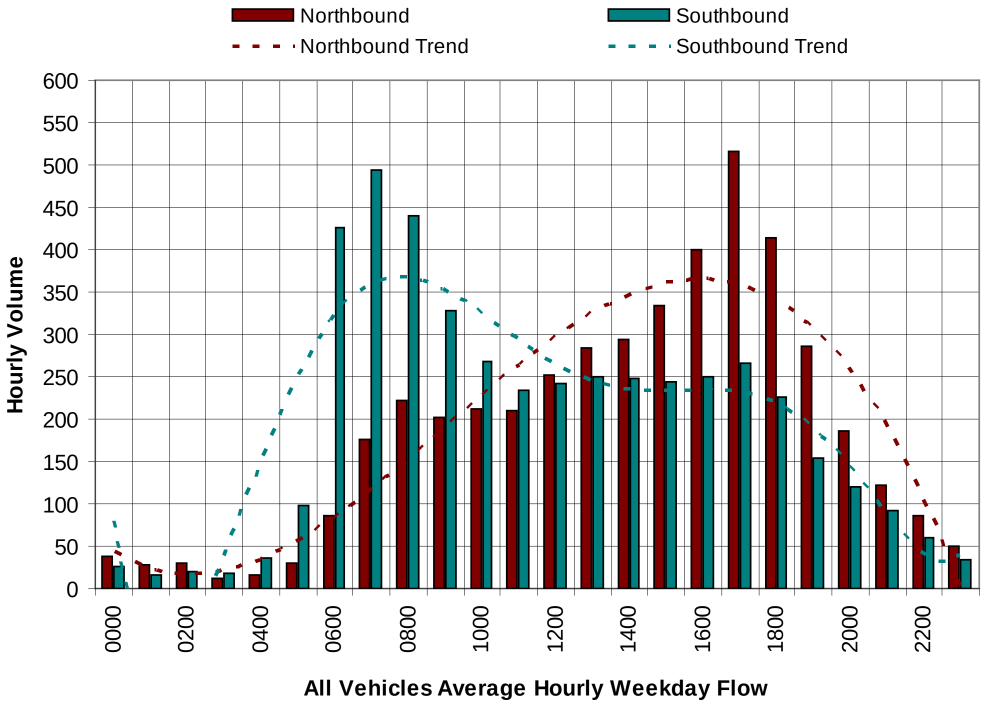


Figure 30 Average Weekday Hourly Traffic Flow 2016

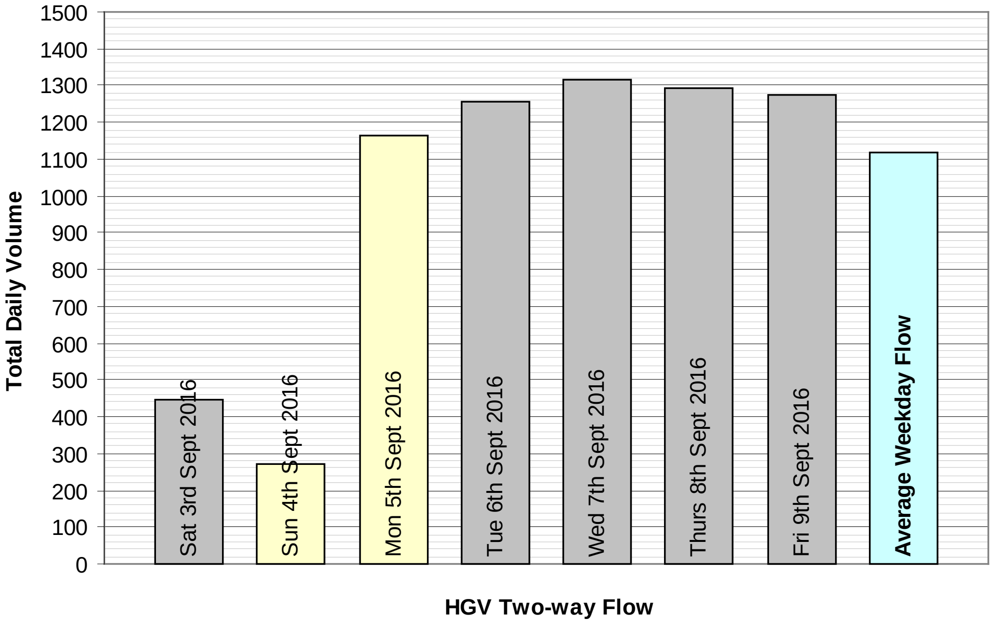


Figure 31 Total & Average Daily Two-way HGV Traffic Flows 2016

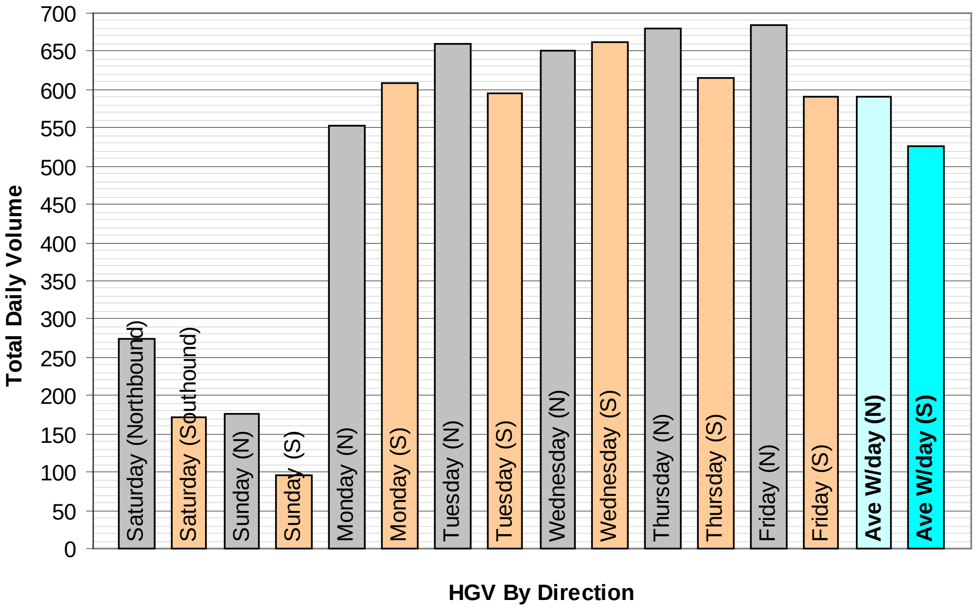


Figure 32 Total & Average Daily HGV Traffic Flows by Direction 2016

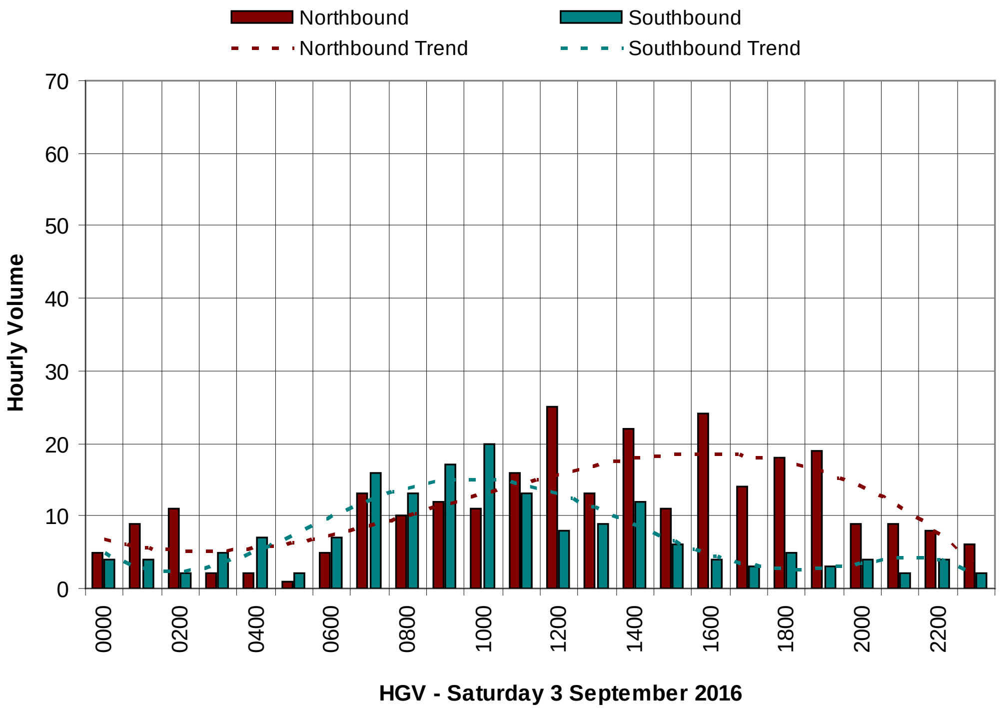


Figure 33 Hourly HGV Traffic Flow - Saturday 3 September 2016

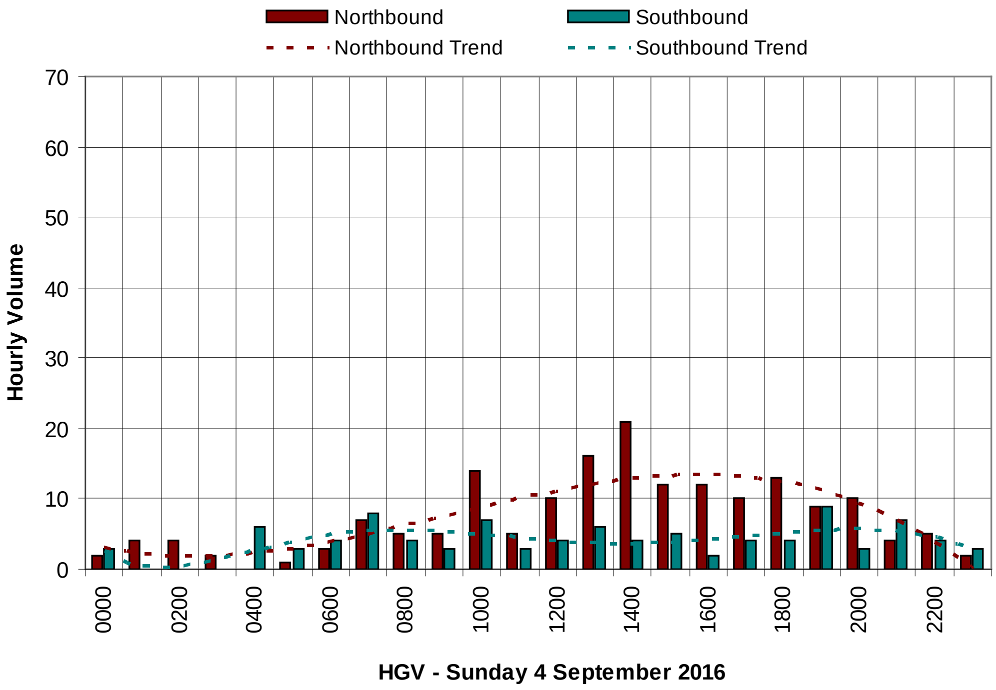


Figure 34 Hourly HGV Traffic Flow - Sunday 4 September 2016

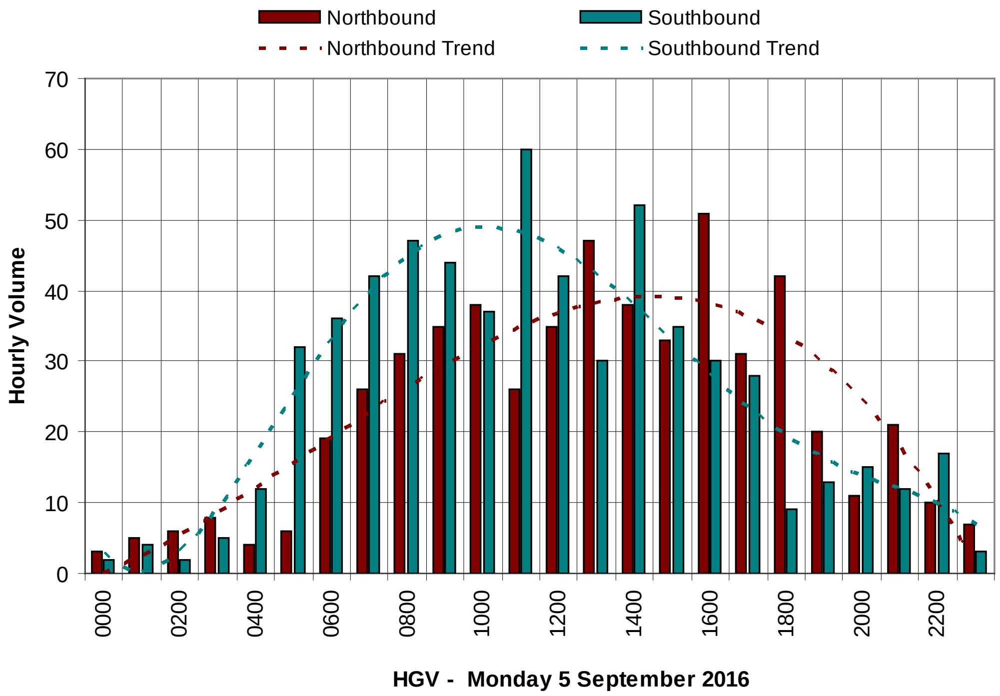


Figure 35 Hourly HGV Traffic Flow - Monday 5 September 2016

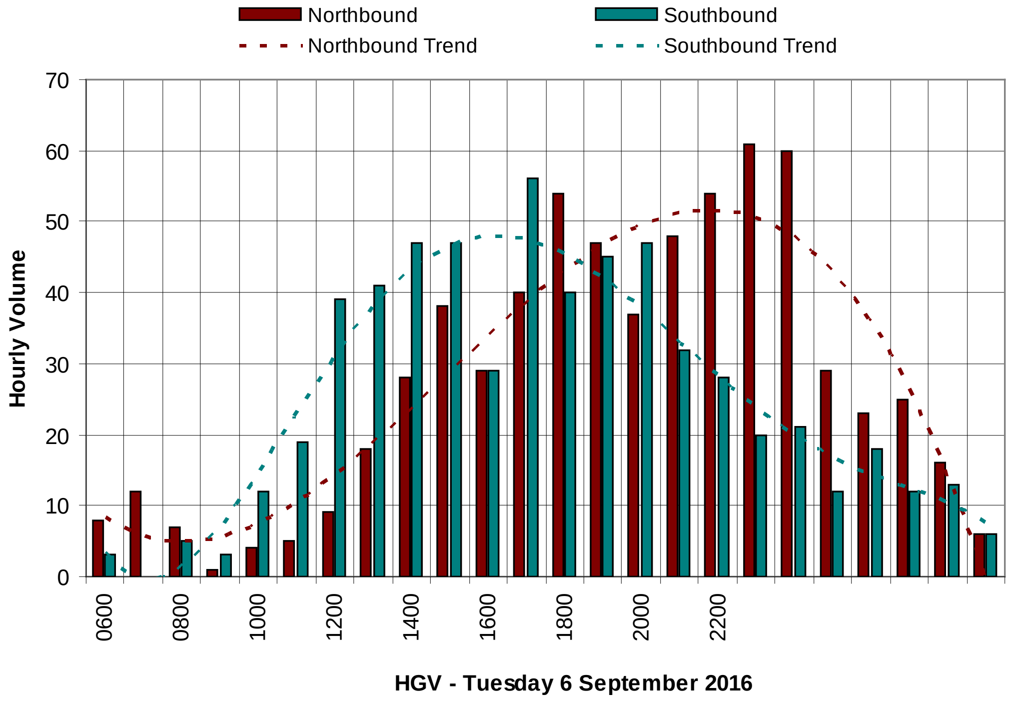


Figure 36 Hourly HGV Traffic Flow - Tuesday 6 September 2016

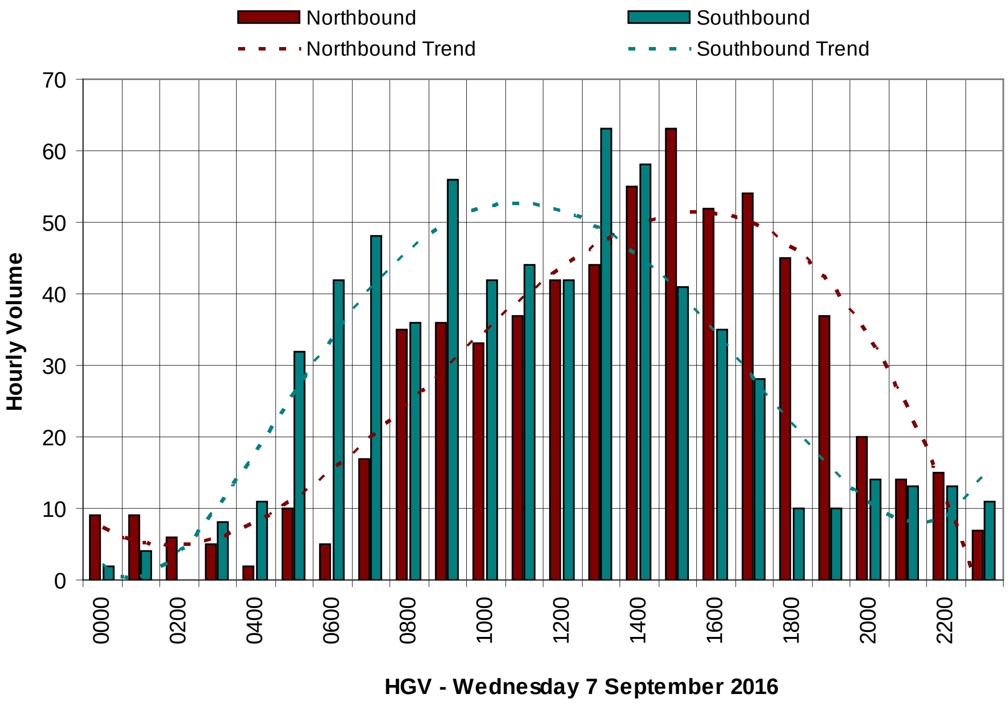


Figure 37 Hourly HGV Traffic Flow – Wednesday 7 September 2016

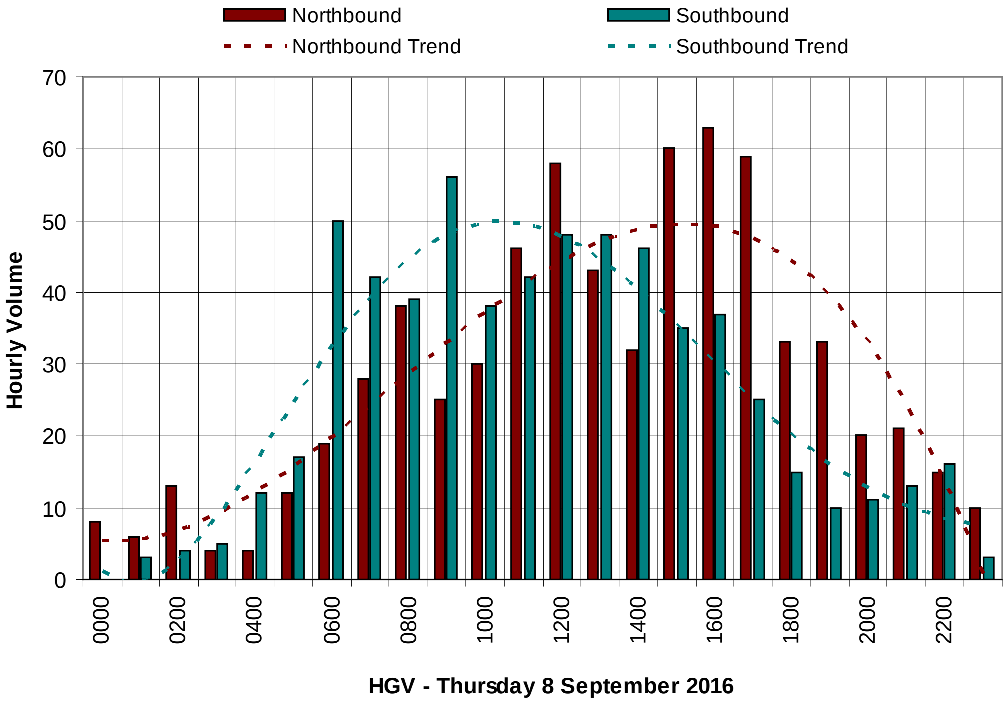


Figure 38 Hourly HGV Traffic Flow – Thursday 8 September 2016

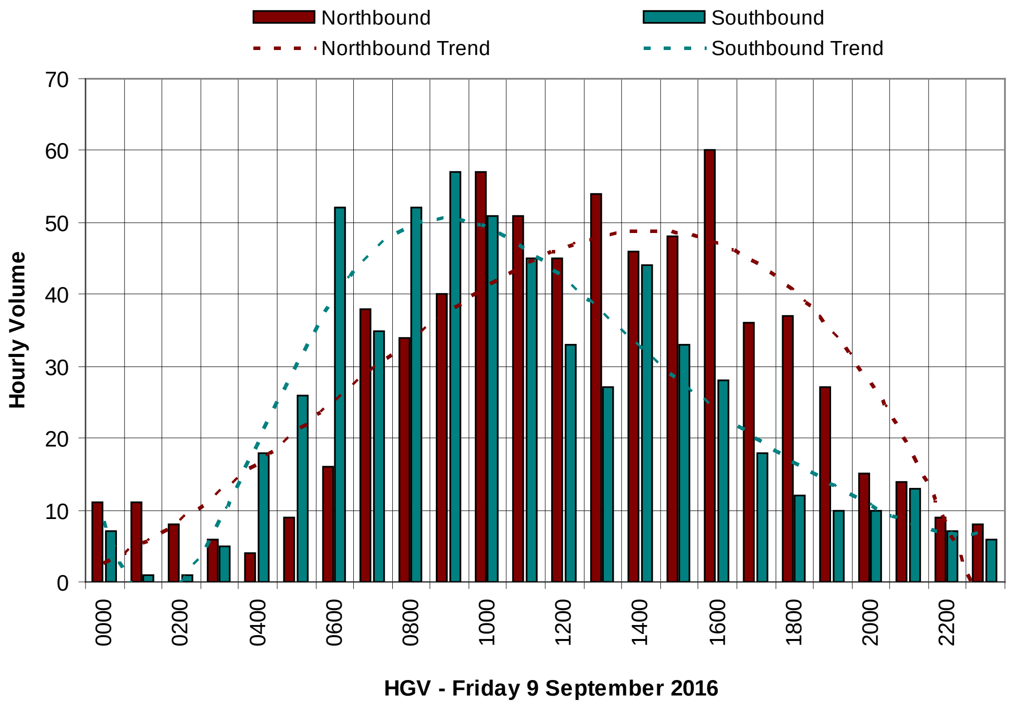


Figure 39 Hourly HGV Traffic Flow - Friday 9 September 2016

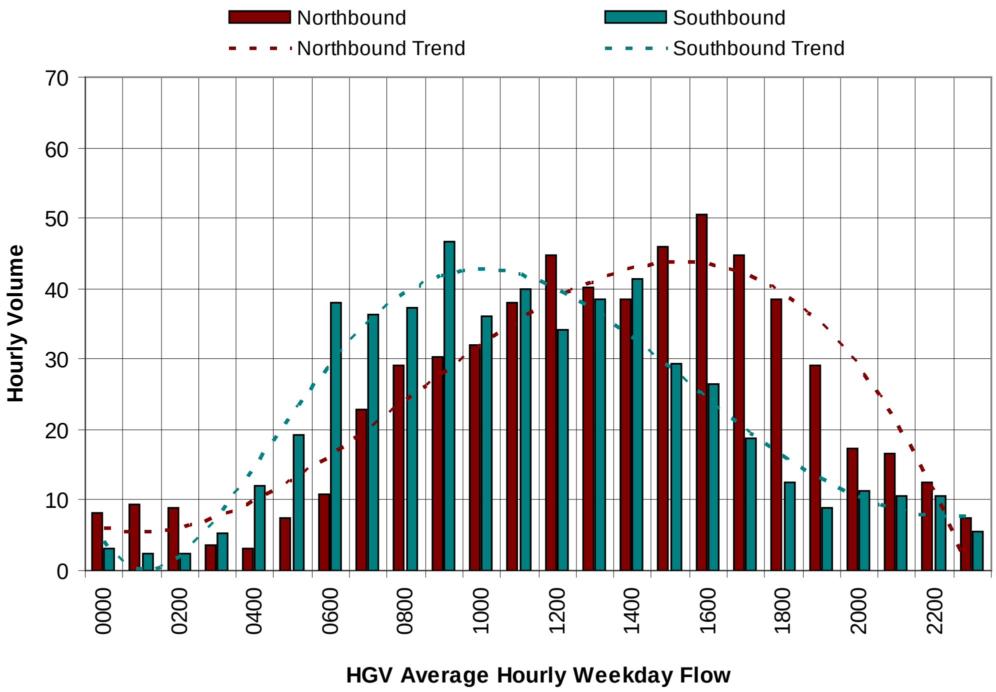


Figure 40 Average Weekday Hourly HGV Traffic Flow 2016

Appendix 8.3

Traffic Profiles

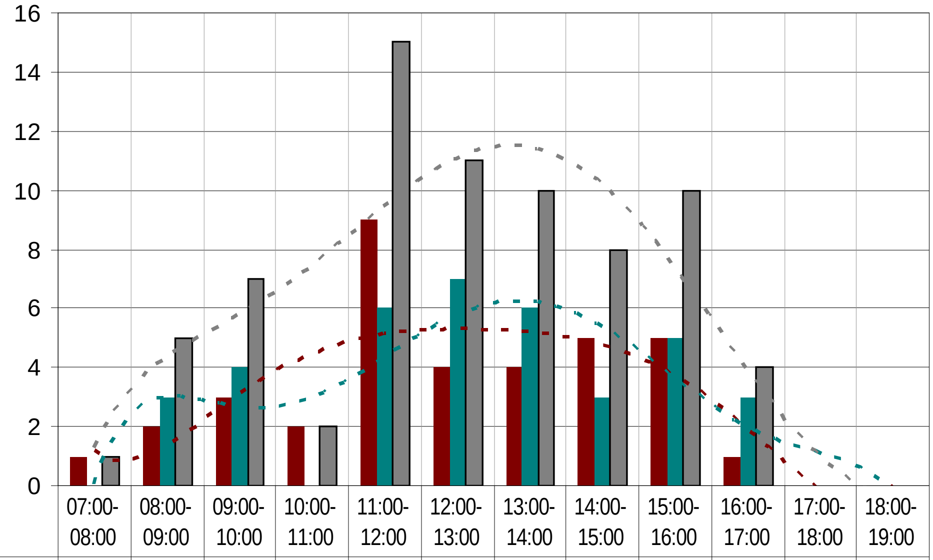
Appendix 8.3

Site Traffic Generation Daily Profile

HGV Traffic Flow & Light Vehicle Flow

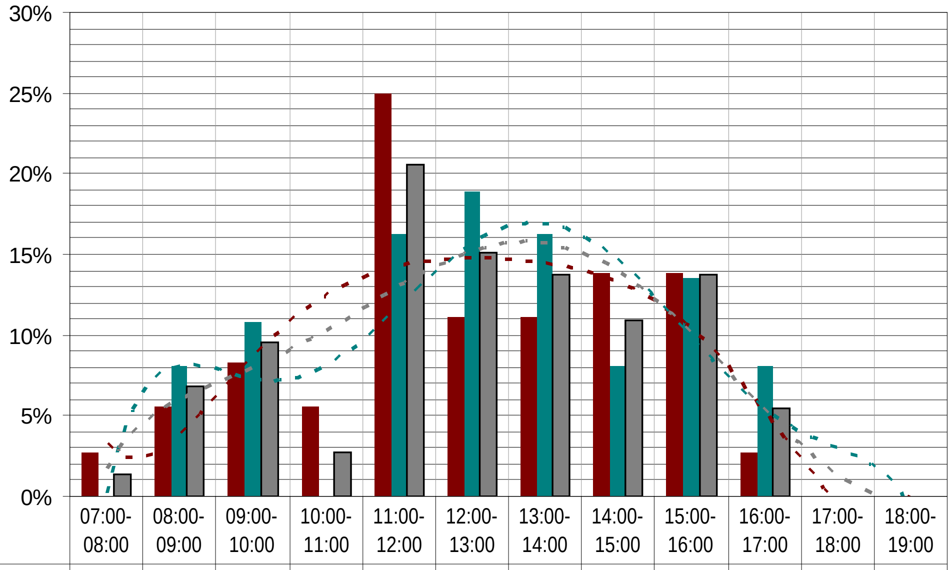
Appendix 8.3

Site Traffic Generation Data



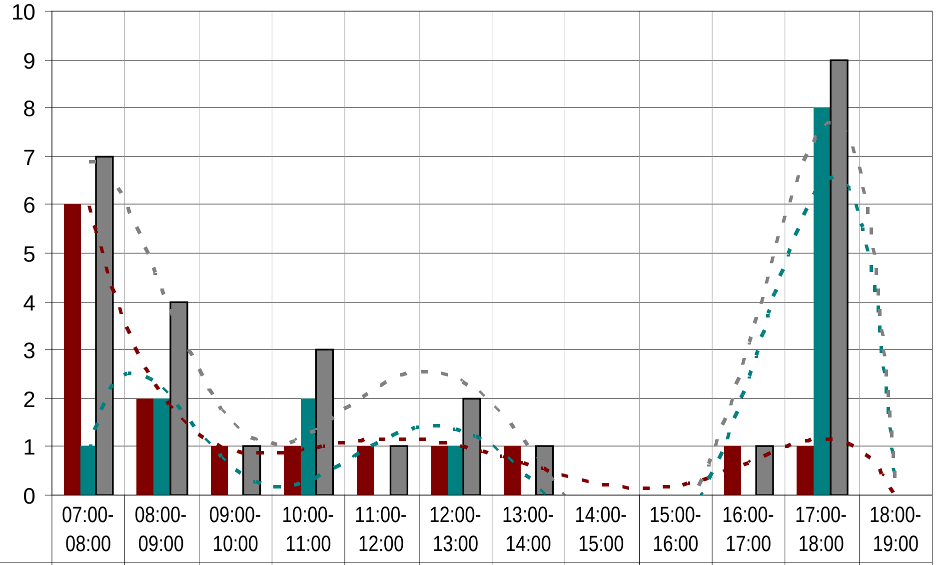
	07:00-08:00	08:00-09:00	09:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00
■ HGV Inbound	1	2	3	2	9	4	4	5	5	1	0	0
■ HGV Outbound	0	3	4	0	6	7	6	3	5	3	0	0
■ HGV Two-way	1	5	7	2	15	11	10	8	10	4	0	0

Figure 1 Daily HGV Inbound, Outbound and Total Flows



	07:00-08:00	08:00-09:00	09:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00
■ HGV Inbound	3%	6%	8%	6%	25%	11%	11%	14%	14%	3%	0%	0%
■ HGV Outbound	0%	8%	11%	0%	16%	19%	16%	8%	14%	8%	0%	0%
■ HGV Two-way	1%	7%	10%	3%	21%	15%	14%	11%	14%	5%	0%	0%

Figure 2 Daily HGV Inbound, Outbound and Total Flow Pattern



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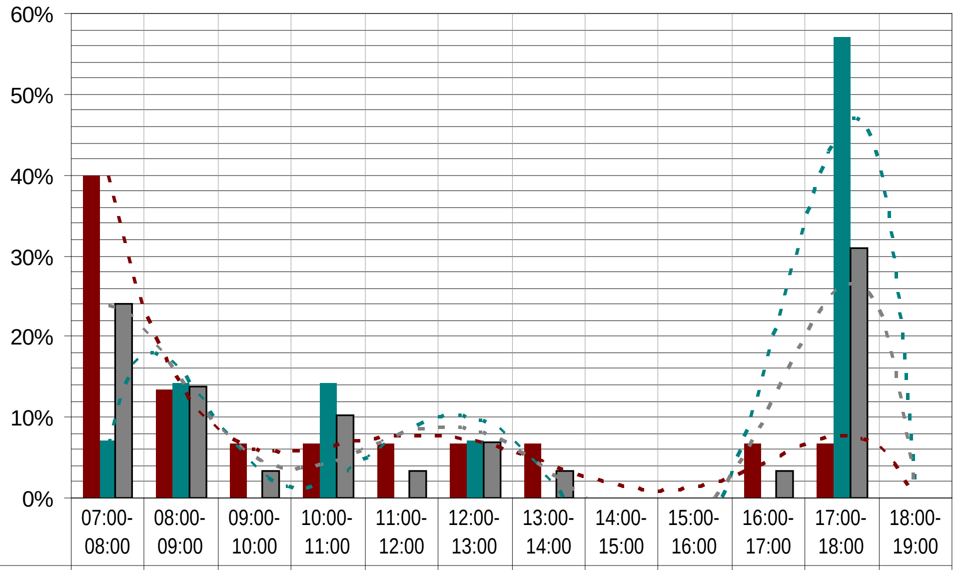
■ Light Veh In	6	2	1	1	1	1	1	0	0	1	1	0
■ Light Veh Out	1	2	0	2	0	1	0	0	0	0	8	0
■ Light Two-way	7	4	1	3	1	2	1	0	0	1	9	0

Figure 3 Daily Light Veh Inbound, Outbound and Total Flows



	07:00-08:00	08:00-09:00	09:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00
■ Light Veh In	40%	13%	7%	7%	7%	7%	7%	0%	0%	7%	7%	0%
■ Light Veh Out	7%	14%	0%	14%	0%	7%	0%	0%	0%	0%	57%	0%
■ Light Two-way	24%	14%	3%	10%	3%	7%	3%	0%	0%	3%	31%	0%

Figure 4 Daily Light Veh Inbound, Outbound and Total Flow Pattern

Appendix 8.4

Forecast Assessment Traffic Generation

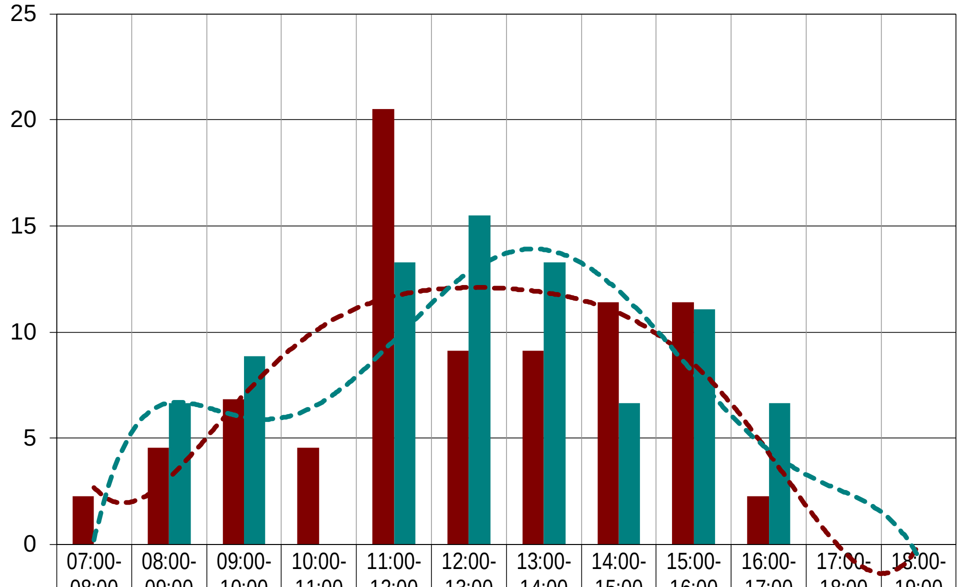
Appendix 10.4

Forecast Daily Traffic Generation

HGV Traffic Flow & Light Vehicle Flow

Appendix 8.4

Site Traffic Generation Data



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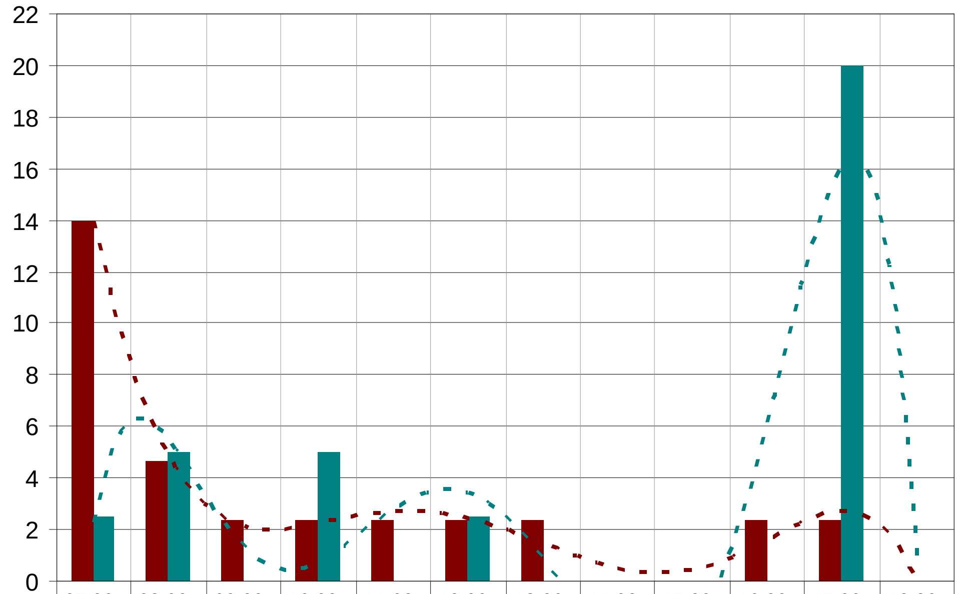
🟥 HGV Inbound	2	5	7	5	21	9	9	11	11	2	0	0
🟩 HGV Outbound	0	7	9	0	13	16	13	7	11	7	0	0

Figure 1 Forecast Daily HGV Inbound, Outbound Assessment Value



	07:00-08:00	08:00-09:00	09:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00
🟥 Future Light Veh In	14	5	2	2	2	2	2	0	0	2	2	0
🟩 Future Light Veh Out	3	5	0	5	0	3	0	0	0	0	20	0

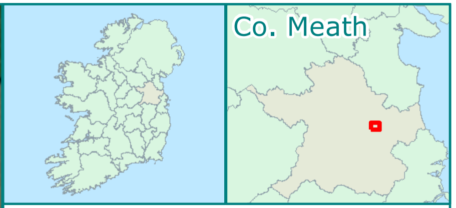
Figure 2 Forecast Daily Light Vehicle Movements Inbound & Outbound

Appendix 9.1

Receptor Locations

Map: R:\Map Production\2014\LW14\821\01\Workspace\MXD\EIS\LW14-821-01_Fig9-1_ReceptorLocations_A4.mxd

Mapping Reproduced Under Licence from the Ordnance Survey Ireland Licence No. EN 0001215 © Government of Ireland



Legend

▭ Site Boundary

● Planning Permission Foundations Laid

● Residential Dwelling

● Residential Dwelling (located within the landownership boundary)

● Unoccupied Derelict Dwelling (located within the landownership boundary)

Date 29/08/2018

Client Name

Knockharley Landfill Ltd.

Project Title

Proposed Development
at Knockharley Landfill

Figure Title

Receptor Locations

Figure No. 9.1 **Rev.** A

Scale 1:15,000 @ A4

FEHILY TIMONEY & COMPANY

CONSULTANTS IN
ENGINEERING &
ENVIRONMENTAL
SCIENCES

Core House, Pouladuff Road, Cork, T12 D773, Ireland
T: +353-21-4964133, F: +353-21-4464

Unit 16 J5 Plaza, North Park Business Park, Dublin 11, D11 PXTO, Ireland
T: +353-1-6583500, F: +353-1-6583501

W: www.fehilytimoney.ie E: info@ftco.ie

Receptor ID	Description	Easting	Northing
R1	Residential Dwelling	296087	267660
R2	Residential Dwelling	296121	267671
R3	Residential Dwelling	296205	267617
R4	Residential Dwelling	296166	267706
R5	Residential Dwelling	296241	267642
R6	Residential Dwelling	296537	267802
R7	Residential Dwelling	296835	267919
R8	Residential Dwelling	296912	267963
R9	Residential Dwelling	296964	267963
R10	Residential Dwelling	296962	267980
R11	Unoccupied Derelict Dwelling (located within the landownership boundary)	297005	267926
R12	Unoccupied Derelict Dwelling (located within the landownership boundary)	297030	267934
R13	Residential Dwelling	297073	267996
R14	Residential Dwelling	297033	268094
R15	Residential Dwelling	297172	268026
R16	Residential Dwelling	297200	268034
R17	Residential Dwelling	297229	268047
R18	Residential Dwelling	297422	268104
R19	Residential Dwelling	297530	268051
R20	Residential Dwelling	297561	268139
R21	Residential Dwelling	297575	268141
R22	Residential Dwelling	297594	268147
R23	Residential Dwelling	297624	268165
R24	Residential Dwelling	297641	268505
R25	Residential Dwelling	297718	268499
R26	Residential Dwelling	297813	268349
R27	Residential Dwelling	297742	268204
R28	Residential Dwelling	297761	268208
R29	Residential Dwelling	297779	268211
R30	Residential Dwelling	297800	268166
R31	Residential Dwelling	297844	268182
R32	Residential Dwelling	297874	268151
R33	Residential Dwelling	297866	268117

Receptor ID	Description	Easting	Northing
R34	Residential Dwelling	297868	268075
R35	Residential Dwelling	297824	268047
R36	Residential Dwelling	297877	268039
R37	Residential Dwelling	297938	268053
R38	Residential Dwelling	297825	268036
R39	Residential Dwelling	297835	267981
R40	Residential Dwelling	297894	267957
R41	Residential Dwelling	297837	267926
R42	Planning Permission Foundations Laid	297896	267926
R43	Residential Dwelling	297902	267627
R44	Unoccupied Derelict Dwelling (located within the landownership boundary)	297836	267585
R45	Residential Dwelling (located within the landownership boundary)	297893	267369
R46	Residential Dwelling (located within the landownership boundary)	297940	267282
R47	Residential Dwelling (located within the landownership boundary)	297949	267243
R48	Residential Dwelling	297951	267220
R49	Residential Dwelling (located within the landownership boundary)	297959	267185
R50	Residential Dwelling	297881	268010
R51	Residential Dwelling	298014	266955
R52	Residential Dwelling	298057	266826
R53	Residential Dwelling	298050	266796
R54	Residential Dwelling	298172	266540
R55	Residential Dwelling	298122	266488
R56	Residential Dwelling	297978	266147
R57	Residential Dwelling	297923	266067
R58	Residential Dwelling	297916	266057
R59	Residential Dwelling	298199	268267
R60	Residential Dwelling	298196	268170
R61	Residential Dwelling	298120	267879
R62	Residential Dwelling	298176	267882
R63	Residential Dwelling	298159	267844
R64	Residential Dwelling	298166	267833
R65	Residential Dwelling	298236	267847

Receptor ID	Description	Easting	Northing
R66	Residential Dwelling	298275	267777
R67	Residential Dwelling	298252	267724
R68	Residential Dwelling	298292	267710
R69	Residential Dwelling	298349	267632
R70	Residential Dwelling	298383	267587
R71	Residential Dwelling	298743	267222
R72	Residential Dwelling	298762	267176

Appendix 10.1

Ecological Evaluation of Sites

Appendix 10.1 Ecological Evaluation of Sites (NRA, 2009)

Resource Evaluation	Defining Criteria
International Importance	'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA), candidate Special Area of Conservation (cSAC) or proposed Special Protection Area (pSPA). Sites that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended). Features essential to maintaining the coherence of the Natura 2000 Network. Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972). Biosphere Reserve (UNESCO Man & The Biosphere Programme). Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). Biogenetic Reserve under the Council of Europe. European Diploma Site under the Council of Europe. Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).
National Importance	Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park. Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park.

Resource Evaluation	Defining Criteria
	Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive.
County Importance	Area of Special Amenity. Area subject to a Tree Preservation Order. Area of High Amenity, or equivalent, designated under the County Development Plan. Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, if this has been prepared. Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
Local Importance (Higher Value)	Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Sites containing semi natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (Lower Value)	Sites containing small areas of semi natural habitat that are of some local importance for wildlife; Sites or features containing non-native species that are of some importance in maintaining habitat links.

Appendix 10.2

Avian Transect Locations and Habitats of Occurrence

Appendix 10.2: Avian Transect Locations and Habitats of Occurrence

Transect No.	Location	Habitat (dominant habitat first)
1	Along eastern entrance	GA1/GS4, WS2
2	South eastern site	GA1/GS4, WL1, WS2
3	Western site	WS2, GS4
4	North western site	GA1/GS4, WL1
5	North eastern site	GA1/GS4, WL2, WL1, WS2

Appendix 10.3

Glossary of Effects/Impacts

Appendix 10.3 Glossary of Effects (EPA, 2017)

Quality of Impacts

Positive Effects
A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).

Neutral Effects
No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.

Negative/adverse Effects
A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).

Significance of Effects

Imperceptible
An effect capable of measurement but without noticeable consequences.

Not significant
An effect which causes noticeable changes in the character of the environment but without significant consequences.

Slight Effects
An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.

Moderate Effects
An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.

Significant Effects
An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.

Very Significant
An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.

Profound Effects
An effect which obliterates sensitive characteristics.

The Probability of Effects

Likely Effects
The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.

Unlikely Effects
The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.

Duration of Effects

Momentary Effects
Effects lasting from seconds to minutes.

Brief Effects
Effects lasting less than a day.

Temporary Effects
Effects lasting less than a year.

Short-term Effects
Effects lasting one to seven years.

Medium-term Effects
Effects lasting seven to fifteen years.

Long-term Effects
Effects lasting fifteen to sixty years.

Permanent Effects
Effects lasting over sixty years.

Reversible Effects
Effects that can be undone, for example through remediation or restoration.

Types of Effects

Indirect Effects (a.k.a. Secondary Effects)
Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.

Cumulative Effects
The addition of many minor or significant effects, including effects or other projects, to create larger, more significant effects.

'Do Nothing Effects'
The environment as it would be in the future should the subject project not be carried out.

'Worst case' Effects
The effects arising from a project in the case where mitigation measures substantially fail.

Indeterminable Effects
When the full consequences of a change in the environment cannot be described.

Irreversible Effects
When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.

Residual Effects
The degree of environmental change that will occur after the proposed mitigation measures have taken effect.

Synergistic Effects
Where the resultant effect is of greater significance than the sum of its constituents.

Appendix 10.4

Crayfish Leaflet 3

PROTECT IRISH CRAYFISH

HERE IS WHAT YOU CAN DO:

Do not take foreign crayfish into Ireland, or purchase or release foreign species of crayfish in Ireland for any reason.

If you are involved in angling, be on the lookout for anyone who might use imported crayfish as bait.

Always dry fishing gear fully between use on different water bodies. If you can't dry it, disinfect it with a dilute bleach solution.

If you own a pet shop, do not buy in or sell crayfish.

If you suspect foreign crayfish are in a lake or river, contact the National Parks and Wildlife Service immediately – see the State Services page in the phone book or email natureconservation@environ.ie

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government

WHITE CLAWED

White clawed crayfish showing pale underside of claw


Stephanie Peay

GOOD

White clawed crayfish has no white flash between finger and claw

SIGNAL

Signal crayfish showing red underside of claw. Claw is paler on female.


Stephanie Peay

BAD

Signal crayfish has conspicuous white flash at the joint of the finger and claw

Irish crayfish are at high risk that someone may accidentally or even deliberately introduce a different species, which carry a lethal disease, into Ireland or bring in crayfish plague on boats, damp fishing gear or equipment.

Signal Crayfish
Chris Lukhaup

Crayfish plague

The fungus-like *Aphanomyces astaci* that causes the lethal crayfish plague is related to potato blight and grape disease, which also crossed the Atlantic to Europe. Each American crayfish species carries a different strain of the plague. The 'Pacifastacus' strain appears completely lethal and eradicates all native crayfish. It is not even necessary for the American crayfish to be present – the plague fungus produces spores which can be transferred on wet nets and boots, on boats, and even on fish for restocking. Crayfish and trout should therefore never be farmed together.

Contacts

National Parks & Wildlife Service (NPWS)
Department of the Environment, Heritage & Local Government
7 Ely Place
Dublin 2
Tel: 1800 405 000

natureconservation@environ.ie
www.npws.ie

Useful websites:
www.npws.ie
www.noticenature.ie

Text: J.D. Reynolds and C. O'Keeffe
Design: www.slickfish.ie

Crayfish in Ireland and Europe

Freshwater crayfish look like small brownish lobsters. There are about 650 different crayfish species worldwide, but only six species in Europe and only one species in Ireland.

The six European crayfish species are or were widely caught for food, but all are now threatened, chiefly by a fatal disease, the 'crayfish plague' carried by crayfish introduced from North America. There are now ten species of American crayfish across Europe. Many of these alien crayfish now live wild in the UK.

However, Ireland is in the fortunate situation of being the last European country having no alien crayfish and we have one widespread native species, the White-clawed Crayfish, Austropotamobius pallipes. It can be found in Ireland, Britain, France, Spain, Italy and Croatia.

Crayfish are a valuable food item for many freshwater species. Otters, herons, trout and pike all feed on crayfish where they are available.

We have good stocks of native crayfish in Ireland, but the future is under a cloud because of the risk of release of alien species into Ireland.

Signal Crayfish
Chris Lukhaup

Crayfish plague in Ireland

Ireland was hit by crayfish plague in 1987, and lost almost all the crayfish from the Boyne and much of the Shannon. Crayfish are now again seen in small numbers in parts of the Boyne system. Two crayfish lakes, White Lake and Lough Lene, were restocked but the latter lost its stocks again a decade or so later. The strain of plague is unknown, but there is reason to believe that the plague outbreak came as a result of visiting anglers from France or the UK, bringing wet gear which harboured plague spores. There have been crayfish mortalities since 1987, but no verified plague outbreak.

Ireland is fortunate to have no alien crayfish, and it is top priority to keep it this way. However, crayfish are easily transported and can survive long periods out of water.

It is illegal to release crayfish into the wild.

There are several sources of alien crayfish, all of them illegal, but none easily policed. Despite legislative controls, the most likely pathway is into Northern Ireland from Britain, where there are 7 alien species, and Signal Crayfish are now widespread. These were a popular item to farm in Great Britain in the 1980s, but today almost no farms remain, and stocks have escaped into the wild where they are progressively eradicating the White-clawed Crayfish. Despite the clear dangers they present, Signal Crayfish continue to be transplanted around UK and Europe. The UK now estimates that Signal Crayfish have cost the country more than was ever achievable in terms of increased income.

White-clawed Crayfish
Eddie Dunne

Alien invader:

- Over 150 years ago, the first American crayfish were imported to Europe. The Spiny-cheek crayfish, *Orconectes limosus*, is now widespread across Europe. It has ousted the white-clawed crayfish from large French lakes and rivers, and also the larger European "Noble" crayfish *Astacus astacus* from many rivers and smaller lakes further north.
- Less than 50 years ago the Swedish Government introduced Signal crayfish *Pacifastacus leniusculus* from California, in the belief that they would spread through lakes now empty of Noble crayfish. They have done so, but caused the continuing decline of Noble crayfish across Scandinavia.
- 20 years ago the Red Swamp crayfish *Procambarus clarkii* from Louisiana was introduced into Mediterranean deltas in France, Spain and Italy; it has drastically altered the ecology of the deltas and marshes such as the Camargue, and has since spread as far afield as UK.

Control of plague through hygiene:

A parallel approach is to enforce hygiene, so that there is no possibility of plague spores entering Irish waters. Plague spores are easily killed by heat, dryness, salt water, or in extreme cases, by the use of bleach disinfectant. No undisinfected wet gear should be transferred between water systems.

Signal Crayfish
Chris Lukhaup

4 possible pathways for introduction of alien crayfish:

① **For fish-farming:** TV chefs have recently awakened interest in eating Signal Crayfish, and someone may try to introduce them into Ireland, perhaps via Northern Ireland, with the idea that they will be profitable.

② **As bait:** Alien crayfish juveniles are sometimes available as fishing bait, and anglers have often introduced alien fishes by releasing any unused bait into the wild.

③ **Import for sale as food:** Plague first reached Sweden around 1900 by someone dumping diseased crayfish into a lake near Stockholm. Live alien crayfish occasionally turn up in Irish fishmongers, and it could be a matter of time before someone dumps undersized, diseased or poor specimens into an Irish waterway.

④ **Import for the aquarium trade:** Live crayfish are periodically seen in Irish aquarium shops, but many more are available through the internet. Perhaps the most dangerous is the 'Marmokrebs' or Marbled Crayfish, an Orconectes clone which is parthenogenetic, i.e. it can reproduce without mating, and produces large numbers of offspring. These have already been dumped into the wild in two European countries, and a bucket of them was recently intercepted in UK.

Marbled Crayfish
Chris Lukhaup

Appendix 10.5

Appropriate Assessment (AA) Screening Statement

The Appropriate Assessment (AA) Screening Statement is a large document bound separately

Appendix 10.6

Natura Impact Statement (NIS)

The Natura Impact Statement is a large document bound separately

Appendix 11.1

Site Investigation Works – Factual Report

pgl priority geotechnical

Our Ref: GH/Rp/P16114 + attachments (*.pdf)

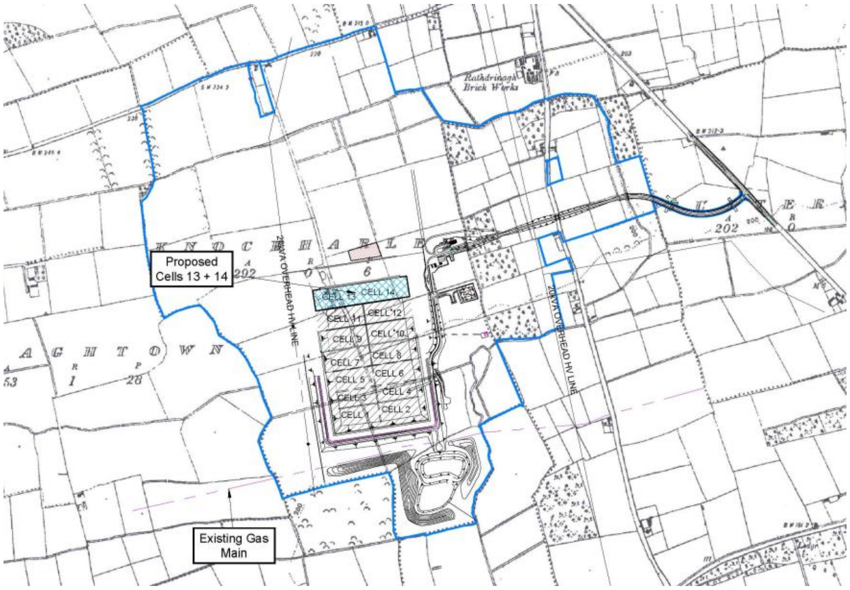
02nd February, 2017

Messrs. Fehily Timoney and Company,
J5 Plaza,
North Park Business Park,
North Road,
Dublin 11.

Re: Knockharley Landfill, Site investigation works; Factual report.

Introduction

In July 2016, Priority Geotechnical were requested by Fehily Timoney & Co. to undertake site investigation works at the site of operational (cells 1 – 12) engineer landfill at Knockharley, Co. Meath on behalf of Knockharley Landfill Ltd. The site lies adjacent to the N2, 1.5 km North of Kentstown village.



Scope

The contract involved cable tool and rotary boring, logging of soils encountered and installation of monitoring wells, laboratory testing and reporting. The scope of the site investigation was specified by Fehily Timoney and comprised of the following:

- 10No cable percussive boreholes;
- 1No. Rotary borehole;
- Groundwater/ groundgas monitoring installations;
- Sampling;
- Indirect geophysical survey 2D electrical resistivity and seismic refraction;
- Laboratory testing and
- Associated reporting.

Objectives

This geotechnical site investigation was required to support an Environmental Impact Assessment (EIA) planning application for landfill related works associated with new cell construction.

This factual report presents the records and data obtained with regard to the ground investigation for Knockharley Landfill and should be read in conjunction with the exploratory and photographic records and laboratory test data attached.

Site Works

This investigation was carried out in accordance with the contract specification: Specification and Related Documents for Ground Investigation in Ireland (Engineers Ireland, October 2006), Eurocode 7- Geotechnical Design Part 2, ground investigation and testing (BS EN 1997-2: 2007) and the relevant British Standards (BS 5930 (1999) Code of Practice for Site Investigation +A2:2010 and BS 1377, Method of Tests for Soil for Civil Engineering Purposes, *in situ* Tests Parts 1 to 9).

The fieldworks were undertaken between on the 05th August and 18th of September, 2016 under the supervision of PGL, Engineering Geologist(s). Details of the plant and equipment used are detailed on the relevant exploratory records, attached.

Cable percussive boreholes

Ten (10) no. rotary boreholes (BH01 – BH10, inclusive) were drilled to depths between 6.5m below ground level (bgl) and 15.0m bgl using PGL's Dando 2000 cable percussive rig with 200mm diameter casing. The exploratory records are attached, herein.

Rotary boreholes

A single (1) no. rotary borehole (RC01) were drilled to depths between 27.0m below ground level (bgl) using PGL's 6t, Deltabase 520 rotary rig with compressed air-mist flush. The exploratory records are attached, herein.

Sampling

A total of one hundred and twenty five (125) bulk disturbed samples (B), one hundred and nine (109) small disturbed samples (D) and nine (9) undisturbed samples (U) were recovered from the exploratory holes in accordance with Geotechnical Investigation and Sampling – Sampling Methods and Groundwater Measurements (EN ISO 22475-1:2006).

In-situ testing

Standard Penetration Test

Ninety one (91) number standard Penetration Tests, N values, were carried out in the cable tool boreholes and five (5) in rotary boreholes; using the 60° solid cone (CPT) in place of the standard split barrel sampler, in accordance with Geotechnical Investigation and Testing, Part 3 Standard penetration test, BS EN ISO 22476-3:2005+A1:2011. The data is presented on the exploratory borehole logs accompanying the factual report. Uncorrected values ranged between 12 and 82 with refusals N>50 also recorded.

Geophysical survey

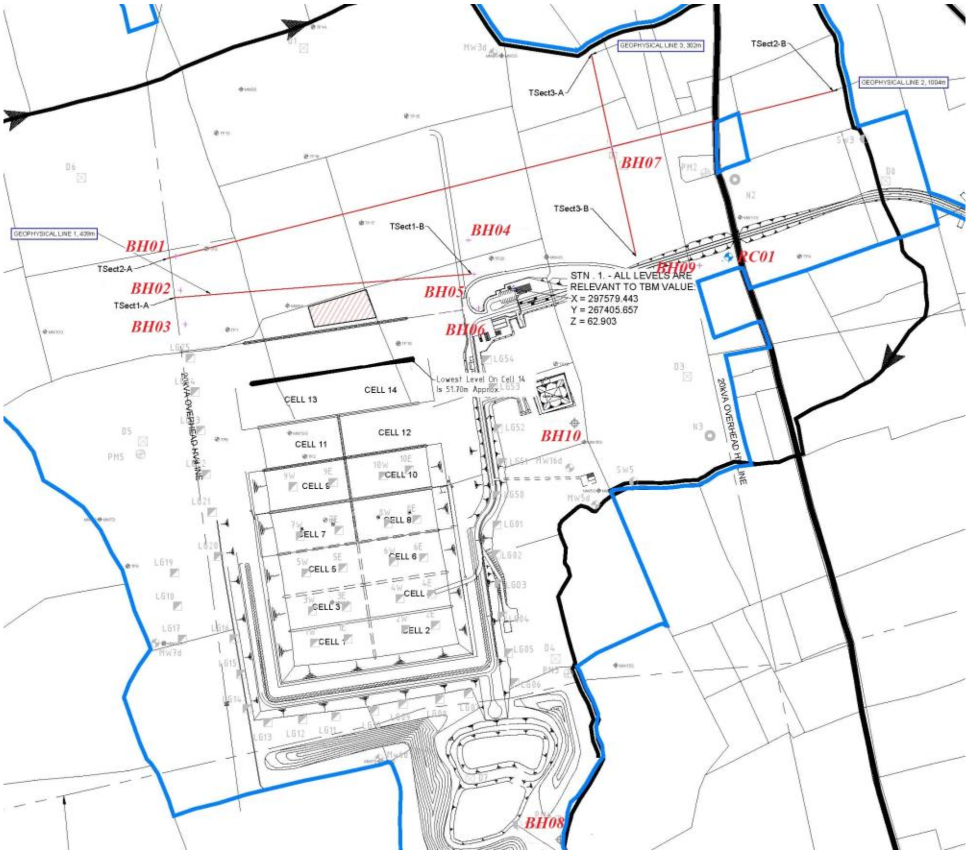
The geophysical survey comprised of continuous 2D Electrical Resistivity (herein referred to as ERT), Seismic Refraction Profiling and Multi-Channel Analysis of Surface Wave (MASW). The survey fieldwork was carried out by PGL between 8th and 15th August, 2016. A separate report has been produced.

Survey and Drawings

Upon completion the ‘as built’ exploration locations were surveyed using Trimble 5700/5800 GPS equipment to the Ordinance Survey Irish Transverse Mercator system of co-ordinates (ITM) and elevations to Malin Head datum. The exploratory locations were summarised below and presented graphically as follows for reference;

Summary of survey details

Location	Easting	Northing	National Elevation, mOD Malin	Final Depth, m bgl
BH01	697022.560	767472.490	63.270	9.2
BH02	697029.920	767419.200	63.940	15.0
BH03	697035.680	767360.860	65.240	7.0
BH04	697429.720	767480.640	62.850	15.0
BH05	697442.830	767446.750	63.260	8.2
BH06	697456.860	767395.370	63.910	7.1
BH07	697651.700	767632.730	60.600	12.0
BH08	697575.850	766599.520	51.390	6.5
BH09	697763.250	767443.530	61.220	10.5
BH10	697602.520	767231.100	59.420	15.0



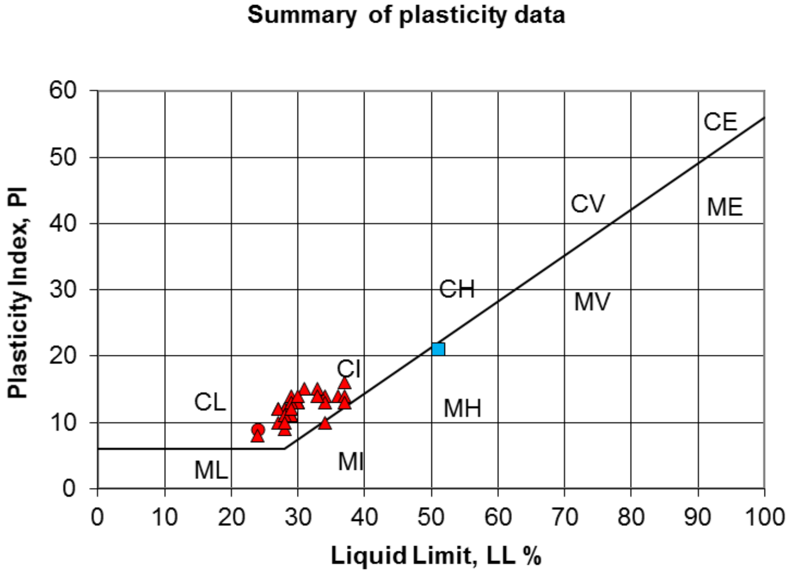
Location layout

Laboratory Testing

Laboratory testing was schedule by PGL on behalf of Fehily Timoney & Co. Testing was carried out by PGL in accordance with BS1377 (1990), Methods of test for soils for civil engineering purposes and the ISRM suggested methods for rock characterisation, testing and monitoring. Specialist chemical analysis was undertaken by Chemtest Ltd. (UK) on behalf of PGL. Specialist permeability testing was undertaken by GSTL Ltd. (UK) on behalf of PGL. The laboratory data accompanies the factual report and was summarised as follows;

SUMMARY OF LABORATORY TESTING

Type	No.	Remarks
Natural Moisture Content	78	11% to 25%
Atterberg Limits	31	Liquid Limit, LL 24% to 51% Plastic Limit, PL 15% to 3% Plasticity Index, PI 8 to 21
Particle Size Distribution	47	Including 29No. hydrometer analysis on fine soils
Loss on ignition	05	1.1% to 2.5%
Moisture Condition Value, MCV	20	0 – 6.5
Max dry density/moisture content relationship	14	9% to 14% 1.95Mg/m^3 to 2.11Mg/m^3
Permeability in triaxial cell	08	7 x 10^{-11} ms^{-1} to 1 x 10^{-10} ms^{-1}



Ground conditions and Groundwater

The full details of the ground conditions encountered are provided for on the exploratory records accompanying this report. The records provide descriptions, in accordance with BS 5930 (1999) +A2: 2010 and Eurocode 7, Geotechnical Investigation and Testing, Identification and classification of soils, Part 1, Identification and description (EN ISO 14688-1: 2002),– Identification and Classification of Soil, Part 2: Classification Principles (EN ISO 14688-2:2004) and Identification and Classification of Rock, Part 1: Identification & Description (EN ISO 14689-1:2004) of the materials encountered, in situ testing and details of the samples taken, together with any observations made during the site investigation.

The site was characterised by stiff glacial deposits (boulder clay) slightly sandy (slightly) gravelly CLAY with low to medium Cobble content to depths up to 17.0m bgl. A more granular layer dense clayey SAND AND GRAVEL/ clayey very sandy GRAVEL was encountered between 3.5m bgl to 7.1m bgl. Boreholes terminated at the target depth 15.0m bgl, else on obstruction after one (1) hour chiselling without progress typically between 6.5m bgl and 12.0m bgl in very stiff deposits/ obstruction. Water was also used to aid drilling. Bedrock was present below a depth 17.0m bgl.

Groundwater was observed during drilling. It should be noted that the normal rate of boring may not permit the recording of equilibrium groundwater levels for any one groundwater water strike where casing may exclude low volume flows as the borehole progresses in stiff glacial deposits. Groundwater conditions observed in the borings or pits are those appertaining to the period of the investigation. Groundwater levels may be subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions, tidal variations etc. The groundwater regime should be assessed from standpipe well installations, where available.

Groundwater was not generally struck, however ‘damp’ and ‘wet’ deposits were recovered. It is assumed that the low volume flow within the stiff CLAY was cut off as casing progressed in low permeability deposits. Groundwater was encountered at 4.5m bgl at BH07 and at 7.1m bgl at RC01.

Eight (8) number 50mm diameter standpipe wells were constructed at locations; BH02, BH05, BH06, BH07, BH08, BH09, BH10 and RC01 for groundwater and groundgas monitoring, else the exploratory holes were backfilled with arisings and pelletized bentonite.

▩	Arisings, backfill to borehole	▧	BENTONITE, backfill to installation/ borehole
⁘	GRAVEL, backfill to installation/ borehole	☰	uPVC slotted pipe (well)

Should you have any queries in relation to the data collected, please do not hesitate to contact our office.

Yours sincerely,
For **Priority Geotechnical,**

Gregory Hayes

Greg Hayes CEng BE MEngSc MIEI
Geotechnical Specialist

No responsibility can be held by PGL for ground conditions between exploratory locations. The exploratory logs provide for ground profiles and configuration of strata relevant to the investigation depths achieved during the fieldworks. Caution shall be taken when extrapolating between such exploratory locations. No liability is accepted for ground conditions extraneous to the exploratory locations.

This report has been prepared for the Employer and their Representative as outline, herein. The information should not be used without their prior written permission. PGL accepts no responsibility or liability for this document being used other than for the purposes for which it was intended.

KEY TO SYMBOLS ON EXPLORATORY HOLE RECORDS

All linear dimensions are in metres or millimetres

DESCRIPTIONS

**	Drillers Description
Friable	Easily crumbled

SAMPLES

U( )	Undisturbed 102mm diameter sample, ( ) denotes number of blows to drive sampler
U( )F, U( )P	F- not recovered, P-partially recovered
U38	Undisturbed 38mm diameter sample
P(F), (P)	Piston sample - disturbed
B	Bulk sample - disturbed
D	Jar Sample - disturbed
W	Water Sample
CBR	California Bearing Ratio mould sample
ES	Chemical Sample for Contamination Analysis
SPTLS	Standard Penetration Test S lump sample from split sampler

CORE RECOVERY AND ROCK QUALITY

TCR	Total Core Recovery (% of Core Run)
SCR	Solid Core Recovery (length of core having at least one full diameter as % of core run)
RQD	Rock Quality Designation (length of solid core greater than 100mm as % of core run)

Where there is insufficient space for the TCR, SCR and RQD, the results may be found in the remarks column

If	Fracture Spacing in mm (Minimum/Average/Maximum) NI - non intact, NR - no recovery
AZCL	Assumed Zone of Core Loss
NI	Non intact

GROUNDWATER

▽	Groundwater strike
▼	Groundwater level after standing period
Date/Water	Date of shift (day/month)/Depth to water at end of previous shift shown above the date and depth to water at beginning of shift given below the date

INSITU TESTING

S	Standard Penetration Test - split barrel sampler
C	Standard Penetration Test - solid 60° cone
SW	Self Weight Penetration
Ivp, HVp (R)	In Situ Vane Test, Hand Vane Test (R) demonstrates remoulded strength
K(F), (C), (R), (P)	Permeability Test
HP	Hand Penetrometer Test

MEASURED PROPERTIES

N	Standard Penetration Test - blows required to drive 300mm after seating drive
x/y	Denotes x blows for y mm within the Standard Penetration Test
x*/y	Denotes x blows for y mm within the seating drive
c_u	Undrained Shear Strength (kN/m^2)
CBR	California Bearing Ratio

ROTARY DRILLING SIZES

Index Letter	Nominal Diameter (mm)	
	Borehole	Core
N	75	54
H	99	76
P	120	92
S	146	113

Key Sheet

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Fax: 021 4638690
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Drilled By:	AK
Logged By:	GH
Borehole No.	**BH01**
	Sheet 1 of 2
Project Name:	Knockharley Landfill
Project No.	P16114
Co-ords:	697023E - 767472N
Hole Type	CP
Location:	Knockharley, Co. Meath
Level:	63.26m OD
Scale	1:50
Client:	Fehily Timoney and Company
Date:	06/09/2016 - 08/09/2016

Well	Water Strike (m)	**Sample and In Situ Testing** Depth (m)	Type	Results	Depth (m)	Level (mOD)	Legend	Stratum Description
		0.00 - 1.00 0.00 - 1.00	B D					Firm to stiff, brown, slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 63mm to 120mm dia, sub-angular to rounded.
		1.00 - 2.00 1.00 - 2.00 1.00	B D SPT (C)	N=52 (12,12/13,8,19,12)				
		2.00	SPT (C)	25 (17 for 75mm/25 for 0mm)				
		2.50 - 3.00 2.50 - 3.00	B D		2.50	60.76		Stiff, brown grey, slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 63mm to 100mm dia, sub-angular to sub-rounded.
		3.00 - 3.45 3.00	U SPT (C)	25 (25 for 0mm/25 for 0mm)				
		3.45 - 4.00 3.45 - 4.00	B D		3.45	59.82		Stiff, brown, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		4.00	SPT (C)	67 (15,17/67 for 150mm)				
		4.50 - 5.00 4.50 - 5.00	B D					
		5.00	SPT (C)	N=72 (13,15/18,18,17,19)				*5.00 - 6.00m: Driller encountered water.*
		5.50 - 6.00 5.50 - 6.00	B D					
		6.00	SPT (C)	N=77 (10,17/15,18,20,24)				
		6.50 - 7.00 6.50 - 7.00	B D					
		7.00 - 8.00 7.00 - 8.00	B D		7.00	56.26		Stiff, brown, slightly sandy slightly gravelly CLAY with boulder content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		8.00 - 9.20 8.00 - 9.20	B D					

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				Soil damp from 5.00 - 9.20m.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
9.20	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool
2.50	3.50	01:00	Chisel.
6.00	7.20	01:00	Chisel.
7.60	8.00	01:00	Chisel.
8.60	9.20	03:00	Chisel.

Remarks:

Borehole terminated at 9.20m bgl due to obstruction.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	06/09/2016 08:00	0.00	Start of shift.
	06/09/2016 18:00	3.00	End of shift.
	07/09/2016 08:00	3.00	Start of shift.
	07/09/2016 18:00	8.00	End of shift.
	08/09/2016 08:00	8.00	Start of shift.
	08/09/2016 18:00	9.20	End of borehole.

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Drilled By:	AK
Logged By:	GH

Borehole No.
BH01
Sheet 2 of 2

Project Name:	Knockharley Landfill	**Project No.**	P16114
Co-ords:	697023E - 767472N	**Hole Type**	CP
Location:	Knockharley, Co. Meath		
Level:	63.26m OD	**Scale**	1:50
Client:	Fehily Timoney and Company		
Date:	06/09/2016 - 08/09/2016		

Well	Water Strike (m)	**Sample and In Situ Testing** Depth (m)	Type	Results	Depth (m)	Level (mOD)	Legend	Stratum Description
▨					9.20	54.06	▨	Stiff, brown, slightly sandy slightly gravelly CLAY with boulder content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
								End of Borehole at 9.200m

10
11
12
13
14
15
16
17
18

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				Soil damp from 5.00 - 9.20m.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
9.20	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool
2.50	3.50	01:00	Chisel.
6.00	7.20	01:00	Chisel.
7.60	8.00	01:00	Chisel.
8.60	9.20	03:00	Chisel.

Remarks:

Borehole terminated at 9.20m bgl due to obstruction.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	06/09/2016 08:00	0.00	Start of shift.
	06/09/2016 18:00	3.00	End of shift.
	07/09/2016 08:00	3.00	Start of shift.
	07/09/2016 18:00	8.00	End of shift.
	08/09/2016 08:00	8.00	Start of shift.
	08/09/2016 18:00	9.20	End of borehole.

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Drilled By:	AK	Borehole No.	**BH02**
Logged By:	GH		Sheet 1 of 2
Project Name:	Knockharley Landfill	**Project No.**	P16114
Co-ords:	697030E - 767419N	**Hole Type**	CP
Location:	Knockharley, Co. Meath		
Level:	63.94m OD	**Scale**	1:50
Client:	Fehily Timoney and Company		
Date:	01/09/2016 - 06/09/2016		

Well	Water Strike (m)	Sample and In Situ Testing			Depth (m)	Level (mOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00 - 0.50	B					Brown, slightly sandy CLAY. Sand is fine to coarse.
		0.00 - 0.50	D					
		0.50 - 1.20	B		0.50	63.44		Brown, slightly sandy CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		0.50 - 1.20	D					
		1.00	SPT (C)	N=25 (5,8/7,7,6,5)				
					1.20	62.74		Stiff, dark brown, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		1.20 - 2.00	B					
		1.20 - 2.00	D					
		2.00	SPT (C)	N=25 (7,8/7,6,6,6)				*2.00 - 3.00m: Driller described soil as 'wet'.*
		2.50 - 3.00	B		2.50	61.44		Dark brown, slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 63mm to 100mm dia, sub-angular to sub-rounded.
		2.50 - 3.00	D					
		3.00 - 3.45	U					
		3.50 - 4.00	B		3.50	60.44		Dense, black, clayey SAND and GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		4.00	SPT (C)	N=52 (12,10/11,14,12,15)				
		4.50 - 5.00	B		4.50	59.44		Very dense, black, clayey very sandy GRAVEL with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 63mm to 80mm dia, sub-angular to sub-rounded.
		5.00	SPT (C)	N=66 (12,12/14,18,16,18)				
		5.50 - 6.00	B		5.50	58.44		Stiff, black, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		6.00	SPT (C)	N=51 (14,15/16,12,10,13)				*6.00 - 7.00m: Driller described soil as moist.*
		6.50 - 7.00	B		6.50	57.44		Very stiff, brown grey, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		6.50 - 7.00	D					
		7.00	SPT (C)	N=82 (12,16/18,21,21,22)				
		7.50 - 8.00	B					
		7.50 - 8.00	D					
		8.00	SPT (C)	N=80 (15,18/18,19,21,22)				
		8.50 - 9.00	B					
		8.50 - 9.00	D					
		9.00	SPT (C)	N=79 (16,16/18,22,20,19)				

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
15.00	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool

Remarks:

Borehole terminated at 15.00m bgl due to obstruction, possible boulder. 50mm dia standpipe installed. Response zone from 4.00 to 15.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	01/09/2016 08:00	0.00	Start of shift.
	01/09/2016 18:00	6.00	End of shift.
	02/09/2016 08:00	6.00	Start of shift.
	02/09/2016 18:00	9.00	End of shift.
6	05/09/2016 08:00	9.00	Start of shift.
	05/09/2016 18:00	14.00	End of shift.
	06/09/2016 08:00	14.00	Start of shift.

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Drilled By:	AK	**Logged By:**	GH	Borehole No.	**BH02**
					Sheet 2 of 2
Project Name:	Knockharley Landfill	**Project No.**	P16114		
Co-ords:	697030E - 767419N	**Hole Type**	CP		
Location:	Knockharley, Co. Meath	**Level:**	63.94m OD	**Scale**	1:50
Client:	Fehily Timoney and Company	**Date:**	01/09/2016 - 06/09/2016		

Well	Water Strike (m)	**Sample and In Situ Testing**			Depth (m)	Level (mOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		9.50 - 10.00 9.50 - 10.00	B D						
		10.00	SPT (C)	N=58 (8,11/13,13,15,17)				*Driller added water to help with drilling.*	10
		10.50 - 11.00 10.50 - 11.00	B D						
		11.00	SPT (C)	N=66 (12,14/14,17,15,20)					11
		11.50 - 12.00 11.50 - 12.00	B D						
		12.00	SPT (C)	N=71 (8,12/15,17,18,21)					12
		12.50 - 13.00 12.50 - 13.00	B D						
		13.00	SPT (C)	N=56 (10,12/15,10,10,21)					13
		13.50 - 14.00 13.50 - 14.00	B D						
		14.00	SPT (C)	N=67 (10,10/17,10,19,21)					14
		14.50 - 15.00 14.50 - 15.00	B D						
		15.00	SPT (C)	25 (25 for 0mm/25 for 0mm)	15.00	48.94		End of Borehole at 15.000m	15
									16
									17
									18

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
15.00	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool

Remarks:

Borehole terminated at 15.00m bgl due to obstruction, possible boulder. 50mm dia standpipe installed. Response zone from 4.00 to 15.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	01/09/2016 08:00	0.00	Start of shift.
	01/09/2016 18:00	6.00	End of shift.
	02/09/2016 08:00	6.00	Start of shift.
	02/09/2016 18:00	9.00	End of shift.
6	05/09/2016 08:00	9.00	Start of shift.
	05/09/2016 18:00	14.00	End of shift.
	06/09/2016 08:00	14.00	Start of shift.

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Drilled By:	AK	Borehole No.	**BH03**
Logged By:	GH	Sheet 1 of 1	
Project Name:	Knockharley Landfill	**Project No.**	P16114
Co-ords:	697036E - 767361N	**Hole Type**	CP
Location:	Knockharley, Co. Meath	**Level:**	65.24m OD
Scale	1:50		
Client:	Fehily Timoney and Company	**Date:**	30/09/2016 - 14/09/2031

Well	Water Strike (m)	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (mOD)	Legend	Stratum Description	
		0.00 - 1.00 0.00 - 1.00	B D					Brown, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.	
		1.00 - 1.45	U		1.00	64.24		Very stiff, grey black, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.	1
		1.45 - 2.00 1.45 - 2.00	B D					*1.00 - 2.00m: Driller described soil as moist.*	
		2.00	SPT (C)	N=51 (9,8/8,11,15,17)				*2.00 - 3.00m: Driller described soil as wet.*	2
		2.50 - 3.00 2.50 - 3.00	B D						
		3.00	SPT (C)	N=50 (5,7/7,11,14,18)					3
		3.50 - 4.00 3.50 - 4.00	B D						
		4.00	SPT (C)	N=62 (12,12/15,14,15,18)					4
		4.50 - 5.00 4.50 - 5.00	B D		4.50	60.74		Very stiff, grey black, slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 63mm to 100mm dia, sub-angular to sub-rounded.	
		5.00	SPT (C)	N=60 (7,10/12,15,15,18)					5
		5.50 - 6.00 5.50 - 6.00	B D						
		6.00	SPT (C)	N=72 (10,13/16,17,20,19)				*6.00 - 7.00m: Driller described soil as moist.*	6
		6.50 - 7.00 6.50 - 7.00	B D						
		7.00	SPT (C)	25 (43 for 75mm/25 for 0mm)	7.00	58.24		End of Borehole at 7.000m	7
									8
									9

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
7.00	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool
7.00	7.10	01:00	Chisel.

Remarks:

Borehole terminated at 7.00m bgl due to obstruction.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	30/08/2016 08:00	0.00	Start of shift.
	01/09/2016 08:00	7.10	Start of shift.
	01/09/2016 18:00	7.10	End of borehole.
	30/09/2016 18:00	7.10	End of shift.

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Drilled By:	**Logged By:**	Borehole No.
AK	GH	**BH04**
		Sheet 1 of 2

Project Name:	Knockharley Landfill	**Project No.**	P16114
Co-ords:	697430E - 767481N	**Hole Type**	CP
Location:	Knockharley, Co. Meath	**Scale**	1:50
Level:	62.85m OD		
Client:	Fehily Timoney and Company	**Date:**	19/08/2016 - 23/08/2016

Water Strike (m)	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (mOD)	Stratum Description
	0.00 - 0.40 0.00 - 0.40	B D				Topsoil. Light brown, slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are sub-angular to sub-rounded.
	0.40 - 1.00 0.40 - 1.00	B D		0.40	62.45	Dark brown, slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are sub-angular to rounded.
	1.00	SPT (C)	N=49 (12,12/13,14,12,10)			
	1.50 - 2.00 1.50 - 2.00	B D		1.50	61.35	Stiff, black, sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
	2.00	SPT (C)	N=37 (10,12/10,9,9,9)	2.00	60.85	Stiff, grey, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
	2.50 - 3.00 2.50 - 3.00	B D				
	3.00	SPT (C)	N=42 (10,11/12,10,9,11)			
	3.50 - 4.00 3.50 - 4.00	B D				
	4.00 - 4.45 4.00	U SPT (C)	N=51 (7,12/15,13,12,11)			
	4.50 - 5.00 4.50 - 5.00	B D				
	5.00	SPT (C)	N=52 (14,14/12,13,13,14)			
	5.50 - 6.00 5.50 - 6.00	B D				
	6.00 - 6.45 6.00	B SPT (C)	0 (50 for 75mm/,,,)	6.00	56.85	Dense, grey, very clayey very sandy GRAVEL with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, angular to sub-angular. Cobbles are 145mm dia and angular.
				6.45	56.40	Stiff, grey, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, angular to sub-angular.
	7.00	SPT (C)	N=38 (9,8/9,11,10,8)			
	7.50 - 8.00 7.50 - 8.00	B D				
	8.00	SPT (C)	N=42 (6,12/9,9,11,13)			
	8.50 - 9.00 8.50 - 9.00	B D				
	9.00	SPT (C)	N=34 (7,10/8,8,9,9)			

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
15.00	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool

Remarks:

Borehole terminated at 15.00m bgl due to obstruction. 50mm dia standpipe installed. Response zone from 4.00- 15.00m.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	19/08/2016 08:00	0.00	Start of shift.
Dry	19/08/2016 18:00	4.00	End of shift.
Dry	22/08/2016 08:00	4.00	Start of shift.
Dry	22/08/2016 18:00	8.00	End of shift.
Dry	23/08/2016 08:00	8.00	Start of shift.
Dry	23/08/2016 18:00	15.00	End of borehole.

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Drilled By:	**Logged By:**	Borehole No.
AK	GH	**BH04**
		Sheet 2 of 2

Project Name: Knockharley Landfill	**Project No.** P16114	**Co-ords:** 697430E - 767481N	**Hole Type** CP
Location: Knockharley, Co. Meath		**Level:** 62.85m OD	**Scale** 1:50
Client: Fehily Timoney and Company		**Date:** 19/08/2016 - 23/08/2016	

Well	Water Strike (m)	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (mOD)	Legend	Stratum Description
								Stiff, grey, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, angular to sub-angular.
		9.50 - 10.00 9.50 - 10.00	B D					
		10.00	SPT (C)	N=35 (9,11/10,10,8,7)				
		10.50 - 11.00 10.50 - 11.00	B D					
		11.00	SPT (C)	N=39 (8,12/9,10,11,9)				
		11.50 - 12.00 11.50 - 12.00	B D					
		12.00	SPT()	N=37 (9,12/10,12,8,7)				
		12.50 - 13.00 12.50 - 13.00	B D					
		13.00	SPT (C)	N=48 (8,14/12,10,12,14)				
		13.50 - 14.00 13.50 - 14.00	B D					
		14.00	SPT (C)	N=41 (10,10/10,12,9,10)				
		14.50 - 15.00 14.50 - 15.00	B D					
		15.00	SPT (C)	N=52 (7,8/12,13,15,12)	15.00	47.85		End of Borehole at 15.000m

10
11
12
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16
17
18

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
15.00	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool

Remarks:

Borehole terminated at 15.00m bgl due to obstruction. 50mm dia standpipe installed.
Response zone from 4.00- 15.00m.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	19/08/2016 08:00	0.00	Start of shift.
Dry	19/08/2016 18:00	4.00	End of shift.
Dry	22/08/2016 08:00	4.00	Start of shift.
Dry	22/08/2016 18:00	8.00	End of shift.
Dry	23/08/2016 08:00	8.00	Start of shift.
Dry	23/08/2016 18:00	15.00	End of borehole.

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Drilled By:	AK	Borehole No.	**BH05**
Logged By:	GH	Sheet 1 of 1	
Project Name:	Knockharley Landfill	**Project No.**	P16114
Co-ords:	697443E - 767447N	**Hole Type**	CP
Location:	Knockharley, Co. Meath	**Level:**	63.26m OD
Scale	1:50		
Client:	Fehily Timoney and Company	**Date:**	17/08/2016 - 19/08/2016

Well	Water Strike (m)	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (mOD)	Legend	Stratum Description
		0.00 - 0.50 0.00 - 0.50	B D					Topsoil. Light brown, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse and sub-angular.
		0.50 - 1.40 0.50 - 1.40	B D		0.50	62.76		Brown, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		1.00	SPT (C)	N=15 (2,3/3,3,4,5)				
		1.40 - 2.00 1.40 - 2.00	B D		1.40	61.86		Firm, brown, slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 70mm to 120mm dia, sub-angular to sub-rounded.
		2.00	SPT (C)	N=15 (3,3/4,3,4,4)				
		2.50 - 3.00 2.50 - 3.00	B D					
		3.00 - 3.45 3.00	U SPT (C)	N=31 (6,6/7,6,8,10)				
		3.50 - 4.00 3.50 - 4.00	B D		3.50	59.76		Stiff, dark brown, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		4.00	SPT (C)	N=38 (12,10/10,8,9,11)				*Stiff below 3.50m.*
		4.50 - 5.00 4.50 - 5.00	B D					
		5.00	SPT (C)	N=49 (12,12/13,11,12,13)				
		5.50 - 6.00 5.50 - 6.00	B D					
		6.00	SPT (C)	N=47 (12,13/11,10,12,14)				
		6.50 - 7.00 6.50 - 7.00	B D		6.50	56.76		Very dense, dark brown, clayey sandy GRAVEL with high cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 70mm to 100mm dia, sub-angular to sub-rounded.
		7.00	SPT (C)	N=78 (15,16/18,18,20,22)				
		7.50 - 8.00 7.50 - 8.00	B D					
		8.00	SPT (C)	25 (10,11/25 for 225mm)	8.00	55.26		Driller chiseled from 8.00 - 8.20m.
					8.20	55.06		End of Borehole at 8.200m

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
8.20	200	200

Chiselling:

Depth Top	Depth Base	Duration	Tool
8.00	8.30	01:00	Chisel.

Equipment: Dando 2000.

Remarks:

Borehole terminated at 8.20m bgl due to obstruction. 50mm dia standpipe installed. Response zone from 5.00 - 8.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	17/08/2016 08:00	0.00	Start of shift.
Dry	17/08/2016 18:00	2.00	End of shift.
Dry	18/08/2016 08:00	2.00	Start of shift.
Dry	18/08/2016 18:00	8.00	End of shift.
4	19/08/2016 08:00	8.00	Start of shift.
Dry	19/08/2016 18:00	8.20	End of borehole.

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Drilled By:	AK	Borehole No.	**BH06**
Logged By:	GH	Sheet 1 of 1	
Project Name:	Knockharley Landfill	**Project No.**	P16114
Co-ords:	697457E - 767395N	**Hole Type**	CP
Location:	Knockharley, Co. Meath	**Level:**	63.91m OD
Scale	1:50		
Client:	Fehily Timoney and Company	**Date:**	15/08/2016 - 17/08/2016

Water Strike (m)	Sample Depth (m)	Type	Results	Depth (m)	Level (mOD)	Stratum Description
						Topsoil.
	0.50 0.50 - 1.00	D B		0.50	63.41	Firm, brown, slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 80mm to 100mm dia, sub-angular to sub-rounded.
	1.00 - 2.00 1.00 - 2.00 1.00	B D SPT (C)	N=12 (2,2/3,2,4,3)			
	2.00	SPT (C)	N=15 (4,4/3,4,4,4)			
	2.70 2.70 - 3.20 3.00	D B SPT (C)	N=14 (3,4/4,3,3,4)	2.70	61.21	Firm, dark grey black, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
	4.00 - 5.00	B		4.00	59.91	Stiff, dark grey black, slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 70mm to 100mm dia, sub-angular to sub-rounded.
	5.00 5.00 - 6.00 5.00 5.50	D B SPT (C) D	N=22 (6,5/6,6,5,5)			*5.00 - 6.00m: Driller described the soil as moist.*
	6.00 - 7.00 6.00	B SPT (C)	N=34 (8,9/8,7,9,10)	6.00	57.91	Dense, brown, clayey very sandy GRAVEL with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 70mm to 100mm dia and sub-rounded. *7.00m: Driller described soil as wet.*
	7.10 7.10	D SPT (C)	25 (15,17/25 for 225mm)	7.10	56.81	End of Borehole at 7.100m

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
7.10	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool
6.00	6.30	01:00	Chisel.
7.00	7.10	01:00	Chisel.

Remarks:

Borehole terminated at 7.10m bgl due to obstruction. 50mm standpipe installed. Response zone from 3.00 - 7.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	15/08/2016 08:00	0.00	Start of shift.
	15/08/2016 18:00	0.50	End of shift.
	16/08/2016 08:00	0.50	Start of shift.
	16/08/2016 18:00	6.30	End of shift.
4.0	17/08/2016 08:00	6.30	Start of shift.
6.5	17/08/2016 18:00	7.10	End of borehole.

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Drilled By:	AK	Borehole No.	**BH07**
Logged By:	AH	Sheet 1 of 2	

Project Name:	Knockharley Landfill	**Project No.**	P16114
Co-ords:	697652E - 767633N	**Hole Type**	CP
Location:	Knockharley, Co. Meath	**Level:**	60.60m OD
Scale	1:50		
Client:	Fehily Timoney and Company	**Date:**	25/08/2016 - 29/08/2016

Water Strike (m)	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (mOD)	Stratum Description
	0.00 - 0.70 0.00 - 0.70	B D				Topsoil. Brown grey, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to medium and angular.
				0.70	59.90	Stiff, grey brown, slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse and angular. Cobbles are 150mm to 200mm dia, angular to sub-angular.
	1.00	SPT (C)	N=70 (10,17/17,18,15,20)			
	1.50 - 2.00 1.50 - 2.00	B D				
	2.00	SPT (C)	N=74 (10,10/19,17,20,18)			
	2.50 - 3.00 2.50 - 3.00	B D				
	3.00 - 3.45	U				
	3.45 - 4.00 3.45 - 4.00	B D		3.45	57.15	Stiff, grey, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse and angular.
	4.00	SPT (C)	N=69 (10,12/15,15,18,21)			
▼	4.50 - 5.00 4.50 - 5.00	B D				
	5.00	SPT (C)	25 (7,17/25 for 225mm)			*5.00 - 7.00m: Driller described soil as wet.*
	5.50 - 6.00 5.50 - 6.00	B D		5.50	55.10	Clayey SAND and GRAVEL. Sand is fine to coarse. Gravel is fine to coarse and sub-angular.
	6.00 - 7.00 6.00 - 7.00	B D		6.00	54.60	Very stiff, grey, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine and sub-angular.
	7.00 - 7.45	U				*7.00 - 9.00m: Driller described soil as moist.*
	7.45 - 8.00 7.45 - 8.00	B D				
	8.00	SPT (C)	N=72 (17,15/16,18,20,18)			
	8.50 - 9.00 8.50 - 9.00	B D				
	9.00	SPT (C)	N=71 (18,17/17,16,18,20)			

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
4.50				See shift data.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
12.00	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool
11.00	11.70	01:00	Chisel.
11.70	12.00	01:00	Chisel.

Remarks:

Borehole terminated at 12.00m bgl due to obstruction. 50mm dia. standpipe installed.
Response zone from 4.00 - 12.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	25/08/2016 08:00	0.00	Start of shift.
	25/08/2016 18:00	6.00	End of shift.
	26/08/2016 08:00	6.00	Start of shift.
	26/08/2016 18:00	11.00	End of shift.
3	29/08/2016 08:00	11.00	Start of shift.
0	29/08/2016 18:00	12.00	End of borehole.

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Drilled By:	AK	**Logged By:**	AH	Borehole No.	**BH07** Sheet 2 of 2
Project Name:	Knockharley Landfill	**Project No.**	P16114	**Co-ords:**	697652E - 767633N
Hole Type	CP				
Location:	Knockharley, Co. Meath	**Level:**	60.60m OD	**Scale**	1:50
Client:	Fehily Timoney and Company	**Date:**	25/08/2016 - 29/08/2016		

Well	Water Strike (m)	Sample and In Situ Testing			Depth (m)	Level (mOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		9.50 - 10.00	B					Very stiff, grey, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine and sub-angular.
		9.50 - 10.00	D					
		10.00	SPT (C)	N=71 (18,17/17,16,18,20)				
		10.50 - 11.00	B					
		10.50 - 11.00	D					
		11.00 - 12.00	B		11.00	49.60		Very stiff, grey, slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 63mm to 100mm dia.
		11.00	SPT (C)	25 (19,/25 for 225mm)				
		12.00	SPT (C)	25 (,/25 for 225mm)	12.00	48.60		End of Borehole at 12.000m

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
4.50				See shift data.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
12.00	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool
11.00	11.70	01:00	Chisel.
11.70	12.00	01:00	Chisel.

Remarks:

Borehole terminated at 12.00m bgl due to obstruction. 50mm dia. standpipe installed.
Response zone from 4.00 - 12.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	25/08/2016 08:00	0.00	Start of shift.
	25/08/2016 18:00	6.00	End of shift.
	26/08/2016 08:00	6.00	Start of shift.
	26/08/2016 18:00	11.00	End of shift.
3	29/08/2016 08:00	11.00	Start of shift.
0	29/08/2016 18:00	12.00	End of borehole.

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Drilled By:	AK
Logged By:	AH
Borehole No.	**BH08**
	Sheet 1 of 1
Project Name:	Knockharley Landfill
Project No.	P16114
Co-ords:	697576E - 766600N
Hole Type	CP
Location:	Knockharley, Co. Meath
Level:	51.39m OD
Scale	1:50
Client:	Fehily Timoney and Company
Date:	14/09/2016 - 16/09/2016

Well	Water Strike (m)	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (mOD)	Stratum Description
		0.00 - 0.90 0.00 - 0.90	B D				Brown grey slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		0.90 - 1.50 0.90 - 1.50	B D				
		1.50 - 2.00 1.50 - 2.00	B D		1.50	49.89	Stiff, grey, slightly sandy gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Cobbles are 80mm to 140mm dia, sub-rounded, Limestone lithology.
		2.00	SPT (C)	25 (46 for 75mm/25 for 0mm)			*2.20 - 4.40m: Driller noted boulder content.*
		2.50 - 3.00 2.50 - 3.00	B D				
		3.00	SPT (C)	N=74 (14,16/18,18,18,20)			
		3.50 - 4.00 3.50 - 4.00	B D		3.50	47.89	Stiff, grey, slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse and sub-angular. Cobbles are 190mm dia, sub-angular, Limestone lithology.
		4.00	SPT (C)	25 (21 for 75mm/25 for 0mm)			
		4.50 - 5.00 4.50 - 5.00	B D				
		5.00	SPT (C)	N=61 (10,12/11,15,18,17)			
		5.50 - 6.00 5.50 - 6.00	B D				
		6.00 - 6.50 6.00	B SPT (C)	25 (25 for 0mm/25 for 0mm)			
					6.50	44.89	End of Borehole at 6.500m

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
6.50	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool
1.60	2.00	01:00	Chisel.
4.00	4.40	01:00	Chisel.
6.00	6.50	01:30	Chisel.

Remarks:

Borehole terminated at 6.50m bgl due to obstruction.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	14/09/2016 08:00	0.00	Start of shift.
	14/09/2016 18:00	2.00	End of shift.
	15/09/2016 08:00	2.00	Start of shift.
	15/09/2016 18:00	6.50	End of shift.
	16/09/2016 08:00	6.50	Start of shift.
	16/09/2016 18:00	6.50	End of borehole.

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Drilled By:	AK
Logged By:	AH

Borehole No.
BH09
Sheet 1 of 2

Project Name:	Knockharley Landfill	**Project No.**	P16114
Co-ords:	697763E - 767444N	**Hole Type**	CP
Location:	Knockharley, Co. Meath		
Level:	61.22m OD	**Scale**	1:50
Client:	Fehily Timoney and Company		
Date:	12/09/2016 - 13/09/2016		

Well	Water Strike (m)	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (mOD)	Legend	Stratum Description
		0.00 - 0.80 0.00 - 0.80	B D					Brown, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to medium and angular.
		0.80 - 1.60 0.80 - 1.60	B D		0.80	60.42		Grey brown, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse and angular.
		1.60 - 2.30 1.60 - 2.30	B D		1.60	59.62		Grey brown, slightly sandy slightly gravelly CLAY with high cobble content. Sand is fine to coarse. Gravel is fine to coarse. Cobbles are 190mm dia, sub-rounded, Limestone lithology.
		2.00	SPT (C)	25 (25 for 0mm/25 for 0mm)				
					2.30	58.92		Stiff, grey slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse and sub-angular.
		2.40 - 3.00 2.40 - 3.00	B D					
		3.00	SPT (C)	N=81 (12,17/20,19,21,21)				*3.00 - 4.50m: Driller described soil as moist.*
		3.50 - 4.00 3.50 - 4.00	B D					
		4.00	SPT (C)	N=52 (7,12/10,13,13,16)				
		4.50 - 5.00 4.50 - 5.00	B D					
		5.00	SPT (C)	N=71 (12,15/16,15,18,22)				
		5.50 - 6.00 5.50 - 6.00	B D		5.50	55.72		Stiff, grey, slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		6.00	SPT (C)	N=69 (14,17/16,16,16,21)				
		6.50 - 7.00 6.50 - 7.00	B D					
		7.00	SPT (C)	N=76 (10,12/17,18,18,23)				
		7.50 - 8.00 7.50 - 8.00	B D					
		8.00	SPT (C)	25 (46 for 75mm/25 for 0mm)				
		8.50 - 9.00 8.50 - 9.00	B D					
		9.00	SPT (C)	N=81 (18,15/17,20,21,23)				

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
10.50	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool
2.00	2.50	01:30	Chisel.
7.90	8.60	01:00	Chisel.
10.50	10.50	01:00	Chisel.

Remarks:

Borehole terminated at 10.50m bgl due to obstruction. 50mm dia. standpipe installed. Response zone from 3.50 - 10.50m.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	12/09/2016 08:00	0.00	Start of shift.
Dry.	12/09/2016 18:00	4.50	End of shift.
Dry.	13/09/2016 08:00	4.50	Start of shift.
Dry.	13/09/2016 18:00	10.50	End of borehole.

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Drilled By:	AK
Logged By:	AH
Borehole No.	**BH09**
	Sheet 2 of 2
Project Name:	Knockharley Landfill
Project No.	P16114
Co-ords:	697763E - 767444N
Hole Type	CP
Location:	Knockharley, Co. Meath
Level:	61.22m OD
Scale	1:50
Client:	Fehily Timoney and Company
Date:	12/09/2016 - 13/09/2016

Well	Water Strike (m)	Sample and In Situ Testing			Depth (m)	Level (mOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		9.50 - 10.00 9.50 - 10.00	B D					Stiff, grey, slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		10.00 - 10.50 10.00	B SPT (C)	25 (48 for 75mm/25 for 0mm)	10.00	51.22		COBBLES. Cobbles are 63mm to 160mm dia, sub-angular to sub-rounded, Limestone lithology.
					10.50	50.72		End of Borehole at 10.500m

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
10.50	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool
2.00	2.50	01:30	Chisel.
7.90	8.60	01:00	Chisel.
10.50	10.50	01:00	Chisel.

Remarks:

Borehole terminated at 10.50m bgl due to obstruction. 50mm dia. standpipe installed. Response zone from 3.50 - 10.50m.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	12/09/2016 08:00	0.00	Start of shift.
Dry.	12/09/2016 18:00	4.50	End of shift.
Dry.	13/09/2016 08:00	4.50	Start of shift.
Dry.	13/09/2016 18:00	10.50	End of borehole.

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Drilled By:	AK	Borehole No.	**BH10**
Logged By:	AH		Sheet 1 of 2
Project Name:	Knockharley Landfill	**Project No.**	P16114
Co-ords:	697603E - 767231N	**Hole Type**	CP
Location:	Knockharley, Co. Meath	**Level:**	59.42m OD
Scale	1:50		
Client:	Fehily Timoney and Company	**Date:**	23/08/2016 - 25/08/2016

Well	Water Strike (m)	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (mOD)	Legend	Stratum Description	
		0.00 - 1.00 0.00 - 1.00	B D					Topsoil. Grey brown, slightly sandy very gravelly SILT with concrete, plastic, rootlets. Sand is fine to coarse. Gravel is fine to coarse, angular to sub-angular.	
		1.00	SPT (C)	N=16 (5,5/4,4,4,4)					1
		1.50 - 2.00 1.50 - 2.00	B D		1.50	57.92		Stiff, grey brown, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, angular to sub-angular.	
		2.00	SPT (C)	N=26 (7,10/7,5,7,7)					2
		2.50 - 3.00 2.50 - 3.00	B D						
		3.00 - 3.45	U						3
		3.45 - 4.00 3.45 - 4.00	B D		3.45	55.97		Stiff, grey, slightly sandy gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, angular to sub-angular. Cobbles are 110mm to 150mm dia and angular.	
		4.00	SPT (C)	N=51 (12,15/14,12,12,13)					4
		4.50 - 5.00 4.50 - 5.00	B D						
		5.00	SPT (C)	N=36 (12,12/10,9,7,10)					5
		5.50 - 6.00 5.50 - 6.00	B D					*5.50m: Driller described the soil as wet.*	
		6.00 - 6.50	U						6
		6.50 - 7.00 6.50 - 7.00	B D		6.50	52.92		Stiff, grey, slightly gravelly sandy CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine and sub-rounded.	
		7.00	SPT (C)	N=28 (7,8/7,6,8,7)					7
		7.50 - 8.00 7.50 - 8.00	B D						
		8.00	SPT (C)	N=50 (10,11/12,12,12,14)					8
		8.50 - 9.00 8.50 - 9.00	B D						
		9.00	SPT (C)	N=55 (7,7/11,12,12,20)					9

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
15.00	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool

Remarks:

Borehole terminated at 15.00m bgl due to obstruction. 50mm dia standpipe installed. Response from 4.00 - 15.00m.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	23/08/2016 08:00	0.00	Start of shift.
	23/08/2016 18:00	3.00	End of shift.
	24/08/2016 08:00	3.00	Start of shift.
	24/08/2016 18:00	14.00	End of shift.
	25/08/2016 08:00	14.00	Start of shift.
	25/08/2016 18:00	15.00	End of borehole.

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Drilled By:	Borehole No.
AK	**BH10**
Logged By:	
AH	Sheet 2 of 2

Project Name:	Knockharley Landfill	**Project No.** P16114	**Co-ords:**	697603E - 767231N	**Hole Type** CP
Location:	Knockharley, Co. Meath		**Level:**	59.42m OD	**Scale** 1:50
Client:	Fehily Timoney and Company		**Date:**	23/08/2016 - 25/08/2016	

Well	Water Strike (m)	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (mOD)	Legend	Stratum Description
		9.50 - 10.00 9.50 - 10.00	B D					Stiff, grey, slightly gravelly sandy CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine and sub-rounded.
		10.00	SPT (C)	N=61 (8,15/14,14,18,15)	10.00	49.42		Stiff, grey, slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, angular to sub-angular. Cobbles are 110mm dia and angular.
		10.50 - 11.00 10.50 - 11.00	B D					
		11.00	SPT (C)	N=66 (7,10/13,17,18,18)				
		11.50 - 12.00 11.50 - 12.00	B D					
		12.00	SPT (C)	N=46 (10,10/9,10,12,15)				
		12.50 - 13.00 12.50 - 13.00	B D					
		13.00	SPT (C)	N=74 (15,15/18,20,18,18)	13.00	46.42		Dark grey, slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine and sub-angular.
		13.50 - 14.00 13.50 - 14.00	B D					
		14.00	SPT (C)	N=71 (17,17/16,17,20,18)				
		14.50 - 15.00 14.50 - 15.00	B D					
		15.00	SPT (C)	N=76 (20,18/18,19,20,19)	15.00	44.42		End of Borehole at 15.000m

10
11
12
13
14
15
16
17
18

Groundwater:

Struck (m)	Rose to	After (mins)	Sealed	Comment
				None encountered.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
15.00	200	200

Equipment: Dando 2000.

Chiselling:

Depth Top	Depth Base	Duration	Tool

Remarks:

Borehole terminated at 15.00m bgl due to obstruction. 50mm dia standpipe installed. Response from 4.00 - 15.00m.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	23/08/2016 08:00	0.00	Start of shift.
	23/08/2016 18:00	3.00	End of shift.
	24/08/2016 08:00	3.00	Start of shift.
	24/08/2016 18:00	14.00	End of shift.
	25/08/2016 08:00	14.00	Start of shift.
	25/08/2016 18:00	15.00	End of borehole.

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Borehole No.
RC01
Sheet 1 of 3

Project Name:	Knockharley Landfill	Project No. P16114	Co-ords:	697777.46 - 767447.42	Hole Type RC
Location:	Knockharley, Co. Meath		Level:	61.18m OD	Scale 1:50
Client:	Fehily Timoney and Company		Dates:	05/08/2016	Logged By GH

Well	Water Strike (m)	Depth (m)	Type /Fs	Coring TCR	Coring SCR	Coring RQD	Depth (m) / FI	Level (mOD)	Legend	Stratum Description
		0.00 - 1.00	B							Light brown, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		1.00 - 2.00	B							
		2.00 - 3.00	B				2.00	59.18		Dark grey black, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		3.00 - 4.00	B				3.00	58.18		Black, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		4.00 - 5.00	B				4.00	57.18		Dark brown, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse. sub-angular to sub-rounded.
		5.00 - 6.00	B							
		6.00 - 7.00	B				6.00	55.18		Grey, slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
	▼	7.00 - 8.00	B				7.00	54.18		Brown, clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		8.00 - 9.00	B				8.00	53.18		Dark brown, silty slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.
		9.00 - 10.00	B							

Groundwater:

Struck, m	Rose to	After, min	Sealed	Comment
7.10				See shift data.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
27.00		

Equipment: Deltabase 520.

Chiselling:

Depth Top	Depth Base	Duration	Tool

Remarks:

Borehole terminated at 27.00m bgl. 50mm dia standpipe installed. Response zone from 20.00 - 27.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	05/08/2016 08:00	0.00	Start of shift.
7.1	05/08/2016 18:00	27.00	End of borehole.

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Project Name: Knockharley Landfill	Project No. P16114	Co-ords:	697777.46 - 767447.42	Hole Type RC
Location: Knockharley, Co. Meath		Level:	61.18m OD	Scale 1:50
Client: Fehily Timoney and Company		Dates:	05/08/2016	Logged By GH

Well	Water Strike (m)	Depth (m)	Type /Fs	Coring TCR	SCR	RQD	Depth (m) / FI	Level (mOD)	Legend	Stratum Description	
										Dark brown, silty slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.	
		10.00 - 11.00	B								10
		11.00 - 12.00	B								11
		12.00 - 13.00	B								12
		13.00 - 14.00	B								13
		14.00 - 15.00	B								14
											15
											16
							17.00	44.18		Open hole boring. Driller described: Rock.	17
											18

Groundwater:

Struck, m	Rose to	After, min	Sealed	Comment
7.10				See shift data.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
27.00		

Equipment: Deltabase 520.

Chiselling:

Depth Top	Depth Base	Duration	Tool

Remarks:

Borehole terminated at 27.00m bgl. 50mm dia standpipe installed. Response zone from 20.00 - 27.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	05/08/2016 08:00	0.00	Start of shift.
7.1	05/08/2016 18:00	27.00	End of borehole.

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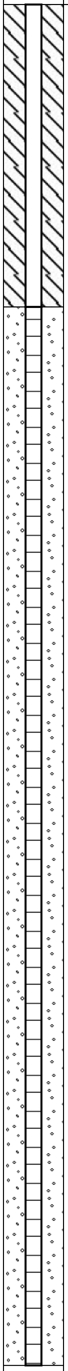
Project Name:	Knockharley Landfill	Project No. P16114	Co-ords:	697777.46 - 767447.42	Hole Type RC
Location:	Knockharley, Co. Meath		Level:	61.18m OD	Scale 1:50
Client:	Fehily Timoney and Company		Dates:	05/08/2016	Logged By GH

Well	Water Strike (m)	Depth (m)	Type /Fs	Coring TCR	SCR	RQD	Depth (m) / FI	Level (mOD)	Legend	Stratum Description	
										Open hole boring. Driller described: Rock.	
											19
											20
											21
											22
											23
											24
											25
											26
							27.00	34.18		End of Borehole at 27.000m	27



Groundwater:

Struck, m	Rose to	After, min	Sealed	Comment
7.10				See shift data.

Hole Information:

Hole Depth (m)	Hole Dia (mm)	Casing Dia (mm)
27.00		

Equipment: Deltabase 520.

Chiselling:

Depth Top	Depth Base	Duration	Tool

Remarks:

Borehole terminated at 27.00m bgl. 50mm dia standpipe installed. Response zone from 20.00 - 27.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth (m)	Remarks
	05/08/2016 08:00	0.00	Start of shift.
7.1	05/08/2016 18:00	27.00	End of borehole.

KEY TO SYMBOLS - LABORATORY TEST RESULT

U	Undisturbed Sample	
P	Piston Sample	
TWS	Thin Wall Sample	
B	Bulk Sample - Disturbed	
D	Jar Sample - Disturbed	
W	Water Sample	
pH	Acidity/Alkalinity Index	
SO_3	% - Total Sulphate Content (acid soluble)	
SO_3	g/ltr - Water Soluble Sulphate (Water or 2:1 Aqueous Soil Extract)	
+	Calcareous Reaction	
Cl	Chloride Content	
PI	Plasticity Index	
<425	% of material in sample passing 425 micron sieve	
LL	Liquid Limit	
PL	Plastic Limit	
MC	Water Content	
NP	Non Plastic	
Yb	Bulk Density	
Yd	Dry Density	
Ps	Particle Density	
U/D	Undrained/Drained Triaxial	
U/C	Unconsolidated/Consolidated Triaxial	
T/M	Single Stage/Multistage Triaxial	
100/38	Sample Diameter (mm)	
REM	Remoulded Triaxial Test Specimen	
TST	Triaxial Suction Test	
V	Vane Test	
DSB	Drained Shear Box	
RSB	Residual Shear Box	
RS	Ring Shear	
σ_3	Cell Pressure	
σ_1-σ_3	Deviator Stress	
c	Cohesion	
c_	Effective Cohesion Intercept	
ϕ	Angle of Shearing Resistance - Degrees	
ϕ_	Effective Angle of Shearing Resistance	
εf	Strain at Failure	
*	Failed under 1^{st} Load	
**	Failed under 2^{nd} Load	
#	Untestable	
##	Excessive Strain	
p_o	Effective Overburden Pressure	
m_v	Coefficient of Volume Decrease	
c_v	Coefficient of Consolidation	
Opt	Optimum	
Nat	Natural	
Std	Standard Compaction - 2.5kg Rammer	(¶ CBR)
Hvy	Heavy Compaction - 4.5kg Rammer	(§ CBR)
Vib	Vibratory Compaction	
CBR	California Bearing Ratio	
Sat m.c.	Saturation Moisture Content	
MCV	Moisture Condition Value	

Key sheet

pgl priority geotechnical

PRIORITY GEOTECHNICAL	Natural Moisture Content/Atterberg Limits Summary BS 1377 : Part 2 : 1990 : Clause 3	Job Ref
Location	**Knockharley Landfill**	**P16114**

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH01	2	0	D	Slightly sandy slightly gravelly CLAY	21				
BH01	3	1	B	Slightly sandy slightly gravelly CLAY with medium cobble content		24	15	9	71.6
BH01	4	1	D	Slightly sandy slightly gravelly CLAY	15				
BH01	6	2.5	D	Slightly sandy gravelly CLAY	16				
BH01	8	3.45	B	Slightly sandy slightly gravelly CLAY with low cobble content		28	19	9	66.6
BH01	9	3.45	D	Slightly sandy slighlty gravelly CLAY	16				
BH01	11	4.5	D	Slightly sandy slightly gravelly CLAY	16				
BH01	15	6.5	D	Slightly sandy slightly gravelly CLAY	15				
BH01	16	7	B	Slightly sandy slightly gravelly CLAY		29	16	13	67.8
BH01	17	7	D	Slightly sandy slightly gravelly CLAY	16				
BH01	19	8	D	Slightly sandy slightly gravelly CLAY	20				
BH02	2	0	D	Slightly sandy CLAY	24				
BH02	3	0.5	B	Slightly sandy CLAY		36	22	14	94.9
BH02	4	0.5	D	Slightly sandy CLAY	25				
BH02	6	1.2	D	Slightly sandy gravelly CLAY	22				
BH02	7	2.5	B	Slightly sandy gravelly CLAY with low cobble content		28	16	12	66.2
BH02	8	2.5	D	Slightly sandy gravelly CLAY	13				
BH02	13	6.5	B	Slightly sandy gravelly CLAY		30	17	13	65.5
BH02	14	6.5	D	Slightly sandy gravelly CLAY	15				
BH02	16	7.5	D	Slightly sandy gravelly CLAY	14				
BH02	20	9.5	D	Slightly sandy gravelly CLAY	16				
BH02	22	10.5	D	Slightly sandy gravelly CLAY	15				

PRIORITY GEOTECHNICAL

Natural Moisture Content/Atterberg Limits Summary

BS 1377 : Part 2 : 1990 : Clause 3

Location	Knockharley Landfill	Job Ref P16114

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH03	4	1.45	B	Slightly gravelly sandy CLAY		27	15	12	77.2
BH03	5	1.45	D	Slightly gravelly sandy CLAY	13				
BH03	8	3.5	B	Slightly gravelly sandy CLAY		29	18	11	64.3
BH03	9	3.5	D	Slightly gravelly sandy CLAY	15				
BH03	11	4.5	D	Slightly gravelly sandy CLAY	17				
BH03	12	5.5	B	Slightly sandy slightly gravelly CLAY		30	17	13	100
BH03	13	5.5	D	Slightly sandy slightly gravelly CLAY	15				
BH03	15	6.5	D	Slightly sandy slightly gravelly CLAY	15				
BH04	4	0.4	D	Slightly sandy slightly gravelly CLAY	15				
BH04	5	1.5	B	Slightly gravelly sandy CLAY		34	20	14	66.7
BH04	6	1.5	D	Slightly gravelly sandy CLAY	17				
BH04	7	2.5	B	Slightly sandy slightly gravelly CLAY		31	16	15	68.3
BH04	8	2.5	D	Slightly sandy slightly gravelly CLAY	14				
BH04	10	3.5	D	Slightly sandy slightly gravelly CLAY	12				
BH04	13	4.5	D	Slightly sandy slightly gravelly CLAY	13				
BH04	15	5.5	D	Slightly sandy slightly gravelly CLAY	12				
BH04	17	6	B	Very clayey very sandy GRAVEL with medium cobble content		27	17	10	61.7
BH04	18	7.5	D	Slightly sandy slightly gravelly CLAY	11				
BH04	22	9.5	D	Slightly sandy slightly gravelly CLAY	13				
BH04	24	10.5	D	Slightly sandy slightly gravelly CLAY	13				
BH04	28	12.5	D	Slightly sandy slightly gravelly CLAY	12				
BH04	32	14.5	D	Slightly sandy slightly gravelly CLAY	15				

PRIORITY GEOTECHNICAL

Natural Moisture Content/Atterberg Limits Summary

BS 1377 : Part 2 : 1990 : Clause 3

Job Ref

Location | Knockharley Landfill | P16114

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH05	5	1.4	B	Slightly sandy gravelly CLAY		34	24	10	71.7
BH05	6	1.4	D	Slightly sandy gravelly CLAY	15				
BH05	8	2.5	D	Slightly sandy gravelly CLAY	13				
BH05	10	3.5	D	Slightly sandy gravelly CLAY	12				
BH05	11	4.5	B	Slightly sandy gravelly CLAY		29	18	11	61.8
BH05	12	4.5	D	Slightly sandy gravelly CLAY	14				
BH05	14	5.5	D	Slightly sandy gravelly CLAY	12				
BH05	16	6.5	D	Slightly sandy gravelly CLAY	12				
BH05	17	7.5	B	Clayey sandy GRAVEL with high cobble content		28	16	12	63.9
BH05	18	7.5	D	Clayey sandy GRAVEL	13				
BH06	3	1	B	Slightly sandy gravelly CLAY with low cobble content		34	21	13	64.1
BH06	6	2.7	B	Slightly sandy gravelly CLAY		24	16	8	64.6
BH06	5	2.7	D	Slightly sandy gravelly CLAY	14				
BH06	7	4	B	Slightly sandy gravelly CLAY with low cobble content		27	15	12	67.4
BH06	8	5	D	Slightly sandy gravelly CLAY	16				
BH06	10	5.5	D	Slightly sandy gravelly CLAY	14				
BH06	12	7.1	D	Clayey very sandy GRAVEL	12				
BH07	2	0	D	Slightly sandy slightly gravelly CLAY	25				
BH07	3	1.5	B	Slightly sandy slightly gravelly CLAY with low cobble content		37	23	14	75.4
BH07	4	1.5	D	Slightly sandy slightly gravelly CLAY	15				
BH07	6	2.5	D	Slightly sandy slightly gravelly CLAY	11				
BH07	9	3.45	D	Slightly sandy gravelly CLAY	15				

PRIORITY GEOTECHNICAL	**Natural Moisture Content/Atterberg Limits Summary** BS 1377 : Part 2 : 1990 : Clause 3	Job Ref
Location	Knockharley Landfill	P16114

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH07	10	4.5	B	Slightly sandy gravelly CLAY with low cobble content		30	17	13	66.8
BH07	11	4.5	D	Slightly sandy gravelly CLAY	13				
BH07	15	6	D	Slightly sandy gravelly CLAY	14				
BH07	17	7.45	B	Slightly sandy gravelly CLAY with low cobble content		29	15	14	66.1
BH07	18	7.45	D	Slightly sandy gravelly CLAY	13				
BH07	22	9.5	D	Slightly sandy slightly gravelly CLAY	12				
BH08	2	0	D	Slightly sandy gravelly CLAY	21				
BH08	4	0.9	D	Slightly sandy gravelly CLAY	19				
BH08	6	1.5	D	Slightly sandy gravelly CLAY	20				
BH08	8	2.5	D	Slightly sandy gravelly CLAY	11				
BH08	10	3.5	D	Slightly sandy gravelly CLAY	8.2				
BH08	11	4.5	B	Slightly sandy gravelly CLAY		33	18	15	72.9
BH08	12	4.5	D	Slightly sandy gravelly CLAY	16				
BH08	14	5.5	D	Slightly sandy gravelly CLAY	13				
BH09	2	0	D	Slightly sandy slightly gravelly CLAY	34				
BH09	5	1.6	B	COBBLES with clayey sandy GRAVEL		33	19	14	67.9
BH09	8	2.4	D	Slightly sandy gravelly CLAY	12				
BH09	10	3.5	D	Slightly sandy gravelly CLAY	14				
BH09	12	4.5	D	Slightly sandy gravelly CLAY	12				
BH09	13	5.5	B	Slightly sandy gravelly CLAY with medium cobble content		29	16	13	61.8
BH09	14	5.5	D	Slightly sandy gravelly CLAY	8.6				
BH09	16	6.5	D	Slightly sandy gravelly CLAY	12				

PRIORITY GEOTECHNICAL

Natural Moisture Content/Atterberg Limits Summary

BS 1377 : Part 2 : 1990 : Clause 3

Job Ref

Location

Knockharley Landfill

P16114

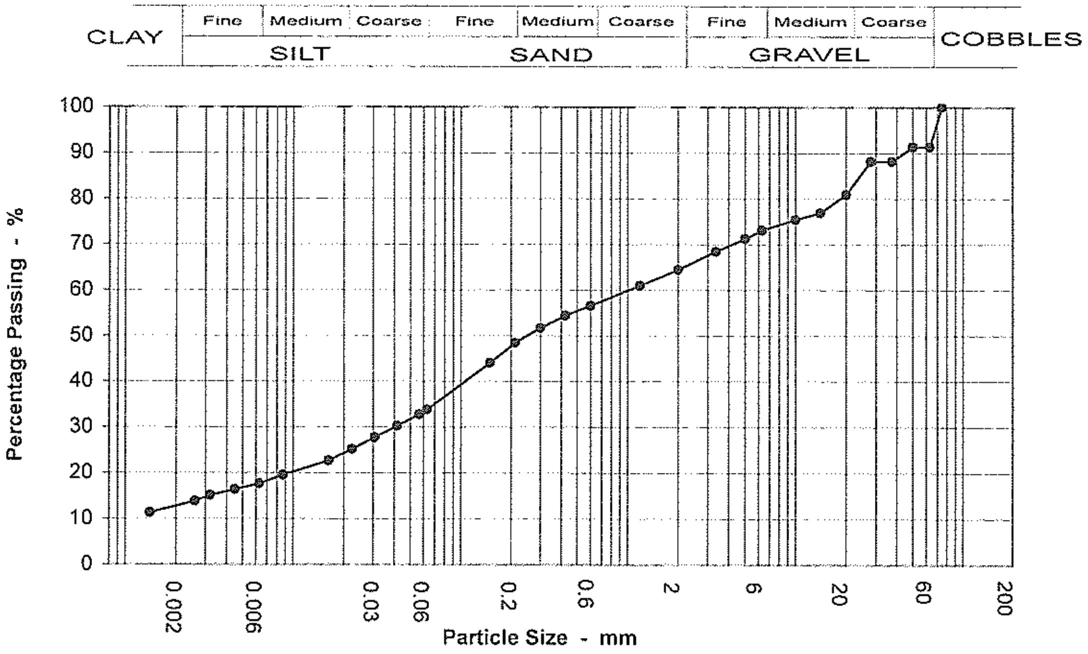
Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH09	18	7.5	D	Slightly sandy gravelly CLAY	11				
BH09	20	8.5	D	Slightly sandy gravelly CLAY	11				
BH09	22	9.5	D	Slightly sandy gravelly CLAY	16				
BH10	2	0	D	Slightly sandy slightly gravelly SILT	17				
BH10	3	1.5	B	Slightly sandy slightly gravelly SILT		51	30	21	83
BH10	4	1.5	D	Slightly sandy slightly gravelly SILT	34				
BH10	5	2.5	B	Slightly sandy slightly gravelly CLAY		37	24	13	67
BH10	6	2.5	D	Slightly sandy slightly gravelly CLAY	18				
BH10	9	3.45	D	Slighlty sandy slightly gravelly CLAY	11				
BH10	10	4.5	B	Slightly sandy gravelly CLAY with high cobble content		28	17	11	65.9
BH10	11	4.5	D	Slightly sandy gravelly CLAY	9.7				
BH10	13	5.5	D	Slightly sandy gravelly CLAY	13				
BH10	17	7.5	B	Slightly sandy slightly gravelly CLAY		28	18	10	71.4
BH10	18	7.5	D	Slightly sandy slightly gravelly CLAY	15				
BH10	19	8.5	B	Slightly sandy slightly gravelly CLAY		29	17	12	67.6
BH10	20	8.5	D	Slightly sandy slightly gravelly CLAY	9.1				
BH10	24	10.5	D	Slightly sandy slightly gravelly CLAY	11				
BH10	25	11.5	B	Slightly sandy slightly gravelly CLAY		30	16	14	67.1
BH10	28	12.5	D	Slightly sandy slightly gravelly CLAY	13				
BH10	29	13.5	B	Slightly sandy slightly gravelly CLAY with medium cobble content		37	21	16	52.6
BH10	30	13.5	D	Slightly sandy slightly gravelly CLAY	16				

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P16114
Borehole / Pit No	BH01
Sample No	3
Depth	1.00 m
Sample type	B
Location	Knockharley Landfill
Soil Description	Slightly sandy slightly gravelly CLAY with medium cobble content



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	33
90	100	0.042	30
75	100	0.031	28
63	91	0.022	25
50	91	0.016	23
37.5	88	0.009	20
28	88	0.006	18
20	81	0.005	16
14	77	0.003	15
10	75	0.003	14
6.3	73	0.001	11
5	71		
3.35	68		
2	64		
1.18	61		
0.6	57		
0.425	54		
0.3	52		
0.212	48		
0.15	44		
0.063	34		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	8.6
Gravel	26.9
Sand	31.2
Silt	20.7
Clay	12.6

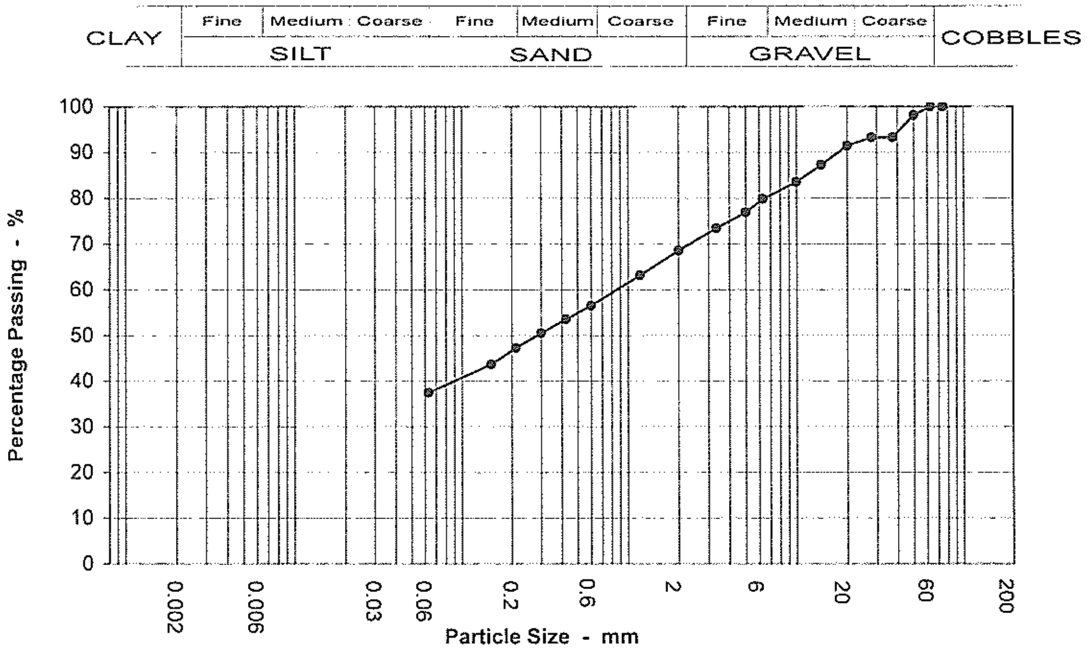
Grading Analysis	
D100	75.000
D60	1.056
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Location	**Knockharley Landfill**	Job Ref	P16114
		Borehole / Pit No	BH01
		Sample No	8
Soil Description	Slightly sandy slightly gravelly CLAY with low cobble content	Depth	3.45 m
		Sample type	B



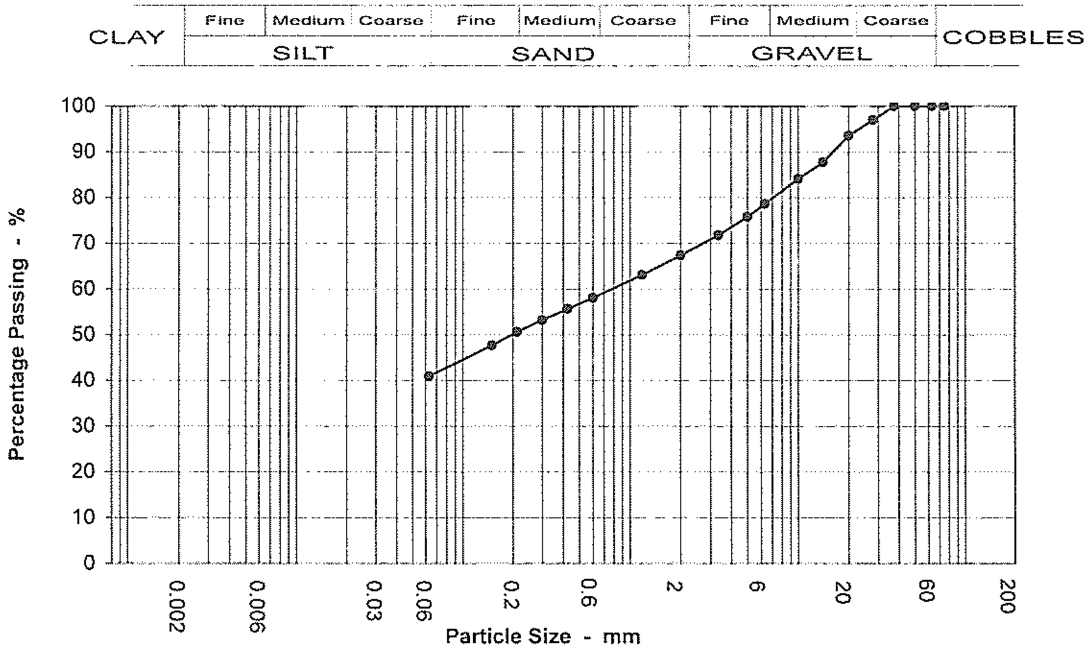
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	98		
37.5	93		
28	93		
20	91		
14	87		
10	83		
6.3	80		
5	77		
3.35	73		
2	69		
1.18	63		
0.6	56		
0.425	54		
0.3	50		
0.212	47		
0.15	44		
0.063	37		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.4
Gravel	31.0
Sand	31.1
Silt & Clay	37.5

Grading Analysis	
D100	63.000
D60	0.908
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P16114**
		Borehole / Pit No	BH01
Location	**Knockharley Landfill**	Sample No	10
		Depth	4.50 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample type	B



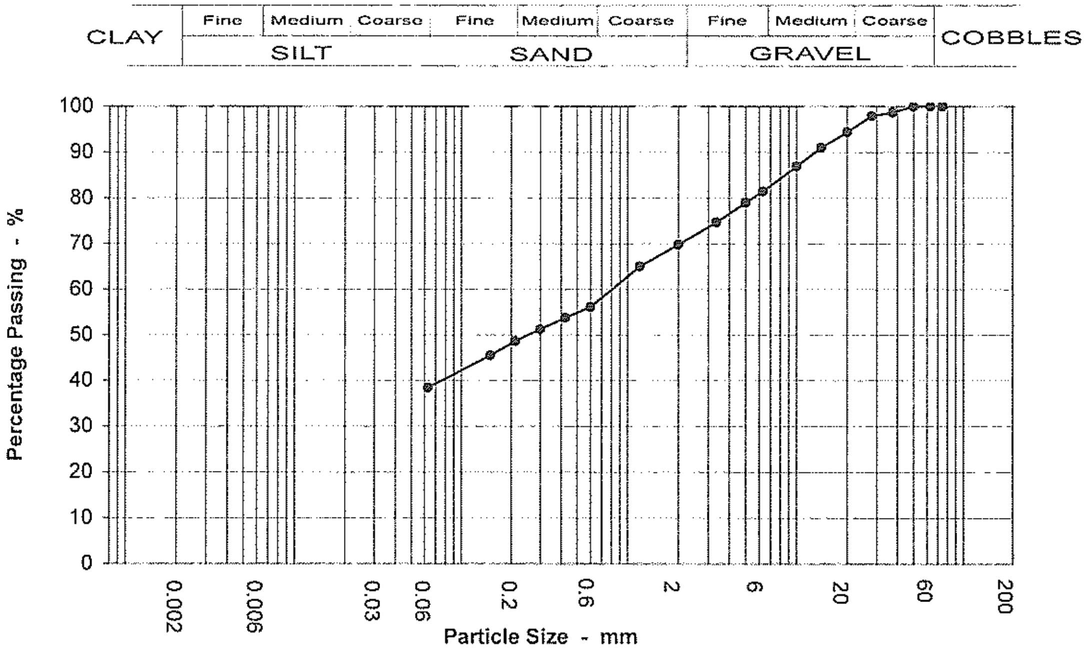
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	94		
14	88		
10	84		
6.3	79		
5	76		
3.35	72		
2	67		
1.18	63		
0.6	58		
0.425	56		
0.3	53		
0.212	51		
0.15	48		
0.063	41		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	32.7
Sand	26.3
Silt & Clay	41.0

Grading Analysis	
D100	37.500
D60	0.828
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16114
		Borehole / Pit No	BH01
Location	Knockharley Landfill	Sample No	12
		Depth	5.50 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	99		
28	98		
20	94		
14	91		
10	87		
6.3	81		
5	79		
3.35	75		
2	70		
1.18	65		
0.6	56		
0.425	54		
0.3	51		
0.212	49		
0.15	45		
0.063	38		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	30.2
Sand	31.4
Silt & Clay	38.4

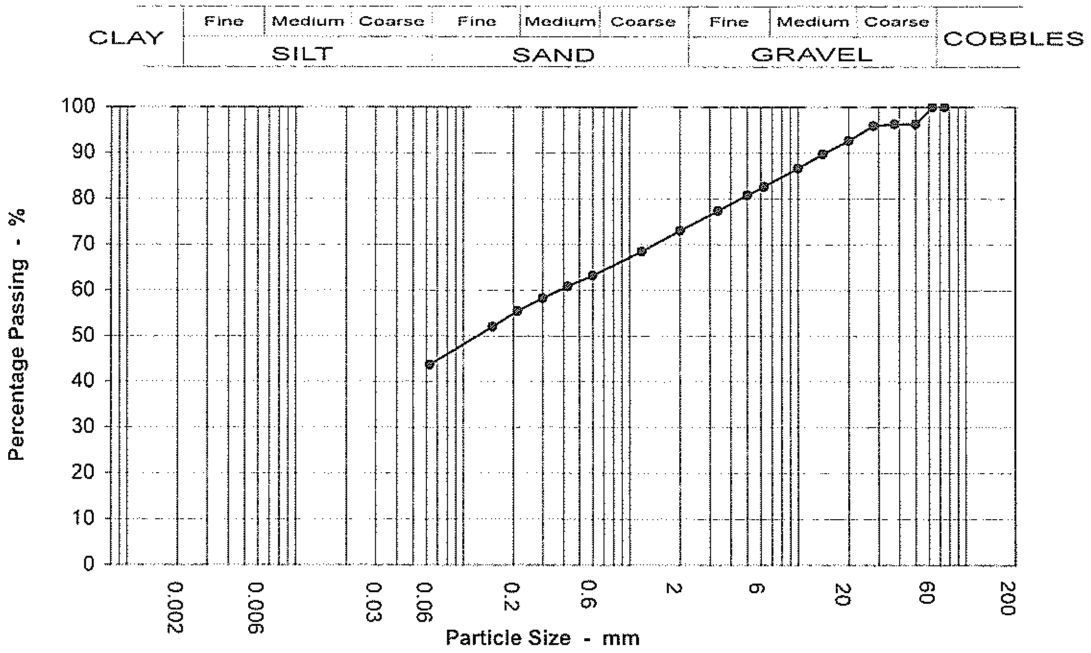
Grading Analysis	
D100	50.000
D60	0.852
D10	
Uniformity Coefficient	N/A

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P16114
Borehole / Pit No	BH01
Sample No	16
Depth	7.00 m
Sample type	B

Location	**Knockharley Landfill**
Soil Description	Slightly sandy slightly gravelly CLAY



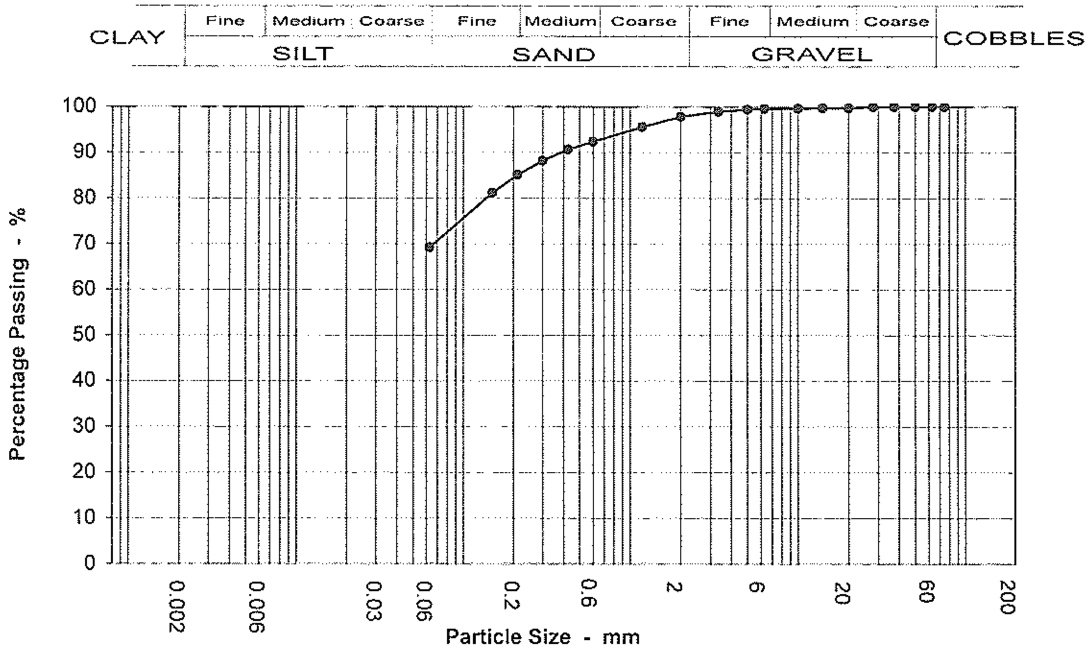
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	96		
37.5	96		
28	96		
20	93		
14	90		
10	87		
6.3	83		
5	81		
3.35	77		
2	73		
1.18	68		
0.6	63		
0.425	61		
0.3	58		
0.212	55		
0.15	52		
0.063	44		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.9
Gravel	26.2
Sand	29.3
Silt & Clay	43.7

Grading Analysis	
D100	63.000
D60	0.386
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16114
		Borehole / Pit No	BH02
Location	**Knockharley Landfill**	Sample No	3
		Depth	0.50 m
Soil Description	Slightly sandy CLAY	Sample type	B



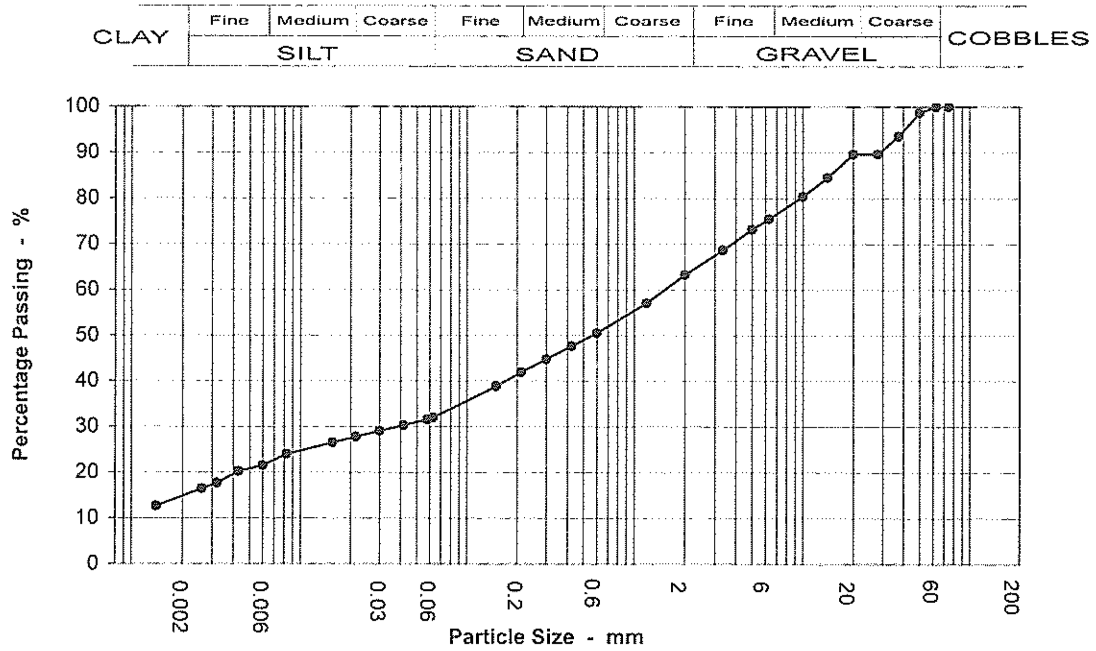
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	99		
3.35	99		
2	98		
1.18	96		
0.6	92		
0.425	91		
0.3	88		
0.212	85		
0.15	81		
0.063	69		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	2.1
Sand	28.6
Silt & Clay	69.2

Grading Analysis	
D100	28.000
D60	
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16114
		Borehole / Pit No	BH02
Location	**Knockharley Landfill**	Sample No	7
		Depth	2.50 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



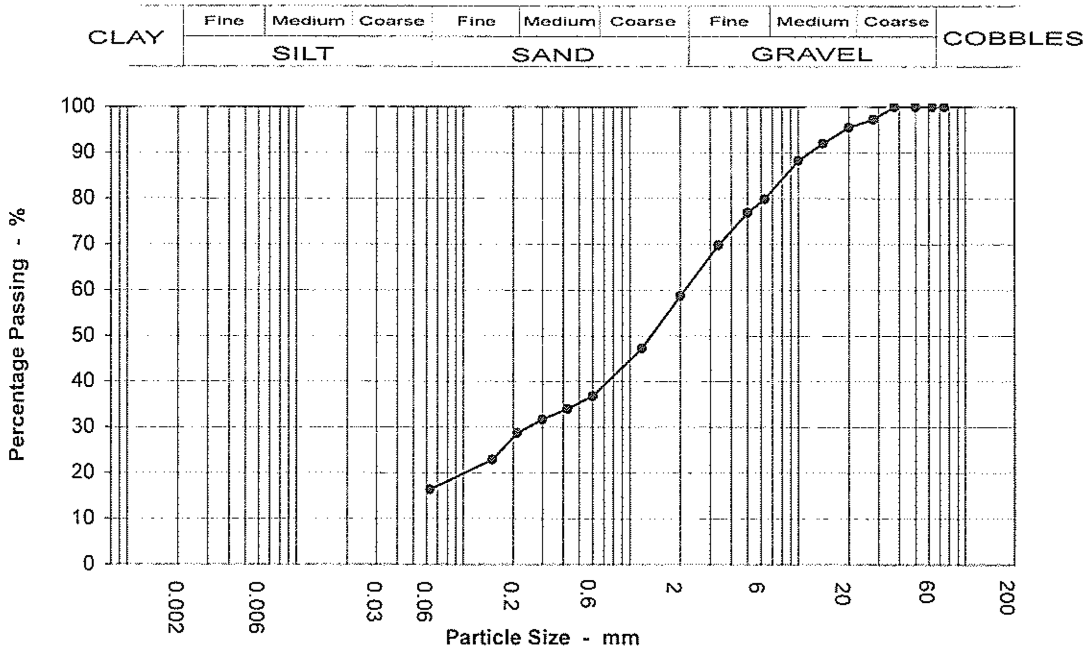
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.058	32
90	100	0.042	30
75	100	0.030	29
63	100	0.022	28
50	99	0.016	27
37.5	94	0.008	24
28	90	0.006	21
20	90	0.004	20
14	85	0.003	18
10	80	0.003	16
6.3	75	0.001	13
5	73		
3.35	69		
2	63		
1.18	57		
0.6	51		
0.425	48		
0.3	45		
0.212	42		
0.15	39		
0.063	32		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.3
Gravel	36.4
Sand	31.5
Silt	17.2
Clay	14.5

Grading Analysis	
D100	63.000
D60	1.570
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P16114**
		Borehole / Pit No	BH02
Location	**Knockharley Landfill**	Sample No	10
		Depth	3.50 m
Soil Description	Clayey SAND AND GRAVEL	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	95		
14	92		
10	88		
6.3	80		
5	77		
3.35	70		
2	59		
1.18	47		
0.6	37		
0.425	34		
0.3	32		
0.212	29		
0.15	23		
0.063	16		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	41.3
Sand	42.4
Silt & Clay	16.4

Grading Analysis	
D100	37.500
D60	2.155
D10	
Uniformity Coefficient	N/A

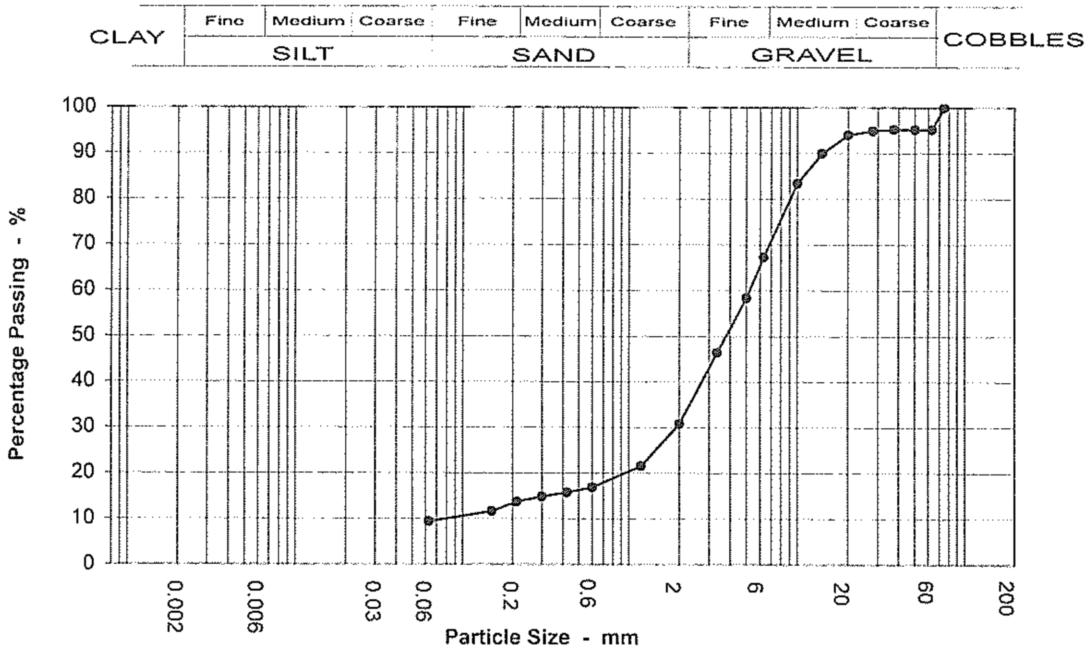
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P16114
Borehole / Pit No	BH02
Sample No	11
Depth	4.50 m
Sample type	B

Location	**Knockharley Landfill**
Soil Description	Clayey very sandy GRAVEL with low cobble content



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	95		
50	95		
37.5	95		
28	95		
20	94		
14	90		
10	83		
6.3	67		
5	58		
3.35	46		
2	31		
1.18	22		
0.6	17		
0.425	16		
0.3	15		
0.212	14		
0.15	12		
0.063	9		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	4.8
Gravel	64.4
Sand	21.4
Silt & Clay	9.4

Grading Analysis	
D100	75.000
D60	5.240
D10	0.087
Uniformity Coefficient	60

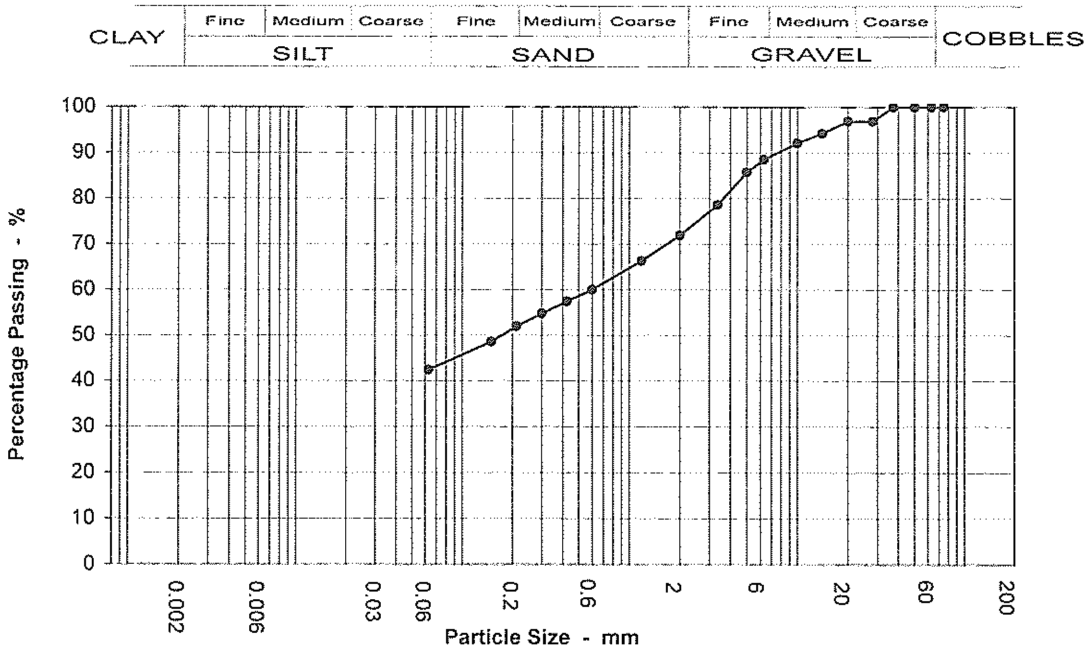
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P16114
Borehole / Pit No	BH02
Sample No	12
Depth	5.50 m
Sample type	B

Location	**Knockharley Landfill**
Soil Description	Slightly sandy slightly gravelly CLAY



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	97		
14	94		
10	92		
6.3	89		
5	86		
3.35	79		
2	72		
1.18	66		
0.6	60		
0.425	57		
0.3	55		
0.212	52		
0.15	49		
0.063	42		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	28.2
Sand	29.5
Silt & Clay	42.4

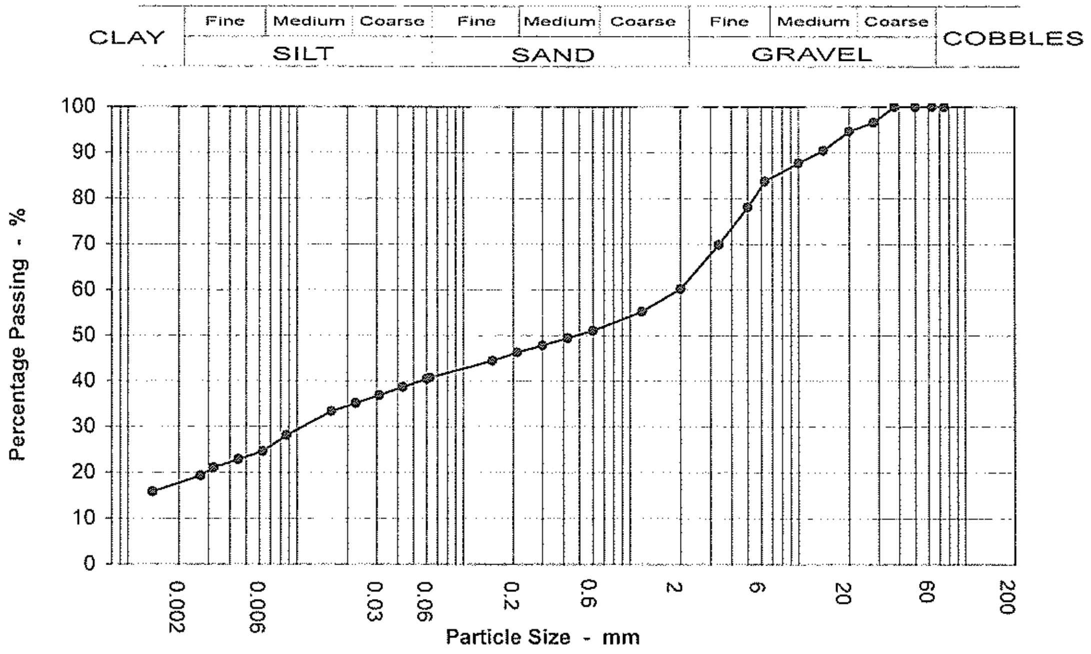
Grading Analysis	
D100	37.500
D60	0.603
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	**P16114**
Borehole / Pit No	BH02
Sample No	13
Depth	6.50 m
Sample type	B
Location	**Knockharley Landfill**
Soil Description	Slightly sandy gravelly CLAY



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.060	40
90	100	0.043	39
75	100	0.031	37
63	100	0.022	35
50	100	0.016	33
37.5	100	0.009	28
28	97	0.006	25
20	95	0.005	23
14	90	0.003	21
10	88	0.003	19
6.3	84	0.001	16
5	78		
3.35	70		
2	60		
1.18	55		
0.6	51		
0.425	49		
0.3	48		
0.212	46		
0.15	44		
0.063	41		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	39.8
Sand	19.7
Silt	23.0
Clay	17.4

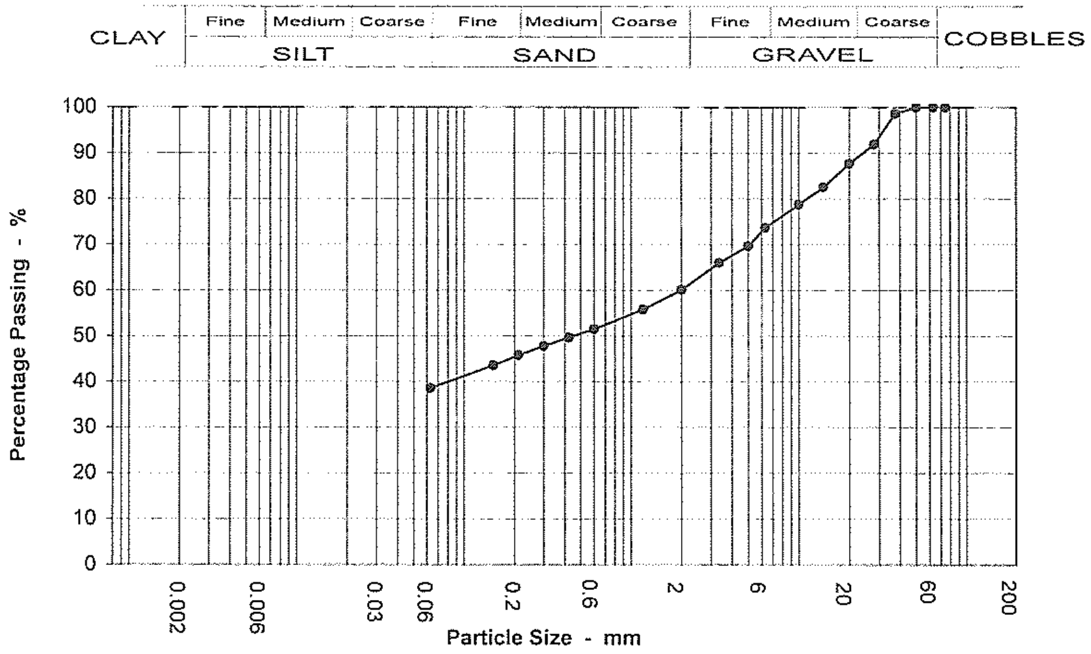
Grading Analysis	
D100	37.500
D60	1.974
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16114**
		Borehole / Pit No	BH02
Location	**Knockharley Landfill**	Sample No	23
		Depth	11.50 m
Soil Description	Slightly sandy gravelly CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	99		
28	92		
20	88		
14	82		
10	79		
6.3	74		
5	70		
3.35	66		
2	60		
1.18	56		
0.6	51		
0.425	50		
0.3	48		
0.212	46		
0.15	44		
0.063	39		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	40.0
Sand	21.5
Silt & Clay	38.6

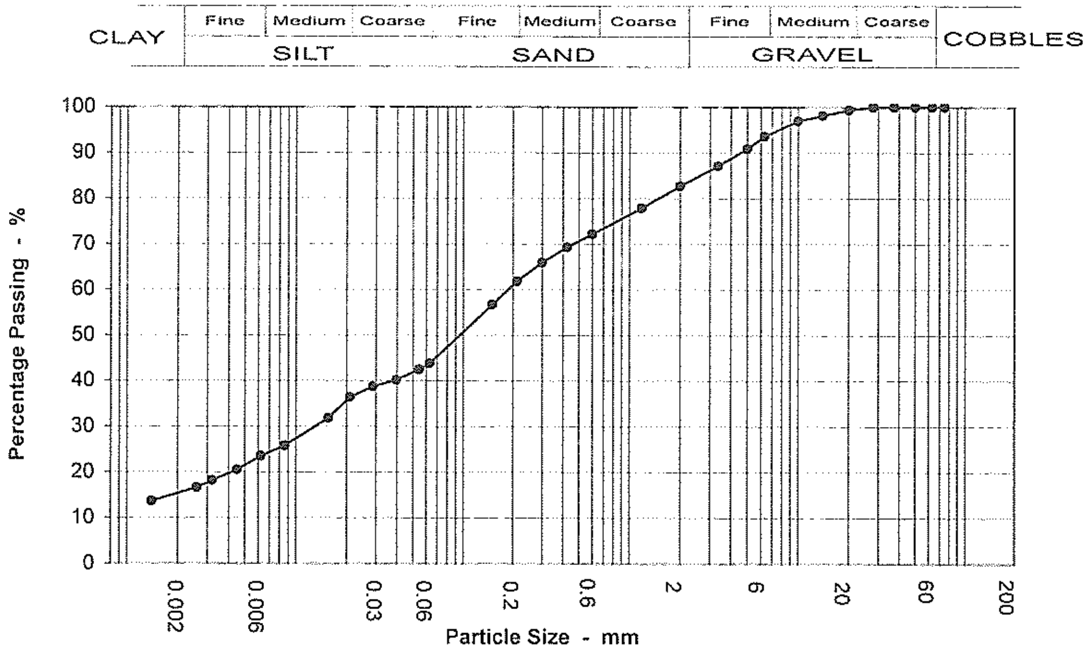
Grading Analysis	
D100	50.000
D60	1.997
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16114**
		Borehole / Pit No	BH03
Location	**Knockharley Landfill**	Sample No	4
		Depth	1.45 m
Soil Description	Slightly gravelly sandy CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.054	42
90	100	0.040	40
75	100	0.029	39
63	100	0.021	36
50	100	0.016	32
37.5	100	0.009	26
28	100	0.006	24
20	99	0.005	20
14	98	0.003	18
10	97	0.003	17
6.3	94	0.001	14
5	91		
3.35	87		
2	83		
1.18	78		
0.6	72		
0.425	69		
0.3	66		
0.212	62		
0.15	57		
0.063	44		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	17.3
Sand	39.4
Silt	28.2
Clay	15.2

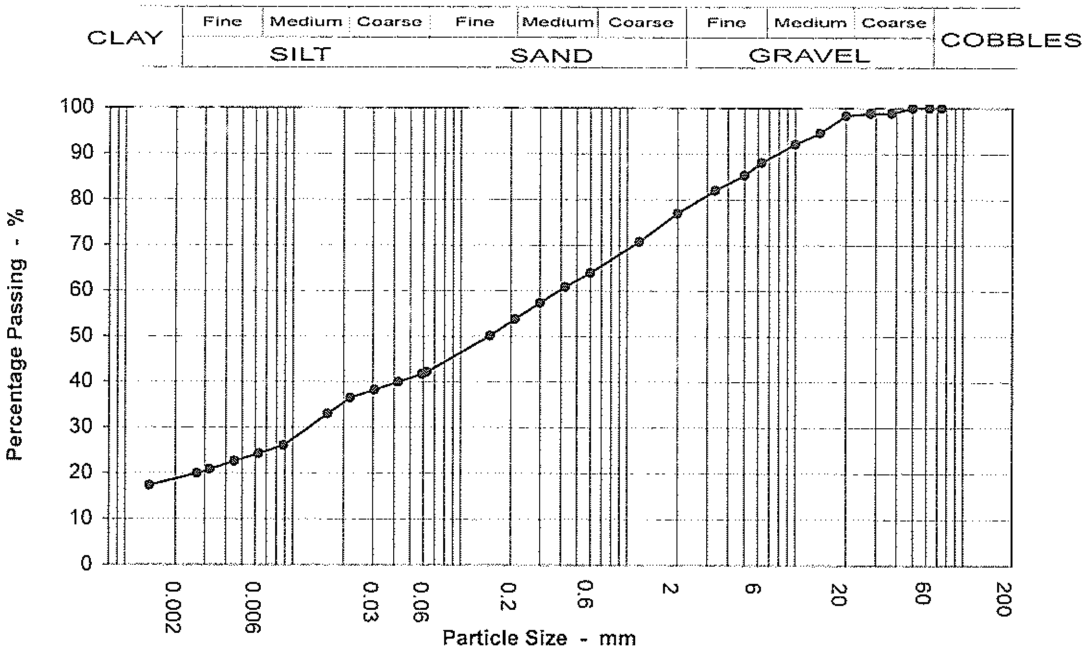
Grading Analysis	
D100	28.000
D60	0.190
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Location	**Knockharley Landfill**	Job Ref	**P16114**
		Borehole / Pit No	BH03
		Sample No	8
Soil Description	Slightly gravelly sandy CLAY	Depth	3.50 m
		Sample type	B



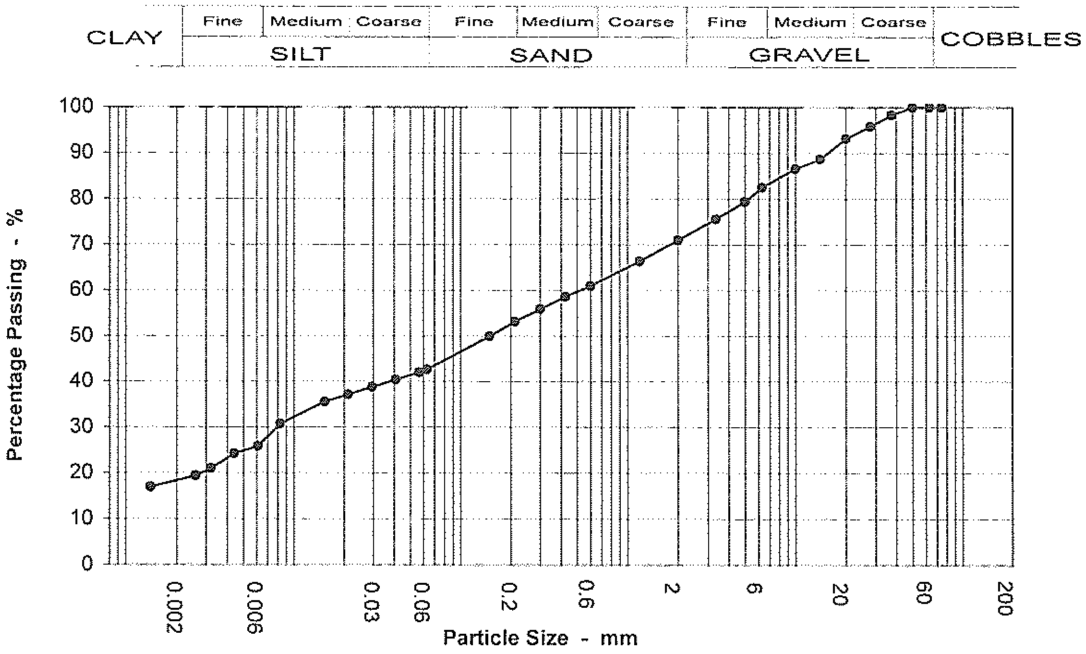
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	42
90	100	0.043	40
75	100	0.031	38
63	100	0.022	36
50	100	0.016	33
37.5	99	0.009	26
28	99	0.006	24
20	98	0.005	23
14	95	0.003	21
10	92	0.003	20
6.3	88	0.001	17
5	85		
3.35	82		
2	77		
1.18	71		
0.6	64		
0.425	61		
0.3	57		
0.212	54		
0.15	50		
0.063	42		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	23.0
Sand	35.2
Silt	23.2
Clay	18.6

Grading Analysis	
D100	50.000
D60	0.397
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	# PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16114
		Borehole / Pit No	BH03
Location	**Knockharley Landfill**	Sample No	12
		Depth	5.50 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	42
90	100	0.041	40
75	100	0.030	39
63	100	0.021	37
50	100	0.015	36
37.5	98	0.008	31
28	96	0.006	26
20	93	0.004	24
14	89	0.003	21
10	87	0.003	19
6.3	83	0.001	17
5	79		
3.35	76		
2	71		
1.18	66		
0.6	61		
0.425	59		
0.3	56		
0.212	53		
0.15	50		
0.063	43		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	29.1
Sand	28.6
Silt	24.2
Clay	18.2

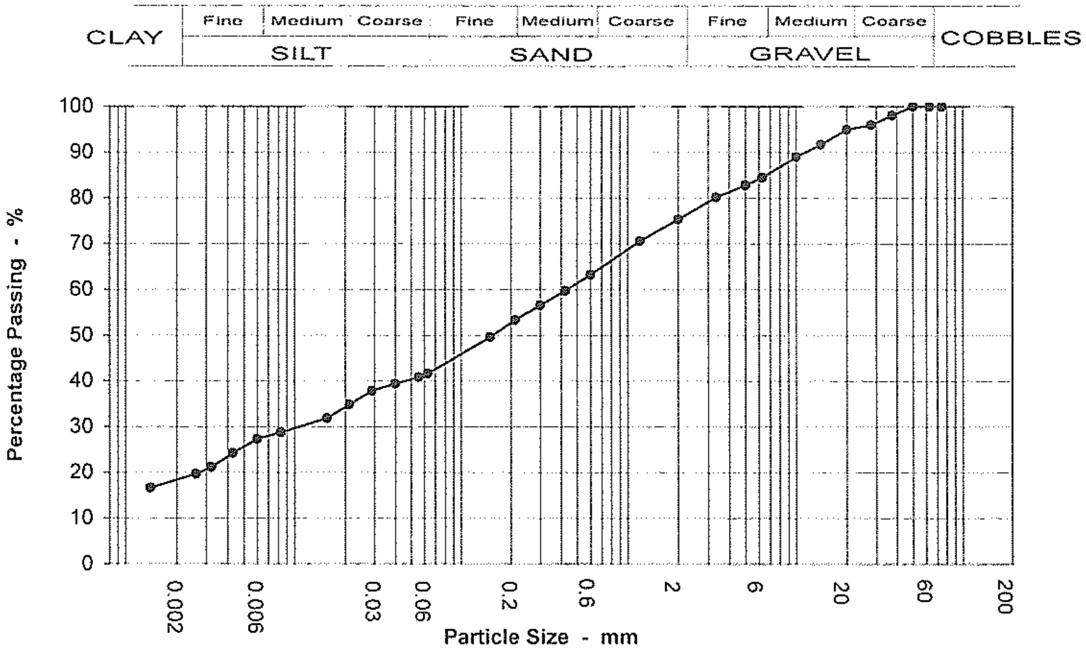
Grading Analysis	
D100	50.000
D60	0.529
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P16114	Borehole / Pit No	BH04
Location	Knockharley Landfill	Sample No	5
		Depth	1.50 m
Soil Description	Slightly gravelly sandy CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.056	41
90	100	0.040	39
75	100	0.029	38
63	100	0.021	35
50	100	0.016	32
37.5	98	0.008	29
28	96	0.006	27
20	95	0.004	24
14	92	0.003	21
10	89	0.003	20
6.3	84	0.001	17
5	83		
3.35	80		
2	75		
1.18	71		
0.6	63		
0.425	60		
0.3	57		
0.212	53		
0.15	50		
0.063	42		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	24.7
Sand	34.0
Silt	23.1
Clay	18.2

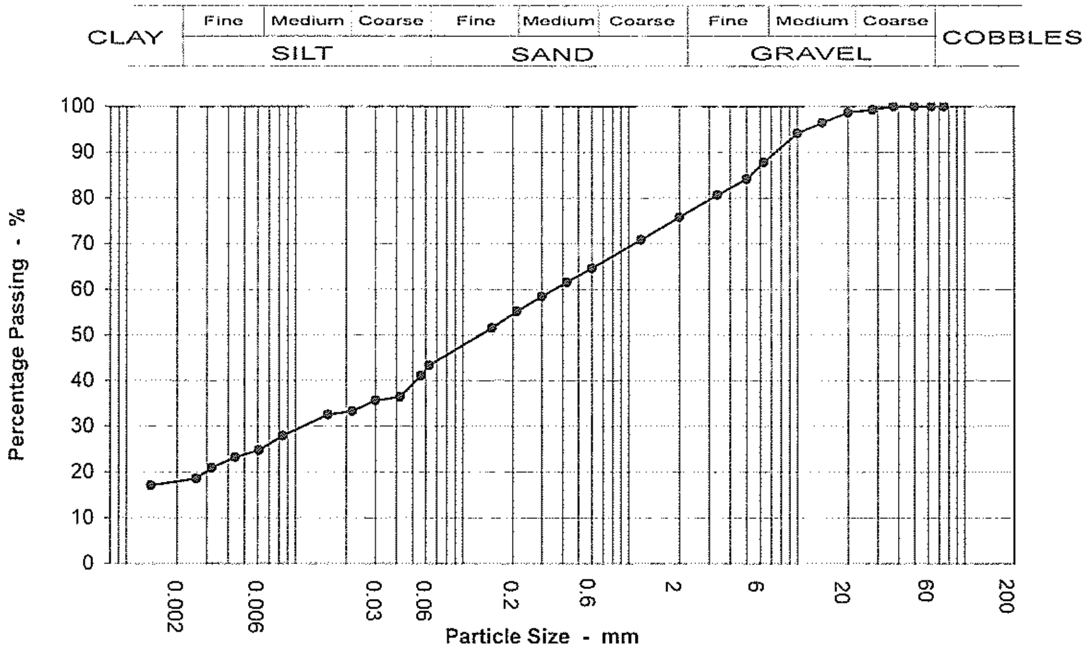
Grading Analysis	
D100	50.000
D60	0.439
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Location	**Knockharley Landfill**	**Job Ref**	**P16114**
		Borehole / Pit No	BH04
		Sample No	7
Soil Description	Slightly sandy slightly gravelly CLAY	Depth	2.50 m
		Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.056	41
90	100	0.042	36
75	100	0.030	36
63	100	0.022	33
50	100	0.016	33
37.5	100	0.008	28
28	99	0.006	25
20	99	0.004	23
14	96	0.003	21
10	94	0.003	19
6.3	88	0.001	17
5	84		
3.35	81		
2	76		
1.18	71		
0.6	65		
0.425	62		
0.3	58		
0.212	55		
0.15	51		
0.063	43		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	24.2
Sand	33.4
Silt	24.5
Clay	17.8

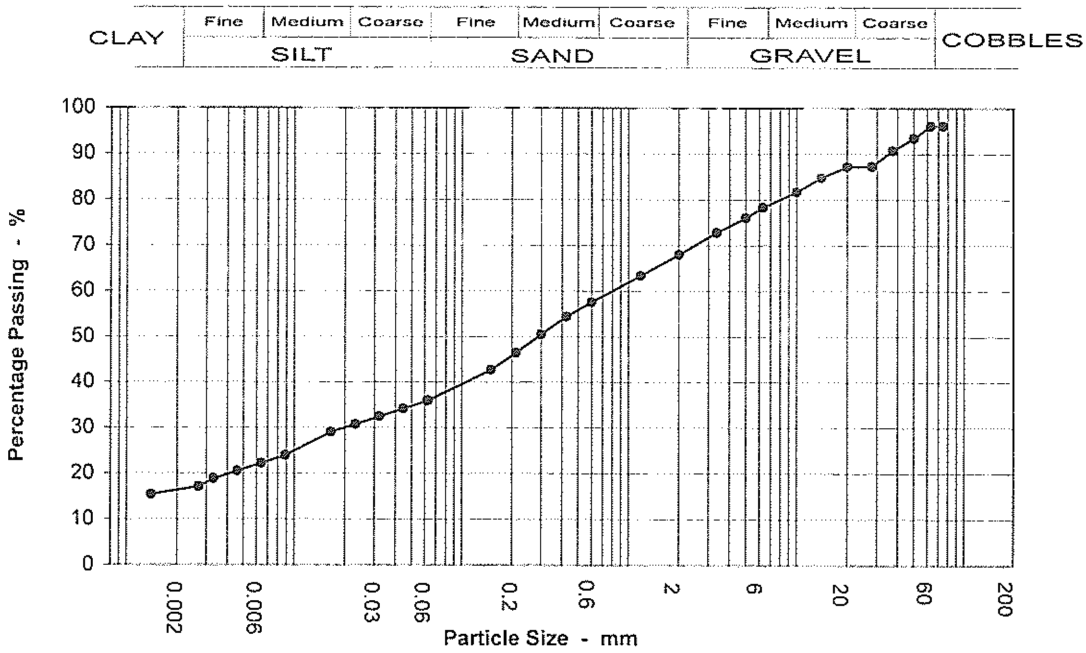
Grading Analysis	
D100	37.500
D60	0.364
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16114**
		Borehole / Pit No	BH04
Location	**Knockharley Landfill**	Sample No	14
		Depth	5.50 m
Soil Description	Slightly sandy slightly gravelly CLAY with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.062	36
90	100	0.045	34
75	96	0.032	32
63	96	0.023	31
50	93	0.017	29
37.5	91	0.009	24
28	87	0.006	22
20	87	0.005	21
14	85	0.003	19
10	82	0.003	17
6.3	78	0.001	15
5	76		
3.35	73		
2	68		
1.18	63		
0.6	58		
0.425	54		
0.3	50		
0.212	46		
0.15	43		
0.063	36		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	4.6
Gravel	27.5
Sand	32.3
Silt	19.5
Clay	16.2

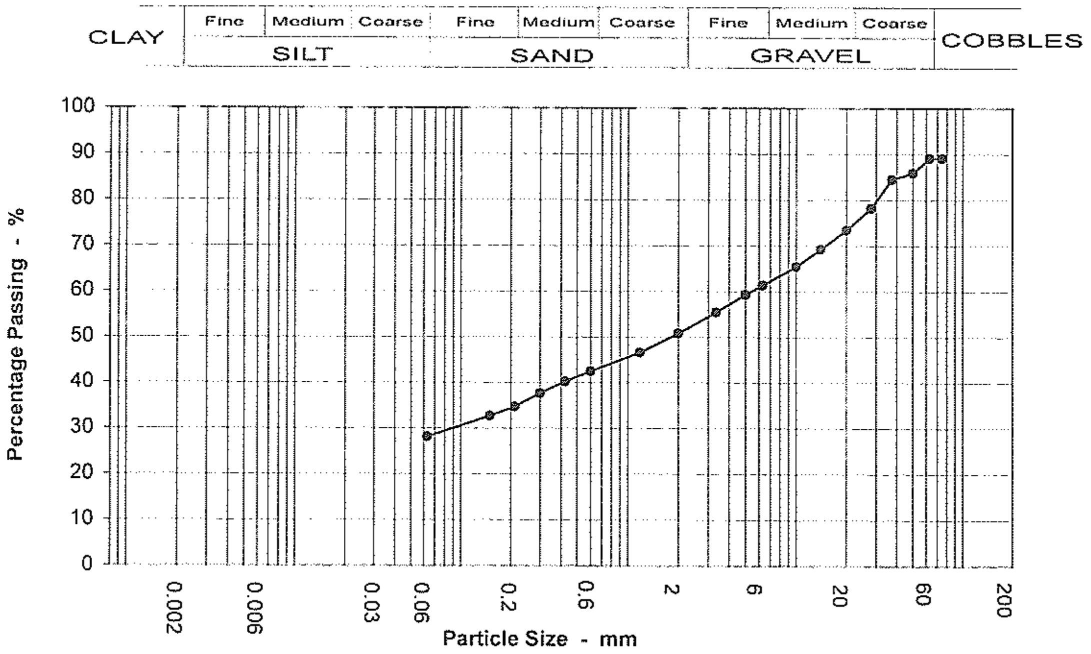
Grading Analysis	
D100	90.000
D60	0.847
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16114**
		Borehole / Pit No	BH04
Location	**Knockharley Landfill**	Sample No	17
		Depth	6.00 m
Soil Description	Very clayey very sandy GRAVEL with medium cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	89		
75	89		
63	89		
50	86		
37.5	84		
28	78		
20	73		
14	69		
10	65		
6.3	61		
5	59		
3.35	55		
2	51		
1.18	47		
0.6	42		
0.425	40		
0.3	38		
0.212	35		
0.15	33		
0.063	28		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	11.6
Gravel	37.5
Sand	22.7
Silt & Clay	28.1

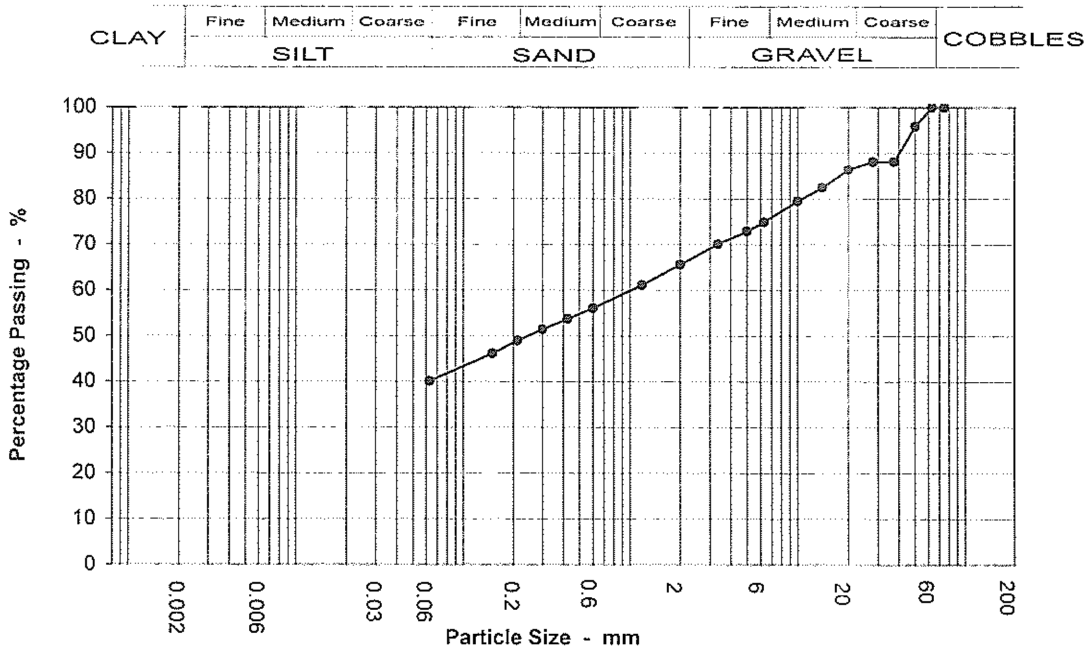
Grading Analysis	
D100	125.000
D60	5.462
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16114**
		Borehole / Pit No	BH04
Location	**Knockharley Landfill**	Sample No	21
		Depth	9.50 m
Soil Description	Slightly sandy slightly gravelly CLAY with low cobble content	Sample type	B



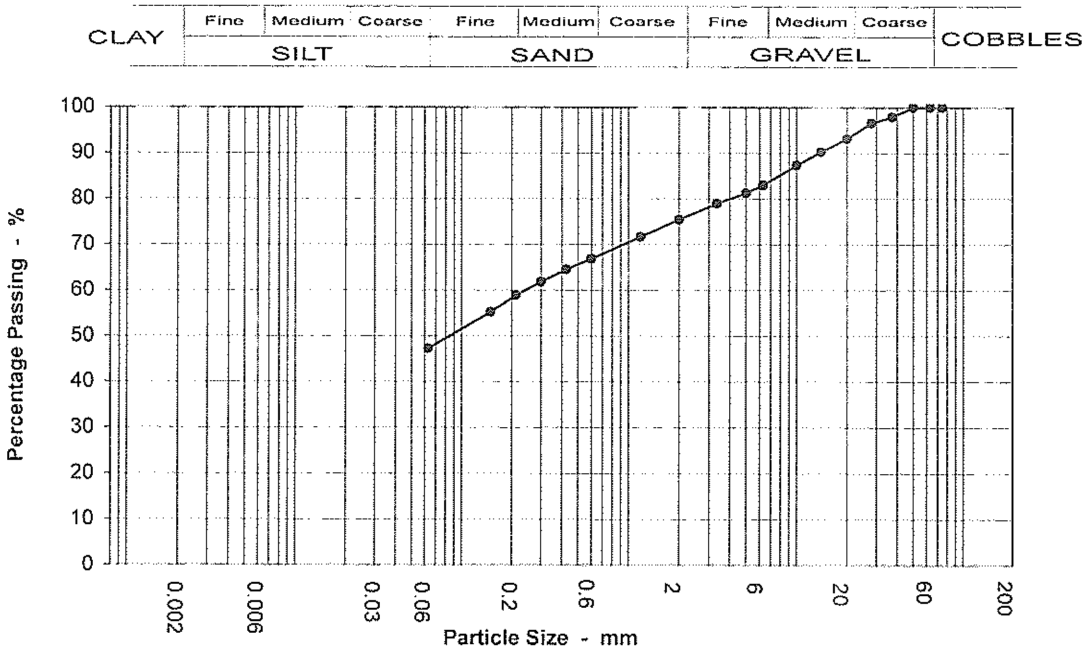
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	96		
37.5	88		
28	88		
20	86		
14	82		
10	80		
6.3	75		
5	73		
3.35	70		
2	66		
1.18	61		
0.6	56		
0.425	54		
0.3	51		
0.212	49		
0.15	46		
0.063	40		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	1.0
Gravel	33.5
Sand	25.5
Silt & Clay	40.1

Grading Analysis	
D100	63.000
D60	1.054
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16114
		Borehole / Pit No	BH04
Location	**Knockharley Landfill**	Sample No	29
		Depth	13.50 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	98		
28	97		
20	93		
14	90		
10	87		
6.3	83		
5	81		
3.35	79		
2	75		
1.18	72		
0.6	67		
0.425	65		
0.3	62		
0.212	59		
0.15	55		
0.063	47		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	24.6
Sand	28.2
Silt & Clay	47.2

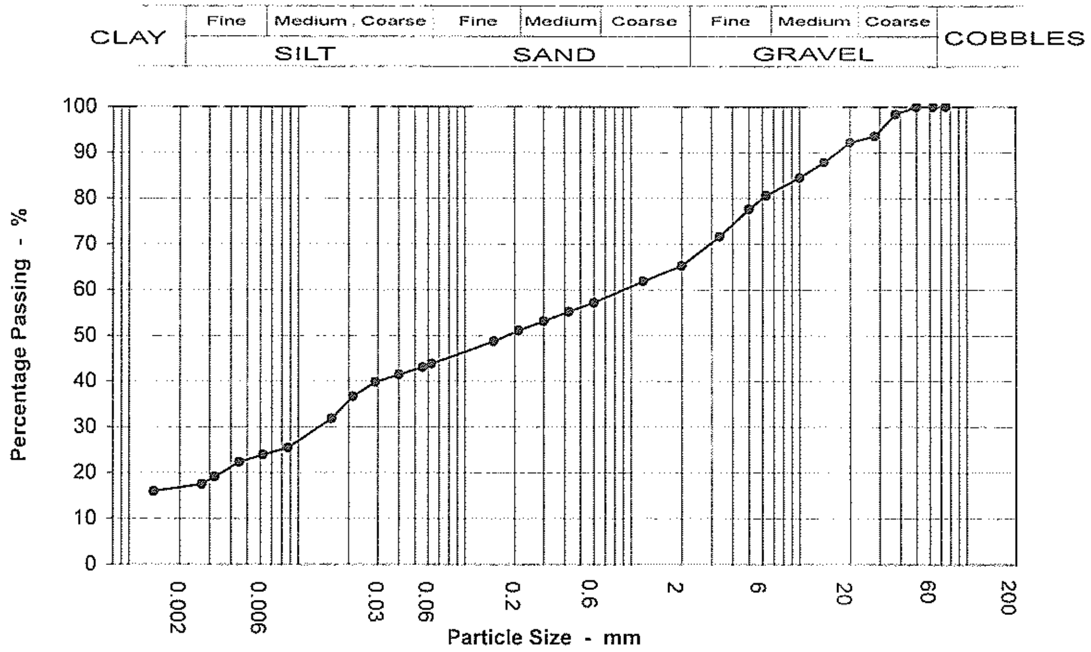
Grading Analysis	
D100	50.000
D60	0.246
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	**P16114**
Borehole / Pit No	BH05
Sample No	5
Depth	1.40 m
Sample type	B
Location	**Knockharley Landfill**
Soil Description	Slightly sandy gravelly CLAY



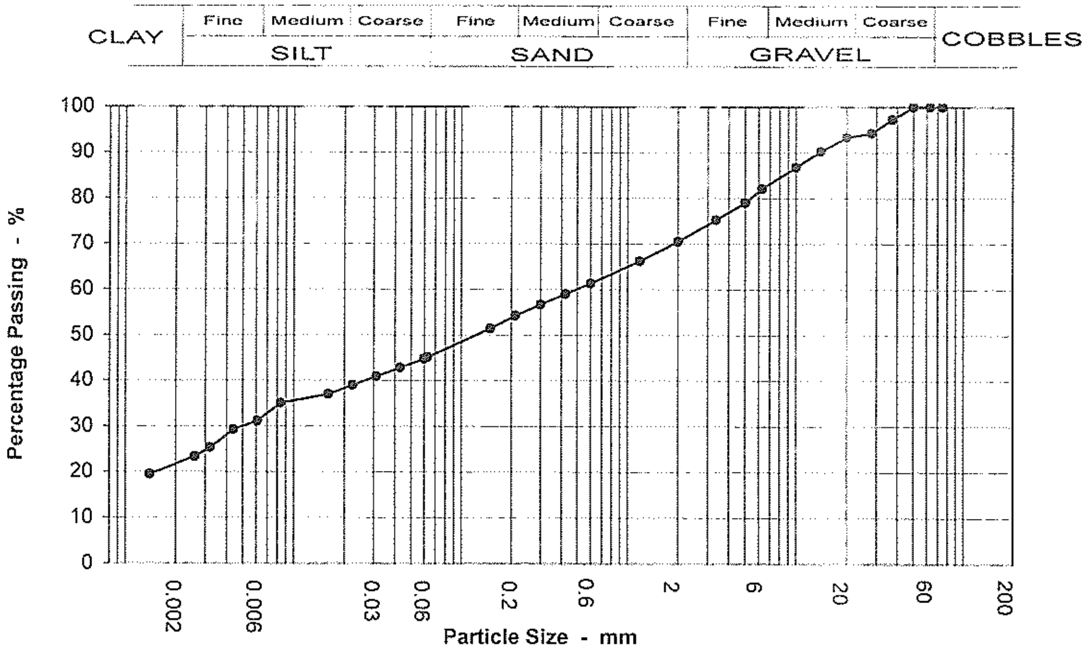
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.056	43
90	100	0.040	41
75	100	0.029	40
63	100	0.021	37
50	100	0.016	32
37.5	98	0.009	25
28	94	0.006	24
20	92	0.005	22
14	88	0.003	19
10	84	0.003	18
6.3	81	0.001	16
5	78		
3.35	72		
2	65		
1.18	62		
0.6	57		
0.425	55		
0.3	53		
0.212	51		
0.15	49		
0.063	44		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	34.8
Sand	21.7
Silt	26.8
Clay	16.7

Grading Analysis	
D100	50.000
D60	0.947
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	Job Ref	P16114
		Borehole / Pit No	BH05
Location	**Knockharley Landfill**	Sample No	11
		Depth	4.50 m
Soil Description	Slightly sandy gravelly CLAY	Sample type	B



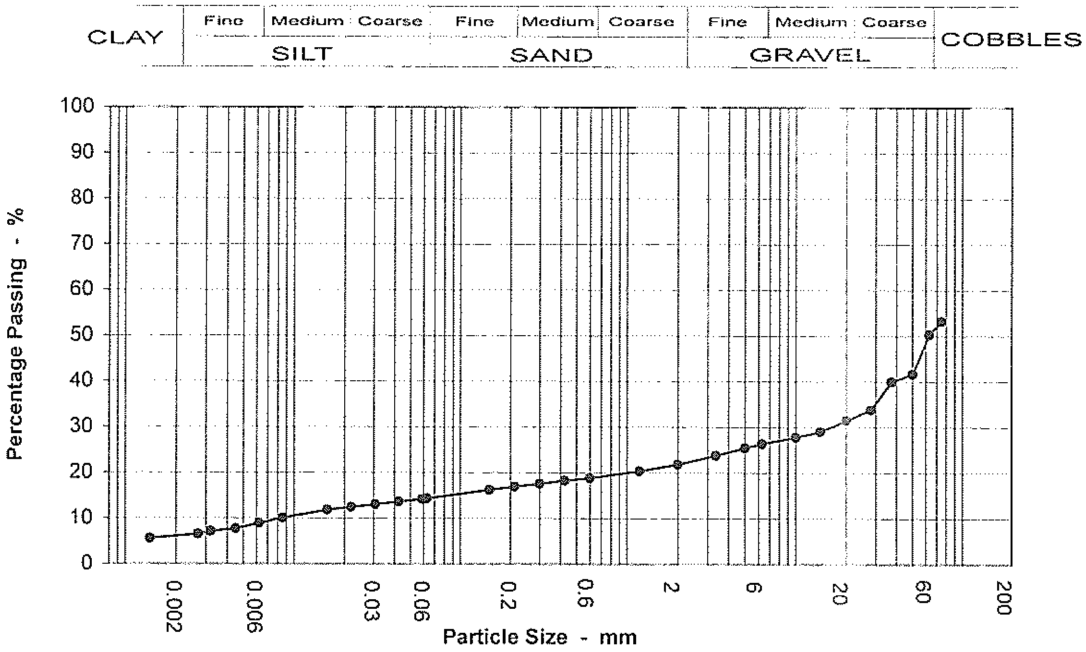
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.060	45
90	100	0.043	43
75	100	0.031	41
63	100	0.022	39
50	100	0.016	37
37.5	97	0.008	35
28	94	0.006	31
20	93	0.004	29
14	90	0.003	25
10	87	0.003	23
6.3	82	0.001	19
5	79		
3.35	75		
2	71		
1.18	66		
0.6	61		
0.425	59		
0.3	57		
0.212	54		
0.15	51		
0.063	45		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	29.5
Sand	25.7
Silt	23.4
Clay	21.4

Grading Analysis	
D100	50.000
D60	0.502
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	Job Ref	**P16114**
		Borehole / Pit No	BH05
Location	**Knockharley Landfill**	Sample No	17
		Depth	7.50 m
Soil Description	Clayey sandy GRAVEL with high cobble content	Sample type	B



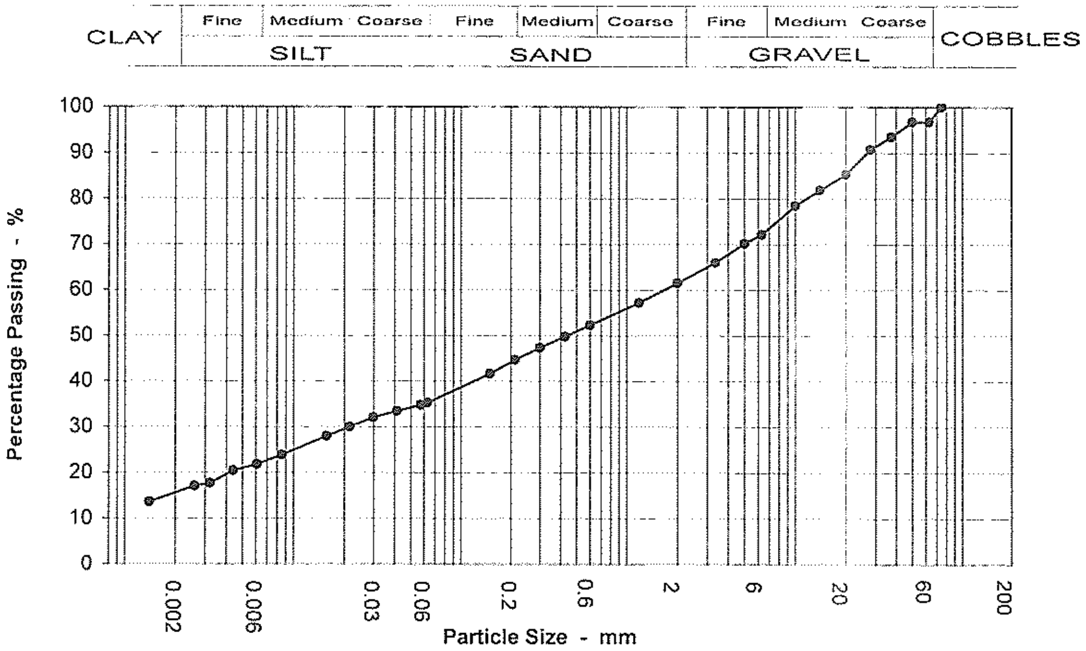
Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	14
90	56	0.043	14
75	53	0.031	13
63	50	0.022	12
50	42	0.016	12
37.5	40	0.009	10
28	34	0.006	9
20	31	0.005	8
14	29	0.003	7
10	28	0.003	7
6.3	26	0.001	6
5	25		
3.35	24		
2	22		
1.18	20		
0.6	19		
0.425	18		
0.3	18		
0.212	17		
0.15	16		
0.063	14		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	51.8
Gravel	26.4
Sand	7.6
Silt	8.2
Clay	6.0

Grading Analysis	
D100	125.000
D60	93.272
D10	0.008
Uniformity Coefficient	11053

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	Job Ref	**P16114**
		Borehole / Pit No	BH06
Location	**Knockharley Landfill**	Sample No	3
		Depth	1.00 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	35
90	100	0.041	33
75	100	0.030	32
63	97	0.022	30
50	97	0.016	28
37.5	94	0.009	24
28	91	0.006	22
20	85	0.004	20
14	82	0.003	18
10	78	0.003	17
6.3	72	0.001	14
5	70		
3.35	66		
2	61		
1.18	57		
0.6	52		
0.425	50		
0.3	47		
0.212	45		
0.15	42		
0.063	35		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	3.2
Gravel	35.3
Sand	26.5
Silt	19.7
Clay	15.3

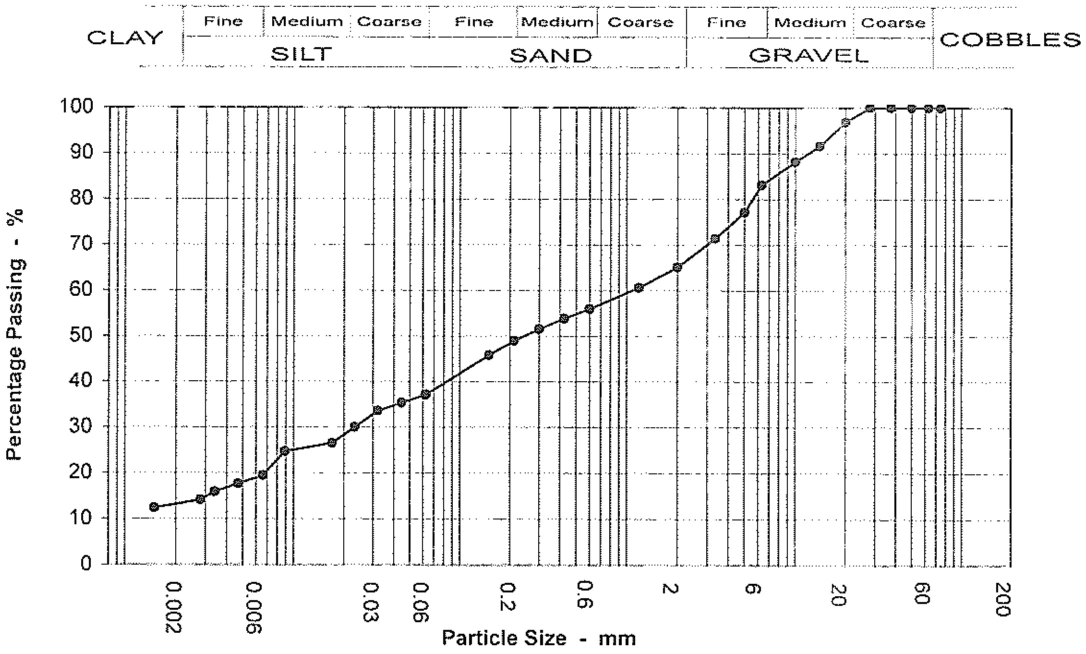
Grading Analysis	
D100	75.000
D60	1.715
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P16114
Borehole / Pit No	BH06
Sample No	6
Depth	2.70 m
Sample type	B
Location	**Knockharley Landfill**
Soil Description	Slightly sandy gravelly CLAY



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.062	37
90	100	0.045	35
75	100	0.032	34
63	100	0.023	30
50	100	0.017	26
37.5	100	0.009	25
28	100	0.007	19
20	97	0.005	18
14	92	0.003	16
10	88	0.003	14
6.3	83	0.002	12
5	77		
3.35	71		
2	65		
1.18	61		
0.6	56		
0.425	54		
0.3	52		
0.212	49		
0.15	46		
0.063	37		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	34.9
Sand	28.2
Silt	23.8
Clay	13.0

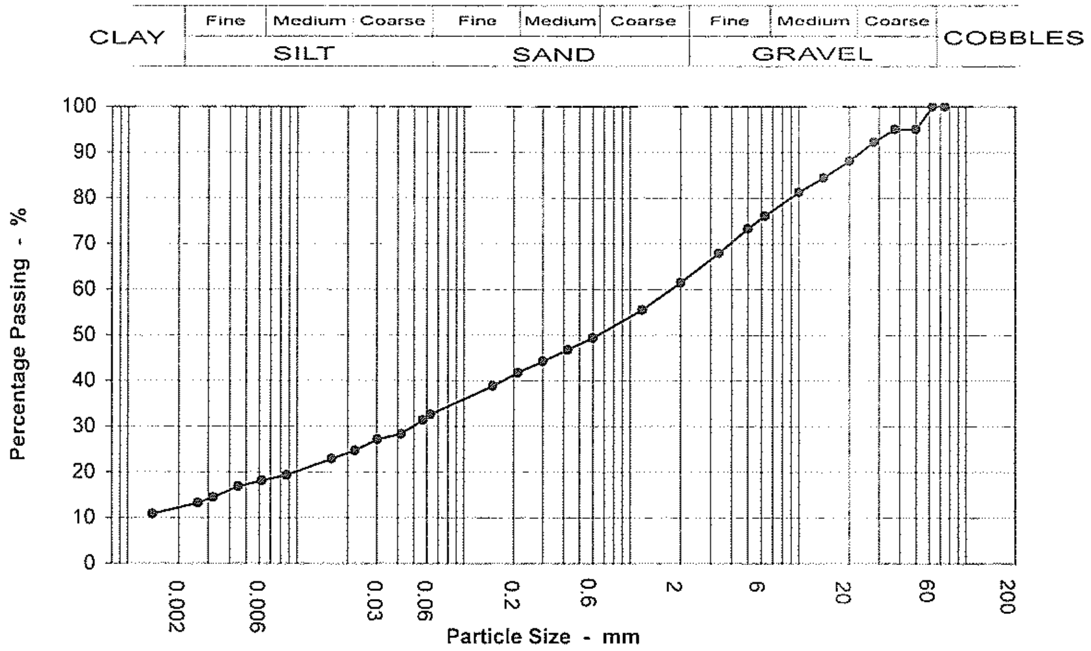
Grading Analysis	
D100	28.000
D60	1.102
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Location	**Knockharley Landfill**	Job Ref	**P16114**
		Borehole / Pit No	BH06
		Sample No	7
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Depth	4.00 m
		Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	31
90	100	0.042	28
75	100	0.030	27
63	100	0.022	25
50	95	0.016	23
37.5	95	0.009	19
28	92	0.006	18
20	88	0.005	17
14	84	0.003	14
10	81	0.003	13
6.3	76	0.001	11
5	73		
3.35	68		
2	61		
1.18	56		
0.6	49		
0.425	47		
0.3	44		
0.212	42		
0.15	39		
0.063	33		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	1.1
Gravel	37.4
Sand	29.4
Silt	20.0
Clay	12.1

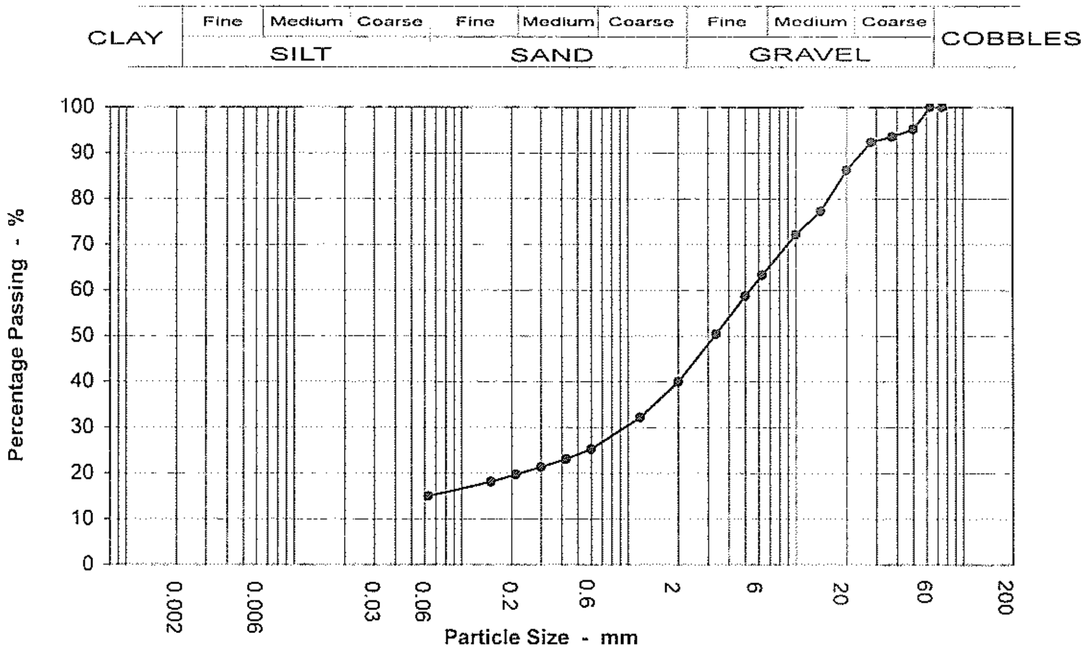
Grading Analysis	
D100	63.000
D60	1.798
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	P16114
		Borehole / Pit No	BH06
Location	**Knockharley Landfill**	Sample No	11
		Depth	6.00 m
Soil Description	Clayey very sandy GRAVEL with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	95		
37.5	94		
28	92		
20	86		
14	77		
10	72		
6.3	63		
5	59		
3.35	50		
2	40		
1.18	32		
0.6	25		
0.425	23		
0.3	21		
0.212	20		
0.15	18		
0.063	15		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	1.1
Gravel	58.9
Sand	25.0
Silt & Clay	14.9

Grading Analysis	
D100	63.000
D60	5.364
D10	
Uniformity Coefficient	N/A

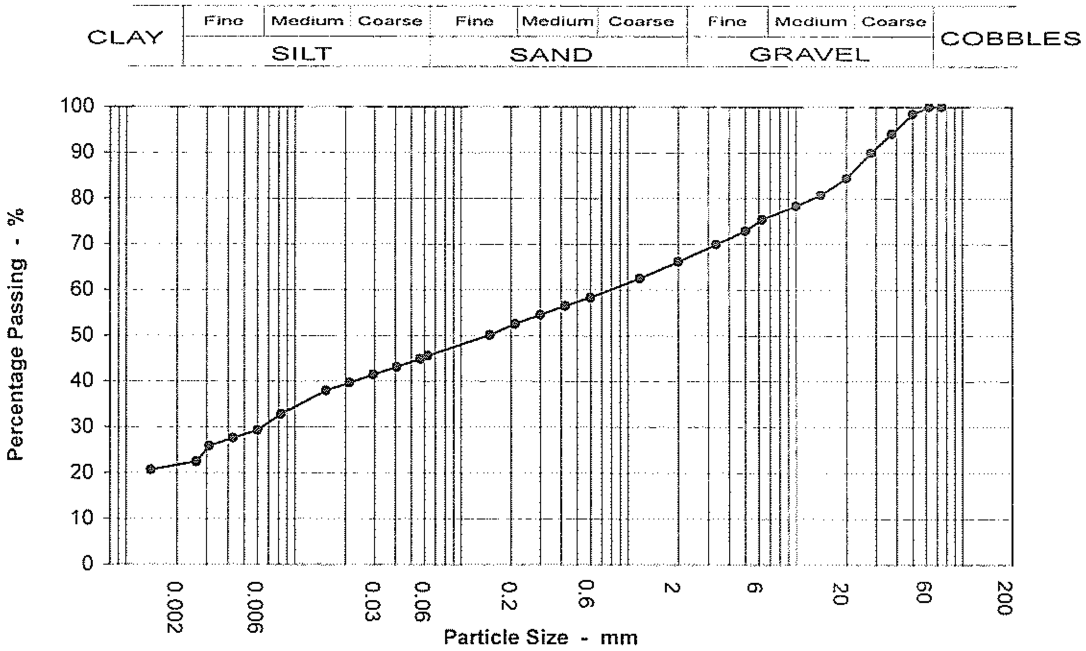
PRIORITY
GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P16114
Borehole / Pit No	BH07
Sample No	3
Depth	1.50 m
Sample type	B

Location	**Knockharley Landfill**
Soil Description	Slightly sandy slightly gravelly CLAY with low cobble content



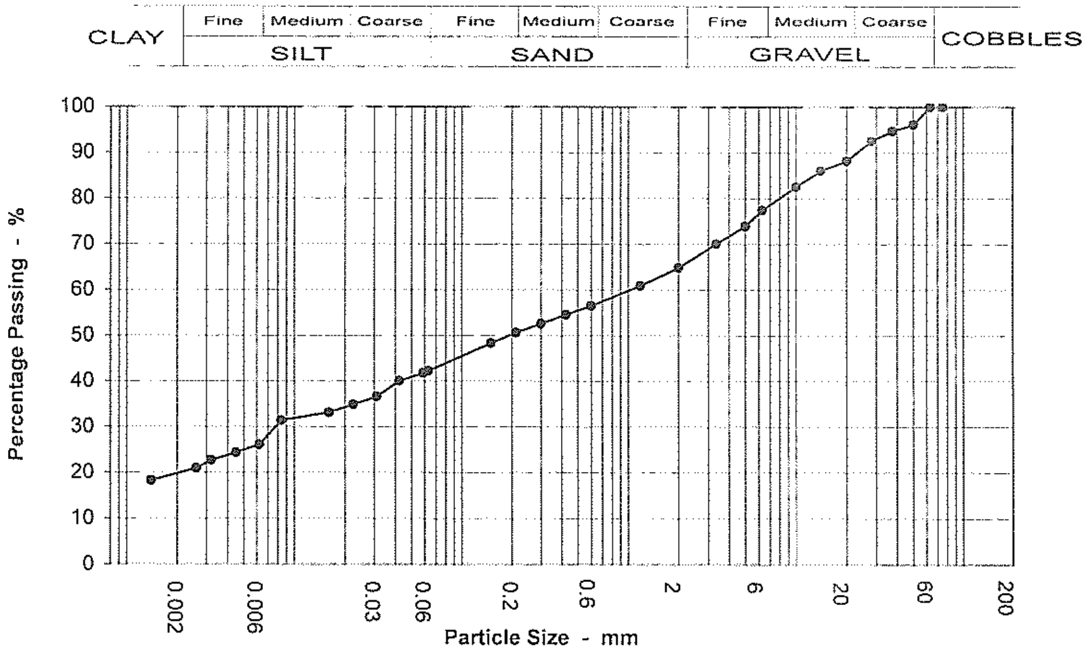
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	45
90	100	0.041	43
75	100	0.030	41
63	100	0.021	40
50	98	0.015	38
37.5	94	0.008	33
28	90	0.006	29
20	84	0.004	28
14	81	0.003	26
10	78	0.003	22
6.3	75	0.001	21
5	73		
3.35	70		
2	66		
1.18	62		
0.6	58		
0.425	56		
0.3	55		
0.212	52		
0.15	50		
0.063	46		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.4
Gravel	33.5
Sand	20.9
Silt	23.7
Clay	21.6

Grading Analysis	
D100	63.000
D60	0.838
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16114
		Borehole / Pit No	BH07
Location	**Knockharley Landfill**	Sample No	10
		Depth	4.50 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



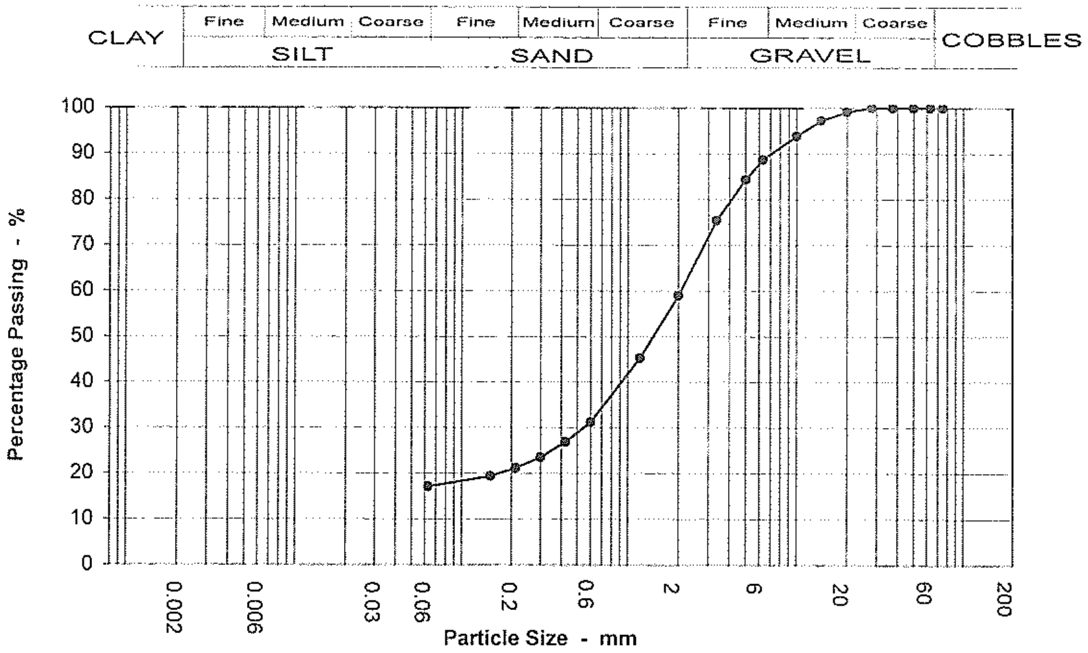
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	42
90	100	0.043	40
75	100	0.031	37
63	100	0.022	35
50	96	0.016	33
37.5	95	0.008	31
28	92	0.006	26
20	88	0.005	24
14	86	0.003	23
10	82	0.003	21
6.3	77	0.001	18
5	74		
3.35	70		
2	65		
1.18	61		
0.6	56		
0.425	55		
0.3	53		
0.212	51		
0.15	48		
0.063	42		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.9
Gravel	34.3
Sand	22.9
Silt	22.3
Clay	19.6

Grading Analysis	
D100	63.000
D60	1.061
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	Job Ref	**P16114**
		Borehole / Pit No	BH07
Location	**Knockharley Landfill**	Sample No	12
		Depth	5.50 m
Soil Description	Clayey SAND AND GRAVEL	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	99		
14	97		
10	94		
6.3	89		
5	84		
3.35	75		
2	59		
1.18	45		
0.6	31		
0.425	27		
0.3	23		
0.212	21		
0.15	19		
0.063	17		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	41.1
Sand	41.9
Silt & Clay	17.1

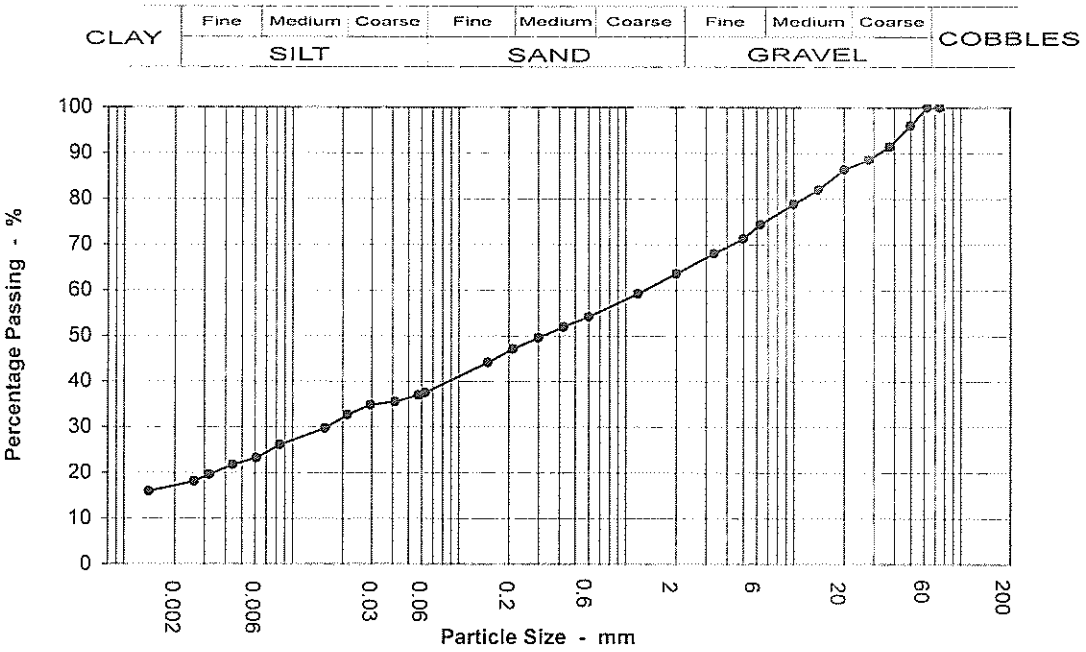
Grading Analysis	
D100	28.000
D60	2.088
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16114**
		Borehole / Pit No	BH07
Location	**Knockharley Landfill**	Sample No	17
		Depth	7.45 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	37
90	100	0.041	36
75	100	0.030	35
63	100	0.021	33
50	96	0.016	30
37.5	91	0.008	26
28	89	0.006	23
20	86	0.004	22
14	82	0.003	20
10	79	0.003	18
6.3	74	0.001	16
5	71		
3.35	68		
2	64		
1.18	59		
0.6	54		
0.425	52		
0.3	50		
0.212	47		
0.15	44		
0.063	38		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.9
Gravel	35.5
Sand	26.4
Silt	20.2
Clay	17.1

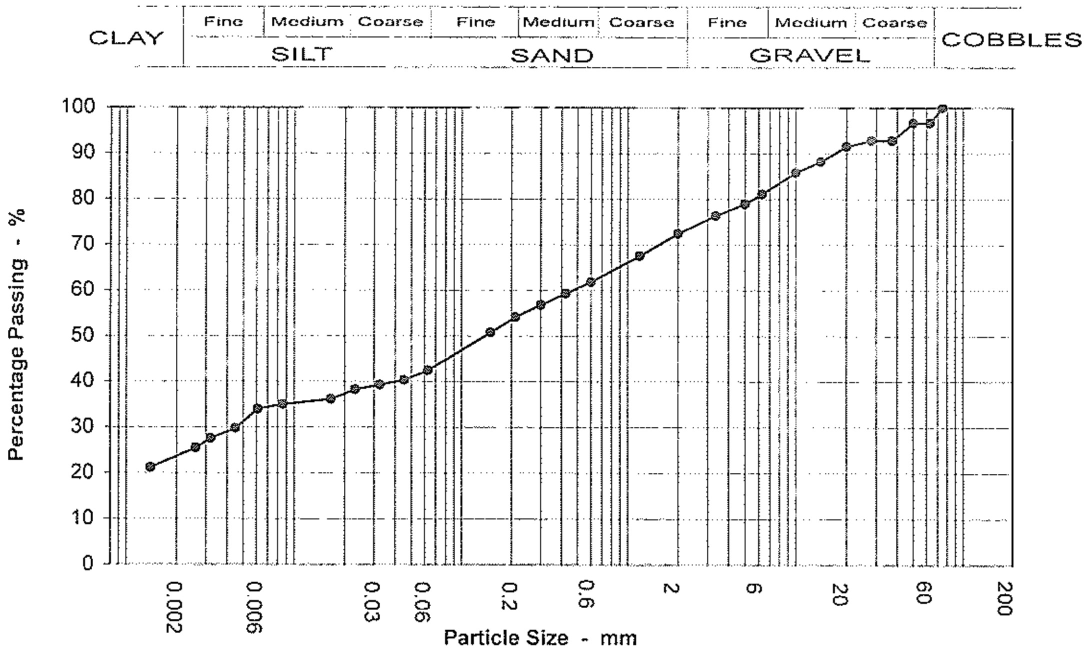
Grading Analysis	
D100	63.000
D60	1.326
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Location	**Knockharley Landfill**	Job Ref	**P16114**
		Borehole / Pit No	BH07
		Sample No	21
		Depth	9.50 m
Soil Description	Slightly sandy slightly gravelly CLAY with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	42
90	100	0.045	40
75	100	0.032	39
63	97	0.023	38
50	97	0.017	36
37.5	93	0.009	35
28	93	0.006	34
20	92	0.005	30
14	88	0.003	28
10	86	0.003	25
6.3	81	0.001	21
5	79		
3.35	76		
2	72		
1.18	68		
0.6	62		
0.425	59		
0.3	57		
0.212	54		
0.15	51		
0.063	42		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	3.3
Gravel	24.2
Sand	30.4
Silt	18.7
Clay	23.3

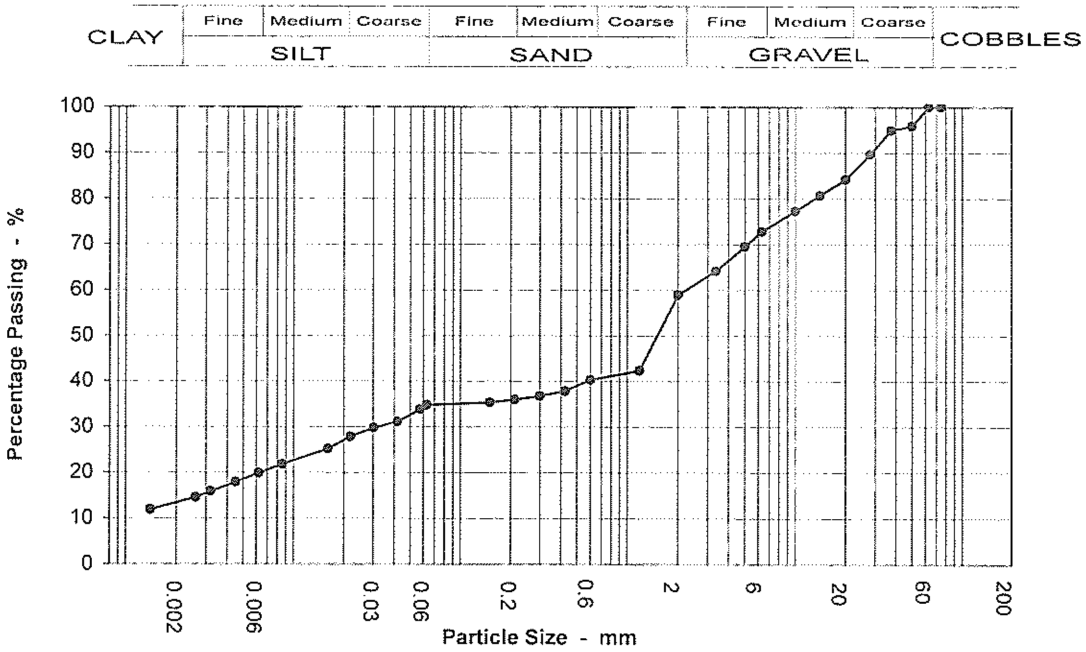
Grading Analysis	
D100	75.000
D60	0.476
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16114**
		Borehole / Pit No	BH08
Location	**Knockharley Landfill**	Sample No	3
		Depth	0.90 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



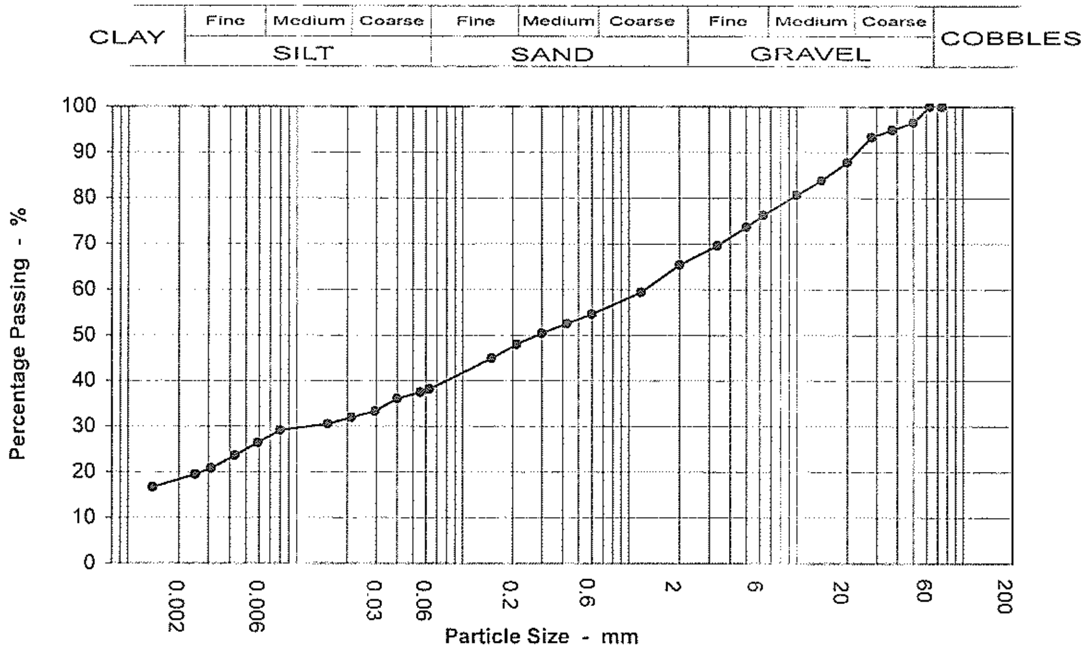
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	34
90	100	0.042	31
75	100	0.030	30
63	100	0.022	28
50	96	0.016	25
37.5	95	0.009	22
28	90	0.006	20
20	84	0.005	18
14	81	0.003	16
10	77	0.003	15
6.3	73	0.001	12
5	70		
3.35	64		
2	59		
1.18	42		
0.6	40		
0.425	38		
0.3	37		
0.212	36		
0.15	35		
0.063	35		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	1.0
Gravel	40.1
Sand	24.7
Silt	21.0
Clay	13.2

Grading Analysis	
D100	63.000
D60	2.274
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P16114**
		Borehole / Pit No	BH08
Location	**Knockharley Landfill**	Sample No	7
		Depth	2.50 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



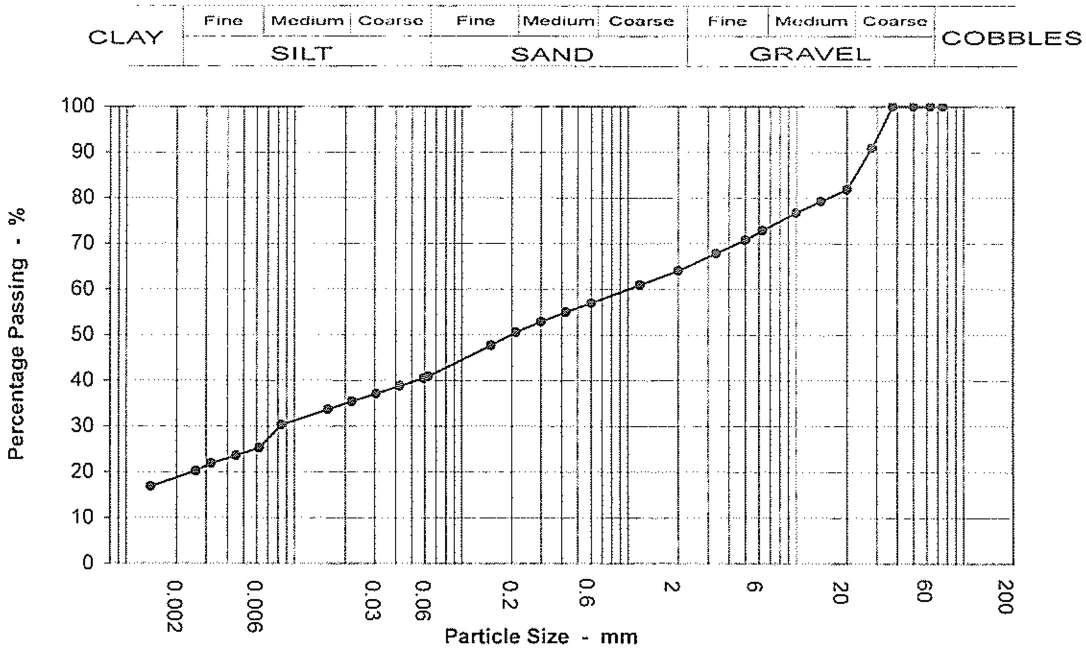
Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.056	37
90	100	0.040	36
75	100	0.030	33
63	100	0.021	32
50	97	0.015	31
37.5	95	0.008	29
28	93	0.006	26
20	88	0.004	24
14	84	0.003	21
10	81	0.003	19
6.3	76	0.001	17
5	74		
3.35	70		
2	65		
1.18	59		
0.6	55		
0.425	53		
0.3	50		
0.212	48		
0.15	45		
0.063	38		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.8
Gravel	33.9
Sand	27.5
Silt	19.7
Clay	18.2

Grading Analysis	
D100	63.000
D60	1.268
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	Job Ref	**P16114**
		Borehole / Pit No	BH08
Location	**Knockharley Landfill**	Sample No	11
		Depth	4.50 m
Soil Description	Slightly sandy gravelly CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	40
90	100	0.043	39
75	100	0.031	37
63	100	0.022	35
50	100	0.016	34
37.5	100	0.008	30
28	91	0.006	25
20	82	0.005	24
14	79	0.003	22
10	77	0.003	20
6.3	73	0.001	17
5	71		
3.35	68		
2	64		
1.18	61		
0.6	57		
0.425	55		
0.3	53		
0.212	51		
0.15	48		
0.063	41		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	35.9
Sand	23.5
Silt	22.0
Clay	18.5

Grading Analysis	
D100	37.500
D60	1.055
D10	
Uniformity Coefficient	N/A

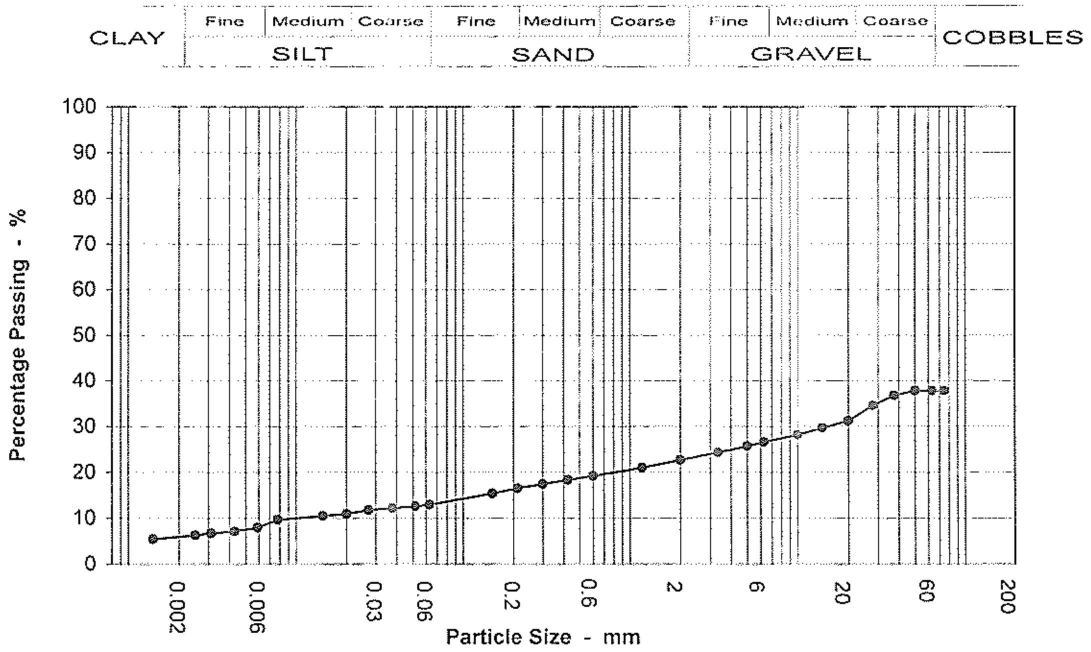
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P16114
Borehole / Pit No	BH09
Sample No	5
Depth	1.60 m
Sample type	B

Location	**Knockharley Landfill**
Soil Description	COBBLES with clayey sandy GRAVEL



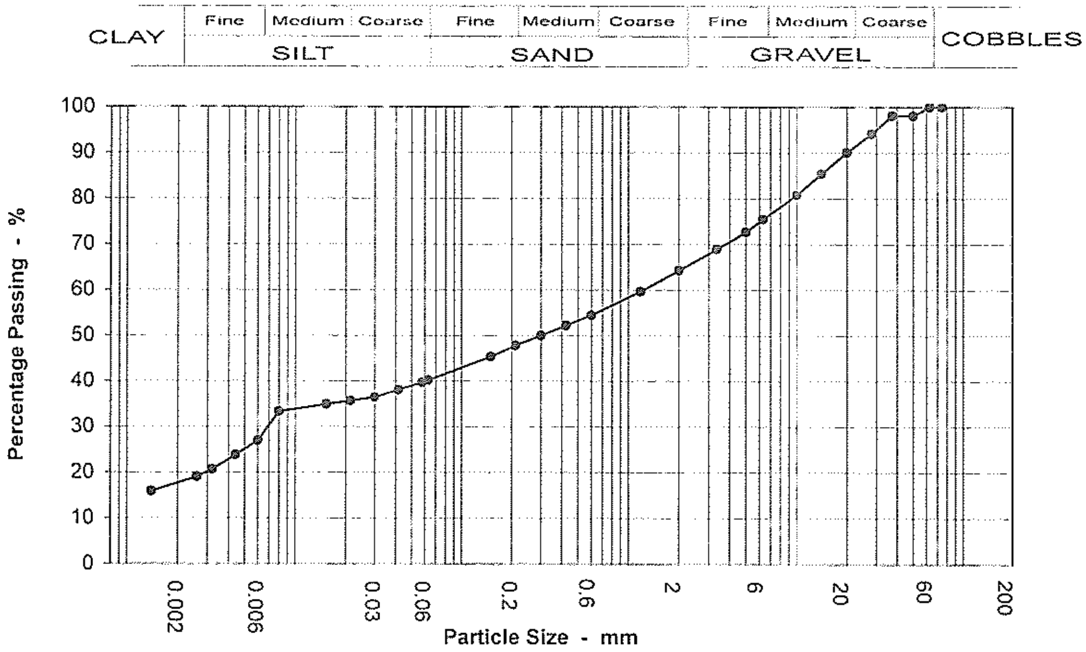
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.052	13
90	38	0.038	12
75	38	0.027	12
63	38	0.020	11
50	38	0.015	11
37.5	37	0.008	10
28	35	0.006	8
20	31	0.004	7
14	30	0.003	7
10	28	0.003	6
6.3	27	0.001	5
5	26		
3.35	24		
2	23		
1.18	21		
0.6	19		
0.425	18		
0.3	17		
0.212	17		
0.15	15		
0.063	13		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	62.2
Gravel	15.1
Sand	9.8
Silt	6.9
Clay	5.9

Grading Analysis	
D100	125.000
D60	102.495
D10	0.011
Uniformity Coefficient	9750

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	Job Ref	**P16114**
		Borehole / Pit No	BH09
Location	**Knockharley Landfill**	Sample No	9
		Depth	3.50 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



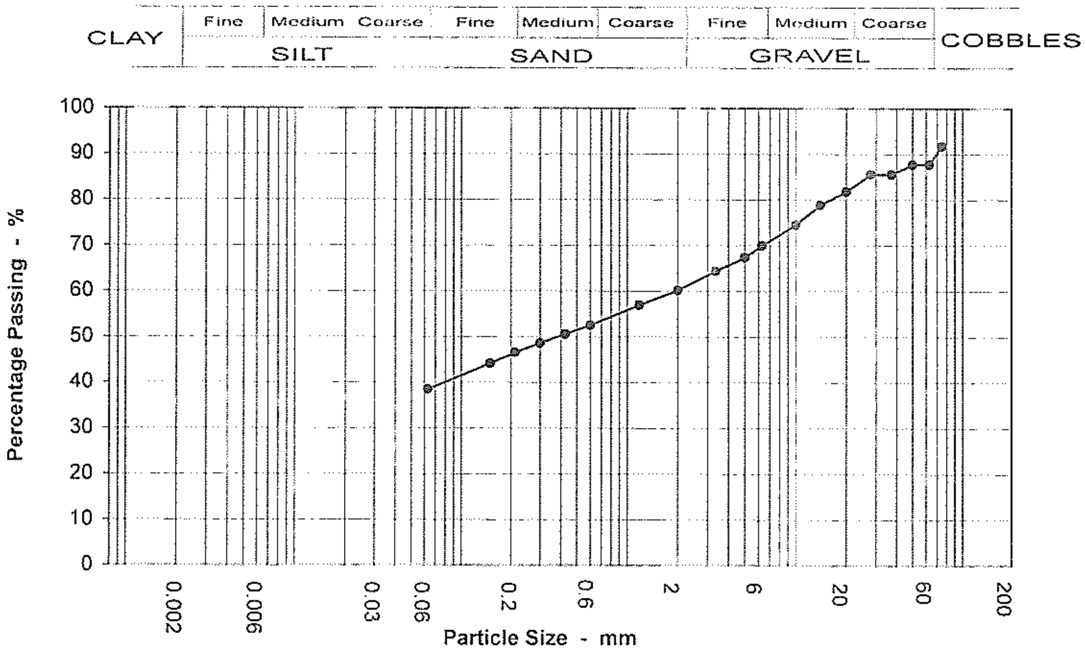
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.058	40
90	100	0.042	38
75	100	0.030	36
63	100	0.021	36
50	98	0.015	35
37.5	98	0.008	33
28	94	0.006	27
20	90	0.004	24
14	85	0.003	21
10	81	0.003	19
6.3	75	0.001	16
5	73		
3.35	69		
2	64		
1.18	60		
0.6	54		
0.425	52		
0.3	50		
0.212	48		
0.15	45		
0.063	40		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.4
Gravel	35.3
Sand	24.4
Silt	22.4
Clay	17.5

Grading Analysis	
D100	63.000
D60	1.252
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16114
		Borehole / Pit No	BH09
Location	**Knockharley Landfill**	Sample No	13
		Depth	5.50 m
Soil Description	Slightly sandy gravelly CLAY with medium cobble content	Sample type	B



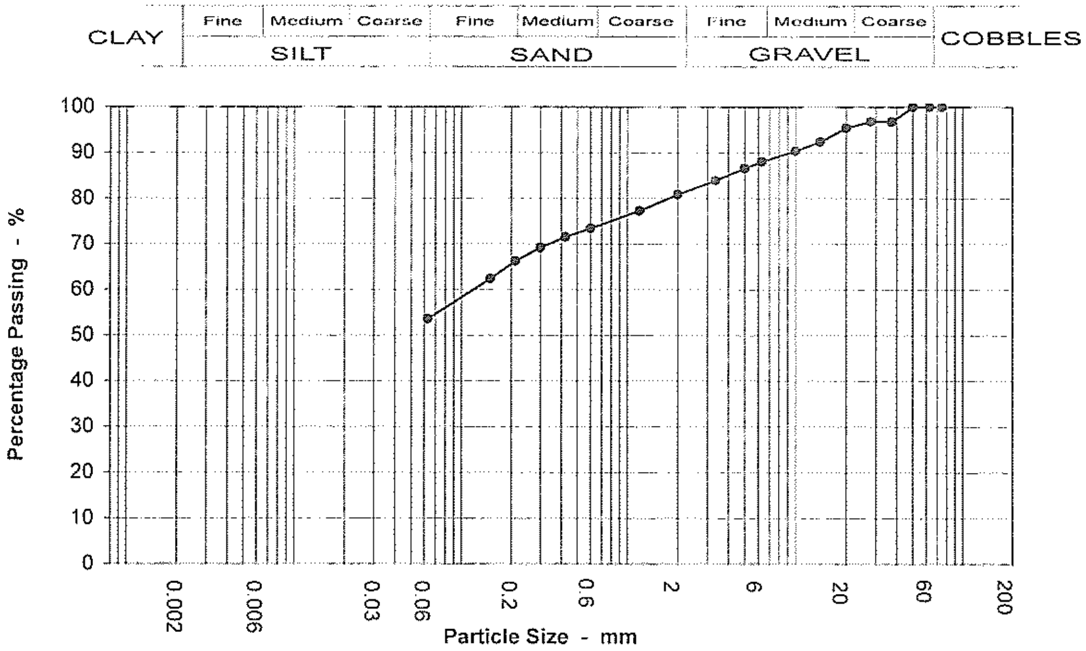
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	92		
63	88		
50	88		
37.5	86		
28	86		
20	82		
14	79		
10	74		
6.3	70		
5	67		
3.35	64		
2	60		
1.18	57		
0.6	52		
0.425	51		
0.3	49		
0.212	47		
0.15	44		
0.063	38		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	12.3
Gravel	27.6
Sand	21.6
Silt & Clay	38.5

Grading Analysis	
D100	90.000
D60	1.973
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P16114**
		Borehole / Pit No	BH10
Location	**Knockharley Landfill**	Sample No	3
		Depth	1.50 m
Soil Description	Slightly sandy slightly gravelly SILT	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	97		
28	97		
20	95		
14	92		
10	90		
6.3	88		
5	87		
3.35	84		
2	81		
1.18	77		
0.6	73		
0.425	72		
0.3	69		
0.212	66		
0.15	62		
0.063	54		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	19.2
Sand	27.3
Silt & Clay	53.5

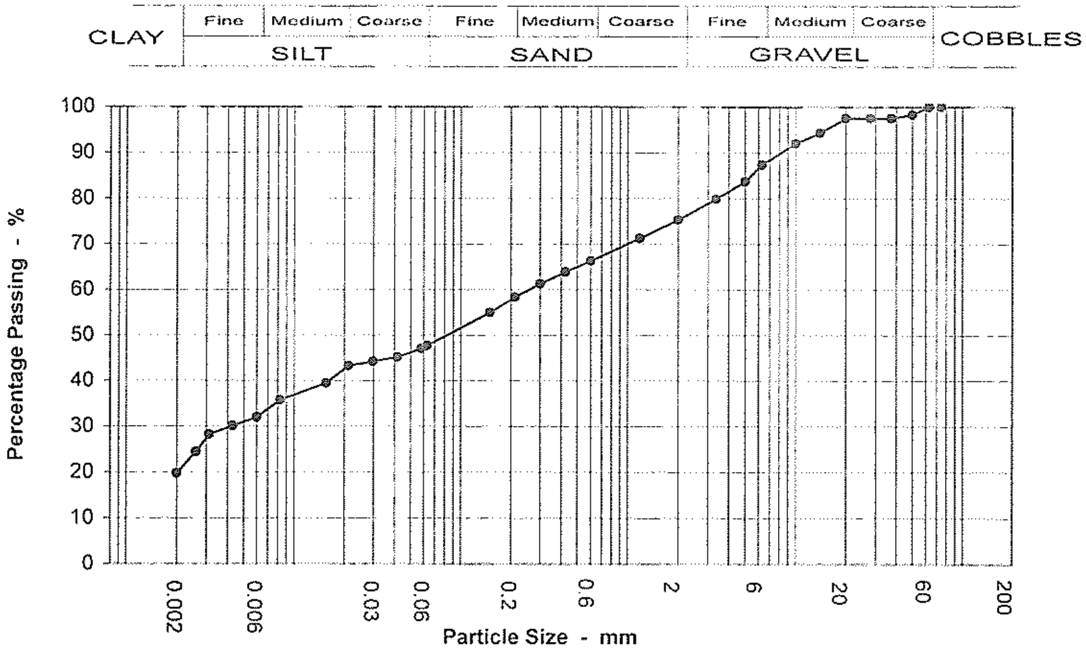
Grading Analysis	
D100	50.000
D60	0.127
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	P16114
		Borehole / Pit No	BH10
Location	Knockharley Landfill	Sample No	5
		Depth	2.50 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample type	B



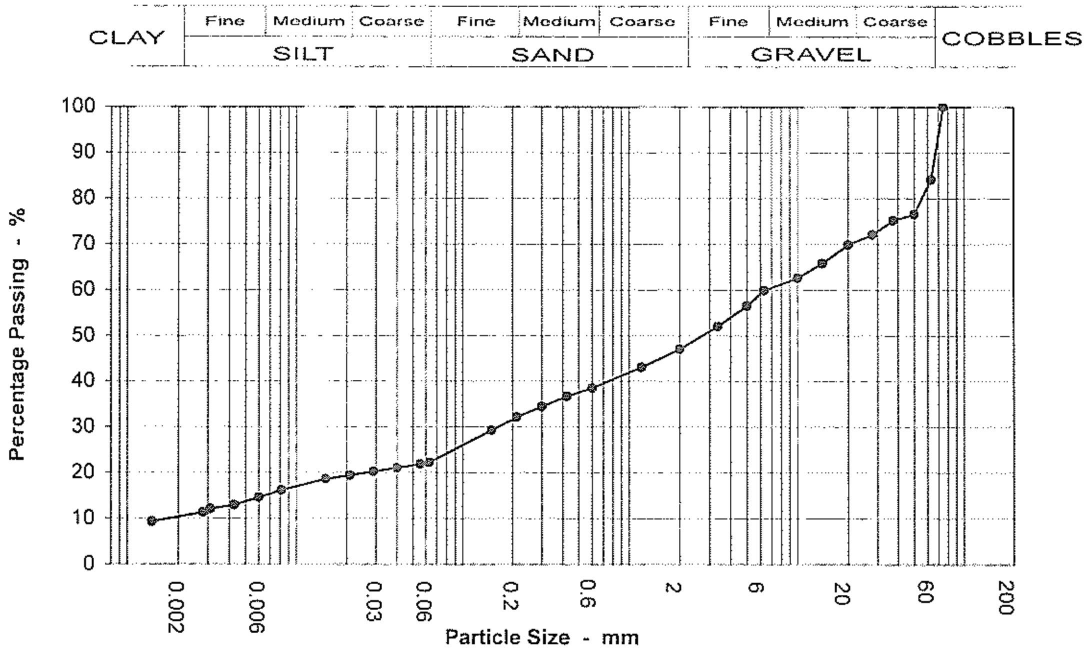
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.058	47
90	100	0.042	45
75	100	0.030	44
63	100	0.021	43
50	98	0.016	40
37.5	98	0.008	36
28	98	0.006	32
20	98	0.004	30
14	94	0.003	28
10	92	0.003	24
6.3	87	0.002	20
5	84		
3.35	80		
2	75		
1.18	71		
0.6	66		
0.425	64		
0.3	61		
0.212	58		
0.15	55		
0.063	48		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.4
Gravel	24.3
Sand	28.0
Silt & Clay	27.5

Grading Analysis	
D100	63.000
D60	0.263
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P16114**
		Borehole / Pit No	BH10
Location	**Knockharley Landfill**	Sample No	10
		Depth	4.50 m
Soil Description	Slightly sandy gravelly CLAY with high cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.056	22
90	100	0.040	21
75	100	0.029	20
63	84	0.021	19
50	76	0.015	19
37.5	75	0.008	16
28	72	0.006	15
20	70	0.004	13
14	66	0.003	12
10	63	0.003	11
6.3	60	0.001	9
5	56		
3.35	52		
2	47		
1.18	43		
0.6	38		
0.425	37		
0.3	34		
0.212	32		
0.15	29		
0.063	22		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	17.7
Gravel	35.3
Sand	25.0
Silt	11.9
Clay	10.2

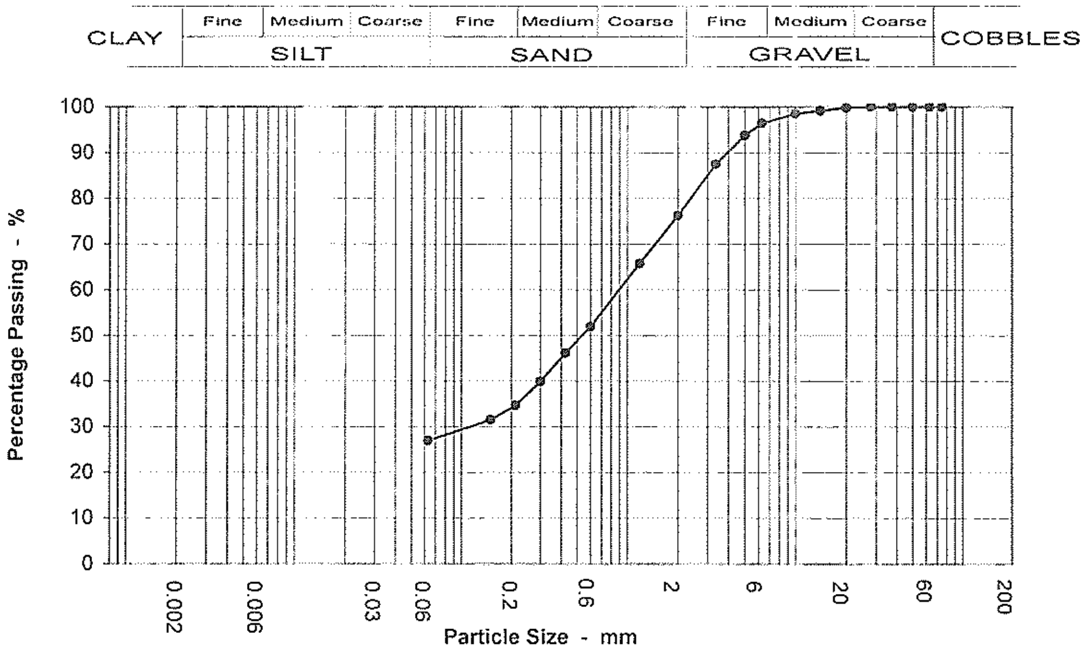
Grading Analysis	
D100	75.000
D60	6.524
D10	0.002
Uniformity Coefficient	3448

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16114**
		Borehole / Pit No	BH10
Location	**Knockharley Landfill**	Sample No	14
		Depth	6.50 m
Soil Description	Slightly gravelly sandy CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	99		
6.3	96		
5	94		
3.35	87		
2	76		
1.18	66		
0.6	52		
0.425	46		
0.3	40		
0.212	35		
0.15	31		
0.063	27		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	23.8
Sand	49.3
Silt & Clay	26.9

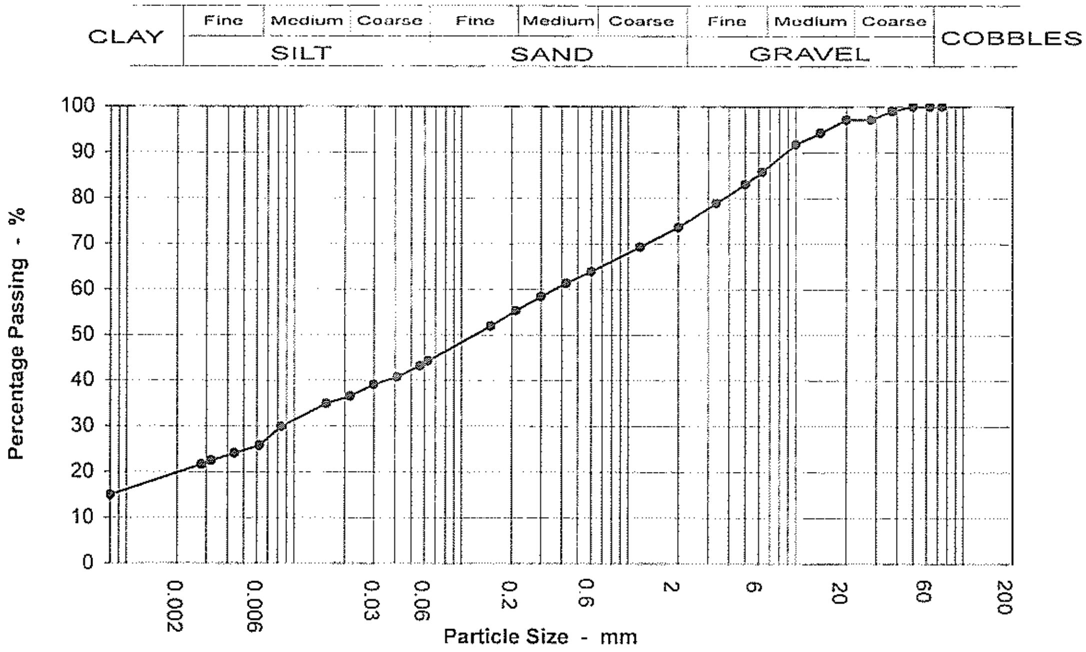
Grading Analysis	
D100	28.000
D60	0.940
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P16114
Borehole / Pit No	BH10
Sample No	19
Depth	8.50 m
Sample type	B
Location	**Knockharley Landfill**
Soil Description	Slightly sandy slightly gravelly CLAY



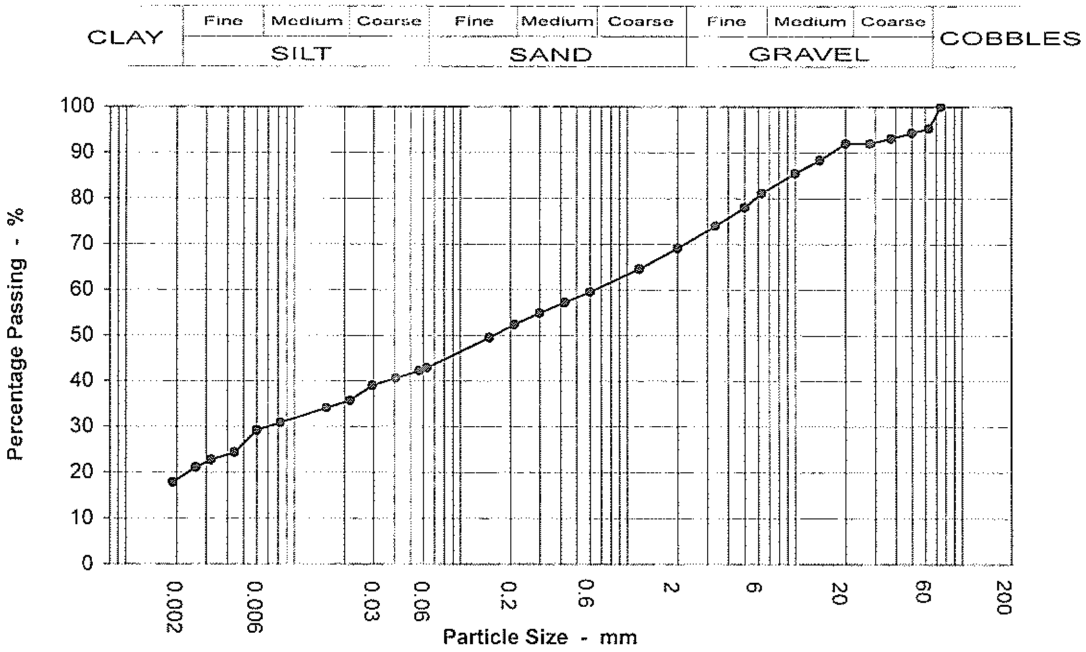
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	43
90	100	0.041	41
75	100	0.030	39
63	100	0.022	37
50	100	0.016	35
37.5	99	0.008	30
28	97	0.006	26
20	97	0.004	24
14	94	0.003	22
10	92	0.003	22
6.3	86	0.001	15
5	83		
3.35	79		
2	74		
1.18	69		
0.6	64		
0.425	61		
0.3	58		
0.212	55		
0.15	52		
0.063	44		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	26.4
Sand	29.9
Silt	24.8
Clay	18.9

Grading Analysis	
D100	50.000
D60	0.370
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16114
		Borehole / Pit No	BH10
Location	**Knockharley Landfill**	Sample No	23
		Depth	10.50 m
Soil Description	Slightly sandy slightly gravelly CLAY with medium cobble content	Sample type	B



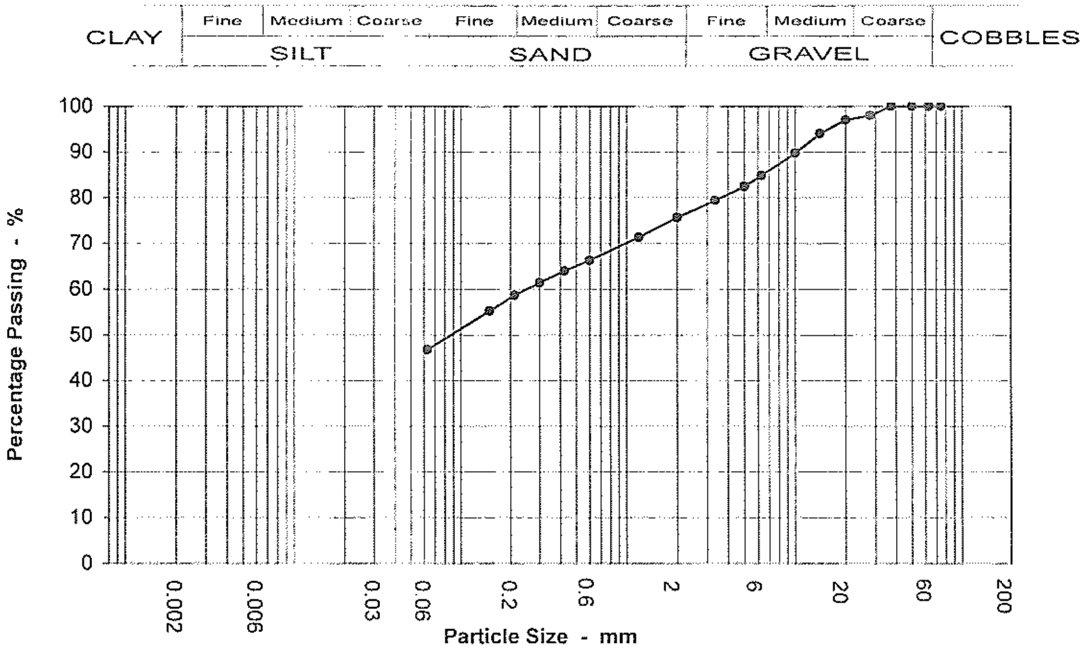
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	42
90	100	0.041	41
75	100	0.030	39
63	95	0.022	36
50	94	0.016	34
37.5	93	0.008	31
28	92	0.006	29
20	92	0.004	24
14	88	0.003	23
10	85	0.003	21
6.3	81	0.002	18
5	78		
3.35	74		
2	69		
1.18	64		
0.6	59		
0.425	57		
0.3	55		
0.212	52		
0.15	49		
0.063	43		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	5.0
Gravel	26.0
Sand	26.5
Silt	24.2
Clay	18.3

Grading Analysis	
D100	75.000
D60	0.661
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16114
		Borehole / Pit No	BH10
Location	Knockharley Landfill	Sample No	25
		Depth	11.50 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	98		
20	97		
14	94		
10	90		
6.3	85		
5	82		
3.35	79		
2	76		
1.18	71		
0.6	66		
0.425	64		
0.3	61		
0.212	59		
0.15	55		
0.063	47		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	24.4
Sand	28.9
Silt & Clay	46.7

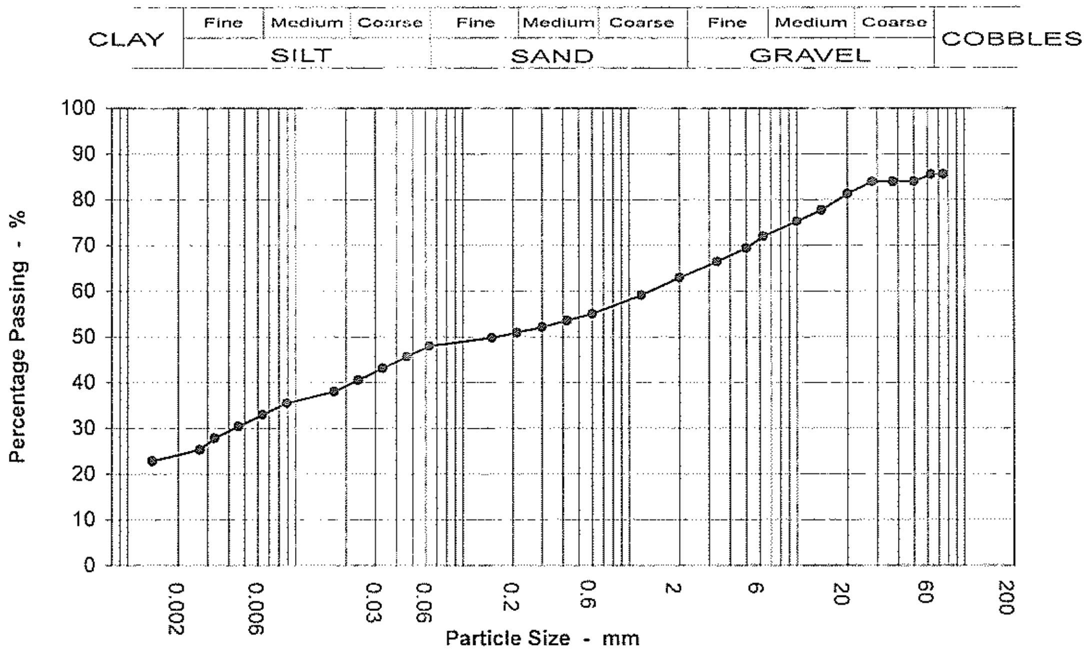
Grading Analysis	
D100	37.500
D60	0.256
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Location	**Knockharley Landfill**	**Job Ref**	**P16114**
		Borehole / Pit No	BH10
		Sample No	29
Soil Description	Slightly sandy slightly gravelly CLAY with medium cobble content	Depth	13.50 m
		Sample type	B



Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	48
90	100	0.046	46
75	86	0.033	43
63	86	0.024	41
50	84	0.017	38
37.5	84	0.009	35
28	84	0.006	33
20	81	0.005	30
14	78	0.003	28
10	75	0.003	25
6.3	72	0.001	23
5	69		
3.35	66		
2	63		
1.18	59		
0.6	55		
0.425	54		
0.3	52		
0.212	51		
0.15	50		
0.063	48		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	14.9
Gravel	22.3
Sand	15.3
Silt	23.6
Clay	24.0

Grading Analysis	
D100	90.000
D60	1.384
D10	
Uniformity Coefficient	N/A

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Final Report

Report No.: 16-26718-1

Initial Date of Issue: 09-Nov-2016

Client Priority Geotechnical Ltd

Client Address: Unit 12
Owenacurra Business Park
Midleton
County Cork
Ireland

Contact(s): Colette Kelly

Project P16114 - Knockaharley

Quotation No.: **Date Received:** 02-Nov-2016

Order No.: 9119 **Date Instructed:** 03-Nov-2016

No. of Samples: 5

Turnaround (Wkdays): 5 **Results Due:** 09-Nov-2016

Date Approved: 09-Nov-2016

Approved By:

Details: Robert Monk, Technical Development Chemist

Results - Soil

Project: P16114 - Knockaharley

Client: Priority Geotechnical Ltd	**Chemtest Job No.:**				16-26718	16-26718	16-26718	16-26718	16-26718
Quotation No.:	**Chemtest Sample ID.:**				373795	373796	373797	373798	373799
Order No.: 9119	Client Sample Ref.:				BH01	BH02	BH02	BH2	BH4
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				1.00	0.50	1.20	2.50	1.50
	Date Sampled:				27-Oct-2016	27-Oct-2016	27-Oct-2016	27-Oct-2016	27-Oct-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Moisture	N	2030	%	0.020	12	16	19	11	12
LOI 440	N	2620	%	0.10	1.7	1.7	2.2	1.1	2.5

Test Methods

SOP	Title	Parameters included	Method summary
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2620	LOI 440	LOI 440	Determination of the proportion by mass that is lost from a soil by ignition at 440°C.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

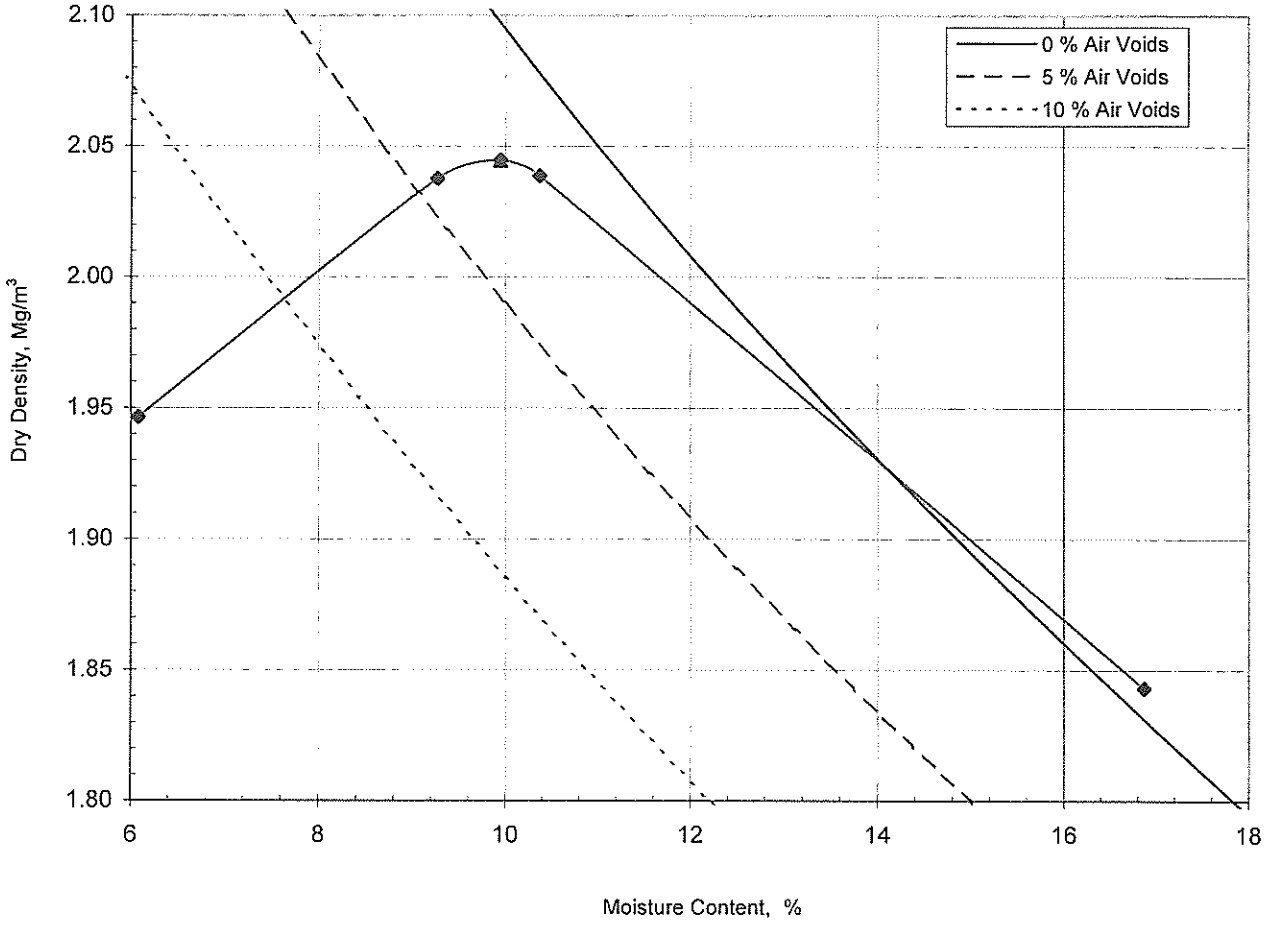
A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

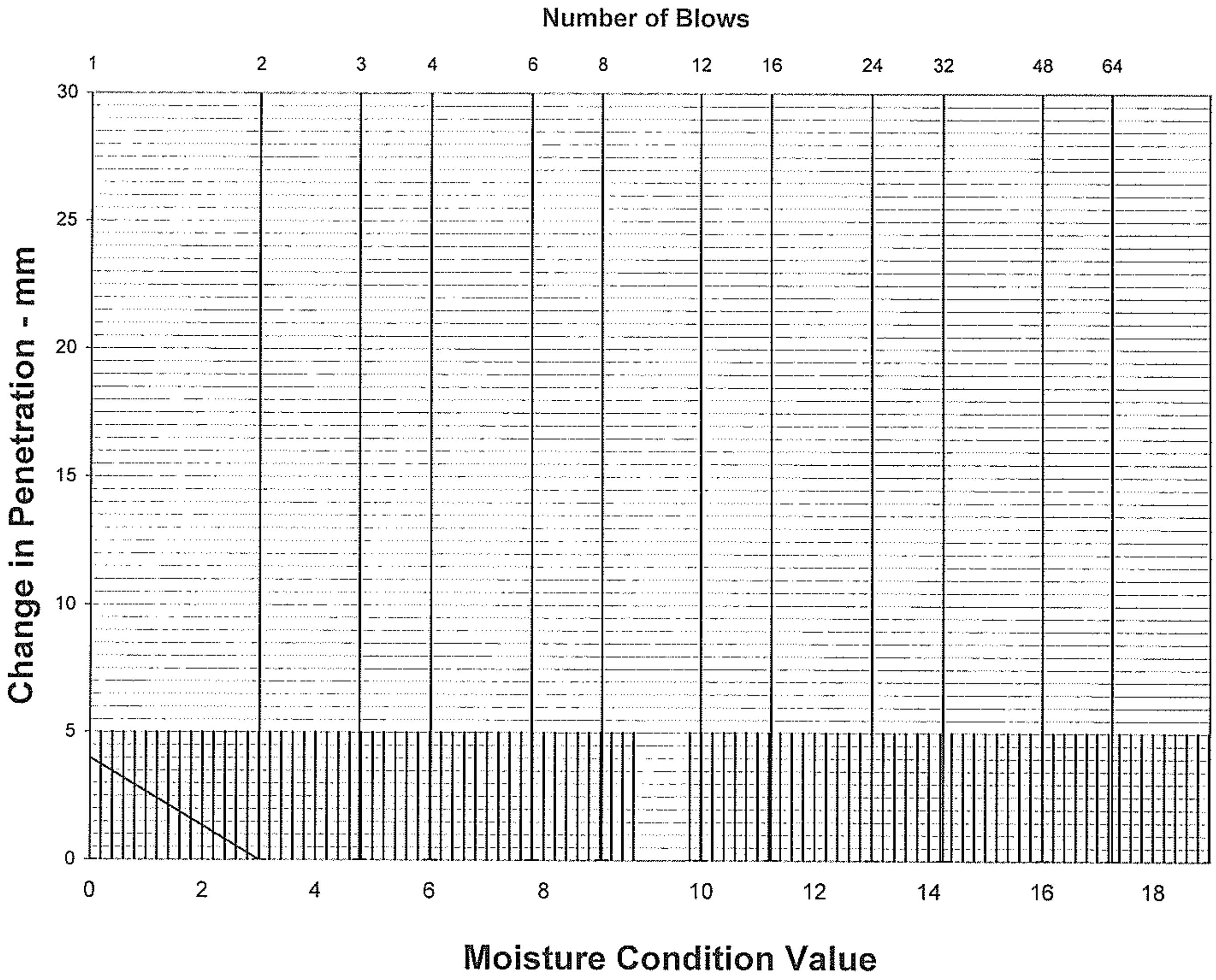
If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P16114**
		Borehole / Pit No	BH01
Site Name	**Knockharley Landfill**	Sample No	5
		Depth	2.50 m
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B



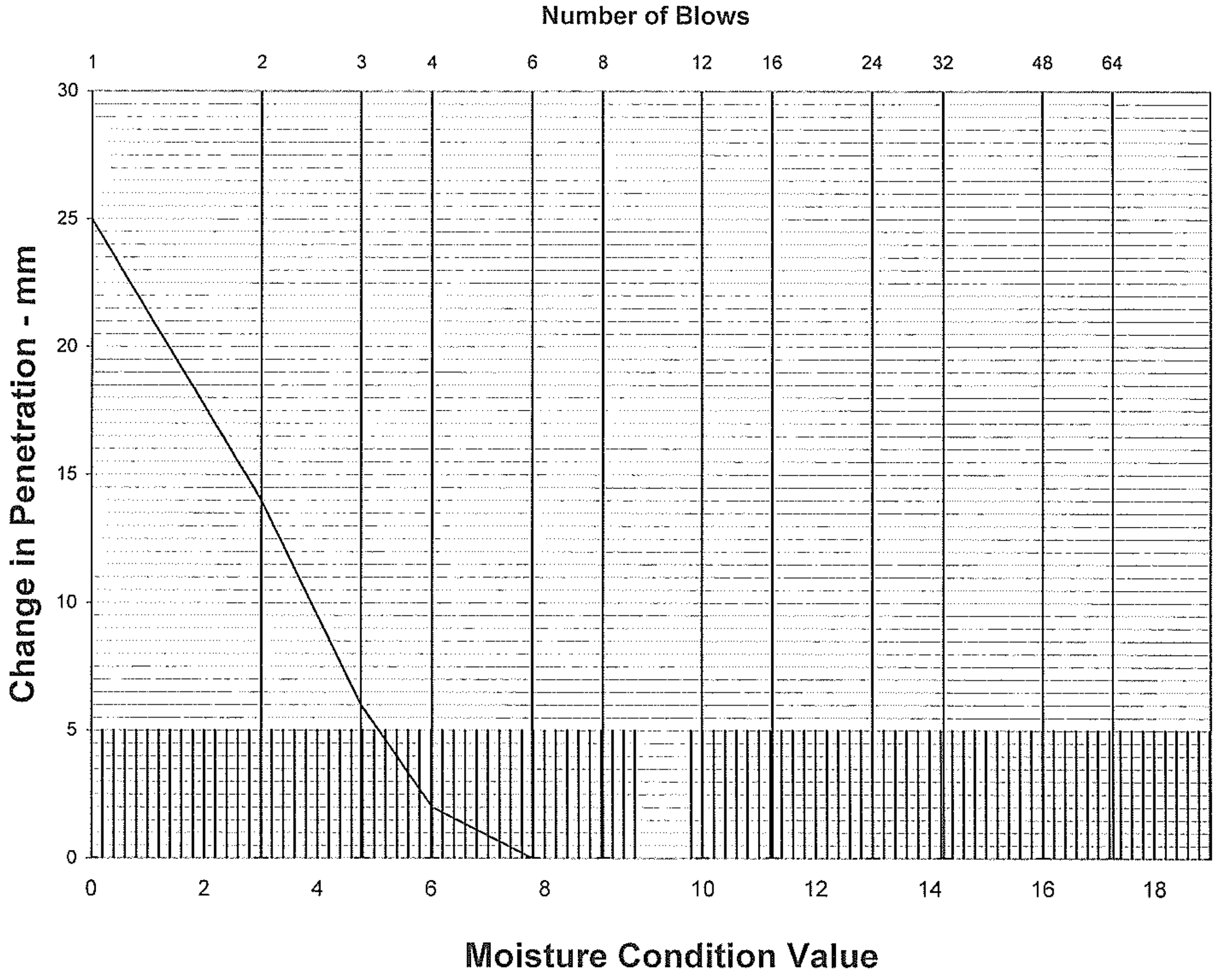
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	0
Mass Retained on 20.0 mm Sieve	%	3
Grading Zone		2
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.04
Optimum Moisture Content	%	9.9
Natural Moisture Content	%	16.87

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
		Borehole / Pit No	BH01
Location	Knockharley Landfill	Sample No	8
Soil Description	Slightly sandy slightly gravelly CLAY with low cobble content	Sample Type	B
		Depth	3.45 m



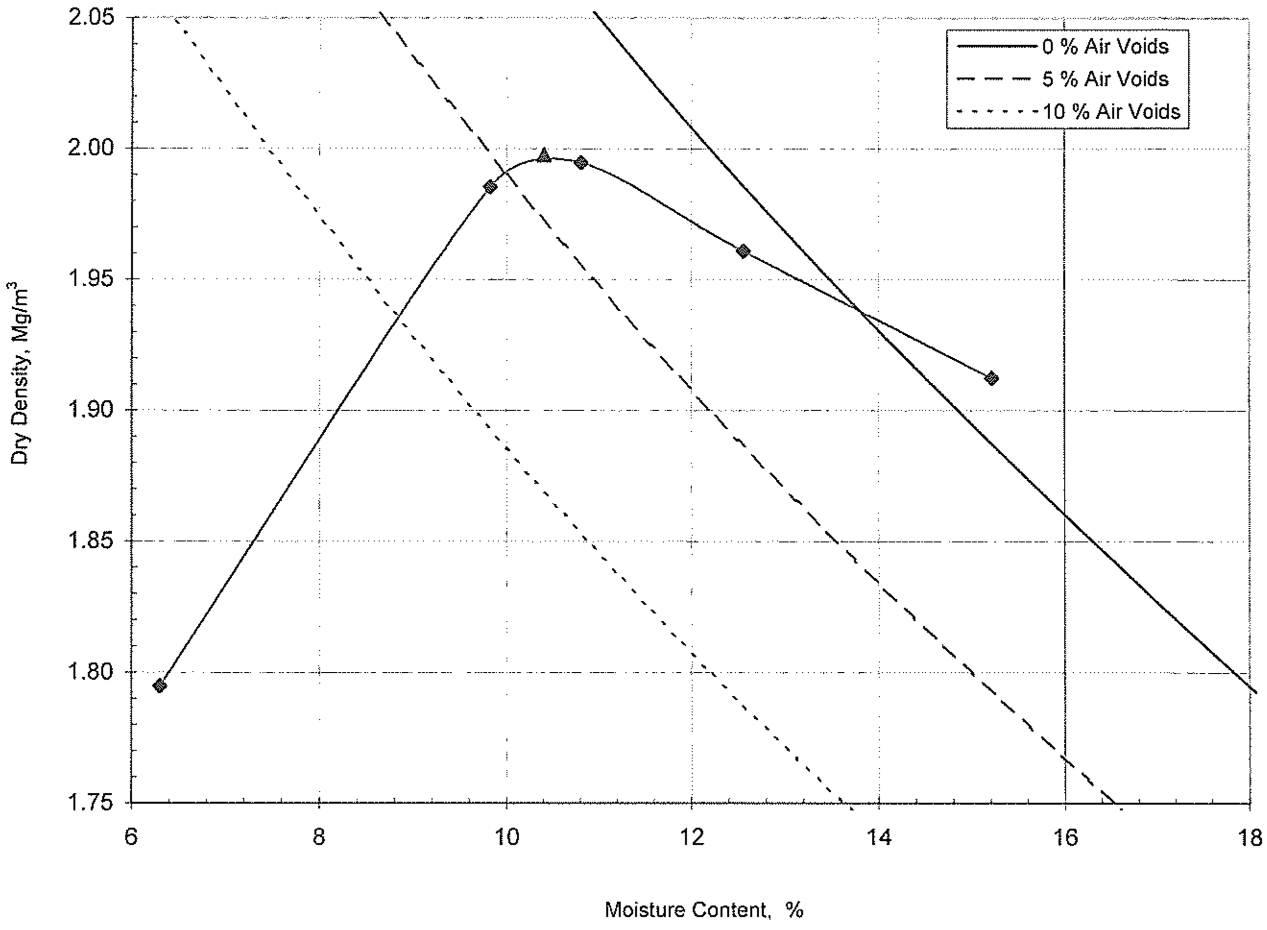
Specimen No		1	2	3	4	5	6
Moisture Condition Value		0.0					
Moisture Content	%	14.78					
Bulk density after compaction	Mg/m³	2.12					
Dry density after compaction	Mg/m³	1.85					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	7.6					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
Location	Knockharley Landfill	Borehole / Pit No	BH01
		Sample No	12
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B
		Depth	5.50 m



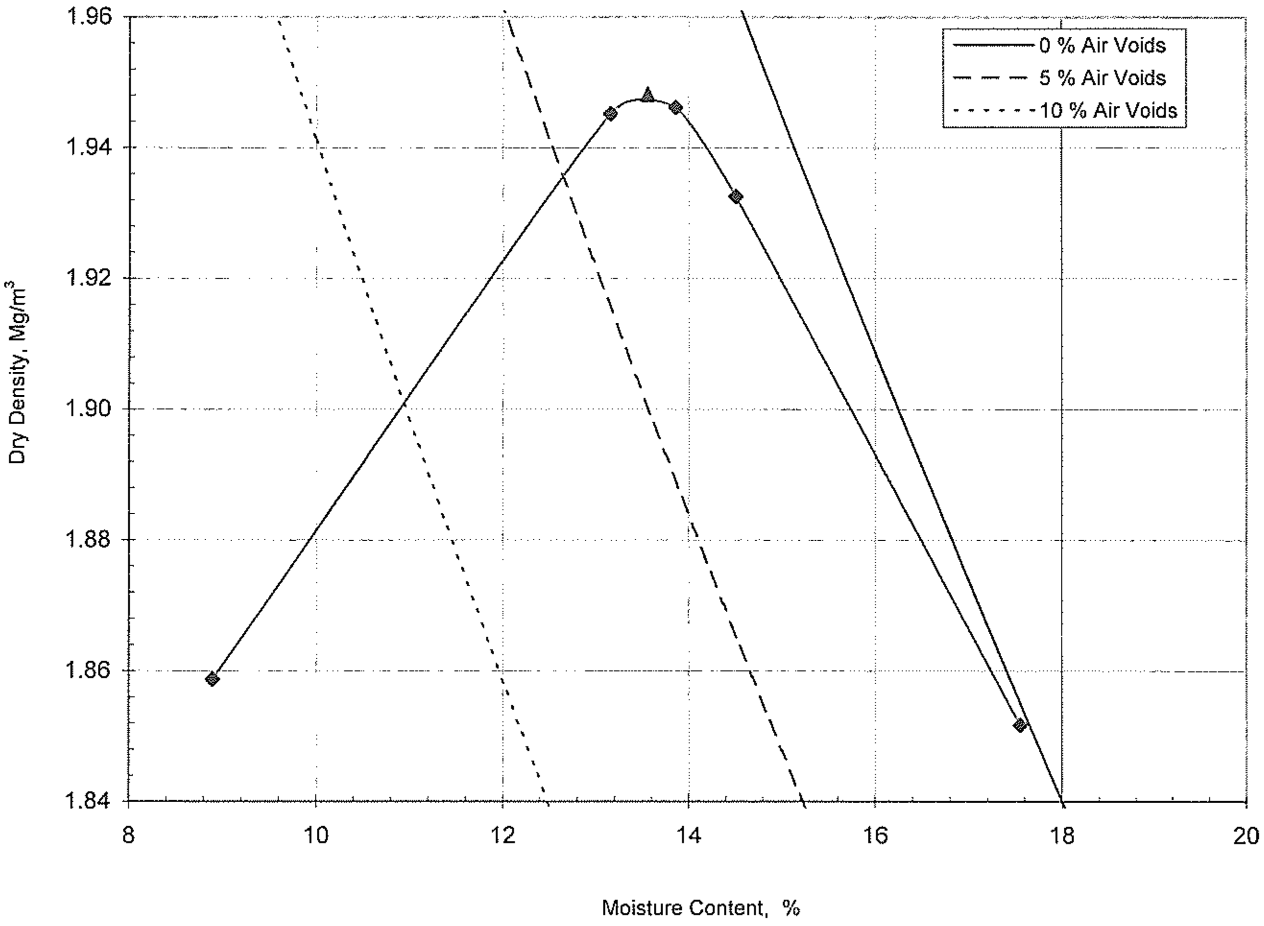
Specimen No		1	2	3	4	5	6
Moisture Condition Value		5.0					
Moisture Content	%	13.40					
Bulk density after compaction	Mg/m³	2.25					
Dry density after compaction	Mg/m³	1.98					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	5.0					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P16114**
		Borehole / Pit No	BH01
Site Name	**Knockharley Landfill**	Sample No	14
		Depth	6.50 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B



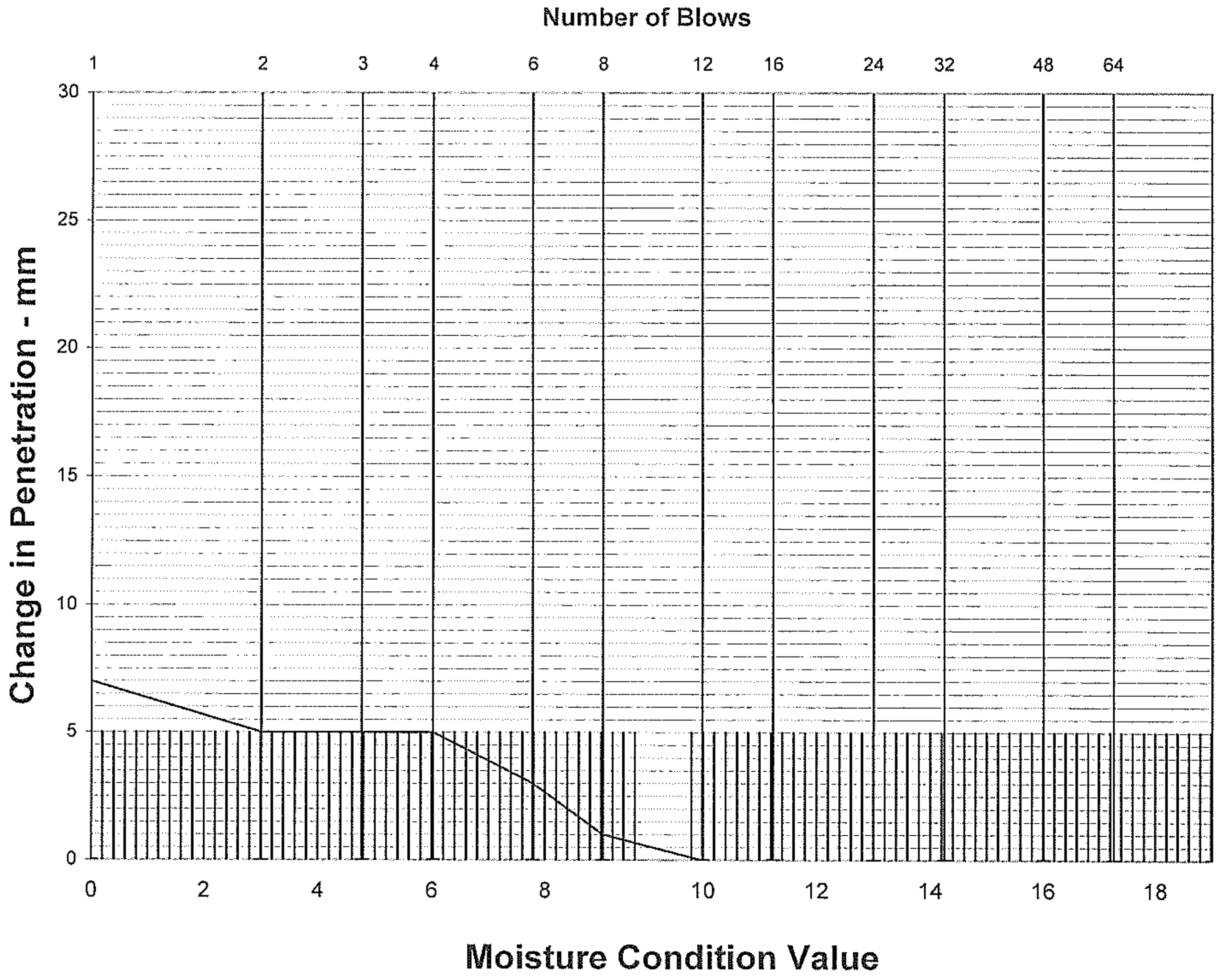
Preparation	3.2
Test Method	2.5 kg Rammer
Mould Type	CBR
Samples Used	Single Sample
Mass Retained on 37.5 mm Sieve %	0
Mass Retained on 20.0 mm Sieve %	0
Grading Zone	2
Particle Density - Assumed Mg/m³	2.65
Maximum Dry Density Mg/m³	2.00
Optimum Moisture Content %	10
Natural Moisture Content %	15.21

PRIORITY GEOTECHNICAL	Dry Density / Moisture Content Relationship BS 1377 : Part 4 : 1990 : Clause 3	Job Ref	P16114
		Borehole / Pit No	BH02
Site Name	**Knockharley Landfill**	Sample No	5
		Depth	1.20 m
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B



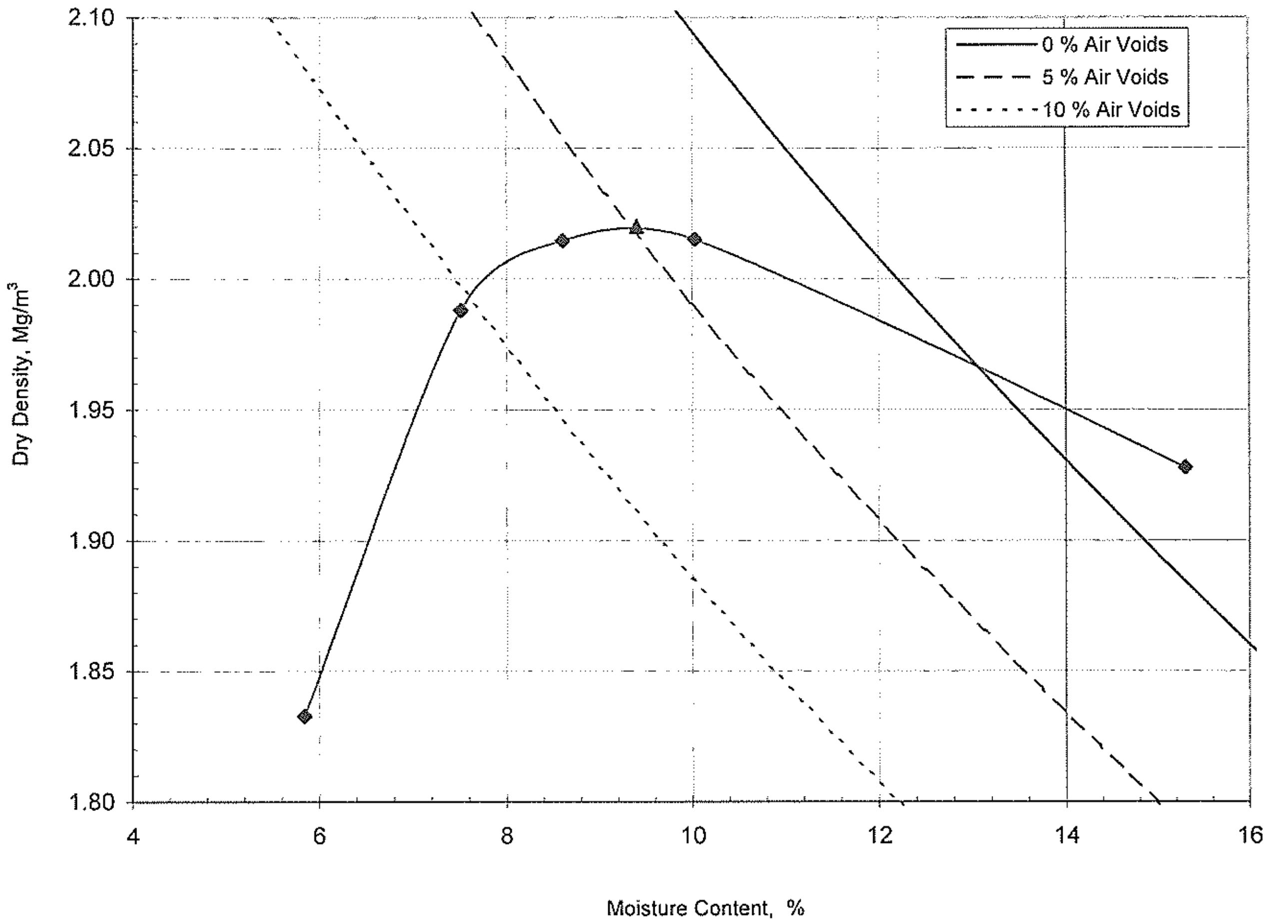
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	8
Mass Retained on 20.0 mm Sieve	%	14
Grading Zone		5
Particle Density - Assumed	Mg/m³	2.75
Maximum Dry Density	Mg/m³	1.95
Optimum Moisture Content	%	14
Natural Moisture Content	%	17.55

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
Location	Knockharley Landfill	Borehole / Pit No	BH02
		Sample No	10
Soil Description	Clayey SAND AND GRAVEL	Sample Type	B
		Depth	3.50 m



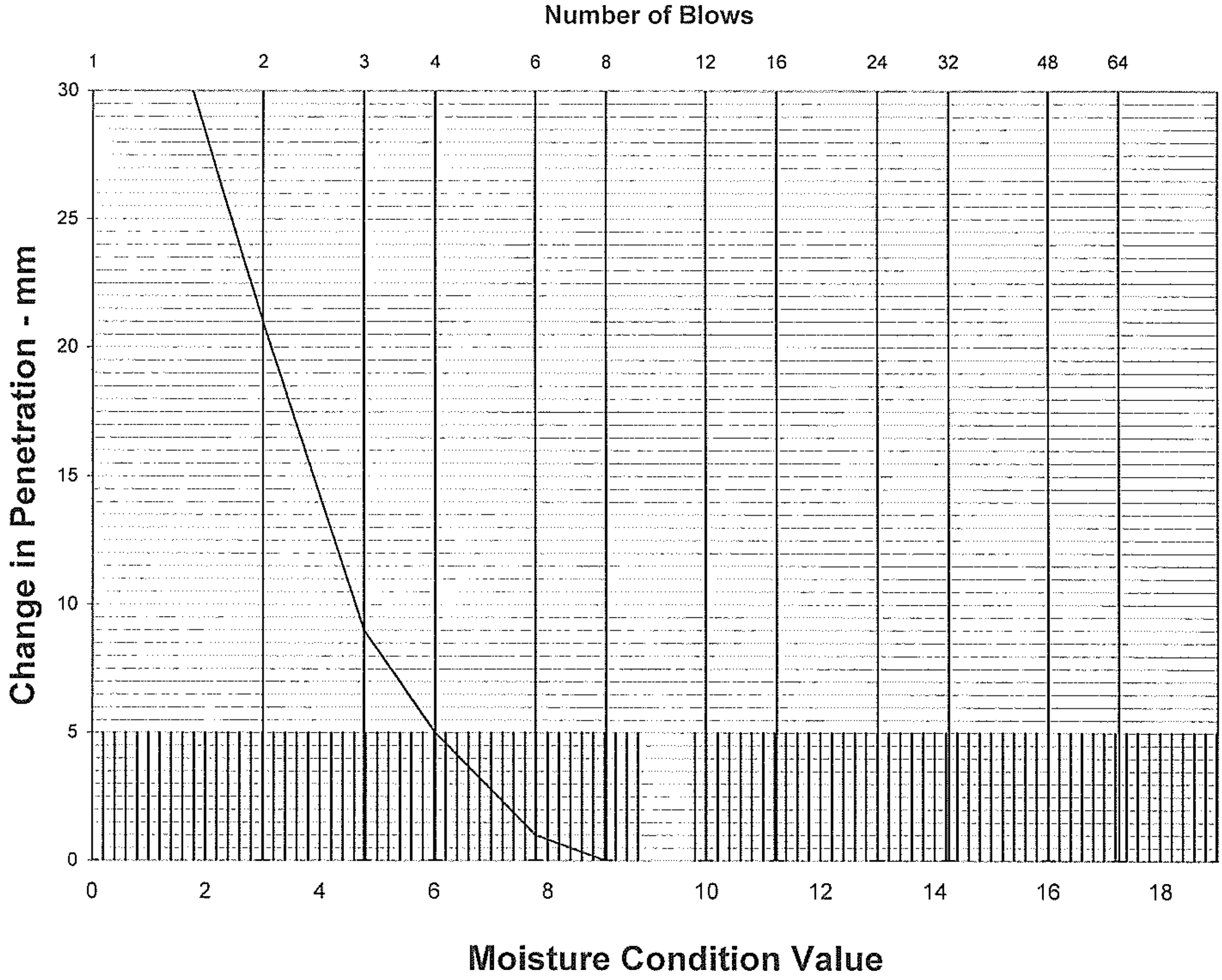
Specimen No		1	2	3	4	5	6
Moisture Condition Value		6.5					
Moisture Content	%	9.43					
Bulk density after compaction	Mg/m³	2.33					
Dry density after compaction	Mg/m³	2.13					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	4.2					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P16114**
		Borehole / Pit No	BH02
Site Name	**Knockharley Landfill**	Sample No	15
		Depth	7.50 m
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B



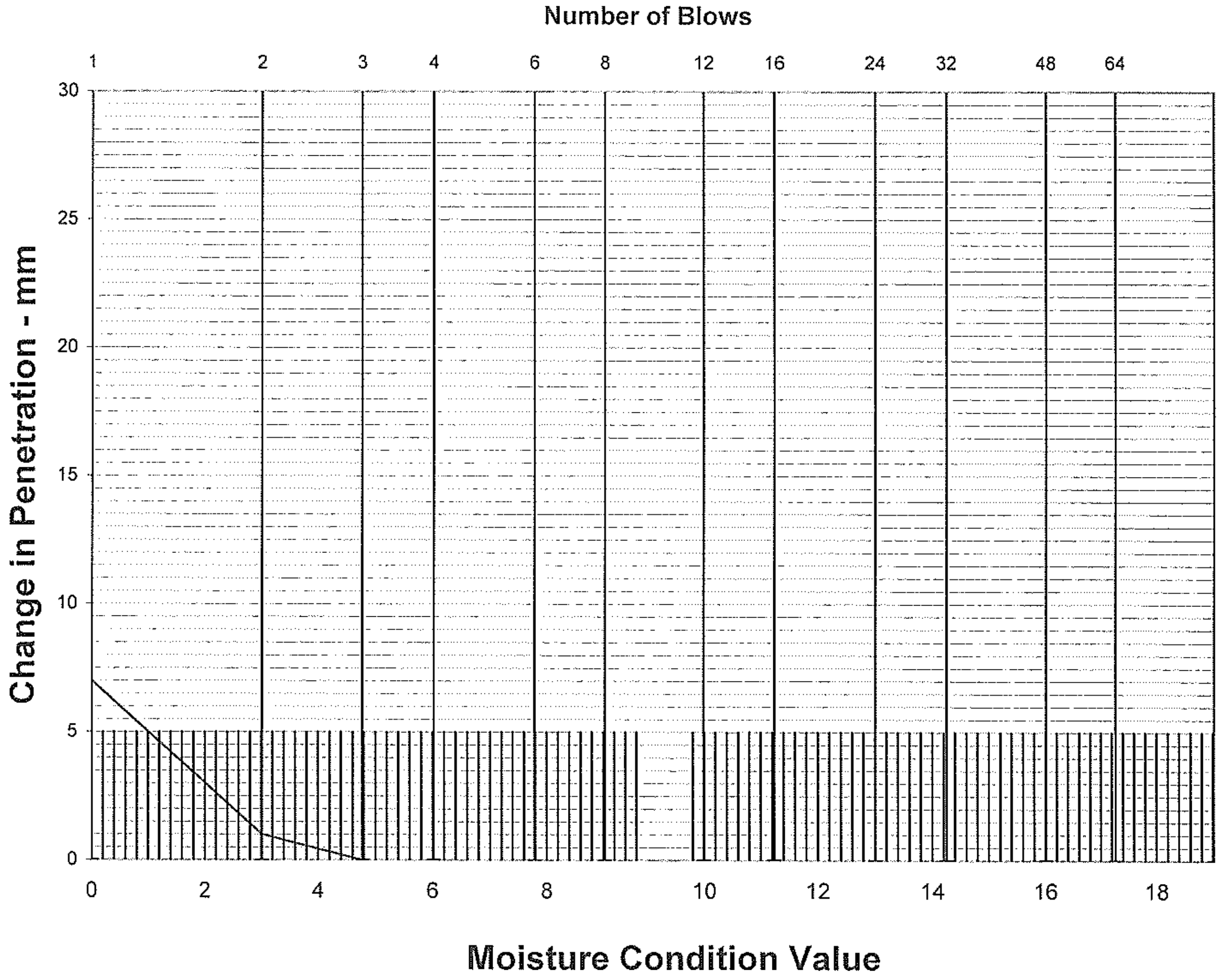
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	4
Mass Retained on 20.0 mm Sieve	%	5
Grading Zone		4
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.02
Optimum Moisture Content	%	9.4
Natural Moisture Content	%	15.30

	Moisture Condition Value BS 1377 : Part 4 : 1990 Clause 5	Job Ref	P16114
		Borehole / Pit No	BH02
Location	Knockharley Landfill	Sample No	17
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	8.50 m



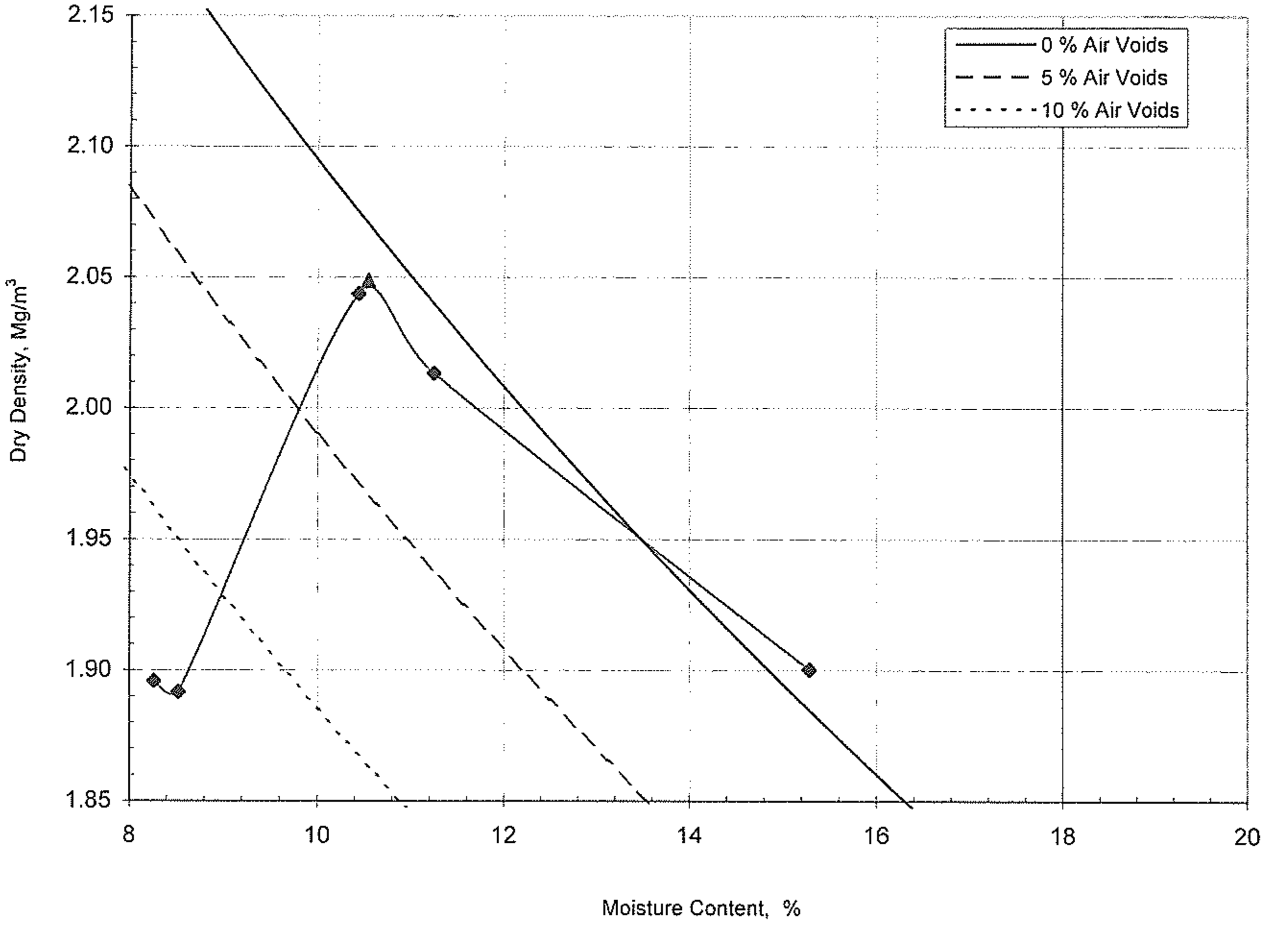
Specimen No		1	2	3	4	5	6
Moisture Condition Value		5.2					
Moisture Content	%	14.50					
Bulk density after compaction	Mg/m³	2.22					
Dry density after compaction	Mg/m³	1.94					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	1.6					

	Moisture Condition Value BS 1377 : Part 4 : 1990 Clause 5	Job Ref	P16114
Location	Knockharley Landfill	Borehole / Pit No	BH02
		Sample No	21
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	10.50 m



Specimen No	1	2	3	4	5	6
Moisture Condition Value	1.0					
Moisture Content %	16.43					
Bulk density after compaction Mg/m³	2.17					
Dry density after compaction Mg/m³	1.86					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	5.1					

PRIORITY GEOTECHNICAL	Dry Density / Moisture Content Relationship BS 1377 : Part 4 : 1990 : Clause 3	Job Ref	P16114
		Borehole / Pit No	BH03
Site Name	**Knockharley Landfill**	Sample No	10
		Depth	4.50 m
Soil Description	Slightly gravelly sandy CLAY	Sample Type	B

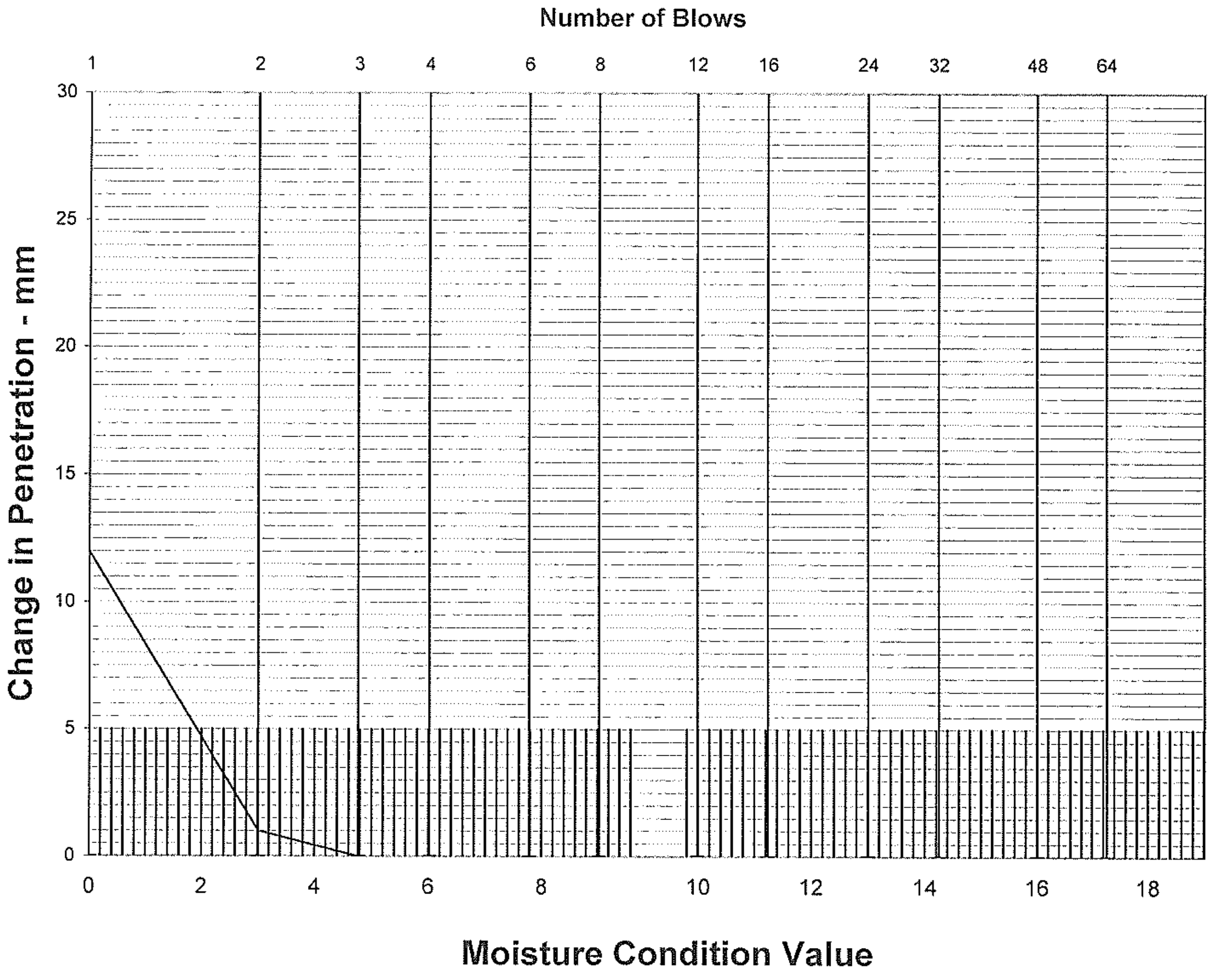


Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	2
Mass Retained on 20.0 mm Sieve	%	8
Grading Zone		4
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.05
Optimum Moisture Content	%	11
Natural Moisture Content	%	15.29

Moisture Condition Value

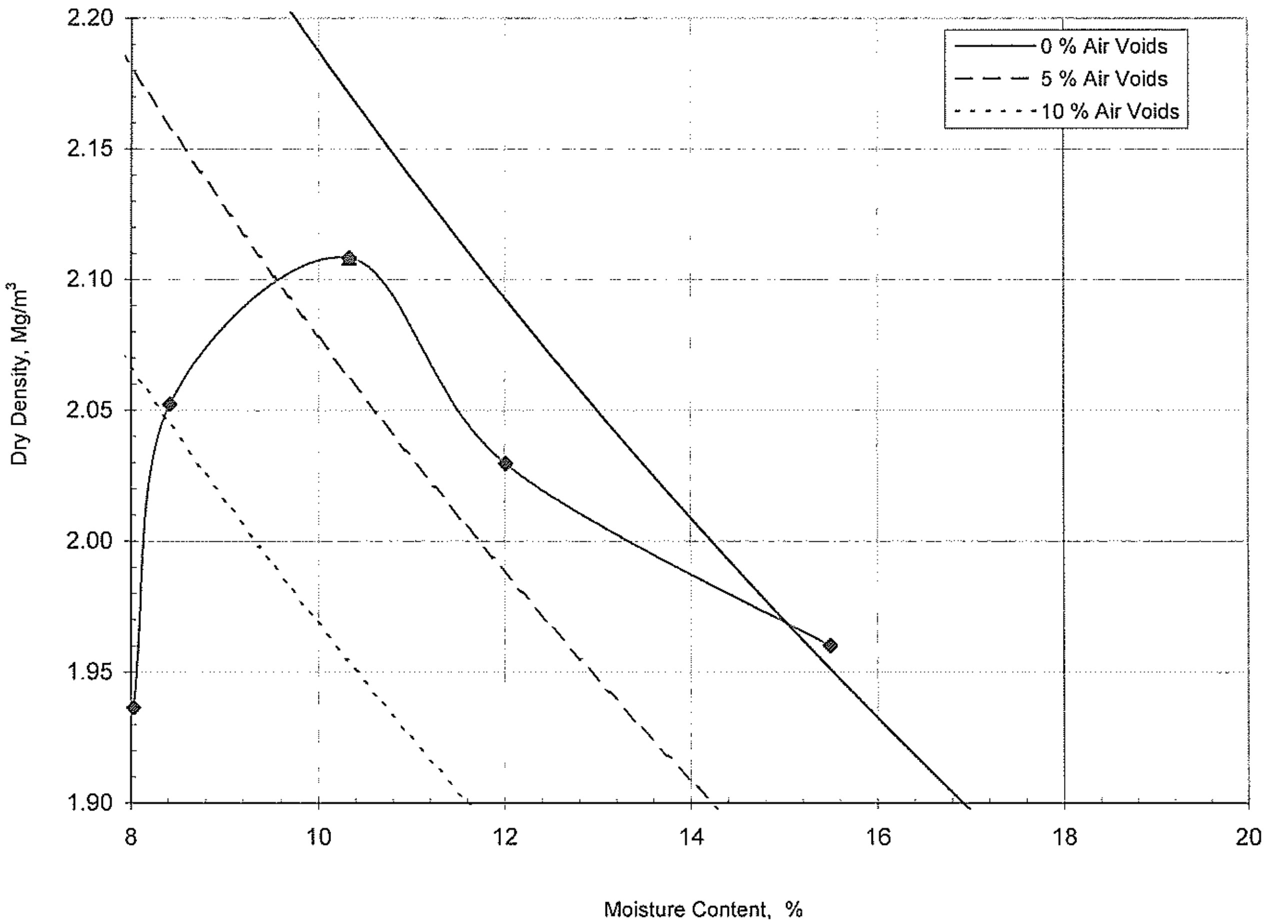
BS 1377 : Part 4 : 1990 Clause 5

Location	Knockharley Landfill	Job Ref	P16114
		Borehole / Pit No	BH03
		Sample No	10
Soil Description	Slightly gravelly sandy CLAY	Sample Type	B
		Depth	4.50 m



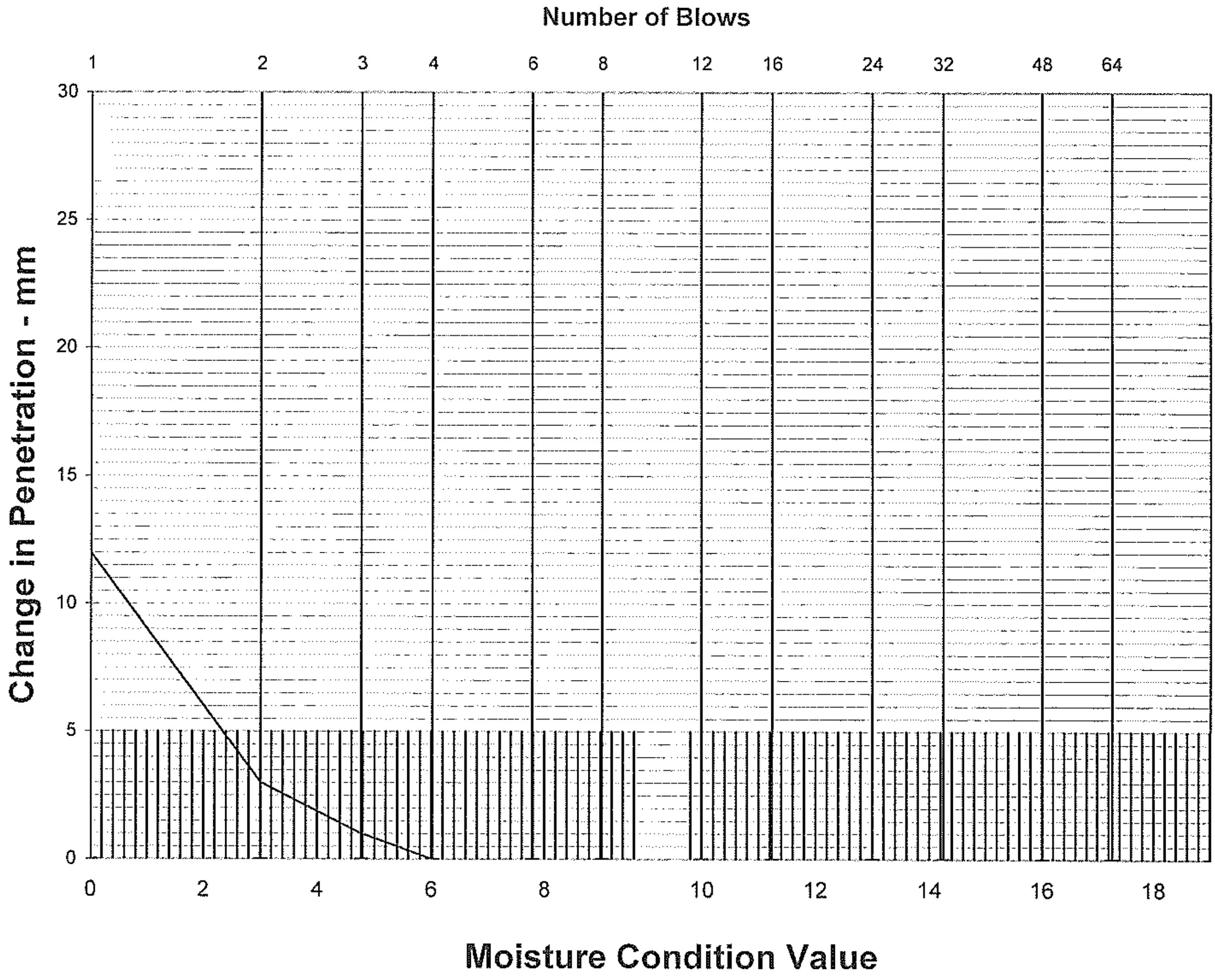
Specimen No		1	2	3	4	5	6
Moisture Condition Value		1.9					
Moisture Content	%	15.29					
Bulk density after compaction	Mg/m³	2.05					
Dry density after compaction	Mg/m³	1.78					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	7.9					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P16114**
		Borehole / Pit No	BH03
Site Name	**Knockharley Landfill**	Sample No	14
		Depth	6.50 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B



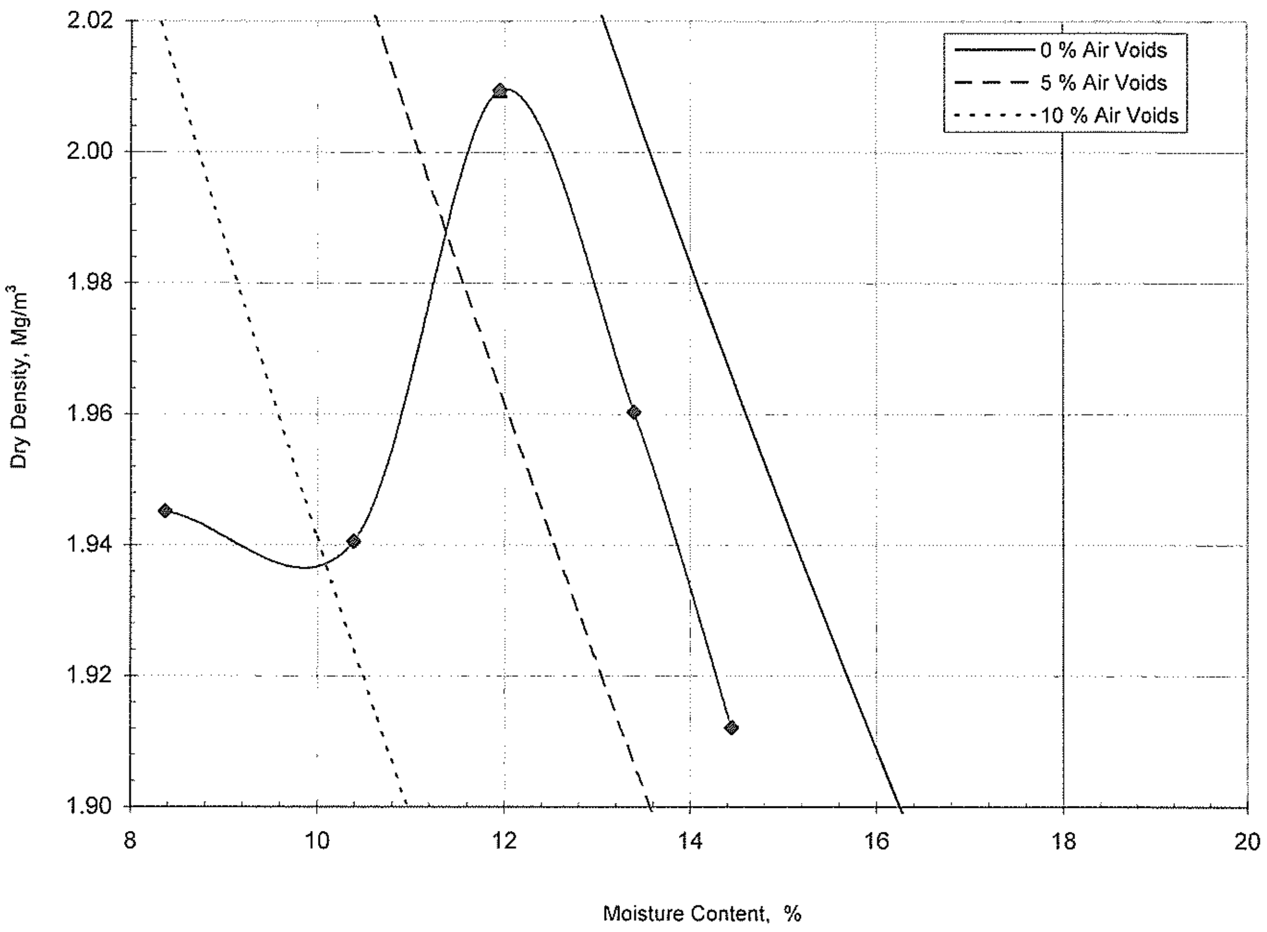
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	3
Mass Retained on 20.0 mm Sieve	%	11
Grading Zone		4
Particle Density - Assumed	Mg/m³	2.80
Maximum Dry Density	Mg/m³	2.11
Optimum Moisture Content	%	10
Natural Moisture Content	%	15.50

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
		Borehole / Pit No	BH03
Location	Knockharley Landfill	Sample No	14
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B
		Depth	6.50 m



Specimen No	1	2	3	4	5	6
Moisture Condition Value	2.3					
Moisture Content %	15.50					
Bulk density after compaction Mg/m³	2.22					
Dry density after compaction Mg/m³	1.92					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	10.8					

PRIORITY GEOTECHNICAL	Dry Density / Moisture Content Relationship BS 1377 : Part 4 : 1990 : Clause 3	Job Ref	P16114
		Borehole / Pit No	BH04
Site Name	**Knockharley Landfill**	Sample No	9
		Depth	3.50 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B

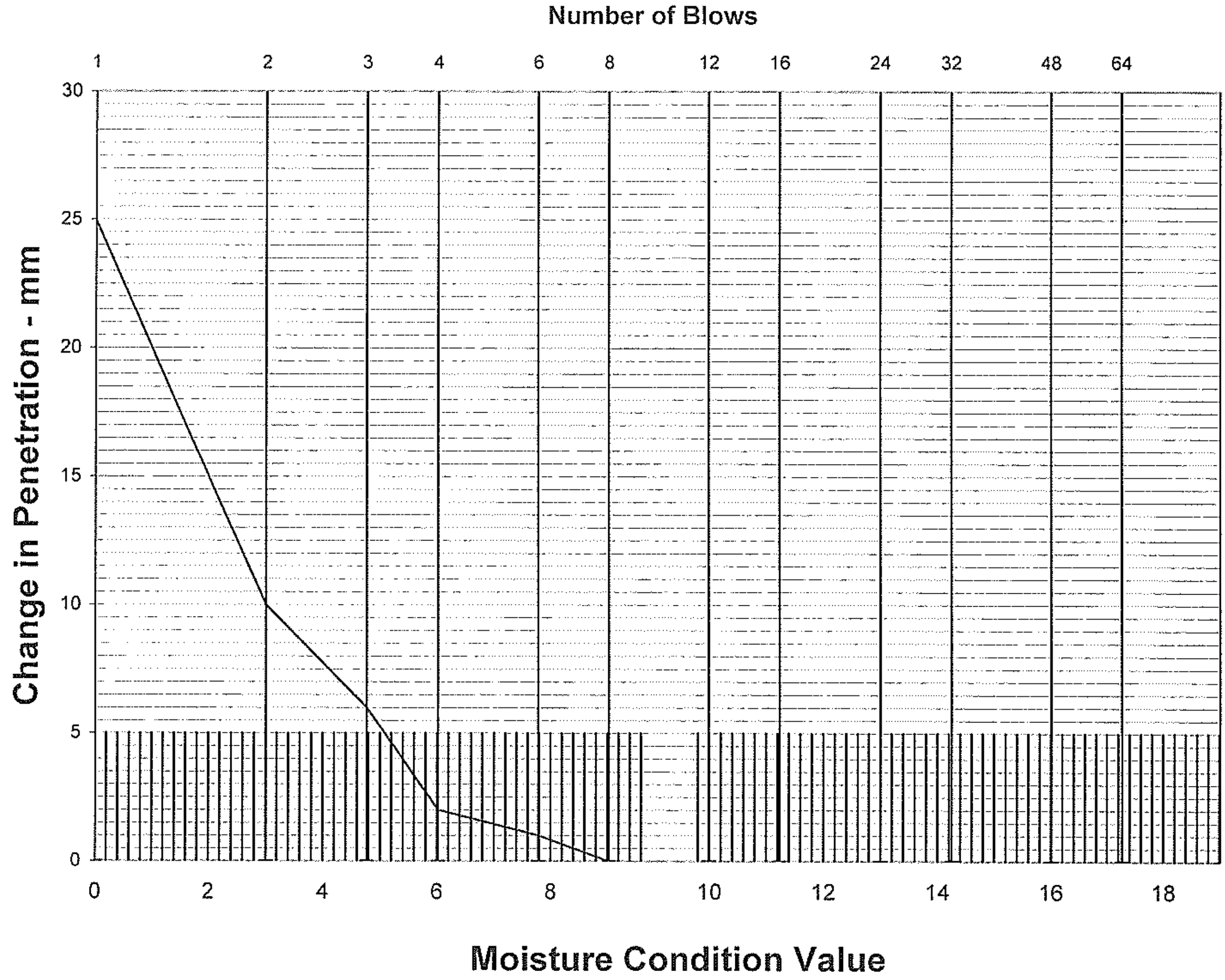


Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	0
Mass Retained on 20.0 mm Sieve	%	1
Grading Zone		2
Particle Density - Assumed	Mg/m³	2.75
Maximum Dry Density	Mg/m³	2.01
Optimum Moisture Content	%	12
Natural Moisture Content	%	13.39

Moisture Condition Value

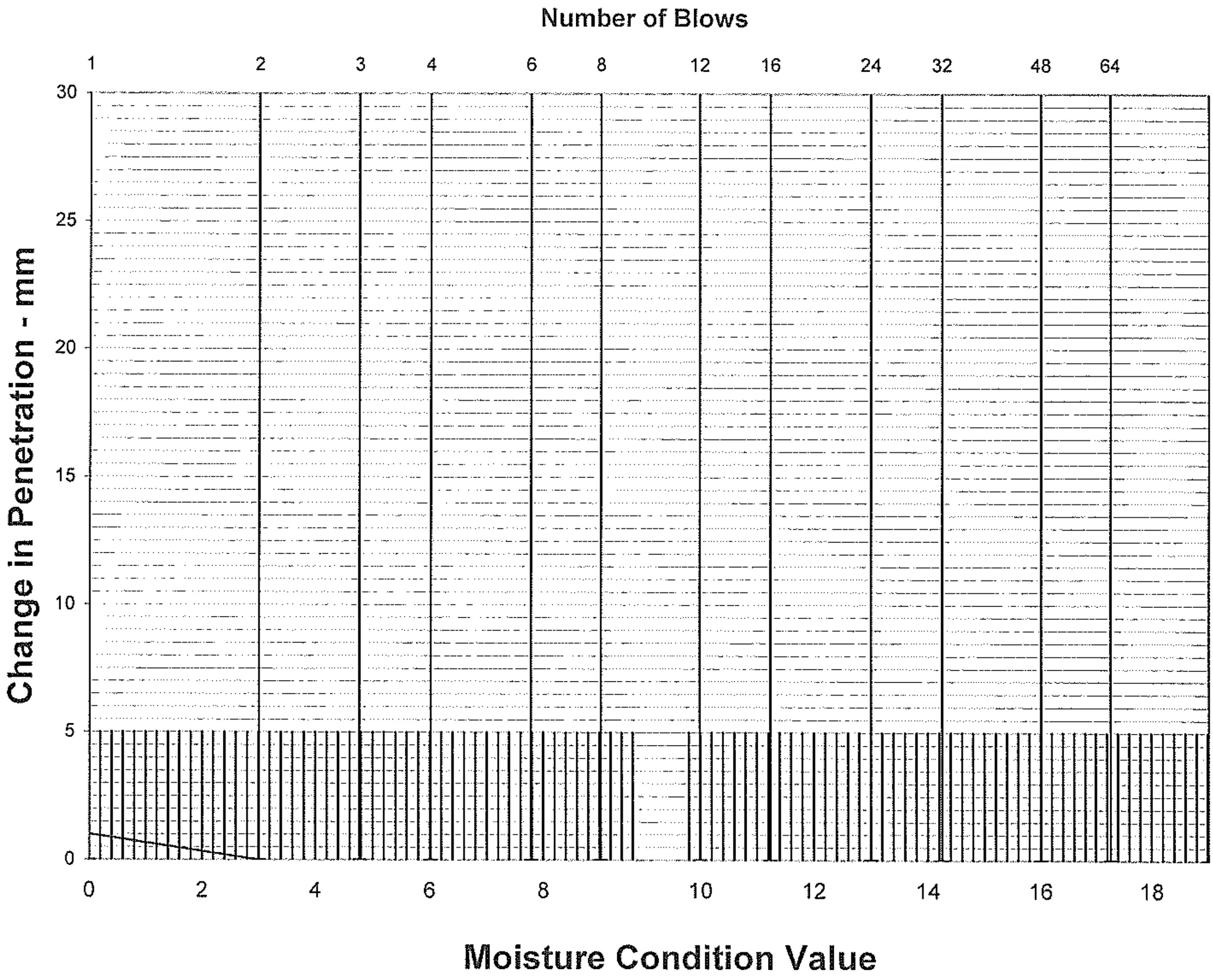
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P16114**
Location	Knockharley Landfill	Borehole / Pit No	BH04
		Sample No	12
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B
		Depth	4.50 m



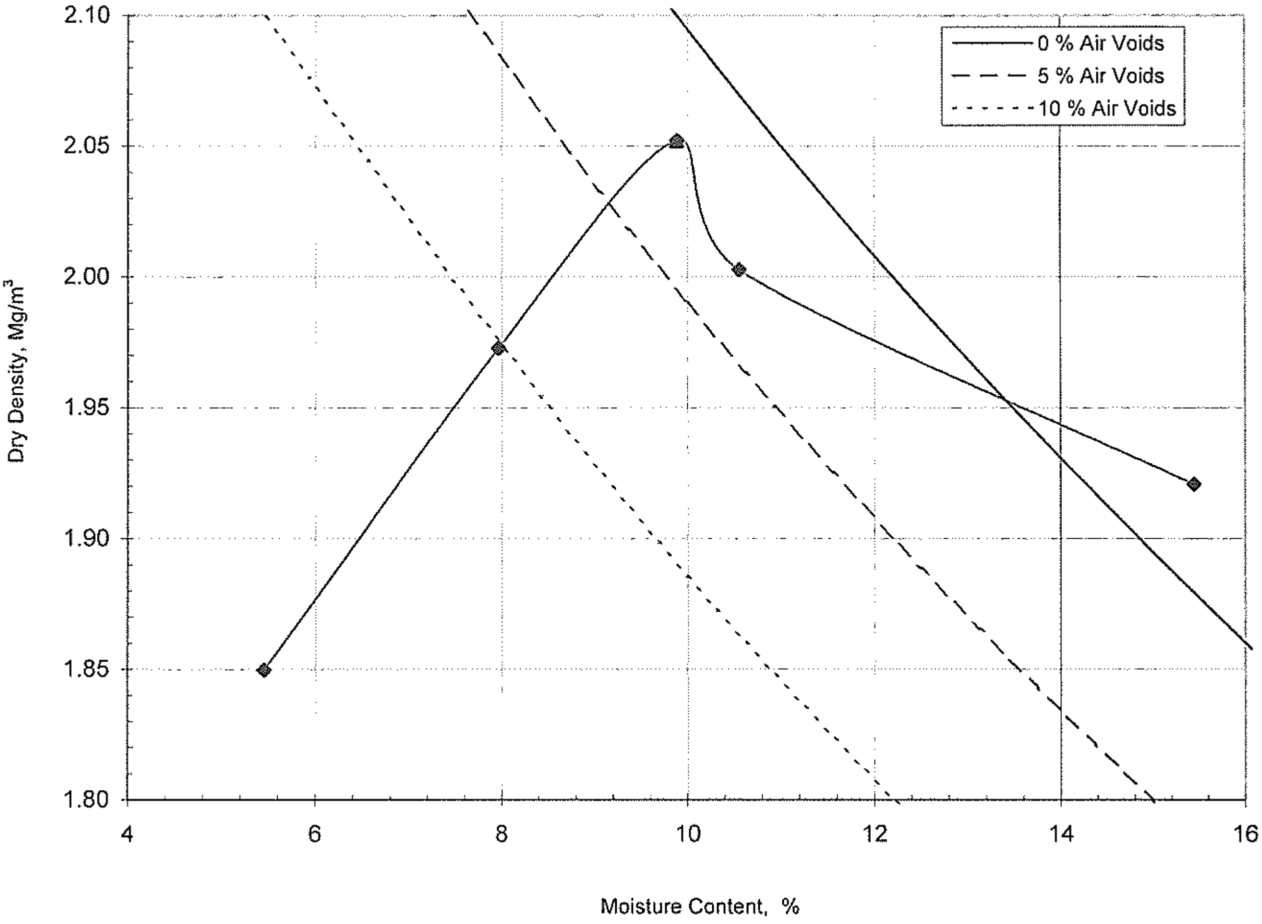
Specimen No	1	2	3	4	5	6
Moisture Condition Value	4.0					
Moisture Content %	12.65					
Bulk density after compaction Mg/m³	2.27					
Dry density after compaction Mg/m³	2.02					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	2.7					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
		Borehole / Pit No	BH04
Location	Knockharley Landfill	Sample No	17
Soil Description	Very clayey very sandy GRAVEL with medium cobble content	Sample Type	B
		Depth	6.00 m



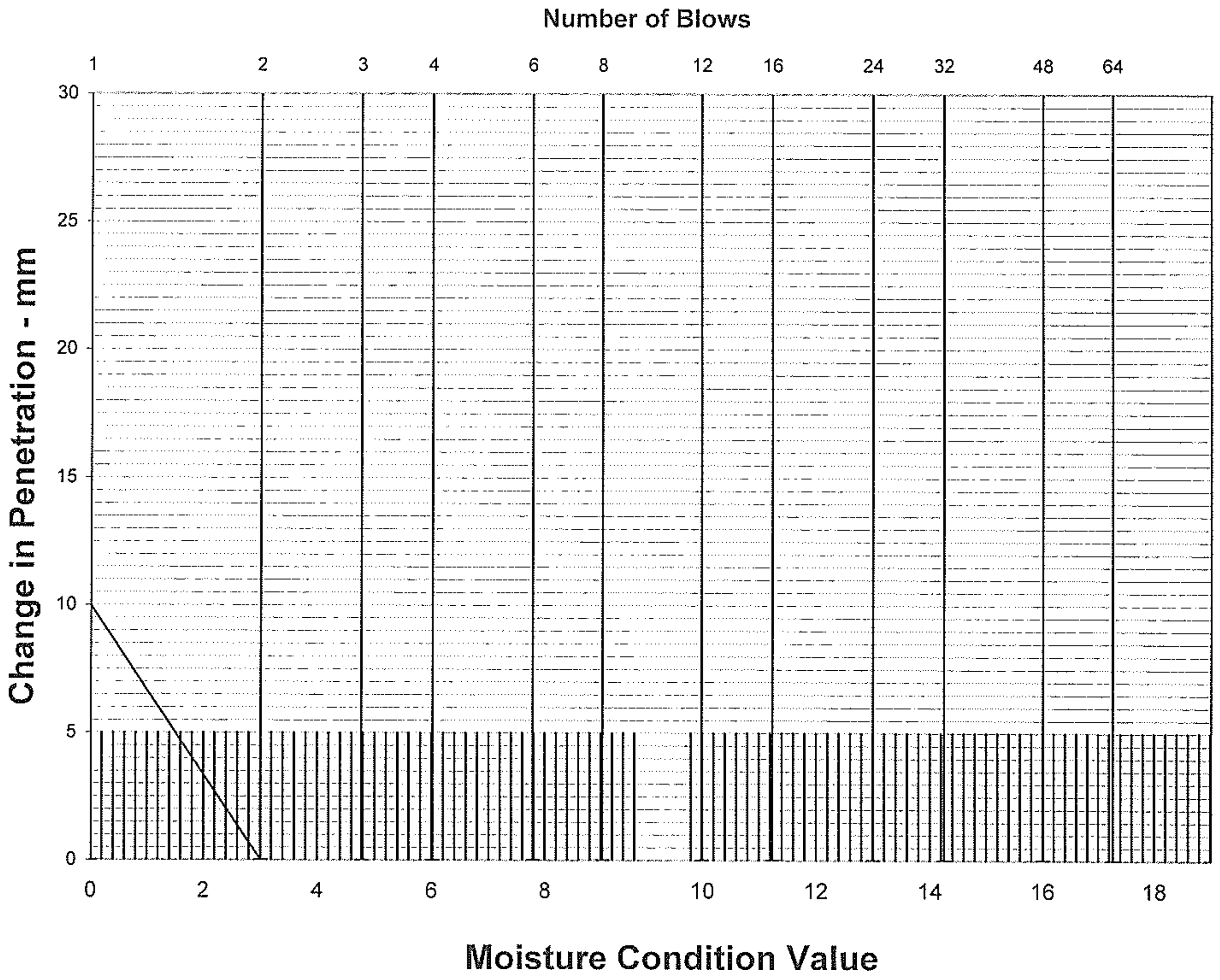
Specimen No	1	2	3	4	5	6
Moisture Condition Value	0.0					
Moisture Content %	13.49					
Bulk density after compaction Mg/m³	2.25					
Dry density after compaction Mg/m³	1.98					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	24.9					

PRIORITY GEOTECHNICAL	Dry Density / Moisture Content Relationship BS 1377 : Part 4 : 1990 : Clause 3	Job Ref	P16114
		Borehole / Pit No	BH04
Site Name	**Knockharley Landfill**	Sample No	19
		Depth	8.50 m
Soil Description	Slightly sandy slighlty gravelly CLAY	Sample Type	B



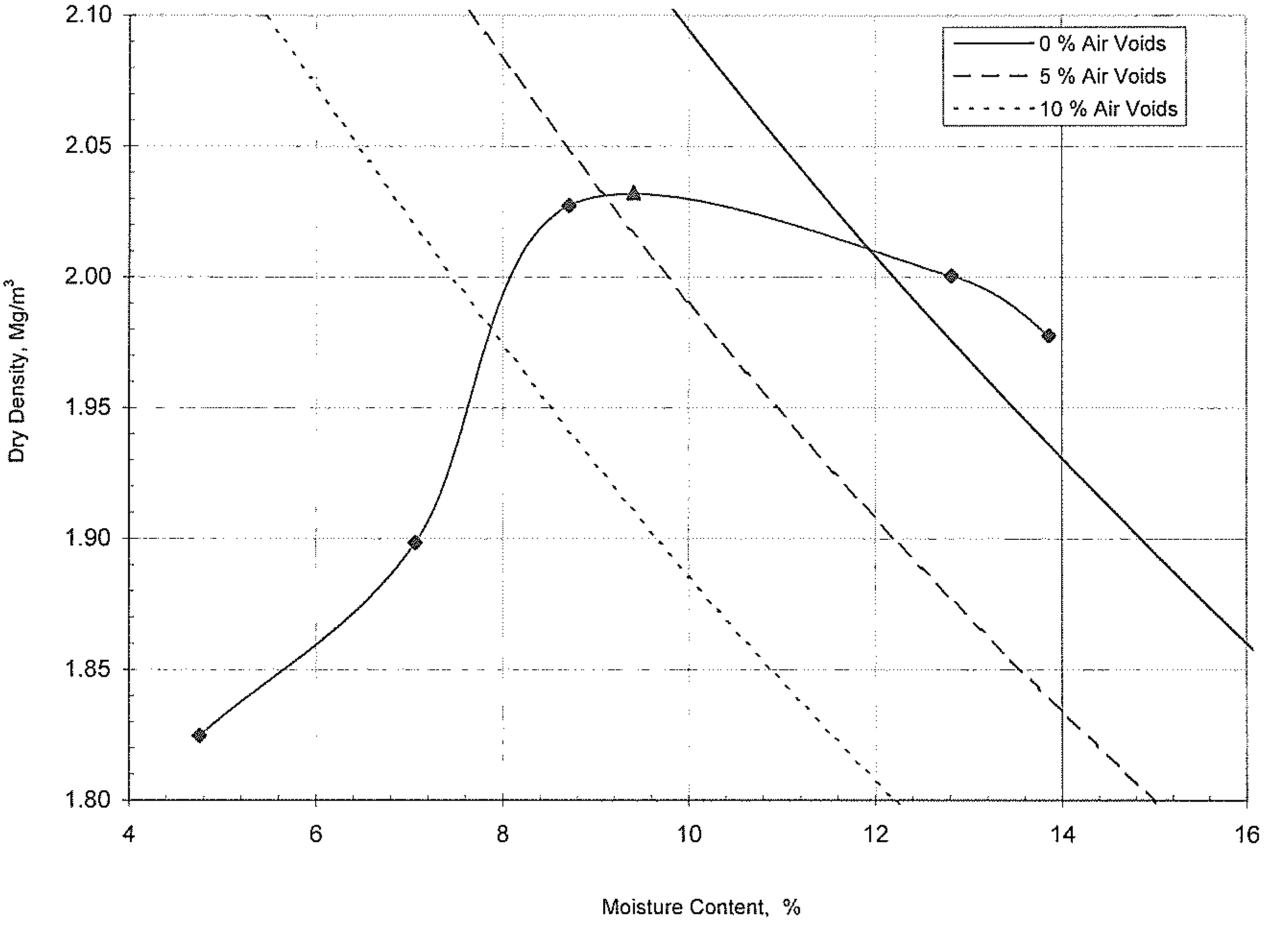
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	0
Mass Retained on 20.0 mm Sieve	%	6
Grading Zone		3
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.05
Optimum Moisture Content	%	9.9
Natural Moisture Content	%	15.44

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
Location	Knockharley Landfill	Borehole / Pit No	BH05
		Sample No	9
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	3.50 m



Specimen No	1	2	3	4	5	6
Moisture Condition Value	1.5					
Moisture Content %	13.58					
Bulk density after compaction Mg/m³	2.25					
Dry density after compaction Mg/m³	1.98					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	15.7					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P16114**
		Borehole / Pit No	BH05
Site Name	**Knockharley Landfill**	Sample No	13
		Depth	5.50 m
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B

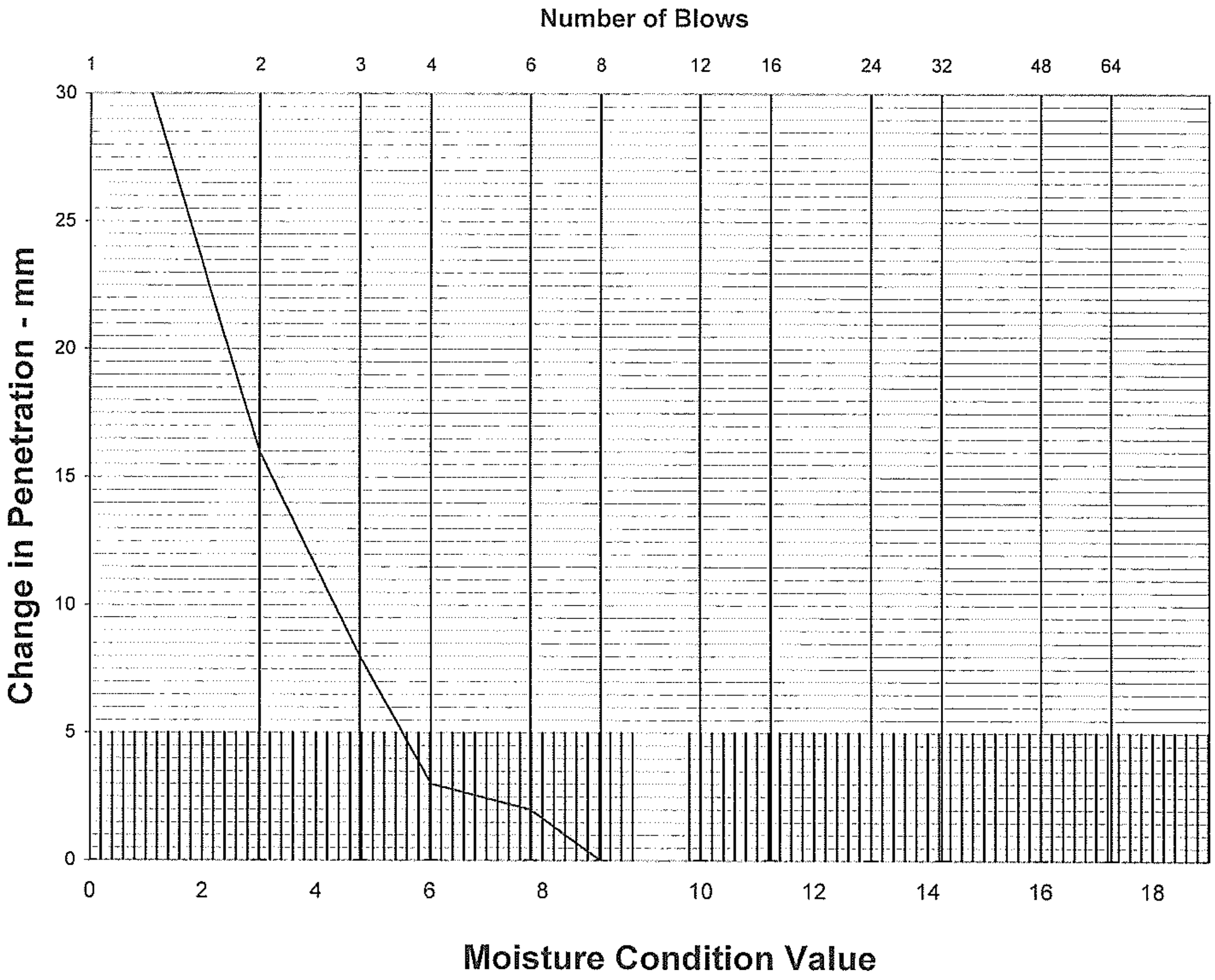


Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	2
Mass Retained on 20.0 mm Sieve	%	8
Grading Zone		4
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.03
Optimum Moisture Content	%	9.4
Natural Moisture Content	%	12.82

Moisture Condition Value

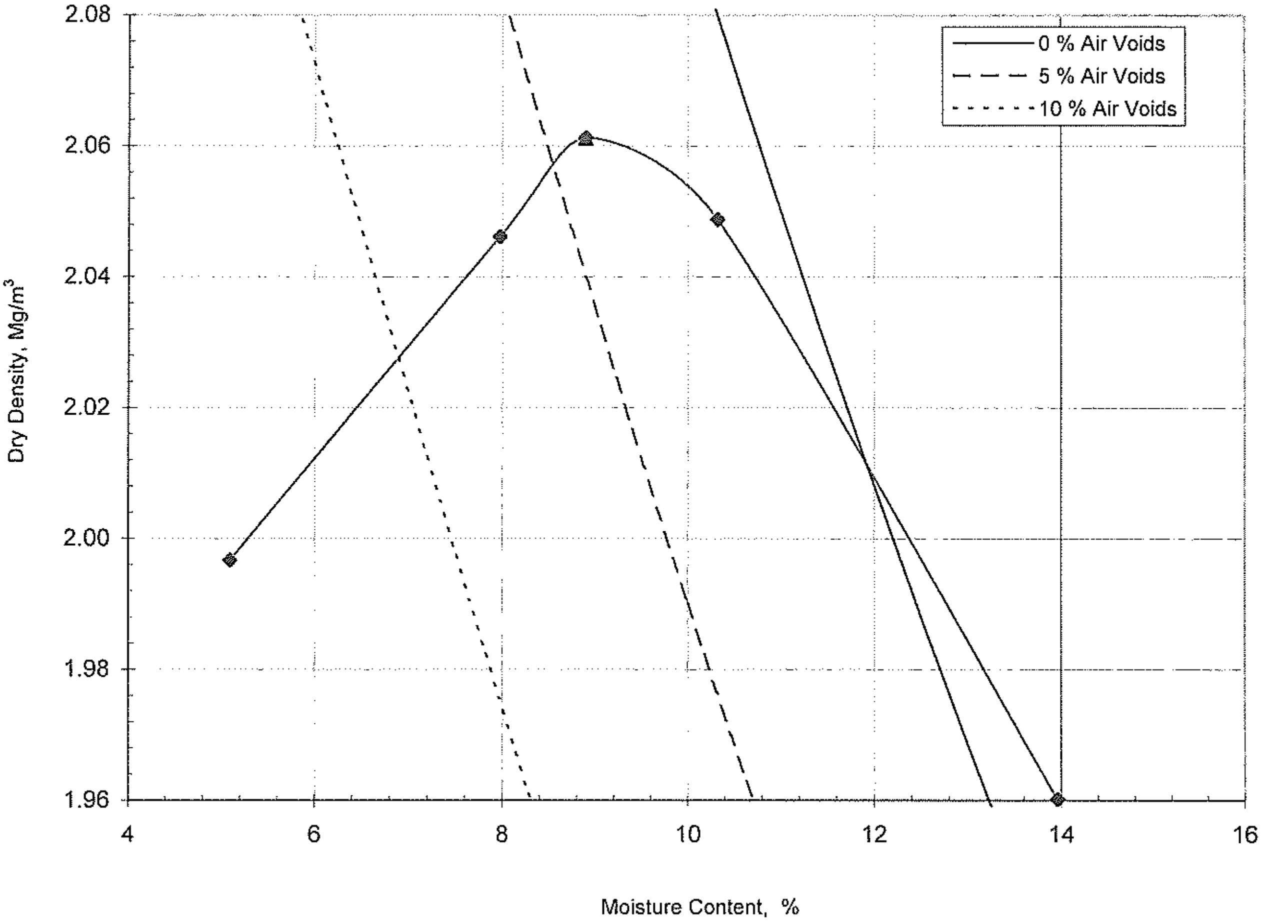
BS 1377 : Part 4 : 1990 Clause 5

Location	Knockharley Landfill	**Job Ref**	**P16114**
		Borehole / Pit No	BH05
		Sample No	15
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	6.50 m



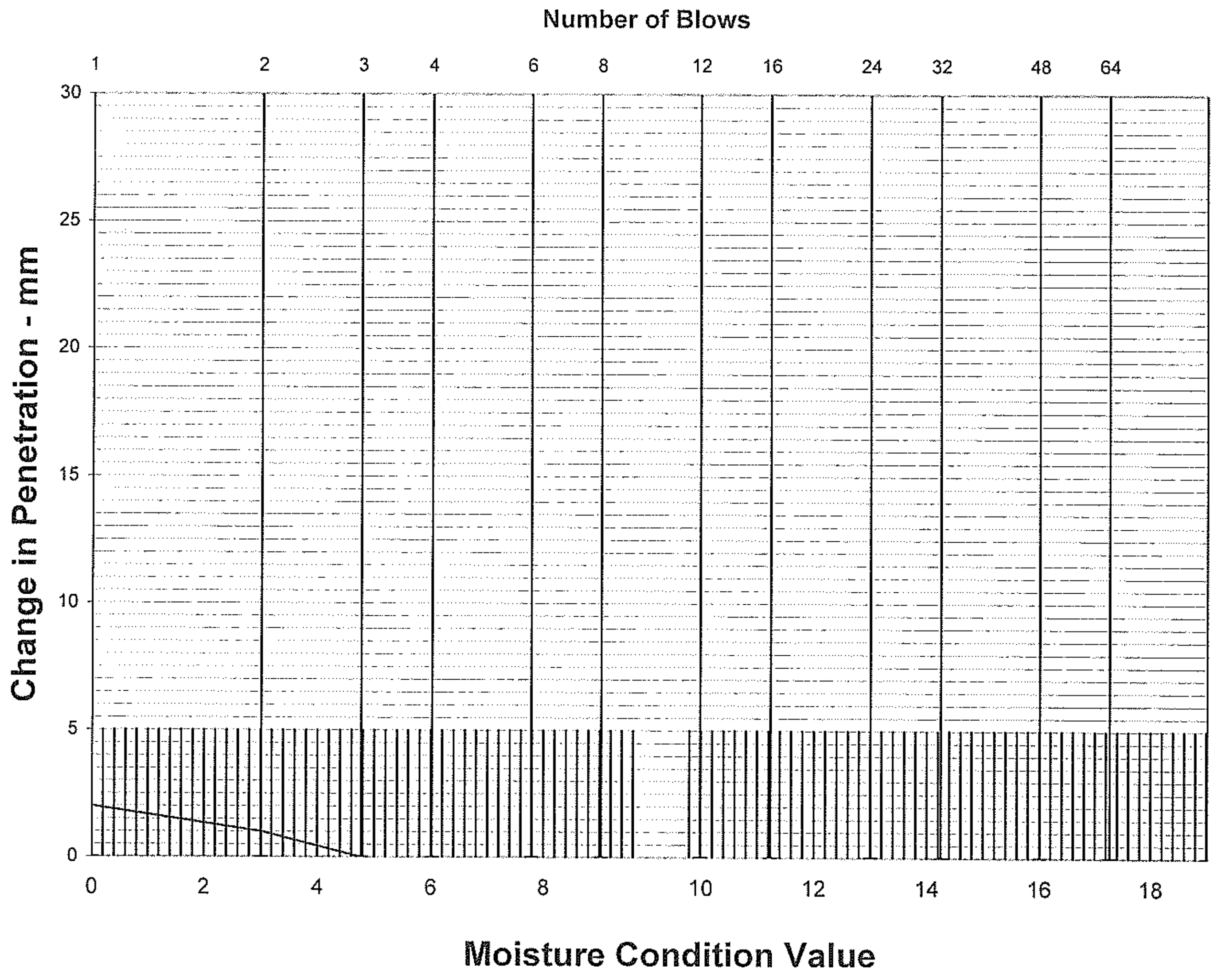
Specimen No	1	2	3	4	5	6
Moisture Condition Value	4.5					
Moisture Content %	12.93					
Bulk density after compaction Mg/m³	2.19					
Dry density after compaction Mg/m³	1.94					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	37.0					

PRIORITY GEOTECHNICAL	Dry Density / Moisture Content Relationship BS 1377 : Part 4 : 1990 : Clause 3	Job Ref	P16114
		Borehole / Pit No	BH06
Site Name	**Knockharley Landfill**	Sample No	9
		Depth	5.00 m
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B



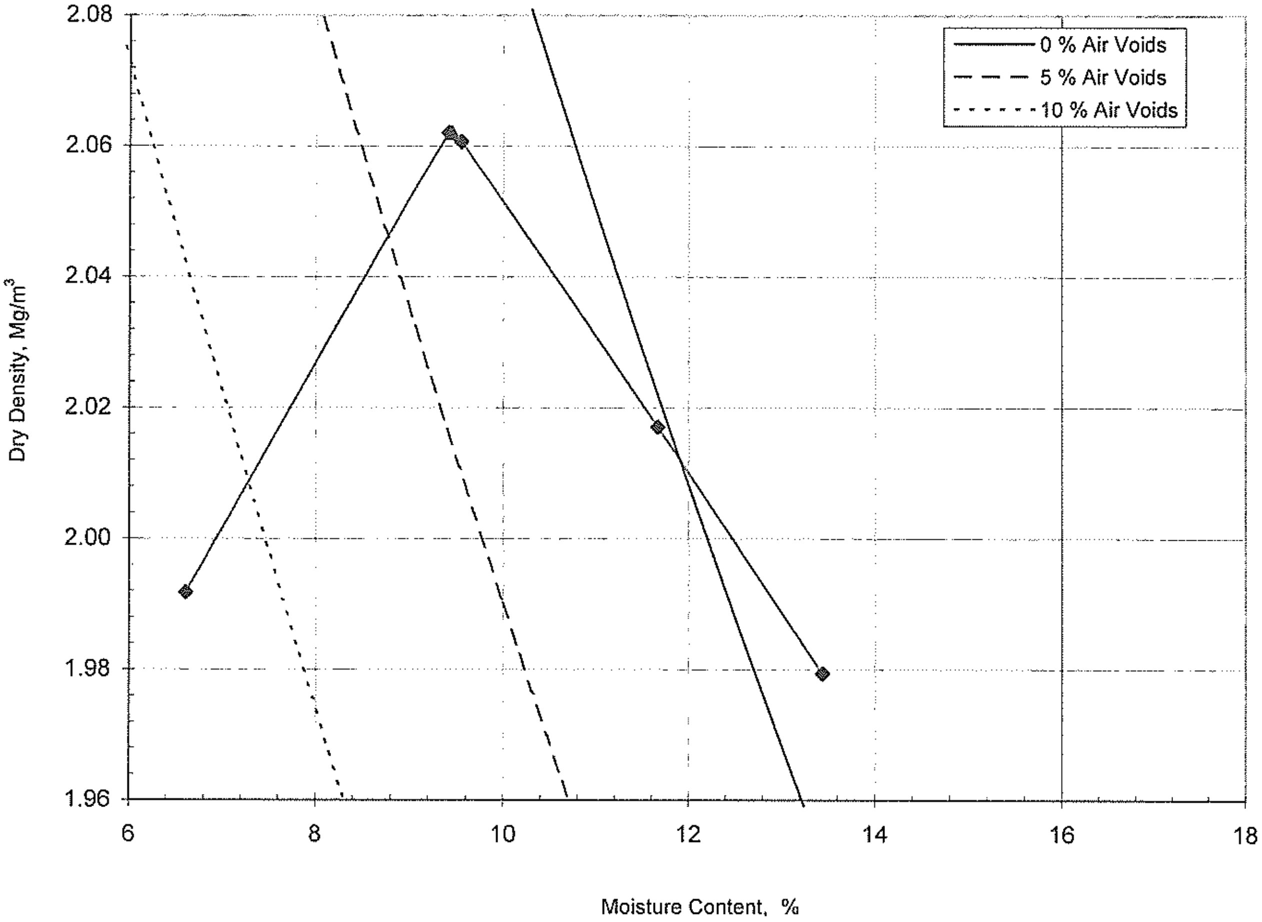
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	0
Mass Retained on 20.0 mm Sieve	%	5
Grading Zone		3
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.06
Optimum Moisture Content	%	8.9
Natural Moisture Content	%	13.96

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
Location	Knockharley Landfill	Borehole / Pit No	BH06
		Sample No	9
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	5.00 m



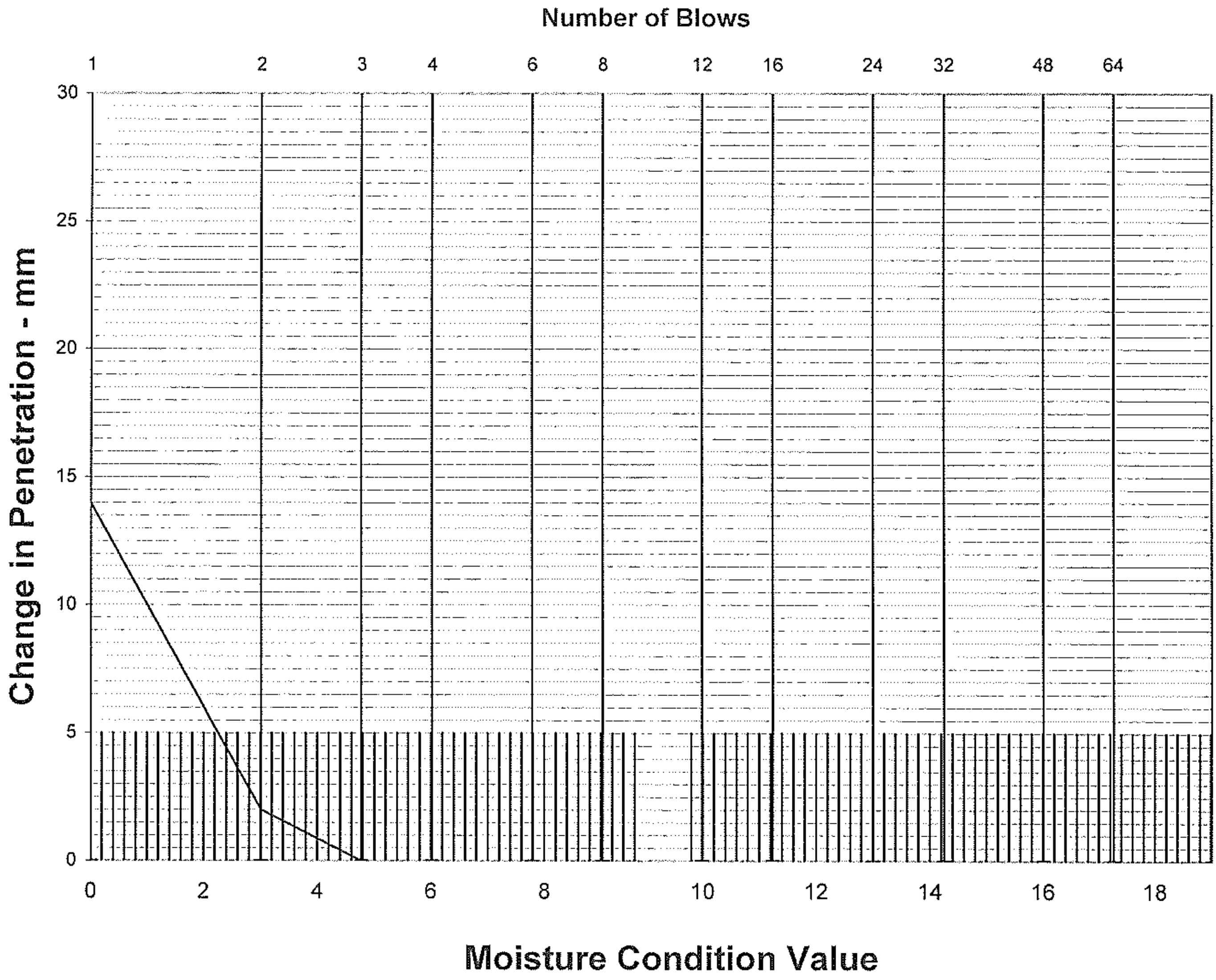
Specimen No	1	2	3	4	5	6
Moisture Condition Value	0.0					
Moisture Content %	13.74					
Bulk density after compaction Mg/m³	2.22					
Dry density after compaction Mg/m³	1.95					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	5.1					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P16114**
		Borehole / Pit No	BH07
Site Name	**Knockharley Landfill**	Sample No	14
		Depth	6.00 m
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B



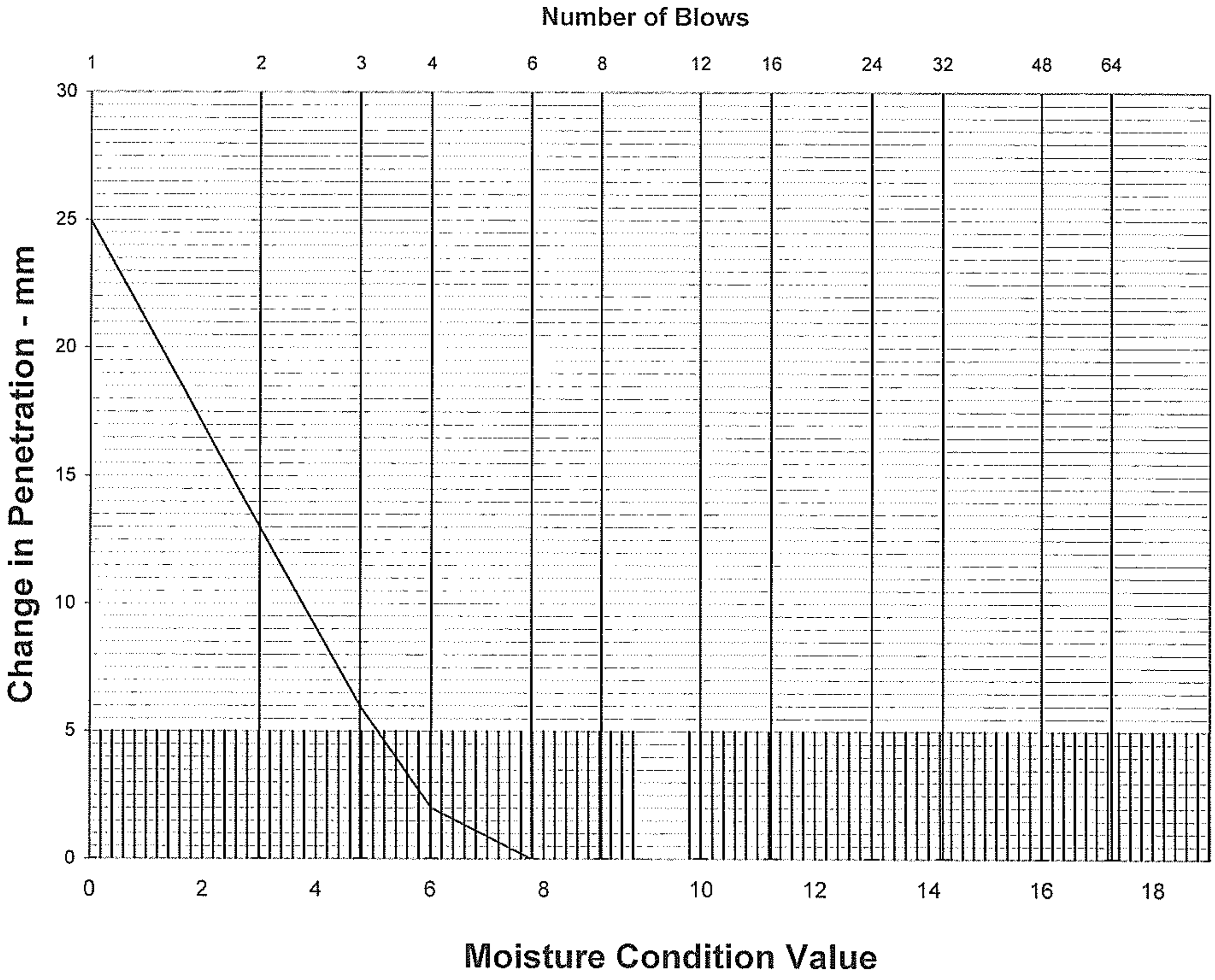
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	0
Mass Retained on 20.0 mm Sieve	%	4
Grading Zone		2
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.06
Optimum Moisture Content	%	9.5
Natural Moisture Content	%	13.44

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
		Borehole / Pit No	BH07
Location	Knockharley Landfill	Sample No	14
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	6.00 m



Specimen No	1	2	3	4	5	6
Moisture Condition Value	2.3					
Moisture Content %	13.44					
Bulk density after compaction Mg/m³	2.19					
Dry density after compaction Mg/m³	1.93					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	5.9					

	Moisture Condition Value BS 1377 : Part 4 : 1990 Clause 5	Job Ref	P16114
Location	Knockharley Landfill	Borehole / Pit No	BH08
		Sample No	3
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample Type	B
		Depth	0.90 m

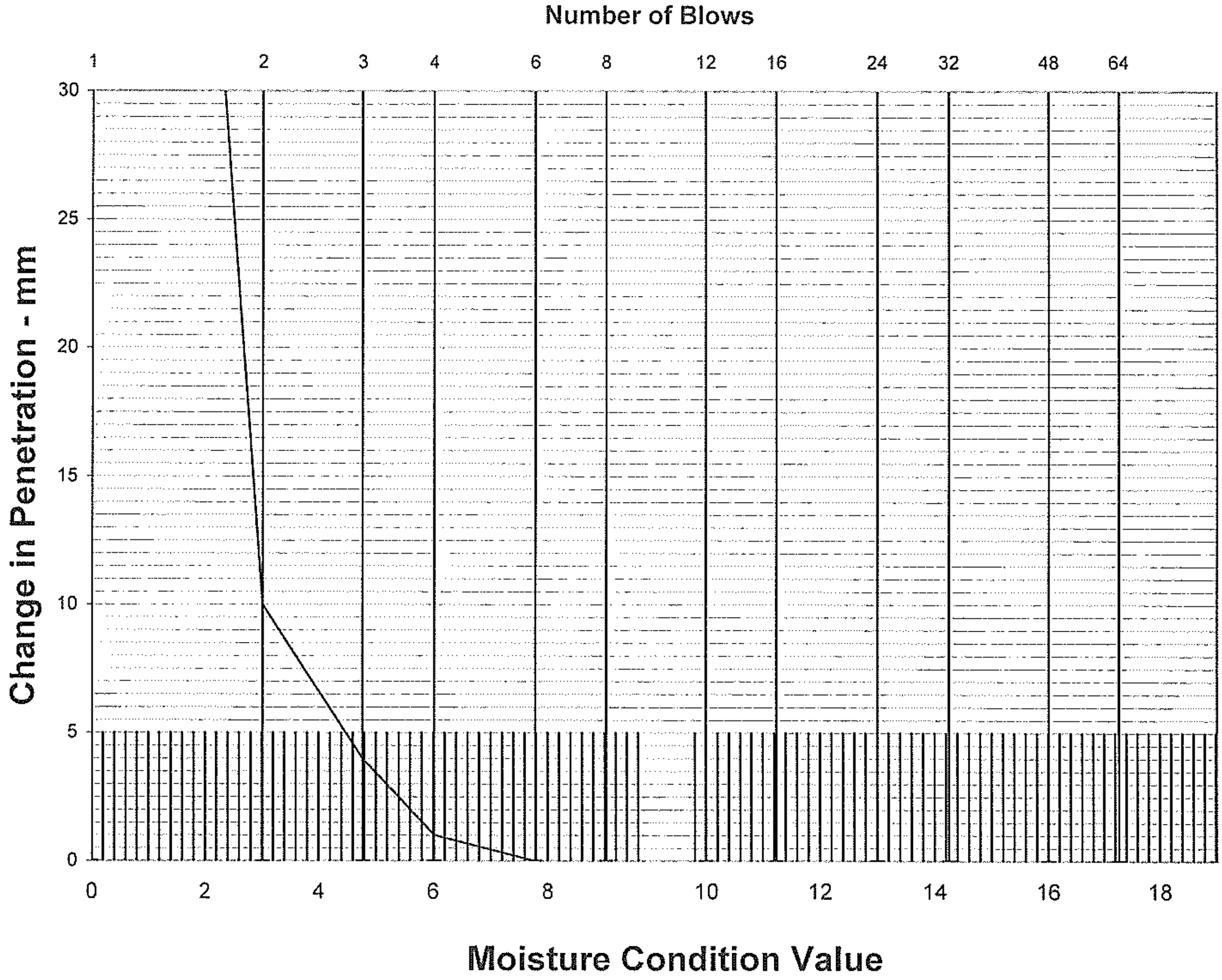


Specimen No		1	2	3	4	5	6
Moisture Condition Value		5.0					
Moisture Content	%	15.34					
Bulk density after compaction	Mg/m³	2.05					
Dry density after compaction	Mg/m³	1.78					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	14.4					

Moisture Condition Value

BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	P16114
		Borehole / Pit No	BH08
Location	Knockharley Landfill	Sample No	5
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	1.50 m



Specimen No		1	2	3	4	5	6
Moisture Condition Value		3.2					
Moisture Content	%	11.85					
Bulk density after compaction	Mg/m³	2.22					
Dry density after compaction	Mg/m³	1.98					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	39.8					

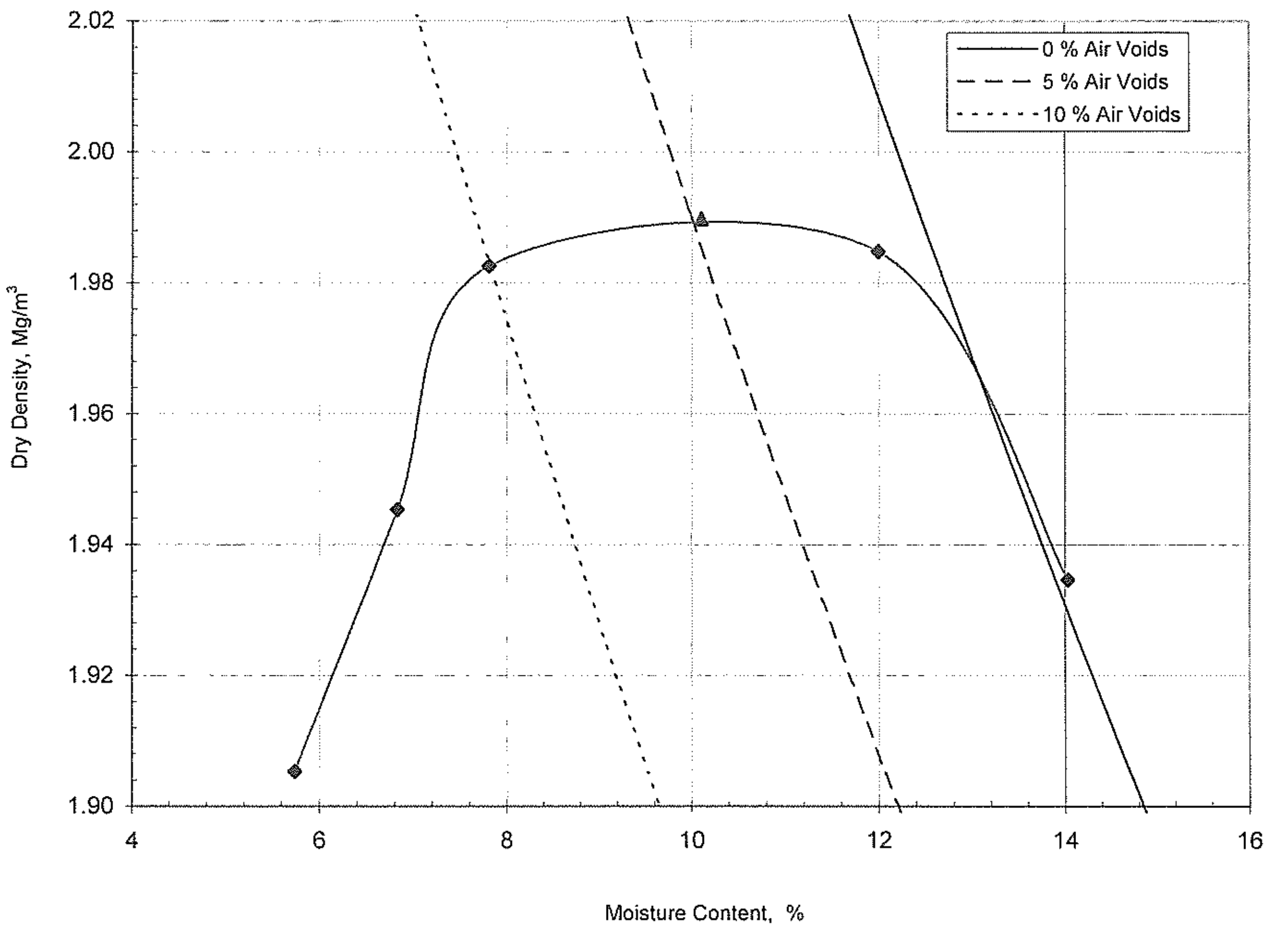
PRIORITY
GEOTECHNICAL

Dry Density / Moisture Content Relationship

BS 1377 : Part 4 : 1990 : Clause 3

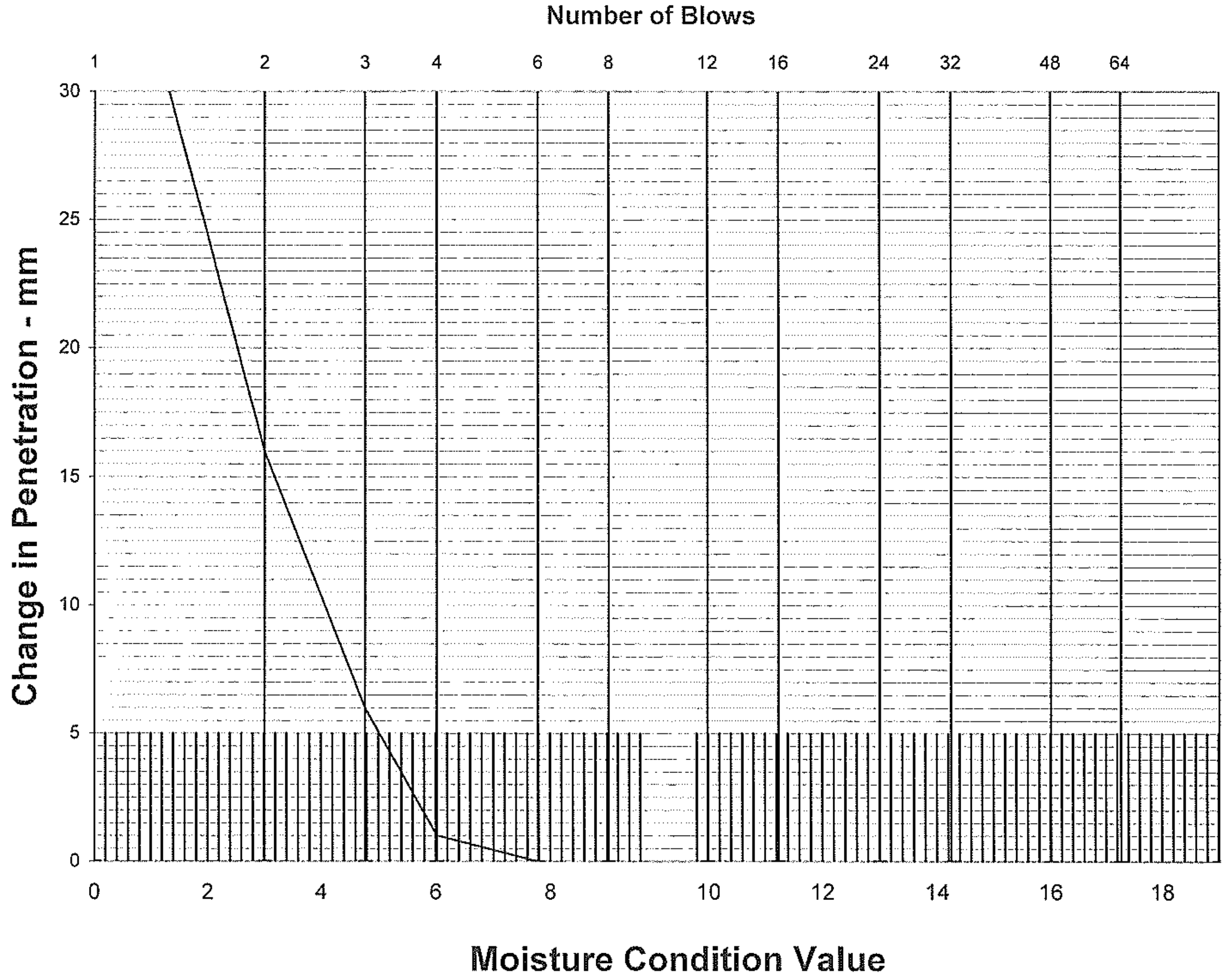
Job Ref	P16114
Borehole / Pit No	BH08
Sample No	7
Depth	2.50 m
Sample Type	B

Site Name	**Knockharley Landfill**
Soil Description	Slightly sandy gravelly CLAY with low cobble content



Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	5
Mass Retained on 20.0 mm Sieve	%	12
Grading Zone		4
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	1.99
Optimum Moisture Content	%	10
Natural Moisture Content	%	14.03

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
		Borehole / Pit No	BH08
Location	Knockharley Landfill	Sample No	7
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample Type	B
		Depth	2.50 m

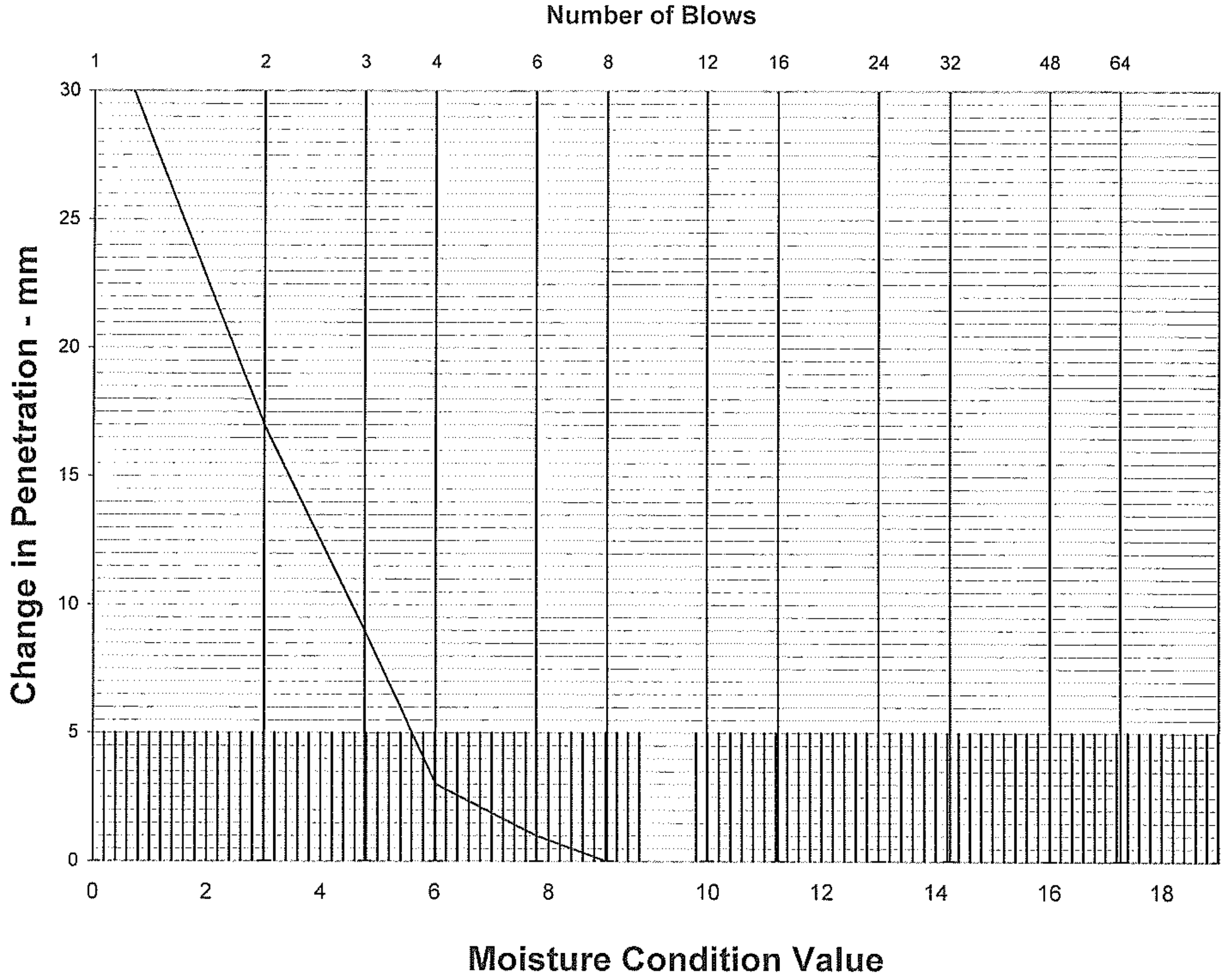


Specimen No		1	2	3	4	5	6
Moisture Condition Value		4.3					
Moisture Content	%	14.01					
Bulk density after compaction	Mg/m³	2.19					
Dry density after compaction	Mg/m³	1.92					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	11.6					

Moisture Condition Value

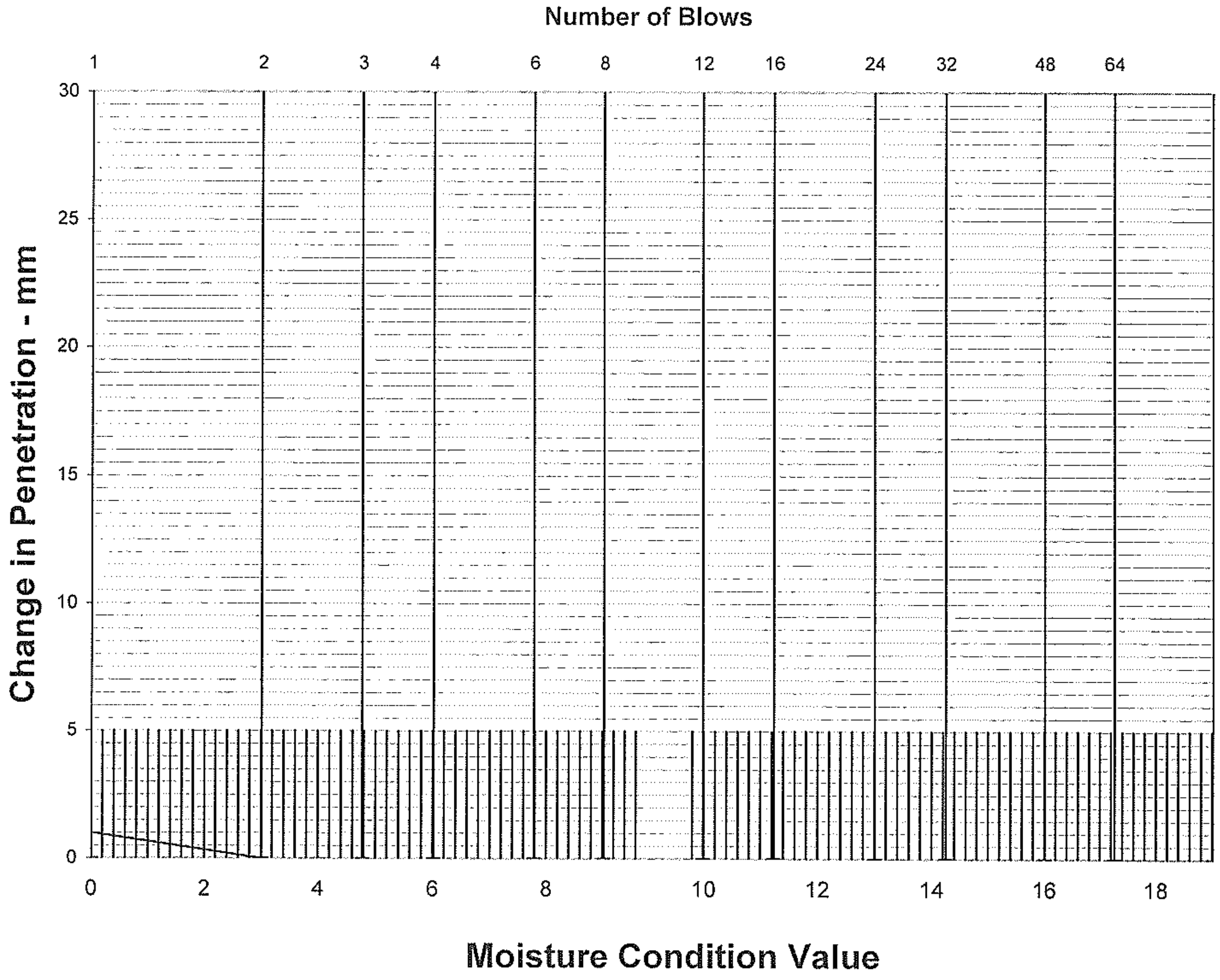
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P16114**
		Borehole / Pit No	BH09
Location	Knockharley Landfill	Sample No	3
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	0.80 m



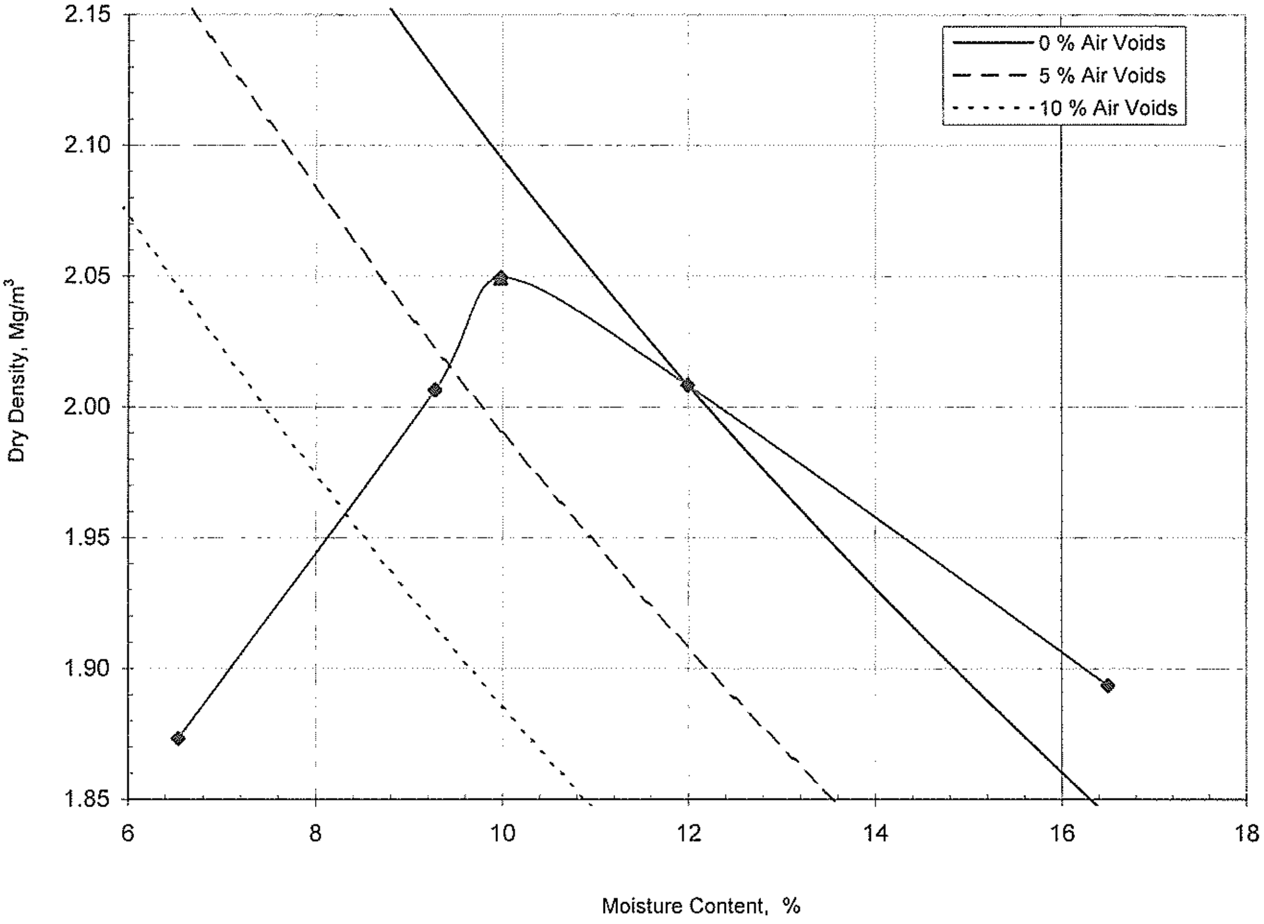
Specimen No	1	2	3	4	5	6
Moisture Condition Value	5.1					
Moisture Content %	18.76					
Bulk density after compaction Mg/m³	2.03					
Dry density after compaction Mg/m³	1.71					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	15.7					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
Location	Knockharley Landfill	Borehole / Pit No	BH09
		Sample No	5
Soil Description	COBBLES with clayey sandy GRAVEL	Sample Type	B
		Depth	1.60 m



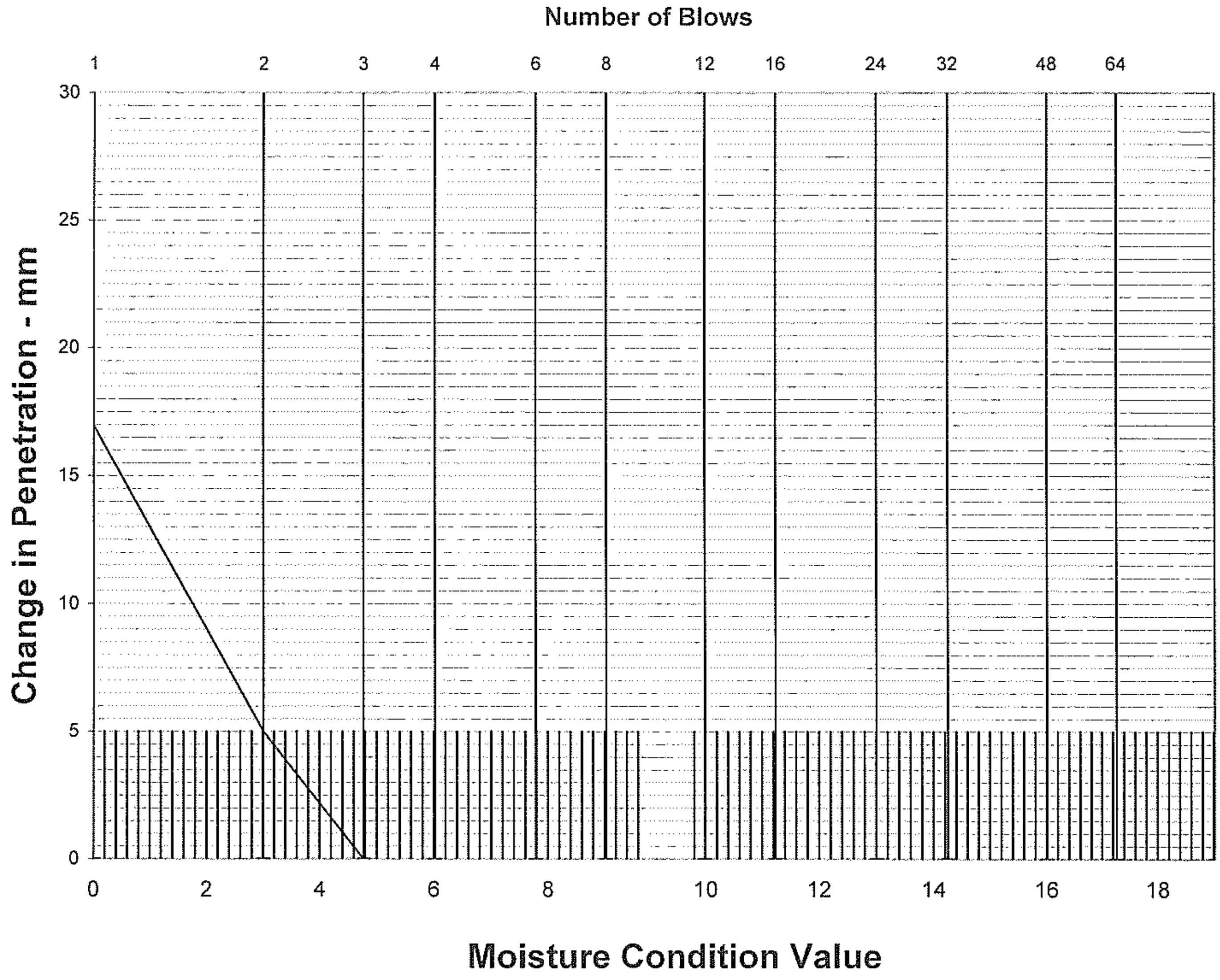
Specimen No	1	2	3	4	5	6
Moisture Condition Value	-12.0					
Moisture Content %	19.22					
Bulk density after compaction Mg/m³	2.07					
Dry density after compaction Mg/m³	1.74					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	65.2					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P16114**
		Borehole / Pit No	BH09
Site Name	**Knockharley Landfill**	Sample No	7
		Depth	2.40 m
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B



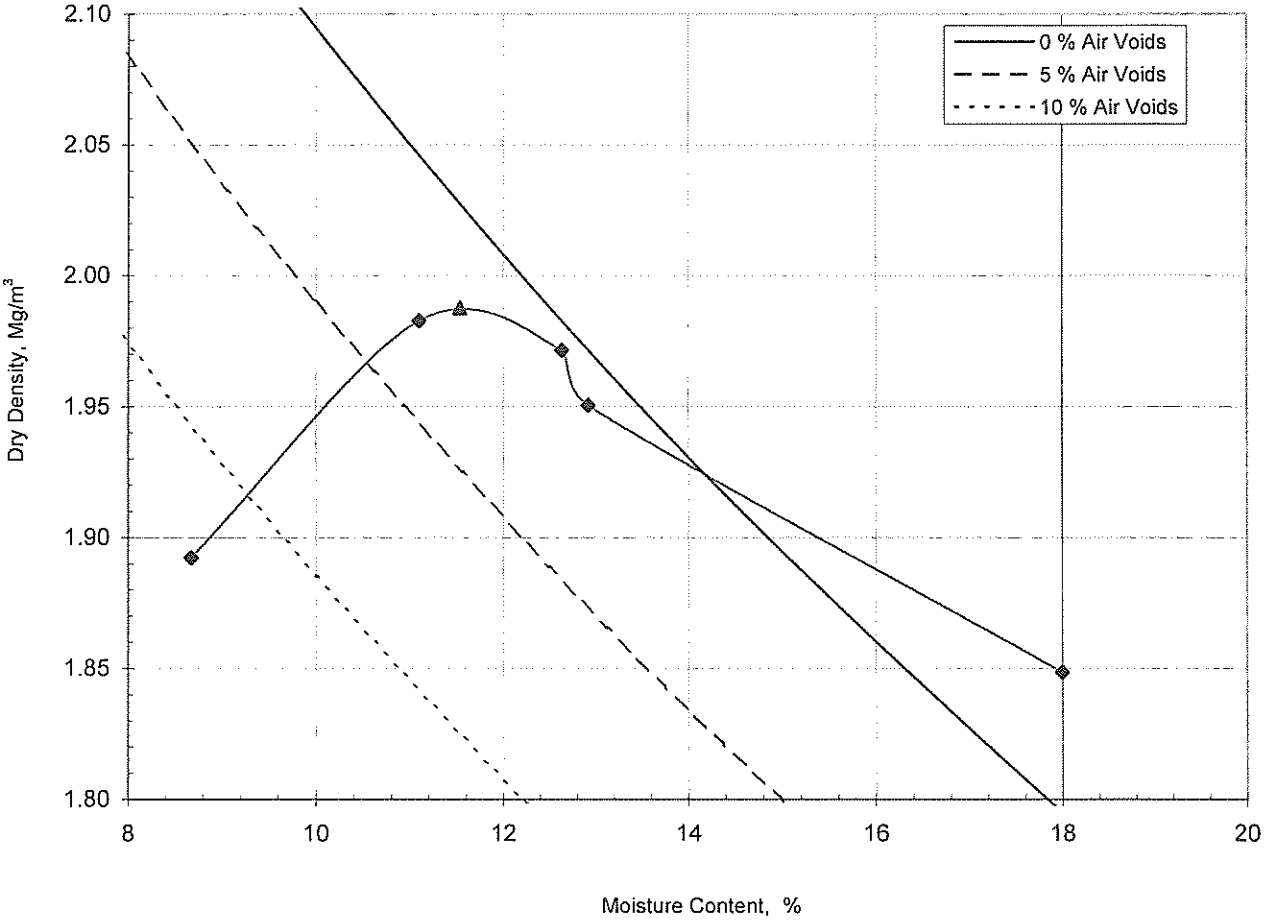
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	8
Mass Retained on 20.0 mm Sieve	%	13
Grading Zone		5
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.05
Optimum Moisture Content	%	10.0
Natural Moisture Content	%	16.50

	# Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
		Borehole / Pit No	BH09
Location	Knockharley Landfill	Sample No	7
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	2.40 m



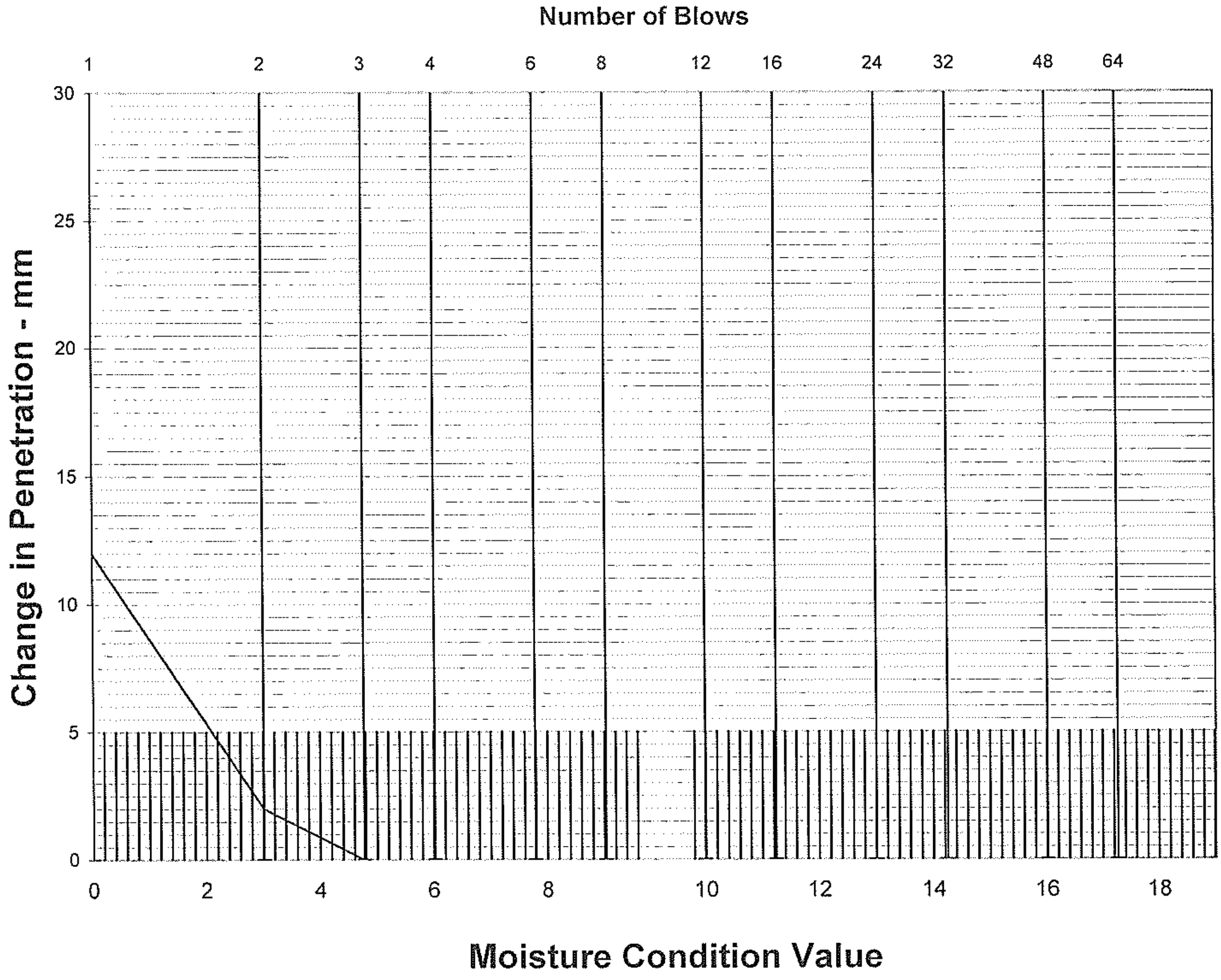
Specimen No		1	2	3	4	5	6
Moisture Condition Value		3.0					
Moisture Content	%	16.46					
Bulk density after compaction	Mg/m³	2.07					
Dry density after compaction	Mg/m³	1.78					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	12.9					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P16114**
		Borehole / Pit No	BH10
Site Name	**Knockharley Landfill**	Sample No	8
		Depth	3.45 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B



Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	1
Mass Retained on 20.0 mm Sieve	%	19
Grading Zone		4
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	1.99
Optimum Moisture Content	%	12
Natural Moisture Content	%	18.00

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P16114**
		Borehole / Pit No	BH10
Location	Knockharley Landfill	Sample No	8
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B
		Depth	3.45 m



Specimen No	1	2	3	4	5	6
Moisture Condition Value	2.1					
Moisture Content %	30.88					
Bulk density after compaction Mg/m³	2.14					
Dry density after compaction Mg/m³	1.64					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	20.8					

Contract Number: 32851

Client's Reference: **P16114**

Report Date: **14-11-2016**

Client
Priority Geotechnical Limited
Unit 12
Owenacurra Business Park
Midleton
Co. Cork.

Contract Title: **Knockaharley Landfill**
For the attention of: **Colette Kelly**

Date Received: **26-10-2016**
Date Commenced: **26-10-2016**
Date Completed: **14-11-2016**

Test Description	Qty
Triaxial Permeability Test with One Back Pressure System Head K H, Vol. 3, Clause 20.4.2 - @ Non Accredited Test	8
Disposal of Samples on Project	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:
Alex Wynn (Associate Director) - Benjamin Sharp (Contracts Manager) - Emma Sharp (Office Manager)
Paul Evans (Quality/Technical Manager) - Vaughan Edwards (Managing Director)

Determination of a Permeabilty in a Triaxial Cell
One Back Pressure Method
K.H.Head:Volume 3:Section 20.4.2

Date:	**01-Nov-16**
Sample Number:	**BH01**
Depth (m):	**3.00**
Sample Type:	**Undisturbed**
Sample Preparation:	**Undisturbed**
Start Date:	**28-Oct-16**
Completion Date:	**01-Nov-16**
Test Duration (Days):	**4**
Operator:	**J. JENKINS**

Initial Conditions:		**Final Conditions:**	
Diameter (mm):	**103.0**	**Bulk Density (Mg/m3)**	**2.34**
Length (mm):	**105.0**	**Moisture Content (%)**	**14**
Bulk Density (Mg/m3):	**2.32**	**Dry Density (Mg/m3):**	**2.06**
Moisture Content (%):	**12**		
Dry Density (Mg/m3):	**2.06**		

Permeability:

Mean Effective Stress (kPa):	**125**
Hydraulic Gradient:	**145.71**
Coefficient of Permeability (k_v) (m/s) @ 20oC:	**8.88 $^{x\ 10\ -11}$**

Description:

Dark grey sl fine gravelly sl sandy silty CLAY

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

	14.11.16		14.11.16
Checked by	**Date**	**Approved by**	**Date**

GSTL
GEO Site & Testing Services Limited

Knockharley Landfill

Contract No.
32851

Client Ref No.
P16114

Determination of a Permeabilty in a Triaxial Cell
One Back Pressure Method
K.H.Head:Volume 3:Section 20.4.2

Date: 01-Nov-16
Sample Number: BH02
Depth (m): 3.00
Sample Type: Undisturbed
Sample Preparation: Undisturbed
Start Date: 28-Oct-16
Completion Date: 01-Nov-16
Test Duration (Days): 4
Operator: J. JENKINS

Initial Conditions:		**Final Conditions:**	
Diameter (mm):	105.0	Bulk Density (Mg/m3)	2.41
Length (mm):	103.0	Moisture Content (%)	12
Bulk Density (Mg/m3):	2.39	Dry Density (Mg/m3):	2.14
Moisture Content (%):	11		
Dry Density (Mg/m3):	2.14		

Permeability:

Mean Effective Stress (kPa): 125
Hydraulic Gradient: 148.54
Coefficient of Permeability (k_v) (m/s) @ 20oC: 1.12 $^{x\ 10\ -10}$

Description:

Dark grey sl fine gravelly sl sandy silty CLAY

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

	14.11.16		14.11.16
Checked by	**Date**	**Approved by**	**Date**

GSTL
GEO Site & Testing Services Limited

Knockharley Landfill

Contract No.
32851

Client Ref No.
P16114

Determination of a Permeabilty in a Triaxial Cell
One Back Pressure Method
K.H.Head:Volume 3:Section 20.4.2

Date:	**05-Nov-16**
Sample Number:	**BH03**
Depth (m):	**1.00**
Sample Type:	**Undisturbed**
Sample Preparation:	**Undisturbed**
Start Date:	**01-Nov-16**
Completion Date:	**05-Nov-16**
Test Duration (Days):	**4**
Operator:	**J. JENKINS**

Initial Conditions:		**Final Conditions:**	
Diameter (mm):	**105.0**	**Bulk Density (Mg/m3)**	**2.27**
Length (mm):	**103.0**	**Moisture Content (%)**	**17**
Bulk Density (Mg/m3):	**2.23**	**Dry Density (Mg/m3):**	**1.93**
Moisture Content (%):	**16**		
Dry Density (Mg/m3):	**1.93**		

Permeability:

Mean Effective Stress (kPa):	**125**
Hydraulic Gradient:	**148.54**
Coefficient of Permeability (k_v) (m/s) @ 20oC:	**9.63** $^{\text{x 10 -11}}$

Description:

Dark grey sl fine gravelly sl sandy silty CLAY

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

	14.11.16		14.11.16
Checked by	**Date**	**Approved by**	**Date**

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Knockharley Landfill

Contract No.
32851

Client Ref No.
P16114

Determination of a Permeabilty in a Triaxial Cell
One Back Pressure Method
K.H.Head:Volume 3:Section 20.4.2

Date:	**05-Nov-16**
Sample Number:	**BH04**
Depth (m):	**4.00**
Sample Type:	**Undisturbed**
Sample Preparation:	**Undisturbed**
Start Date:	**01-Nov-16**
Completion Date:	**05-Nov-16**
Test Duration (Days):	**4**
Operator:	**J. JENKINS**

Initial Conditions:		**Final Conditions:**	
Diameter (mm):	**105.0**	**Bulk Density (Mg/m3)**	**2.27**
Length (mm):	**103.0**	**Moisture Content (%)**	**10**
Bulk Density (Mg/m3):	**2.27**	**Dry Density (Mg/m3):**	**2.07**
Moisture Content (%):	**10**		
Dry Density (Mg/m3):	**2.07**		

Permeability:

Mean Effective Stress (kPa):	**125**
Hydraulic Gradient:	**148.54**
Coefficient of Permeability (k_v) (m/s) @ 20oC:	**7.26** $^{\text{x 10 -11}}$

Description:

Dark grey sl fine gravelly sl sandy silty CLAY

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

	14.11.16		14.11.16
Checked by	**Date**	**Approved by**	**Date**

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Contract No.
32851

Client Ref No.
P16114

Determination of a Permeabilty in a Triaxial Cell
One Back Pressure Method

K.H.Head:Volume 3:Section 20.4.2

Date:	**09-Nov-16**
Sample Number:	**BH07**
Depth (m):	**3.00**
Sample Type:	**Undisturbed**
Sample Preparation:	**Undisturbed**
Start Date:	**05-Nov-16**
Completion Date:	**09-Nov-16**
Test Duration (Days):	**4**
Operator:	**J. JENKINS**

Initial Conditions:		**Final Conditions:**	
Diameter (mm):	**105.0**	**Bulk Density (Mg/m3)**	**2.19**
Length (mm):	**103.0**	**Moisture Content (%)**	**10**
Bulk Density (Mg/m3):	**2.17**	**Dry Density (Mg/m3):**	**1.98**
Moisture Content (%):	**9**		
Dry Density (Mg/m3):	**1.98**		

Permeability:

Mean Effective Stress (kPa):	**125**
Hydraulic Gradient:	**148.54**
Coefficient of Permeability (k_v) (m/s) @ 20oC:	**8.95** $\times 10^{-11}$

Description:

Dark grey sl fine gravelly sl sandy silty CLAY

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

D P	14.11.16	D P	14.11.16
Checked by	**Date**	**Approved by**	**Date**

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GEO Site & Testing Services Limited

Knockharley Landfill

Contract No.
32851

Client Ref No.
P16114

Determination of a Permeabilty in a Triaxial Cell
One Back Pressure Method
K.H.Head:Volume 3:Section 20.4.2

Date:	**09-Nov-16**
Sample Number:	**BH07**
Depth (m):	**7.00**
Sample Type:	**Undisturbed**
Sample Preparation:	**Undisturbed**
Start Date:	**05-Nov-16**
Completion Date:	**09-Nov-16**
Test Duration (Days):	**4**
Operator:	**J. JENKINS**

Initial Conditions:		**Final Conditions:**	
Diameter (mm):	**105.0**	**Bulk Density (Mg/m3)**	**2.31**
Length (mm):	**103.0**	**Moisture Content (%)**	**11**
Bulk Density (Mg/m3):	**2.28**	**Dry Density (Mg/m3):**	**2.09**
Moisture Content (%):	**9**		
Dry Density (Mg/m3):	**2.09**		

Permeability:

Mean Effective Stress (kPa):	**125**
Hydraulic Gradient:	**148.54**
Coefficient of Permeability (k_v) (m/s) @ 20oC:	**7.14** $^{x\ 10\ -11}$

Description:

Dark grey sl fine gravelly sl sandy silty CLAY

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

D P Gran
14.11.16
Checked by **Date**

D P Gran
14.11.16
Approved by **Date**

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Knockharley Landfill

Contract No.
32851

Client Ref No.
P16114

Determination of a Permeabilty in a Triaxial Cell
One Back Pressure Method
K.H.Head:Volume 3:Section 20.4.2

Date:	**11-Nov-16**
Sample Number:	**BH010**
Depth (m):	**3.00**
Sample Type:	**Undisturbed**
Sample Preparation:	**Undisturbed**
Start Date:	**07-Nov-16**
Completion Date:	**11-Nov-16**
Test Duration (Days):	**4**
Operator:	**J. JENKINS**

Initial Conditions:		**Final Conditions:**	
Diameter (mm):	**105.0**	**Bulk Density (Mg/m3)**	**2.13**
Length (mm):	**103.0**	**Moisture Content (%)**	**18**
Bulk Density (Mg/m3):	**2.10**	**Dry Density (Mg/m3):**	**1.81**
Moisture Content (%):	**16**		
Dry Density (Mg/m3):	**1.81**		

Permeability:

Mean Effective Stress (kPa):	**125**
Hydraulic Gradient:	**148.54**
Coefficient of Permeability (k_v) (m/s) @ 20oC:	**3.23 $\times 10^{-10}$**

Description:

Brown sl fine gravelly sl sandy silty CLAY

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

	14.11.16		14.11.16
Checked by	**Date**	**Approved by**	**Date**

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Knockharley Landfill

Contract No.
32851

Client Ref No.
P16114

Determination of a Permeabilty in a Triaxial Cell
One Back Pressure Method
K.H.Head:Volume 3:Section 20.4.2

Date:	**11-Nov-16**
Sample Number:	**BH010**
Depth (m):	**6.00**
Sample Type:	**Undisturbed**
Sample Preparation:	**Undisturbed**
Start Date:	**07-Nov-16**
Completion Date:	**11-Nov-16**
Test Duration (Days):	**4**
Operator:	**J. JENKINS**

Initial Conditions:		**Final Conditions:**	
Diameter (mm):	**105.0**	**Bulk Density (Mg/m3)**	**2.26**
Length (mm):	**103.0**	**Moisture Content (%)**	**17**
Bulk Density (Mg/m3):	**2.23**	**Dry Density (Mg/m3):**	**1.93**
Moisture Content (%):	**16**		
Dry Density (Mg/m3):	**1.93**		

Permeability:

Mean Effective Stress (kPa):	**125**
Hydraulic Gradient:	**148.54**
Coefficient of Permeability (k_v) (m/s) @ 20oC:	**2.42** $^{x\ 10\ -10}$

Description:

Dark grey sl fine gravelly sl sandy silty CLAY

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

	14.11.16		14.11.16
Checked by	**Date**	**Approved by**	**Date**

GSTL
GEO Site & Testing Services Limited

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Contract No.
32851

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KNOCKHARLEY LANDFILL

GEOPHYSICAL INVESTIGATION

DRAFT REPORT

Report No. P16114_GP_Rp_Rev.01

Client:	**Consulting Engineers:**
Knockharley Landfill Ltd.	Fehily Timoney & Company J5 Plaza North Business Park North Road Dublin 11 Ireland D11 PXT0

REPORT CONTROL SHEET

<table>
<tr><td>Client</td><td colspan="6">Knockharley Landfill Ltd.</td></tr>
<tr><td>Engineer Representative</td><td colspan="6">Fehily Timoney & Company</td></tr>
<tr><td>Project Name</td><td colspan="6">Knockharley Landfill Geophysical Survey</td></tr>
<tr><td>Document Name</td><td colspan="6">Technical Report</td></tr>
<tr><td>Project Number</td><td colspan="6">P16114_GP</td></tr>
<tr><td rowspan="2">This Report Comprises of</td><td>TOC</td><td>Text</td><td>No. of Volume</td><td>No. of Appendices</td><td>Drawings</td><td>Electronic data</td></tr>
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</table>

Revision	**Status**	**Author(s)**	**Approved By**	**Issue Date**
Rev.01	Draft - for comment	HP	GH	27.10.2016

A) Introduction

A.1) Scope of Works

Priority Geotechnical Ltd. (herein referred to as PGL) was instructed by Fehily Timoney & Company on behalf of Knockharley Landfill Ltd. to undertake a geophysical survey in conjunction with a site investigation survey at Knockharley Landfill, Co. Meath (Fig.A.1).

The geophysical survey comprised of continuous 2D Electrical Resistivity (herein referred to as ERT), Seismic Refraction Profiling and Multi-Channel Analysis of Surface Wave (MASW) along pre-designated transects in the proposed cell development area to the north of the existing landfill.

PGL recorded geophysical data along 3 designated transects as outlined on Drawing No. LW14-821-01-900-004 labelled Transect A, B and C. Transect B was seen to cross a public road and thus was divided into two transects.

One of the transects, Transect A was moved slightly to the south due to active machinery working in the direct path of the survey profile. This change was agreed with the client on site prior to the works beginning.

The survey fieldwork was carried out between 8th August 2016 – 15th August 2016.

Figure A.1: Satellite image showing Knockharley Landfill (www.google.ie/maps).

A.2) Survey Objectives

The survey objectives were as follows:

- Identification of overburden horizons.
- Establish depth to bedrock.

A.3) Site Topography

The proposed cell development area consisted mainly of grass fields as well as an area of dumped material to the west of the area. Topography along the survey profiles ranged from 58 to 67m (OD Malin).

A.4) Intrusive Works

The following intrusive geotechnical data, carried out by PGL was made available at the time of writing of this geophysical report. The geotechnical data has been used in to aid in the geophysical interpretation.

The following cable percussive boreholes were completed on the site:

- BH01, BH02, BH03, BH04, BH05, BH06, BH07 and BH10

The following rotary core boreholes were completed on the site:

- RC01

The location of the site investigation has been given in the accompanying drawings.

A.5) GSI Site Geology

According to the GSI 100k Geology Map (see Fig.A.2) the survey area is underlain by the Balrickard Formation, described as coarse sandstone and shale.

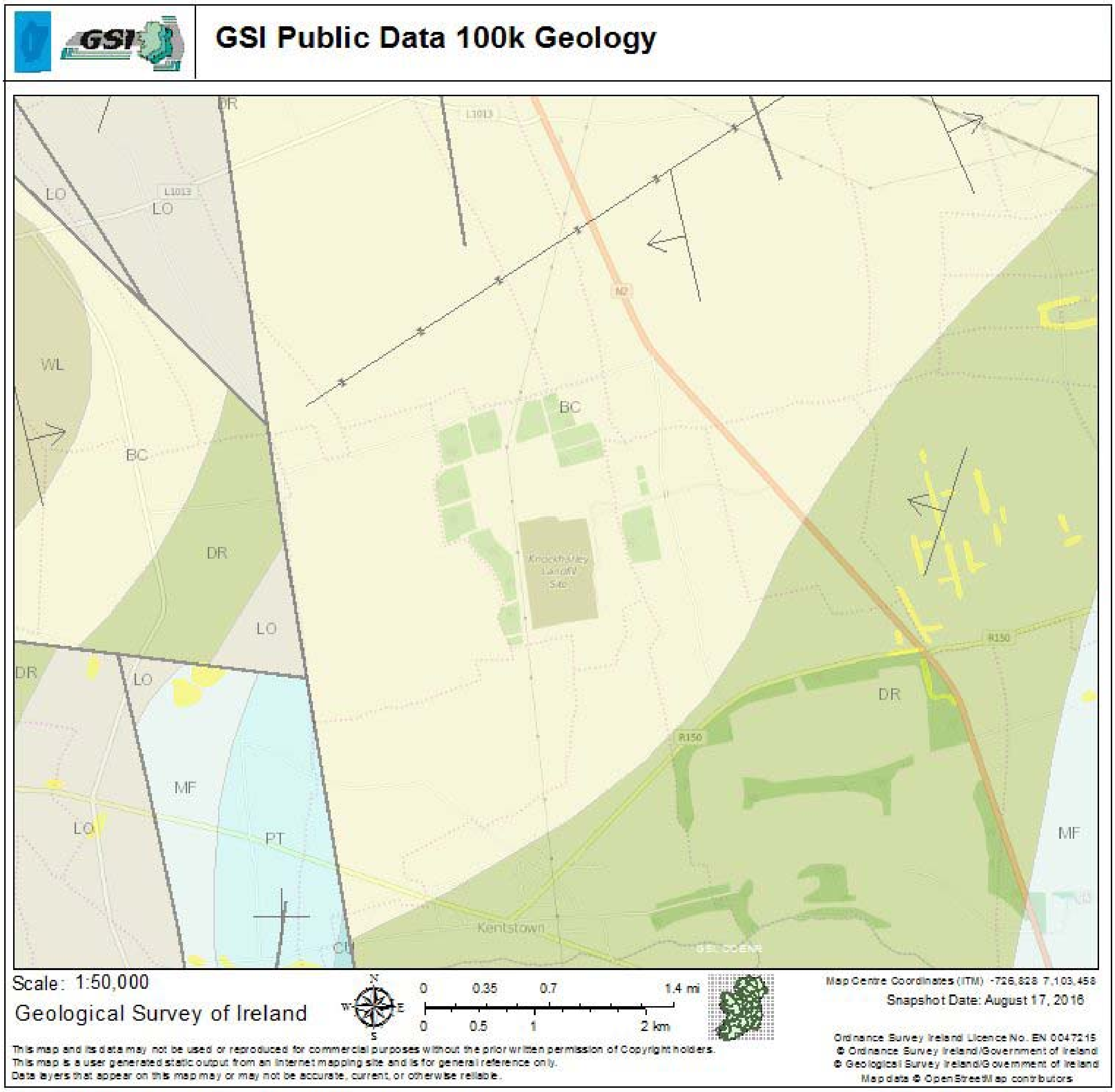


Figure A.2: GSI 100k Bedrock Geology Map of the site. The Balrickard Formation (BC) is shown in transparent yellow-green underlying the survey area.

A.6) Teagasc Soils Map

According to the Teagasc Soils Map (see Fig.A.3) the site is largely underlain by till derived chiefly from Namurian rocks (shown in pink below) with some bands of alluvium (shown in yellow).

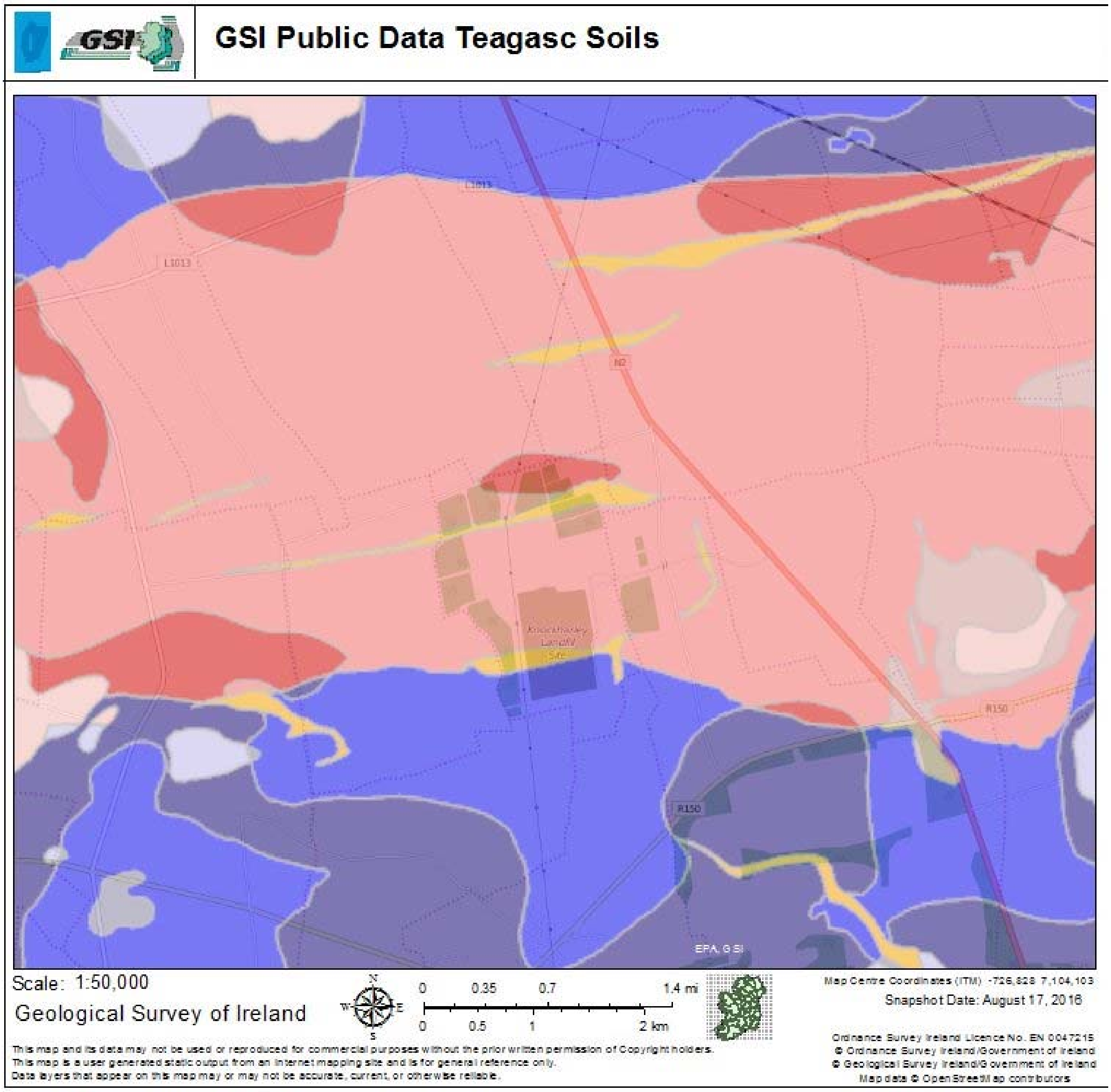


Figure A.3: Teagasc Soils Map showing the site to be underlain by till from Namurian rocks (shown in pink).

A.7) Cross Section Chainage

Data is presented by PGL in the accompanying drawings as cross sections. All data is presented from west towards east or from south towards north. Distance along each of these cross sections is tied into the 4 no. continuous ERT profiles collected along the pre-designated transects.

B) Results and Findings

Seismic refraction, ERT and MASW profiles were acquired along the pre-designated transects as outlined on Drawing No. LW14-821-01-900-004. For a full account of the methodology used during this survey see APPENDIX B: SURVEY METHODOLOGY.

B.1) 2D Electrical Resistivity Tomography (ERT)

PGL recorded 4 no. ERT profiles data along 3 pre-designated transects as outlined on Drawing No. LW14-821-01-900-004 labelled Transect A, B and C. Transect B was seen to cross a public road and thus was divided into two ERT profiles. ERT profiles are named ERT_01 through to ERT_04.

Profile No.	Profile Length	Electrode Spacing	Pre-Designated Transect No.
ERT_01	310m	5m	Transect 3
ERT_02	875m	5m	Transect 2A
ERT_03	150m	5m	Transect 2B
ERT_04	475m	5m	Transect 1

Survey data was recorded in Imager Pro™ 2006 processed using Res2DInv™ (Campus Geophysical Instruments, 1997), where the raw files were edited and inverted. Up to 5 iterations of the measured data were carried out for each profile to obtain a 2D depth model of the apparent resistivities. Resistivity values in the inverted profiles varied from c. 0 to 350 Ohm-m.

In order to accurately delineate overburden and bedrock layers the ERT method relies on there being a notable ground resistivity contrast between both layers.

The electrical resistivity profiles have been generally interpreted on the following basis;

Resistivity (Ohm-m)	Interpretation
75-100 (near surface)	Sandy Gravelly CLAY (Glacial Till)
Less than 50 (at depth)	Shale / Mudstone bedrock

Table B.1: Interpretation based on electrical resistivity

B.2) Seismic Refraction

PGL recorded 24 no. seismic refraction profiles data along 3 pre-designated transects as outlined on Drawing No. LW14-821-01-900-004 labelled Transect A, B and C. Seismic refraction profiles are named S1 through to S24.

Where possible seismic refraction profiles were collected continuously. The geophone spacing used for this survey was 3m providing seismic velocities for overburden and bedrock materials.

Modelled seismic velocities ranged from c. 100 to 3000 m/s for the soil and bedrock materials.

The seismic refraction data has generally been interpreted on the following basis:

P-Wave velocity (m/s)	Interpretation
0 - 500	Soft Sandy Gravelly CLAY
500 – 1000	Firm Sandy Gravelly CLAY
1000 - 1800	Stiff Sandy Gravelly CLAY
1800 – 2900	Very Stiff Sandy Gravelly CLAY
> 2900	Fresh bedrock

Table B.2: Interpretation based on P-Wave velocity

B.3) Multi-Channel Analysis of Surface Wave

PGL recorded 24 no. seismic refraction profiles data along 3 pre-designated transects as outlined on Drawing No. LW14-821-01-900-004 labelled Transect A, B and C. On each of these refraction profiles 8 no. individual shots were recorded for the purpose of MASW Profiling.

The results of the MASW profiling are presented as soundings at 24 no. locations each located at the centre point of each of the seismic refraction profiles. The locations of these soundings are presented in APPENDIX A: DRAWINGS; Drawing No. P16114_GP_D01 & P16114_GP_D02.

The tabulated results for these locations, along with calculated Poissons Ratio, Bulk Modulus, Youngs Modulus and Small Strain Shear Modulus, are presented in APPENDIX C: MASW RESULTS.

C) Geophysical Interpretation Summary

The modelled profiles and geophysical interpretations are shown in APPENDIX A: DRAWING: Drawing No. P16114_GP_03 to P16010_GP_09.

The geophysical survey was a non-invasive process and involved interpretation of readings made at the ground surface. This interpretation was based on the existing knowledge of ground conditions, typical geophysical response of known materials and the experience of the authors.

The site conditions can be summarised as thus;

C.1) Layer 1: Overburden

C.1.i) Resistivity

Resistivity values for the Layer 1 material were seen to be relatively low, typically ranging between 75 and 100ohm-m, increasing to a maximum of c. 150ohm-m. Resistivity for Layer 1 was seen to be very consistent across the site reflecting Layer 1 to be a relatively homogenous material. The resistivity values of Layer 1 are typical of Glacial Till (Sandy Gravelly CLAY).

C.1.ii) Seismic Velocity

P-wave seismic velocity was seen to increase rapidly with depth for Layer 1. Seismic velocity was seen to increase to >1000m/s, indicative of stiff overburden, in the first 1 to 2m below ground level (bgl). The bulk of the Layer 1 material was seen to show P-wave seismic velocities ranging from 2000 - 2600m/indicative of a very stiff overburden material.

C.1.iii) Layer1 Summary

The thickness of Layer 1 was seen to vary between 15 to 20m but generally was around 17m. Due to the site investigation results, the resistivity and seismic velocities observed for Layer 1 the layer has been interpreted as Sandy Gravelly CLAY.

C.2) Layer 2

C.2.i) Resistivity

To the east (generally east of 297550E) of the survey area there was seen to be a distinct contrast in resistivity between Layer 1 (overburden) and Layer 2 (bedrock). Here Layer 2 was seen to be slightly lower in resistivity than Layer 1. In this area Layer 1 was seen to be generally <50ohm-m. This small contrast in resistivity was not seen in the east of the survey area where the decrease in resistivity with depth was not on the same scale. A transition can be seen on

ERT_02 between 400m and 600m along the cross section. (see APPENDIX A: DRAWING: Drawing No. P16114_GP_05).

C.2.ii) Seismic Velocity

P-wave seismic velocity was used to delineate the Layer 1 / Layer 2 boundary in areas where a resistivity contrast was not observed. Layer 2 was identified by an increase in P-wave velocity to >2900m/s indicative of fresh rock.

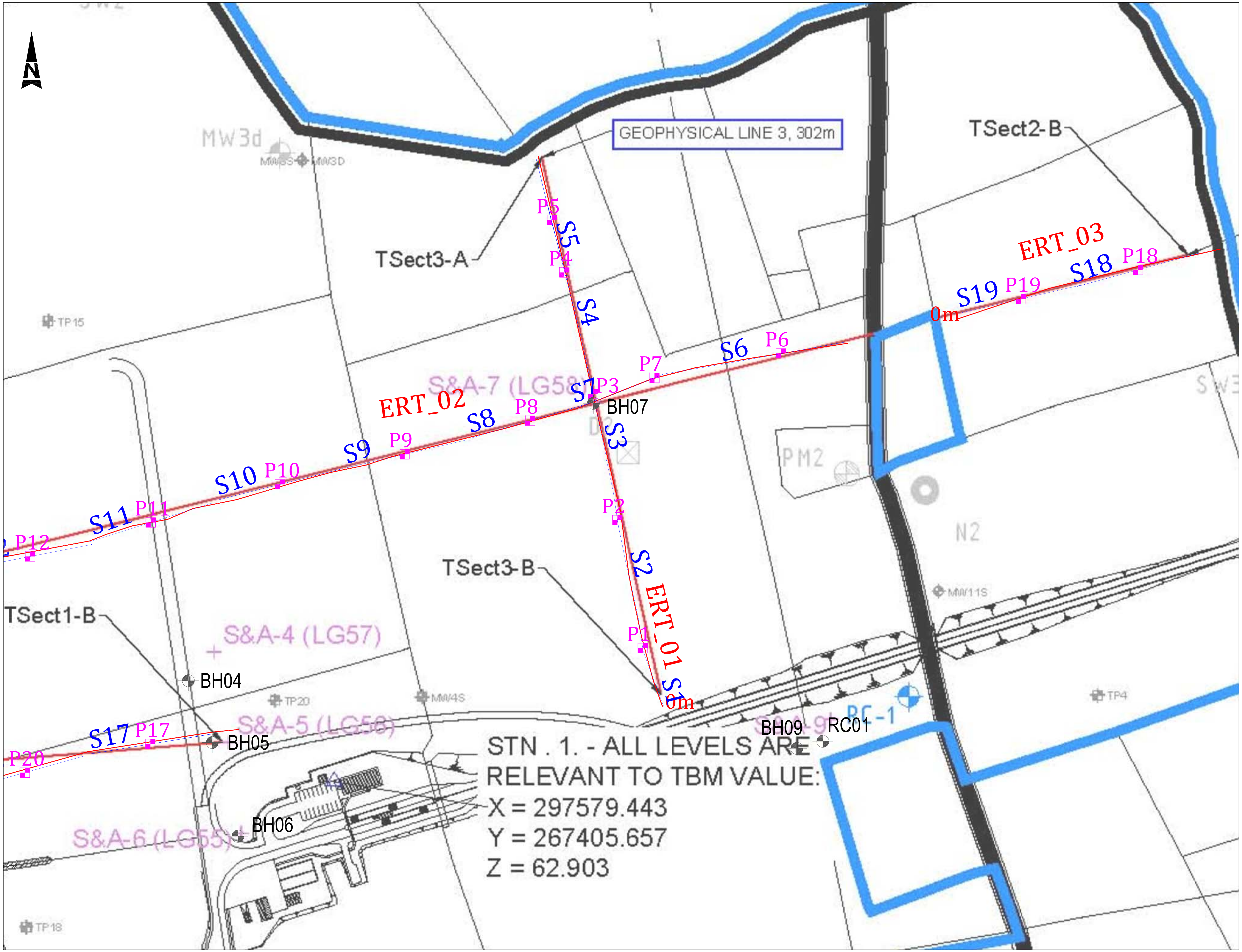
C.2.iii) Layer 2 Summary

The Layer 1 / Layer 2 boundary was seen to range in elevation from 42 to 52m OD across the site. The layer has been identified as a shale / mudstone bedrock material due to the low resistivity and observed seismic velocity.

APPENDIX A: DRAWINGS

Drawing Number	Description	Scale
P16114_GP_D01	Geophysical profile location map	1:2000 at A3
P16114_GP_D02	Geophysical profile location map	1:2000 at A3
P16114_GP_D03	ERT_01 cross-section with interpretation	1:1000 at A3
P16114_GP_D04	ERT_02 cross-section with interpretation Sheet 1 of 3	1:1000 at A3
P16114_GP_D05	ERT_02 cross-section with interpretation Sheet 2 of 3	1:1000 at A3
P16114_GP_D06	ERT_02 cross-section with interpretation Sheet 3 of 3	1:1000 at A3
P16114_GP_D07	ERT_03 cross-section with interpretation	1:1000 at A3
P16114_GP_D08	ERT_04 cross-section with interpretation Sheet 1 of 2	1:1000 at A3
P16114_GP_D09	ERT_04 cross-section with interpretation Sheet 2 of 2	1:1000 at A3

Figure 1: Location Map showing location of ERT profiles ERT_01, ERT_02, ERT_03 - Scale 1:2000



JOB NAME:

KNOCKHARLEY LANDFILL,
KNOCKHARLEY, CO. MEATH.

Sheet Title:

LOCATION MAP 1 of 2:
GEOPHYSICAL PROFILE
LOCATION MAP

JOB NUMBER:

P16114_GP

DRAWING NUMBER:

P16114_GP_D01

DRAWN BY:

Hugh Power

SURVEY DATES:

08/08/2016 - 12/08/2016

SCALE:

As stated @ A3

APPROVED:

REVISION:

Rev.01

LEGEND:

ERT_01	ERT Profile
S1	Seismic Refraction Profile
▨	MASW Sounding (results included in Report)
⊕	Priority Geotechnical Boreholes

pgl priority geotechnical

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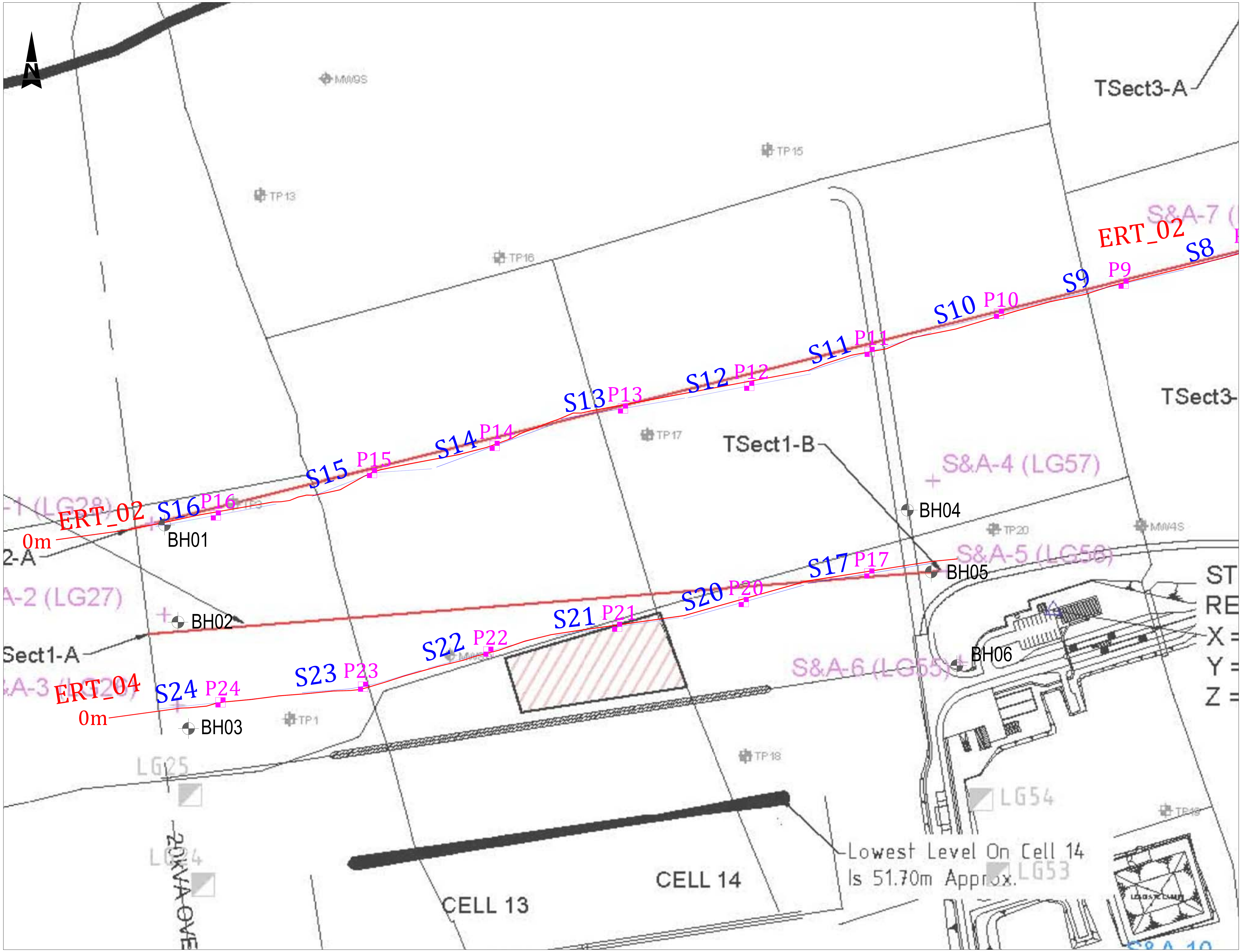
Figure 1: Location Map showing location of ERT profiles 02 & 04 - Scale 1:2000



JOB NAME:

KNOCKHARLEY LANDFILL,
KNOCKHARLEY, CO. MEATH.

Sheet Title:

LOCATION MAP 2 of 2:
GEOPHYSICAL PROFILE
LOCATION MAP

JOB NUMBER:

P16114_GP

DRAWING NUMBER:

P16114_GP_D02

DRAWN BY:

Hugh Power

SURVEY DATES:

08/08/2016 - 12/08/2016

SCALE: As stated @ A3

APPROVED:

REVISION:

Rev.01

LEGEND:

ERT_01	ERT Profile
S1	Seismic Refraction Profile
▪	MASW Sounding (results included in Report)
⊕	Priority Geotechnical Boreholes

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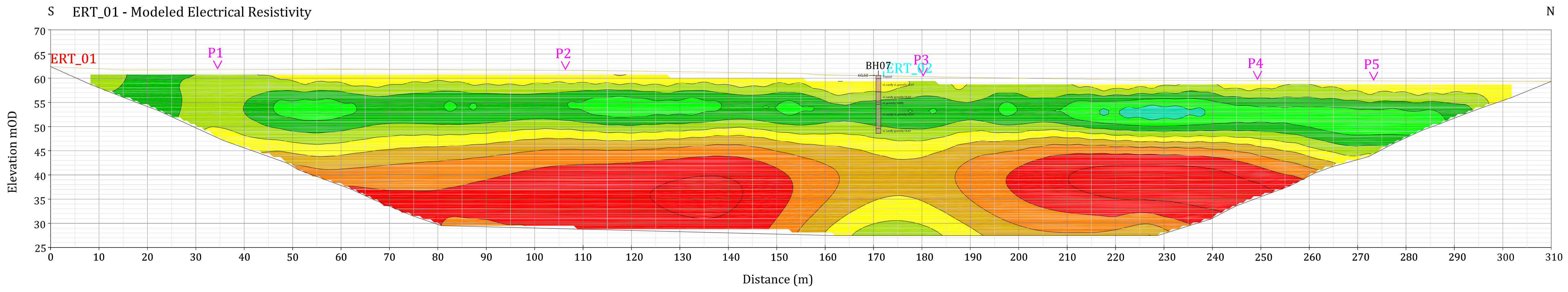
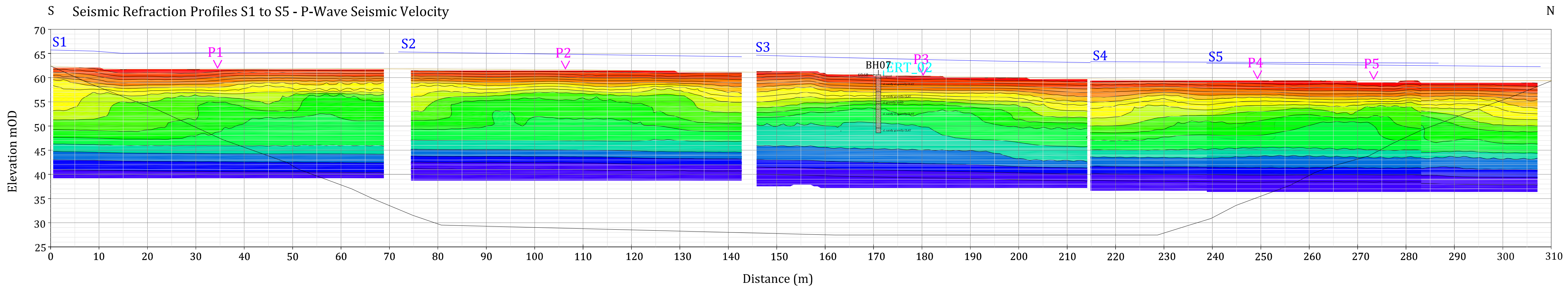
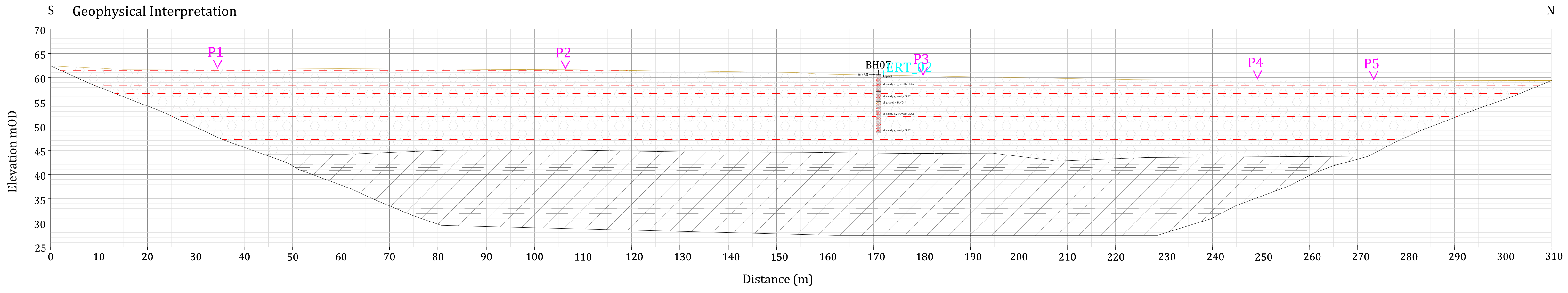
www.prioritygeotechnical.ie

Figure 1: Cross-Section of ERT_01 - Scale 1:1000


S ERT_01 - Modeled Electrical Resistivity N


S Seismic Refraction Profiles S1 to S5 - P-Wave Seismic Velocity N


S Geophysical Interpretation N

JOB NAME:

KNOCKHARLEY LANDFILL,
KNOCKHARLEY, CO. MEATH.

Sheet Title:

ERT_01 CROSS-SECTION
WITH GEOPHYSICAL
INTERPRETATION

JOB NUMBER:

P16114_GP

DRAWING NUMBER:

P16114_GP_D03

DRAWN BY:

Hugh Power

SURVEY DATES:

08/08/2016 - 12/08/2016

SCALE:

As stated @ A3

APPROVED:

REVISION:

Rev.01

LEGEND:

Geophysical Interpretation

▨ Sandy Gravely CLAY

▨ SLATE / MUDSTONE Bedrock

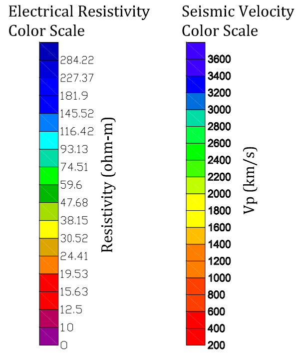


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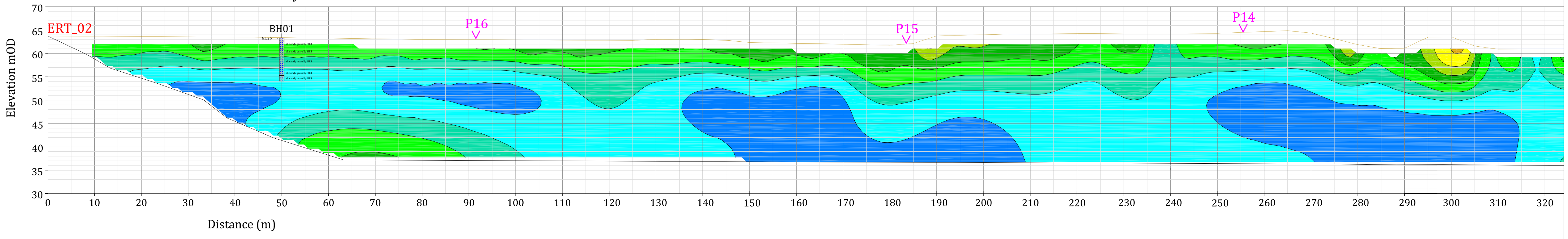
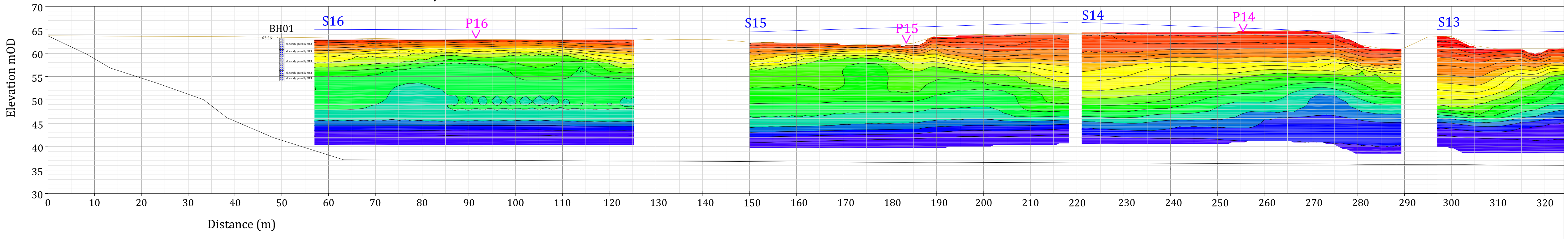
Figure 1: Cross-Section of ERT_02 - Scale 1:1000

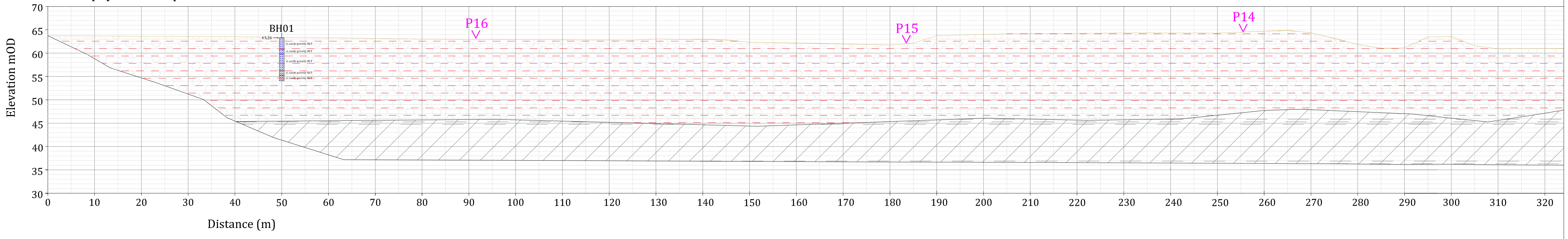
W ERT_02 - Modeled Electrical Resistivity



W Seismic Refraction Profiles S6 to S16 - P-Wave Seismic Velocity



W Geophysical Interpretation



JOB NAME:

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Sheet Title:

ERT_02 CROSS-SECTION
S16, S15, S14
Sheet 1 of 3

JOB NUMBER:

P16114_GP

DRAWING NUMBER:

P16114_GP_D04

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Hugh Power

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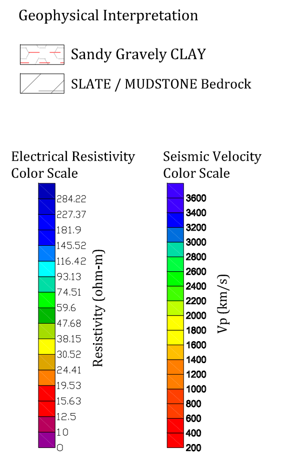

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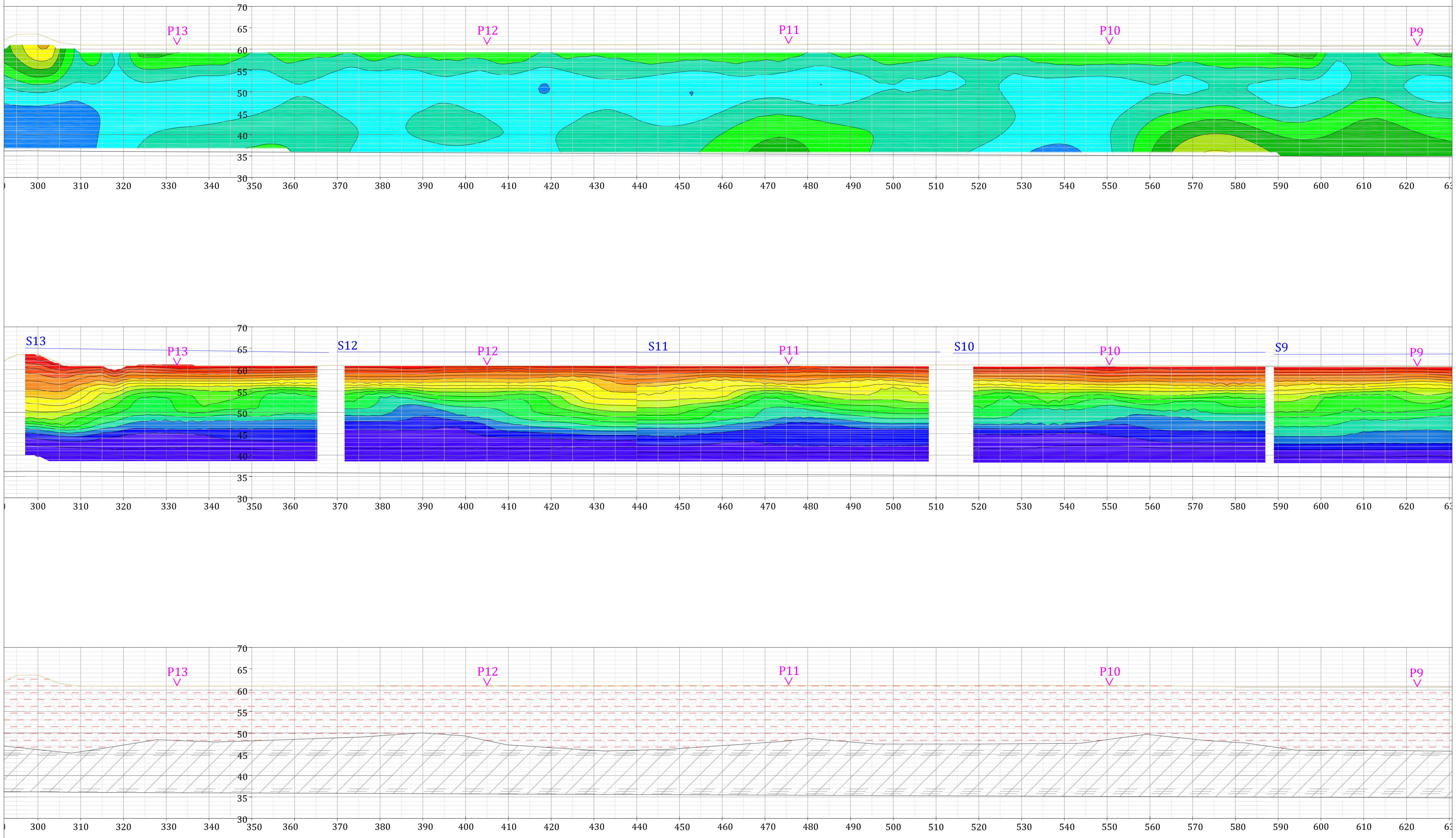
Figure 2: Cross-Section of ERT_02 continued - Scale 1:1000



JOB NAME:

KNOCKHARLEY LANDFILL,
KNOCKHARLEY, CO. MEATH.

Sheet Title:

ERT_02 CROSS-SECTION
S13, S12, S11, S10, S9
Sheet 2 of 3

JOB NUMBER:

P16114_GP

DRAWING NUMBER:

P16114_GP_D05

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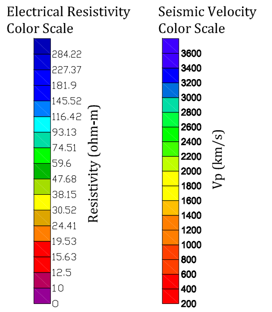

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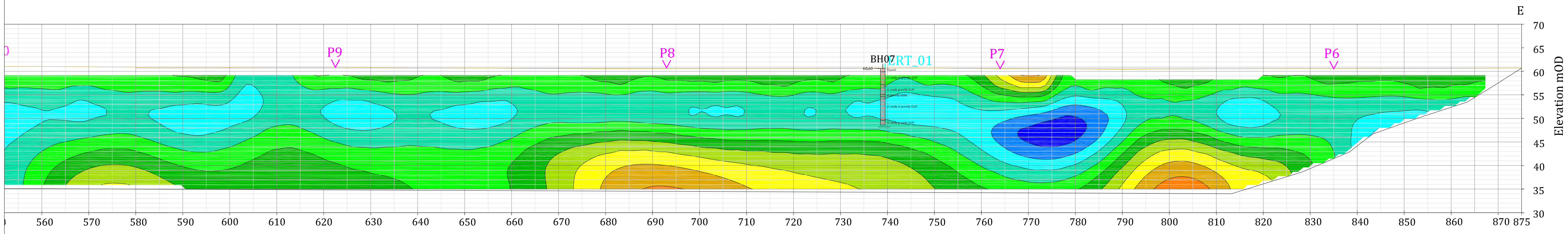
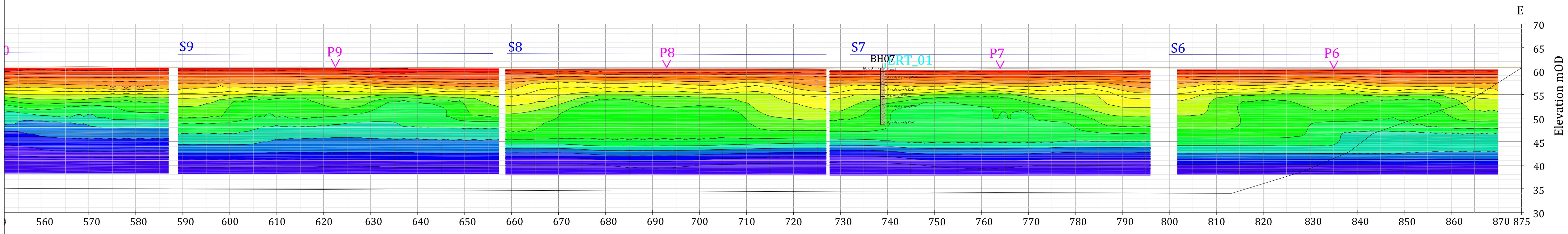
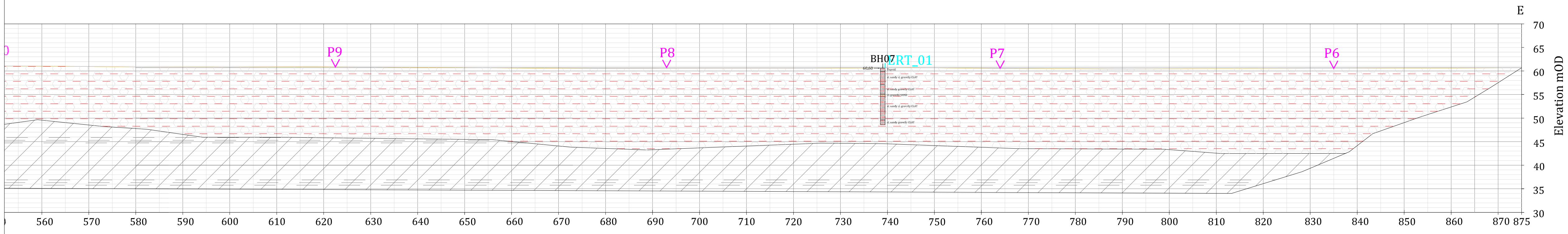
Figure 3: Cross-Section of ERT_02 continued - Scale 1:1000







JOB NAME:

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Sheet Title:

ERT_02 CROSS-SECTION
S6, S7, S8, S9
Sheet 3 of 3

JOB NUMBER:

P16114_GP

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P16114_GP_D06

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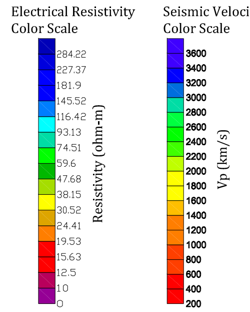

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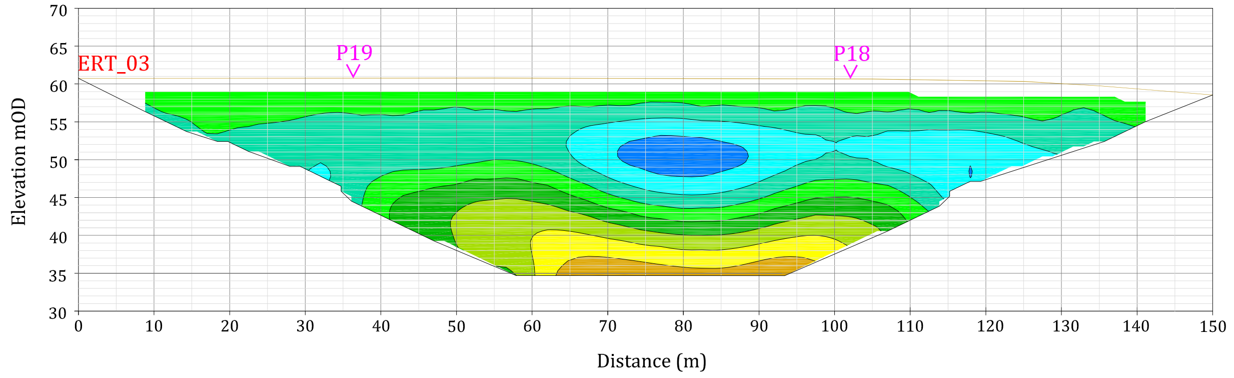
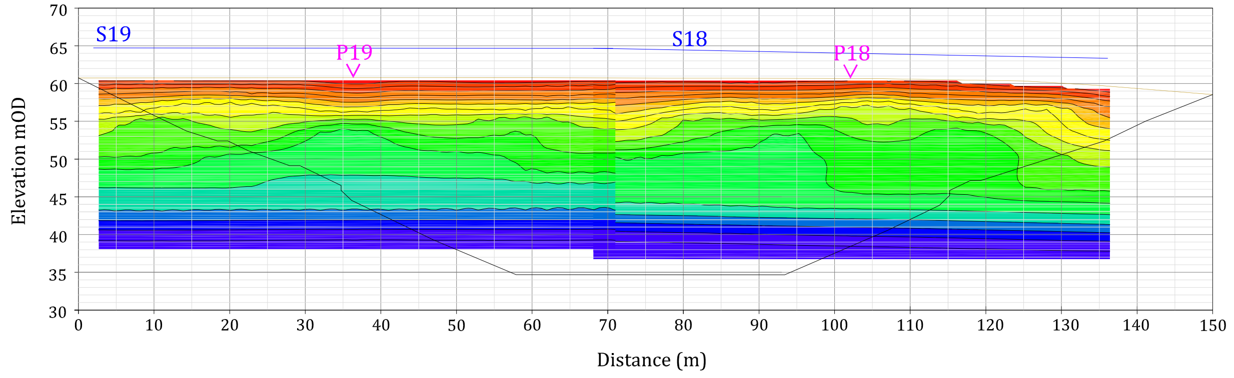
Figure 1: Cross-Section of ERT_03 - Scale 1:1000

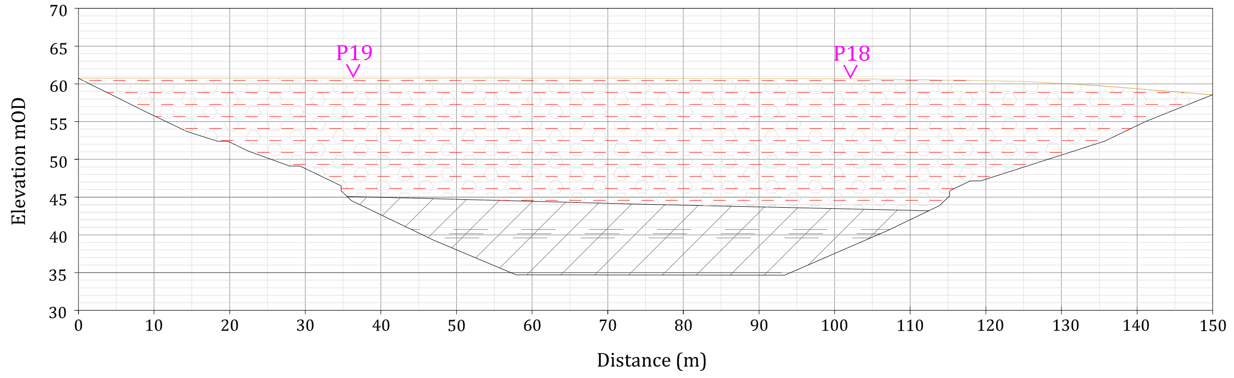
W ERT_03 - Modeled Electrical Resistivity E



W Seismic Refraction Profiles S18 to S19 - P-Wave Seismic Velocity E



W Geophysical Interpretation E



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ERT_03 CROSS-SECTION
S18, S19

JOB NUMBER:

P16114_GP

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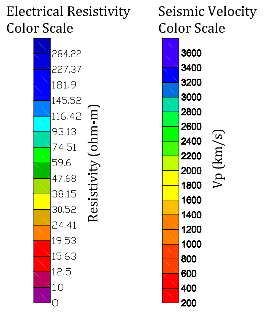

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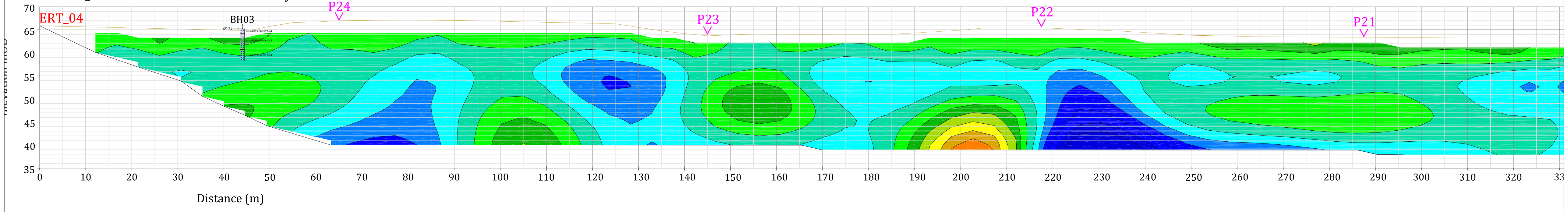
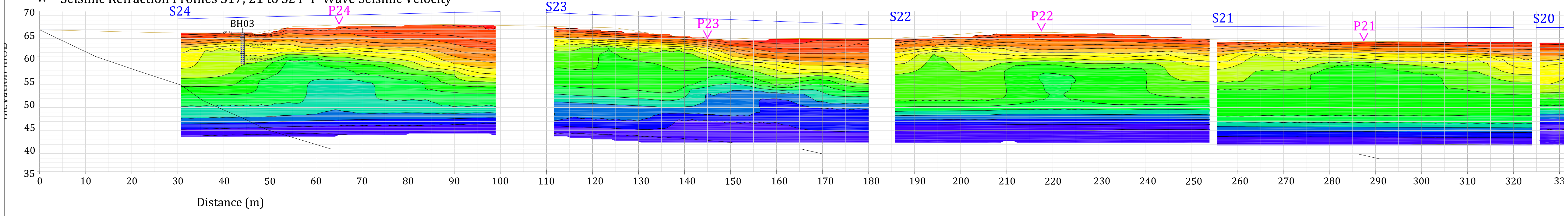
Figure 1: Cross-Section of ERT_04 - Scale 1:1000

01/02

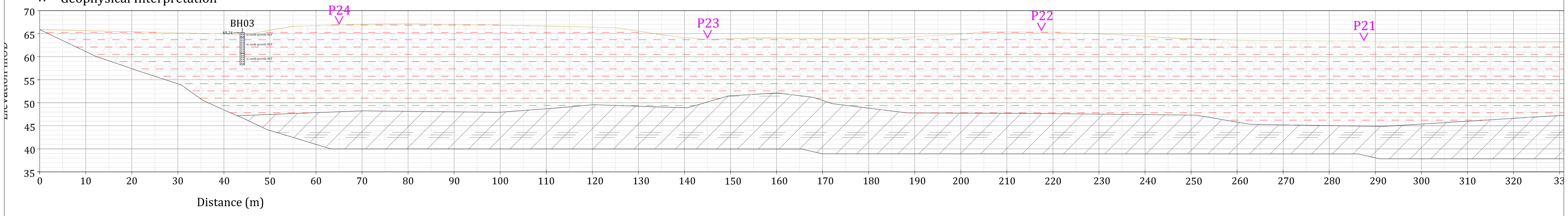
W ERT_04 - Modeled Electrical Resisitivity



W Seismic Refraction Profiles S17, 21 to S24- P-Wave Seismic Velocity



W Geophysical Interpretation



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Sheet Title:

ERT_04 CROSS-SECTION
S24, S23, S22, S21
Sheet 1 of 2

JOB NUMBER:

P16114_GP

DRAWING NUMBER:

P16114_GP_D08

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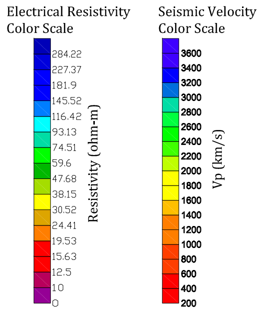

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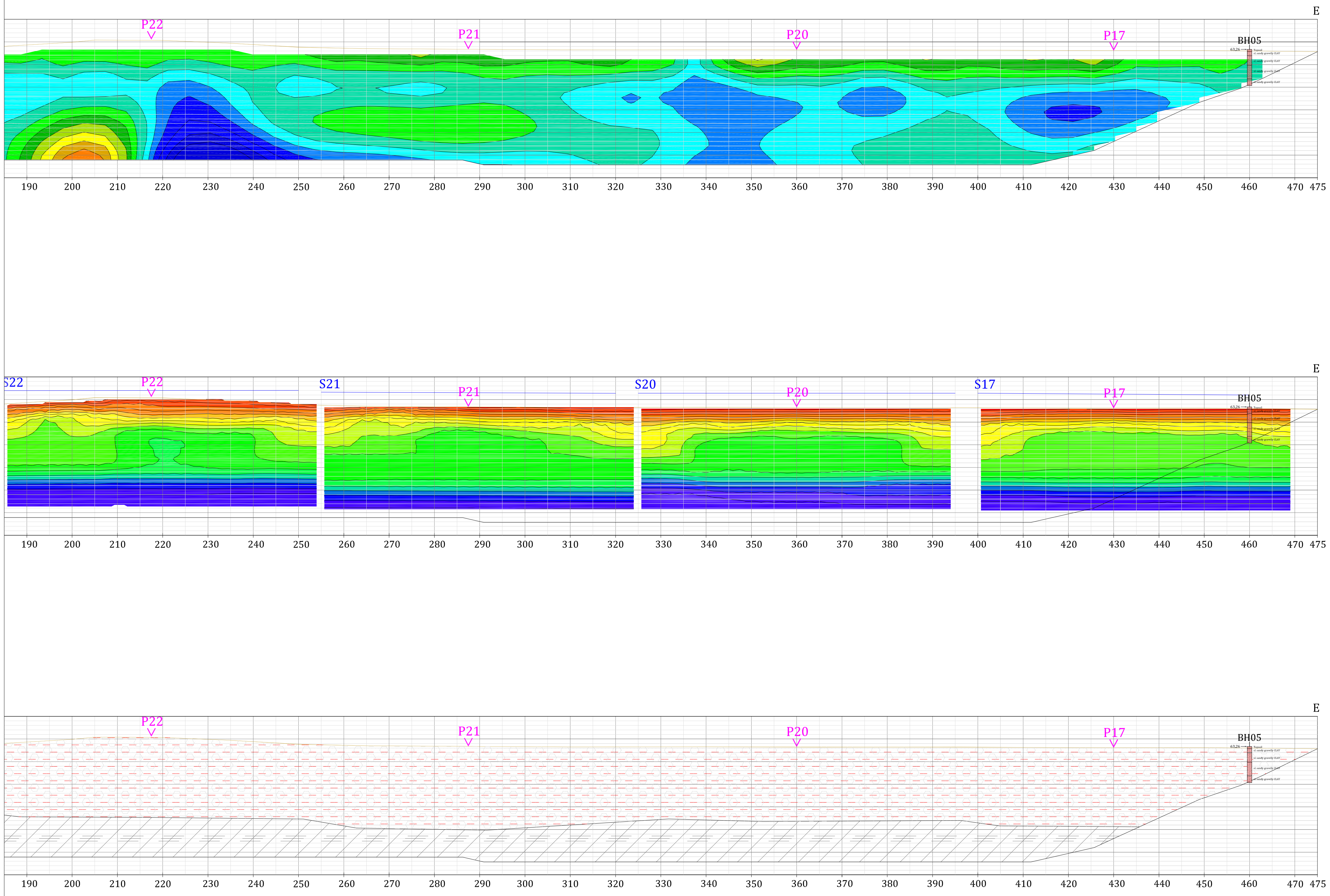
Figure 2: Cross-Section of ERT_04 continued - Scale 1:1000

02/02



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ERT_04 CROSS-SECTION
S20, S17
Sheet 2 of 2

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DRAWING NUMBER:

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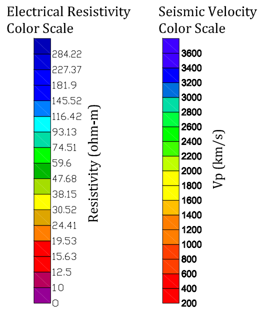

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B) APPENDIX B: SURVEY METHODOLOGY

B.1) 2D Electrical Resistivity Tomography

A total of 4 no. combined 2D Electrical Resistivity Tomography (herein referred to as ERT) profiles were acquired. ERT was used to image the sub-surface through electrical resistivity measurements made at the surface.

B.1.i) Methodology and Data Acquisition

The Wenner Alpha Array protocol was utilized during this survey. The Wenner Array uses four equally spaced electrodes. Current is injected through the two outer electrodes and potential is measured between the two inner electrodes. The electrode spacing used for this survey was 5m providing resistivity readings to a depth of approximately 26m.

Multicore resistivity cables with 32 take-outs were used with stainless steel electrodes. Resistivity measurements were undertaken with a Campus Tigre Resistivity meter and recorded to a laptop via Imager Pro™ 2006 acquisition software.

Contact resistivities were checked prior to running the survey, to ensure an adequate electrical contact between the ground and the electrodes were made. Electrodes with poor contacts were treated with saline solution and rechecked till an optimum contact resistance were obtained.

Measured profiles were inverted on site to ensure data quality. Any spurious readings were repeated until satisfactory results were achieved if possible.

B.1.ii) Data Processing

Survey data was processed using Res2DInv (Campus Geophysical Instruments, 1997), where the raw files were edited and inverted. Up to 5 iterations of the measured data were carried out for each profile to obtain a 2D depth model of the apparent resistivities. The least squares deconvolution technique was used to produce an apparent resistivity depth model.

Recorded data is restricted by the array used during the collection of data and should be noted. A degree of fit between the measured apparent resistances and the inverted resistances is calculated by the program, allowing an assessment of the degree of confidence of the inverted data. A damping factor can be applied to smooth erroneous data points; however resolution lessens with an increased damping factor. Each ERT dataset was inverted using five iterations resulting in a RMS error of < 10.0%. This was indicative of good quality data.

B.1.iii) Data Interpretation

It must be noted that geological interpretations from inverted resistivity data are only interpretations based on experience of the interpreter and known resistivity values of materials.

Interpretations are based on contouring and smoothness constraints performed by the inversion.

B.1.iv) **Relocation**

Horizontal control and Elevation was provided by a Trimble VRS (Real Time Kinematic/Virtual Reference Station) enabled GPS. Survey Controller software was used to provide high-accuracy, GNSS positioning.

All positions are plotted in Irish National Grid (ING). Elevations are to O.D. Malin.

B.2) Seismic Refraction Profiling

A total of 24 seismic refraction profiles were acquired along the proposed survey route. Seismic refraction was used to image the seismic velocity of the near surface.

B.2.i) **Methodology and Data Acquisition**

In the seismic refraction survey method a P-wave is generated by a source at the surface resulting in energy travelling through surface layers directly and along boundaries between layers of differing seismic p-wave velocities. Processing of the seismic data allows geological layer thicknesses and boundaries to be established along with layer p-wave velocities.

A 24 channel Geometrics Geode seismic system was utilized with a 24 channel seismic multicore cable, 4.5Hz geophones, and a sledge hammer and plate as a seismic source. Geophones spacing 3m with a profile length of 69m.

Data was recorded using SGOS Seismodule Controller software. A total of 7 shots were undertaken on each seismic line; 2 end-shots, 2 off-shots and 3 mid-shots. To improve signal to noise ratio, individual hammer shots were stacked at each shot location where necessary.

B.2.ii) **Data Processing**

Data processing was undertaken utilizing Seisimager Seismic 2D software programs. Surveyed topography was input for each seismic spread. First breaks were picked after which a tomographic inversion was computed using travel-time computation via ray-tracing. Velocity modeling and travel time plots were constructed for each spread. Seismic velocity phases were picked and the thickness of each velocity unit calculated using the intercept-time method.

B.2.iii) **Data Interpretation**

It should be noted that when layer thicknesses are modelled from the seismic data the areas of greatest coverage (i.e. the centre of the spread) will have the greatest accuracy. At the edges of the spread less ray coverage reduces the accuracy of layer interpretation and thickness calculation.

Approximate errors for velocities are estimated to be +/-10%. Errors for the calculated layer thickness are of the order of +/-15%. Possible errors due to the “hidden layer” and “velocity” effects may also occur (Soske, 1959). Seismic Refraction generally determines the depth to horizontal or near horizontal layers where the compaction/strength/rock quality changes. Where low velocity layers are present or where layers dip with more than 20 degrees angle the accuracy becomes less.

B.2.iv) **Relocation**

Horizontal control and Elevation was provided by a Trimble VRS (Real Time Kinematic/Virtual Reference Station) enabled GPS. Survey Controller software was used to provide high-accuracy, GNSS positioning.

All positions are plotted in Irish National Grid (ING). Elevations are to O.D. Malin

B.3) Multi-Channel Analysis of Surface Wave Profiling

A total of 24 no. seismic refraction profiles were acquired along the proposed survey route. On each of these refraction profiles 8 no. individual shots were recorded for the purpose of MASW Profiling.

B.3.i) **Methodology and Data Acquisition**

In the MASW survey method a surface wave is generated by a source (sledge hammer) at the surface resulting in the generation of a surface wave. Surface waves, often referred to as ‘ground roll’ are characterized as being of low velocity, low frequency and relatively high amplitude.

Surface waves are dispersal, with the frequency range of the surface waves all having different velocities. The surface wave phase velocity spectrum (the velocity of the different frequencies of surface waves) is a good proxy for shear wave velocities.

The frequency range of the surface wave spectrum determines the depth of investigation possible. Lower frequencies see deeper and higher frequencies see shallower.

A 24 channel Geometrics Geode seismic system was utilized with a 24 channel seismic multicore cable, 4.5Hz geophones, and a sledge hammer and plate as a seismic source. Geophones spacing 3m with a profile length of 69m respectively.

Data was recorded using SGOS Seismodule Controller software. A total of 8 shots were undertaken on each seismic line; 4 shots were taken 3m off the end of each side of the survey profiles. No data acquisition filters were used in the acquisition of the MASW shots.

B.3.ii) Data Processing

Multi-channel Analysis of Surface Waves (MASW) for seismic data collected for this project was processed using the Seisimager / SW Surface wave analysis software.

Initial phase velocities were derived for each shot from each spread. All resultant dispersions curves were then assessed and the best curve for each spread selected. These were then further edited with any higher nodes or low quality data removed.

Inversions were then performed on the edited curves based on an initial model comprising 10 layers with a total thickness of 25m. 1D S-wave velocity models were then produced over 10 layers of variable thickness. The resultant model is then outputted showing the corresponding s-wave velocity and layer thickness. Data also shows the depth of interest.

Derived S-wave velocities can then be used with corresponding derived P-wave velocities from seismic refraction models to derive dynamic moduli at relevant depths.

B.3.iii) Data Interpretation

Unlike in seismic refraction profiling surface wave analysis is capable of mapping low velocity zones at depth. The methodology does not require an increase in velocity with depth. Vertical resolution was seen to be variable on the acquired data. Generally, there was high resolution at shallower depths with dense data points but as depth increased the resolution markedly decreased. As a result, thin layers, at depth cannot be identified by this method. The 1D velocity models output from the Seisimager SW software is given in **APPENDIX C: MASW RESULTS**

B.3.iv) Relocation

Horizontal control and Elevation was provided by a Trimble VRS (Real Time Kinematic/Virtual Reference Station) enabled GPS. Survey Controller software was used to provide high-accuracy, GNSS positioning.

All positions are plotted in Irish National Grid (ING). Elevations are to O.D. Malin.

MASW 1D Velocity Model Output

Below are images showing the 1D Velocity Models for each location. The green points show the picked data points. The shaded grey shows the depth of penetration for each location.

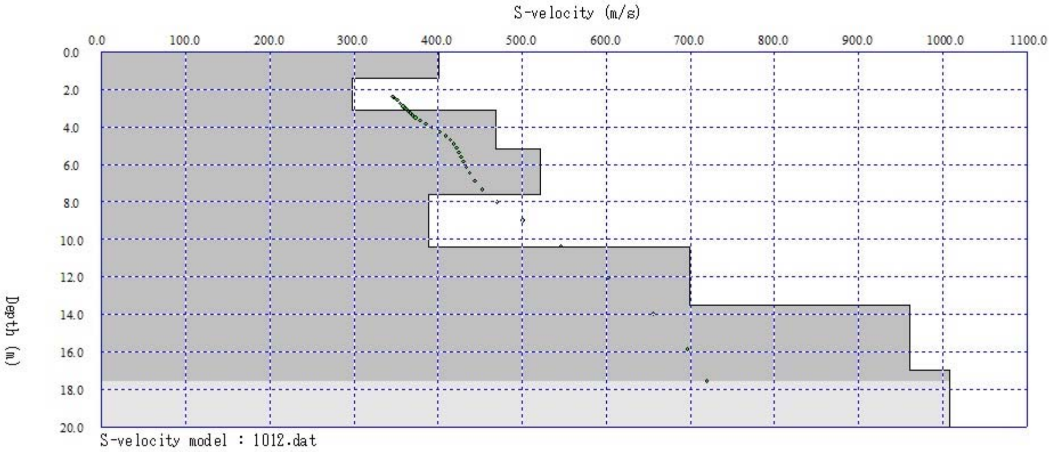

Figure E3.1: 1D Velocity Model for S-Wave P1

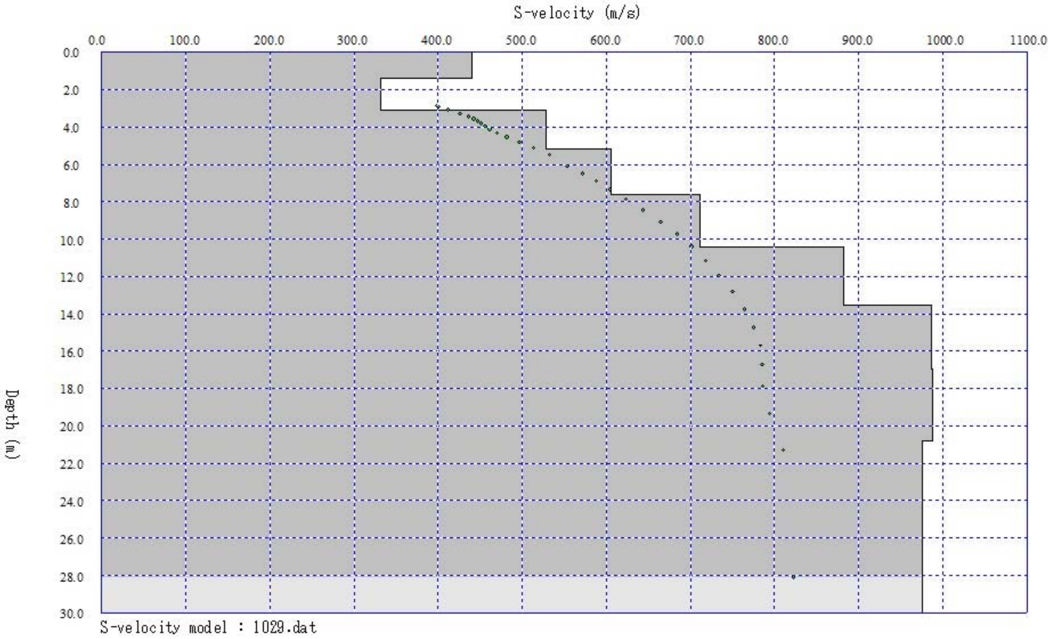

Figure E3.2: 1D Velocity Model for S-Wave P2

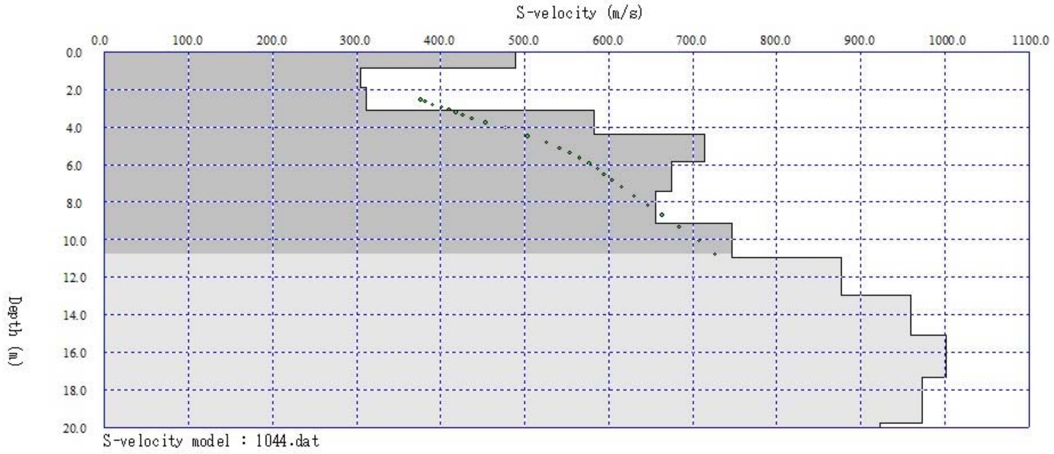

Figure E3.3: 1D Velocity Model for S-Wave P3

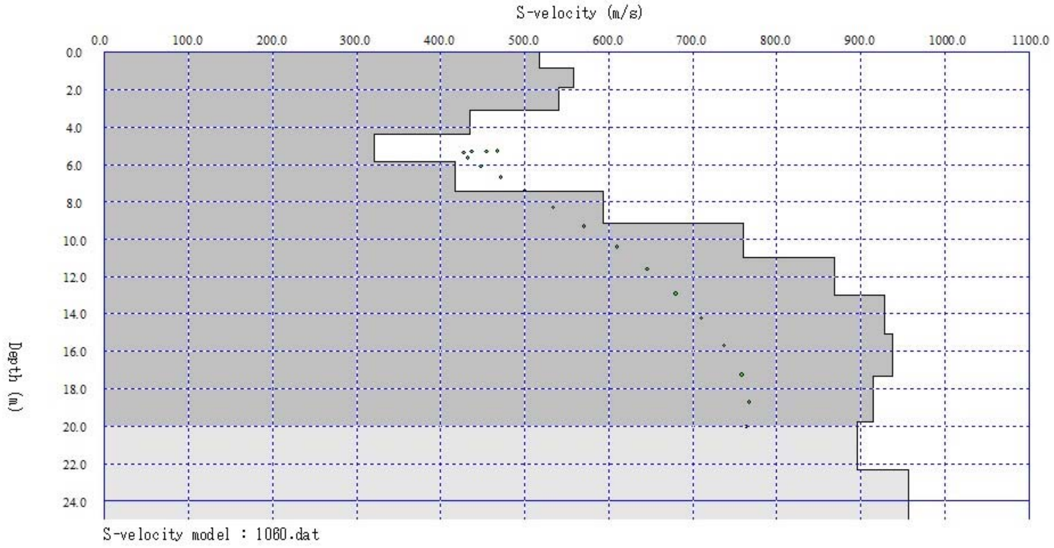

Figure E3.4: 1D Velocity Model for S-Wave P4

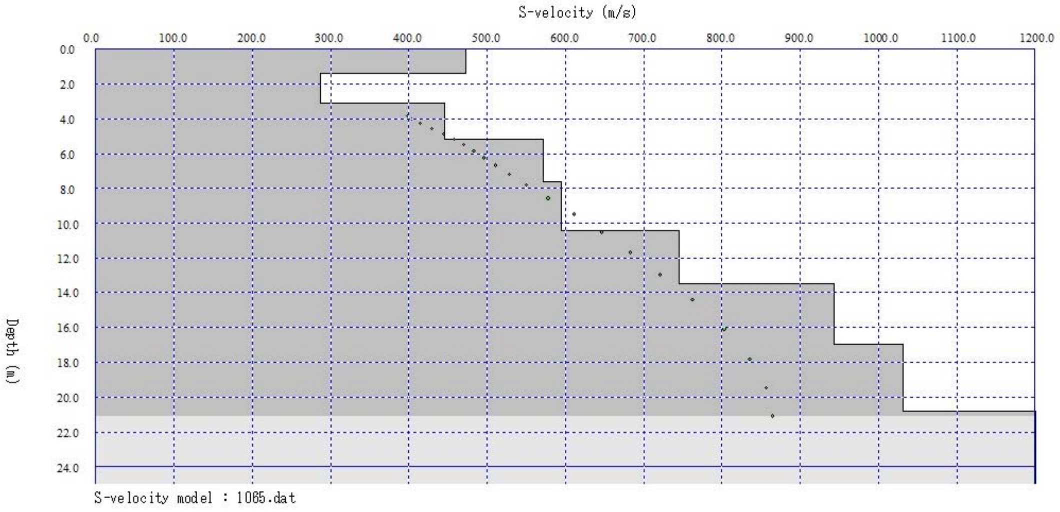

Figure E3.5: 1D Velocity Model for S-Wave P5

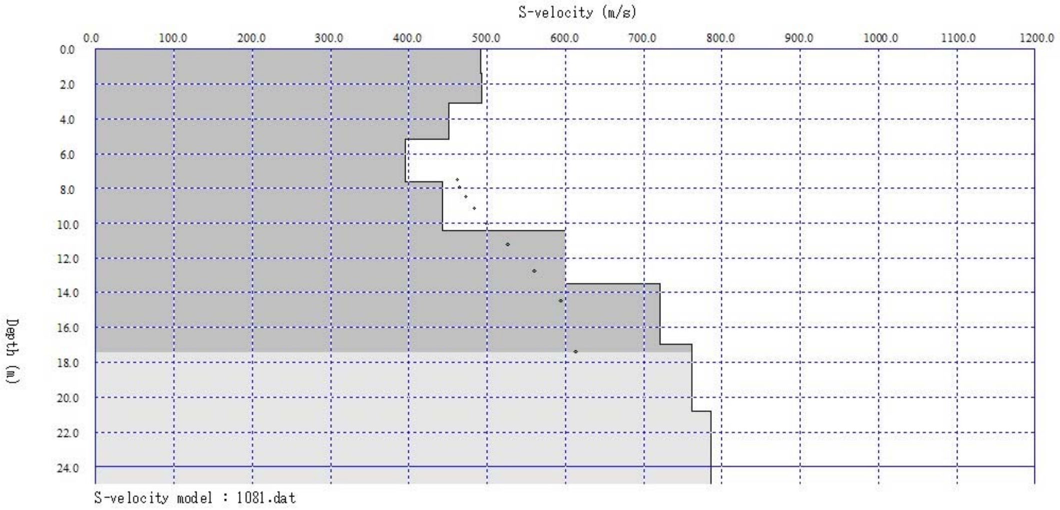

Figure E3.6: 1D Velocity Model for S-Wave P6

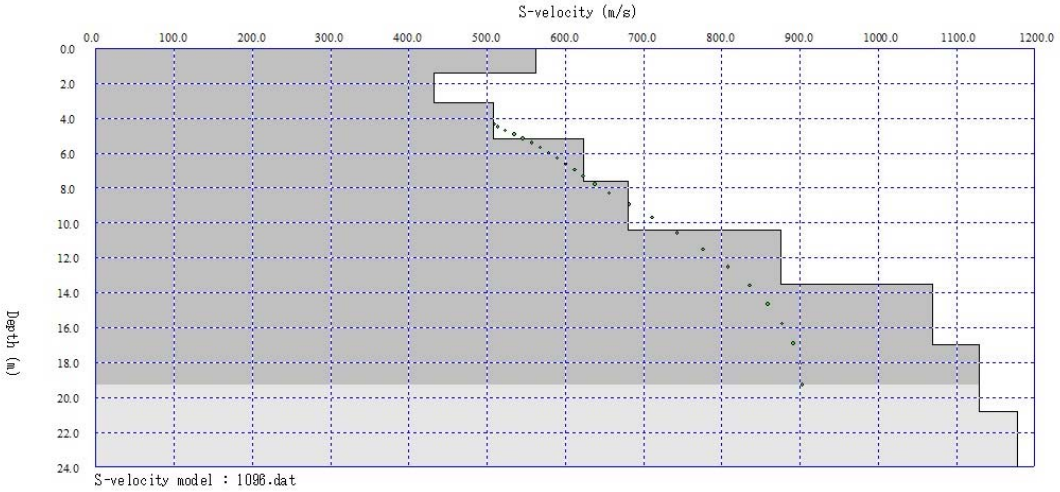

Figure E3.7: 1D Velocity Model for S-Wave P7

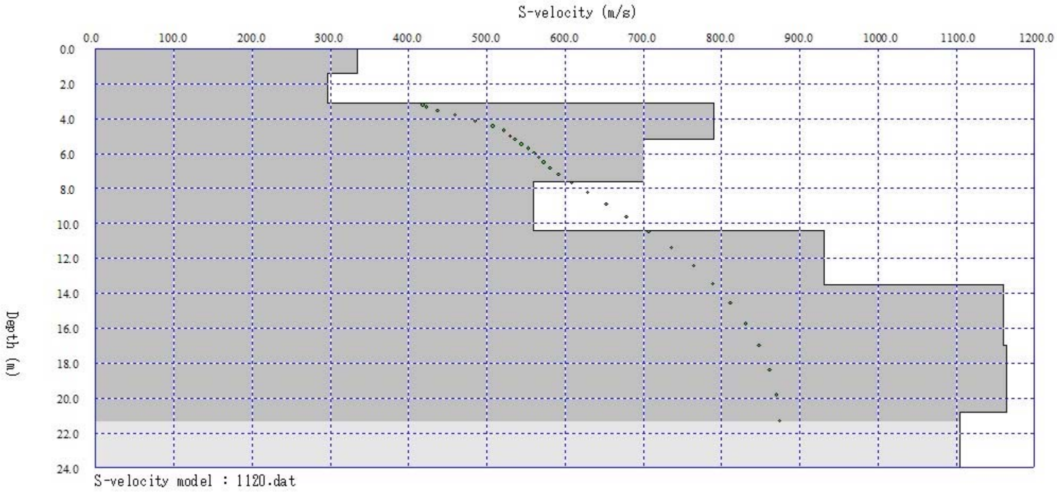

Figure E3.8: 1D Velocity Model for S-Wave P8

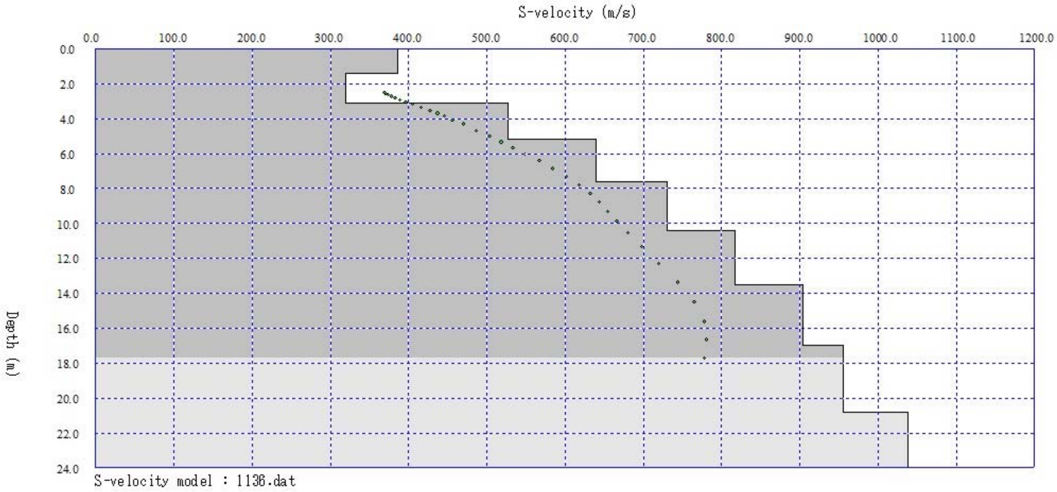

Figure E3.9: 1D Velocity Model for S-Wave P9

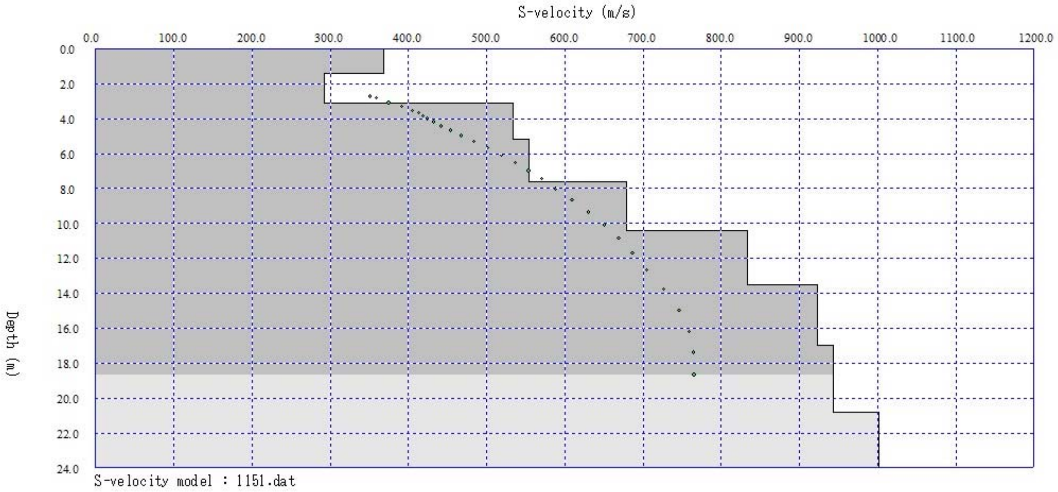

Figure E3.10: 1D Velocity Model for S-Wave P10

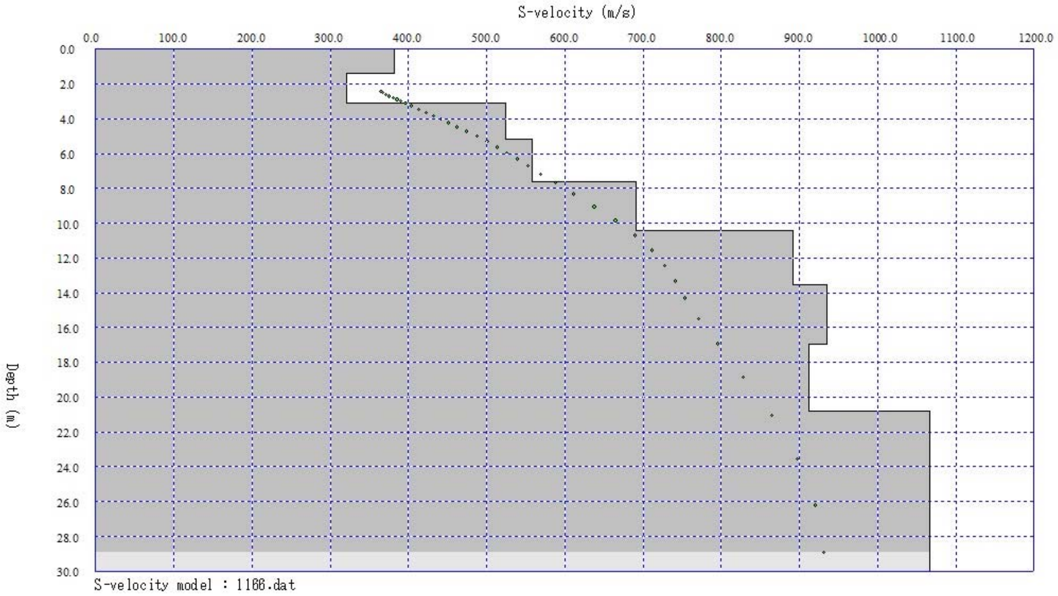

Figure E3.11: 1D Velocity Model for S-Wave P11

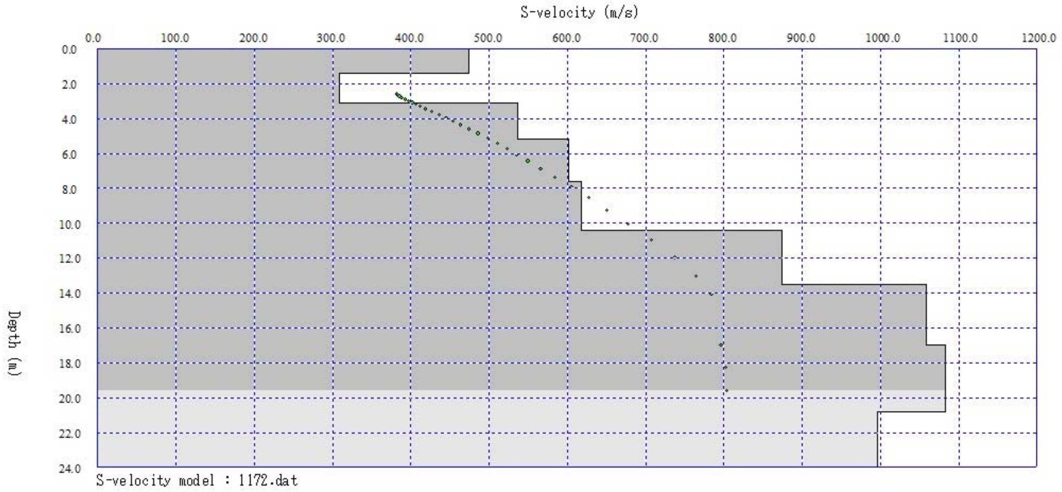

Figure E3.12: 1D Velocity Model for S-Wave P12

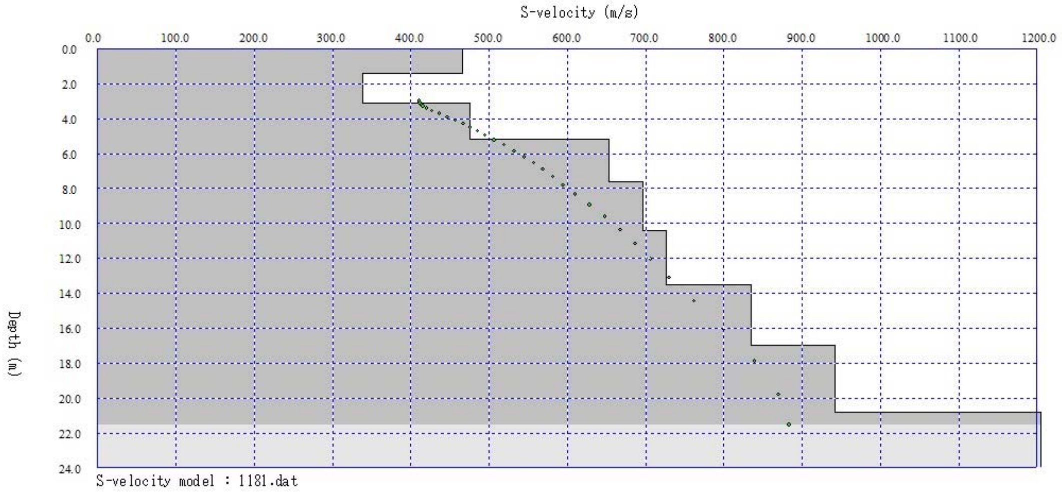

Figure E3.13: 1D Velocity Model for S-Wave P13

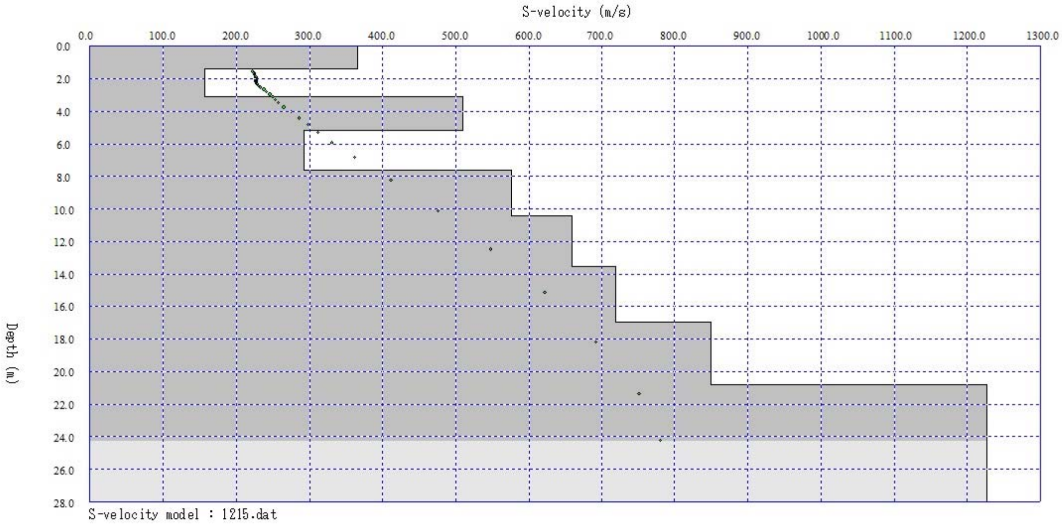

Figure E3.14: 1D Velocity Model for S-Wave P14

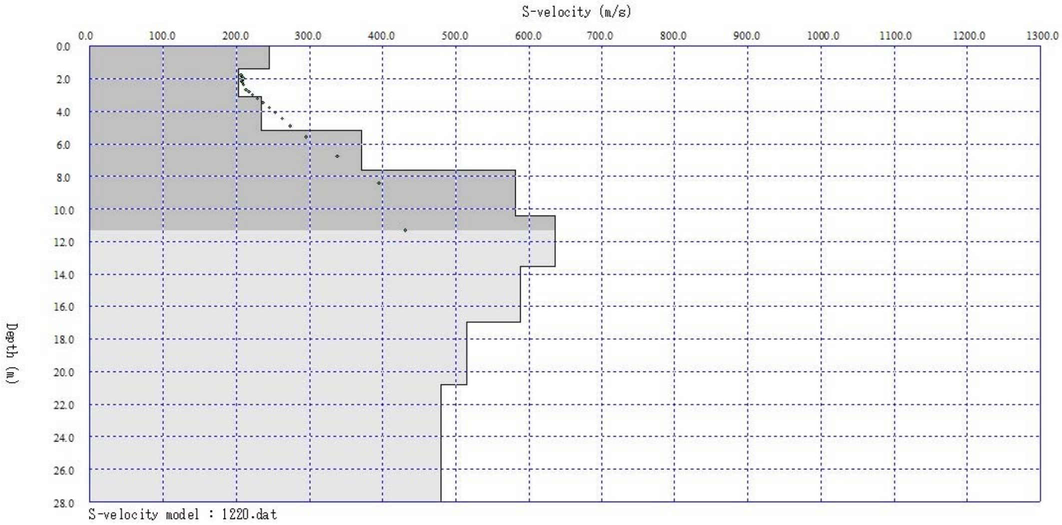

Figure E3.15: 1D Velocity Model for S-Wave P15

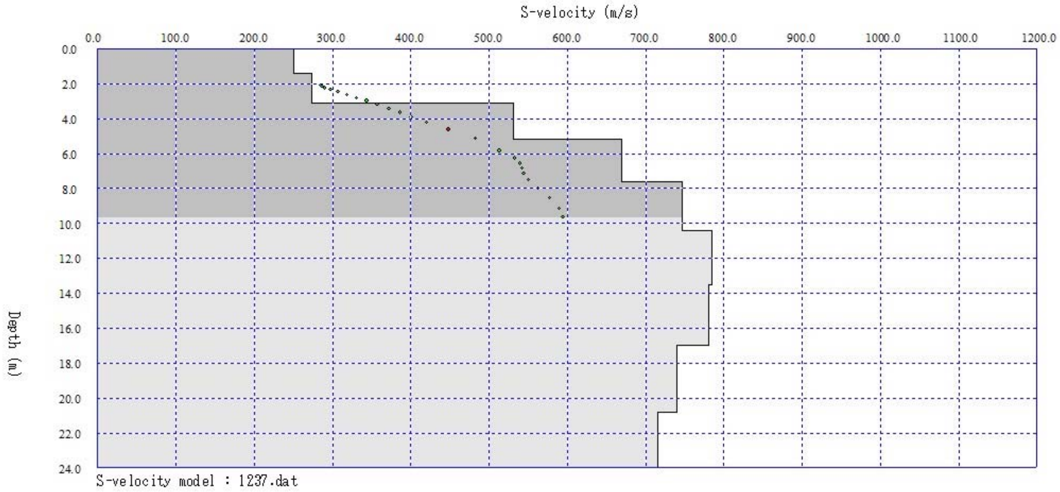

Figure E3.16: 1D Velocity Model for S-Wave P16

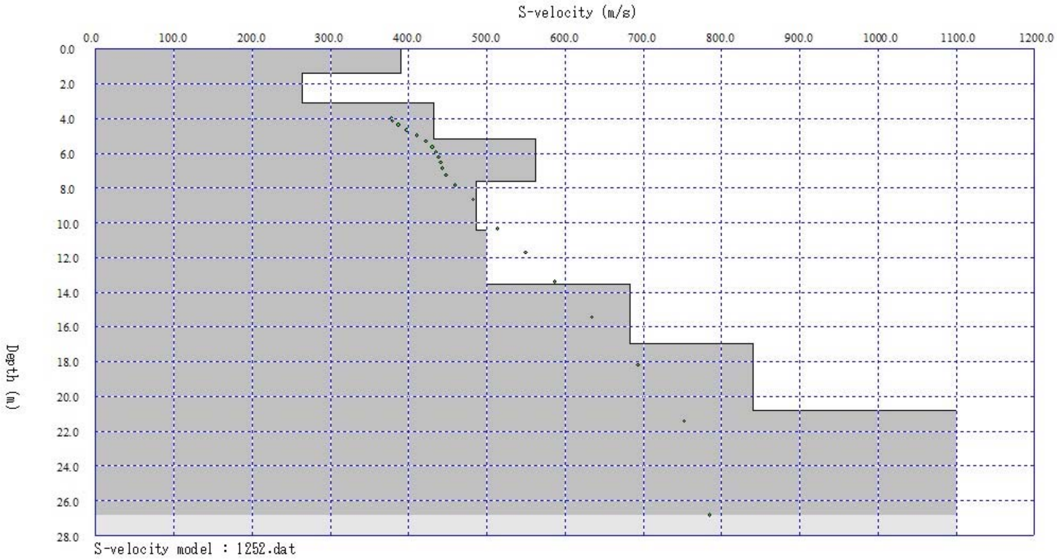

Figure E3.17: 1D Velocity Model for S-Wave P17

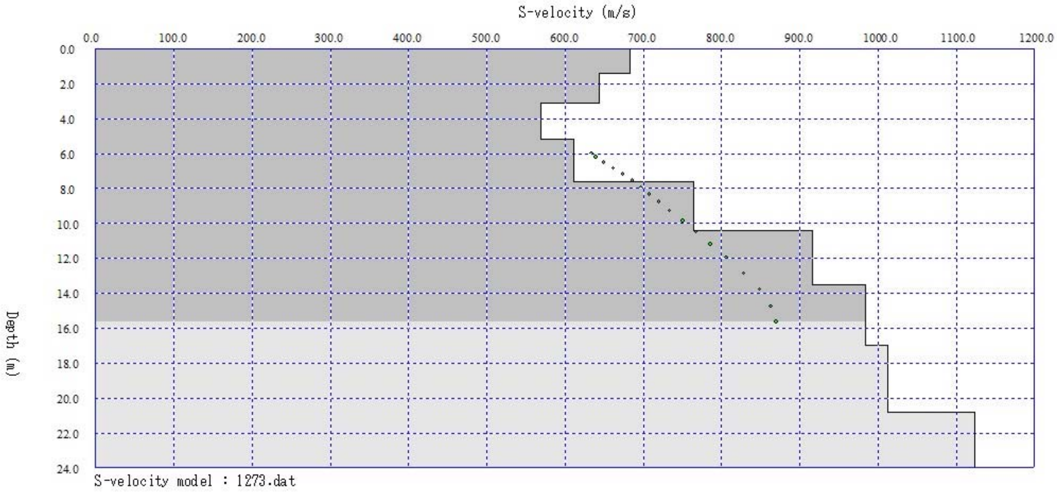

Figure E3.18: 1D Velocity Model for S-Wave P18

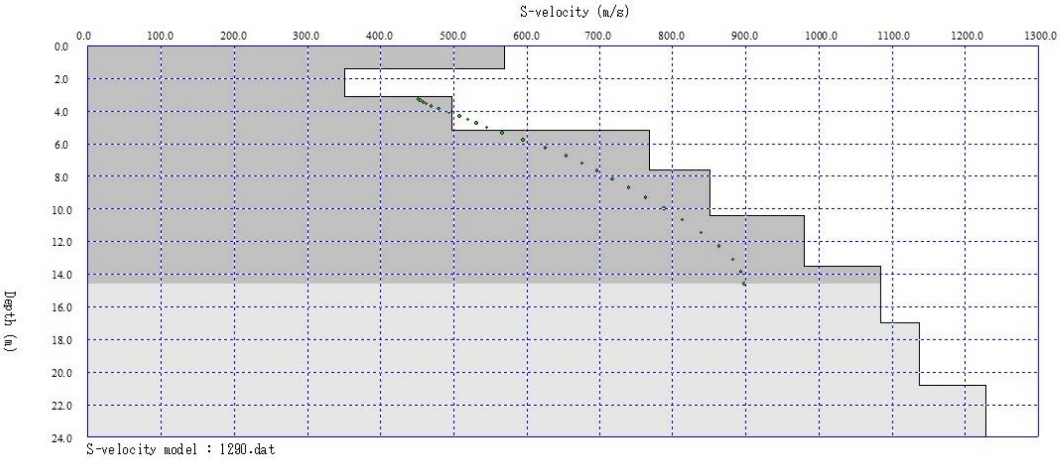

Figure E3.19: 1D Velocity Model for S-Wave P19

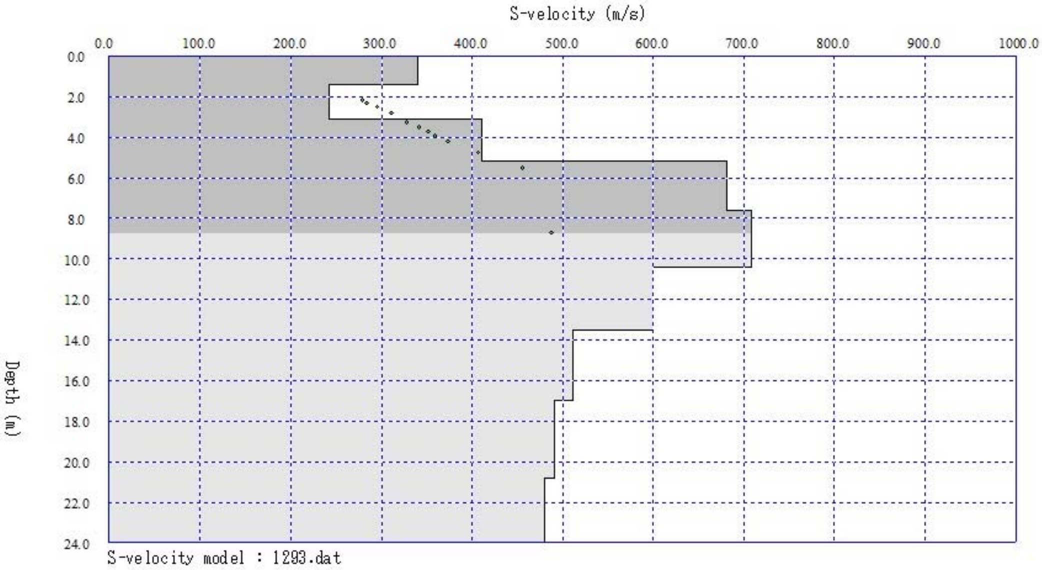

Figure E3.20: 1D Velocity Model for S-Wave P20

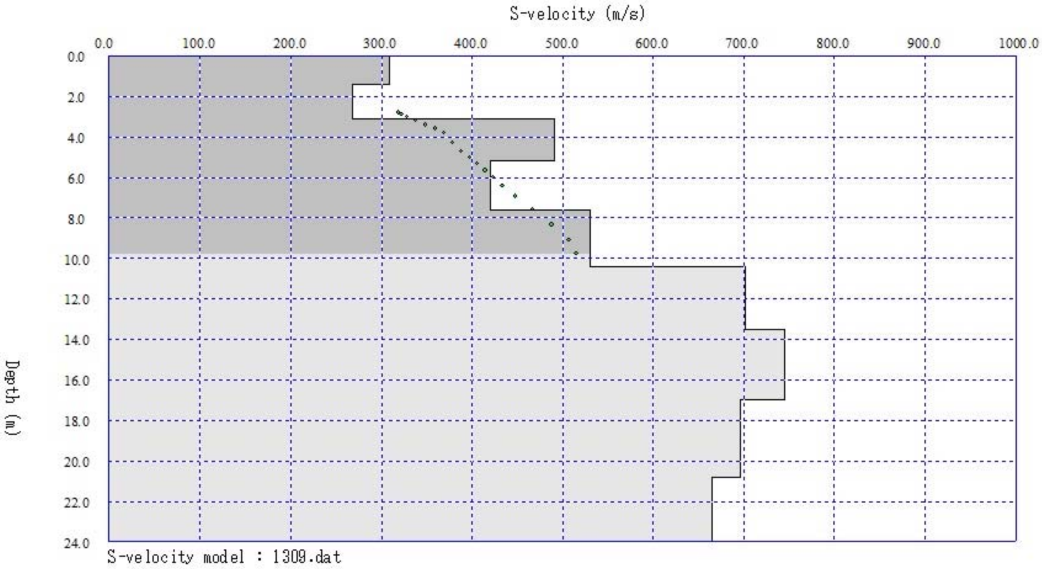

Figure E3.21: 1D Velocity Model for S-Wave P21

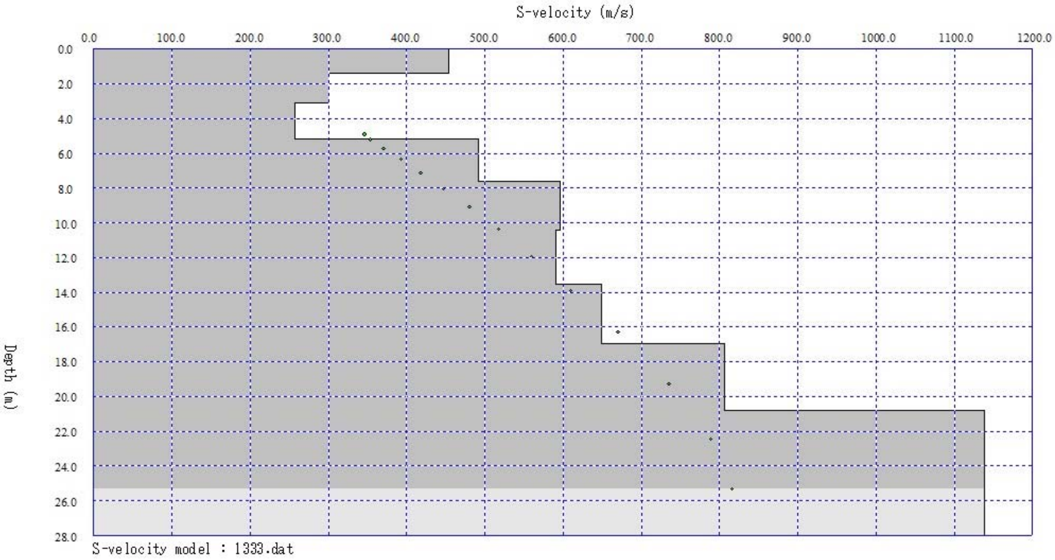

Figure E3.22: 1D Velocity Model for S-Wave P22

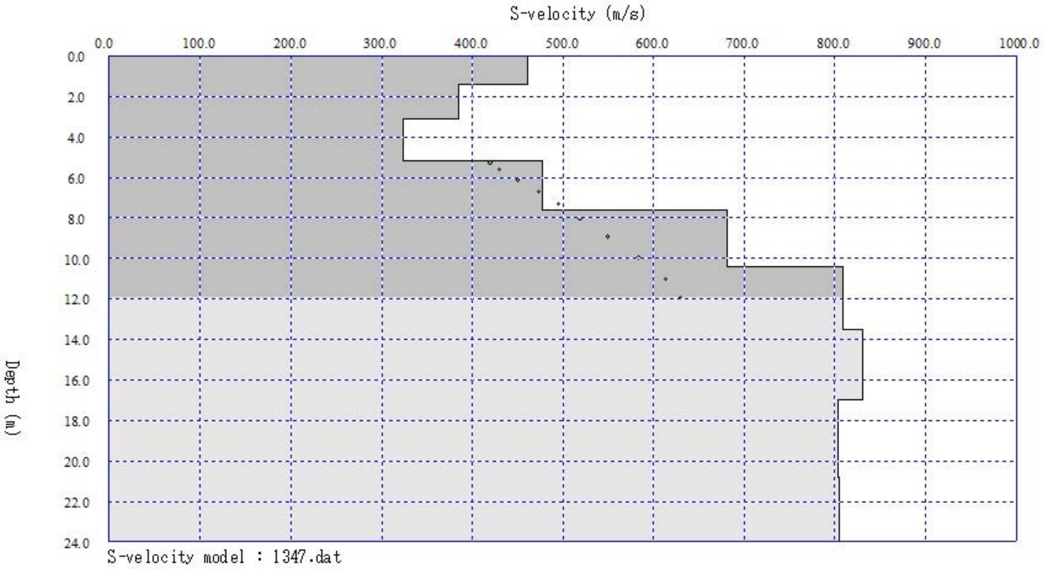

Figure E3.23: 1D Velocity Model for S-Wave P23

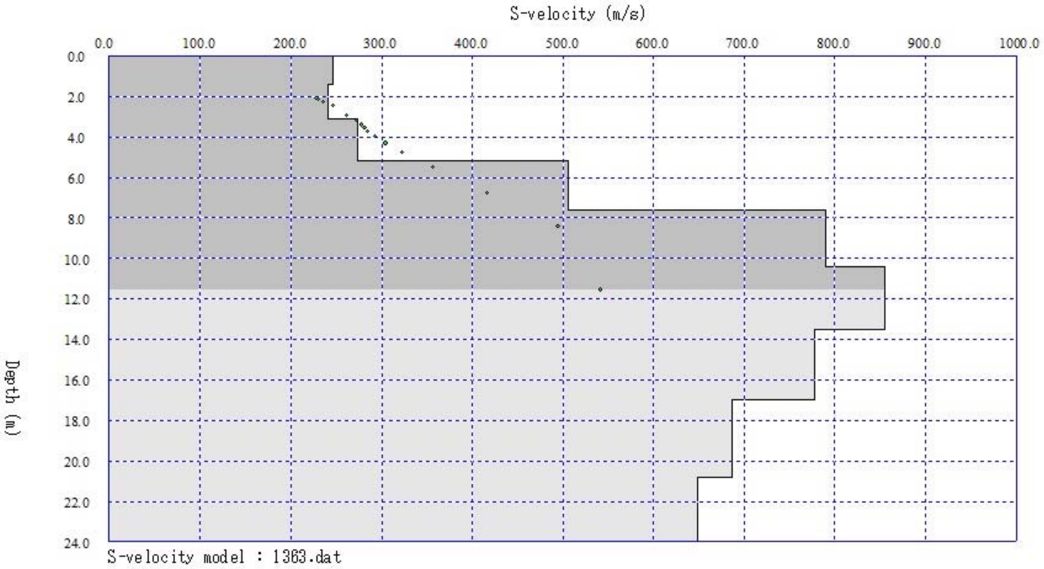

Figure E3.24: 1D Velocity Model for S-Wave P24

APPENDIX C: MASW RESULTS

Below are the results from the MASW Profiling combined with Seismic Refraction (Vp) data as well as ground resistivity. These results correspond to a sounding below 24 no. locations across the survey area. A geophysical interpretation has been included with the results.

Position: P1	
Easting:	297748.9
Northing:	267479.3
Elevation	61.8

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	1.2	444	-	1423	-	-	-	-	Sandy Gravelly CLAY
1.2	2	793	-	1645	-	-	-	-	Sandy Gravelly CLAY
2	5.3	1420	470	1903	0.44	3276.81	1209.39	420.37	Sandy Gravelly CLAY
5.3	10.4	2342	455	2157	0.48	11233.44	1321.86	446.46	Sandy Gravelly CLAY
10.4	17.2	2596	830	2213	0.44	12880.39	4399.58	1524.38	Sandy Gravelly CLAY
17.2	20.6	3067	1008	2307	0.44	18575.82	6748.20	2344.02	MUDSTONE / SHALE

Position: P2	
Easting:	297735.1
Northing:	267549.5
Elevation	61.6

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	2.1	620	332	1547	0.30	367.34	442.97	170.50	Sandy Gravelly CLAY
2.1	4.5	1547	528	1944	0.43	3930.31	1554.55	542.00	Sandy Gravelly CLAY
4.5	10.6	2349	659	2158	0.46	10658.92	2731.67	937.25	Sandy Gravelly CLAY
10.6	16.6	2674	935	2229	0.43	13341.71	5575.04	1948.84	Sandy Gravelly CLAY
16.6	21	3131	982	2319	0.45	19751.75	6464.55	2236.17	MUDSTONE / SHALE

[a] *Density computed from P Wave Velocity*

Position: P3

Easting:	297721.6
Northing:	267618.8
Elevation:	60.5

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	2	489	-	1458	-	-	-	-	Sandy Gravelly CLAY
2	3.1	1013	311	1749	0.45	1569.18	489.86	169.15	Sandy Gravelly CLAY
3.1	4.4	1528	582	1938	0.42	3650.09	1858.11	656.51	Sandy Gravelly CLAY
4.4	9.1	2342	682	2157	0.45	10491.49	2916.24	1003.06	Sandy Gravelly CLAY
9.1	15.8	2866	746	2268	0.46	16948.24	3695.12	1262.29	Sandy Gravelly CLAY
15.8	19	3063	-	2306	-	-	-	-	MUDSTONE / SHALE

Position: P4

Easting:	297706.0
Northing:	267685.3
Elevation:	59.5

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	1.2	535	-	1491	-	-	-	-	Sandy Gravelly CLAY
1.2	3.7	1215	-	1830	-	-	-	-	Sandy Gravelly CLAY
3.7	4.5	1774	-	2012	-	-	-	-	Sandy Gravelly CLAY
4.5	7.4	2161	369	2114	0.48	9486.78	854.73	287.79	Sandy Gravelly CLAY
7.4	13	2555	741	2204	0.45	12774.54	3519.37	1210.17	Sandy Gravelly CLAY
13	15.8	2800	929	2255	0.44	15085.13	5597.80	1946.18	Sandy Gravelly CLAY
15.8	19.1	3071	939	2308	0.45	19051.80	5894.42	2034.76	MUDSTONE / SHALE

[a] *Density computed from P Wave Velocity*

Position: P5	
Easting:	297699.3
Northing:	267714.2
Elevation:	59.3

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	2.1	561	-	1509	-	-	-	-	Sandy Gravelly CLAY
2.1	3.7	1269	-	1850	-	-	-	-	Sandy Gravelly CLAY
3.7	7.1	1887	509	2043	0.46	6569.64	1546.50	529.35	Sandy Gravelly CLAY
7.1	10.4	2519	594	2196	0.47	12902.65	2279.05	774.89	Sandy Gravelly CLAY
10.4	15.9	2760	745	2247	0.46	15453.81	3643.30	1247.10	Sandy Gravelly CLAY
15.9	19.1	3046	987	2303	0.44	18376.91	6467.34	2243.51	SHALE / MUDSTONE

Position: P6	
Easting:	297824.7
Northing:	267641.0
Elevation:	60.6

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	1.2	610	-	1541	-	-	-	-	Sandy Gravelly CLAY
1.2	3.7	1386	-	1891	-	-	-	-	Sandy Gravelly CLAY
3.7	7.1	2029	-	2081	-	-	-	-	Sandy Gravelly CLAY
7.1	10.4	2342	443	2157	0.48	11264.42	1253.95	423.22	Sandy Gravelly CLAY
10.4	13.5	2602	601	2214	0.47	13924.03	2354.09	799.72	Sandy Gravelly CLAY
13.5	15.7	2695	722	2234	0.46	14670.49	3402.96	1164.33	Sandy Gravelly CLAY
15.7	18	2714	-	2238	-	-	-	-	Sandy Gravelly CLAY
18	20.9	3031	-	2300	-	-	-	-	SHALE / MUDSTONE

[a] *Density computed from P Wave Velocity*

Position: P7	
Easting:	297755.4
Northing:	267627.6
Elevation:	60.5

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	2.1	568	-	1513	-	-	-	-	Sandy Gravelly CLAY
2.1	3.1	1261	-	1847	-	-	-	-	Sandy Gravelly CLAY
3.1	5.2	1858	509	2035	0.46	6323.21	1539.12	527.30	Sandy Gravelly CLAY
5.2	10.4	2501	652	2192	0.46	12470.26	2727.85	931.93	Sandy Gravelly CLAY
10.4	13.5	2637	876	2221	0.44	13175.18	4902.64	1704.70	Sandy Gravelly CLAY
13.5	16.8	2722	1070	2239	0.41	13173.23	7222.28	2563.61	Sandy Gravelly CLAY
16.8	20.8	3231	1130	2337	0.43	20420.71	8537.20	2984.37	SHALE / MUDSTONE

Position: P8	
Easting:	297687.3
Northing:	267604.1
Elevation:	60.6

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	2.1	659	-	1571	-	-	-	-	Sandy Gravelly CLAY
2.1	3.1	1245	-	1841	-	-	-	-	Sandy Gravelly CLAY
3.1	5.2	1746	790	2004	0.37	4441.79	3429.93	1250.62	Sandy Gravelly CLAY
5.2	10.4	2292	630	2145	0.46	10133.12	2484.40	851.33	Sandy Gravelly CLAY
10.4	17.1	2557	1046	2204	0.40	11198.00	6750.95	2411.89	Sandy Gravelly CLAY
17.1	20.9	3162	1165	2325	0.42	19036.47	8969.55	3155.03	SHALE / MUDSTONE

[a] *Density computed from P Wave Velocity*

Position: P9

Easting:	297618.4
Northing:	267585.6
Elevation:	60.9

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	2.1	509	-	1472	-	-	-	-	Sandy Gravelly CLAY
2.1	3.1	1035	-	1758	-	-	-	-	Sandy Gravelly CLAY
3.1	5.2	1624	527	1968	0.44	4461.60	1575.32	546.55	Sandy Gravelly CLAY
5.2	7.6	2024	639	2079	0.44	7386.22	2453.06	849.02	Sandy Gravelly CLAY
7.6	10.4	2301	731	2147	0.44	9838.39	3313.10	1147.30	Sandy Gravelly CLAY
10.4	15	2737	861	2242	0.45	14581.20	4804.08	1662.21	Sandy Gravelly CLAY
15	19.2	3031	-	2300	-	-	-	-	SHALE / MUDSTONE

Position: P10

Easting:	297550.1
Northing:	267569.1
Elevation:	61.1

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	2.1	546	-	1499	-	-	-	-	Sandy Gravelly CLAY
2.1	3.1	1119	-	1793	-	-	-	-	Sandy Gravelly CLAY
3.1	5.2	1453	535	1914	0.42	3310.48	1557.53	547.82	Sandy Gravelly CLAY
5.2	7.6	1884	555	2042	0.45	6410.67	1827.51	629.10	Sandy Gravelly CLAY
7.6	12.6	2694	757	2233	0.46	14502.99	3729.78	1279.83	Sandy Gravelly CLAY
12.6	17	3168	923	2326	0.45	20700.34	5760.26	1981.35	SHALE / MUDSTONE

[a] *Density computed from P Wave Velocity*

Position: P11

Easting:	297479.2
Northing:	267548.2
Elevation:	61.1

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	2.1	640	-	1559	-	-	-	-	Sandy Gravelly CLAY
2.1	3.1	1068	320	1772	0.45	1779.48	526.51	181.47	Sandy Gravelly CLAY
3.1	5.2	1375	524	1888	0.42	2878.05	1466.90	518.32	Sandy Gravelly CLAY
5.2	7.6	1894	558	2045	0.45	6487.32	1849.75	636.76	Sandy Gravelly CLAY
7.6	10.5	2520	691	2196	0.46	12550.06	3060.96	1048.74	Sandy Gravelly CLAY
10.5	13	2931	892	2281	0.45	17175.87	5259.36	1814.87	Sandy Gravelly CLAY
13	17	3300	935	2350	0.46	22848.86	5982.90	2054.06	SHALE / MUDSTONE

Position: P12

Easting:	297413.2
Northing:	267529.6
Elevation:	61.1

Depth (m bgl)		**P Wave**	**S Wave**	**Density [a]**	**Poissons**	**K Bulk Modulus**	**E Youngs**	**Small Strain Shear**	**Geophysical**
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	2.1	599	-	1534	-	-	-	-	Sandy Gravelly CLAY
2.1	3.1	1099	-	1785	-	-	-	-	Sandy Gravelly CLAY
3.1	5.2	1510	536	1932	0.43	3666.10	1585.51	555.18	Sandy Gravelly CLAY
5.2	7.6	1959	601	2062	0.45	6921.79	2157.41	744.94	Sandy Gravelly CLAY
7.6	10.4	2479	618	2187	0.47	12329.00	2450.92	835.43	Sandy Gravelly CLAY
10.4	12.7	2868	874	2269	0.45	16350.15	5021.36	1732.92	Sandy Gravelly CLAY
12.7	17	3086	1058	2311	0.43	18556.48	7414.47	2586.32	SHALE / MUDSTONE

[a] *Density computed from P Wave Velocity*

Position: P13

Easting: 297344.0
Northing: 267517.2
Elevation: 61.2

Depth (m bgl)		P Wave	S Wave	Density ^{a}	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	2.7	577	-	1519	-	-	-	-	Sandy Gravelly CLAY
2.7	5.2	1474	476	1921	0.44	3593.18	1254.96	435.21	Sandy Gravelly CLAY
5.2	7.6	2040	653	2083	0.44	7486.01	2563.70	888.37	Sandy Gravelly CLAY
7.6	10.4	2496	696	2191	0.46	12236.04	3094.80	1061.43	Sandy Gravelly CLAY
10.4	12.6	2621	726	2218	0.46	13679.05	3410.15	1169.10	Sandy Gravelly CLAY
12.6	17	3045	835	2303	0.46	19211.50	4686.18	1605.58	SHALE / MUDSTONE

Position: P14

Easting: 297273.6
Northing: 267496.7
Elevation: 65.0

Depth (m bgl)		P Wave	S Wave	Density ^{a}	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	**To**	**[m/s]**	**[m/s]**	**[kg/m³]**	**Ratio**	**[Mpa]**	**Modulus [Mpa]**	**Modulus [Mpa]**	**Interpretation**
0	4.1	654	157	1568	0.47	619.01	113.56	38.64	Fill Material
4.1	5.2	1007	509	1746	0.33	1167.74	1202.04	452.43	Sandy Gravelly CLAY
5.2	7.6	1311	292	1865	0.47	2994.02	468.84	159.05	Sandy Gravelly CLAY
7.6	10.4	1960	575	2063	0.45	7014.82	1981.67	681.96	Sandy Gravelly CLAY
10.4	13.5	2439	659	2179	0.46	11698.35	2763.78	946.10	Sandy Gravelly CLAY
13.5	17.3	2685	720	2232	0.46	14545.39	3380.81	1156.81	Sandy Gravelly CLAY
17.3	20.8	3037	849	2301	0.46	19014.57	4835.71	1658.78	SHALE / MUDSTONE

^{a} *Density computed from P Wave Velocity*

Position: P15

Easting:	297206.4
Northing:	267481.8
Elevation:	62.1

Depth (m bgl) From	To	P Wave [m/s]	S Wave [m/s]	Density [a] [kg/m³]	Poissons Ratio	K Bulk Modulus [Mpa]	E Youngs Modulus [Mpa]	Small Strain Shear Modulus [Mpa]	Geophysical Interpretation
0	1.1	558	-	1507	-	-	-	-	Sandy Gravelly CLAY
1.1	3.1	1384	202	1891	0.49	3518.90	229.78	77.15	Sandy Gravelly CLAY
3.1	5.2	1918	234	2052	0.49	7397.20	335.30	112.33	Sandy Gravelly CLAY
5.2	7.6	2192	372	2121	0.49	9800.57	871.90	293.53	Sandy Gravelly CLAY
7.6	10.4	2345	581	2157	0.47	10892.00	2136.97	728.20	Sandy Gravelly CLAY
10.4	13.5	2613	636	2216	0.47	13937.95	2633.11	896.52	Sandy Gravelly CLAY
13.5	16.5	2832	-	2261	-	-	-	-	Sandy Gravelly CLAY
16.5	19.5	3042	-	2302	-	-	-	-	SHALE / MUDSTONE

Position: P16

Easting:	297120.8
Northing:	267458.6
Elevation:	63.0

Depth (m bgl) From	To	P Wave [m/s]	S Wave [m/s]	Density [a] [kg/m³]	Poissons Ratio	K Bulk Modulus [Mpa]	E Youngs Modulus [Mpa]	Small Strain Shear Modulus [Mpa]	Geophysical Interpretation
0	1.2	701	-	1595	-	-	-	-	Sandy Gravelly CLAY
1.2	3.1	1343	273	1877	0.48	3198.36	413.56	139.86	Sandy Gravelly CLAY
3.1	5.2	2085	531	2095	0.47	8319.14	1730.97	590.65	Sandy Gravelly CLAY
5.2	7.6	2630	670	2220	0.47	14027.03	2920.49	996.55	Sandy Gravelly CLAY
7.6	10.4	2677	746	2230	0.46	14325.59	3618.34	1240.94	Sandy Gravelly CLAY
10.4	17.1	2787	-	2252	-	-	-	-	Sandy Gravelly CLAY
17.1	19.1	2945	-	2284	-	-	-	-	SHALE / MUDSTONE

[a] *Density computed from P Wave Velocity*

Position: P17

Easting:	297479
Northing:	267426.7
Elevation:	63.2

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	2.1	615	-	1544	-	-	-	-	Sandy Gravelly CLAY
2.1	3.1	1261	-	1847	-	-	-	-	Sandy Gravelly CLAY
3.1	3.7	1636	432	1972	0.46	4786.38	1076.24	367.94	Sandy Gravelly CLAY
3.7	7.1	2028	563	2080	0.46	7676.90	1923.12	659.39	Sandy Gravelly CLAY
7.1	14	2322	493	2152	0.48	10905.31	1544.38	523.02	Sandy Gravelly CLAY
14	17.4	2512	684	2195	0.46	12479.90	2998.12	1026.78	Sandy Gravelly CLAY
17.4	20.8	3148	841	2322	0.46	20821.99	4800.79	1642.34	SHALE / MUDSTONE

Position: P18

Easting:	298020.4
Northing:	267686.8
Elevation:	60.7

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	1.3	546	-	1499	-	-	-	-	Sandy Gravelly CLAY
1.3	2.9	1149	-	1805	-	-	-	-	Sandy Gravelly CLAY
2.9	5.5	1727	-	1998	-	-	-	-	Sandy Gravelly CLAY
5.5	7.2	2254	611	2136	0.46	9789.01	2328.99	797.41	Sandy Gravelly CLAY
7.2	10.4	2504	765	2193	0.45	12038.87	3717.92	1283.34	Sandy Gravelly CLAY
10.4	17.1	2570	951	2207	0.42	11917.50	5671.92	1996.21	Sandy Gravelly CLAY
17.1	19.6	2880	-	2271	-	-	-	-	SHALE / MUDSTONE

[a] *Density computed from P Wave Velocity*

Position: P19

Easting: 297956.3

Northing: 267670.8

Elevation: 60.7

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	2.1	537	-	1492	-	-	-	-	Sandy Gravelly CLAY
2.1	2.9	1066	351	1771	0.44	1721.97	628.15	218.23	Sandy Gravelly CLAY
2.9	5.3	1554	497	1946	0.44	4059.44	1387.53	480.77	Sandy Gravelly CLAY
5.3	7.1	2209	768	2125	0.43	8699.61	3588.22	1253.53	Sandy Gravelly CLAY
7.1	10.5	2704	852	2235	0.44	14181.61	4689.29	1622.72	Sandy Gravelly CLAY
10.5	15.7	2788	1032	2253	0.42	14311.40	6816.33	2399.08	Sandy Gravelly CLAY
15.7	19.1	2937	-	2282	-	-	-	-	SHALE / MUDSTONE

Position: P20

Easting: 297410.2

Northing: 267411.1

Elevation: 63.2

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	2.1	564	-	1511	-	-	-	-	Sandy Gravelly CLAY
2.1	2.9	1210	243	1828	0.48	2532.97	319.35	107.96	Sandy Gravelly CLAY
2.9	5.3	1846	410	2032	0.47	6469.09	1007.00	341.58	Sandy Gravelly CLAY
5.3	7.1	2235	682	2131	0.45	9325.68	2872.41	991.40	Sandy Gravelly CLAY
7.1	15.7	2450	709	2181	0.45	11629.96	3188.82	1096.34	Sandy Gravelly CLAY
15.7	16.4	2826	-	2260	-	-	-	-	Sandy Gravelly CLAY
16.4	19.1	3137	-	2320	-	-	-	-	SHALE / MUDSTONE

[a] *Density computed from P Wave Velocity*

Position: P21

Easting: 297340.8
Northing: 267397.5
Elevation: 63.4

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	1.2	555	-	1505	-	-	-	-	Sandy Gravelly CLAY
1.2	2.9	1234	-	1837	-	-	-	-	Sandy Gravelly CLAY
2.9	3.7	1677	491	1984	0.45	4941.55	1389.92	478.25	Sandy Gravelly CLAY
3.7	5.3	2044	491	2084	0.47	8038.66	1476.76	502.51	Sandy Gravelly CLAY
5.3	7.6	2445	420	2180	0.48	12518.76	1141.90	384.53	Sandy Gravelly CLAY
7.6	10.5	2523	532	2197	0.48	13156.53	1836.52	621.82	Sandy Gravelly CLAY
10.5	18.5	2532	-	2199	-	-	-	-	Sandy Gravelly CLAY
18.5	19.1	2901	-	2275	-	-	-	-	SHALE / MUDSTONE

Position: P22

Easting: 297270.2
Northing: 267383.8
Elevation: 65.4

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	2.2	758	-	1627	-	-	-	-	Sandy Gravelly CLAY
2.2	3.9	1131	-	1798	-	-	-	-	Sandy Gravelly CLAY
3.9	5.7	1551	-	1945	-	-	-	-	Sandy Gravelly CLAY
5.7	7.5	2053	492	2087	0.47	8121.70	1484.56	505.11	Sandy Gravelly CLAY
7.5	17.6	2589	620	2211	0.47	13688.99	2498.34	850.02	Sandy Gravelly CLAY
17.6	20.8	2947	807	2284	0.46	17853.77	4341.88	1487.49	SHALE / MUDSTONE

[a] *Density computed from P Wave Velocity*

Position: P23
Easting: 297201.5
Northing: 267364.6
Elevation: 63.8

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	1.2	599	-	1534	-	-	-	-	Sandy Gravelly CLAY
1.2	2.7	1190	-	1821	-	-	-	-	Sandy Gravelly CLAY
2.7	5.2	1766	-	2010	-	-	-	-	Sandy Gravelly CLAY
5.2	6.7	2183	477	2119	0.47	9455.26	1422.21	482.13	Sandy Gravelly CLAY
6.7	9.9	2541	682	2201	0.46	12846.30	2991.69	1023.72	Sandy Gravelly CLAY
9.9	13.5	2894	810	2274	0.46	17054.36	4348.56	1491.79	Sandy Gravelly CLAY
13.5	16.4	3011	-	2296	-	-	-	-	SHALE / MUDSTONE

Position: P24
Easting: 297123.3
Northing: 267356.0
Elevation: 67.0

Depth (m bgl)		P Wave	S Wave	Density [a]	Poissons	K Bulk Modulus	E Youngs	Small Strain Shear	Geophysical
From	To	[m/s]	[m/s]	[kg/m³]	Ratio	[Mpa]	Modulus [Mpa]	Modulus [Mpa]	Interpretation
0	1.2	700	-	1595	-	-	-	-	Sandy Gravelly CLAY
1.2	2.9	1001	240	1744	0.47	1613.30	295.18	100.44	Sandy Gravelly CLAY
2.9	5.4	1400	274	1896	0.48	3526.86	421.42	142.36	Sandy Gravelly CLAY
5.4	7.2	1943	505	2058	0.46	7070.41	1536.62	524.88	Sandy Gravelly CLAY
7.2	10.6	2527	790	2198	0.45	12206.85	3966.59	1371.73	Sandy Gravelly CLAY
10.6	12.4	2678	856	2230	0.44	13815.03	4716.16	1634.04	Sandy Gravelly CLAY
12.4	18.8	2991	-	2293	-	-	-	-	Sandy Gravelly CLAY
18.8	21.1	3057	-	2305	-	-	-	-	SHALE / MUDSTONE

[a] *Density computed from P Wave Velocity*

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Appendix 11.2

Groundwater Quality Results 2013 - 2018

Parameter	Units	Date	IGV†	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Ammoniacal Nitrogen as N	mg/l	17/08/2011	0.19	0.396	0.313	0.501	0.445	0.503	0.544	0.557
pH (Field)	pH units	17/08/2011	6.5 - 9.5	6.64	6.59	6.78	6.84	7.13	6.54	6.86
Electrical Conductivity (Lab)	mS/cm	17/08/2011	1	0.577	0.598	0.706	0.543	0.522	0.54	0.545
Electrical Conductivity (in-situ)	mS/cm	17/08/2011	1	0.643	0.561	0.708	0.524	0.642	0.631	0.612
Oxygen, dissolved (Field)	mg/l	17/08/2011	NAC	3.58	3.47	0.93	3.2	3.54	2.66	3.81
Temperature (Field)	° C	17/08/2011	25	10.1	10.6	10.1	10.7	11.1	10.5	10.2
Chloride	mg/l	17/08/2011	30	23.3	18.8	25	19.3	17.5	16.2	18.4
Iron	mg/l	17/08/2011	0.2	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	17/08/2011	5	3.25	2.97	2.89	2.85	2.79	2.94	2.92
Sodium	mg/l	17/08/2011	150	40.3	37.2	46.5	25.1	24.9	62.7	26.2
Total Oxidised Nitrogen	mg/l	17/08/2011	NAC	<0.1	<0.1	<0.1	<0.1	0.143	<0.1	<0.1
Total Organic carbon	mg/l	17/08/2011	--	<3	<3	<3	<3	<3	4.77	<3
Phenols	µg/l	17/08/2011	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Boron	µg/l	17/08/2011	1000	88.3	79.3	73.8	115	53.3	81	84.3
Cadmium	µg/l	17/08/2011	5	0.104	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Calcium	mg/l	17/08/2011	200	53	82.2	82.5	85	71	41.4	82.1
Total chromium	µg/l	17/08/2011	30	13.6	7.57	8.89	16.6	13.4	10.7	10.9
Copper	µg/l	17/08/2011	30	<0.85	1.19	<0.85	<0.85	<0.85	<0.85	<0.85
Total cyanide	mg/l	17/08/2011	0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	mg/l	17/08/2011	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	µg/l	17/08/2011	10	0.08	0.039	0.029	0.41	<0.02	<0.02	0.034
Magnesium	mg/l	17/08/2011	50	24.5	19.9	21.3	16.9	20.8	15	17.6
Manganese	µg/l	17/08/2011	50	168	66.5	109	289	107	83.6	248
Mercury	µg/l	17/08/2011	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sulphate	mg/l	17/08/2011	200	31.9	63.3	189	14.5	37.2	46.5	24.3
Alkalinity, Total as CaCO3	mg/l	17/08/2011	200	295	300	200	270	235	260	242
Phosphate (ortho) as PO4	mg/l	17/08/2011	0.03	0.097	<0.05	<0.05	<0.05	<0.05	0.062	<0.05
Residue on evaporation	mg/l	17/08/2011	--	451	603	590	251	659	473	260
Zinc	µg/l	17/08/2011	10	2.88	<0.41	0.736	2.34	0.421	0.419	0.696
Faecal coliforms	CFU/100ml	17/08/2011	0	200	0	0	0	0	51	0

Parameter	Units	Date	IGV†	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Total coliforms	CFU/100ml	17/08/2011	0	200	0	0	0	0	51	0
List I / II substances	Please see appendix III									
Dissolved Antimony	µg/l	17/08/2011	--	<0.16	<0.16	<0.16	4.24	0.795	<0.16	1.35
Dissolved Arsenic	µg/l	17/08/2011	10	2.46	1.95	0.23	0.959	0.649	-	0.344
Dissolved Barium	µg/l	17/08/2011	--	63.7	45.4	11.2	130	60.5	32.9	95.8
Dissolved Beryllium	µg/l	17/08/2011	--	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Dissolved Cobalt	µg/l	17/08/2011	--	0.254	0.175	0.164	0.084	0.158	0.075	0.086
Dissolved Molybdenum	µg/l	17/08/2011	--	2.41	3.7	1.22	2.71	1.7	1.56	2.55
Dissolved Nickel	µg/l	17/08/2011	50	1.75	2.06	1.68	0.303	0.99	0.947	0.273
Dissolved Phosphorus	µg/l	17/08/2011	--	47.9	<6.3	<6.3	22.6	13.1	16.5	8.68
Dissolved Selenium	µg/l	17/08/2011	--	<0.39	<0.39	<0.39	0.451	<0.39	<0.39	0.397
Dissolved Silicon	mg/l	17/08/2011	--	8.3	7.11	8.85	9.79	7.31	6.92	10.2
Dissolved Silver	µg/l	17/08/2011	--	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Dissolved Tellurium	µg/l	17/08/2011	--	<2	<2	<2	<2	<2	<2	<2
Dissolved Thallium	µg/l	17/08/2011	--	<0.96	<0.96	<0.96	<0.96	<0.96	<0.96	<0.96
Dissolved Tin	µg/l	17/08/2011	--	<0.36	<0.36	<0.36	0.944	0.576	<0.36	0.662
Dissolved Titanium	µg/l	17/08/2011	--	2.12	3.75	1.99	2.69	<1.5	1.62	<1.5
Dissolved Uranium	µg/l	17/08/2011	--	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Dissolved Vanadium	µg/l	17/08/2011	--	3.83	1.66	2.49	4.38	3.13	3.03	3.7
Total Phosphorus	µg/l	17/08/2011	--	106	394	122	25.7	183	44	<20

IGV=Interim Guideline Value

Parameter	Units	Date	IGV†	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Ammoniacal Nitrogen as N	mg/l	25/11/2011	0.19	0.357	<0.2	0.434	0.38	0.508	0.393	0.506
pH (Field)	pH units	25/11/2011	6.5 - 9.5	8.01	7.42	7.92	7.4	7.51	7.42	7.33
Temperature	° C	25/11/2011	25	9.2	11.6	9.3	11.3	11.4	13	10.9
Electrical Conductivity	mS/cm	25/11/2011	1	0.699	0.607	0.863	0.548	0.523	0.583	0.543
Oxygen, dissolved (Field)	mg/l	25/11/2011	NAC	5.22	6.58	2.13	6.04	7.75	7.84	6.96
Temperature (Field)	° C	25/11/2011	25	9.2	11.6	9.3	11.3	11.4	13	10.9
Chloride	mg/l	25/11/2011	30	23.8	19.4	27	18.5	14.6	16.6	17.9
Iron	mg/l	25/11/2011	0.2	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	25/11/2011	5	4.53	2.52	5.82	2.71	2.82	5.48	3.4
Sodium	mg/l	25/11/2011	150	42.5	39.6	51.2	24.9	23.7	49.6	25.6
Total Oxidised Nitrogen	mg/l	25/11/2011	NAC	0.111	<0.1	<0.1	<0.1	<0.1	0.118	<0.1
Total Organic carbon	mg/l	25/11/2011	--	3.15	4.19	<3	<3	3.49	3.71	3.09
Phenols	µg/l	25/11/2011	<0.002	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Faecal coliforms	CFU/100ml	25/11/2011	0	0	0	0	12	2	0	0
Total coliforms	CFU/100ml	25/11/2011	0	0	98	0	146	2	500	0
Parameter	**Units**	**Date**	**GWTL†**	**MW1d**	**MW2d**	**MW3d**	**MW5d**	**MW6d**	**MW7d**	**MW16d**
Ammoniacal Nitrogen as N	mg/l	14/02/2012	1.96	0.443	<0.2	0.447	0.431	0.436	<0.2	0.506
pH (Field)	pH units	14/02/2012	8.28	7.12	6.84	7.23	7.41	7.32	7.08	6.97
Temperature (Field)	° C	14/02/2012	25	8.83	10.37	8.97	9.17	8.437	8.97	9
Electrical Conductivity	mS/cm	14/02/2012	0.95	0.631	0.612	0.731	0.542	0.518	0.571	0.541
Oxygen, dissolved (Field)	mg/l	14/02/2012	NAC	5.03	4.13	1.47	5.71	7.14	7.68	6.32
Chloride	mg/l	14/02/2012	31.28	22.4	17.9	24.3	18.2	16.5	14.6	17.6
Iron	mg/l	14/02/2012	0.2	<0.019	<0.019	0.46	0.119	<0.019	<0.019	0.06
Potassium	mg/l	14/02/2012	6.25	3.69	2.62	3.15	2.48	2.77	2.65	2.77
Sodium	mg/l	14/02/2012	112.33	42.4	37.6	49.3	26.1	25.1	60.9	26.1
Total Oxidised Nitrogen	mg/l	14/02/2012	NAC	<0.1	<0.1	<0.1	<0.1	0.157	0.189	<0.1
Total Organic carbon	mg/l	14/02/2012	12.99	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Phenols	µg/l	14/02/2012	0.02	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Faecal coliforms	CFU/100ml	14/02/2012	0	0	3	0	2	2	0	0
Total coliforms	CFU/100ml	14/02/2012	0	0	3	0	2	2	0	0

Parameter	Units	Date	GWTL†	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Ammoniacal Nitrogen as N	mg/l	15/05/2012	1.96	0.238	0.397	<0.2	0.347	0.375	<0.2	0.544
pH (Field)	pH units	15/05/2012	8.28	7.5	7.46	7.52	7.31	7.39	7.52	7.43
Temperature (Field)	º C	15/05/2012	25	10.8	11.3	10.7	11.1	12	12.2	11.8
Electrical Conductivity	mS/cm	15/05/2012	0.95	0.652	0.693	0.737	0.542	0.642	0.647	0.534
Oxygen, dissolved (Field)	mg/l	15/05/2012	NAC	3.18	3.24	4.82	3.62	3.88	5.13	4.32
Chloride	mg/l	15/05/2012	31.28	24	19.5	21.8	19.2	19.1	22.1	18.6
Iron	mg/l	15/05/2012	0.2	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	15/05/2012	6.25	6.21	5.33	6.22	<2.34	2.59	2.57	<2.34
Sodium	mg/l	15/05/2012	112.33	43.9	42.5	44.2	27	26.4	75.9	27.1
Total Oxidised Nitrogen	mg/l	15/05/2012	NAC	<0.1	<0.1	0.913	<0.1	0.212	0.271	<0.1
Total Organic carbon	mg/l	15/05/2012	12.99	<3	3.68	5.19	<3	8.25	10.2	7.44
Phenols	µg/l	15/05/2012	0.02	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Faecal coliforms	CFU/100ml	15/05/2012	-	990	20	0	97	19	0	3
Total coliforms	CFU/100ml	15/05/2012	-	5370	>2420	2420	64900	13100	138	1990
Parameter	**Units**	**Date**	**GWTL†**	**MW1d**	**MW2d**	**MW3d**	**MW5d**	**MW6d**	**MW7d**	**MW16d**
pH (Field)	pH Units	01/08/2012	8.28	7.2	7.32	7.56	7.32	7.42	7.47	7.38
Electrical Conductivity (Laboratory)	mS/cm	01/08/2012	0.95	0.532	0.54	0.571	0.648	0.52	0.511	0.528
Electrical Conductivity (in-situ)	mS/cm	01/08/2012	0.95	0.598	0.544	0.575	0.722	0.587	0.507	0.612
Temperature (Field)		01/08/2012	25	13.8	14.3	14.2	13.7	15.1	15	14.6
Ammoniacal Nitrogen as N	mg/l as N	01/08/2012	1.96	0.68	0.226	0.228	0.436	0.401	0.51	0.721
Oxygen, dissolved (Field)	mg/l	01/08/2012	12.99	3.02	3.22	4.21	3.71	3.92	5.08	4.27
Organic Carbon, Total	mg/l	01/08/2012	12.99	<3	<3	<3	<3	3.39	<3	<3
Potassium (diss.filt)	mg/l	01/08/2012	6.25	<2.34	<2.34	2.81	2.57	<2.34	<2.34	<2.34
Sodium (diss.filt)	mg/l	01/08/2012	NAC	25.8	<0.076	39.3	46.8	25.3	24.7	<0.076
Iron (diss.filt)	mg/l	01/08/2012	0.02	<0.019	<0.019	0.0638	<0.019	<0.019	<0.019	<0.019
Phenols, Total monohydric	mg/l	01/08/2012	0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

GWTL = Revised Groundwater Trigger Levels

Parameter	Units	Date	GWTL†	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH Units	12/11/2012	8.28	6.79	6.83	6.74	6.66	6.94	6.9	6.44
Temperature (Field)	C	12/11/2012	25	11.9	12.2	12.2	12.2	12.1	12.4	12.5
Ammoniacal Nitrogen as N	mg/l as N	12/11/2012	1.96	0.23	0.12	0.46	0.39	0.53	0.4	0.51
Oxygen, dissolved (Field)	mg/l	12/11/2012	NAC	9.86	6.92	7.9	7.46	7.46	10.02	8.38
Chloride	mg/l	12/11/2012	31.28	23.99	19.1	25.43	18.52	16.6	15.92	17.31
Organic Carbon, Total	mg/l	12/11/2012	12.99	0.99	1.3	0.86	0.83	0.93	0.94	0.94
Potassium (diss.filt)	mg/l	12/11/2012	6.25	7.2	2.9	4.5	2.9	3.2	5.4	3.1
Sodium (diss.filt)	mg/l	12/11/2012	112.33	37.9	30.6	45	24.4	24	63.8	24.6
Iron	mg/l	12/11/2012	-	17.48	7.456	2.195	0.344	0.539	0.471	0.709
Total Oxidised Nitrogen as N	mg/l	12/11/2012	NAC	<2	<2	<2	<2	<2	<2	<2
Phenols, Total monohydric	mg/l	12/11/2012	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Coliforms, Total*	MPN/100ml	12/11/2012		235.9	7330	6500	920.8	137.2	2160	1046.2
Faecal Coliforms (W)*	CFU/100ml	12/11/2012		<1	32	15	<1	<1	<1	6
TSS	mg/l	12/11/2012		654	210	79	5	45	7	82

GWTL = Revised Groundwater Trigger Levels

Parameter	Units	Date	GWTL†	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Ammoniacal Nitrogen as N	mg/l as N	07/03/2013	1.96	0.07	<0.01	0.4	0.38	0.5	0.86	0.38
Chloride	mg/l	07/03/2013	31.28	28.62	17.58	24.78	17.64	17.94	15.2	17.18
Organic Carbon, Total	mg/l	07/03/2013	12.99	1.06	<0.5	1.33	<0.5	<0.5	0.95	1.55
Potassium (total)	mg/l	07/03/2013	6.25*	12.7	3	4	2.4	3.7	3.7	2.8
Sodium (total)	mg/l	07/03/2013	112.3*	44.1	38.8	47.9	27.2	27.5	68.6	27.9
Iron (total)	mg/l	07/03/2013		164.5	3.653	4.776	0.531	10.71	0.358	0.961
Total Oxidised Nitrogen as N	mg/l	07/03/2013	NAC	<2	<2	<2	<2	<2	<2	<2
Phenols, Total monohydric	mg/l	07/03/2013	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Coliforms, Total*	MPN/100ml	07/03/2013		1236	2419	4.1	6.2	3	21.3	5.2
Faecal Coliforms (W)*	CFU/100ml	07/03/2013		1	1	<1	<1	<1	1	<1
TSS	mg/l	07/03/2013		1372	153	69	11	288	7	10

GWTL = Revised Groundwater Trigger Levels

Parameter	Units	Date	GWTL†	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH	pH Units	13/06/2013	8.28	8.24	7.67	7.59	7.55	7.81	7.98	7.85
Electrical Conductivity	mS/cm	13/06/2013		658	695	806	639	613	621	647
Temperature (Field)		13/06/2013	25	9.3	10	8.9	10.1	9.6	9.8	9.5
Ammoniacal Nitrogen as N	mg/l as N	13/06/2013	1.96	<0.00	<0.01	<0.01	0.12	<0.01	<0.01	<0.01
Oxygen, dissolved (Field)	mg/l	13/06/2013	NAC	-	-	-	-	-	-	-
Chloride	mg/l	13/06/2013	31.28	30.01	17.86	24.21	17.56	17.08	15.59	19.48
Organic Carbon, Total	mg/l	13/06/2013	12.99	1.72	1.23	<0.5	0.81	0.73	0.6	<0.5
Potassium (diss.filt)	mg/l	13/06/2013	6.25	6.5	3.2	3.9	2.4	4	3.5	2.7
Sodium (diss.filt)	mg/l	13/06/2013	112.3	26.4	24.7	31.4	17.2	16.8	45.7	17.2
Iron (total)	mg/l	13/06/2013		41.75	3.225	3.498	1.988	3.822	0.754	0.116
Total Oxidised Nitrogen as N	mg/l	13/06/2013	NAC	<2	<2	<2	<2	<2	<2	<2
Phenols, Total monohydric	mg/l	13/06/2013	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Coliforms, Total*	MPN/100ml	13/06/2013		7.4	1986.3	7.5	2419.6	816.4	48	14.6
Faecal Coliforms (W)*	CFU/100ml	13/06/2013		<1	<1	<1	<1	<1	<1	<1
TSS	mg/l	13/06/2013		2140	96	30	17	93	7	4

GWTL = Revised Groundwater Trigger Levels

Parameter	Units	Date	GWTL[1] /IGV[2]	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	28/08/2013	8.28 [1]	7.57	7.35	7.33	7.32	7.58	7.6	7.24
Electrical Conductivity (Lab)	mS/cm	28/08/2013	8.28	0.642	0.682	0.776	0.621	0.606	0.613	0.636
Electrical Conductivity (in-situ)	mS/cm	28/08/2013		0.53	0.569	0.663	0.52	0.505	0.521	0.528
Oxygen, dissolved (Field)	mg/l	28/08/2013	NAC[1]	2.94	5.24	4.89	3.36	4.04	4.44	4.45
Temperature (Field)	° C	28/08/2013	251	14.1	13.9	13.5	15.7	15.3	16.9	14.9
Ammoniacal Nitrogen as N	mg/l	28/08/2013	1.961	<0.01	0.02	0.14	0.21	<0.01	0.35	0.17
Chloride	mg/l	28/08/2013	31.281	25.5	18.24	25.37	17.76	17.57	15.81	17.36
Total Iron	mg/l	28/08/2013		278	2.118	0.5	0.344	40.9	0.631	0.695
Potassium	mg/l	28/08/2013	6.25 [1]	57.2	3.8	9.4	2.6	<0.4	<0.4	3
Sodium	mg/l	28/08/2013	112.3 [1]	40.6	35.7	41	24.7	<0.15	<0.15	25.2
Total Oxidised Nitrogen	mg/l	28/08/2013	NAC[1]	<2	<2	<2	<2	<2	<2	<2
Total Organic carbon	mg/l	28/08/2013	12.99 [1]	1.92	1.08	0.66	<0.5	2.02	<0.5	<0.5

Parameter	Units	Date	GWTL[1] /IGV[2]	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Phenols	mg/l	28/08/2013	0.02 [1]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Boron	µg/l	28/08/2013	1000 [2]	731	57	322	58	329	57	62
Total Cadmium	µg/l	28/08/2013	5 [2]	0	0.2	1.6	0.6	3	0.7	0.8
Calcium	mg/l	28/08/2013	200 [2]	91	94.5	87.2	102	<0.1	<0.1	98.8
Total chromium	mg/l	28/08/2013	30 [2]	0.3	0.003	0.036	0.001	0.059	0.001	0.001
Total Copper	µg/l	28/08/2013	30 [2]	200	21	<2	6	<2	24	8
Cyanide	mg/l	28/08/2013	0.01 [2]	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Fluoride	mg/l	28/08/2013	1 [2]	0.2	0.2	0.2	0.3	0.1	0.1	0.3
Total Lead	µg/l	28/08/2013	10 [2]	100	4.5	11.9	0.6	22.3	2.4	0.8
Total Magnesium	mg/l	28/08/2013	50 [2]	66.4	20.5	23.6	17.8	<0.15	<0.15	19
Total Manganese	µg/l	28/08/2013	50 [2]	4,100	119	296	263	672	188	286
Total Mercury	µg/l	28/08/2013	0.001 [2]	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Sulphate	mg/l	28/08/2013	200 [2]	43.8	79.1	197.3	<20	45.6	52.4	25.4
Alkalinity, as CaCO3	mg/l	28/08/2013	200 [2]	253	273	186	289	270	265	286
Phosphate (ortho) as PO4	mg/l	28/08/2013	0.03 [2]	0.111	<0.025	0.65	0.194	0.069	0.079	<0.025
Residue on evaporation	%	28/08/2013	n/d	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Zinc	µg/l	28/08/2013	10 [2]	n/d	11	67	<1.9	86	3	<1.9
Faecal coliforms	CFU/100ml	28/08/2013	0 [2]	240	4,000	<1	<1	<1	7	1
Total coliforms	CFU/100ml	28/08/2013	0 [2]	19,863	69,700	411	326	24	5,200	15
List I / II substances		28/08/2013	Please see appendix III							

MAC = Maximum Allowable Concentrations

[1] = Revised Groundwater Trigger Levels

[2] = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Prot

NAC = No abnormal change

Parameter	Units	Date	GTL	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	18/11/2013	8.28	7.54	7.39	7.34	7.35	7.39	7.51	7.31
Electrical Conductivity (Lab)	mS/cm	18/11/2013		0.59	0.615	0.701	0.559	0.534	0.597	0.572
Electrical Conductivity (field)	mS/cm	18/11/2013		0.556	0.583	0.667	0.53	0.508	0.558	0.538
Oxygen, dissolved (Field)	mg/l	18/11/2013	NAC	2.79	1.31	1.43	2.25	2.75	3.17	0.95
Temperature (Field)	° C	18/11/2013	25	9.5	9.7	9.6	9.6	9.4	9	10.3
Ammoniacal Nitrogen as N	mg/l	18/11/2013	1.96	0.2	0.07	0.42	0.38	0.32	0.29	0.48
Chloride	mg/l	18/11/2013	31.28	24.57	18.9	25.31	18.79	12.19	19.2	18.1
Total Iron	mg/l	18/11/2013		1.186	7.84	2.109	3.847	1.083	2.709	1.418
Potassium	mg/l	18/11/2013	6.25	3.4	2.3	3.1	2.3	2.1	2.1	2.5
Sodium	mg/l	18/11/2013	112.3	42	37	50	26	14	23	27
Total Oxidised Nitrogen	mg/l	18/11/2013	NAC	<2	<2	<2	<2	<2	<2	<2
Total Organic carbon	mg/l	18/11/2013	12.99	0.93	8	1.56	1.16	1.83	8.62	0.89
Phenols	mg/l	18/11/2013	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Faecal coliforms	CFU/100ml	18/11/2013		<1	170	<1	<1	10	10	400
Total coliforms	CFU/100ml	18/11/2013		26	1,198	31	226	20	17,329	6,290

GTL=Groundwater Trigger Level. NAC=No Abnormal Change

NAC = No abnormal change

Parameter	Units	Date	GTL	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	14/01/2014	8.28	7.53	7.42	7.37	7.3	7.36	7.42	7.42
Electrical Conductivity (Lab)	mS/cm	14/01/2014		0.597	0.614	0.721	0.567	0.479	0.599	0.546
Electrical Conductivity (field)	mS/cm	14/01/2014		0.545	0.576	0.667	0.529	0.466	0.578	0.537
Oxygen, dissolved (Field)	mg/l	14/01/2014	NAC	2.58	2.01	1.76	2.07	2.35	3.35	3.5
Temperature (Field)	° C	14/01/2014	25	9.5	9.7	9.6	9.6	9.4	9	10.3
Ammoniacal Nitrogen as N	mg/l	14/01/2014	1.96	0.208	0.268	0.604	0.558	0.22	<0.2	0.683
Chloride	mg/l	14/01/2014	31.28	25.5	19	25.6	19.5	12.9	18.9	17.7
Dissolved Iron	mg/l	14/01/2014		<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	14/01/2014	6.25	5.17	2.83	3.33	2.51	2.09	2.26	2.76
Sodium	mg/l	14/01/2014	112.3	39.7	38.4	49.7	26	8.69	22.8	27.2
Total Oxidised Nitrogen	mg/l	14/01/2014	NAC	<0.1	<0.1	<0.1	<0.1	0.23	0.256	<0.1
Total Organic carbon	mg/l	14/01/2014	12.99	<3	3.31	<3	<3	5.16	3.8	3.14
Phenols	mg/l	14/01/2014	0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Faecal coliforms	CFU/100ml	14/01/2014		<1	<1	<1	<1	10	<1	<1
Total coliforms	CFU/100ml	14/01/2014		<1	1,240	49.6	921	866	5,170	261

Parameter	Units	Date	GTL	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	17/06/2014	8.28	7.48	7.38	7.31	7.36	7.55	7.35	7.38
Electrical Conductivity (Lab)	mS/cm	17/06/2014		0.566	0.607	0.696	0.557	0.531	0.605	0.557
Electrical Conductivity (field)	mS/cm	17/06/2014		0.645	0.688	0.812	0.631	0.607	0.694	0.641
Oxygen, dissolved (Field)	mg/l	17/06/2014	NAC	3.45	1.91	3.24	3.37	1.61	1.58	1.87
Temperature (Field)	° C	17/06/2014	25	17.5	17.4	16.5	16.6	15.8	16.5	16.6
Ammoniacal Nitrogen as N	mg/l	17/06/2014	1.96	0.255	<0.2	0.524	0.474	0.525	0.348	0.613
Chloride	mg/l	17/06/2014	31.28	23	18.2	24.5	18.1	16.2	18.7	17.5
Dissolved Iron	mg/l	17/06/2014		<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	17/06/2014	6.25	3.43	2.7	3.78	2.63	2.66	2.18	2.91
Sodium	mg/l	17/06/2014	112.3	39.7	35.8	46.4	24.2	21.6	21.2	24.4
Total Oxidised Nitrogen	mg/l	17/06/2014	NAC	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic carbon	mg/l	17/06/2014	12.99	<3	<3	<3	<3	<3	<3	<3

GTL=Groundwater Trigger Level

NAC=No Abnormal Change

Parameter	Units	Date	GTL	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Phenols	mg/l	17/06/2014	0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Faecal coliforms	CFU/100ml	17/06/2014		<1	<1	<1	<100	<1	<1	<1
Total coliforms	CFU/100ml	17/06/2014		<1	21	<1	<100	<1	<1	3

GTL=Groundwater Trigger Level

NAC=No Abnormal Change

Parameter	Units	Date	MAC	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	20/08/2014	8.28[1]	7.69	7.51	7.49	7.42	7.66	7.51	7.45
Electrical Conductivity (Field)	mS/cm	20/08/2014		0.64	0.677	0.787	0.624	0.605	0.604	0.633
Oxygen, dissolved (Field)	mg/l	20/08/2014	NAC[1]	2.76	1.15	0.26	1.49	3.16	3.6	1.71
Temperature (Field)	° C	20/08/2014	25[1]	11.1	10.9	10.7	11.2	10.8	12.2	10.7
Ammoniacal Nitrogen as N	mg/l	20/08/2014	1.96[1]	0.293	0.228	0.502	0.436	0.569	0.268	0.569
Chloride	mg/l	20/08/2014	31.28[1]	24.5	20.2	26.3	19.7	17.6	20.2	19.2
Iron	mg/l	20/08/2014		<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	20/08/2014	6.25[1]	3.05	1.99	2.9	1.86	2.22	1.72	2.18
Sodium	mg/l	20/08/2014	112.3[1]	38.2	36.1	46.2	24	22.9	22.1	24.8
Total Oxidised Nitrogen	mg/l	20/08/2014	NAC[1]	0.131	0.103	<0.1	<0.1	<0.1	0.1	<0.1
Total Organic carbon	mg/l	20/08/2014	12.99[1]	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	20/08/2014	0.02[1]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Boron	µg/l	20/08/2014	1000[2]	36.6	51.8	39.6	67	46.2	33.6	56.1
Cadmium	µg/l	20/08/2014	5[2]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Calcium	mg/l	20/08/2014	200[2]	71.7	91.4	94.8	85.6	76.3	104	80.2
Chromium	mg/l	20/08/2014	30[2]	3.35	1.98	2.73	1.91	1.89	2.45	2.41
Copper	µg/l	20/08/2014	30[2]	<0.85	<0.85	0.918	<0.85	<0.85	<0.85	<0.85
Cyanide	mg/l	20/08/2014	0.01[2]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	mg/l	20/08/2014	1[2]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	µg/l	20/08/2014	10[2]	0.092	0.092	0.092	0.092	0.092	0.092	0.092
Magnesium	mg/l	20/08/2014	50[2]	33	21.8	24.6	17.2	21.7	18	17.1
Manganese	µg/l	20/08/2014	50[2]	1,070	115	129	266	123	2,340	246
Mercury	µg/l	20/08/2014	0.001[2]	0.0286	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sulphate	mg/l	20/08/2014	200[2]	31.3	65.7	184	14.3	33.2	21	21.2
Alkalinity, as CaCO3	mg/l	20/08/2014	200[2]	320	285	200	305	275	330	305
Phosphate (ortho) as PO4	mg/l	20/08/2014	0.03[2]	0.104	0.096	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	µg/l	20/08/2014	10[2]	1.33	2.07	3.11	2.5	3.56	2.46	4.26
Faecal coliforms	CFU/100ml	20/08/2014	0[2]	<1	<1	<1	<1	<1	<1	<1
Total coliforms	CFU/100ml	20/08/2014	0[2]	17,200	155,000	22500	140	48800	24,200	115
List I / II substances		20/08/2014	Please see appendix III of quarterly report							

MAC = Maximum Allowable Concentrations. 1 = Revised Groundwater Trigger Levels. 2 = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland. NAC = No abnormal change

Parameter	Units	Date	MAC	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	17/11/2014	8.28[1]	7.67	7.59	7.66	7.5	7.73	7.64	7.52
pH (Lab)	pH units	17/11/2014	8.28[1]	7.74	7.74	7.56	7.66	8.18	7.73	7.63
Electrical Conductivity (Field)	µS/cm	17/11/2014	-	643	665	788	624	514	679	634

Electrical Conductivity (Lab)	mS/cm	17/11/2014	-	0.59	0.602	0.7	0.571	0.462	0.608	0.564
Oxygen, dissolved (Field)	mg/l	17/11/2014	-	0.81	1.34	0.71	0.9	1.13	2.39	1.01
Temperature (Field)	° C	17/11/2014	-	10.2	10.4	107	10.1	10.7	10.2	10.5
Ammoniacal Nitrogen as N	mg/l	17/11/2014	1.96 [1]	0.328	<0.2	0.57	0.55	0.459	0.493	0.675
Chloride	mg/l	17/11/2014	31.28 [1]	22.6	18.6	25.3	19.1	12.1	19.6	18.4
Iron	mg/l	17/11/2014	-	19.8	2.51	1.71	0.553	0.91	0.231	0.539
Potassium	mg/l	17/11/2014	6.25 [1]	4.14	2.36	3.06	2.44	2.24	2.16	2.5
Sodium	mg/l	17/11/2014	112.3 [1]	38.5	33.8	46.3	24.3	12.4	22.4	24.8
Total Oxidised Nitrogen	mg/l	17/11/2014	NAC[1]	<0.1	<0.1	<0.1	<0.1	<0.1	0.195	<0.1
Total Organic carbon	mg/l	17/11/2014	12.99 [1]	<3	3.93	<3	<3	6.14	3.12	<3
Phenols	mg/l	17/11/2014	0.02 [1]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Faecal coliforms	CFU/100ml	17/11/2014	0 [2]	<1	1	<1	<1	13	89	1
Total coliforms	CFU/100ml	17/11/2014	0 [2]	166	1550	26.2	<1	1990	530	276

MAC = Maximum Allowable Concentrations. 1 = Revised Groundwater Trigger Levels. 2 = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland. NAC = No abnormal change

Parameter	Units	Date	GTL^{1}/IGV^{2}	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	17/02/2015	8.28 ^{1}	7.21	7.24	7.26	7.18	7.23	7.23	7.61
pH (Lab)	pH units	17/02/2015	8.28 ^{1}	7.73	7.76	7.56	7.62	7.89	7.8	7.9
Electrical Conductivity (Field)	µS/cm	17/02/2015	1 ^{2}	0.649	0.681	0.796	0.632	0.609	0.691	0.642
Electrical Conductivity (Lab)	mS/cm	17/02/2015	1 ^{2}	0.583	0.599	0.684	0.558	0.534	0.601	0.582
Oxygen, dissolved (Field)	mg/l	17/02/2015	-	-	-	-	-	-	-	-
Temperature (Field)	° C	17/02/2015	-	9.2	9.2	9.1	9.1	8.6	8.1	9
Ammoniacal Nitrogen as N	mg/l	17/02/2015	1.96 ^{1}	0.378	<0.2	0.61	0.562	0.673	<0.2	0.662
Chloride	mg/l	17/02/2015	31.28 ^{1}	22.6	17.6	24.5	18.2	16.2	19.8	17.8
Iron	mg/l	17/02/2015	0.2 ^{2}	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	17/02/2015	6.25 ^{1}	3.13	2.56	3.3	2.35	2.67	3.22	2.68
Sodium	mg/l	17/02/2015	112.3 ^{1}	36.9	33.4	43	22.8	21.3	20.1	23.9
Total Oxidised Nitrogen	mg/l	17/02/2015	NAC^{1}	<0.1	0.131	<0.1	<0.1	<0.1	0.235	<0.1
Total Organic carbon	mg/l	17/02/2015	12.99 ^{1}	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	17/02/2015	0.02 ^{1}	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
TPH / Oil & Greases	mg/l	17/02/2015	-	<1	<1	<1	<1	<1	<1	<1
Faecal coliforms	CFU/100ml	17/02/2015	0 ^{2}	<1	<1	<1	<1	**2**	<1	<1
Total coliforms	CFU/100ml	17/02/2015	0 ^{2}	<1	**~4000**	<1	**22**	**2**	<1	<1

Parameter	Units	Date	GTL^{1}/IGV^{2}	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	21/05/2015	8.28 ^{1}	6.74	7.15	7.25	7.22	7.26	7.19	7.21
pH (Lab)	pH units	21/05/2015	8.28 ^{1}	7.65	7.98	7.96	7.94	8.01	8.04	7.9
Electrical Conductivity (Field)	µS/cm	21/05/2015	1 ^{2}	0.675	0.663	0.764	0.594	0.586	0.664	0.613
Electrical Conductivity (Lab)	mS/cm	21/05/2015	1 ^{2}	0.619	0.61	0.718	0.569	0.537	0.612	0.587
Oxygen, dissolved (Field)	mg/l	21/05/2015	-	5.04	3.04	3.99	2.67	2.5	2.34	2.83
Temperature (Field)	° C	21/05/2015	-	19.6	10.6	10.1	11.6	13.6	9.3	14.2
Ammoniacal Nitrogen as N	mg/l	21/05/2015	1.96 ^{1}	0.647	<0.2	0.528	0.506	0.61	0.338	0.673
Chloride	mg/l	21/05/2015	31.28 ^{1}	23.2	18	24.1	18.1	16.1	19	17.4
Iron	mg/l	21/05/2015	0.2 ^{2}	<0.019	0.202	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	21/05/2015	6.25 ^{1}	3.81	2.97	3.69	2.94	2.87	2.53	3.21
Sodium	mg/l	21/05/2015	112.3 ^{1}	37.7	39	50.4	27.6	24.9	24.3	27.9

1 = Revised Groundwater Trigger Levels. 2 = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland. NAC = No abnormal change

Parameter	Units	Date	GTL[1]/IGV[2]	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Total Oxidised Nitrogen	mg/l	21/05/2015	NAC[1]	<0.1	0.143	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic carbon	mg/l	21/05/2015	12.99 [1]	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	21/05/2015	0.02 [1]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Faecal coliforms	CFU/100ml	21/05/2015	0 [2]	<1	<1	<1	<1	**1**	**13**	<1
Total coliforms	CFU/100ml	21/05/2015	0 [2]	**25.6**	**>2420**	**>2420**	**83.3**	**53.8**	**>2420**	**6.3**

Parameter	Units	Date	GTL[1]/IGV[2]	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	25/08/2015	8.28 [1]	8.23	7.29	8.1	8.01	8.25	6.83	7.89
pH (Lab)	pH units	25/08/2015	8.28 [1]	7.74	7.74	8.1	7.85	7.86	7.77	8.26
Electrical Conductivity (Field)	mS/cm	25/08/2015	1 [2]	0.508	0.512	0.626	0.465	0.451	0.504	0.476
Electrical Conductivity (Lab)	mS/cm	25/08/2015	1 [2]	0.545	0.609	0.676	0.442	0.551	0.617	0.574
Oxygen, dissolved (Field)	%	25/08/2015	-	55.8	4.09*	27.4	50.4	60	51.8	33.5
Temperature (Field)	° C	25/08/2015	25 [1]	13.4	10.3	14	10.1	10.3	9.8	10.6
Ammoniacal Nitrogen as NH3	mg/l	25/08/2015	1.96 [1]	0.522	0.277	0.635	0.556	0.798	0.452	0.772
Chloride	mg/l	25/08/2015	31.28 [1]	22.7	18.2	23.7	19.3	16.5	19	18.2
Iron	mg/l	25/08/2015	1.96 [1]	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	0.0283
Potassium	mg/l	25/08/2015	31.28 [1]	3.71	2.47	3.82	2.43	2.72	2.35	2.52
Sodium	mg/l	25/08/2015		37.4	36.7	49.8	23.3	24.3	25.5	23.9
Total Oxidised Nitrogen	mg/l	25/08/2015	6.25 [1]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic carbon	mg/l	25/08/2015	112.3 [1]	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	25/08/2015	NAC[1]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Faecal coliforms	CFU/100ml	25/08/2015	12.99 [1]	**4**	<1	**3**	<1	**13**	**4**	<1
Total coliforms	MPN/100ml	25/08/2015	0.02 [1]	**365**	**1,010**	**201**	**15.6**	**138**	**92100**	**921**
Boron (diss. Filt)	µg/l	25/08/2015	0 [2]	40.3	57.9	36.4	81.9	49.8	36.3	88.1
Cadmium	µg/l	25/08/2015	0 [2]	<0.1	<0.1	<0.1	<0.1	<0.1	0.164	<0.1
Calcium (total unfilt.)	mg/l	25/08/2015	200 [2]	105	83.1	78.8	90.2	84.4	134	86.1
Chromium	µg/l	25/08/2015	30 [2]	4.52	3.76	1.84	4.27	3.82	5.3	4.39
Copper	µg/l	25/08/2015	30 [2]	<0.85	<0.85	1.36	<0.85	<0.85	<0.85	<0.85
Cyanide	mg/l	25/08/2015	0.01 [2]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

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Parameter	Units	Date	GTL[1]/IGV[2]	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Fluoride	mg/l	25/08/2015	1 [2]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead (diss. Filt)	µg/l	25/08/2015	10 [2]	0.053	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Magnesium (total unfilt.)	mg/l	25/08/2015	50 [2]	47.6	20.1	21.2	18.1	23.1	19.5	18.2
Manganese (total unfilt.)	µg/l	25/08/2015	50 [2]	**3,770**	**93.8**	**168**	**295**	**379**	**1,400**	**251**
Mercury (total unfilt.)	µg/l	25/08/2015	0.001 [2]	**0.0212**	<0.02	<0.02	<0.02	<0.02	**0.149**	<0.02
Sulphate	mg/l	25/08/2015	200 [2]	30.7	62.2	180	17	36.9	22.5	23.9
Alkalinity, as CaCO3	mg/l	25/08/2015	200 [2]	**370**	**290**	**210**	**320**	**310**	**395**	**310**
Phosphate (ortho) as PO4	mg/l	25/08/2015	0.03 [2]	**0.088**	<0.05	<0.05	<0.05	**0.051**	**0.061**	**0.058**
Zinc	µg/l	25/08/2015	10 [2]	1.1	0.913	9.95	1.15	1.55	2.57	0.821
List I / II substances		25/08/2015	Please see appendix II							

Parameter	Units	Date	GTL[1]/IGV[2]	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	22/10/2015	8.28 [1]	7.667	7.557	7.509	7.409	7.646	7.45	7.445
pH (Lab)	pH units	22/10/2015	8.28 [1]	7.8	7.66	7.75	7.6	7.84	7.59	7.65
Electrical Conductivity (Field)	µS/cm	22/10/2015	1 [2]	0.664	0.689	0.802	0.636	0.616	0.707	0.646
Electrical Conductivity (Lab)	mS/cm	22/10/2015	1 [2]	0.566	0.614	0.68	0.573	0.542	0.629	0.577
Oxygen, dissolved (Field)	**%**	22/10/2015	-	6.06	6.65	4.07	5.11	7.81	6.71	5.57
Temperature (Field)	° C	22/10/2015	-	10.3	10.5	10	10.2	10.2	10	10.9
Ammoniacal Nitrogen as NH3	mg/l	22/10/2015	1.96 [1]	0.291	<0.2	0.555	0.4	0.642	0.364	0.542
Chloride	mg/l	22/10/2015	31.28 [1]	23.9	19.2	25.7	19.2	17.2	20.5	18.5
Iron	mg/l	22/10/2015		<0.019	<0.019	0.0226	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	22/10/2015	6.25 [1]	3.85	2.48	3.17	2.43	2.7	2.37	2.74
Sodium	mg/l	22/10/2015	112.3 [1]	37.7	34.3	44.2	23.4	22.8	25.3	23.9
Total Oxidised Nitrogen	mg/l	22/10/2015	NAC[1]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic carbon	mg/l	22/10/2015	12.99 [1]	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	22/10/2015	0.02 [1]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Faecal coliforms	CFU/100ml	22/10/2015	0 [2]	<1	<1	<1	<1	<1	**20**	**2**
Total coliforms	MPN/100ml	22/10/2015	0 [2]	**54.5**	**210**	**4.1**	**1120**	**>2420**	**>24200**	**249**

1 = Revised Groundwater Trigger Levels. 2 = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland. NAC = No ab

Parameter	Units	Date	GTL[1]/IGV[2]	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	09/02/2016	8.28 [1]	7.613	7.494	7.374	7.353	7.527	7.4	7.447
pH (Lab)	pH units	09/02/2016	8.28 [1]	7.69	7.69	7.71	7.65	7.81	7.93	7.82
Electrical Conductivity (Field)	mS/cm	09/02/2016	1 [2]	0.643	0.67	0.781	0.619	0.586	0.682	0.626
Electrical Conductivity (Lab)	mS/cm	09/02/2016	1 [2]	0.565	0.602	0.695	0.548	0.53	0.613	0.56
Oxygen, dissolved (Field)	mg/l	09/02/2016	NAC[2]	5.53	4.91	3.88	3.8	6.93	4	6.46
Temperature (Field)	° C	09/02/2016	25 [2]	9.6	9.8	9.5	9	9.6	9	9.7
Ammoniacal Nitrogen as NH3	mg/l	09/02/2016	1.96 [1]	0.656	<0.2	0.664	0.56	0.663	0.368	0.681
Chloride	mg/l	09/02/2016	31.28 [1]	23.7	19.3	26.3	19.1	10.7	20.4	18.6
Iron	mg/l	09/02/2016	0.2 [2]	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Sodium (diss.filt)	mg/l	09/02/2016	112.3 [1]	36.4	33.1	44.5	23.2	15	20	23.9
Potassium (diss.filt)	mg/l	09/02/2016	6.25 [1]	3.43	2.32	3.19	2.36	2.47	2.11	3
Total Oxidised Nitrogen	mg/l	09/02/2016	NAC[2]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic carbon	mg/l	09/02/2016	12.99 [1]	<3	<3	<3	<3	<3	<3	<3
Phenol	mg/l	09/02/2016	0.02 [1]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total coliforms	CFU/100ml	09/02/2016	0 [2]	**85.5**	**6.3**	**1**	**2**	**148**	**345**	**1**
Faecal coliforms	MPN/100ml	09/02/2016	0 [2]	<1	<1	<1	<1	<1	-	<1

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Parameter	Units	Date	GTL[1]/IGV[2]	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	25/04/2016	8.28 [1]	7.496	7.404	7.333	7.352	7.616	7.387	7.39
pH (Lab)	pH units	25/04/2016	8.28 [1]	7.8	7.7	7.56	7.53	7.68	7.55	7.61
Electrical Conductivity (Field)	mS/cm	25/04/2016	1 [2]	0.685	0.684	0.792	0.628	0.608	0.692	0.638
Electrical Conductivity (Lab)	mS/cm	25/04/2016	1 [2]	0.56	0.565	0.664	0.529	0.509	0.577	0.559
Oxygen, dissolved (Field)	mg/l	25/04/2016	NAC[2]	4.84	5.74	3.94	5.15	7.65	5.94	5.73
Temperature (Field)	° C	25/04/2016	25 [2]	10.1	10.6	10.4	10.1	9.9	9.3	10.6
Ammoniacal Nitrogen as NH3	mg/l	25/04/2016	1.96 [1]	0.346	0.165	0.474	0.43	0.641	0.303	0.699
Chloride	mg/l	25/04/2016	31.28 [1]	23	21.1	25.4	18.5	13.4	20.3	17.8
Iron	mg/l	25/04/2016	0.2 [2]	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Sodium (diss.filt)	mg/l	25/04/2016	112.3 [1]	44.8	40.5	52.6	28.7	23.3	24	28.2
Potassium (diss.filt)	mg/l	25/04/2016	6.25 [1]	4.75	3.17	4.16	3.18	3.46	2.8	3.4
Total Oxidised Nitrogen	mg/l	25/04/2016	NAC[2]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic carbon	mg/l	25/04/2016	12.99 [1]	<3	<3	<3	<3	<3	<3	<3
Phenol	mg/l	25/04/2016	0.02 [1]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total coliforms	CFU/100ml	25/04/2016	0 [2]	**>2,420**	**579**	**17.1**	**1**	**45.7**	**27.2**	**5.2**
Faecal coliforms	MPN/100ml	25/04/2016	0 [2]	**>100**	<1	<1	<1	**2**	<1	<1

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Parameter	Units	Date	GTL^{1}/IGV^{2}	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	05/08/2016	8.28 ^{1}	7.339	7.424	7.302	7.54	7.59	7.04	7.221
pH (Lab)	pH units	05/08/2016	8.28 ^{1}	7.79	7.65	7.69	7.65	8.01	7.7	7.78
Electrical Conductivity (Field)	µS/cm	05/08/2016	1 ^{2}	0.664	0.704	0.806	0.637	0.615	0.703	0.649
Electrical Conductivity (Lab)	mS/cm	05/08/2016	1 ^{2}	0.603	0.511	0.704	0.535	0.533	0.578	0.579
Oxygen, dissolved (Field)	mg/l	05/08/2016	NAC^{2}	5.49	5.22	4.62	5.28	6.38	5.03	6.45
Oxygen, dissolved (Field)	%	05/08/2016	NAC^{2}	51.2	50.4	42.3	48.5	58.6	45.3	59.4
Oxygen,dissolved (lab)	mg/l	05/08/2016	NAC^{2}	6.66	6.11	6.97	7.03	7.35	7.79	7.02
Temperature (Field)	° C	05/08/2016	25 ^{2}	10.8	11.9	10.4	10.8	10.9	10.4	11.1
Ammoniacal Nitrogen as N	mg/l	05/08/2016	1.96 ^{1}	0.263	<0.2	0.649	0.467	0.565	0.397	0.608
Chloride	mg/l	05/08/2016	31.28 ^{1}	24.2	19.4	25.5	19.3	16.6	21.2	18.6
Iron	mg/l	05/08/2016	0.2 ^{2}	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	05/08/2016	6.25 ^{1}	3.96	2.44	3.03	2.45	2.71	2.44	2.75
Sodium	mg/l	05/08/2016	112.3 ^{1}	38	34.4	44.4	23.5	22.5	22.2	23.7
Total Oxidised Nitrogen	mg/l	05/08/2016	NAC^{2}	<0.1	<0.1	<0.1	<0.1	<0.1	0.397	<0.1
Total Organic carbon	mg/l	05/08/2016	12.99 ^{1}	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	05/08/2016	0.02 ^{1}	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Total coliforms	CFU/100ml	05/08/2016	0 ^{2}	**38.9**	**1120**	**613**	**8.4**	**8.6**	**196**	<1
Faecal Coliforms	MPN/100ml	05/08/2016	0 ^{2}	6	<1	<1	<1	<1	<1	<1
Boron (diss. Filt)	µg/l	05/08/2016	1000 ^{2}	29.8	48.3	47.2	45.2	42.8	29.2	58.5
Cadmium	µg/l	05/08/2016	5 ^{2}	0.228	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Calcium (total unfilt.)	mg/l	05/08/2016	200 ^{2}	75	82.5	86.9	89.1	86.6	129	89.8
Chromium (tot. unfilt)	µg/l	05/08/2016	30 ^{2}	21.7	<3	<3	<3	8.54	5.08	3.7
Copper	µg/l	05/08/2016	30 ^{2}	<0.85	<0.85	<0.85	<0.85	<0.85	<0.85	<0.85
Cyanide	mg/l	05/08/2016	0.01 ^{2}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	mg/l	05/08/2016	1 ^{2}	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	µg/l	05/08/2016	10 ^{2}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Magnesium (tot. unfilt)	mg/l	05/08/2016	50 ^{2}	32.3	20	22.5	17.6	23.6	19.4	18.6
Manganese (tot. unfilt)	µg/l	05/08/2016	50 ^{2}	**1130**	**92.1**	**149**	**279**	**233**	**1090**	**307**
Mercury	µg/l	05/08/2016	0.001 ^{2}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sulphate	mg/l	05/08/2016	200 ^{2}	37.1	67.8	183	16.8	34.8	25.9	20
Alkalinity, as CaCO3	mg/l	05/08/2016	NAC^{2}	305	290	200	305	280	365	315
Phosphate (ortho) as PO4	mg/l	05/08/2016	0.03 ^{2}	**0.06**	**<0.05**	**<0.05**	**<0.05**	**0.053**	**<0.05**	**<0.05**
Zinc	µg/l	05/08/2016	100 ^{2}	<1.3	2.7	<1.3	<1.3	1.38	2.33	<1.3
List I / II substances		05/08/2016		Please see laboratory certificate in quarterly report						

1 = Revised Groundwater Trigger Levels. 2 = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland. NAC = No abnormal change

Parameter	Units	Date	GTL^{1}/IGV^{2}	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	18/01/2017	8.28 ^{1}	7.861	7.487	7.393	8.123	8.063	7.538	8.052
pH (Lab)	pH units	18/01/2017	8.28 ^{1}	7.79	7.82	7.6	7.75	7.68	7.63	7.58
Electrical Conductivity (Field)	µS/cm	18/01/2017	1 ^{2}	0.655	0.677	0.792	0.625	0.605	0.693	0.635
Electrical Conductivity (Lab)	mS/cm	18/01/2017	1 ^{2}	0.569	0.597	0.678	0.575	0.552	0.598	0.576
Oxygen, dissolved (Field)	mg/l	18/01/2017	NAC^{2}	5.68	3.24	2.15	2.84	7.2	4.34	3.36
Oxygen, dissolved (Field)	%	18/01/2017	NAC^{2}	49.4	28.2	18.8	24.7	63	37.7	29.7
Temperature (Field)	° C	18/01/2017	25 ^{2}	9.8	10.3	9.9	10	10.2	9.8	10.4
Ammoniacal Nitrogen as N	mg/l	18/01/2017	1.96 ^{1}	0.147	0.148	0.419	0.349	0.508	0.247	0.547
Chloride	mg/l	18/01/2017	31.28 ^{1}	24.1	19.7	26.2	19.1	17.3	20.8	18.7
Iron	mg/l	18/01/2017	0.2 ^{2}	<0.019	<0.019	0.0329	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	18/01/2017	6.25 ^{1}	3.58	2.23	3	2.16	2.32	2.17	2.52
Sodium	mg/l	18/01/2017	112.3 ^{1}	39.1	35	46.8	23.8	22.4	20.8	24.3
Total Oxidised Nitrogen	mg/l	18/01/2017	NAC^{2}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic carbon	mg/l	18/01/2017	12.99 ^{1}	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	18/01/2017	0.02 ^{1}	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025
Faecal Coliforms	CFU/100ml	18/01/2017	0 ^{2}	**14**	**130**	**1**	**4**	<1	**65**	**50**
Total Coliforms	MPN/100ml	18/01/2017	0 ^{2}	**291**	**816**	**19.5**	<1	<1	**42.8**	**157**

1 = Revised Groundwater Trigger Levels. 2 = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland. NAC = No abnormal change

Parameter	Units	Date	GTL^{1}/IGV^{2}	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH (Field)	pH units	23/05/2017	8.28 ^{1}	7.55	7.554	7.423	7.47	7.132	7.551	7.394
pH (Lab)	pH units	23/05/2017	8.28 ^{1}	7.76	8.01	7.94	8.24	7.84	7.58	8
Electrical Conductivity (Field)	µS/cm	23/05/2017	1 ^{2}	680	696	807	639	617	707	649
Electrical Conductivity (Lab)	mS/cm	23/05/2017	1 ^{2}	0.57	0.57	0.674	0.518	0.517	0.707	0.54
Oxygen, dissolved (Field)	mg/l	23/05/2017	NAC^{2}	4.12	3.43	3.05	5.25	4.93	5.21	1.5
Oxygen, dissolved (Field)	%	23/05/2017	NAC^{2}	38.76	32.58	28.9	49.39	46.6	50.07	14.28
Temperature (Field)	° C	23/05/2017	25 ^{2}	10.4	10.8	10.7	10.4	10.6	11.3	10.9
Ammoniacal Nitrogen as N	mg/l	23/05/2017	1.96 ^{1}	<0.2	0.336	0.46	0.571	0.245	0.676	0.636
Chloride	mg/l	23/05/2017	31.28 ^{1}	23.8	20.1	26.4	19.8	18	20.9	19.2
Iron	mg/l	23/05/2017	0.2 ^{2}	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	23/05/2017	6.25 ^{1}	3.59	2.38	3.36	2.51	2.59	2.64	2.9
Sodium	mg/l	23/05/2017	112.3 ^{1}	41.4	36.7	48	26.3	24	23.8	26.7
Total Oxidised Nitrogen	mg/l	23/05/2017	NAC^{2}	0.183	0.181	0.449	0.424	0.403	<1	0.391
Total Organic carbon	mg/l	23/05/2017	12.99 ^{1}	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	23/05/2017	0.02 ^{1}	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Faecal Coliforms	CFU/100ml	23/05/2017	0 ^{2}	**2**	**7**	**0**	**0**	196	-	**0**
Total Coliforms	MPN/100ml	23/05/2017	0 ^{2}	**2**	**7**	**0**	0	196	-	**0**

1 = Revised Groundwater Trigger Levels. 2 = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland. NAC = No abnormal change

Parameter	**Units**	**Date**	**GTL^1/IGV^2**	**MW1d**	**MW2d**	**MW3d**	**MW5d**	**MW6d**	**MW7d**	**MW16d**	**MW17d**
pH (Field)	pH units	18/09/2017	8.28 ^{1}	7.878	7.865	7.713	7.801	8.033	7.638	7.703	7.765
pH (Lab)	pH units	18/09/2017	8.28 ^{1}	7.79	7.86	7.65	8.06	7.98	7.87	8.14	7.75
Electrical Conductivity (Field)	µS/cm	18/09/2017	1 ^{2}	0.667	0.697	0.808	0.623	0.625	0.712	0.648	0.703
Electrical Conductivity (Lab)	mS/cm	18/09/2017	1 ^{2}	0.549	0.564	0.664	0.53	0.541	0.614	0.542	0.575
Oxygen, dissolved (Field)	mg/l	18/09/2017	NAC^2	6.78	3.78	3.66	6.83	9.1	6.06	5.83	4.15
Oxygen, dissolved (Field)	%	18/09/2017	NAC^2	64.09	35.48	34.19	65.94	87.04	57.56	55.5	39.51
Temperature (Field)	° C	18/09/2017	25 ^{2}	10.6	10.3	10.1	11.5	11.1	10.8	10.9	10.9
Ammoniacal Nitrogen as N	mg/l	18/09/2017	1.96 ^{1}	0.336	<0.2	0.414	0.354	0.508	0.309	0.47	0.918
Chloride	mg/l	18/09/2017	31.28 ^{1}	24.1	19.6	25.9	20.1	17.7	20.8	18.7	12.9
Iron	mg/l	18/09/2017	0.2 ^{2}	0.0745	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	18/09/2017	6.25 ^{1}	3.64	2.56	2.78	2.54	2.78	1.81	2.41	4.44
Sodium	mg/l	18/09/2017	112.3 ^{1}	40.5	37.1	46.1	24.6	24.3	21.1	25.6	34.7
Total Oxidised Nitrogen	mg/l	18/09/2017	NAC^2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.27
Total Organic carbon	mg/l	18/09/2017	12.99 ^{1}	<3	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	18/09/2017	0.02 ^{1}	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Faecal Coliforms	MPN/100ml	18/09/2017	0 ^{2}	**13**	**7400**	**1800**	**5900**	**660**	**9800**	**9800**	**930**
Total coliforms	CFU/100ml	18/09/2017	0 ^{2}	0	0	0	**18**	**600**	0	0	**13**
Boron (diss. Filt)	µg/l	18/09/2017	1000 ^{2}	25.2	40.2	29	42.5	43.2	23.7	49.7	62.9
Cadmium	µg/l	18/09/2017	5 ^{2}	0.244	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.0966
Calcium (total unfilt.)	mg/l	18/09/2017	200 ^{2}	121	84.9	88.5	87.5	75.5	102	87.4	88.4
Chromium (tot. unfilt)	µg/l	18/09/2017	30 ^{2}	<3	<3	<3	<3	<3	<3	<3	<3
Copper	µg/l	18/09/2017	30 ^{2}	0.424	<0.3	<0.3	<0.3	0.946	<0.3	<0.3	0.478
Cyanide	mg/l	18/09/2017	0.01 ^{2}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	mg/l	18/09/2017	1 ^{2}	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	µg/l	18/09/2017	10 ^{2}	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Magnesium (tot. unfilt)	mg/l	18/09/2017	50 ^{2}	54.6	20.5	22.6	17.4	21.1	16.8	18.5	27.4
Manganese (tot. unfilt)	µg/l	18/09/2017	50 ^{2}	2.4	1.72	0.662	3.97	93.7	715	4.63	<0.5
Mercury	µg/l	18/09/2017	0.001 ^{2}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sulphate	mg/l	18/09/2017	200 ^{2}	36.6	68.8	190	15.9	36.3	21.5	24.8	52.5
Alkalinity, as CaCO3	mg/l	18/09/2017	NAC^2	380	275	200	305	280	335	305	420
Phosphate (ortho) as PO4	mg/l	18/09/2017	0.03 ^{2}	0.057	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	µg/l	18/09/2017	100 ^{2}	<1	<1	1.03	4.08	8.73	1.04	3.02	<1
List I / II substances		18/09/2017		Please see laboratory certificate in quarterly report							

1 = Revised Groundwater Trigger Levels. 2 = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland. NAC = No abnormal change

Parameter	Units	Date	GTL[1]/IGV[2]	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d	MW17d
pH (Field)	pH units	05/12/2017	8.28 [1]	nm*	nm	nm	nm	nm	nm	nm	nm
pH (Lab)	pH units	05/12/2017	8.28 [1]	7.8	7.82	7.62	7.57	7.93	7.63	7.6	7.69
Electrical Conductivity (Field)	µS/cm	05/12/2017	1 [2]	0.668	0.691	0.813	0.641	0.624	0.712	0.652	0.694
Electrical Conductivity (Lab)	mS/cm	05/12/2017	1 [2]	0.576	0.594	0.697	0.553	0.541	0.602	0.559	0.594
Oxygen, dissolved (Field)	mg/l	05/12/2017	NAC[2]	2.03	3.61	2.53	1.73	9.3	4.72	6.12	5.01
Oxygen, dissolved (Field)	%	05/12/2017	NAC[2]	19.1	34	23.6	16.1	87.5	44.1	56.5	46.8
Temperature (Field)	° C	05/12/2017	25 [2]	10.3	10.4	10	10	10.4	10.1	9.6	10.1
Ammoniacal Nitrogen as N	mg/l	05/12/2017	1.96 [1]	<0.2	<0.2	0.696	0.539	0.77	<0.2	0.729	1.39
Chloride	mg/l	05/12/2017	31.28 [1]	23.8	19.6	26.8	19.5	17.1	21.5	18.5	13.8
Iron	mg/l	05/12/2017	0.2 [2]	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Potassium	mg/l	05/12/2017	6.25 [1]	3.34	2.24	3.06	2.57	2.74	2.21	2.69	4.3
Sodium	mg/l	05/12/2017	112.3 [1]	39.3	34.6	46.2	25.9	23.1	21.8	25.1	33.5
Total Oxidised Nitrogen	mg/l	05/12/2017	NAC[2]	0.153	<0.1	<0.1	<0.1	0.106	<0.1	<0.1	0.32
Total Organic carbon	mg/l	05/12/2017	12.99 [1]	<3	<3	<3	<3	<3	<3	<3	<3
Phenols	mg/l	05/12/2017	0.02 [1]	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Faecal Coliforms	CFU/100ml	05/12/2017	0 [2]								
Total Coliforms	MPN/100ml	05/12/2017	0 [2]								
*nm= Not measured, field pH probe is currently in for repair.											

1 = Revised Groundwater Trigger Levels. 2 = Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland. NAC = No abnormal change

Appendix 12.1

Southern Attenuation Pond LW14-821-02 Calc. Set.02

Knockharley Landfill Ltd

Strategic Development Report Knockharley
Appendix 12.1

Prepared for:
Knockharley Landfill Ltd

Revision: ***0*** ***Date:*** ***05/10/17***

Prepared by:
Fehily Timoney & Co.
Core House,
Pouladuff Road,
Cork.

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: MCreedon **CHECKED:** ENA
DATE: 05/10/17 **REVISION:** 0
JOB NUMBER: LW10-172-02
CALC NUMBER: C-02
FILE C:\Users\emer.nicaoidh\Documents\workingfiles\uss.ftco.ie\Chapter 12 Appendix 12.1 LW14-812-01 Calc 02 Check on Southern pond capacity.xls
SHEET Calc Rev Control

PROJECT: Strategic Development Report Knockharley

DESCRIPTION: Pond Design Check

Rev	Date	Purpose and Description	Prepared	Checked	Reviewed	Approved
0	05/10/2017	Check on Pond Design	MCreedon	ENA	CJC	BG

DESIGNED: MC **CHECKED:** ENA
DATE: 5.10.17 **REVISION:** 4
JOB NUMBER: LW14-821-01
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES **CALC NUMBER:** C-06
Cork : Tel 021-4964133 Fax 021-4964464 **FILE** https://uss.ftco.ie/__files/renditiondirect/375424/LW1482101
SHEET Storm Water Calc

PROJECT: **Strategic Development Report Knockharley**
DESCRIPTION: **Stormwater pond design for proposed development and review of existing capacity**

Ref. Output

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i References

Previous FTC void/earthworks calculations
1 Constructed wetlands Stefanakis et al Elsevier ISBN 978-0-12-404612-2 2014
2 Hydraulic design of stilling basins and energy dissipators USBR Engineering Monograph No 25.
Appendix (Mullingar rainfall data

ii Figures

F1 Figure 1 North and South Watershed Areas Within Site See Fig 12-2 EIAS/EIA

iii Appendices

A GDSDS Procedure
B1 Pond-GDSDS During Construction
B2 Pond-GDSDS Post Construction
C Developed Area
D Pond size
E Outflow
F Weir Calc
G Met Rainfall

Contents

1.0 Introduction and Purpose

There is a surface water divide on the site running east to west and there will be a requirement to install new stormwater outfall on the northern perimeter to accommodate development of future cells for the currently permitted planning development and to provide an outfall for the proposed IBA landfill. In addition provison will also be required to provide additional compensatory flooding to replace that which will removed by the proposed development footprint.
There is an existing surface water attenuation pond on the southern perimeter of the site.

The purpose of this calc set is to:

Establish if the existing Stormwater pond is fit for purpose

2.0 Design Criteria

Run off assessment to be defined using GDSDS procedure suggested by the Greater Dublin Strategic Drainage Study, detailed design criteria for design elements presented in respective sections

3.0 Stormwater Attenuation

3.1 Overview

Stormwater calcs for the 2017 planning application are presented in the following appendices. Summary outputs from respective sheets presented in Section 4.0 below.

A	GDSDS Procedure - Overview of philosophy to size storm pond based on Greater Dublin Strategic Drainage Study
B1	Pond - GDSDS - during Construction
B2	Pond - GDSDS - post Construction
C	Development Area
D	Pond size
E	Ouflow - Outflow pipe sizing
F	Weir - Sizing of spills on
G	Met rainfall

3.2 Catchment

Impervious runoff applies to the southern catchment area when it is assume that:
Runoff coefficient on roads and hardstanding is 100 % of roads
Runoff coefficient for ash and MSW caps is 0.5. This assumes pro-active covering of waste.

Current southern site area	73.74	ha to facilitate definition of Q_{bar} Figure 1 identifies southern site area
Impervious area during construction	16.39	ha
Impervious area post construction	19.66	ha

Ref.

Output

F1

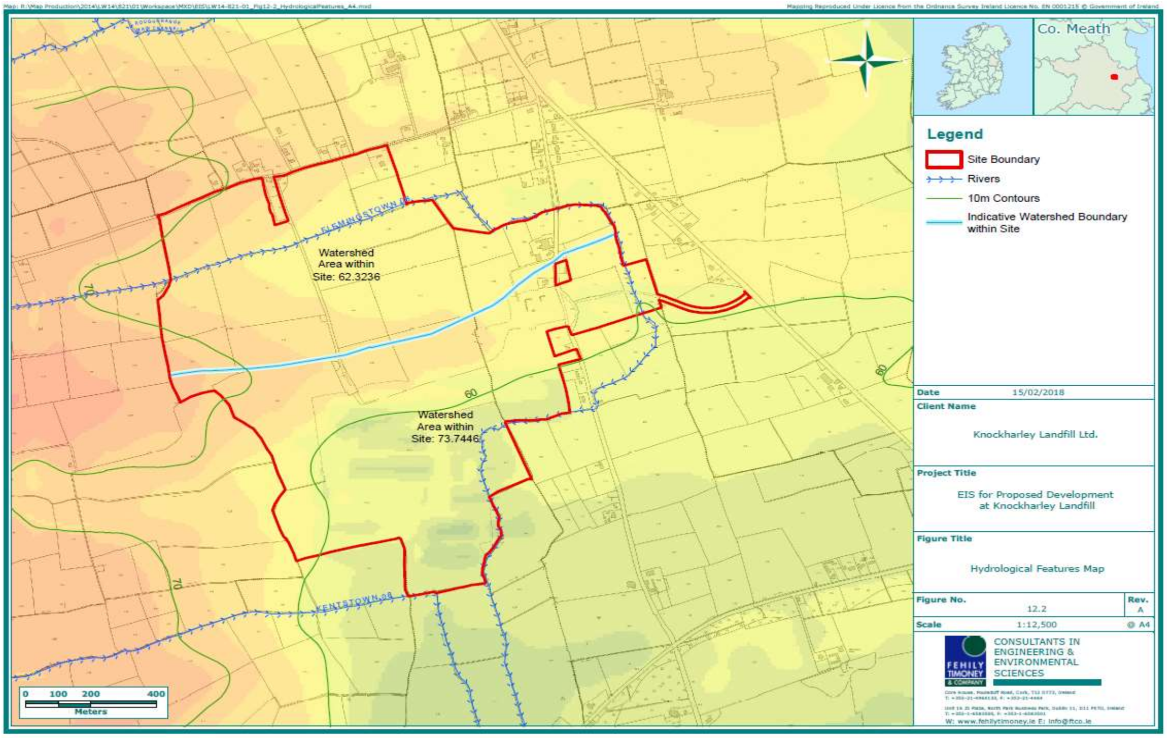

Figure 1 North and South Watershed Areas Within Site

Catchment Areas for during constrcution:

Description	ha	m²	Unfactored	Factor	Total
Development Area	73.74	737,446	73.74		73.74
Remaining	56.27	562,674	56.27	0.10	5.63
Capped Area	13.43	134,300	13.43	0.50	6.72
Existing building	0.36	3,600	0.36	1.00	0.36
Impervious allow 5%	3.69	36,872	3.69	1.00	3.69
Totals			**73.74**		**16.39**

Catchment Areas for post constrcution:

Description	ha	m²	Unfactored	Factor	Total
Development Area	73.74	737,446	73.74		73.74
Remaining	56.27	562,674	56.27	0.10	5.63
MSW Cap area	13.43	134,300	13.43	0.50	6.72
Building existing	0.36	3,600	0.36	1.00	0.36
Impervious allow 5%	3.69	36,872	3.69	1.00	3.69
Building new	3.27	32,674	3.27	1.00	3.27
Totals			**73.74**		**19.66**

Ref. Output

4.0 Stormwater Design Summary Inputs and Infrastructure Requirements

4.1 GDSDS Outputs

			Notes	
	During construction	Post Construction	Length m	Width m
Development Area ha	73.74	73.74		
Impervious Area ha	16.39	19.66		
1:20 Pond Storage m^3 requirement	3,188	4,160		
Live storage Phase 1 m^3	4,253		91	81
Live storage Phase 2 m^3		4,253		
Dead storage m^3	7,197	7,197		
0.75m Freeboard m^3	4,239	4,239		
Excavated volume m^3				
Nutrient Removal	OK	OK		
Spillage capacity	OK	OK		
Suspended solids GDGDS	OK	OK		
Suspended solids removal	100%		Based on BH 8, 10, 10A and 15 from Original	
Out flow pipe for 1:20 year mm		358	No hydro brake required	
Weir length 1:100 year Return period m		1.00		

4.2 Wetland

Wetland not required for suspended solids compliance downstream of the attenuation lagoon. However given there may be a risk of colloidal suspensions, provision will be made in planning application for wetlands d/s of attenuation lagoon outfall prior to discharging into watercourse. The Wetland will polish s/s solids further, i.e less than 25mg/l.

The wetland will be a free water surface wetland. Traditionally these wetlands are effective at removing suspended solids, and BOD. Removal of nitrogen pathogens and other pollutants e.g heavy metals is high. Phosphorous removal will
Ref 1 however be low.

4.3 Pipe Outflow

1:20 year greenfield flow rate #REF! l/s

Two alternatives available either a floating discharge or a pipe discharge. In event that a pipe discharge is employed with a 2.0m live head the required diameter for a 1:20 year discharge is 300 mm.

4.3 Spill

In the event that out flow pipes become blocked or pipe design flows are exceeded spill and energy dissipation will be required.

	Spill design capacity to be 1:100 or greater	Design flow rate	366.82	l/s throttle	
	Maximum 1:100 flow if outflow blocked and pond full during construction		1.42	m^3/s	
	Maximum 1:100 flow if outflow blocked and pond full post construction		1.70	m^3/s	
				cf/s/ft	
Ref 2	Energy disspiation to use USBR baffle chute	Design flow rate	35	width	
			0.99	$m^3/s/ft$	
			3.30	$m^3/s/m$ width	
	Minimum width for construction 1000 mm		1000	mm	OK
	Spill requirement during construction		1.42	m^3/s	
	Spill requirement post construction	Design flow rate	1.70	m^3/s	
App F	Spill Length		13.25	m	

Appendix 12.2

Surface Water Management Plan







ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

APPENDIX 12-2

SURFACE WATER MANAGEMEN PLAN FOR KNOCKHARLEY LANDFILL

NOVEMBER 2018

Knockharley Landfill Ltd.
Kentstown, Navan,Co.Meath

FEHILY
TIMONEY
& COMPANY

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1. SURFACE WATER MANAGEMENT PLAN

1.1 Background

Fehily Timoney & Company was commissioned by Knockharley Landfill Limited to update the surface water management plan for the proposed development at Knockharley Landfill, Co. Meath. The surface water management plan was prepared in accordance with CIRIA C698 (1) and Greater Dublin Strategic Drainage Study (GDSDS) (2).

1.2 Scope

The surface water management plan was prepared taking into consideration the preliminary drainage information already included as part of the environmental impact assessment undertaken for the Environmental Impact Assessment Report (EIAR).

This surface water management plan provides for the site layout as set out in Drawing No. LW14-821-01 P000-003 Proposed Site Layout included in Volume 4 of this EIAR.

This report addresses how surface water will be managed on site in terms of infrastructure, operational procedures, monitoring and reporting.

There is an existing surface water attenuation pond on site and Appendix 12-1 of Volume 3 of the EIAR concluded that the size of the attenuation pond (with slight adjustment to the outlet control) would be adequate to provide for the new development in the southern catchment (leachate management and biological treatment facilities) in accordance with current guidance on such facilities in GDSDS (2).

A review of the proposed development also concluded the need for an additional storm water management system to accommodate surface water runoff from the "Northern" catchment within the facility boundary. Details of the "Northern" storm water management system are presented in Chapter 12 of Volume 2 of the EIAR and sizing calculations are included in Appendix 12-4 of Volume 3 of this EIAR.

The following guidelines were also considered in the development of this report:

- The SuDs Manual (3)
- CIRIA Environmental good practice on site Construction Industry Research and Information Association (4)
- Best Practice Guide BPGCS005 Oil Storage Guidelines (5)
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Watercourses (6)
- Control of Water Pollution from Linear Construction Sites (C648) (7)
- Control of Water Pollution from Construction Sites. Guidance for Consultants and Contractors (8)
- Sustainable Construction Procurement. A Guide to Delivering Environmentally Responsible Projects (9)
- UK Pollution Prevention Guidelines (PPG):
    - PPG1: Understanding your environmental responsibilities – good environmental practice, 2013 (10)
    - GPPG: Above ground oil storage tanks, 2011 (11)
    - PPG3: Pollution Prevention Guidelines (12)
    - GP4: Treatment and disposal of wastewater where is no connection to the public foul sewer (13)
    - PPG5: Works and maintenance in or near water (14)
    - PPG6: Working at construction and demolition sites (15)
    - PPG7: The safe operation of refuelling facilities (16)
    - GPP8: Safe storage and disposal of used oils (17)
    - GPP21: Pollution incident response plans (18)
    - PPG22: Dealing with Spills, 2011 (19)
    - PPG26: Drums and intermediate bulk containers (20)

The purpose of this surface water management plan is to provide a fully informed drainage design to the developer which will satisfy the planning requirements. The surface water management plan will consider the construction, operation and maintenance phases. The decommissioning phase requires the same precautionary measures as the construction phase and is therefore not discussed separately.

The run-off characteristics of the site and the consequent effects on the receiving waters downstream namely the Knockharley Stream, which is a tributary of the River Nanny was examined.

While the proposed development site is not located within a site designated for environmental conservation, four designated sites and one area of scientific interest are located within 5 km of the site, including Balrath Woods (Site Code No. 001579, proposed natural heritage area), Thomastown Bog (Site Code No. 001593, proposed natural heritage area), Rossnaree Riverbank (Site Code No. 001589, proposed natural heritage area), River Boyne and River Blackwater (Site Code 002299, special area of conservation) and Painestown Quarry (Site Code No. 789, area of scientific interest). Chapter 10 of Volume 2 the EIAR shows the location of these designated sites in relation to Knockharley Landfill. It should be noted that Balrath Woods pNHA is located downstream of the site, however none of the other designated sites receive drainage from the existing site.

2. DRAINAGE OF LANDFILL DEVELOPMENT

Knockharley Stream flows east from the western boundary of the facility, through the northern portion of the site where the proposed northern attenuation pond will discharge via a wetland, it then turns south and follows the boundary of the site to the south and continuing south away from the facility to the River Nanny. The stream crosses the boundary and flows into the site in two locations at the east and south east of the facility. The existing southern attenuation pond discharges via a wetland on the southern boundary. A second tributary, the Kentstown Stream flows east along the southern boundary before turning south and joining the Veldonstown Stream, just upstream of its confluence with the Knockharley Steam. The Knockharley Stream is also referred to as the Flemingstown Stream.

The existing and proposed surface water quality and biological monitoring points are shown on Drawing No's LW14-821-01-P-050-001 and LW14-821-01-P-050-002 in Volume 4 of the EIAR. Baseline monitoring was carried out prior to any development on site and monitoring has been carried out throughout the operational phase to date. There is therefore an established database of water quality parameters for the Knockharley Stream in the northern portion of the site where the proposed new attenuation pond will discharge to.

Water quality is monitored upstream and downstream of the site and is compared to the baseline pre-construction to demonstrate that the facility is not impacting on water quality. Water quality monitoring reports are submitted to the EPA in compliance with the licence, any incidents are reported to the EPA in accordance with the licence. A summary of the existing water quality is included in Chapter 12 of the EIAR.

2.1 Existing Surface Water Drainage

Drainage from adjoining lands onto the site is directed around the property and flows into the local drainage network at the southern boundary of the facility.

Surface water from the landfill is drained via the main landfill swale to a purpose-built "Southern" storm water attenuation pond and constructed wetland. Swales are vegetated channels over which flows are treated at low velocities. They are appropriate according to The SuDS Manual (3) as pre-treatment devices for SUDS components receiving point source inflows. The existing swales drain the surface water on the embankments surrounding the landfill cells. These swales are of approximate depth 600 mm with a bottom width of 1000 mm and side slopes at 1 in 3 as shown in Figure 2.1. The swales have been constructed in accordance with CIRIA C698 (1). As the landfill cells develop, the surface water swale will continue to be constructed around the landfill embankments.

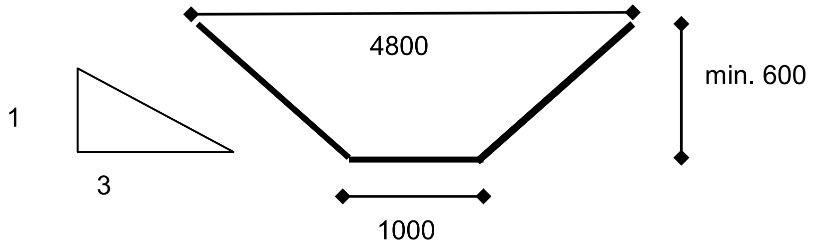

Figure 2.1: Typical Swale Design

The "Southern" storm water attenuation pond is lined with an engineered lining system, comprising a HDPE membrane (permeability $1X10^{-9}$ m/s) and layer of engineered clay to the same specification as the landfill cells. The constructed wetland comprises a shallow clay-lined pond both naturally colonised and planted with appropriate species.   The outflow from the constructed wetland flows into the local drainage network at the south-eastern corner of the site.

Surface water arising from all roads and hardstandings is diverted to the main surface water sewer. This surface water trunk sewer serves the overall landfill site and runs from north to south adjacent to the landfill access road to the west of the proposed biological waste treatment facility. This sewer varies from a 225mm diameter up to a 750 mm diameter where it runs through the site of the proposed biological treatment facility.

There is also a 450mm diameter spur from this trunk sewer which runs from east to west and connects to the trunk sewer.

The trunk sewer discharges to an existing attenuation pond and wetland serving the overall site, via a Class 1 bypass proprietary oil/water separator. This petrol interceptor will prevent hazardous chemical and petroleum products from entering the attenuation and wetland system downstream.

This attenuation system was designed to manage the runoff from the development for up to a 1 in 100-year design return period storm event.

Existing Groundwater Drains:

Groundwater drains are built at the bottom of the landfill cells to drain the maximum estimated groundwater flows (3 m^3 per day-see Section 2.5 of this report)) which are expected to be encountered on the site. The groundwater drains consist of trenches of 1000 mm deep and 1000 mm wide below the bottom of the cells. These are filled with filter material and wrapped in geotextile, as shown in Figure 2.2.

150 mm diameter open jointed concrete pipe are installed at the base of the trench. Flows are collected in this pipe and conveyed to the attenuation pond on site.

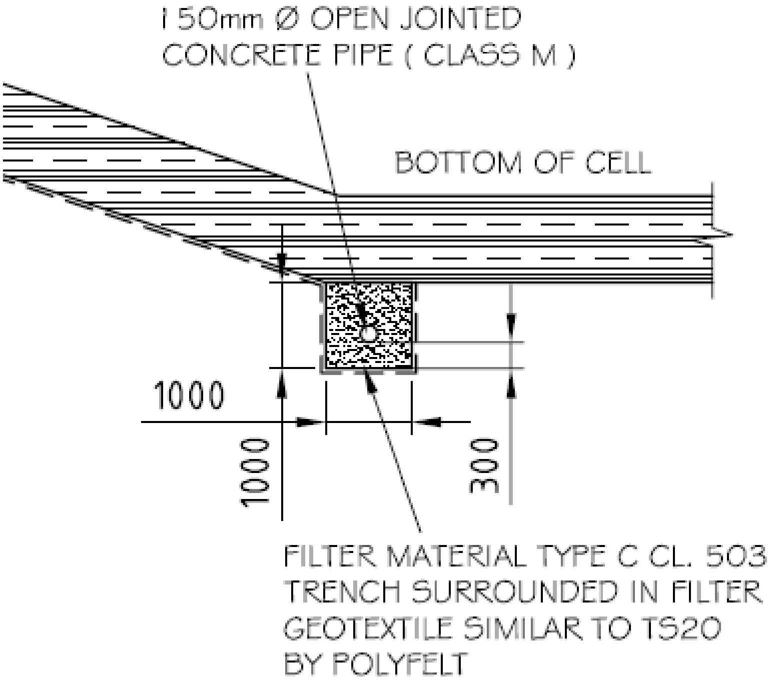

Figure 2.2: Detail of Groundwater Drain

2.2 Proposed Surface Water Drainage

A sustainable urban drainage system (SuDS) approach was applied to storm water management where appropriate and possible within the site, the overall strategy aims to provide an effective system to mitigate the adverse effects of urban storm water runoff on the environment by reducing runoff rates, volumes and frequency, reducing pollutant concentrations in storm water, contributing to amenity, aesthetics and biodiversity enhancement and allow for the maximum collection of rainwater for re-use where possible. In addition, SuDS features will replicate the natural characteristics of rainfall runoff for the site by providing control of run-off at source.

SuDS is a requirement of Meath County Council under the Greater Dublin Regional Code of Practice for Drainage Works (21) and Greater Dublin Strategic Drainage Study (GDSDS) (2). Additionally, these systems are recommended under the new guidelines, The Planning System and Flood Risk Management Guidelines for Planning Authorities (22).

There are a number of SuDS features proposed which have been designed in accordance with The SuDS Manual (3) as follows:

Filter strips (vegetated buffers):

These are vegetated strips of land over which flows are treated at low velocities, as shown in the typical details in Figure 2.3 and Figure 2.4. They are appropriate according to The SuDS Manual (3) as pre-treatment devices for SuDS components receiving sheet flow from adjacent impervious areas. The filter strips provided will be wide, gently sloping areas of grass treating runoff from adjacent impermeable areas and roofs, at source, running over its surface. Filter strips also have an attenuating effect on runoff and can allow some infiltration to the ground where the sub-grade is suitable.

These are located adjacent to hard-standing areas. These filter strips will be located post construction where gentle strips are achieved for example adjacent to the existing administration building, as shown in the Figure below.

Figure 2.3: Typical Filter Strip

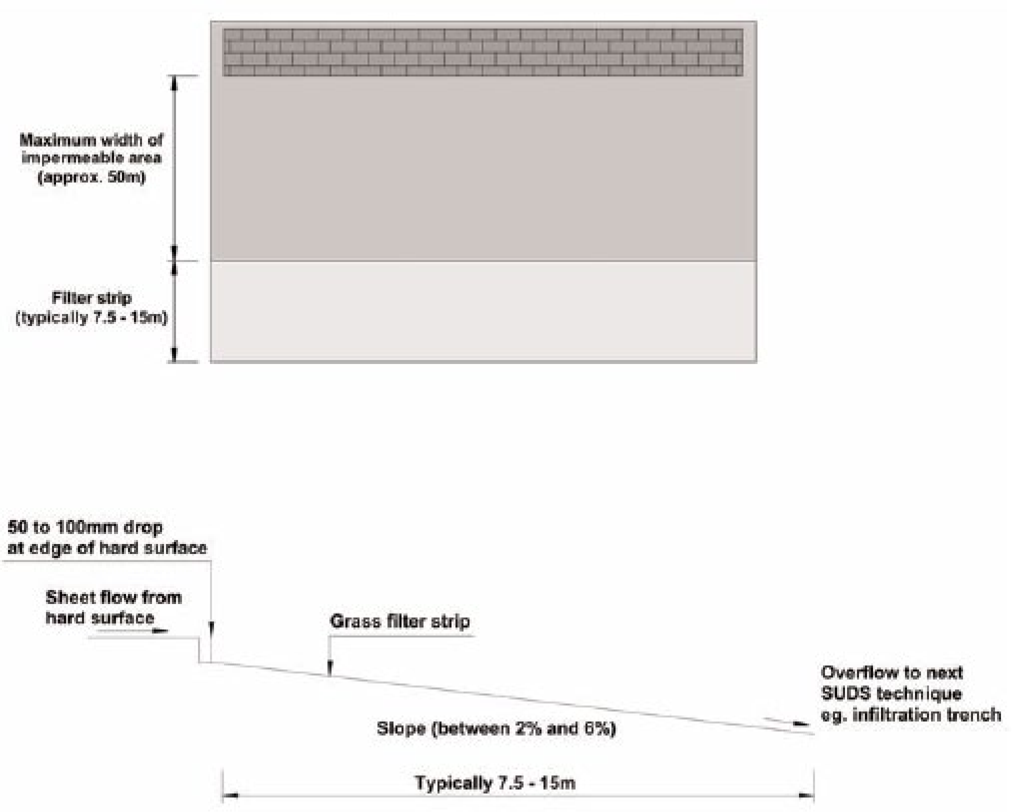

Figure 2.4: Typical Plan and Elevation of Filter Strip

Filter drain:

Filter drains are trenches filled with permeable material with a perforated collection pipe at the invert to collect and convey the water, as shown in Figure 2.5. They may have an optional permeable 'sandy' topsoil at surface. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site. The filter drains can treat, convey and attenuate runoff, at source, and can infiltrate to the ground where the sub-grade is suitable. These systems will allow some form of storage for small rainfall events and can result in water evaporation and adsorption in small quantities, therefore there will be less run-off from these areas in small rainfall events thus mimicking the natural response for this catchment. The filter drains proposed for this site will be located adjacent to the access road to the loading areas as shown in Drawings LW14-821-01-P-0000-003 to LW14-821-01-P-0000-011 in Volume 4 of the EIAR.

Figure 2.5: Typical Filter Drain

Silt fences:

Silt fences or similar approved will be provided adjacent to and/or surrounding earthworks and forestry operations to support suspended solids management practised during construction works. Typical details are shown in Drawing LW14-821-01-P-0500-005 of Volume 4 of the EIAR.

Proposed rainwater harvesting and storage systems

Some of the non-potable water requirements of the biological treatment facility along with floor wash-down and vehicle wash-down requirements will be met through utilisation of rain water harvesting.

Two 40 m^3 rain water harvesting tanks (80 m^3 combined capacity) are proposed. Rainwater from the roofs will be collected in a tank and stored for re-use as grey water in the treatment facility, and for supply to a water storage tank as required. This is regarded as a source control technique also. Two systems will be provided, one for each side of the treatment facility, these will be located under the open space area adjacent to the fire tender turning area to the north of the site and the other system will be located under the loading area to the south of the facility. The locations of these systems are shown in Planning Drawings LW14-821-01-P-1700-0003 in Volume 4 of the EIAR.

All of the SuDS designs described above will be installed in accordance with the CIRIA guidance (1). All of the elements of the drainage system are designed to gravitate towards one of the two attenuation ponds .

2.3 Quantity of Surface Water to be used as Process Water

As stated above rainwater harvesting will meet some of the requirements of the non-potable water for office and amenity building (toilets), floor wash-down and vehicle wash-down in the proposed biological treatment facility. At full capacity the expected surface water consumption for process water is estimated as follows:

Floor Wash-down:	50 m^3/month
Vehicle Wash-down:	116 m^3/month
Total:	**166 m^3/month**

The facility will be serviced by the two 40 m^3 rain water harvesting tanks (80 m^3 combined capacity). The total roof area is 5,400 m^2. The annual rainfall for Mullingar, Co. Westmeath[1] provided by Met Éireann is 929 mm. The annual volume of rainwater which can be collected assuming 100% collection efficiencies is therefore 5016.6 m^3. The monthly volume collected will be approximately 416 m^3. On this basis it is expected that the wash down requirements for the facility of 166 m^3 per month will be serviced by the rain water harvesting system. In the event of drought conditions (<34.8 mm in 14 days), it is proposed to pump clean water from the storm water attenuation pond to supplement the rainwater harvesting thus effectively removing the need for potable water within the process, i.e. wash down etc.

When the rain water harvesting tanks are full the incoming flows will be diverted back into the drainage system, which is routed to the attenuation pond. The attenuation ponds are sized to take all the surface water run-off from the site including from the roofs, to allow for a period of shut down at the facility, where the greywater usage will be suspended and the rain water harvesting tanks will remain full (worst case scenario).

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[1] Nearby met station

2.4 Attenuation and Sediment Control

In order to avoid an increase in hydrographic peaks due to the proposed development the existing "Southern" attenuation pond (managing surface runoff south of the water shed divide) will be supplemented with a new "Northern" Attenuation Pond. For details of the watershed dividing the site refer to Chapter 12 of Volume 2 of the EIAR.

The attenuation ponds together with adjacent wetlands, will also operate as settlement areas. The efficiency of the attenuation ponds to settle out suspended solids have been estimated to reduce the outflow concentration of suspended solids to less than 25 mg/l. This is below the waste licence limit of 35 mg/l and is within the limits set out in the European Directive 2006/44/EC on the quality of fresh waters needing protection or improvement in order to support fish life. The "Southern" attenuation pond and wetland are already in place at the site. The proposed "Northern" attenuation pond and wetland will be the first element of constuction within the "Northen" catchment. Any disturbance during construction will not increase the suspended solids concentration above the allowable limits. Calculations for attenuation and settlement and the criteria applied are included in Appendix 12-4 of Volume 3 of the EIAR.

The greenfield discharge for respective catchments was calculated using the following equation:

$$\text{QBAR} = 0.00108\ (\text{Area}^{\,0.89})(\text{SAAR}^{\,1.17})(\text{Soil}^{\,2.17})$$

The 20 year growth factor of 1.52 was then applied to QBAR for the greenfield site. The permitted outflow rate for a 20 year storm was determined as 0.255 m^3/s and 0.284 m^3/s for the northern and southern ponds respectively.

Checks on the pond size were undertaken with regard to the efficiency of the removal of pollutants as recommended by CIRIA B14 (23) and GDSDS guidelines (2) and these are included in the pond calculations.

Both attenuation ponds were designed to fully attenuate a 1 in 20-year flow and to contain a 1 in 100-year flow preventing it from overtopping the banks of the pond, in accordance with the GDSDS guidelines (2). An overflow weir in the "Southern" storm water management system is in place to take the flows in excess of the 1 in 20- year flow. An overflow weir in the proposed "Northern" attenuation pond will discharge via a baffled chute structure to the Knockharley stream. Normal outflows from both attenuation ponds (existing and proposed) will gravitate through wetlands before reaching the Knockharley Stream at their respective locations. The normal outflow is controlled to the green field (pre-development) flow rates by an outlet control valve.

It is proposed to adjust the outflow control to cater for the additional volumes associated with the proposed development south of the water shed in the "Southern" storm water attenuation pond. The modifications will not impact on the design philosophy outlined which limits the flows from the ponds to greenfield rates and also provides suspended solids treatment for all the discharges and runoff from paved areas. The proposed "Northern" attenuation pond will employ a floating outflow structure or similar approved to maintain greenfield rates. The ponds and wetland locations are shown on Drawing No. LW14-821-01-P-0000-005 Proposed Site Layout Plan Sheet 2 of 8 in Volume 4 of the EIAR and are also illustrated in Figure 12.9 of Chapter 12 of Volume 2 of the EIAR. Calculations for the design are included in Appendix 12-4 of Volume 3 of this EIAR.

All drainage will be put in place ahead of construction such that any part of the proposed development will have a functioning drainage system in place.

The proposed development will impact surface water runoff from both the Northern and Southern catchments of the site. The surface water inputs to the respective site drainage systems are set out in Table 2.1.

As each phase of the landfill is constructed, groundwater seeps may be encountered. Under- cell drainage has been installed which discharges to the surface water system. This drainage system effectively depresses the overburden water table to the underside level of the landfill liner.

The actual flow was measured on 4th May 2011 at just under 1 m^3 per day. Since 16 of 28 landfill cells are fully developed and construction of two more is nearly complete, the groundwater catchment currently draining to the groundwater drain is 50% of the total. It is estimated that full development at the current levels would result in twice the current discharge at 2 m^3 per day.

For the proposed development it is proposed to construct the IBA cells above the level of the existing landfill cells on average by approximately 3 to 4 m (for cells 29 through to 32). The groundwater drainage will be connected by gravity to the lower adjacent groundwater system underlying cell 16. An estimate for the long-term combined flow from the groundwater drainage system of 3 m^3 per day is deemed to be conservative. The groundwater flows will be accommodated in the storm water pond. In the context of the overall hydrological regime, this flow is of very low significance.

Table 2.1: Surface Water Input to the Site Drainage System

Catchment	Site Area	Capped area	Impermeable Area	Greenfield Area
	ha	ha	ha	ha
Northern	73.74	13.43	6.95	56.27
Southern	66.19	19.63	3.31	43.25

The following assumptions were made in the determination of the quantity of surface water to be discharged to the on-site drainage system:

- The new roads, hardstanding and buildings all have an impermeability factor of 1.0
- Rainwater harvesting has not been taken into account in this calculation (conservative assessment).
- Capped landfill cells/green areas have an impermeability factor of 0.25, based on the recommended range of values for the impermeability factor for parks (0.1 - 0.3) in Waste and Wastewater Engineering Systems (24). The impermeability factor takes account of infiltration and evapotranspiration at the capped landfill.
- Groundwater flows, estimated at 3 m^3 per day are conveyed to the pond which has the capacity to cater for these flows.

Appendix 12.1 of Volume 3 of the EIAR shows the existing "Southern" stormwater attenuation lagoon has sufficient attenuation and suspended solids managmet capacity to accommodate additional loading from the propoosed leachate managment and biological treatment facilities.

Appendix 12.4 of Volume 3 of the EIAR provides details of runoff from the "Northern" catchment and capacities of the proposed holding pond and attenuation lagoon.

In Appendix 12.6 Hydrological Study of Volume 3 of the EIAR, the Knockharley Stream was assessed for its capacity to accommodate the catchment 100-year flow, as well as the maximum attenuated discharge from the overall site development ("Northern" and "Southern" catchment outfalls). A maximum outflow of 1.83 m^3/s was determined from the model for a 100-year flood event. For the purposes of modelling the stream post development, the area contributing to the southern attenuation pond was excluded from the catchment flows for Q100 as appropriate along the route of the stream and the pond outflow for Q100 was inputted at the pond outfall to the stream. The hydraulic model of the Knockharley Stream did not indicate that any increase in flood risk would occur downstream as a result of the proposed works. Conversely, the controlled outflow from the proposed attenuation pond indicated that a lag is introduced in the system which will result in a slight decrease in flood flows downstream.

2.5 Proposed Mitigation during Construction

Mitigation measures proposed during the construction phase are outlined in Chapter 12 and in in Appendix 2-0 Construction and Environmental Management Plan (CEMP) of Volume 3 of the EIAR.

Key objectives in the CEMP to prevent runoff and consequent sediment release into the nearby watercourses receiving flow from the proposed development site are summarised below as follows:

- During the permitted stream diversion and culverting, in-stream sedimentation traps will be positioned prior to construction, and maintained for the duration. All diverted water /run-off can be sent to the onsite surface water attenuation lagoon to minimise sediment entering the stream, if required.
- Additional silt fencing and silt-prevention measures will be kept on site for use in emergencies. All silt fencing as required will be installed in advance of the works.
- No work will take place on site during severe weather conditions.
- All fuels will be kept in bunded areas. Any diesel or fuel oils stored on site will be bunded to 110 % of the capacity of the storage tank in accordance with the facilities waste licence. Design and installation of fuel tanks to be in accordance with best practice guidelines BPGCS005, oil storage guidelines.
- Re-fuelling of plant during construction will be carried out in a designated refuelling area.
- During construction, daily visual inspections will be performed. If sediment appears to be entering streams, work will stop immediately and measures to identify the source will be undertaken and measures undertaken to stop further sediment entering the stream.
- The proposed berms will be re-planted as either compensatory forestry or. with a suitable mix of native tree and shrub species and should be akin to the existing planting scheme.

2.6 Proposed Mitigation During Operation and Maintenance

The existing landfill facility was designed to ensure surface water discharges to receiving waters are not detrimental to water quality. Rainfall on the undeveloped parts of the site discharge directly to the surface water drainage system. Rainfall on active fill and waste storage areas is collected in the leachate collection system. The surface drainage from all roads, capped areas and hard standing areas is directed to the surface water attenuation pond via an oil interceptor. Drainage from the existing waste inspection and quarantine bays is directed to the leachate lagoon. Drainage from the biological treatment facility will be directed to an underground leachate tank.

In addition:

- All surface water run-off from the permitted development will flow through an existing class 1 interceptor. This petrol interceptor will prevent chemical and petroleum products from entering the attenuation and wetland system downstream. Surface water will discharge from the interceptor to the existing attenuation pond and wetland provided for the landfill. Additional Class 1 interceptors will be provided for the proposed development at outfalls from filter drains surrounding the IBA facility.
- Bypass chambers in the road drainage system surrounding the IBA facility will direct contaminated storm runoff into the adjacent IBA facility cell 32 at two locations during IBA operations.
- Both (existing "Southern" and proposed "Northern") surface water attenuation ponds are / will be sized to manage a 1 in a 100-year storm, in accordance with the GDSDS guidelines (2)**.**
- Constructed wetlands downstream of the existing "Southern" and proposed "Northern" attenuation ponds will receive surface water discharges to further attenuate flows and 'polish' storm water suspended solids before discharge to the Knockharley Stream.
- A combination of roof and pavement storm water will be managed to provide an effective system to mitigate the adverse effects of storm water runoff on the environment. There are a number of SuDS features proposed such as filter strips, filter drains and rainwater harvesting from the roof of the biological treatment facility and stored in tanks, for grey water usage.

- All fuels are to be kept in bunded areas. Any diesel or fuel oils stored on site will be bunded to 110 % of the capacity of the storage tank in accordance with the facilities waste licence. Design and installation of fuel tanks to be in accordance with best practice guidelines BPGCS005, oil storage guidelines.
- There is continuous monitoring of total organic carbon, pH and conductivity on the "Southern" surface water attenuation pond discharge and there is an automated shut-off of discharge in the event of exceedance of the trigger level for TOC which is 20 mg/l.
- There will be continuous monitoring of total organic carbon, pH, turbidity and conductivity on the "Northern" surface water holding pond discharge and there will be an automated shut-off of discharge in the event of an exceedance of the trigger level which will be initially set at 20 mg/l TOC
- Ongoing biannual surface water physio-chemical and annual biological monitoring will be undertaken in accordance with the licence conditions. Comparison of upstream and downstream monitoring locations will ensure there is no long-term impact on the surface quality in waters receiving drainage from the site.
- In the event of a pollution incident onsite, the discharge from the existing "Southern" surface water pond can be shut down to prevent pollution entering the watercourse. In the event of a pollution incident on the proposed "Northern" development the discharge from the holding pond and attenuation pond can be shut down to prevent pollution entering the watercourse.
- In the event of an upstream pollution event off-site, there is also a diversion device at the "Southern" outfall on the Knockharley stream to allow the stream to be diverted into the sites pollution control infrastructure, if required.
- Inspection and maintenance of the surface water management system including swales, culverts, rainwater harvesting tank filters and outfalls will be undertaken regularly, to ensure no blockages have occurred and the system is operating correctly

2.7 Proposed Mitigation during Decommissioning

In the event of decommissioning of the development, activities would take place in a similar fashion to the construction phase. There would be disturbance to underlying soils and therefore a risk again of silt laden run-off entering the receiving watercourse. The mitigation applied will therefore be as for the mitigation during construction as outlined in Section 2.6 above.

2.8 Proposed Flood Compensation Culvert

It is proposed to replace the existing culvert at CH4695 with a new flood compensation culvert at CH4814 where the stream flows through the site. The proposed "Southern" storm water attenuation pond is shown in Drawing LW14-821-01-P-0500-000 with details in Drawings 001 through 004 in Volume 4 of the EIAR

The proposed flood compensation culvert location at CH4814 is designed to facilitate two primary functions:

- conveyance of 1:100-year events, and
- throttling of 1:1000-year flood events to provide compensation storage.

The preliminary sizing of the orifice to facilitate upstream flood compensation during a 1:1000-year flood events is 825 mm diameter. The orifice will be placed on the headwall of a 1500 mm culvert which will convey both 1:100 and 1:1000-year flood events. The orifice will facilitate passing of 1:100-year flood events with minimal impacts on upstream levels. The orifice will throttle 1:1000-year flood events, cause upstream levels to rise to c. 60.5 mAOD and provide compensatory flood protection for the receiving downstream catchment. The flood compensation volume will be greater than the volume lost through placing the "Northern" storm water management system within a 1:1000-year flood plain.

If the flood compensation culvert becomes blocked an overflow spill will be provided to accommodate a 1:1000-year flood event.

Compensatory flood storage will be provided within the development area if the 1 in 100-year flood is exceeded. In such an event, when the attenuation pond has reached its 1 in 100-year flood event capacity, the inlet into the pond will be closed and surface water held in a holding pond upstream of the northern attenuation pond.

A Section 50 application will be submitted to the Office of Public Works (OPW) at detailed design stage for approval for the proposed culvert.

2.9 Permitted Stream Diversion

Permission was granted in the original planning permission to divert a section of the Knockharley Stream at the north western corner of the landfill footprint. The design of the proposed stream diversion at CH5113 (part of the development) will increase the flow path by approximately 8 m. The bed slope between these two points will change from 1:124 over the original 130 m to 1:171 over the new length of 171 m. The impacts of the increase in length and change in grade was re-examined in the 2016 HECRAS hydraulic model as part of the Hydrological Study (Appendix 12.6 of Volume 3 of the EIAR). The model showed that, the existing stream channel along this section of the reach of the stream had adequate capacity to contain the design flood flow between these two points and the new length showed no decrease in that capacity. The cross-section of the diverted stream will remain unchanged.

A Section 50 application will be submitted to the Office of Public Works (OPW) at detailed design stage for approval for the proposed stream diversion.

2.10 Maintenance and Monitoring

- Inspection and maintenance of the surface water management system including swales, culverts, rainwater harvesting tanks and outfalls will be undertaken regularly, to ensure no blockages have occurred and the system is operating correctly.
- Adequate access will be provided to all swale areas for inspection and maintenance.
- The landfill operater shall have responsibility for ensuring that all the mitigation and maintenance measures included in the surface water management plan are put in place.
- Water quality monitoring will be carried out in accordance with the licence during the construction and operation and aftercare stages.
- The CEMP details the emergency plan for a surface water incident during construction.

Appendix 12.3

Licence Compliance Surface Water Quality Results

Appendix 12.3: Licence Compliance Surface Water Monitoring Results Q2 2012-Q2 2018

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
Ammoniacal Nitrogen	mg/l	12/01/2012	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
BOD	mg/l	12/01/2012	**3**	<2	<2	<2	<2	**4**	3	<2
COD	mg/l	12/01/2012	7	<4	7	10	<4	5	8	4
Chloride	mg/l	12/01/2012	22	20	25	27	15	26	26	15
Dissolved Oxygen (lab)	mg/l	12/01/2012	**10.5**	**9.4**	**8.7**	**9.2**	7.7	**10.4**	**9.8**	8
Electrical Conductivity (lab)	mS/cm	12/01/2012	0.554	0.558	0.584	0.596	**0.781**	0.622	0.626	0.778
pH (lab)	pH units	12/01/2012	8.2	8	7.9	7.9	7.7	8.1	8.1	7.8
Total Suspended Solids	mg/l	12/01/2012	5	2	6	3	3	9	2	3
Ammoniacal Nitrogen	mg/l	02/05/2012	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
BOD	mg/l	02/05/2012	<5	<5	<5	<5	<2	<3	<3	3
COD	mg/l	02/05/2012	28	**32**	31	32	10	18	24	10
Chloride	mg/l	02/05/2012	14	15	14	16	16	22	18	16
Dissolved Oxygen (lab)	mg/l	02/05/2012	9.2	8.8	**8.7**	**8.7**	**9.1**	**9**	**8.8**	9.1
Electrical Conductivity (lab)	mS/cm	02/05/2012	0.448	0.441	0.433	0.432	0.658	0.567	0.503	0.658
pH (lab)	pH units	02/05/2012	7.9	7.4	7.5	7.6	7.9	7.9	7.8	8
Total Suspended Solids	mg/l	02/05/2012	6	7	6	8	2	8	12	3
Ammoniacal Nitrogen	mg/l	12/07/2012	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.42	<0.08
pH (lab)	pH units	12/07/2012	7.3	6.8	7.0	6.9	7.0	6.8	7.3	7.1
BOD	mg/l	12/07/2012	<3	<3	<3	**8**	<5	<3	**9**	<5
COD	mg/l	12/07/2012	18	22	26	18	29	19	**47**	31
Electrical Conductivity (lab)	mS/cm	12/07/2012	0.575	0.555	0.564	0.617	0.581	0.614	0.702	0.618
Chloride	mg/l	12/07/2012	20	15	15	12	19	12	23	18
Total Suspended Solids	mg/l	12/07/2012	13	3	3	5	7	2	10	11
Dissolved Oxygen (lab)	mg/l	12/07/2012	9.3	7.8	7.6	**8.8**	8.2	8.2	8.2	8.2
Alkalinity	mg/l	15/11/2012	**330**	**350**	**345**	**320**	195	**360**	**345**	185
Ammoniacal Nitrogen	mg/l	15/11/2012	0.27	**0.25**	0.10	0.12	<0.08	<0.08	<0.08	0.13
pH (lab)	pH units	15/11/2012	8.0	7.8	7.8	7.9	7.8	8.2	8.1	7.8
BOD	mg/l	15/11/2012	<5	<5	<5	<5	<3	<3	<5	5
Cadmium	ug/l	15/11/2012	0.061	<0.030	<0.030	<0.030	<0.030	<0.030	0.047	<0.030
Calcium	mg/l	15/11/2012	**123**	**124**	**119**	**119**	**141**	**140**	**131**	142
COD	mg/l	15/11/2012	33	29	35	39	18	21	29	20
Copper	ug/l	15/11/2012	2.4	1.6	2.2	2.6	**31**	1.4	**1.5**	1.7

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
Electrical Conductivity (lab)	mS/cm	15/11/2012	0.589	0.592	0.587	0.583	0.714	0.658	0.622	0.709
Chloride	mg/l	15/11/2012	20	15	18	20	16	23	20	17
Dissolved Oxygen (lab)	mg/l	15/11/2012	8.9	8.7	9	**8.6**	**9.2**	**8.8**	**8.8**	9.2
Iron	mg/l	15/11/2012	**0.17**	**0.18**	**0.18**	**0.25**	<0.05	**0.16**	**0.25**	<0.05
Lead	ug/l	15/11/2012	<10	<10	<10	<10	<10	<10	<10	<10
Magnesium	mg/l	15/11/2012	**9**	**9**	**10**	**9**	**16**	**11**	10	16
Manganese	µg/l	15/11/2012	<30	<30	<30	<30	<30	<30	<30	<30
Mercury	ug/l	15/11/2012	0.018	0.012	0.011	<0.010	<0.010	<0.010	<0.010	<0.010
Orthophosphate	mg/l	15/11/2012	<1	<1	<1	<1	<1	<1	<1	<1
Potassium	mg/l	15/11/2012	7	6	8	8	5	6	6	5
Sodium	mg/l	15/11/2012	12	8	11	11	12	**10**	11	13
Sulphate	mg/l	15/11/2012	12	12	13	13	219	23	21	219
Total Suspended Solids	mg/l	15/11/2012	7	4	5	6	10	8	7	4
Total Chromium	ug/l	15/11/2012	1.1	<1	<1	<1	<1	<1	<1	<1
TON	mg/l	15/11/2012	1.0	1.0	1.1	1.1	0.19	2.2	1.3	0.15
Total Phosphorous	mg/l	15/11/2012	0.34	**0.29**	**0.37**	0.34	0.09	0.30	0.30	0.07
Zinc	mg/l	15/11/2012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammoniacal Nitrogen	mg/l	21/02/2013	<0.08	<0.08	<0.08	0.28	<0.08	0.13	0.12	<0.08
BOD	mg/l	21/02/2013	2	<2	<2	3	<3	<2	<3	<3
COD	mg/l	21/02/2013	12	14	17	23	20	13	17	19
Chloride	mg/l	21/02/2013	24	22	23	25	25	23	26	26
Dissolved Oxygen (lab)	mg/l	21/02/2013	8.8	8.7	8.5	**8.8**	8.9	**8.8**	8.5	8.7
Electrical Conductivity (lab)	mS/cm	21/02/2013	0.608	0.62	0.629	0.651	0.747	0.672	0.676	0.75
pH (lab)	pH units	21/02/2013	8.3	8.2	8	7.9	7.7	8.1	8	7.9
Total Suspended Solids	mg/l	21/02/2013	6	6	13	8	4	5	7	19
Ammoniacal Nitrogen	mg/l	24/04/2013	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
BOD	mg/l	24/04/2013	<2	<2	<2	2	3	2	<2	3
COD	mg/l	24/04/2013	11	12	12	14	23	10	13	22
Chloride	mg/l	24/04/2013	**37**	25	29	30	30	26	28	30
Dissolved Oxygen (lab)	mg/l	24/04/2013	8.7	8.8	9	**8.8**	8.8	**8.9**	**9**	9
Electrical Conductivity (lab)	mS/cm	24/04/2013	0.648	0.623	0.64	0.64	0.693	0.627	0.649	0.685
pH (lab)	pH units	24/04/2013	8.2	8	7.9	7.9	7.5	8.2	8.2	7.7

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
Total Suspended Solids	mg/l	24/04/2013	5	10	3	6	8	12	6	7
Ammoniacal Nitrogen	mg/l	22/08/2013	<0.08	0.11	0.12	0.17	<0.08	0.51	0.29	<0.08
BOD	mg/l	22/08/2013	<3	<3	<2	4	<3	**7**	<5	<5
COD	mg/l	22/08/2013	17	17	44	34	**125**	**34**	23	29
Chloride	mg/l	22/08/2013	**38**	40	**50**	28	24	37	29	24
Dissolved Oxygen (lab)	mg/l	22/08/2013	8.7	8.7	**8.7**	**8.9**	8.5	8.6	**8.6**	8.7
Temperature	°C	22/08/2013	14.5	14.4	14.5	14.7	17.1	14.6	14.9	16.3
Electrical Conductivity (lab)	mS/cm	22/08/2013	0.681	0.707	0.663	**0.742**	0.65	0.925	0.676	0.647
Electrical Conductivity (field)	mS/cm	22/08/2013	0.585	0.613	0.573	0.649	0.599	**0.779**	0.595	0.609
pH (lab)	pH units	22/08/2013	8	7.8	7.7	7.5	7.2	7.5	7.7	7.1
pH (field)	pH units	22/08/2013	**8.89**	**8.7**	**8.48**	**8.48**	**8.46**	8.34	**8.7**	**8.49**
Total Suspended Solids	mg/l	22/08/2013	14	7	7	**19**	**31**	**25**	5	3
Alkalinity	mg/l	22/08/2013	**345**	**350**	**335**	**385**	135	**355**	240	140
Cadmium	ug/l	22/08/2013	<1	<1	<0.1	<0.1	<0.1	<1	<0.1	<0.1
Calcium	mg/l	22/08/2013	**119**	**116**	**113**	**139**	**106**	**168**	**117**	107
Copper	ug/l	22/08/2013	0.71	4	1.9	1.2	1	2.5	**1**	1.3
Iron	mg/l	22/08/2013	**0.13**	**0.11**	**0.42**	0.09	0.06	**0.59**	**0.09**	0.13
Lead	ug/l	22/08/2013	<2	<2	<2	<2	<2	<2	<2	<2
Magnesium	mg/l	22/08/2013	**13**	**12**	**10**	**12**	**17**	**15**	14	17
Manganese	ug/l	22/08/2013	<30	80	210	170	<30	1700	50	<30
Mercury	ug/l	22/08/2013	0.023	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Orthophosphate	mg/l	22/08/2013	1	<1	1	<1	<1	3	1	<1
Potassium	mg/l	22/08/2013	9	12	10	6	1	25	4	<1
Sodium	mg/l	22/08/2013	**20**	**25**	**21**	**17**	**19**	**14**	**21**	19
Sulphate	mg/l	22/08/2013	27	24	20	32	221	154	136	221
Total Chromium	ug/l	22/08/2013	<1	<1	<1	<1	<1	<1	<1	<1
TON	mg/l	22/08/2013	0.72	0.21	0.16	0.57	<0.17	<0.17	0.71	<0.17
Total Phosphorous	mg/l	22/08/2013	**0.57**	**0.61**	**0.56**	0.52	0.1	1.04	**0.48**	<0.05
Zinc	mg/l	22/08/2013	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	0.01
Temperature	°C	07/11/2013	7.3	6.6	6.3	6.8	6.4	7.2	7.1	6.5
pH (lab)	pH units	07/11/2013	8.1	8	7.9	7.9	7.6	8.2	8.2	7.6
pH (field)	pH units	07/11/2013	**8.54**	8.34	**8.31**	**8.64**	**8.2**	8.35	**8.44**	**8.32**

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
Electrical Conductivity (lab)	mS/cm	07/11/2013	0.553	0.541	0.56	0.567	**0.776**	0.618	0.604	0.769
Electrical Conductivity (field)	mS/cm	07/11/2013	0.386	0.429	0.382	0.396	0.538	0.431	0.421	0.542
Ammoniacal Nitrogen	mg/l	07/11/2013	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Dissolved Oxygen (lab)	mg/l	07/11/2013	9.2	8.9	**8.8**	**8.8**	8.8	**9.1**	**9.1**	9.1
Chloride	mg/l	07/11/2013	25	18	22	24	19	29	25	19
Total Suspended Solids	mg/l	07/11/2013	4	1	1	2	1	3	1	1
BOD	mg/l	07/11/2013	<2	<2	<2	<2	<2	<2	<2	<2
COD	mg/l	07/11/2013	16	15	18	18	8	12	11	7
Temperature	°C	13/03/2014	6.4	5.9	5.8	5.7	6.7	6	6.2	6.7
pH (lab)	pH units	13/03/2014	8.4	8.3	8.1	8.2	8.1	8.4	8.4	8.1
pH (field)	pH units	13/03/2014	**8.49**	8.29	**8.25**	7.85	7.97	8.3	8.38	**8.54**
Electrical Conductivity (lab)	mS/cm	13/03/2014	0.549	0.553	0.56	0.557	0.648	0.576	0.58	0.651
Electrical Conductivity (field)	mS/cm	13/03/2014	0.394	0.391	0.393	0.418	0.475	0.412	0.416	0.477
Ammoniacal Nitrogen	mg/l	13/03/2014	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Dissolved Oxygen (lab)	mg/l	13/03/2014	**9.9**	**9.4**	**9.4**	**9.6**	**10.7**	**9.6**	**9.7**	10.9
Chloride	mg/l	13/03/2014	23	20	23	24	18	23	24	18
Total Suspended Solids	mg/l	13/03/2014	2	7	9	4	2	2	3	2
BOD	mg/l	13/03/2014	<2	<2	3	<2	<2	<2	<2	<2
COD	mg/l	13/03/2014	14	17	16	17	13	8	14	13
Temperature	°C	29/05/2014	11.1	11.1	11.3	11.4	14.8	10.9	11.8	14.9
pH (lab)	pH units	29/05/2014	8.1	8	7.9	8.1	7.6	8.3	8.3	7.6
pH (field)	pH units	29/05/2014	**8.63**	8.4	**8.34**	8.06	7.86	8.34	**8.53**	7.97
Electrical Conductivity (lab)	mS/cm	29/05/2014	0.52	0.515	0.52	0.53	0.66	0.612	0.582	0.66
Electrical Conductivity (field)	mS/cm	29/05/2014	0.417	0.434	0.424	0.4223	0.589	0.362	0.478	0.589
Ammoniacal Nitrogen	mg/l	29/05/2014	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Dissolved Oxygen (lab)	mg/l	29/05/2014	8.8	9	8.3	8.4	7.9	**8.8**	**8.7**	7.9
Chloride	mg/l	29/05/2014	17	16	16	16	15	22	20	15
Total Suspended Solids	mg/l	29/05/2014	4	<1	1	**16**	<1	8	8	10
BOD	mg/l	29/05/2014	<3	<3	<3	<3	<2	<2	<2	<2
COD	mg/l	29/05/2014	22	17	19	17	11	13	15	16
Temperature	°C	14/08/2014	13.4	12.8	12.9	13	15.6	13.1	13.9	15.6
pH (lab)	pH units	14/08/2014	8.3	8.1	7.9	8.1	7.4	8.2	8.1	7.2

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
pH (field)	pH units	14/08/2014	**9.12**	**8.73**	**8.65**	**8.52**	**8.42**	**8.53**	**8.92**	**8.5**
Electrical Conductivity (lab)	mS/cm	14/08/2014	0.577	0.574	0.583	0.58	0.593	0.62	0.611	0.592
Electrical Conductivity (field)	mS/cm	14/08/2014	0.486	0.482	0.49	0.491	0.537	0.519	0.529	0.538
Ammoniacal Nitrogen	mg/l	14/08/2014	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Dissolved Oxygen (lab)	mg/l	14/08/2014	8.8	8.4	**8.8**	**8.5**	8.1	**8.9**	8.2	7.9
Chloride	mg/l	14/08/2014	21	20	21	22	14	24	25	14
Total Suspended Solids	mg/l	14/08/2014	28	4	2	4	1	1	5	2
BOD	mg/l	14/08/2014	**4**	3	3	<3	<2	<2	<2	<2
COD	mg/l	14/08/2014	24	15	15	19	9	11	14	13
Ammoniacal Nitrogen	mg/l	20/11/2014	<0.08	<0.08	<0.08	<0.08	0.21	<0.08	<0.08	0.22
Alkalinity	mg/l	20/11/2014	255	220	**250**	**255**	135	**300**	**260**	150
pH (lab)	pH units	20/11/2014	7.8	7.6	7.6	7.7	7.4	8.0	7.8	7.4
BOD	mg/l	20/11/2014	<3	<3	<3	<3	<3	<2	<2	<2
COD	mg/l	20/11/2014	23	20	24	26	25	15	7	7
Electrical Conductivity (lab)	mS/cm	20/11/2014	0.488	0.469	0.472	0.485	0.463	0.572	0.523	0.459
Chloride	mg/l	20/11/2014	19	15	18	20	13	27	21	13
Cadmium	ug/l	20/11/2014	0.05	0.06	0.05	0.05	0.08	0.04	0.06	0.06
Calcium	mg/l	20/11/2014	93	94	**92**	**95**	**84**	**117**	**105**	84
Copper	ug/l	20/11/2014	2.6	2.4	2.2	2.5	4.4	1.8	**2.8**	5.2
Dissolved Oxygen (lab)	mg/l	20/11/2014	**10.1**	**10.1**	**9.7**	**9.9**	**9.9**	**9.5**	**9.3**	9.0
Iron	mg/l	20/11/2014	**0.12**	**0.45**	**0.43**	**0.30**	**0.54**	**0.12**	**0.22**	0.54
Lead	ug/l	20/11/2014	0.17	0.17	0.21	0.19	0.69	<0.09	0.28	0.94
Manganese	ug/l	20/11/2014	<30	<30	30.00	<30	30.00	<30	<30	40.00
Magnesium	mg/l	20/11/2014	6	**5**	**6**	**6**	**8**	**9**	7	8
Mercury	ug/l	20/11/2014	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Orthophosphate	mg/l	20/11/2014	<1	<1	<1	<1	<1	<1	<1	<1
Potassium	mg/l	20/11/2014	3	2	3	3	3	4	3	4
Sodium	mg/l	20/11/2014	12	**10**	11	11	7	**10**	11	9
Sulphate	mg/l	20/11/2014	17	21	21	21	117	28	29	115
Suspended Solids	mg/l	20/11/2014	5	6	7	**27**	9	**14**	12	13
TON	mg/l	20/11/2014	2	1	1	1	1	4	2	1
Total Chromium	ug/l	20/11/2014	<0.25	0.54	0.43	0.34	0.68	<0.25	0.32	0.85

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
Total Phosphorous	mg/l	20/11/2014	0.17	**0.13**	0.18	0.22	0.19	0.17	0.17	0.18
Zinc	mg/l	20/11/2014	<0.01	0.01	0.02	<0.01	0.02	0.02	<0.01	0.02
Temperature	°C	12/03/2015	7.9	7.5	6.9	6.8	6.9	7.4	7.3	6.8
pH (lab)	pH units	12/03/2015	8.3	8.1	8	8	7.6	8.2	8.2	7.5
pH (field)	pH units	12/03/2015	**8.88**	8.41	**8.56**	7.27	7.91	8.21	**8.88**	7.77
Electrical Conductivity (lab)	mS/cm	12/03/2015	0.551	0.584	0.589	0.591	**0.843**	0.607	0.612	0.843
Electrical Conductivity (field)	mS/cm	12/03/2015	0.393	0.415	0.41	0.42	0.598	0.434	0.373	0.571
Ammoniacal Nitrogen	mg/l	12/03/2015	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Dissolved Oxygen (lab)	mg/l	12/03/2015	8.8	8.7	**8.8**	**8.5**	8.7	**8.9**	8	8.3
Dissolved Oxygen (field)	%	12/03/2015	99.3	95	94.9	98	99.9	100	99.3	100
Chloride	mg/l	12/03/2015	22	22	28	29	18	25	27	19
Total Suspended Solids	mg/l	12/03/2015	1	<1	1	1	8	**29**	11	<1
BOD	mg/l	12/03/2015	<2	<2	<2	<2	<2	<2	<2	<2
COD	mg/l	12/03/2015	13	10	12	11	13	12	13	16
Temperature	°C	21/05/2015	8.9	7.9	8.4	8.5	10.7	8.3	9.1	10.5
pH (lab)	pH units	21/05/2015	8.4	8.2	8.1	8	7.5	8.2	8.2	7.5
pH (field)	pH units	21/05/2015	**8.8**	7.97	**8.05**	7.68	7.45	8.17	8.3	7.41
Electrical Conductivity (lab)	mS/cm	21/05/2015	0.588	0.59	0.603	0.606	**0.793**	0.672	0.648	0.794
Electrical Conductivity (field)	mS/cm	21/05/2015	0.479	0.504	0.486	0.502	0.65	0.543	0.533	0.672
Ammoniacal Nitrogen	mg/l	21/05/2015	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Dissolved Oxygen (lab)	mg/l	21/05/2015	8.8	8.7	8.6	**8.7**	8.7	8.5	**8.8**	8.6
Dissolved Oxygen (field)	%	21/05/2015	97	75	97	89	63	92	96	61
Chloride	mg/l	21/05/2015	21	20	23	24	17	26	25	17
Total Suspended Solids	mg/l	21/05/2015	6	7	4	2	7	3	9	4
BOD	mg/l	21/05/2015	<2	<2	<2	<2	<2	<2	<2	<2
COD	mg/l	21/05/2015	11	8	13	11	13	15	15	14
Temperature	°C	20/08/2015	13.2	12.2	13.5	13.4	16.6	13.7	16	16.8
pH (lab)	pH units	20/08/2015	8.2	8	7.9	7.8	**7.7**	7.9	7.9	7.6
pH (field)	pH units	20/08/2015	**8.42**	7.85	**8**	7.9	7.85	7.87	**8.2**	7.85
Electrical Conductivity (lab)	mS/cm	20/08/2015	0.577	0.65	0.536	0.571	0.673	**0.936**	0.674	0.676
Electrical Conductivity (field)	mS/cm	20/08/2015	0.563	0.597	0.503	0.66	0.606	**0.883**	0.667	0.684
Ammoniacal Nitrogen	mg/l	20/08/2015	<0.08	0.08	<0.08	<0.08	<0.08	**3.1**	<0.08	0.09

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
Dissolved Oxygen (lab)	mg/l	20/08/2015	8.5	8.2	7.8	7.8	7.8	7.4	8.2	8
Dissolved Oxygen (field)	%	20/08/2015	99.7	98.2	84.5	99.8	77.8	70	99.1	97.7
Chloride	mg/l	20/08/2015	25	35	31	31	20	**57**	22	20
Total Suspended Solids	mg/l	20/08/2015	2	5	4	1	7	**13**	3	4
BOD	mg/l	20/08/2015	<2	<5	<3	<3	<3	**10**	<3	<3
COD	mg/l	20/08/2015	16	**28**	20	22	23	**69**	25	19
Alkalinity	mg/l	20/08/2015	**310**	**340**	**240**	**275**	95	**480**	110	95
Copper	µg/l	20/08/2015	1	1	0.6	0.6	0.9	2.4	**1.3**	1
Cadmium	µg/l	20/08/2015	<0.03	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03
Calcium	mg/l	20/08/2015	**113**	**120**	**99**	**105**	**117**	**137**	**120**	118
Iron	mg/l	20/08/2015	**0.12**	**0.35**	**0.23**	**0.18**	0.08	**1.5**	**0.11**	0.1
Lead	µg/l	20/08/2015	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09
Manganese	µg/l	20/08/2015	**60**	**240**	**200**	**270**	**50**	**2600**	**60**	70
Magnesium	mg/l	20/08/2015	**8**	**9**	**8**	**8**	**20**	**19**	**17**	19
Mercury	µg/l	20/08/2015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Orthophosphate	mg/l	20/08/2015	1	1	1	1	<1	3	<1	<1
Potassium	mg/l	20/08/2015	4	**8**	5	5	3	**57**	4	3
Sodium	mg/l	20/08/2015	12	**16**	**15**	**15**	**15**	**19**	**16**	16
Sulphate	mg/l	20/08/2015	**29**	19	**42**	**34**	**282**	7	**254**	277
TON	mg/l	20/08/2015	0.35	0.48	0.29	0.32	0.12	0.31	0.19	0.13
Chromium	µg/l	20/08/2015	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Total Phosphorous	mg/l	20/08/2015	0.4	**0.53**	**0.64**	0.46	0.05	**1.5**	0.14	<0.05
Zinc	mg/l	20/08/2015	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Temperature	°C	05/11/2015	9.7	8.8	8.16	9.4	9.2	9.4	9.4	9.1
pH (lab)	pH units	05/11/2015	**7.3**	**7.1**	**6.9**	**6.9**	**6.3**	**7**	**7**	6.1
pH (field)	pH units	05/11/2015	**8.27**	8.03	**8.16**	**8.15**	7.81	8.29	**8.34**	7.96
Electrical Conductivity (lab)	mS/cm	05/11/2015	0.676	0.625	0.624	0.629	**0.804**	0.653	0.659	0.809
Electrical Conductivity (field)	mS/cm	05/11/2015	0.267	0.561	0.507	0.468	0.656	0.54	0.54	0.684
Ammoniacal Nitrogen	mg/l	05/11/2015	0.13	<0.08	<0.08	<0.08	<0.08	<0.08	0.08	<0.08
Dissolved Oxygen (lab)	mg/l	05/11/2015	8.8	**9**	**8.8**	**8.9**	8.8	8.6	**8.8**	9
Dissolved Oxygen (field)	%	05/11/2015	71	70	66	84	88	75	72	93
Chloride	mg/l	05/11/2015	**45**	22	25	28	19	29	28	19

Appendix 12.3: Licence Compliance Surface Water Monitoring Results Q2 2012-Q2 2018

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
Total Suspended Solids	mg/l	05/11/2015	<1	<1	<1	<1	<1	**20**	4	5
pH (lab)	pH units	25/02/2016	**7.9**	7.6	7.7	7.7	7.5	7.9	7.9	7.5
Electrical Conductivity (lab)	mS/cm	25/02/2016	**0.592**	0.529	0.535	0.54	**0.792**	0.605	0.587	0.819
Temperature	°C	25/02/2016	3.7	3.8	2.6	2.8	2.9	3.5	3.3	3.1
Ammoniacal Nitrogen	mg/l	25/02/2016	<0.08	<0.08	<0.08	0.09	0.09	0.12	<0.08	0.08
Dissolved Oxygen (lab)	mg/l	25/02/2016	**9.5**	**9.4**	**9.1**	**9.4**	**9.3**	**9.4**	**9.5**	9.4
Chloride	mg/l	25/02/2016	24	17	20	20	24	24	25	23
Total Suspended Solids	mg/l	25/02/2016	1	8	6	4	5	2	6	7
BOD	mg/l	25/02/2016	<3	<3	<2	<2	<3	<2	<2	<2
COD	mg/l	25/02/2016	15	15	14	14	15	12	10	11
pH (lab)	pH units	31/05/2016	**8.28**	8.1	7.96	8.02	7.37	8.21	**8.13**	7.34
Electrical Conductivity (lab)	mS/cm	31/05/2016	0.712	0.652	0.665	0.709	0.696	0.665	0.684	0.7
Temperature	°C	31/05/2016	15.1	14.2	14.5	14.2	18.3	14.5	16.7	18.1
Ammoniacal Nitrogen	mg/l	31/05/2016	0.04	0.09	0.11	0.12	0.46	0.38	0.1	0.05
Dissolved Oxygen (lab)	mg/l	31/05/2016	**10**	**9**	**9**	**9**	**10**	**9**	**9**	9
Chloride	mg/l	31/05/2016	18.3	18.5	23	25.2	11.1	22.3	25.3	11.2
Total Suspended Solids	mg/l	31/05/2016	<10	<10	<10	<10	<10	<10	<10	<10
BOD	mg/l	31/05/2016	1	1	1	1	**4**	1	1	3
COD	mg/l	31/05/2016	8	11	19	10	22	19	15	21
BOD	mg/l	05/11/2015	**6**	<3	<3	<3	<3	<5	**4**	<3
COD	mg/l	05/11/2015	24	17	21	19	15	**30**	20	16
pH (lab)	pH units	05/09/2016	8.06	7.92	7.64	7.75	7.22	8	7.87	7.16
Electrical Conductivity (lab)	mS/cm	05/09/2016	0.638	0.592	0.656	0.672	0.72	0.668	0.527	0.726
Temperature	°C	05/09/2016	17.9	18	17.8	17	17.4	17.4	17.9	17.7
Chloride	mg/l	05/09/2016	22	21.2	27.7	27.6	15.7	29.8	24.2	15.7
Ammoniacal Nitrogen	mg/l	05/09/2016	0.16	**0.23**	0.15	0.21	0.05	0.78	0.21	0.05
BOD	mg/l	05/09/2016	2	1	3	2	2	2	2	2
COD	mg/l	05/09/2016	20	16	27	20	<7	8	18	<7
Total Suspended Solids	mg/l	05/09/2016	<10	<10	<10	14	<10	11	<10	<10
Dissolved Oxygen (lab)	mg/l	05/09/2016	8	8	7	7	6	8	8	6
Cadmium	µg/l	20/12/2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Calcium	mg/l	20/12/2016	**124**	**131.3**	**127.9**	**129.2**	**170.8**	**136.8**	**131.3**	170.2

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
Total Chromium	µg/l	20/12/2016	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Copper	µg/l	20/12/2016	>7	>7	>7	>7	>7	>7	>7	>7
Iron	mg/l	20/12/2016	<0.02	0.046	0.047	0.039	<0.02	0.03	<0.02	<0.02
Lead	µg/l	20/12/2016	<5	<5	<5	<5	<5	<5	<5	<5
Magnesium	mg/l	20/12/2016	**8.9**	**9.6**	**9.6**	**9.1**	**22.8**	**9.8**	10.3	22.8
Manganese	µg/l	20/12/2016	9	38	32	21	44	7	80	11
Mercury	µg/l	20/12/2016	<1	<1	<1	<1	<1	<1	<1	<1
Potassium	mg/l	20/12/2016	3	3	3.6	3.2	3.8	5.5	3.4	3.8
Sodium	mg/l	20/12/2016	11	10.7	12.1	11.4	15.7	8.6	10.8	15.7
Zinc	ug/l	20/12/2016	<3	<3	<3	<3	<3	<3	<3	<3
Total Phosphorous	mg/l	20/12/2016	0.153	0.141	0.15	0.129	0.048	0.245	**0.202**	0.042
Sulphate	mg/l	20/12/2016	17.6	22.6	23.6	25.4	365.2	35.1	39.7	369
Chloride	mg/l	20/12/2016	16.3	14.7	18.8	20.3	21.5	29.9	21	19.4
TON	mg/l	20/12/2016	1	0.8	0.9	1.2	<0.2	2.7	1.2	<0.2
Ammoniacal Nitrogen	mg/l	20/12/2016	0.04	0.06	0.1	0.11	0.07	0.78	0.49	0.07
Alkalinity	mg/l	20/12/2016	**322**	**322**	**326**	**324**	170	**330**	**332**	170
BOD	mg/l	20/12/2016	<1	<1	<1	<1	<1	<1	<1	<1
COD	mg/l	20/12/2016	<7	<7	<7	<7	<7	12	<7	<7
Dissolved Oxygen (lab)	mg/l	20/12/2016	9	**10**	**9**	**10**	**9**	**11**	**9**	9
Electrical Conductivity (lab)	mS/cm	20/12/2016	0.652	0.672	**0.781**	0.689	**0.965**	**0.744**	0.696	0.99
pH (lab)	pH units	20/12/2016	7.99	7.89	7.75	7.8	7.21	7.83	7.8	7.53
Total Suspended Solids	mg/l	20/12/2016	<10	<10	<10	<10	<10	<10	81	<10
Temperature	°C	20/12/2016	5.1	4	4.2	4.4	3.7	5.1	4.7	3.5
Electrical Conductivity (field)	mS/cm	20/12/2016	0.67	**0.688**	**0.707**	0.719	**1.102**	**0.944**	**0.743**	1.016
pH (field)	pH units	20/12/2016	9.22	9.04	8.9	8.92	8.74	8.82	8.86	8.76
pH	pH units	21/02/2017	8.18	8.08	8.05	8.07	7.66	8.26	8.2	7.69
Electrical Conductivity (lab)	mS/cm	21/02/2017	**0.753**	**0.688**	**0.697**	0.704	**1.092**	**0.727**	0.717	1.111
Temperature	°C	21/02/2017	10.7	10.1	10.3	10.2	10.1	9.9	11	10.4
Ammoniacal Nitrogen	mg/l	21/02/2017	0.06	0.12	0.012	0.12	0.1	0.15	0.12	0.07
Dissolved Oxygen	mg/l	21/02/2017	**10**	**9**	**9**	**9**	7	**10**	**10**	6
Chloride	mg/l	21/02/2017	24.2	18.8	24.7	27.7	20.9	27.7	25.2	21.1
Total Suspended Solids	mg/l	21/02/2017	<10	<10	<10	<10	<10	11	<10	13

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
BOD	mg/l	21/02/2017	1	2	2	1	1	1	<1	<1
COD	mg/l	21/02/2017	17	14	14	10	9	<7	12	16
pH	pH units	24/05/2017	8.22	8.13	8.07	8.13	7.43	8	7.98	7.58
Electrical Conductivity (lab)	mS/cm	24/05/2017	0.715	0.64	0.637	0.642	**0.854**	0.678	0.703	0.837
Temperature	°C	24/05/2017	14.6	14.9	14.6	14.6	16.2	14.9	15.5	17.9
Ammoniacal Nitrogen	mg/l	24/05/2017	0.06	0.14	0.1	0.19	0.16	0.28	0.34	0.12
Dissolved Oxygen	mg/l	24/05/2017	8	8	8	8	8	8	8	7
Chloride	mg/l	24/05/2017	25.1	27.4	31.6	31.9	14.4	19.6	29	14
Total Suspended Solids	mg/l	24/05/2017	<10	<10	<10	<10	<10	<10	<10	54
BOD	mg/l	24/05/2017	<1	2	2	1	**54**	**4**	3	4
COD	mg/l	24/05/2017	<7	<7	<7	11	22	<7	7	15
pH	pH units	25/08/2017	8.19	8.12	**8.1**	8.07	7.12	8.19	**8.03**	7.23
Electrical Conductivity (lab)	mS/cm	25/08/2017	0.561	0.558	0.551	0.602	0.612	0.672	0.618	0.657
Temperature	°C	25/08/2017	14.6	14.4	14.7	15.4	171	15.7	15.6	16.5
Ammoniacal Nitrogen	mg/l	25/08/2017	0.05	0.06	0.06	0.09	0.04	0.09	0.17	0.12
Dissolved Oxygen	mg/l	25/08/2017	9	8	8	8	6	**9**	8	6
Chloride	mg/l	25/08/2017	22	15.9	19.7	22	13.2	25.5	20.9	13
Total Suspended Solids	mg/l	25/08/2017	<10	<10	<10	10	<10	10	<10	<10
BOD	mg/l	25/08/2017	<1	<1	<1	<1	1	<1	1	2
COD	mg/l	25/08/2017	18	20	13	24	11	14	14	15
pH	pH units	16/11/2017	8.08	8.08	**8.01**	8.04	7.6	8.1	8.03	7.3
Electrical Conductivity (lab)	mS/cm	16/11/2017	0.635	0.645	0.652	0.677	**0.95**	**0.797**	**0.726**	1.008
Temperature	°C	16/11/2017	8.4	8.3	8.1	8.1	7.9	8.1	7.9	7.6
Ammoniacal Nitrogen	mg/l	16/11/2017	0.03	0.05	0.08	0.06	0.03	**2.15**	0.23	0.02
Dissolved Oxygen	mg/l	16/11/2017	**10**	**10**	**9**	**10**	6	9	9	4
Chloride	mg/l	16/11/2017	16.5	16.6	23.7	21.7	15.4	32.3	22	15.2
Total Suspended Solids	mg/l	16/11/2017	<10	<10	<10	<10	<10	<10	<10	<10
BOD	mg/l	16/11/2017	<1	<1	<1	<1	<1	<1	<1	<1
COD	mg/l	16/11/2017	7	9	10	25	<7	14	7	<7
pH	pH units	26/02/2018	7.84	8.4	8.96	8.42	8.07	7.85	7.99	8.09
Electrical Conductivity (lab)	mS/cm	26/02/2018	0.637	0.624	0.671	0.978	**0.931**	**0.749**	**0.724**	0.934
Temperature	°C	26/02/2018	2.8	2.8	2.4	2.6	2.4	2.9	3.2	3.4

Appendix 12.3: Licence Compliance Surface Water Monitoring Results Q2 2012-Q2 2018

Parameter	Units	Date	SW1	SW2	SW3	SW5	SW6	SW7	SW8	SW9
Ammoniacal Nitrogen	mg/l	26/02/2018	0.07	0.11	0.34	0.09	0.08	**3.39**	**0.86**	0.08
Dissolved Oxygen	mg/l	26/02/2018	9	10	10	10	9	10	10	9
Chloride	mg/l	26/02/2018	23.8	26	29.6	31.3	27.7	30.6	28.9	27.5
Total Suspended Solids	mg/l	26/02/2018	<10	<10	<10	<10	17	<10	<10	<10
BOD	mg/l	26/02/2018	<1	<1	<1	1	2	1	1	2
COD	mg/l	26/02/2018	12	17	31	13	9	<7	18	20
pH	pH units	06/04/2018	7.71	7.77	7.65	7.63	7.63	7.84	7.66	7.4
Electrical Conductivity (lab)	mS/cm	06/04/2018	0.663	0.658	0.653	0.688	**0.977**	**0.79**	**0.764**	0.968
Temperature	°C	06/04/2018	5.9	5.4	4.5	5.6	7.6	7.5	5.4	6.9
Ammoniacal Nitrogen	mg/l	06/04/2018	0.06	**0.61**	0.09	0.11	0.05	1.48	**0.51**	0.93
Dissolved Oxygen	mg/l	06/04/2018	9	10	10	10	9	10	10	9
Chloride	mg/l	06/04/2018	23.8	26	29.6	31.3	27.7	30.6	28.9	27.5
Total Suspended Solids	mg/l	06/04/2018	<10	<10	<10	<10	17	<10	<10	<10
BOD	mg/l	06/04/2018	<1	<1	<1	1	2	1	1	2
COD	mg/l	06/04/2018	12	17	31	13	9	<7	18	20

Bold font indicates results above the baseline

Appendix 12.4

Northern Storm Water Management




Knockharley Landfill Ltd

Strategic Development Report Knockharley

Chapter 12 Appendix 12.4

Northern Storm Water Management

Prepared for:
Knockharley Landfill Ltd

***Revision:* 0** ***Date:* 20/11/18**

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DATE: 20/11/18 **REVISION:** 0
JOB NUMBER: LW14-821-01
CALC NUMBER: C-06
FILE C:\Users\marieg\Documents\workingfiles\uss.ftco.ie\LW1482101 Chapter 12 Appendix 12.4 _Calc Set 06 Attenuation Pond Design.xls
SHEET Calc Rev Control

PROJECT: Strategic Development Report Knockharley
DESCRIPTION: Attenuation, leachate treatment, and wetland footprints

Page 1 of 12

Rev	Date	Purpose and Description	Prepared	Checked	Reviewed	Approved
0	20/11/2018	Issue for EIAR	CJC	CJC	BG	BG

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Cork : Tel 021-4964133 Fax 021-4964464 **FILE** C:\Users\marieg\Documents\workingfiles\uss.ftco.ie\LW1482101 Chapter 12 Appendix 12.4 Calc Set 06 Attenuation Pond Design.xls
SHEET Storm Water Calc

PROJECT: **Strategic Development Report Knockharley**
DESCRIPTION: **Stormwater design for proposed development and review of existing capacity**

Ref. Output

i References

Previous FTC void/earthworks calculations
1 Waste Licence W0146-02
2 Mullingar rainfall data
3 http://www.iit.ie/pdf/Slurry%20Tank%20Capacity%20Charts.pdf
4 FT WAC tests
5 Flood modelling Knockharly MC / FT
6 Fem Frans flood assessment report Halcrow Barry
7 FT draft layout drawing
8 HECRAS model knockharley stream
9 Development Drawing LW14-821-P-0000-003 Proposed Site Layout Plan
10 Constructed wetlands Stefanakis et al Elsevier ISBN 978-0-12-404612-2 2014
11 Open Channel Hydraulics R French ISBN 0-07-022134-0
12 Hydraulic design of stilling basins and energy dissipators USBR Engineering Monograph No
13 FT Calc set Chapter 12 Appendix 12.1 LW14-812-01 Calc set 02 Check on Southern pond
14 OPW LAR 5 Aug 16

ii Figures

F1 LW14-821-P-0050-002 Proposed Site Layout Plan
F2 Figure 2 3D Overview of Proposed Final Development
F3 Figure 3 Catchment Areas
F4 Figure 4 1:1000 Return Period Rainfall Event and Associated Flood Plain Footprint
F5 Figure 5 Proposed Attenuation Pond Outfall and Compensatory Flood Protection Measures
F6 Figure 6 Channel Section at Node 4769 Adjacent to Proposed Attenuation Lagoon
F7 Figure 7 Culvert Objective to Facilitate d/s flow of 0.6m3/s for 1:1000 yer rainfall event.
F8 Figure 8 Culvert Diameter to Provide 1:1000 compensation.
F9 Figure 9 Upstream Flood Footprint for top of water surface @ 60.50 m AOD
F10 Figure 10 Upstream Flood Footprint for top of water surface @ 6.95 m AOD (Blocked Culvert)

iii Appendices

		Attached to EIS submission
A	GDSDS Procedure	No
B	EIS Development Area	No
C	GDSCS Runoff Assessmennt	No
D	Pond size	No
E	Compensatory Flood Area	No
F	Outflows	No
G	Weir Calc	No
H	Met Rainfall	No
I	Suspended Solids	No
J	Sand Filter	No
K	Femrams Study prepared by Barry (not	No
L	Southern Pond	No
M	OPW Flood Risk	Yes

Ref.

Output

Contents

1.0 Introduction and Purpose

There is a surface water divide on the site running east to west and there will be a requirement to install new stormwater outfall on the northern perimeter to accommodate development of future cells for the currently permitted planning development and to provide an outfall for the proposed IBA landfill. In addition provison will also be required to provide additional compensatory flooding to replace that which will removed by the proposed development footprint.

The purpose of this calc set is to:

Define the catchment area and associated Qbar flows
Size and locate appropriate attenuation storage
Make provison for suspended solid loadings as may developep during operations and capping to facilitate compliance with 25mg/l ELV license limit

Make provision for compensatory flood provision to offset that which will be lost by landfllling within the existing flood plain

2.0 Design Criteria

Run off assessment to be defined using GDSDS procedure suggested by the Greater Dublin Strategic Drainage Study, detailed design criteria for design elements presented in respective sections

3.0 Stormwater Attenuation

3.1 Overview

Stormwater calcs for the 2017 planning application are presented in 4.0 below. EIS submission excludes supporting Appendices listed below

A GDSDS Procedure - Overview of philosophy to size storm pond based on Greater Dublin Strategic Drainage Study

B EIS Devl Area
C - GDSDS- Sizes attenuation pond
D Pond size -
E Comp Flood Area
F Outflow
G Weir Calc
H Met rainfall-
I SS removal
J sand filter
K FEMFRAMS Flood study carried out by Barrys not presented in EIS calc set
L Southern Pond

The following appendix has been included in EIS submission
M Flood Risk Report OPW

3.2 Catchment

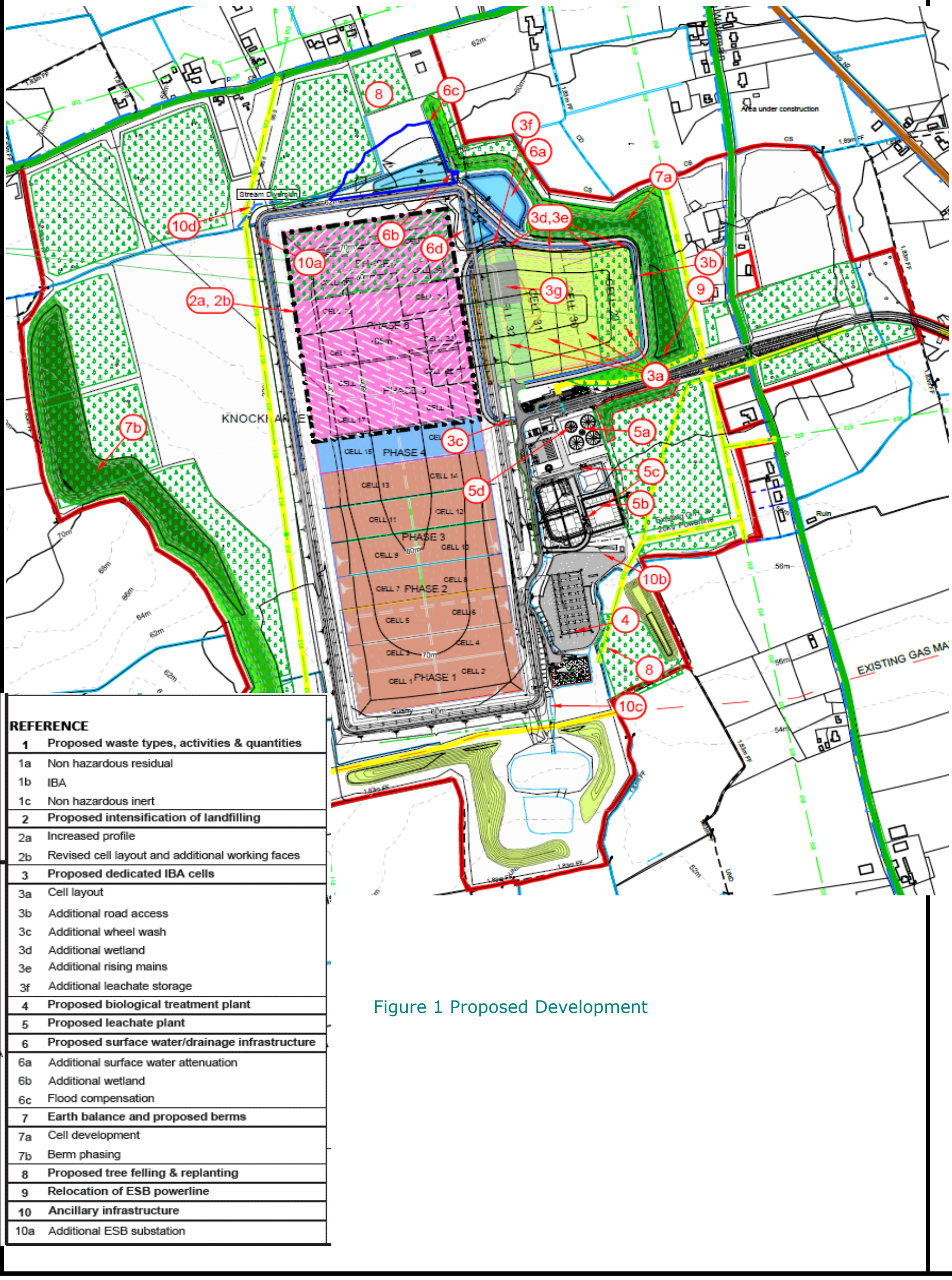
Impervious runoff applies to the operational phase when it is assume that:
Runoff coefficient on roads and hardstading is 100 % of roads
Runoff coefficient for ash and MSW caps is 0.5. This assumes pro-active covering of waste

Current site development area 66.19 ha to facilitate definition of Q_{bar}
Impervious area 17.45 ha

Sheet "EIS Dev Area" summary outputs

Description	ha	m^2	Factored	Sub T	Total
Development Area	66.19	661,863	66.19		66.19
Remaining	43.25		43.25	0.10	4.33
IBA landfill and MSW cells	19.63	196,267	19.63	0.50	9.81
Future cell					
Impervious allow 5%	3.31	33,093	3.31	1.00	3.31
Totals			**66.19**		**17.45**

F1



REFERENCE

1	**Proposed waste types, activities & quantities**
1a	Non hazardous residual
1b	IBA
1c	Non hazardous inert
2	**Proposed intensification of landfilling**
2a	Increased profile
2b	Revised cell layout and additional working faces
3	**Proposed dedicated IBA cells**
3a	Cell layout
3b	Additional road access
3c	Additional wheel wash
3d	Additional wetland
3e	Additional rising mains
3f	Additional leachate storage
4	**Proposed biological treatment plant**
5	**Proposed leachate plant**
6	**Proposed surface water/drainage infrastructure**
6a	Additional surface water attenuation
6b	Additional wetland
6c	Flood compensation
7	**Earth balance and proposed berms**
7a	Cell development
7b	Berm phasing
8	**Proposed tree felling & replanting**
9	**Relocation of ESB powerline**
10	**Ancillary infrastructure**
10a	Additional ESB substation

Figure 1 Proposed Development

F2

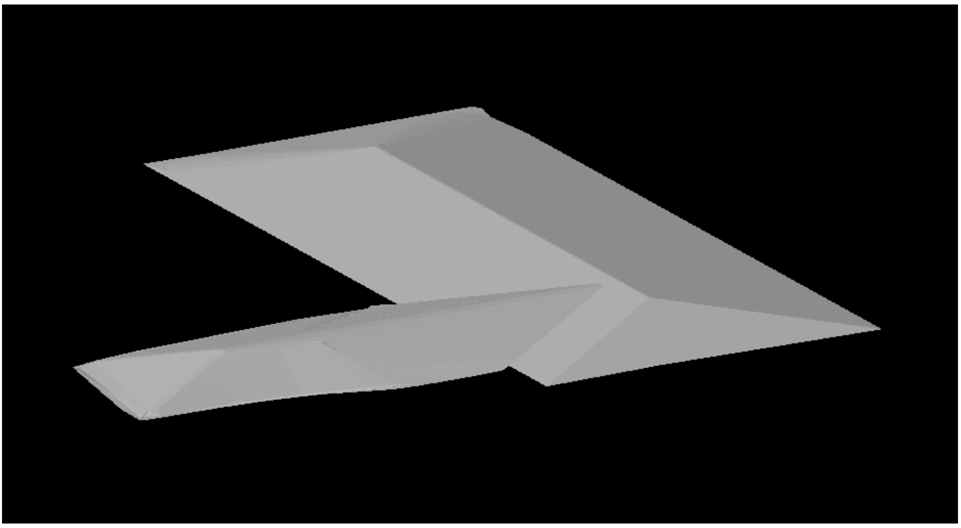


Figure 2 3D Overview of Proposed Final Development

F3

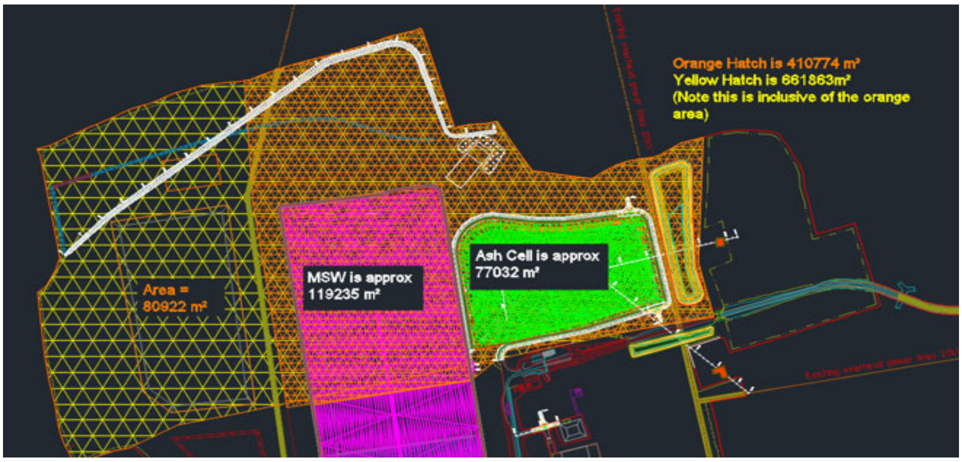


Figure 3 Catchment Areas

3.3 Flood Compensation

Proposed works impact on Nannymodel Flood extents. Philosophy adopted was to create equivalent or greater storage than that which will be lost in placing the landfill footprint within the existing flood plain

The proposed landfill and attenuation pond footprints overly a flood plain impacted by 1:1000 year return rainfall events. Preliminary studies indicate that 7,000 m^3 will be lost as a result of the proposed devlopment. To offset this loss the design proposal is to install a culvert within anan embankment to throttle 1:000 year flows, cause localised upstream containment and thereby provide equivalent or greater attenuation to that which was prviously provided by low lying areas. See Figures 3 and 4 below.

F4

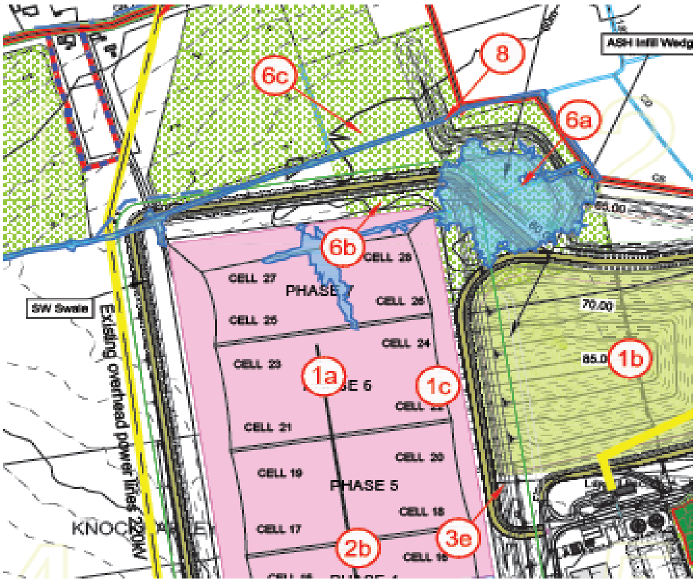


Figure 4 1:1000 Return Period Rainfall Event and Associated Flood Plain Footprint

F5

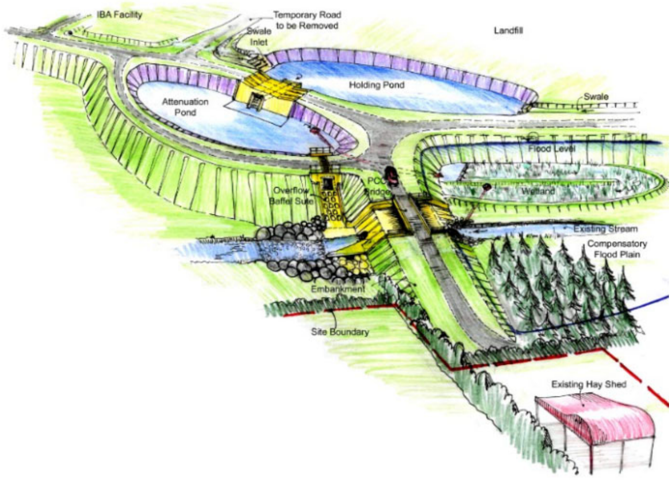


Figure 5 Proposed Attenuation Pond Outfall and Compensatory Flood Protection Measures

Ref.

Output

4.0 Stormwater Design Summary Inputs and Infrastructure Requirements

4.1 GDSDS Outputs

			Notes	
	Phase 1		Length m	Width m
Development Area ha	66.19			
Impervious Area ha	17.45			
1:20 Pond Storage m^3 requirement	3,672			
Live storage Phase 1 m^3	4,698		146	65
Dead storage m^3	4,969			
0.75m Freeboard m^3	4,034			
Excavated volume m^3				
Nutrient Removal	OK	OK		
Spillage capacity	OK	OK		
Suspended solids GDGDS	OK	OK		
Suspended solids removal	100%		Based on BH 8, 10, 10A and 15 from Original WYG EIS	
Out flow pipe for 1:20 year mm		600	No hydro brake required	
Weir length 1:100 year Return period m		7.00		
Pipe diameter for spill mm		1000	Outflow form Pond and Wetland	

4.2 Wetland

Wetland not required for suspended solids compliance downstream of the attenuation lagoon. However given there may be a risk of colloidal suspensions, provision will be made in planning application for wetlands d/s of attenuation lagoon outfall prior to discharging into watercourse. The Wetland will polish s/s solids further, i.e less than 25mg/l.

Ref 10 The wetland will be a free water surface wetland. Traditionally these wetlands are effective at removing suspended solids, and BOD. Removal of nitrogen pathogens and other pollutants e.g heavy metals is high. Phosphorous removal will however be low.

4.3 Pipe Outflow

1:20 year greenfield flow rate 255.32 l/s

Two alternatives available either a floating discharge or a pipe discharge. In event that a pipe discharge is employed with a 2.0m live head the required diameter for a 1:20 year discharge is 300 mm.

4.4 Spill

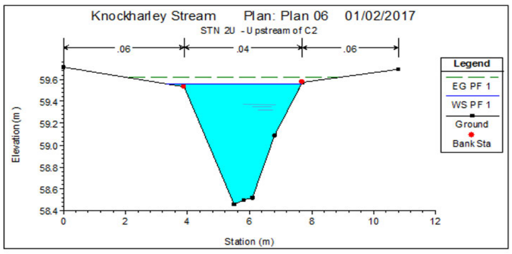
In the event that out flow pipes become blocked or pipe design flows are exceeded spill and energy dissipation will be required.

	Spill design capacity to be 1:100 or greater	Design flow rate	329.22	l/s throttle	
	Maximum 1:100 flow if outflow blocked and pond full		3.24	m^3/s	
Ref 12	Energy dissipation to use USBR baffle chute	Design flow rate	35	cf/s/ft	
			0.99	m^3/s/ft	
			3.30	m^3/s/m	
	BC Minimum width for construction 1000 mm		1000	mm	OK
	Spill requirement	Design flow rate	3.24	m^3/s	
AppG	Spill Length		13.25	m	

5.0 Nanny Compensatory Flood Provision

Ref 8 The proposed foot print impinges on a natuarally occuring flood plain which comes into effect following a 1:1000 return period rainfall event. The low lying area lies within the fooprint of the permitted development and in the natural low point where it is proposed to install an attenuation lagoon. The footprint also requires a minor stream re-alignment, see Figure 4.

F6



1 in 1000 year River Model at Node 4769 – HECRAS

Figure 6 Channel Section at Node 4769 Adjacent to Proposed Attenuation Lagoon

Figure 6 above is an extract from HERAS modelling carriedout an shows that minor overtopping of the existing channel occurs following a 1:1000 RT rainfall event.

5.1 Design Criteria for Compensatory Flooding

					Summary outputs from Sheet FEMFRAMS
	Existing flood storage 1:1000		7677	m^3	Ref 6 & FT GIS/CAD modelling
Ref 8	1:100 flood flow rate		1.83	m^3/s	HECCRAS Design flow @ node 4769
Ref 8	1:1000 flood flow rate		2.43	m^3/s	HECCRAS Design flow @ node 4769
	1:100 throttle flow		0.60	m^3/s	Diff between 1:100 and 1:1000
	Bank		59.62	m	HECCRAS Design flow @ node 4769
	Invert		58.4	m	HECCRAS Design flow @ node 4769
	HWL 1:100		59.39	m	HECCRAS Design flow @ node 4769
	HWL 1:1000	60.5	59.56	m	HECCRAS Design flow @ node 4769
	Target u/s elevation		60.5	m	Gives 7,977 m^3

HECRAS modeling carried out by FT in 2010 showed the 1.83 m^3/s (1:100) was contained within stream. 2.43 m^3/s1:1000 opertopped slightly by some 170 mm

This overtopping was accommodated in low lying areas (7,677 m^3)

The flood component of the design flow that needs to be accommodated in upstream storage is therefore any flow in excess of the 1:100, 1.83m^3/s flow, and equal to or less than the 1:1000 flood event (i.e. 2.43 m^3/s)

This can be achieved by lowing the proposed attentuation pond to accommodate compensatory flooding and attenuation or by causing compensatory flooding u/s

If the pond were to be deepened groundwater may be a problem and it would either cause pond to float or fill in the attenuation void. Therefore attenuation at the natural low point i.e the existing compensation area is not sensible. Furthremore this low point is proposed for attenuation of storm water runoof from the permitted and proposed developments.

Accordingly it is recommended that compensatory flooding be initiated immediately upstream of the proposed attenuation pond location.

Therefore the design objective is to install a culvert that will convey 1:100 year storm flows unimpeded but throttle 1:1000 flows such that compensatory storage occurs immediately u/s of the proposed culvert.

5.2 Culvert Analysis

5.2.1 Compensatory Flood Volume and 1:1000 Elevations

3D modelling shows that the following compensation volumes can be relalised for respective elevations:

Elevation m	Volume m^3
59.9	1,251
60.25	4,467
60.5	7,977
61	16,571
61.4	31,028

5.2.2 Culvert Concept

Figure 4 artists impression is summarised below in Figure 7

F7 Target elevation

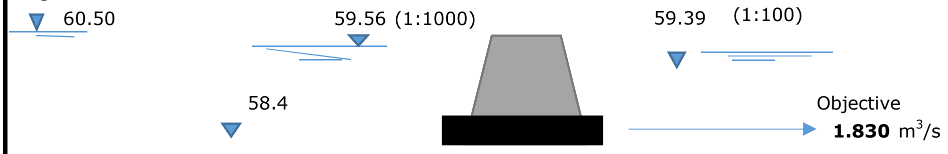
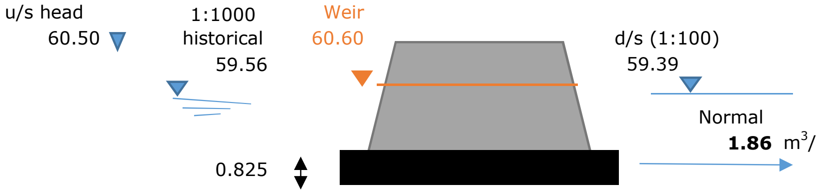


Figure 7 Culvert Objective to Facilitate d/s flow of 0.6m3/s for 1:1000 yer rainfall event.

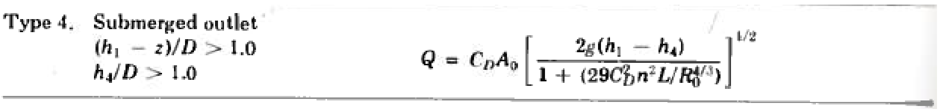
F8



OK

Structure return period design based on 1:100 Ok

Figure 8 Culvert Diameter to Provide 1:1000 compensation.


Type 4. Submerged outlet
$(h_1 - z)/D > 1.0$
$h_4/D > 1.0$

$$Q = C_D A_0 \left[\frac{2g(h_1 - h_4)}{1 + (29 C_D^2 n^2 L / R_0^{4/3})} \right]^{1/2}$$

5.2.3 Culvert Underflow Capacity

Ref 11

Diameter	0.825		
A	0.53456	2g(h1-h4)	21.778
P	2.59181	CdAo	0.441
R	0.20625	L/R^4/3	49.211
Cd	0.825	1+29 Cd^2n^2*L/R^4/3	1.2186
(h1-h4)	1.11	Nb head required to pass 1.83 m^3/s aprox 750-800 mm	
n	0.015		
L	6	Culvert d/s 1500 mm diam	
Q	1.864 m^3/s		

Ref.

Output

5.2.4 Weir Calc

The 1000-year discharge	2.43	m^3/s	
Head over weir	0.35	m	
Discharge through broad crested weir, Q* = 1.705*B*H^1.5			
Weir width	7.00	m	
Discharge capacity of the weir, Qcap =	2.47	m^3/s	OK
Weir elevation	60.60	m	
Flood level if culvert blocked	60.95	m	

F9

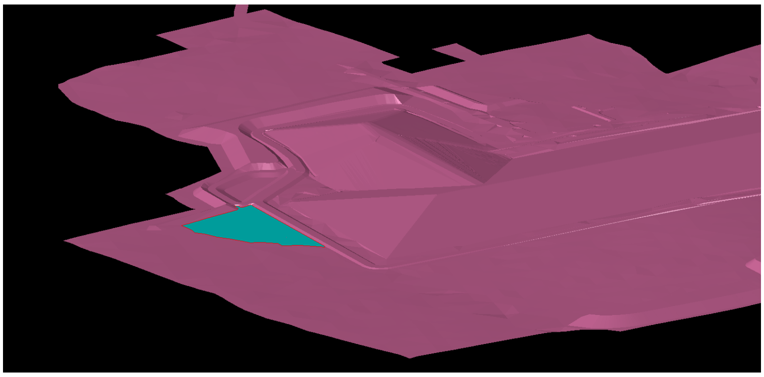


Figure 9 Upstream Flood Footprint for top of water surface @ 60.50 m AOD

F10

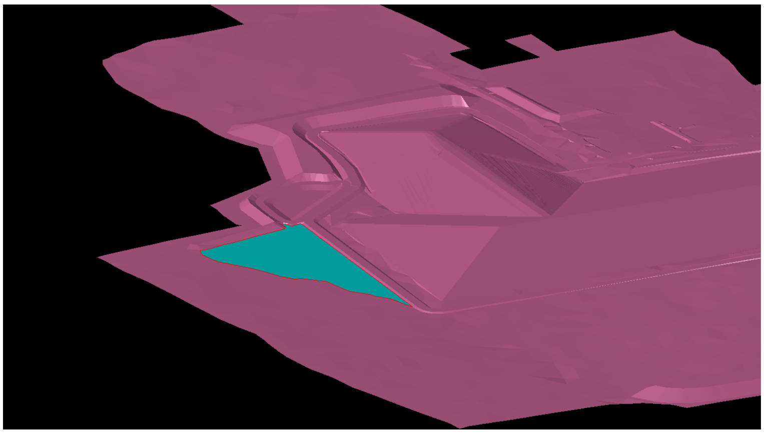


Figure 10 Upstream Flood Footprint for top of water surface @ 6.95 m AOD (Blocked Culvert)

Installation of a culvert will not impede fish movements.
Assuming a worst case scenario with of a blocked culvert the spill will overflowy and the ponding footprint may extend as shown in Figure 10 and still remain within the licensed boundary.

5.2.5 Miscellaneous Considerations

Installation of a culvert will not impede fish movements.

Assuming a worst case scenario with of a blocked culvert the spill will come into play and the ponding footprint may extend as shown in Figure 9 and still remain within the licensed boundary.

OPW Section 50 required for proposed culvert and stream realignment

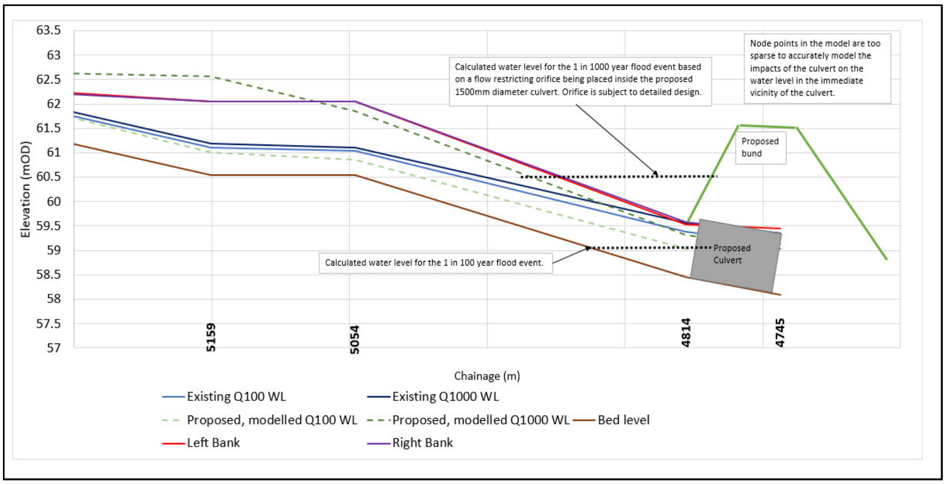
During detailed design following need to be examined

Exit gradient
Need or othewise for piles to address exit gradient if a problem
Scour depth. For EIS purposes assume 1.0m
Concrete protection to embankment
Assume sequent depth will submerge hydraulic jump
If culvert blocked sequent depth may not submerge hydrualic jump under low flow conditions
Head accoss culvert during reepsctie flow conditions and analysis may impact orifice diameter

5.3 HECRAS Results

River Sta	Description	1 in 100 year flood event			1 in 1000 year flood event		
		Water surface elevation (mOD)		Change in water level (m)	Water surface elevation (mOD)		Change in water level (m)
		Existing Scenario	Proposed Scenario		Existing Scenario	Proposed Scenario	
5500*		63.94	63.94	0	64.39	64.39	0
5499*		Culvert			Culvert		
5494*	Downstream of existing culvert at western perimeter	63.64	63.64	0	63.86	63.86	0
5408*		62.71	62.77	0.06	62.79	62.72	-0.07
5159*		61.11	61	-0.11	61.19	62.57	1.38
5054*		61.04	60.84	-0.2	61.1	61.85	0.75
4814	Flood Compensation Culvert	59.39	59.028***	-0.362	59.56	60.5**	0.94
4745		59.13	58.92	-0.21	59.35	59.04	-0.31
4736		58.66	58.66	0	58.75	58.75	0
3755		58.25	58.25	0	58.4	58.4	0
3754		Culvert			Culvert		
3737		57.63	57.63	0	57.67	57.67	0
2942		53.5	53.5	0	53.81	53.81	0
2622		52.7	52.7	0	53.23	53.23	0
2621		Culvert			Culvert		
2612		52.68	52.69	0.01	53.23	53.23	0
1615		48.25	48.25	0	48.09	48.09	0
1603		Culvert			Culvert		
1569		48.13	48.13	0	47.94	47.94	0
1112		46.14	46.14	0	46.67	46.67	0
1100		Culvert			Culvert		
1074		46.08	46.08	0	46.47	46.47	
1072		Culvert			Culvert		
1067		45.17	45.17	0	45.3	45.3	0
15		38.35	38.35	0	38.63	38.63	0
8		Culvert			Culvert		
0		38.07	38.07	0	38.17	38.17	0

*chainage increases by 8m as a result of the stream diversion for the proposed scenario
Proposed Scenario has a 825mm diameter orifice in the flood compensation culvert at chainage 4814 to achieve a storage level of 60.5mOD in a 1 in 1000 year flood.
** Based on top water level required to achieve compensatory storage
*** Reduced water level due to the removal of culvert downstream



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DATE:	20.11.18	**REVISION:**	0
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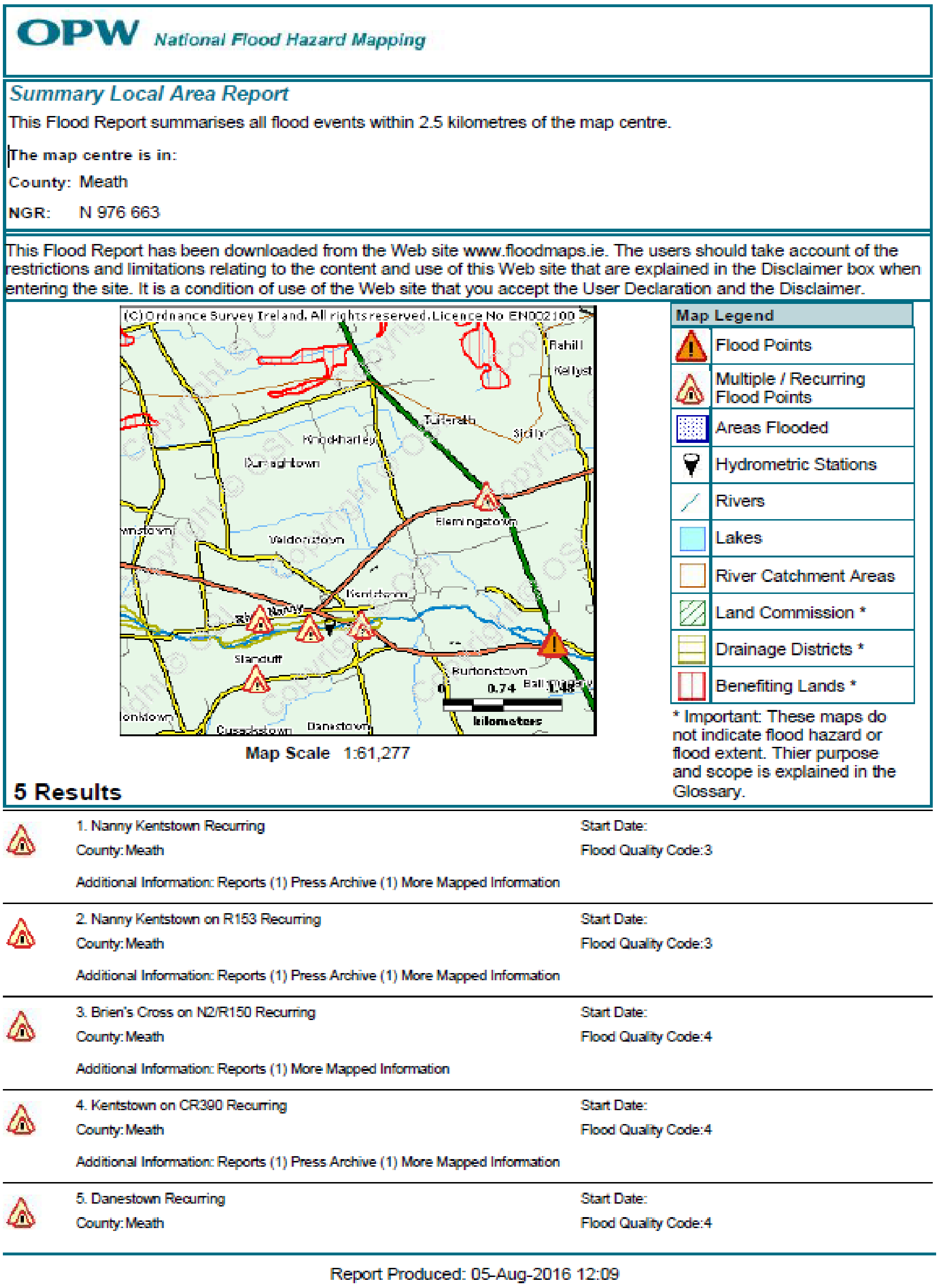
CALC NUMI	c-06		
FILE	C:\Users\marieg\Documents\workingfiles\uss.ftco.ie\LW1482101 Chapter 12 Appendix 12.4 _Calc Set 06 Attenuation Pond Design.xls		
SHEET	M Flood Risk Report		

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCI
Cork : Tel 021-4964133 Fax 021-4964464

PROJECT: **Strategic Development Report Knockharley**
DESCRIPTION: **Flood Risk Report**



OPW *National Flood Hazard Mapping*

Summary Local Area Report

This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:
County: Meath
NGR: N 976 663

This Flood Report has been downloaded from the Web site www.floodmaps.ie. The users should take account of the restrictions and limitations relating to the content and use of this Web site that are explained in the Disclaimer box when entering the site. It is a condition of use of the Web site that you accept the User Declaration and the Disclaimer.

Map Scale 1:61,277

Map Legend	
⚠	Flood Points
⚠	Multiple / Recurring Flood Points
▨	Areas Flooded
▼	Hydrometric Stations
╱	Rivers
▢	Lakes
▢	River Catchment Areas
▨	Land Commission *
▤	Drainage Districts *
▥	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

5 Results

⚠	1. Nanny Kentstown Recurring County: Meath Additional Information: Reports (1) Press Archive (1) More Mapped Information	Start Date: Flood Quality Code:3
⚠	2. Nanny Kentstown on R153 Recurring County: Meath Additional Information: Reports (1) Press Archive (1) More Mapped Information	Start Date: Flood Quality Code:3
⚠	3. Brien's Cross on N2/R150 Recurring County: Meath Additional Information: Reports (1) More Mapped Information	Start Date: Flood Quality Code:4
⚠	4. Kentstown on CR390 Recurring County: Meath Additional Information: Reports (1) Press Archive (1) More Mapped Information	Start Date: Flood Quality Code:4
⚠	5. Danestown Recurring County: Meath	Start Date: Flood Quality Code:4

Report Produced: 05-Aug-2016 12:09

Appendix 12.5

Flood Risk Assessment

APPENDIX 12-5

FLOOD RISK ASSESSMENT FOR A PROPOSED DEVELOPMENT AT KNOCKHARLEY LANDFILL, COUNTY MEATH

KNOCKHARLEY LANDFILL LTD.

NOVEMBER 2018

Knockharley Landfill Ltd.
Kentstown, Navan,Co.Meath

FEHILY
TIMONEY
& COMPANY

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1 FLOOD RISK ASSESSMENT

1.1 Background

Fehily Timoney & Company (FT) was commissioned by Knockharley Landfill Ltd. to prepare a Flood Risk Assessment (FRA) for a proposed development at Knockharley Landfill in Navan, County Meath to support the planning application for the site.

The proposed development comprises:

- the acceptance of 444,000 tonnes of waste for non- hazardous cells
- raising the height of future cells in the permitted development from 74 mAOD to 85 mAOD (and construction of permitted cells under current planning permission)
- a new IBA facility including building within new cells
- a biological treatment facility comprising a building and hardstanding marshalling yard
- a leachate management facility comprising hardstanding areas, bunded storage and floating cover lagoons
- screening berms
- a surface water management system comprising holding pond, attenuation lagoon and wetland
- a culvert and embankment across the existing Knockharley stream to provide compensatory flood provision to offset lost flood storage realised during a 1:1000-year storm that will be lost as a consequence of providing storm water attenuation provision for both the permitted and proposed future developments
- felling of c. 12.5 ha forestry and replanting of c.16.8 ha
- 2 no. new ESB sub stations and new overhead 20kVA ESB supply
- extension of existing below ground infrastructure (power, water, telemetry, leachate rising mains, drainage) and car park extension at existing administration building

The proposed new development shall, generally, be executed within a ‘green field’ setting. Refer to Drawings LW14-821-01-P-0000-003 to LW14-821-01-P-0000-011 for the proposed site layout in Volume 4 of this EIAR.

The proposed new development at Knockharley Landfill will require the surface water management system to be constructed in 1:1000-year flood plain. This report examines the site-specific flood risk assessment and was prepared in accordance with the guidelines produced by the Department of Environment, Heritage and Local Government (DoEHLG) – “The Planning System and Flood Risk Management Guidelines for Planning Authorities” (November 2009).

1.2 Scope and Purpose

The flood risk assessment for the proposed development was prepared by assessing the extent of the catchment which had the potential to be impacted upon by the proposed development. The history of flooding in the existing environment was then examined and any potential increase in the risk of flooding due to the proposed development was estimated. The flood risk posed to the proposed development was also considered. The cumulative impact of the proposed development along with any other nearby developments was considered in the flood risk assessment.

Lands for the proposed development would originally have drained towards the Knockharley Stream which runs through the site, however much of the site is now artificially drained. Drainage from the landfill facility is currently directed towards a storm water pond located on the southern boundary of the facility and afterwards to a constructed wetland before it flows into the Knockharley Steam.

Drainage from adjoining lands is now directed around the facility and flows into the local drainage network at the southern edge of the facility.

As part of the proposed development it is proposed to divert the stream that runs to the north of the proposed development to follow a route further north to ensure that the watercourse will run sufficiently clear of the permitted development works.

A previous hydrological study undertaken by FT in 2011, included modelling of the Knockharley Stream where it enters the site up to where it joins the River Nanny. This model was adopted as part of this flood risk assessment, to determine the impact of the proposed new watercourse diversion and the inclusion of outfalls from the drainage of the proposed new development at Knockharley Landfill. The model was run for extreme flood events, for the 1 in 100-year return period and the 1 in 1000-year return period events.

Flood mapping produced by the OPW as part of the Preliminary Flood Risk Assessment (PFRA) indicates that the land in an area of the proposed development lies within an area which is susceptible to flooding in the 1 in 1000-year flood event. This mapping shows an indicative flood extent outline. It is this mapping which has formed the basis for this flood risk assessment.

The purpose of this flood risk assessment is to assess the risk posed to the proposed development from fluvial and pluvial flooding. The flood risk arising from the proposed development, the change in the run-off characteristics of the site and the consequent effects on the receiving environment are also considered. Where required, mitigation measures will be proposed and incorporated into the layout design for the proposed development.

This flood risk assessment has been carried out using information from the OPW PFRA mapping together with the available topographical survey data of the site for the proposed development.

In this way a site-specific definition of the probabilities of flood risk was interpreted for the site. Flood zone mapping was prepared as an output from this assessment.

1.3 Regional and Local Spatial Plans

In the Regional Planning Guidelines for the Greater Dublin Area 2010-2022 the key policy recommendations are set out, regarding avoidance and management of flood risk within the Greater Dublin Area (GDA) with the objective of promoting:

1. The identification of appropriate policy responses for priority areas, including areas that transcend administrative boundaries and where there appears to be significant flood risk.

2. Requirements on foot of the guidelines for co-operation, implementation and co-ordination of more detailed area level strategic flood risk assessment in City and County Development Plans and Local Area Plans.

A Regional Flood Risk Appraisal is contained within the Environment Report prepared as part of the Strategic Environmental Assessment of the Regional Planning Guidelines.

The Regional Planning Guidelines recognise the need to protect, across the GDA, the natural flood plains and riparian corridors of all rivers in the region that have not already been built on.

In the Environmental Report prepared as part of the Strategic Environmental Assessment of the Regional Planning Guidelines, the Regional Flood Risk Appraisal does not highlight the area for the proposed development at Knockharley Landfill in particular, however generally, of increasing concern, as outlined in the appraisal are the consequences of climate change which are impacting on sea levels, the nature and pattern of rainfall events and general weather patterns.

The Regional Flood Risk Appraisal also cites The Department of the Environment, Heritage and Local Government and the Office of Public Works (OPW) Planning Guidelines The Planning System and Flood Risk Management, in November 2009 and advocates that these guidelines provide a clear and transparent assessment of flood risk at all stages in the planning process and set out that regional flood risk appraisal and management policy recommendations are necessary to set a policy framework for Development and Local

Area Plans at the local level. Key guiding principles for Flood Risk Assessment are as follows:

- Avoid Risk where possible.
- Substitute less vulnerable uses where avoidance is not possible.
- Mitigate and manage the risk where avoidance and substitution are not possible.

The Regional Flood Risk Appraisal recognises the work undertaken by the OPW, who is currently involved in preparing catchment-based flood risk management plans (Catchment Flood Risk Assessment and Management (CFRAM) Studies with the relevant local authorities, the Environmental Protection Agency (EPA) and other key agencies, providing an integrated and pro-active approach to flood risk and the mechanism through which predictive flood maps and Flood Risk Management Plans (FRMPs) are being developed.

These CFRAM studies will establish a prioritised set of flood risk management measures for their relevant areas, including the use of physical and management responses. The River Nanny and its tributaries were modelled as part of the Fingal East Meath Flood Risk Assessment and Management (FEM FRAM) Study. This included the Knockharley Stream up to approximately 2 km upstream of the site. The results of the modelling in the FEM FRAM Study will be considered as part of this flood risk assessment.

The relevant Development Plan is the Meath County Development Plan, 2013-2019. The policies and objectives set out in this plan related to flood protection are summarized below:

It is the policy of Meath County Council:

WS POL 29 *To have regard to the "Planning System and Flood Risk Management – Guidelines for Planning Authorities" (DoEHLG/OPW, 2009) through the use of the sequential approach and application of the Justification Tests for Development Management and Development Plans, during the period of this Plan.*

WS POL 30 *To have regard to the findings and recommendations of the current Strategic Flood Risk Assessment prepared as part of the County Development Plan review. See Appendix 6.*

WS POL 31 *To ensure that all developments have regard to the surface water management policies in the Greater Dublin Strategic Drainage Study (GDSDS). Compliance with the recommendations contained in Technical Guidance Document, Volume 2, Chapter 4 of the Greater Dublin Strategic Drainage Study shall be required in all instances.*

WS POL 32 *To ensure that a flood risk assessment is carried out for any development proposal, where flood risk may be an issue in accordance with the "Planning System and Flood Risk Management – Guidelines for Planning Authorities" (DoECLG/OPW, 2009). This assessment shall be appropriate to the scale and nature of risk to the potential development.*

WS POL 33 *To consult with the Office of Public Works in relation to proposed developments in the vicinity of drainage channels and rivers for which the OPW are responsible, and the Council will, retain a strip of 10 metres on either side of such channel where required, to facilitate access thereto.*

WS POL 34 *To consult, where necessary, with Inland Fisheries Ireland, the National Parks and Wildlife Service and other relevant agencies in the construction of flood alleviation measures in County Meath.*

WS POL 35 *To ensure that flood risk management is incorporated into the preparation of Local Area Plans and Town Development Plans in accordance with 'The Planning System and Flood Risk Management - Guidelines for Planning Authorities (2009)'*

WS POL 36 *To have regard to the recommendations of the Fingal East Meath Flood Risk Assessment and Management Study, the Eastern, North West and Neagh Bann Catchment Flood Risk Assessment and Management Study when finalised and approved*

It is the objective of Meath County Council:

WS OBJ 11 *To undertake a review of the 'Strategic Flood Risk Assessment for County Meath' following the publication of the flood mapping which is being produced as part of the Catchment Flood Risk Assessment and Management (CFRAM) Studies.*

***WS OBJ 12** To design flood relief measures to ensure appropriate protection for alluvial woodland (i.e. a qualifying interest) along the Boyne.*

***WS OBJ 13** To design flood relief measures to protect the conservation objectives of Natura 2000 sites and to avoid indirect impacts of conflict with other qualifying interests or Natura 2000 sites.*

***WS OBJ 14** To promote positive flood relief measures that can enhance habitats in the Boyne floodplain such as swales, constructed wetland basins etc.*

***WS OBJ 15** To seek to ensure that construction works are designed so as not to result in surface water runoff into cSAC or SPAs either directly or indirectly via a watercourse.*

A Strategic Flood Risk Assessment (SFRA) was prepared for County Meath for the Meath CDP 2013-2019. Flood Zone mapping was prepared as part of this SFRA, indicating Flood Zones A (1% AEP) and Flood Zones B (0.1% AEP) in the vicinity of the urban settlements in County Meath.

Following a study of the Flood Zones indicated in the SFRA, it was observed that the proposed development site is outside the scope of the settlements assessed as part of this SFRA. The SFRA concludes that Flood Risk Management policies should be implemented from the CDP. The flood forecasting and warning system was recommended for the Nanny River & Delvin River.

This Site-Specific Flood Risk Assessment sets out to achieve the aims and objectives of the Regional Planning Guidelines and the development plan with respect to flood risk and the proposed development.

1.4 Methodology

The site-specific flood risk assessment was prepared by an in-house specialist water engineer in FT. The flood risk assessment was prepared in accordance with the guidelines produced by the Department of Environment, Heritage and Local Government (DoEHLG) – "The Planning System and Flood Risk Management Guidelines for Planning Authorities" (November 2009).

The methodology used to prepare the flood risk assessment followed a sequential approach as follows:

1. The Q100 flood level was determined from the modelling in the Hydrological Study prepared by FT in 2011, along with the modelling prepared as part of the FEM FRAM Study and the areas at risk on site identified from the available topographical survey of the site.
2. The Site-Specific Flood Risk Assessment Report was prepared in accordance with the guidelines produced by the Department of Environment, Heritage and Local Government (DoEHLG) - *The Planning System and Flood Risk Management Guidelines for Planning Authorities, November 2009.*

   The report was prepared as follows:

   a. The nature and location of the development was described in terms of the existing hydrological environment.
   b. All existing historical information on previous events was set out as made available from the Office of Public Works (OPW) flood hazard mapping website and the OPW CFRAM Study website.
   c. A predictive assessment of less frequent or more extreme events (i.e. events with a return period of 1 in 100 and a 1 in 1000) was developed.
   d. Flood zones were identified.
   e. The impact of the proposed development on flood risk elsewhere was addressed.
   f. The vulnerability of those that could occupy the proposed development was considered in terms of their safe access and egress from the development i.e. construction personnel, operators, visitors, maintenance workers and the public.
   g. Modifications were proposed to mitigate any flood risk to or from the proposed development, together with examining the consequences of their failure. Evidence of the degree of confidence in the success of these mitigation measures was also declared.
   h. Residual risks were identified.
   i. A Justification Test was applied to this proposed development.

1.5 Supporting Appendices

Supporting Appendices in this report also present the following information:

Appendix A:	OPW Flood Map Report
Appendix B:	Justification Test
Appendix C:	Hydrological Calculations and a summary table defining key hydrological and hydraulic design assumptions and criteria
Appendix D:	OPW Summary Local Area Report showing the River Nanny in flood in mid-November 2009. Photographs from Balrath over a 3km stretch to Duleek.

2 EXISTING HYDROLOGICAL ENVIRONMENT

2.1 Location of Proposed Development

The proposed development is located to the north of Kentstown, at Knockharley, in Navan, County Meath, as shown in Drawing LW14-821-01-P-0000-003 Existing Site Layout in Volume 4 of this EIAR.

The nearest environmentally designated sites, Laytown Dunes/Nanny Estuary proposed Natural Heritage Area (pNHA), Site Code 000554 and River Nanny Estuary and Shore Special Protection Area (SPA), Site Code 004158, lie approximately 21km by hydrological links to the west of the boundary of the existing and proposed development at Knockharley Landfill site, at its nearest point. It is not anticipated that the proposed development will impact on these or any other environmentally designated sites.

2.2 Existing Drainage

2.2.1 General Site Drainage

A detailed description of the existing surface water regime is included in Chapter 12 and Appendix 12.6 Hydrological Study of Volume 3 of this EIAR.

The site is sloped with elevations ranging from 70mOD in the north west to 55mOD in the south east of the site. The site is a mix of, constructed landfill and associated facilities with some forested areas, some woodland scrub and marshland.

The drains and watercourses in the vicinity of the site are shown on Volume 2 Chapter 12 Surface Water Figure 12.2– Hydrological Features Map of this EIAR.

2.2.2 Internal Site Drainage

A site walkover survey took place on 27 July 2016 and 5 August 2016, to establish the pattern of existing drainage on the site and to record any significant hydrological features on the proposed development site. The hydrological features of the site were noted and these features are shown in Volume 2 Chapter 12 Surface Water Figure 12-3. A repeat walkover survey was carried out on 16 November 2018 and confirmed no changes to the existing drainage on site or to the significant hydrological features.

Surface water run-off from the site drains over land and via a network of forestry and manmade drainage ditches to tributary streams of the River Nanny. Surface water is also drained via an operating drainage system from the landfill facility and directed towards a storm water pond and afterwards to a constructed wetland before it flows into the local drainage network which in turn flows into the Kentstown Stream.

Tree-felling will be required to facilitate the proposed new development. The existing forestry drains will be collected where required and surface water flows diverted around any new proposed development, as shown in Volume 4 of this EIAR in Drawing No.'s LW14-821-01-P-0000-003 to LW14-821-01-P-0000-011.

It was noted during the site visit that there is some marshy ground on site with rushes.

2.3 Existing Site Geology and Hydrogeology

The Geological Survey of Ireland (GSI) website provides information on their public online mapping service at www.GSI.ie on groundwater and subsoils, see Volume 2 Chapter 1 Soils and Geology Figure 11.5 and Figure 11.1 of this EIAR.

The soil at the Knockharley Landfill site is mainly Shale and Sandstone Till with some Limestone Till to the south of the site. There is evidence of alluvium along the line of the stream to the north of the site and along the line of an old stream which was rerouted to facilitate the original landfill development to the south. Alluvium can be an indicator of historic flooding.

The groundwater vulnerability on the site is classified as low.

2.4 Existing Flood History

The flooding history for the Knockharley Stream and the area in the vicinity of the proposed development was examined and is set out in Section 12.3.4 of Chapter 12 Hydrology & Surface Water Quality of Volume 2 of the EIAR.

2.5 Existing Mapping and Surveys

Discovery mapping at 1:50,000 scale with contours at 10 m intervals was used in this assessment for the lands around the perimeter of the site. A topographical survey of the site was available and this was used in the production of site specific flood zone mapping discussed in Section 3.1 of this report.

3 PREDICTIVE ASSESSMENT

3.1 Flooding Patterns

Figure 12.7 in Chapter 12 Surface Water of Volume 2 of this EIAR replicates OPW flood mapping to illustrate the extent of existing fluvial Flood Zone B flooding within the site boundary per and post development. There is no Flood Zone A flooding within the site boundary for the permitted development. Figure 12.3 also shows that Pluvial flooding, as indicated by OPW mapping, occurs locally in small areas within the permitted development.

Figure 12-7 also shows fluvial extents for the proposed development following installation of a flood compensation culvert.

The topographic survey of the site was examined together with the indicative flood line in the proximity of the site, to determine this site-specific flood risk assessment and HECRAS modelling carried out as part of the Hydrology Study in Appendix 12-7 of Volume 3 of this EIAR showed the following:

- That the current course of the Knockharley Stream can cater for a 1 in 100-year flood event without overtopping the stream's bank.
- Following construction of the proposed stream diversion, the Knockharley Stream will be able to cater for a 1 in 100-year flood event without overtopping the stream's bank.
- Following construction of the proposed flood compensation culvert, the Knockharley Stream will be able to cater for a 1 in 100-year flood event without overtopping the stream's bank.
- Following construction of the proposed flood compensation culvert, water will back-up as shown in Figure 12.5 Proposed Scenario Flood Zones in Chapter 12 of Volume 2 of this EIAR following a 1 in 1000-year flood event.

3.2 Flood Zones

A map indicating the flood zones on the existing site has been created by FT. The definition to describe the flood zones is in line with "The Planning System and Flood Risk Management Guidelines", as follows:

Flood zones are geographical areas within which the likelihood of flooding is in a particular range and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. There are three types or levels of flood zones defined for the purposes of these Guidelines:

Flood Zone A – *where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding):*

Flood Zone B – *where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and*

Flood Zone C – *where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.*

These flood zones are determined on the basis of the probability of river and coastal flooding only and should be prepared by suitably qualified experts with hydrological experience. The limits of the zones are broadly in line with those in common usage internationally. They are based on the current assessment of the 1% and the 0.1% fluvial events and the 0.5% and 0.1% tidal events, without the inclusion of climate change factors.

The provision of flood protection measures in appropriate locations, such as in or adjacent to town centres, can significantly reduce flood risk. However, the presence of flood protection structures should be ignored in determining flood zones. This is because areas protected by flood defences still carry a residual risk of flooding from overtopping or breach of defences and the fact that there may be no guarantee that the defences will be maintained in perpetuity. The likelihood and extent of this residual risk needs to be considered, together with the potential impact on proposed uses, at both development plan and development management stages, as well as in emergency planning and applying the other requirements of these Guidelines in chapter 3.

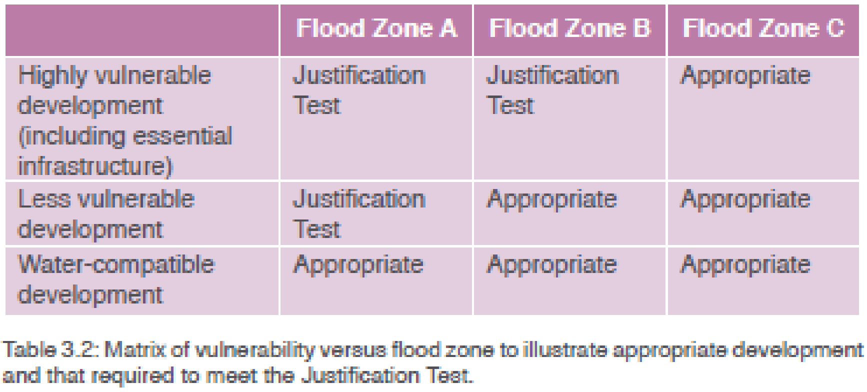
In particular, the finished floor levels within protected zones will need to take account of both urban design considerations and the residual risk remaining.

Flood zone mapping has been generated with flood levels based on the indicative OPW PFRA mapping for Flood Zone A and Flood Zone B for fluvial and pluvial flooding superimposed on a topographical survey carried out on the site.

Flood Zone areas A and B i.e. an area with a probability of flooding in a 1 in 100 and 1:1000-year flooding respectively are indicated in the permitted landfill area. See Figure 12.3 However the surface water from lands draining towards this area were diverted as part of earlier planning applications.

The proposed development is categorised as a 'Highly Vulnerable' development in Table 3.1 of the OPW Guidelines for Planning Authorities 2009 replicated below in Table 3-1.

Table 3-1: OPW Guidelines for Planning Authorities



	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

From the matrix in OPW Table 3.2 of the guidelines (See Table 3-1 above), landfill development requires a Justification Test if it is to be located in 'Flood Zone B'.

A commensurate assessment of the risks of flooding follows to ensure that all aspects of the layout of the development take account of flood risk.

3.3 Flood Flow Conveyance

Figure 12.3 in Volume 2 Chapter 12 Surface Water of this EIAR illustrates the proposed development to be within the OPW indicative flood mapping Flood Zone B area i.e. an area at risk of flooding in a 1 in 1000-year return period flood,

The permitted development has an existing stream crossing at CH 4695 which facilitate access to a shed on the northern boundary of the site. Refer also to Drawing LW14-821-01-P-0500-006 Site Layout with Existing Stream Structures in Volume 4 of this EIAR.

The catchment footprint upstream of the proposed stream diversion and proposed flood compensation culvert are presented in Volume 2 Chapter 12 Surface Water Figure 12-8 this EIAR.

The permitted development requires:

- a watercourse diversion at CH2302

The proposed development requires:

- The structure at CH4695 to be replaced with a compensation culvert which is designed to fulfil the following objectives:
    - Maintain access across the stream.
    - Pass 1:100-year flood events with a 20 % allowance for Climate Change, such that top water levels are maintained within the stream section.
    - Throttle 1:1000-year flood events with a 20 % allowance for Climate Change, such that compensation storage is provided to offset that lost by constructing a storm water management system (holding pond, attenuation lagoon and wetland) in what was a 1:1000-year fluvial flood plain.

As part of the flood risk assessment, preliminary calculations undertaken to size the culverts at the proposed stream crossings show that the following will be required.

- A 900 mm culvert for initial hydraulic assessment albeit that the culvert was later increased to 1500 mm culvert to accommodate possible future otter activity
- A 825 mm eccentric orifice entrance to the 1500 mm culvert to:
    - convey 1:100-year storm flows such that upstream water levels remain below top of bank, and
    - throttle 1:1000-year storm flows to provide compensation storage volume of c 7,977 m^3 at a top water level of 60.5 mAOD which will provide equivalent storage to that which will be lost as a consequence of constructing the Northern storm water management system in the fluvial 1:1000-year flood plain
- An emergency spill to accommodate unforeseen culvert blockages

The analysis showed the stream diversion at CH2302 had no impact on downstream flooding volumes or flow rates.

Details of the proposed structures are presented Volume 4 of this EIAR Drawing series LW140821-01-P-0500 series.

4 ESTIMATED CHANGE IN FLOOD RISK

4.1 Hydrology Assessment of Downstream Flood risk

As part of this flood risk assessment a hydrological study undertaken by FT modelled the Knockharley Stream from where it enters the site to where it joins the River Nanny was used in this flood risk assessment (See Hydrological Study in Appendix 12-6 of Volume 3 of this EIAR) to assess any increase in run-off from the proposed new development.

Table 4.1 below presents summary analyses in relation to Pre and post development 1:100-year flows and associated flood related impacts at Ch 2302 following a Q100 30 minute duration storm event.

Table 4.1 summary analysis shows:

- There will be no increase in greenfield runoff flow rates entering the Knockharley stream because all flows will pass either via the existing "Southern" storm water management system or via the proposed "Northern" storm water management system. The "Northern" storm water management system will be the first element to be constructed for the proposed development in the northern catchment area and will attenuate all runoff flows to greenfield rates.
- The volume of runoff will increase as result of development and the highest volume increase will occur during the operational period.
- The time of concentration for the receiving Veldonstown catchment was estimated to be 75 minutes. The time of concentration for respective peak flows from the catchment u/s of Ch2302 to reach the Veldonstown catchment for respective scenarios less than 75 minutes. Accordingly, there will be no increase flow rates downstream and there will be no increase in flood risk.

Table 4-1: Q100 flows in the Knockharley Stream, Pre and Post Construction

		Run-off[1,3,4]	Change in Runoff Entering Attenuation Ponds	Change in Runoff Entering Downstream Watercourse[6]	Runoff Volume[10]	Change in Runoff Volume	Time to Discharge into Knockharley Stream [8,9,11]	Time to Discharge Veldonstown[7]	Impact
Catchment	**Scenario**	m^3/s	m^3/s	m^3/s	m^3	m^3	mins	mins	
Change in run-off from Entire Development Area[5]	Existing	1.816	0.000	0	3,268	0	0	75	Low[12]
	During Construction	2.025	0.209		3,645	376	18		
	During Operation	2.430	0.614		4,374	1,106	54		
	Decommissioning[2]	1.816	0.000		3,268	0	0		

Notes:

1 Impervious area, factored by runoff coefficient for each surface type.

2 Extent of decommissioning subject to Agency approval. Assumed impervious area not greater than the existing predevelopment area at decommissioning stage.

3 Runoff estimated by the Modified Rational Method, Q = 2.78 x (Rainfall Intensity) x (Contributing Impervious Area).

4 In estimating the runoff, a rainfall intensity for 1 in 100 year return period storm of 30 min. duration supplied by Met Eireann with a factor of 1.1 was applied to allow for climate change in accordance with GDSDS, 30.8mm applied.

5 Catchment Area within site boundary, 139.89 ha.

6 Runoff flows are attenuated in ponds, and discharged at a controlled rate, not exceeding the greenfield runoff rate.

7 Assuming a 1m/s velocity along the modelled 4.5 km reach of stream, gives an approximate time of concentration of 1hr 15m for the Veldonstown stream catchment.

8 The greenfield discharge rate for the "Southern" outfall is $0.351m^3/s$, and $0.329m^3/s$ from the "Northern" outfall.

9 Taking an average discharge of $0.34m^3/s$, the additional runoff volume will be discharged in less time than the TOC.

10 Runoff Volume from 30min storm with return period of 1 in 100 years.

11 Time to discharge additional volume into Knockharley watercourse.

12 Impact is low on the hydrological regime as the time to discharge the additional volume is less that the time of concentration and therefore the discharge of additional volume from the site will have no impact on the peak flow levels in the stream downstram of the Veldonstown catchment.

LW14-821-01_KNH_Increase in overland flow.xlsxKnockharley Runoff Balance

4.2 Hydraulic Assessment of Proposed Changes to Watercourse

FT as (as described in Section 4.1 previously) modelled the Knockharley Stream from where it enters the site to where it joins the River Nanny was used in this flood risk assessment (See Appendix 12-6 of Volume 3 of this EIAR) to assess impacts.

A hydraulic analysis of the 100-year flow was undertaken for the existing stream using the river modelling software HECRAS to examine the capacity of the existing structures and stream channel to convey this extreme flood event. Flow changes were introduced at 6 No. nodes as the catchment increased along the stream. A summary of the hydrological assessment defining flows at respective node locations is provided in Table 4.2.

The HECRAS river modelling software model was run for the existing and proposed scenarios, the former includes the site as is. The latter makes provision for the stream diversion and the flood compensation culvert. The purpose of the analysis, was to determine whether or not the existing and proposed works have a negative impact on the hydraulic capacity of the stream.

As part of the post development proposed scenario, the outflow from the proposed "Northern" attenuation pond at the site was incorporated into the model of the stream. The outflow entered from the pond was the maximum attenuated 'green field' setting discharge from the site associated with a 100-year flood event.

The proposed "Northern" development comprises:

- A new IBA facility
- Modifications to the cap height of the existing residual non-stabilised waste cells
- Additional screening earthen bunds
- "Northern" Storm water management system

The modelling was carried using the following assumptions for the proposed development:

- A stream diversion CH2302 over a length of 171 m to go along the northern perimeter of the site.
- A 900 mm culvert with an 825 eccentric orifice at CH4695 (later increased to 1500 mm to accommodate possible otter activity)
- An outlet at CH4695 for attenuated surface water runoff from the proposed storm water attenuation/wetland outfall for a 1 in 100-year return period storm discharging at greenfield rates into the tributary stream.

Section 50 applications will be submitted to the Office of Public Works (OPW) at detailed design stage for approval for the proposed culvert and the stream diversion.

Table 4-2: Summary Sheet of Hydrological Assessment along Knockharley Stream

Catchment Reference	Distance Along Main Stream Length (km)	HECRAS Chainage Identifier (m)	Catchment Area (km²)	Q100 + CC* (m³/s)	Q1000 + CC* (m³/s)	Location of Site Related Infrastructure
ST1	2.541	5455	1.77	1.517	2.012	Existing Culvert western boundary where stream enters site Proposed stream diversion CH5113 to CH 5284
ST2	3.275	4769	2.19	1.833	2.432	Proposed Compensation Culvert CH4814
ST3	5.069	2897	4.40	3.422	4.539	Outfall from site at CH2303
ST4	6.363	1615	7.80	5.795	7.687	
ST5	6.879	1112	8.74	6.434	8.535	
ST6	7.882	15	10.20	7.417	9.838	

*CC = Allowance for Climate Change of 20%

4.3 Design and Calculations

4.3.1 Hydrological Assessment

The design 100-year return period flood was calculated using the procedures set out in the Flood Studies Supplementary Report (FSSR, 1978) (the 3-variable equation for small catchments of area less than 20 km^2) and the Institute of Hydrology Report No. 124 (IOH, 1994) (the 3-variable equation for small catchments of area less than 25 km^2) at 6 No. locations along a reach length of 5.46 km of the Knockharley Stream as it flows through the site at Knockharley and downstream to meet the River Nanny.

The course of the stream was examined from Discovery Series (1:50,000 mapping) and from survey information. A new topographical survey was commissioned for the route of the proposed new watercourse diversion which was used to inform this assessment.

The stream characteristic SAAR is provided from Met Éireann. The SOIL parameter is determined from FSR Soil maps.

In the above methods, the mean annual flood for the catchment (Qbar) is first calculated using the catchment characteristics in the corresponding 3-variable equations. The resulting Qbar is then multiplied with a regional factor of 1.96 to obtain the 100-year flood. This 100-year flood is then multiplied by a design factor (standard error factor), which is 1.5 in the case of the FSSR equation, and 1.65 for the IOH Report No. 124 equation. The highest Q100 values thus obtained from different methods is adopted as the design 100-year flood.

Results of the hydrological calculations, including a 20% increase for climate change as recommended in current OPW guidelines, are summarised included in Appendix C.

The model was also run for the 1 in 1000-year flood flow in the pre and post development scenarios, to establish if there are any breaches in the stream course and to investigate the source of the 1 in 1000 year return period flooding as indicated in the OPW PFRA mapping. The hydraulic model, shows that the stream's water level exceeds that of both bank levels and causes out of bank flooding, in the vicinity of the proposed flood compensation culvert.

4.3.2 Hydraulic Analysis

A HECRAS hydraulic analysis hydrological Inputs are presented in Table 4.2 and consequent summary pre and post development water elevations in the Knockharley stream are summarised in Table 4.3 below.

The cross-sections at 6 No. locations were surveyed and entered into the at chainages shown in Table 4-2 The last location surveyed at Ch 0 is a distance of 688 m upstream of the confluence of the stream with the River Nanny. Table 4.2 also shows Q100 and Q1000 design flows used in the HECRAS model.

The average bed slope of the Knockharley Stream as calculated using surveyed sections, was 0.00468. Manning's roughness value for the natural channel was taken as n = 0.04 and overbank is taken as n = 0.06.

Hydraulic analysis of the stream channel is based on the procedure suggested in Floodplain Modelling using HEC-RAS 2003.

An existing culvert under the laneway at CH5113 was omitted from the analysis for this run of the model as it will be removed when the final phases of the landfill are in place.

The model was run for the existing scenario and the proposed scenario, which incorporates a proposed new stream diversion at the north-western corner of the landfill site and a culvert at the flood compensation storage area located through the screening berms at the north-eastern corner of the site. The stream diversion over a length of 171m, increases the flow path by approximately 8m. The length of stream channel for diversion has adequate capacity to contain the design flood flow. Therefore, the proposed new cross-section for the stream diversion will remain as existing and the stream will be diverted into the stream diversion chamber as before. The stream diversion will alter the chainage identifiers upstream in the model, increasing each one by 8 m, however for simplicity in comparing results between the existing and proposed development, at different node points the node labels in results Table 4.3 remain unchanged.

HECRAS modelling results show that the existing stream channel throughout its length and the structures are mostly capable of passing the 100-year flood. It was also observed that the channel prior to any development works was flowing to almost full capacity just upstream of the location for a proposed new culvert, at Ch 4814. Out of bank flow was also observed upstream of the proposed culvert with the 1 in 1000-year flow. The access road is set above the flood level. The stream was flowing to full capacity along the length of the location proposed for the stream diversion. Further downstream at Ch 1112, both banks overflowed upstream of the structures at the forked road, with the left bank overflowing between the structures, the second structure here provided adequate capacity to contain the flow. The last structure at Ch 8 indicated over bank flow to the left bank of the main channel, spilling over and through the smaller arch in the bridge structure, providing flood relief.

Analysis in relation to the levels following installation of the proposed compensation culvert and stream diversion shows:

- The stream diversion at CH5113 over 171 m has no discernible impact on upstream levels or ability to convey flood events.
- An 825 mm orifice or similar (subject to detailed design) at CH4695 installed at the entrance to a 1500 mm culvert will convey 1:100-year flood events
- An orifice placed eccentrically at the head of the culvert (diameter 825 mm approximately and subject to detailed design) will provide restrict 1:1000-year flood events and provide flood compensation storage of approximately 7,977 m^3 with an upstream head of 60.5 mAOD details of which are presented in Volume 2 Chapter 12 Surface Water Section 12.4 of this EIAR whilst conveying a flow through the culvert approximately equal to 1.86 m^3/s.
- An orifice placed eccentrically at the head of the culvert (diameter 825 mm approximately and subject to detailed design) will require an upstream head of c.750 mm to convey a 1:100-year flood event of 1/86 m^3/s.

The plan footprint associated with the proposed flood compensation culvert under 1:1000-year flood conditions is presented in Volume 2 Chapter 12 Surface Water Section 12.5 of this EIAR Figure 12.7.

The results of the hydraulic analysis are consistent with an observed history of poor drainage at the site and the evidence of alluvium which is pronounced at certain points along the route of the Knockharley Stream.

The raised water levels within the site for both 1:100 and 1:1000-year flood events are not of concern as these areas are not proposed to be developed and any development close to these areas will be protected by clay berms. Reductions in water levels were observed in the model upstream of the stream diversion chamber and at the bridges downstream of the site. This is largely as a result of transferring the natural outfall for part of the site downstream where the outfall from the development is proposed from the pond and as a result of the outfall from the pond being a controlled outfall. This will have the effect of reducing further any existing flood risk downstream of the site.

Summary tables of flood related impacts downstream of compensation culvert are presented in:

- Table 4.1 shows that there will be no flood impact at the outfall of the Veldonstown catchment, because the time required to discharge the increased volume is less than the time of concentration associated with developing peak flows in the Veldonstown catchment, i.e. the downstream water body is able to accommodate the increased volume discharges at the greenfield discharge rate.
- Table 4.3 which shows HECRAS predicted water elevation levels to define controls upstream and downstream of the proposed compensation culvert and impact of culvert. The impact of the culvert on levels for respective flows relative to the required upstream elevation to achieve the flood storage volume was assessed and replicated from Appendix 12-4 OF volume 3 of this EIAR.
- Table 4.4 which shows the increase in runoff volumes associated with increased hard surface area and increased slope associated with the raised landfill footprint. This table was replicated from Volume 2 Chapter 12 of this EIAR.

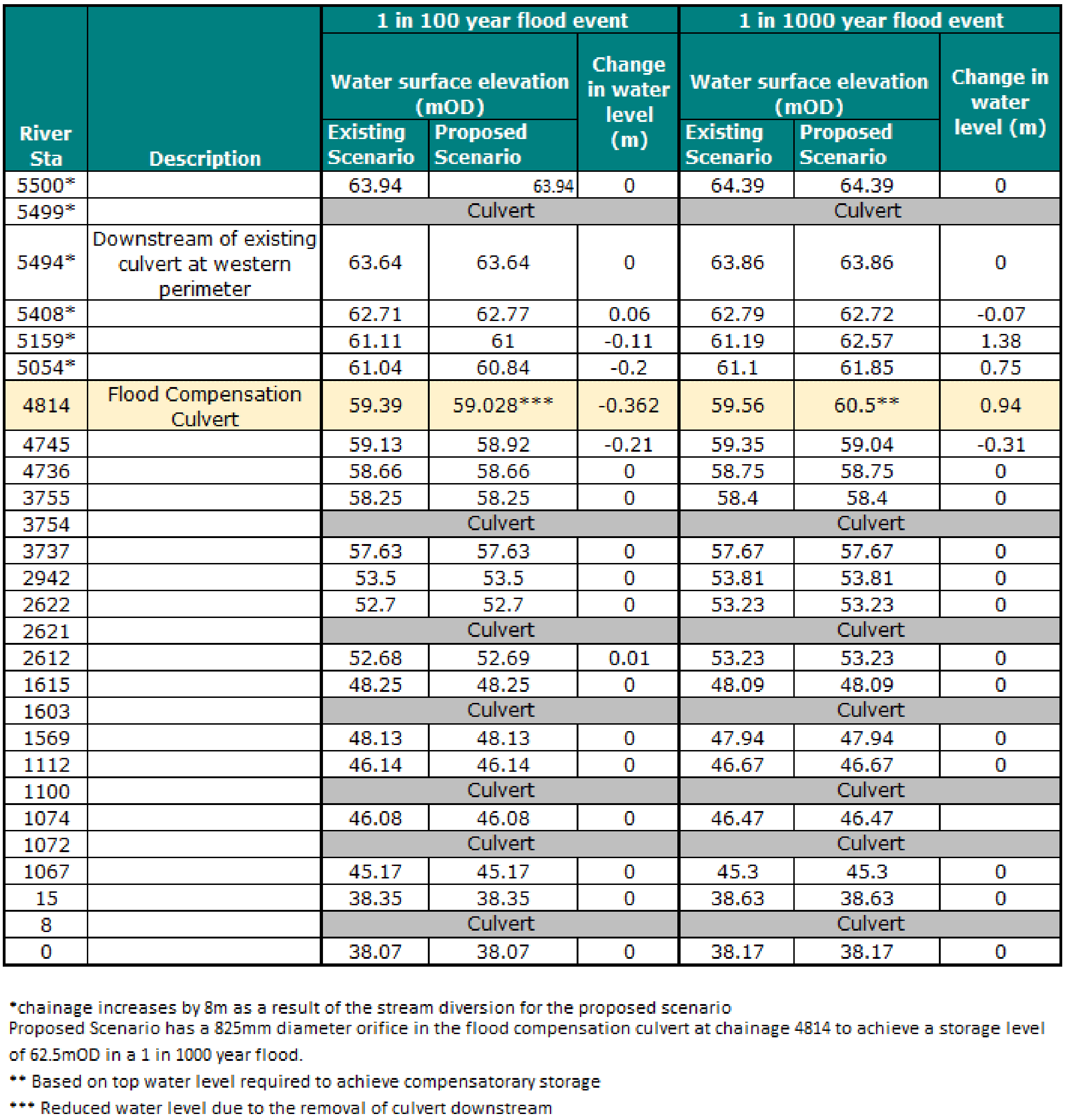
Upstream of the proposed flood compensation culvert (comprising a 1500 mm culvert with an 825 mm orifice or similar approved), water levels will back up within the facility footprint to provide compensatory flood storage to offset flood plain storage lost by constructing the "Northern" stormwater management system within a 1:1000-year flood plain.

Figure 4.1 shows the upstream 1:1000-year flood compensation footprint to be contained locally within the facility boundary. Water depth above existing ground levels will increase up to approximately 1.0 m above existing ground levels during a 1:1000-year flood event assuming a top water level of 60.5 mAOD.

Analysis in Appendix 12-4 of Volume 3 of this EIAR shows water level upstream of the proposed culvert will during a 1:100-year flood increases up to 0.5 m above existing ground level.

The Surface Water Management Plan which accompanies this submission in Appendix 12-2 of Volume 3 of this EIAR outlines the operation of the proposed new surface water attenuation pond serving the runoff from the "Northern" catchment within the site.

Table 4-3: Results of hydraulic analysis



River Sta	Description	1 in 100 year flood event			1 in 1000 year flood event		
		Water surface elevation (mOD)		Change in water level (m)	Water surface elevation (mOD)		Change in water level (m)
		Existing Scenario	Proposed Scenario		Existing Scenario	Proposed Scenario	
5500*		63.94	63.94	0	64.39	64.39	0
5499*		Culvert			Culvert		
5494*	Downstream of existing culvert at western perimeter	63.64	63.64	0	63.86	63.86	0
5408*		62.71	62.77	0.06	62.79	62.72	-0.07
5159*		61.11	61	-0.11	61.19	62.57	1.38
5054*		61.04	60.84	-0.2	61.1	61.85	0.75
4814	Flood Compensation Culvert	59.39	59.028***	-0.362	59.56	60.5**	0.94
4745		59.13	58.92	-0.21	59.35	59.04	-0.31
4736		58.66	58.66	0	58.75	58.75	0
3755		58.25	58.25	0	58.4	58.4	0
3754		Culvert			Culvert		
3737		57.63	57.63	0	57.67	57.67	0
2942		53.5	53.5	0	53.81	53.81	0
2622		52.7	52.7	0	53.23	53.23	0
2621		Culvert			Culvert		
2612		52.68	52.69	0.01	53.23	53.23	0
1615		48.25	48.25	0	48.09	48.09	0
1603		Culvert			Culvert		
1569		48.13	48.13	0	47.94	47.94	0
1112		46.14	46.14	0	46.67	46.67	0
1100		Culvert			Culvert		
1074		46.08	46.08	0	46.47	46.47	
1072		Culvert			Culvert		
1067		45.17	45.17	0	45.3	45.3	0
15		38.35	38.35	0	38.63	38.63	0
8		Culvert			Culvert		
0		38.07	38.07	0	38.17	38.17	0

*chainage increases by 8m as a result of the stream diversion for the proposed scenario
Proposed Scenario has a 825mm diameter orifice in the flood compensation culvert at chainage 4814 to achieve a storage level of 62.5mOD in a 1 in 1000 year flood.

** Based on top water level required to achieve compensatory storage

*** Reduced water level due to the removal of culvert downstream

Refer to Appendix 12.4 of the EIAR for calculation set.

Table 4-4: Summary of Estimated Increase in Surface Water Run-off Volumes

Catchment	% Increase Construction Note 2	% Increase Operation Note 3
Veldonstown - IE_EA_08_352 catchment Note 1	4.60%	4.69%

Note 1 1:100-year Runoff Flow Rate at Outfall of Veldonstown Catchment is 7.42 m^3/s and this has been used as a datum over a respective period assumes as being required to discharge increased runoff at greenfield discharge rate
Note 2 1:100 volume assume to be 1,106 m^3 taking a period of 54 minutes to be discharged from attenuation lagoon see Figure 12-10 below
Note 3 1:100 volume assumed to be 376 m3 taking a period of 18 minutes to be discharged from the attenuation lagoon see Figure 12-10 below.

4.4 CULVERT AND STREAM DIVERSION DETAILS

4.4.1 Location

The location of the proposed flood compensation culvert and the (permitted) stream diversion are shown in the Location Plan below:

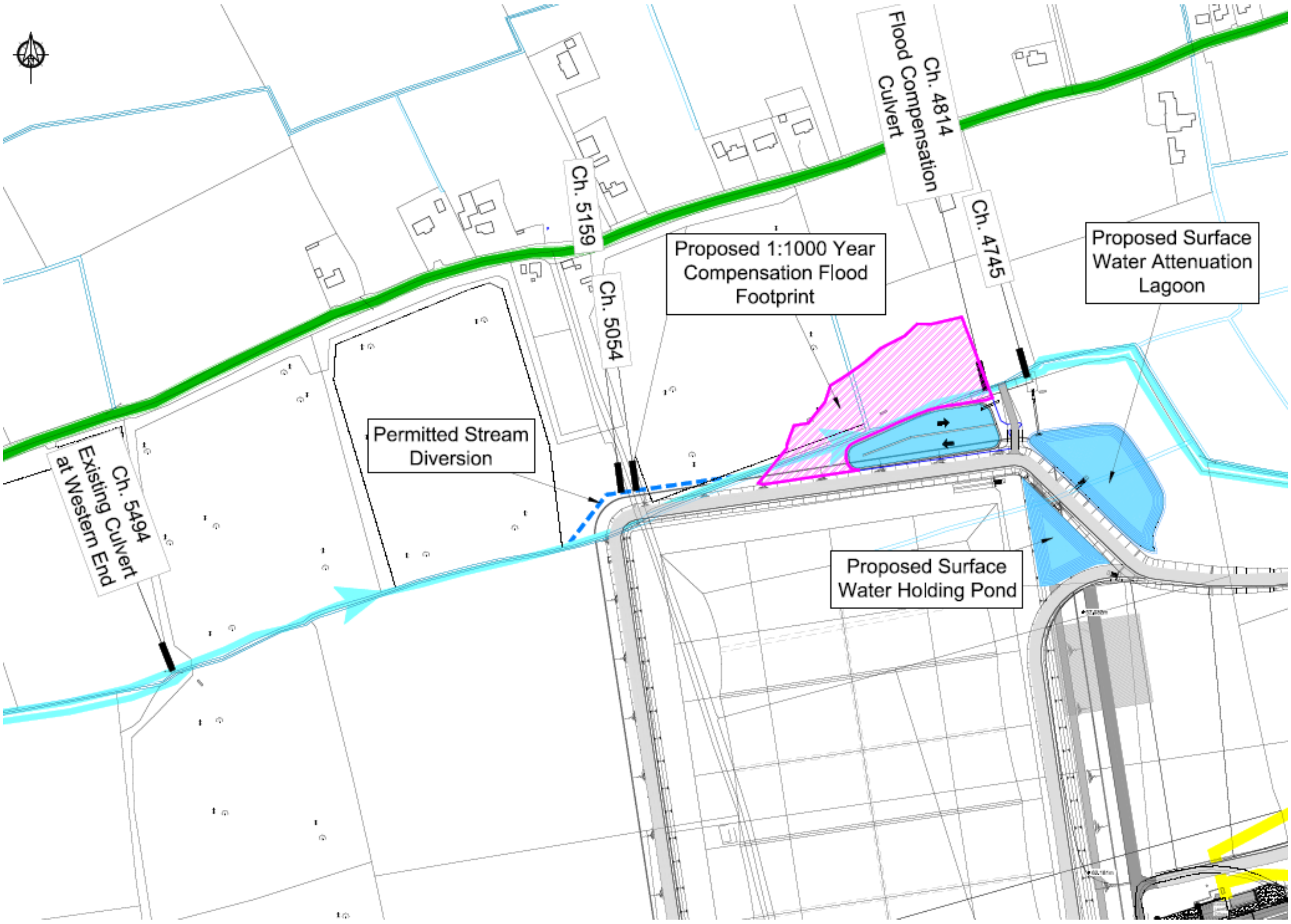


Figure 4-1: Location Plan of Proposed Culvert and Stream Diversion

4.4.2 Dimensions

Taking all the background information and design standards into account the proposed preliminary dimensions for the culverts are set out in Table 4.5.

Table 4-5: Proposed Culvert Dimensions

Culvert Reference	Form	Size (m)Pipe diameter	Length (m)	Invert Level U/S (Streambed Level)	Invert Level D/S (Streambed Level)	Culvert Slope (1:X)
Culvert at chainage 4814	Pipe	1.5/0.825	43	58.457	58.089	117

The preliminary dimensions for the proposed stream diversion are set out in Table 4.6.

Table 4-6: Proposed Stream Diversion Dimensions

Reference	Form	Average Size Width (m) x height (m)	Length (m)	Invert Level U/S (Streambed Level)	Invert Level D/S (Streambed Level)	Slope (1:X)
Stream Diversion	Trapezoidal Channel	1 in 1 side slopes, top width 3m, bottom width 1.m	171	60.55	59.524	167

5 POST-WORKS

5.1 Flood Risk

Based on the assessment of the catchment, and the hydraulic analysis carried out, the risk of flooding in the catchment area will not increase significantly as a result of the proposed diversion/culverting of the Knockharley Stream, or that any properties or dwellings will be adversely affected beyond present risk levels.

The lands in the vicinity of the site have not been identified by the OPW as 'Benefitting Lands'. There are no known Drainage Schemes upstream of the site, maintained by the Local Authority. Historically flooding has occurred downstream of the confluence of the Knockharley Stream with the River Nanny at Balrath cross roads (See OPW Summary Local Area Report included in Appendix D). The hydraulic model of the Knockharley Stream does not indicate that any increase in flood risk would occur at that location as a result of the proposed works. Conversely, the controlled outflow from the attenuation ponds at the development indicates that lags are introduced in the system which will result in a slight decrease in flood flows running downstream. The stream to be diverted/culverted is a 1st order tributary of the River Nanny.

The proposed culvert is designed with flood attenuation in mind and is sized to throttle pass flow from a 1 in 100-year and a 1 in 100- year flood event. In these events the upstream end of the culvert will be surcharged, activating a designated flood compensation storage area onsite, and therefore not causing increase of flood downstream of the site. The stream length to be diverted will match the cross section of the existing channel at this location. The diverted channel will pass a flow from a 100-year flood without surcharging and therefore not cause any restriction in the stream channel. The 1 in 1000-year flow exceeds the top of bank but remains within the confines of the stream's secondary banks.

The surface water drainage runoff south of the watershed from the existing development and proposed leachate management and biological facilities will be attenuated in the existing "Southern" attenuation lagoon and wetland. Surface water drainage from the proposed development north of the water shed for the permitted cells with raised contours and the proposed IBA facility will discharge via the proposed "Northern" stormwater management system comprising Holding Pond, Attenuation lagoon and Wetland. Accordingly, there will be no increase in runoff flow rates to the watercourse. Land drains will be provided around the perimeter of the site to intercept overland flow from neighbouring lands.

5.2 Maintenance

Maintenance requirements will be minimised due to the large internal dimensions of the culverts and the provision of access for maintenance alongside the stream diversion.

5.3 Vulnerability of Infrastructure

Flood Zone A and B locations zones are presented in Volume 2 Chapter 12 Figure 12.3 of this EIAR.

Landfill facilities are classed as 'Highly Vulnerable' as defined in Table 3.1 of The Planning System and Flood Risk Management Guidelines for Planning Authorities, OPW, November 2009, in the event of flooding'. A Flood Zone B area i.e. an area with a probability of flooding in a 1 in 1000- year flood (Flood Zone B) is indicated in the permitted landfill area, where further development is proposed. Table 3.2 of the Guidelines indicates that a 'Highly Vulnerable' development will require a Justification Test if it is to be located in a Flood Zone A or a Flood Zone B area. For this reason, the stream was modelled to identify the source of this indicative flooding and to determine if following an earlier permitted planning application if any risk still remained or if the proposed development created additional flood risk. It was found that the proposed development does not increase the flood risk downstream of the development. Due to surface water runoff from the site being attenuated in ponds which restrict discharge from the pond to that of the greenfield runoff rate, the development dampens the flood peak in the downstream catchment. The flood compensation storage area provides sufficient storage for the 1 in 1000-year flood event on site. The Justification Test is included in Appendix B of this report.

5.4 Impact of Proposed Development

5.4.1 Proposed Layout of Drainage for Proposed Development

A new watercourse diversion and a stream crossing will be required to facilitate the proposed development. The drainage of the proposed development at Knockharley Landfill will consist of grassed swales leading to attenuation facilities, which will discharge to the stream at Greenfield rates.

Interceptor drains will be used to intercept overland flow.

The drainage layout is shown in drawings LW14-821-01-P-0000-003 to LW14-821-01-P-0000-011011 in Volume 4 of this EIAR and in Appendix 12-6 Figure 12.7 of Volume 3 of this EIAS.

5.4.2 Impact of Proposed Development on Downstream Flooding

Surface water run-off from the proposed development may increase minimally due to the change in land use within the development site, however the provision of attenuation facilities at the site will result in a slight decrease in surface water run-off at the site due to the lag time in these facilities.

The impact of the proposed development on the receiving environment in terms of an increase in flooding downstream is therefore considered to be of very low significance.

5.4.3 Impact of Flood Risk Areas on the Proposed Development

The methodology used to prepare the flood risk assessment followed a sequential approach. The OPW PFRA indicative flood mapping was examined together with the topographical survey of the site. As mentioned previously, part of the site is within a fluvial 'Flood Zone B' area. In particular, part of the northern area of the permitted cells which is proposed to be raised as part of the current planning application and part of the soil infill area. A hydrological study was undertaken to determine the source of this flooding and it was found that out of bank flooding occurs in high flow events. Only small areas of indicative pluvial flooding are noted at the site and these areas do not coincide with the proposed development. As there is currently no area of the proposed development associated with flood zone A, due to the interception of overland flows to facilitate earlier planning applications, and only a small area of the proposed development lying within flood Zone B, for which a flood compensation area is provided for, the proposed development is expected to avoid any flood risk during extreme flood events. A Justification Test is included in Appendix B of this Flood Risk Assessment Report which demonstrates that the flood risk has been minimised. The locations of the proposed infrastructure with respect to the flood zones are indicated on Volume 2 Chapter 12 Figure 12.7 of this EIAR.

5.4.4 Vulnerability of Site Personnel and the Public

Flowing waters and standing waters are present in the ditches and streams within the site. A watercourse runs through the site, to the north and to the east of the site. All waterbodies, including the attenuation ponds, will be fenced off adequately during construction.

A buffer zone will be put in place to ensure that no construction takes place within 10m of the watercourses or drains on or adjacent to the site. Construction will be avoided in adverse weather conditions.

5.4.5 Modification and Mitigation Measures

The primary mitigation measure which is advised in the design of the layout of the proposed development is that it should be located outside a 'Flood Zone A' or a 'Flood Zone B' area. In the flood risk assessment, it has been shown that the proposed development is outside of Flood Zone A and that the small area of flood Zone B which lies within the site, which is caused by a pinch point in the channel, namely the existing culvert at the regional road crossing, is mitigated against by providing a compensatory flood storage area.

The following mitigation measures are also proposed for the site:

- The existing ditches through the site will be maintained and kept clear of blockages to avoid an increase in the flood risk to the site;
- The velocities in the surface water runoff from any areas with increased impermeability resulting from the construction will be reduced with the use of attenuation ponds;

6 RESIDUAL RISKS

All mitigation systems will be in place before development works commence. It will be the responsibility of the developer to ensure that these facilities are put in place, and a suitably qualified person will be appointed by the developer to ensure their efficient operation and maintenance. Any residual risk of increased flooding due to the proposed development is expected to be low.

It is not anticipated that the proposed development will impact on any environmentally protected areas downstream.

7 CUMULATIVE FLOOD RISK ASSESSMENT

The increase in the rate of surface water run-off due to the increase in hard surface areas and increases slope associated with raised landfill contours will increase runoff flow rates within the facility. Attenuation provided by the existing "Southern" and proposed "Northern" lagoons will however maintain green field discharge rates such that flow rates entering the stream will not increase because of development.

Runoff volumes entering into the catchment will however increase by approximately 4.69%. This may cause prevailing flood levels adjacent to the facility to remain in place for a slightly longer period which may lead to a minor cumulative flooding impact downstream.

There will be no flood impact at the outfall of the Veldonstown catchment because the time required to discharge the increased volume is less than the time of concentration associated with developing peak flows in the Veldonstown catchment, i.e. the downstream water body is able to accommodate the increased volumetric discharges at the greenfield discharge rate.

The proposed development is at a distance of approximately 7 km to the Veldonstown catchment. It is therefore not expected to have a potential cumulative impact on adjacent downstream developments with the proposed development.

8 CONCLUSIONS AND RECOMMENDATIONS

A site specific flood risk assessment was carried out for the proposed development at Knockharley Landfill. Areas to the north east of the site are subject to flooding from the watercourse which runs along the northern and eastern boundaries of the site in an extreme flood of 1 in 1000 year return period, however, this flooding has been considered as part of the development and a flood compensation area provided to store the flood water from an extreme flood event. The predictive floodplain was generated with flood levels based on the indicative OPW PFRA mapping for Flood Zone A and Flood Zone B for fluvial and pluvial flooding superimposed on a topographical survey carried out on the site. The assessment found that only a small area of pluvial flooding would occur at the site. The siting of any infrastructure was avoided in this area of the site in order to avoid flood damage to sensitive components of the development.

The proposed development site is not expected to impact on any environmentally designated sites in consideration of the distance of the proposed development from such sites.

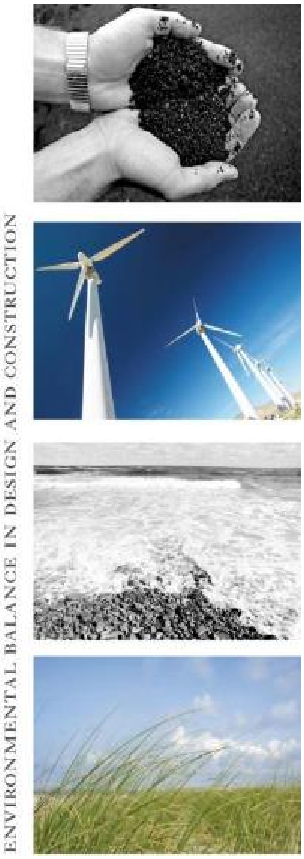
It is not anticipated that flow paths will be significantly obstructed during flooding events. Attenuation facilities will be provided at the site to reduce the rate of surface water run-off from the proposed development. These facilities will also result in a reduced flood risk downstream of the proposed development.

Supporting Appendices in this report also present the following information:

Appendix A:	OPW Flood Map Report
Appendix B:	Justification Test
Appendix C:	Hydrological Calculations comprising summary HECRAS outputs for 1:100 and 1:1000-year flow impacts on Knockharley stream and Report per and post development plus summary table defining key hydrological and hydraulic design assumptions and criteria
Appendix D:	OPW Summary Local Area Report showing the River Nanny in flood in mid-November 2009. Photographs from Balrath over a 3km stretch to Duleek.

Appendix A

OPW Flood Hazard Mapping Report



OPW *National Flood Hazard Mapping*

Summary Local Area Report

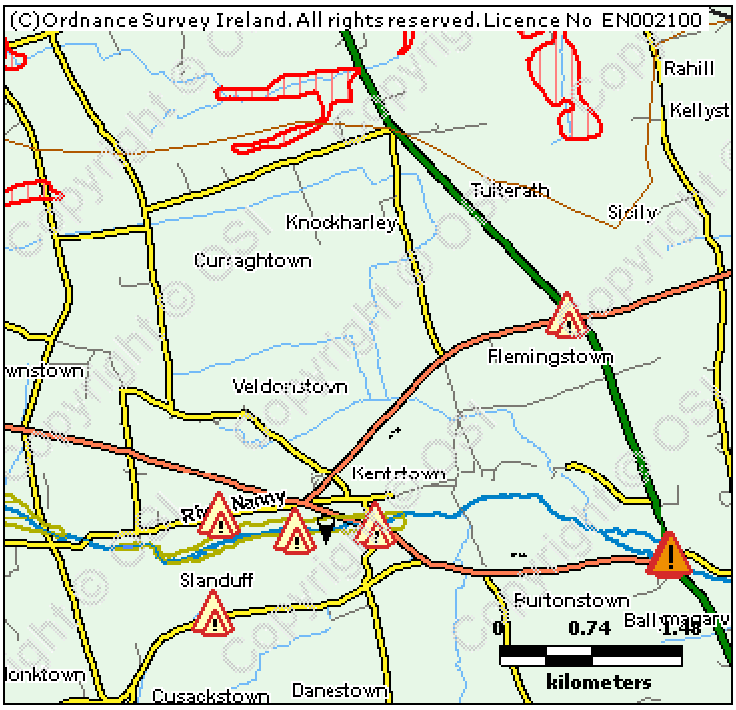
This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Meath

NGR: N 976 663

This Flood Report has been downloaded from the Web site www.floodmaps.ie. The users should take account of the restrictions and limitations relating to the content and use of this Web site that are explained in the Disclaimer box when entering the site. It is a condition of use of the Web site that you accept the User Declaration and the Disclaimer.



Map Scale 1:61,277

Map Legend	
⚠	Flood Points
⚠	Multiple / Recurring Flood Points
▦	Areas Flooded
●	Hydrometric Stations
╱	Rivers
■	Lakes
□	River Catchment Areas
▨	Land Commission *
▤	Drainage Districts *
▥	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

5 Results

⚠ 1. Nanny Kentstown Recurring — Start Date:

County: Meath — Flood Quality Code:3

Additional Information: Reports (1) Press Archive (1) More Mapped Information

⚠ 2. Nanny Kentstown on R153 Recurring — Start Date:

County: Meath — Flood Quality Code:3

Additional Information: Reports (1) Press Archive (1) More Mapped Information

⚠ 3. Brien's Cross on N2/R150 Recurring — Start Date:

County: Meath — Flood Quality Code:4

Additional Information: Reports (1) More Mapped Information

⚠ 4. Kentstown on CR390 Recurring — Start Date:

County: Meath — Flood Quality Code:4

Additional Information: Reports (1) Press Archive (1) More Mapped Information

⚠ 5. Danestown Recurring — Start Date:

County: Meath — Flood Quality Code:4

Report Produced: 05-Aug-2016 12:09

Additional Information: Reports (1) More Mapped Information

Appendix B

Justification Test

ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

Appendix B

Of:

Flood Risk Assessment

JUSTIFICATION TEST

FEHILY TIMONEY & COMPANY

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Introduction

Fehily Timoney & Company (FT) was commissioned by Knockharley Landfill Ltd. to prepare a Flood Risk Assessment (FRA) for a proposed development at Knockharley Landfill in Navan, County Meath to support the planning application for the site.

The proposed future development, hereafter referred to as 'the proposed development' at Knockharley Landfill will comprise:

- the acceptance of 444,000 tonnes of waste for non- hazardous cells
- raising the height of future cells in the permitted development from 74 mAOD to 85 mAOD (and construction of permitted cells under current planning permission)
- an IBA facility including building within new cells
- a biological treatment facility comprising a building and hardstanding marshalling yard
- a leachate management facility comprising hardstanding areas, bunded storage and floating cover lagoons
- screening berms
- a surface water management system comprising holding pond, attenuation lagoon and wetland
- a culvert and embankment (replacing an existing culvert) across the existing Knockharley stream to provide compensatory flood provision to offset lost flood storage realised during a 1:1000-year storm that will be lost as a consequence of providing storm water attenuation provision for both the permitted and proposed future developments within a 1:1000-year flood plain
- Permitted Knockharley stream diversion around the permitted development
- felling of c. 12.5 ha forestry and replanting of c.16.8 ha
- 2 no. new ESB sub stations and new overhead 20kVA ESB supply
- extension of existing below ground infrastructure (power, water, telemetry, leachate rising mains, drainage)

The site-specific flood risk assessment was prepared in accordance with the guidelines produced by the Department of Environment, Heritage and Local Government (DoEHLG) – "The Planning System and Flood Risk Management Guidelines for Planning Authorities" (November 2009). The sequential approach as outlined in the guidelines was adopted in carrying out the FRA.

The site-specific flood risk assessment identified that a Justification Test is required as the proposed development is categorised as a 'Highly Vulnerable' in Table 3.1 of the guidelines for a landfill development. From the matrix in Table 3.2 of the guidelines, landfill development would require a Justification Test if it is located in a 'Flood Zone A' or 'Flood Zone B' area. A part of the proposed development is located in Flood Zone B and on that basis, it is determined that a Justification Test is required for this development.

1.1.1 Site Location

Knockharley Landfill is located approximately 1.5 km north of Kentstown village, Co. Meath in the functional area of Meath County Council. Approximate Irish National grid-co-ordinates are 297371, 267375. It is situated approximately half way between Duleek and Navan.

The existing landfill is located in a rural area approximately 1.5 km north of Kentstown village. The village of Slane is located 7 km north of the site, Duleek is located 7 km to the east and Navan is 10 km to the west. Figure 1.1 shows the location of the site.

The land use of the surrounding area comprises arable and pasture land, in addition to forestry and the landfill. Strong tree-lined hedgerows define the field boundaries of the surrounding land. Roadside hedgerows are similar but are machine-managed in places.

The general topography of the area is low-lying and rises gently from the River Nanny (below 50 m OD) in the south. The site itself, while relatively flat, rises gradually northwards and westward from approximately 50 m at the south-east corner to almost 70 m at the western boundary.

The facility is located on a 135.2 hectare (333 acre site). The existing landfill footprint is positioned near the centre of the landholding.

1.1.2 Flood Risk Assessment Findings

Fehily Timoney and Company (FT) carried out a detailed Flood Risk Assessment (FRA) of the above proposed development at Knockharley, to which this Justification Test is an Appendix of. The FRA found that the site, is boarded by the Knockharley Stream to the north and east and has been subject to flooding in the past. Historically, of poor drainage at the site has been observed and evidence of alluvium which is pronounced at certain points along the route of the Knockharley Stream.

Part of the northern area of the permitted cell development which is proposed to be raised as part of the current planning application and part of proposed "Northern" storm water management system are within a fluvial 'Flood Zone B' area.

A hydrological study was undertaken to determine the source of this flooding and it was found that out of bank flooding occurs in high flow events as a result of an existing constriction on the stream. Only small areas of indicative pluvial flooding are noted at the site and these areas do not coincide with the proposed development. As there is currently no area of the proposed development associated with flood zone A, due to the interception of overland flows to facilitate earlier planning applications, and only a small area of the proposed development lying within flood Zone B, for which a flood compensation area is provided for, the proposed development is expected to avoid any flood risk during extreme flood events. This Justification Test seeks to demonstrate that the flood risk has been minimised. The locations of the proposed infrastructure with respect to the flood zones are indicated on Figures 1 and 2 below which were replicated from Volume 2 Chapter 12 of this EIAS/EIA.

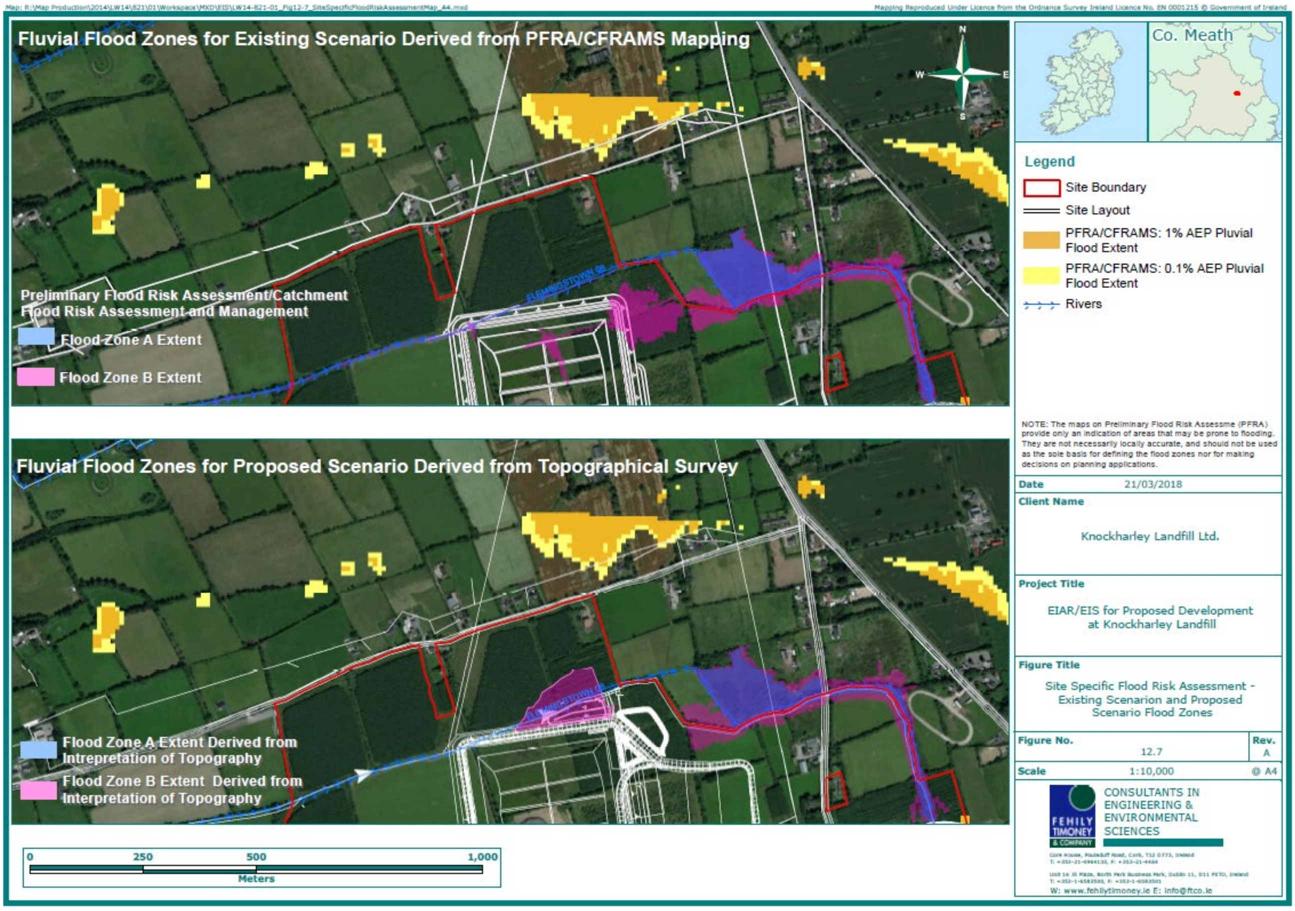


Figure 1: Site Specific Flood Zones

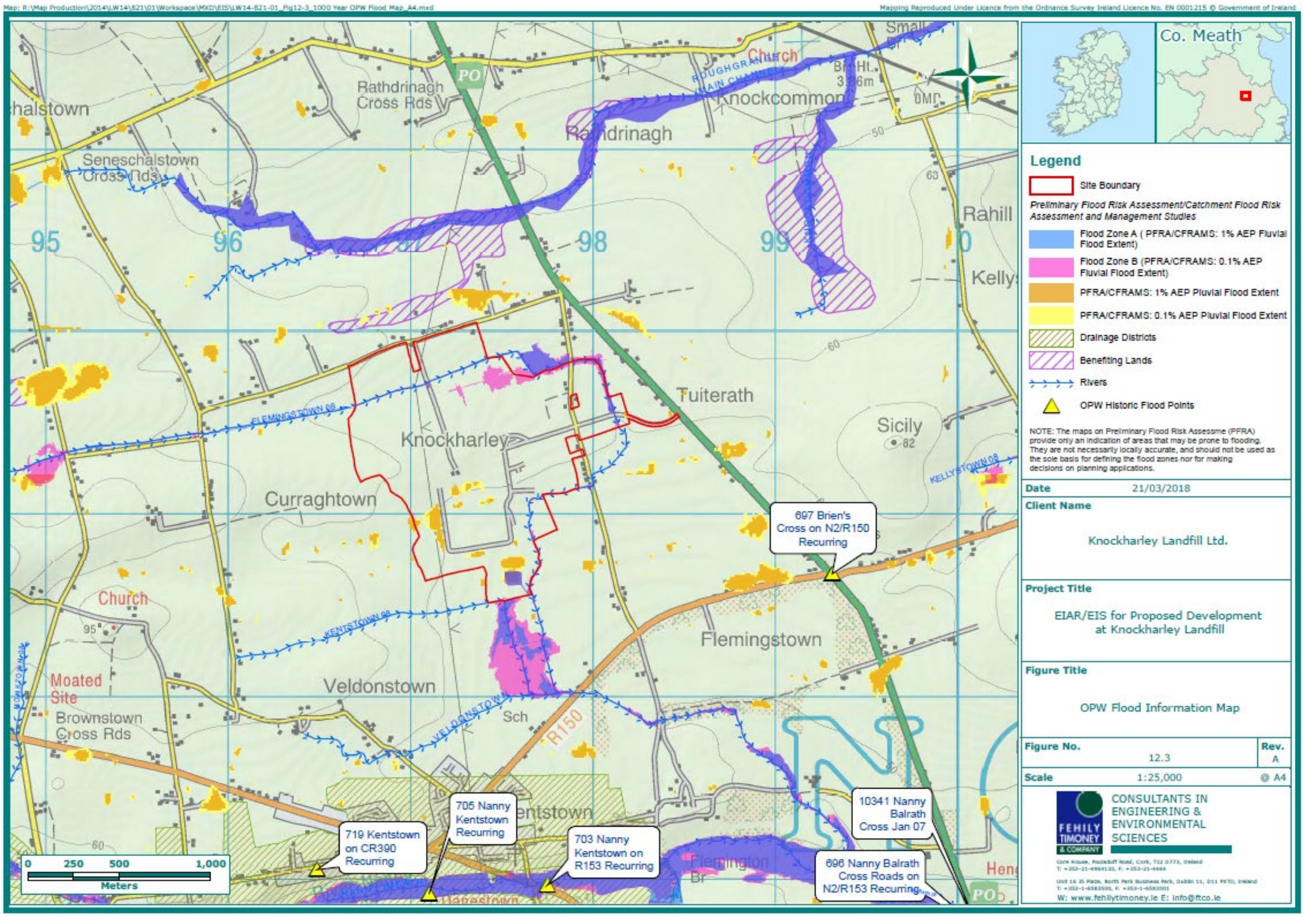
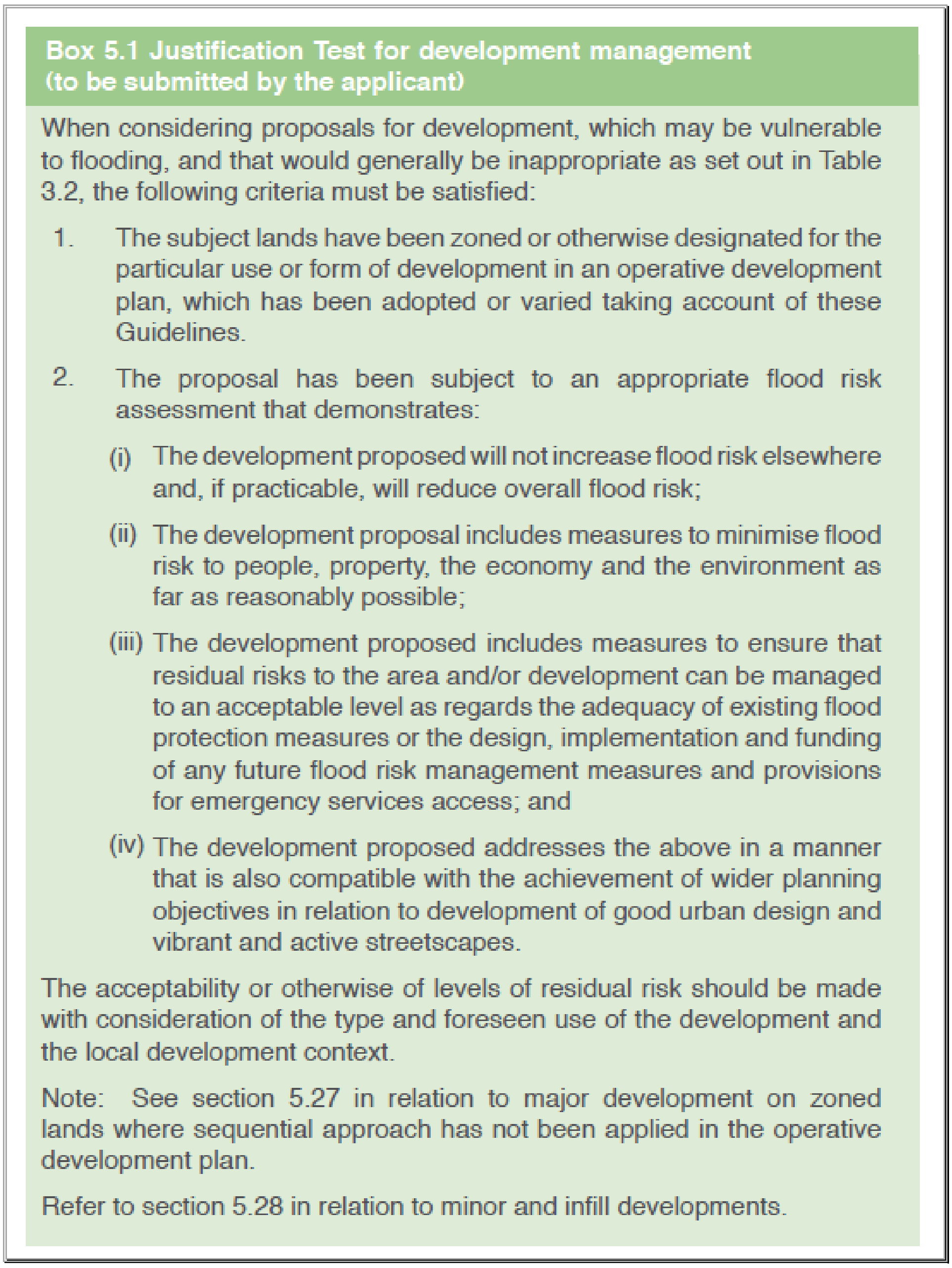


Figure 2: OPW Flood Zones

2 JUSTIFICATION TEST FOR SITE SPECIFIC FLOOD RISK ASSESSMENTS

2.1 Assessment Criteria

For development which is deemed not to be water compatible, within Flood Zone A or B, the Department of Environment, Heritage and Local Government (DoEHLG) – "The Planning System and Flood Risk Management Guidelines for Planning Authorities" (November 2009) requires that a Justification Test be undertaken to assess the suitability of the development, by meeting the requirement of the Justification Test criteria as set out in Box 5.1 of the Planning Guidelines (See Figure 3 below).



Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

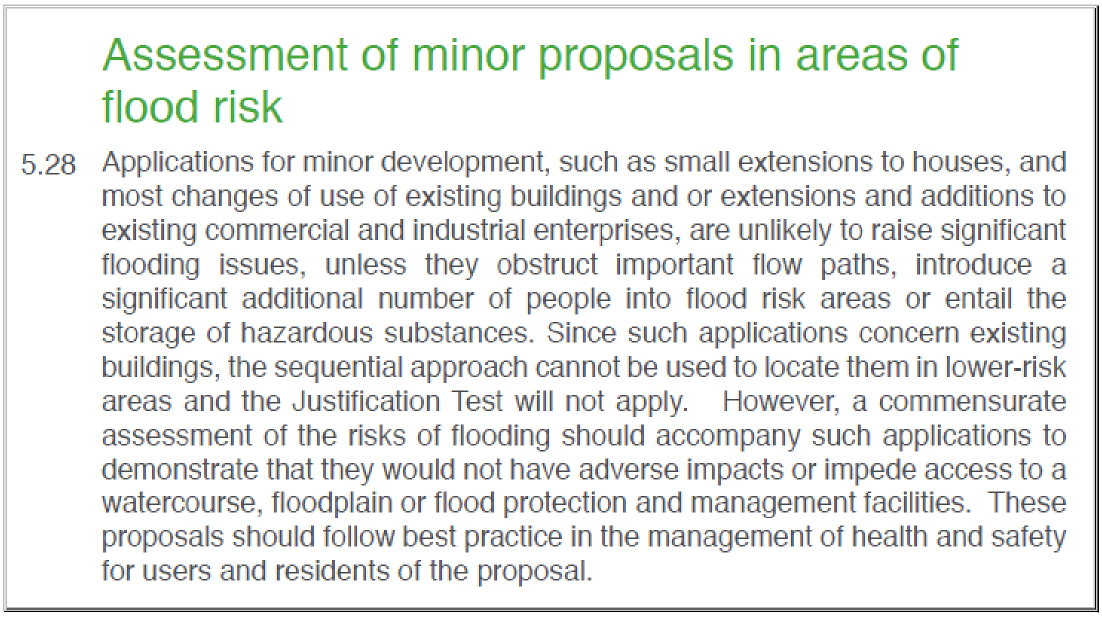
1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:
    (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
    (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
    (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and
    (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 3: Justification Test Criteria as per the Planning Guidelines



Assessment of minor proposals in areas of flood risk

5.28 Applications for minor development, such as small extensions to houses, and most changes of use of existing buildings and or extensions and additions to existing commercial and industrial enterprises, are unlikely to raise significant flooding issues, unless they obstruct important flow paths, introduce a significant additional number of people into flood risk areas or entail the storage of hazardous substances. Since such applications concern existing buildings, the sequential approach cannot be used to locate them in lower-risk areas and the Justification Test will not apply. However, a commensurate assessment of the risks of flooding should accompany such applications to demonstrate that they would not have adverse impacts or impede access to a watercourse, floodplain or flood protection and management facilities. These proposals should follow best practice in the management of health and safety for users and residents of the proposal.

Figure 4: Extract of Note 5.28 from the Planning Guidelines

The proposed Knockharley landfill development is categorised as highly vulnerable and part of the development is located within Flood Zone B, on that basis it is determined that a Justification Test, which satisfies the criteria as set out above in Figure 3, is required for this development.

The proposed development is for the expansion of the already existing landfill facility in Knockharley and includes a diversion and culverting of the Knockharley Stream. The flood risk and management of this risk by means of a flood compensation storage area is addressed as part of the FRA and Volume 2 Chapter 12 of the EIAR/EIA. The proposed development does not introduce a significant additional number of people into the flood risk area, and as the proposed development is associated with already existing development, the sequential approach which was adopted in the proposed development's FRA is unable to relocate the development to a lower risk area. The FRA assessment demonstrates that the proposed development will not have adverse impacts or impede access to the Knockharley Stream or it's river banks. The flood management measures that are proposed as part of the development will be accessible for maintenance purposes.

The following section of this report assesses the criteria required to be satisfied as part of a Justification test against the proposed development.

2.2 Assessment of Proposed Development

2.2.1 Criterion 1

"The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines."

The land at the proposed development is not zoned as part of a Local Area Plan. However, the proposed development is in-keeping with the policies and will assist in fulfilling objectives in the current Meath County Development Plan (2013-2019), in relation to Waste Management. Some of the relevant policies and objectives in the County Development Plan are listed below:

> *WM POL 3 To seek the provision of quality cost effective waste infrastructure and services, which reflect and meet the needs of the community.*
>
> *WM POL 4 To seek in the Council's dealings with private companies that all waste shall be undertaken in compliance with the requirement of the EPA and relevant waste management legislation and policy.*

WM POL 6 To encourage the development of waste infrastructure and associated developments in appropriate locations, as deemed necessary in accordance with the requirements of the Regional Waste Management Plan.

WM POL 12 In examining and assessing the identification, release and development of zoned lands, Meath County Council shall have regard to the recommendations of the Fingal East Meath Flood Risk Assessment and Management Study and the approved Eastern, West and Neagh Bann Catchment Flood Risk Assessment and Management Study.

WM OBJ 1 To facilitate the provision of appropriate waste recovery and disposal facilities in accordance with the principles set out in the appropriate Waste Management Plan applicable from time to time made in accordance with the Waste Management Act 1996.

WM OBJ 13 To support the development of facilities to cater for commercial waste not provided for in the kerbside collection system such as WEEE, C&D type waste and hazardous materials in accordance with the requirements of the North East Waste Management Plan.

WM OBJ 18 To seek to ensure in cooperation with relevant authorities that waste management facilities are appropriately managed and monitored according to best practice to maximise efficiencies and to protect human health and the natural environment.

2.2.2 Criterion 2

(i) "The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk"

The site-specific FRA includes details of the hydrological assessment and hydraulic modelling carried for this proposed development. The results from this modelling illustrates that the risk of flooding is not increased anywhere, other than within the site as a result of the proposed development. This increase in flood risk within the site boundary is a feature of the hydraulic design, which is to provide a flood compensation storage are for flows resulting from extreme events. The proposed culvert and channel diversion does not result in an increased flood risk upstream or downstream of the proposed development boundary. This is shown in Tables 1 and 2 over which notes the change in water levels (between the existing and the proposed development) from the hydraulic mode for the 1 in 100-year and the 1 in 1000-year flood events. A change in water levels only evident within the site boundary.

Table 1: Results of Hydraulic Analysis

		1 in 100 year flood event			1 in 1000 year flood event		
		Water surface elevation (mOD)		Change in water level (m)	Water surface elevation (mOD)		Change in water level (m)
River Sta	Description	Existing Scenario	Proposed Scenario		Existing Scenario	Proposed Scenario	
5500*		63.94	63.94	0	64.39	64.39	0
5499*		Culvert			Culvert		
5494*	Downstream of existing culvert at western perimeter	63.64	63.64	0	63.86	63.86	0
5408*		62.71	62.77	0.06	62.79	62.72	-0.07
5159*		61.11	61	-0.11	61.19	62.57	1.38
5054*		61.04	60.84	-0.2	61.1	61.85	0.75
4814	Flood Compensation Culvert	59.39	59.028***	-0.362	59.56	60.5**	0.94
4745		59.13	58.92	-0.21	59.35	59.04	-0.31
4736		58.66	58.66	0	58.75	58.75	0
3755		58.25	58.25	0	58.4	58.4	0
3754		Culvert			Culvert		
3737		57.63	57.63	0	57.67	57.67	0
2942		53.5	53.5	0	53.81	53.81	0
2622		52.7	52.7	0	53.23	53.23	0
2621		Culvert			Culvert		
2612		52.68	52.69	0.01	53.23	53.23	0
1615		48.25	48.25	0	48.09	48.09	0
1603		Culvert			Culvert		
1569		48.13	48.13	0	47.94	47.94	0
1112		46.14	46.14	0	46.67	46.67	0
1100		Culvert			Culvert		
1074		46.08	46.08	0	46.47	46.47	
1072		Culvert			Culvert		
1067		45.17	45.17	0	45.3	45.3	0
15		38.35	38.35	0	38.63	38.63	0
8		Culvert			Culvert		
0		38.07	38.07	0	38.17	38.17	0

*chainage increases by 8m as a result of the stream diversion for the proposed scenario
Proposed Scenario has a 825mm diameter orifice in the flood compensation culvert at chainage 4814 to achieve a storage level of 60.5mOD in a 1 in 1000 year flood.

** Based on top water level required to achieve compensatory storage

*** Reduced water level due to the removal of culvert downstream

The summary of Hydrology and Hydraulic Design Criteria and Impacts is included in Appendix 12.4 of Volume 3 of this EIS/EIAR.

(ii) "The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible"

The proposed development includes measures which minimise flood risk upstream and downstream in the catchment as follows:

- Surface water run-off from the proposed development may increase minimally due to the change in land use within the development site, however the provision of attenuation facilities on proposed development so that surface water drainage will be attenuated in a pond and wetland for the MSW Cells and in an additional pond for the IBA facility. Therefore, drainage from the site will not increase the runoff to the watercourse, it will in fact result in a slight decrease in surface water run-off at the site due to the lag time in these facilities.
- Land drains have been provided around the perimeter of the site to intercept overland flow from neighbouring lands.

- Existing ditches through the site will be maintained and kept clear of blockages to avoid an increase in the flood risk to the site;
- Velocities in the surface water runoff from any areas with increased impermeability resulting from the construction will be reduced with the use of attenuation ponds
- A compensation flood storage area has been created as part of the development which will throttle flow from extreme events passing through the culvert in the north east of the site and create a storage area upstream with sufficient storage volume to cater for the 1 in 1000-year flood flows. This area will compensate for the lost storage associated with development of the site which lies within Flood Zone B.

(iii) "The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access"

In order to manage residual risks, all mitigation systems, as identified in Volume 2 Chapter 12 of the EIAR/EIA, will be in place before development works commence. It will be the responsibility of the developer to ensure that these facilities are put in place, and a suitably qualified person will be appointed by the developer to ensure their efficient operation and maintenance.

A programme of regular maintenance will be established to ensure that swales remain clear and vegetation is managed.

Any residual risk of increased flooding due to the proposed development is expected to be low and will be managed to an acceptable level by implementation of mitigation measures.

Appendix 12-2of Volume 3 of this EIAR/EIS the surface water management plan, and the design of the all hydraulic structures within the development have included a 20% allowance for climate change, and therefore the design of flood risk mitigation measures is robust and future proofed, however in the event that future flood risk management measures are require, none of the proposed measures will be prohibitive in facilitating additional measures or expanding existing measures.

Access to the site by emergency services is by the N2 to the east of the site.

(iv) "The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes."

The proposed development meets the above criteria and does so in a manner that is compatible with the relevant guidelines set out in Meath County Development Plan (MCDP) (2013-2019), with regard to the appropriate form of development particularly those which pertain to good design and landscapes. As the proposed development is located in a rural environment, urban design is not directly applicable, but the principals and philosophy of design has been adopted by the proposed development.

The proposed development is compatible with the guidelines on green infrastructure:

> *"Existing green infrastructure should be identified at the initial stages of the planning process for development and should guide the design of an appropriate site layout. The landscaping plan submitted with an application should clearly illustrate how existing green infrastructure and opportunities to create more linkages have informed and been incorporated into the development, layout and, if appropriate, management proposals."*

The key principals of urban design as set out in the MCDP which follow, have also been considered and used to shape the proposed landfill facility:

- Character
- Enclosure
- Legibility & Permeability
- Scale
- Public Space
- Diversity
- Longevity
- Hierarchy
- Decoration

2.2.3 Residual risk

As residual risk of flooding at the proposed development or in its vicinity is low and based on the nature of the development as a landfill facility, the residual risk is considered acceptable in the context of the facility and the surrounding landscape and developments.

3 CONCLUSION AND RECOMMENDATIONS

The proposed development, categorised as a vulnerable development and part of which is located in flood zone B and on this basis, requires a Justification Test as part of the Flood Risk Assessment. However, as the proposed development is an expansion of an existing facility, the sequential approach as described in the planning guidelines cannot re-locate the development to a lower risk location.

The development does not introduce a significant increase of people into the flood risk area, however, the proposed development does include the diversion and culverting of the Knockharley Stream. This work however does not increase the flood risk to the area beyond the development boundary of the site.

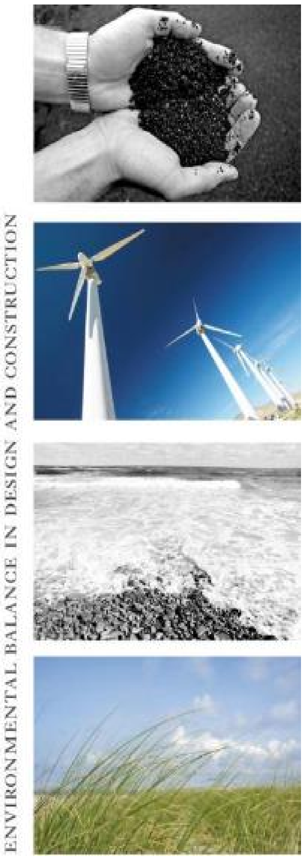
The table below summarises the requirements of the Justification Test and shows that each criterion is met by the proposed development.

3.1 Summary of Justification Test for Development Plans

Proposed development Subject to Justification Test	
Justification Test Criteria	**Criteria Satisfied**
1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.	√
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:	
(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;	√
(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;	
(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and	√
(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.	√

Appendix C

Hydrological calculations



Reviewed Date: Prepared M Creedon Date: 31.01.17

				Design Flow 3 term EQN IOH Method			**Design Flow 3 term EQN FSSR Method**				
Location	**AREA km2**	**SAAR mm**	**SOIL**	**QBAR m3/s**	**Q100(x 1.96SOIL Type >2, x 2.61SOIL Type 1) x 1.65 m3/s**	**Increase by 20% for Climate Change**	**QBAR m3/s**	**Q100(x 1.96) x 1.5 m3/s**	**Increase by 20% for Climate Change**	**Max. Design 100 yr Flood m3/s**	**Max. Design 1000 yr Flood m3/s**
Tributary of River Nanny Catchment 1	1.7700	929	0.3	0.391	1.264	1.517	0.420	1.234	1.481	1.517	2.012

Notes:
1) 3-Term EQN is QBAR = 0.00066 (Area^0.92)(SAAR^1.22)(Soil^2.0) Ref.: Flood Studies Report No. 6 and QBAR = 0.00108 (Area^0.89)(SAAR^1.17)(Soil^2.17) for catchments less thatn 24ha (Inst. Hyd. Report No. 124)
6-Term EQN is QBAR = C [(AREA)0.94.(STMFRQ)0.27.(SOIL)1.23.(RSMD)1.03.(S1085)0.16.(1+LAKE)-0.85]
2) SAAR (Average Annual Rainfall) from Met Eireann.
3) SOIL from FSR Maps.
4) Q100 from Region curves ordinates from Flood Studies Report, Table 2.39 and Ref. to Michael Bruen for Soil Types = 1
5) Factors of Safety multiples of 1.5 and 1.65 included for the relevant formulae.
6) If the Parameters STMFRQ or S1085 do not exist in the culvert catchment then the three term equation is used
7) Catchment areas as determined from WFD and Topographical Survey
8) Climate change - increase of 20% in flows - ref: OPW - Appendix C Standard Specifications for Feasibility and Pre-feasibility Studies for flood relief works - March 2004 (the note is based on the Desk Study carried out by Dr. Michael Bruen

Reviewed Date: Prepared M Creedon Date: 31.01.17

				Design Flow 3 term EQN IOH Method			Design Flow 3 term EQN FSSR Method				
Location	**AREA km2**	**SAAR mm**	**SOIL**	**QBAR m3/s**	**Q100(x 1.96SOIL Type >2, x 2.61SOIL Type 1) x 1.65 m3/s**	**Increase by 20% for Climate Change**	**QBAR m3/s**	**Q100(x 1.96) x 1.5 m3/s**	**Increase by 20% for Climate Change**	**Max. Design 100 yr Flood m3/s**	**Max. Design 1000 yr Flood m3/s**
Tributary of River Nanny Catchment 2	2.1900	929	0.3	0.472	1.528	1.833	0.510	1.501	1.801	1.833	2.432

Notes:
1) 3-Term EQN is QBAR = 0.00066 (Area^0.92)(SAAR^1.22)(Soil^2.0) Ref.: Flood Studies Report No. 6 and QBAR = 0.00108 (Area^0.89)(SAAR^1.17)(Soil^2.17) for catchments less thatn 24ha (Inst. Hyd. Report No. 124)
6-Term EQN is QBAR = C [(AREA)0.94.(STMFRQ)0.27.(SOIL)1.23.(RSMD)1.03.(S1085)0.16.(1+LAKE)-0.85]
2) SAAR (Average Annual Rainfall) from Met Eireann.
3) SOIL from FSR Maps.
4) Q100 from Region curves ordinates from Flood Studies Report, Table 2.39 and Ref. to Michael Bruen for Soil Types = 1
5) Factors of Safety multiples of 1.5 and 1.65 included for the relevant formulae.
6) If the Parameters STMFRQ or S1085 do not exist in the culvert catchment then the three term equation is used
7) Catchment areas as determined from WFD and Topographical Survey
8) Climate change - increase of 20% in flows - ref: OPW - Appendix C Standard Specifications for Feasibility and Pre-feasibility Studies for flood relief works - March 2004 (the note is based on the Desk Study carried out by Dr. Michael Bruen

Reviewed Date: Prepared M Creedon Date: 31.01.17

				Design Flow 3 term EQN IOH Method			**Design Flow 3 term EQN FSSR Method**				
Location	**AREA km2**	**SAAR mm**	**SOIL**	**QBAR m3/s**	**Q100(x 1.96SOIL Type >2, x 2.61SOIL Type 1) x 1.65 m3/s**	**Increase by 20% for Climate Change**	**QBAR m3/s**	**Q100(x 1.96) x 1.5 m3/s**	**Increase by 20% for Climate Change**	**Max. Design 100 yr Flood m3/s**	**Max. Design 1000 yr Flood m3/s**
Tributary of River Nanny Catchment 3	4.4000	929	0.3	0.879	2.843	3.412	0.970	2.852	3.422	3.422	4.539

Notes:
1) 3-Term EQN is QBAR = 0.00066 (Area^0.92)(SAAR^1.22)(Soil^2.0) Ref.: Flood Studies Report No. 6 and QBAR = 0.00108 (Area^0.89)(SAAR^1.17)(Soil^2.17) for catchments less thatn 24ha (Inst. Hyd. Report No. 124)
6-Term EQN is QBAR = C [(AREA)0.94.(STMFRQ)0.27.(SOIL)1.23.(RSMD)1.03.(S1085)0.16.(1+LAKE)-0.85]
2) SAAR (Average Annual Rainfall) from Met Eireann.
3) SOIL from FSR Maps.
4) Q100 from Region curves ordinates from Flood Studies Report, Table 2.39 and Ref. to Michael Bruen for Soil Types = 1
5) Factors of Safety multiples of 1.5 and 1.65 included for the relevant formulae.
6) If the Parameters STMFRQ or S1085 do not exist in the culvert catchment then the three term equation is used
7) Catchment areas as determined from WFD and Topographical Survey
8) Climate change - increase of 20% in flows - ref: OPW - Appendix C Standard Specifications for Feasibility and Pre-feasibility Studies for flood relief works - March 2004 (the note is based on the Desk Study carried out by Dr. Michael Bruen

Reviewed Date: Prepared M Creedon Date: 31.01.17

				Design Flow 3 term EQN IOH Method			**Design Flow 3 term EQN FSSR Method**			**Design Flow 6 term EQN**				
Location	**AREA km2**	**SAAR mm**	**SOIL**	**QBAR m3/s**	**Q100(x 1.96SOIL Type >2, x 2.61SOIL Type 1) x 1.65 m3/s**	**Increase by 20% for Climate Change**	**QBAR m3/s**	**Q100(x 1.96) x 1.5 m3/s**	**Increase by 20% for Climate Change**	**QBAR m3/s**	**Q100(x 1.96) x 1.5 m3/s**	**Increase by 20% for Climate Change**	**Max. Design 100 yr Flood m3/s**	**Max. Design 1000 yr Flood m3/s**
Tributary of River Nanny Catchment 4	7.8000	929	0.3	1.463	4.732	5.679	1.642	4.829	5.795	1.065	3.131	3.757	5.795	7.687

Notes:
1) 3-Term EQN is QBAR = 0.00066 (Area^0.92)(SAAR^1.22)(Soil^2.0) Ref.: Flood Studies Report No. 6 and QBAR = 0.00108 (Area^0.89)(SAAR^1.17)(Soil^2.17) for catchments less thatn 24ha (Inst. Hyd. Report No. 124)
6-Term EQN is QBAR = C [(AREA)0.94.(STMFRQ)0.27.(SOIL)1.23.(RSMD)1.03.(S1085)0.16.(1+LAKE)-0.85]
2) SAAR (Average Annual Rainfall) from Met Eireann.
3) SOIL from FSR Maps.
4) Q100 from Region curves ordinates from Flood Studies Report, Table 2.39 and Ref. to Michael Bruen for Soil Types = 1
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8) Climate change - increase of 20% in flows - ref: OPW - Appendix C Standard Specifications for Feasibility and Pre-feasibility Studies for flood relief works - March 2004 (the note is based on the Desk Study carried out by Dr. Michael Bruen

Reviewed Date: Prepared M Creedon Date: 31.01.17

				Design Flow 3 term EQN IOH Method			**Design Flow 3 term EQN FSSR Method**			**Design Flow 6 term EQN**				
Location	**AREA km2**	**SAAR mm**	**SOIL**	**QBAR m3/s**	**Q100(x 1.96SOIL Type >2, x 2.61SOIL Type 1) x 1.65 m3/s**	**Increase by 20% for Climate Change**	**QBAR m3/s**	**Q100(x 1.96) x 1.5 m3/s**	**Increase by 20% for Climate Change**	**QBAR m3/s**	**Q100(x 1.96) x 1.5 m3/s**	**Increase by 20% for Climate Change**	**Max. Design 100 yr Flood m3/s**	**Max. Design 1000 yr Flood m3/s**
Tributary of River Nanny Catchment 5	8.7400	929	0.3	1.619	5.236	6.284	1.824	5.362	6.434	1.142	3.357	4.029	6.434	8.535

Notes:
1) 3-Term EQN is QBAR = 0.00066 (Area^0.92)(SAAR^1.22)(Soil^2.0) Ref.: Flood Studies Report No. 6 and QBAR = 0.00108 (Area^0.89)(SAAR^1.17)(Soil^2.17) for catchments less thatn 24ha (Inst. Hyd. Report No. 124)
6-Term EQN is QBAR = C [(AREA)0.94.(STMFRQ)0.27.(SOIL)1.23.(RSMD)1.03.(S1085)0.16.(1+LAKE)-0.85]
2) SAAR (Average Annual Rainfall) from Met Eireann.
3) SOIL from FSR Maps.
4) Q100 from Region curves ordinates from Flood Studies Report, Table 2.39 and Ref. to Michael Bruen for Soil Types = 1
5) Factors of Safety multiples of 1.5 and 1.65 included for the relevant formulae.
6) If the Parameters STMFRQ or S1085 do not exist in the culvert catchment then the three term equation is used
7) Catchment areas as determined from WFD and Topographical Survey

8) Climate change - increase of 20% in flows - ref: OPW - Appendix C Standard Specifications for Feasibility and Pre-feasibility Studies for flood relief works - March 2004 (the note is based on the Desk Study carried out by Dr. Michael Bruen

Reviewed Date: Prepared M Creedon Date: 31.01.17

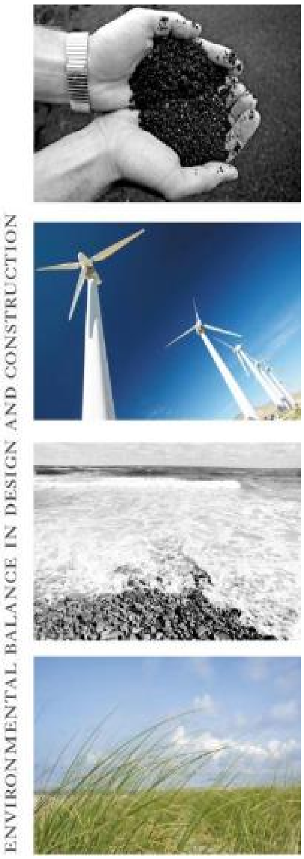
				Design Flow 3 term EQN IOH Method			Design Flow 3 term EQN FSSR Method			Design Flow 6 term EQN				
Location	**AREA km2**	**SAAR mm**	**SOIL**	**QBAR m3/s**	**Q100(x 1.96SOIL Type >2, x 2.61SOIL Type 1) x 1.65 m3/s**	**Increase by 20% for Climate Change**	**QBAR m3/s**	**Q100(x 1.96) x 1.5 m3/s**	**Increase by 20% for Climate Change**	**QBAR m3/s**	**Q100(x 1.96) x 1.5 m3/s**	**Increase by 20% for Climate Change**	**Max. Design 100 yr Flood m3/s**	**Max. Design 1000 yr Flood m3/s**
Tributary of River Nanny Catchment 6	10.2000	929	0.3	1.858	6.008	7.210	2.102	6.181	7.417	1.268	3.728	4.474	7.417	9.838

Notes:
1) 3-Term EQN is QBAR = 0.00066 (Area^0.92)(SAAR^1.22)(Soil^2.0) Ref.: Flood Studies Report No. 6 and QBAR = 0.00108 (Area^0.89)(SAAR^1.17)(Soil^2.17) for catchments less thatn 24ha (Inst. Hyd. Report No. 124)
6-Term EQN is QBAR = C [(AREA)0.94.(STMFRQ)0.27.(SOIL)1.23.(RSMD)1.03.(S1085)0.16.(1+LAKE)-0.85]
2) SAAR (Average Annual Rainfall) from Met Eireann.
3) SOIL from FSR Maps.
4) Q100 from Region curves ordinates from Flood Studies Report, Table 2.39 and Ref. to Michael Bruen for Soil Types = 1
5) Factors of Safety multiples of 1.5 and 1.65 included for the relevant formulae.
6) If the Parameters STMFRQ or S1085 do not exist in the culvert catchment then the three term equation is used
7) Catchment areas as determined from WFD and Topographical Survey

8) Climate change - increase of 20% in flows - ref: OPW - Appendix C Standard Specifications for Feasibility and Pre-feasibility Studies for flood relief works - March 2004 (the note is based on the Desk Study carried out by Dr. Michael Bruen

Appendix D

OPW Summary Local Area Report



River Nanny in flood mid November 2009, not at peak water levels.
The photographs are of the river Nanny from Balrath for about 3km downstream to Duleek

Appendix 12.6

Hydrological Study

KNOCKHARLEY LANDFILL LIMITED

APPENDIX 12-6: HYDROLOGICAL STUDY OF A TRIBUTARY OF THE RIVER NANNY - PROPOSED DEVELOPMENT AT KNOCKHARLEY LANDFILL, CO. MEATH

NOVEMBER 2018

Knockharley Landfill Ltd.
Kentstown, Navan,Co.Meath

FEHILY TIMONEY & COMPANY

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APPENDICES

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1. INTRODUCTION

The hydrological study of a tributary of the River Nanny was prepared by Fehily Timoney & Co (FT) as Appendix 12-6 for Chapter 12 Surface Water in Volume 2 of the EIAR for the proposed Integrated Waste Management Facility at Knockharley Landfill, Co. Meath.

This study:

- Determines the catchment of the watercourse and estimate the 100-year flow.
- Calculates the maximum hydraulic capacity of the existing stream, including culverts, pipes etc., and shall include details of cross sections, invert levels and flow data.
- Assesses the watercourse capacity to accommodate the catchment 100-year flow, as well as the maximum attenuated discharge from the overall development site.
- Describes the nature of works proposed in the diversion/culverting of the existing stream and confirm that these works will not negatively impact on the hydraulic capacity of the stream.
- The study shall also have regard to the proposals for the management and discharge of ground water.

The hydrological study was prepared by an in-house specialist water engineer in FT. The hydrological study was prepared taking cognisance of the guidelines produced by the Department of Environment, Heritage and Local Government (DoEHLG) – "The Planning System and Flood Risk Management Guidelines for Planning Authorities" (November 2009).

The tributary which is assessed in this document runs through the site and the surface water run-off collected at the site discharges into it. This reach of the tributary is known as the Knockharley Stream. The hydrological study was undertaken using specific nodes along the main stream length of the tributary to provide an accurate model of the hydraulic capacity of the stream. The nodes were chosen at the points of constriction (or least capacity) within the stream channel, along a length of 7.882 km up to its confluence with the River Nanny. A survey was undertaken by FT to provide details of the existing stream channel at these nodes. The survey was restricted where access proved to be difficult or where it would involve entering onto private grounds.

A hydraulic analysis of the 1 in 100 and 1 in 1000-year flows was undertaken for the existing stream. This flow was modelled using the river modelling software HECRAS to examine the capacity of the existing structures and stream channel to convey this extreme flood event. Flow changes were introduced at 6 No. nodes as the catchment increased along the stream. A summary of the hydrological assessment at these nodes is provided in Table 1.1 over.

The model was then run with the proposed diversion/culverting in the stream channel (post development scenario) which confirmed that these works will not negatively impact on the hydraulic capacity of the stream.

As part of the post development scenario, the outflow from the attenuation pond at the site was incorporated into the model of the stream. The outflow entered from the pond was the maximum attenuated discharge from the site, in a 100-year storm event.

Table 1.1: Summary Sheet of Hydrological Assessment along Knockharley Stream

Catchment Reference	Distance Along Main Stream Length (km)	HECRAS Chainage Identifier (m)	Catchment Area (km^2)	Q100 + CC* (m^3/s)	Q1000 + CC* (m^3/s)
ST1	2.541	5455	1.77	1.517	2.012
ST2	3.275	4769	2.19	1.833	2.432
ST3	5.069	2897	4.40	3.422	4.539
ST4	6.363	1615	7.80	5.795	7.687
ST5	6.879	1112	8.74	6.434	8.535
ST6	7.882	15	10.20	7.417	9.838

*CC = Allowance for Climate Change of 20%

1.1 Culverting

An ecological assessment carried out at the site in May 2010 revealed two otter spraints in Knockharley Stream in the vicinity of the proposed flood compensation berm to the north west of the site. The spraints appeared to be fresh and marked a regularly used pathway along the stream bank (see Figure 10.4 of the EIAR for location of the spraints). It is unlikely that otters occur in high numbers on the site, due to the small size of the stream and the limited suitability of the habitat further downstream on the site. Otters are less likely to be found on small streams (Knockharley Stream is ~1 m wide) than wider rivers (Bailey & Rochford, 2006). No evidence of breeding (i.e. an otter holt) was found during the ecological assessment.

Nonetheless, measures are proposed to prevent any negative impact on the otters present. Whilst hydraulic studies discussed in this report require an orifice to be installed in the proposed flood prevention culvert at the inlet, According to National Roads Authority guidelines (NRA, 2006) cylindrical culverts should be oversized to allow for the provision of ledges. Ledges should be 500 mm wide, constructed at least 150 mm above the 1 in 5-year flood event, and allow 600 mm of headroom. Accordingly, immediately downstream of the orifice a 1500 mm ope culvert will be installed to accommodate ledges and headroom.

1.2 Stream diversion

Biological monitoring of surface water quality was undertaken by means of a macroinvertebrate 'kick sampling' survey in accordance with Schedule D.5 of the EPA licence for Knockharley Landfill (W0146-02) annually from 2007 (with the exception of 2012) with the most recent survey undertaken in 2017, at four locations, Sites 1–4. Previous biological monitoring surveys by means of calculating EPA Q-values or using the Q-rating system were carried out at sites (sites 1-4) from 2007 to 2011. The Q Values for all four sites averaged at a Q3 or 'Poor status' according to the Water Framework Directive (WFD); upstream and downstream of Knockharley Landfill. Biological monitoring was also conducted from 2013–2017 at the same four sites by means of calculating Small Stream Risk Scores (SSRS) which is a more appropriate methodology for the type of stream on site.

Due to the different methodologies used between previous surveys (2007-2011) and more recent surveys (2013-2017), direct comparison between the Q-values collected in previous years and the 2013–2017 results are not possible. The 2013-2017 surveys have shown that Sites 1–4 were all 'at risk' of not achieving good status. Thus, both methodologies of biological sampling have revealed water quality which is below the required Q4 or 'Good status'; both upstream and downstream of Knockharley Landfill. This indicates that water quality is below the required Q4 or 'Good status' before it enters the Knockharley Landfill site and remains that way downstream of Knockharley Landfill.

The River Nanny holds a small stock of wild trout and is stocked annually with brown trout. It also gets a small run of sea trout (FTC, 2010). Knockharley stream appears to have limited habitat for fish and previous surveys have shown that there are no salmonid fish in the stream, although some three-spined sickleback and eels have been recorded (FTC, 2010).

The stream diversion is not likely to have a significant negative impact on fish, but some impact on the macroinvertebrate community present may occur.

This can easily be mitigated against my removing and transferring the current stream bed material (e.g. gravel, stones) into the proposed new stream channel. This will be done under the supervision of a suitably qualified ecologist.

1.3 References

Bailey, M. and Rochford, J., 2006. Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Biological Water Quality Sampling Reports 2007-2017 in accordance with the licence.

NRA, 2006. Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes.

Toner, P., Bowman, K., Clabby, K., Lucey, J., McGarrigle, M., Concannon, C., Clenaghan, C., Cunningham, P., Delaney, J., Boyle, S., MacCarthaigh, M., Craig, M. and Quinn, R, 2005. Water Quality in Ireland 2001-2003. Environmental Protection Agency, Wexford.

Walsh, A. (2005) Western River Basin District Project Small Streams Risk Score Method Manual. Western Regional Fisheries Board.

1.4 Supporting Appendices

The supporting Appendix for this report also presents the following information:

Appendix A: Photographs of the existing channel and its structures.

Further supporting Appendices of Volume 3 of this EIAR also presents the following information:

Appendix 12.1 - Hydraulic calculations for the southern pond
Appendix 12.2 – Surface Water Management Plan
Appendix 12.4 - Hydraulic calculations for the Northern pond
Appendix 12.5 – Flood Risk Assessment.

2. PROJECT DETAILS

The existing development is an operational residual waste landfill at this site at Knockharley near Kentstown, County Meath. The landfill opened in December 2004 and accepts residual household, commercial and industrial wastes together with construction and demolition wastes, see Drawing LW14-821-01-P-0000-002 Existing Site Layout in Volume 4 of this EIAR.

The landfill operates in accordance with IE Licence (Reg. No. W0146-02).

The existing development consists of the permitted landfill footprint, a complex of buildings and infrastructure comprising an administration building, two weighbridges, inspection slab, quarantine slab, machinery/maintenance garage, car parking and other facilities. These are located within the buildings area to the east of the landfill cells. The permitted landfill footprint is aligned approximately north-south through the centre of the lands. The active area commencing at Phase 1 is located towards the south of the overall footprint and the landfill is currently being filled northwards. The leachate storage lagoon is located to the south of the administrative buildings and the surface water pond is situated to the south of the landfill.

The proposed development comprises:

- the acceptance of 444,000 tonnes of waste for non- hazardous cells
- raising the height of future cells in the permitted development from 74 mAOD to 85 mAOD (and construction of permitted cells under current planning permission)
- a new IBA facility including building within new cells
- a biological treatment facility comprising a building and hardstanding marshalling yard
- a leachate management facility comprising hardstanding areas, bunded storage and floating cover lagoons
- screening berms
- a surface water management system comprising holding pond, attenuation lagoon and wetland
- a culvert and embankment across the existing Knockharley stream to provide compensatory flood provision to offset lost flood storage realised during a 1:1000-year storm that will be lost as a consequence of providing storm water attenuation provision for both the permitted and proposed future developments
- felling of c. 12.5 ha forestry and replanting of c.16.8 ha
- 2 no. new ESB sub stations and new overhead 20kVA ESB supply
- extension of existing below ground infrastructure (power, water, telemetry, leachate rising mains, drainage) and extension of the existing car park at the administration building.

The proposed new development shall, generally, be executed within a 'green field' setting. Refer to in Volume 4 of this EIAR Drawings LW14-821-01-P-0000-003 to LW14-821-01-P-0000-011 for the proposed site layout.

A tributary stream of the River Nanny flows through the site see Drawing LW14-821-01-P-0500-006 Site Layout with Existing Stream Structures in Volume 4 of this EIAR.

The site is bisected by a watershed running in an east west direction. See Figure 12-2 in this report. Runoff from the permitted development currently discharges via the "Southern" attenuation lagoon and wetland. It is proposed to discharge surface water runoff from the proposed development via a new "Northern" storm water management system. Both system will discharge to a tributary known as the Knockharley Stream.

The River Nanny and its tributaries lie in Hydrometric Area 08.

Existing "Southern" Surface Water Management Facility

All of the surface water from the existing developed site discharges to the Knockharley stream via the "Southern" attenuation pond and wetland area. The "Southern" pond discharges at point 309 m to the south of the already diverted section of channel, and the northern pond will discharge immediately upstream of the proposed culvert which is approximately 225m downstream of the proposed stream diversion. The 1 in 100-year storm will not overtop the banks of the ponds and an overflow weir has been provided into the attenuation lagoon area to cater for this event.

Proposed "Northern" Stormwater Management System

As part of the proposed development a new "Northern" storm water management system comprising a holding pond, a surface water attenuation lagoon and wetland area will be developed to cater for the for surface water runoff from the "Northern" catchment within the facility.

The surface water will be fully attenuated in these ponds for a 1 in 20-year return period storm and discharged at Greenfield rates into the Knockharley tributary stream. It is proposed to place the "Northern" storm water management system in the natural low point of the site which will overly the footprint of a 1:1000-year flood plan. Accordingly, proposals for the "Northern" storm water management system make provision for a flood compensation culvert which will be designed to allow 1:100-year flood events to pass with minimal impact on upstream levels. In the event of a 1:1000-year flood event occurring, the culvert will throttle flows and provide compensatory flood storage immediately upstream of the culvert within the facility development. It proposed to replace an existing culvert at CH 4695 with the new flood compensation culvert within an embankment across the Knockharley stream. The embankment will maintain access across the stream and contain compensation flood water.

It is also proposed to divert the stream over a length of 171m, increasing the effective length of the stream by approximately 8.0 m to go around the north-western corner of the site. Permission has been granted for this diversion through the original planning application.

Drawing No. LW14-821-01-P-003 Proposed Site Layout in Volume 4 of this EIAR shows the layout of the site.
Drawing No. LW14-821-01-P-0500 in Volume 4 of this EIAR, shows the chainage locations of existing structures.

This report presents a hydrological assessment, hydraulic analysis (completed using the river modelling software HECRAS) and a detailed description of the proposed culvert and the stream diversion along the main stream channel of the Knockharley Stream.

Section 50 applications will be submitted to the Office of Public Works (OPW) at detailed design stage for approval for the proposed culverts and the proposed stream diversion.

3. DESIGN AND CALCULATIONS

3.1 Background Information

3.1.1 The Knockharley Stream Catchment

The site lies within the River Nanny catchment area close to the catchment divide with the River Boyne catchment. The River Nanny rises to the east of Navan in County Meath and flows in an easterly direction and out into the Irish Sea at Laytown.

At a more local scale, the site lies within the catchment of the Kentstown Stream, a tributary of the River Nanny. The River Nanny is characterised by sudden high flows coinciding with high rainfall periods and particularly low flows in the drier summer months as determined from data collected by Meath County Council's gauging station at the River Nanny in 1990. The upper reaches of the River Nanny catchment are characterised by a high-water table and particularly poor drainage conditions. These conditions are reflected in the depth and high density of field drains in Knockharley. The local surface drainage, including Knockharley Stream, rises in the Realtoge area to the west, flows eastwards around and through the development site before turning to flow southwards to meet the Kentstown Stream and then onwards to meet the River Nanny above Balrath cross roads. The site drains essentially cease flowing in the drier summer months. However, standing water is still observed in the drains in the drier months due to the locally high-water table and the depth of the drains and poor drainage conditions. A number of drain diversions were undertaken and a series of settling lagoons were established as part of the initial site development works.

3.1.2 Existing Site Drainage

Drainage from the landfill facility is directed towards a storm water pond and afterwards to a constructed wetland before it flows into the local drainage network which in turn flows into the Kentstown Stream. Drainage from adjoining lands is now directed around the facility and flows into the local drainage network at the southern edge of the facility.

The surface drainage from the greater part of the development site leaves the property via a deep drainage channel located in the extreme south-east corner. An isolating weir can divert the site drainage to the storm water lagoon in the event of a contamination incident. This would allow the polluted water to be retained on the property until the spill event is investigated and remediated. This provision can equally deal with third-party pollution events arising outside the site boundary. The storm water pond has sufficient capacity to dampen storm peaks and to maintain the current discharge characteristics from the landholding. The ponds also allow for the settling of fines carried by the drainage waters. The proposal has not increased the existing southern pond catchment over what was considered in the original design. The capacity and operation of the ponds is described in more detail in the Surface Water Management Plan that accompanies this submission.

3.1.3 Groundwater

As each phase of the landfill is constructed, groundwater seeps may be encountered. Under-cell drainage has been installed which discharges to the surface water system. This drainage system effectively depresses the overburden water table to the underside level of the landfill liner.

The actual flow was measured on 4th May 2011 at just under 1 m^3 per day. Since 16 of 28 cells are fully developed and excavation for two more is more or less done, the groundwater catchment currently draining to the groundwater drain is just over 50% of the total. It is therefore estimated that full development at the current levels may result in twice the current discharge say 2 m^3 per day.

For the proposed IBA facility development, the floor of cells 29 to 32 will be approximately 3-4 m higher than the adjacent permitted cells 18, 20, 22, 24 and 26.

It is therefore unlikely that significant increase in groundwater flows will result albeit that groundwater control provision will be made by connecting the proposed groundwater pipework in cells 29 through 32 into the insitu groundwater control system within the permitted development in adjacent cell 18.

3.2 Flood History

The flooding history for the Knockharley Stream was examined in the national flooding website maintained by the Office of Public Works (OPW) www.floodmaps.ie.

An extract of the flood map report which summarises all flood events within 2.5 km of the Knockharley site is available in Volume 2 Chapter 12 Surface Water Figure 12-3. Of the six flood incidents listed, none of these occurred on the Knockharley Stream up to its confluence with the River Nanny. One of the flood incidents occurred at Balrath Cross Roads. There are no benefitting lands indicated at the Knockharley site or on lands adjacent to the stream up to its confluence with the River Nanny.

Although there are no recorded flood events along the route of the Knockharley Stream, there is evidence of alluvium along the banks of the stream. This can be seen in the quartenary geological mapping which suggests that the stream may have overtopped its banks historically. Refer to Volume 2 Chapter 11 Soils and Geology Figure 11.1.

As stated previously, the upper reaches of the River Nanny catchment are characterised by a high-water table and particularly poor drainage conditions. These conditions are reflected in the depth and high density of field drains in Knockharley. It would be expected therefore that the river model of the Knockharley Stream would indicate that the existing stream channel would be running at close to full capacity in an extreme flood event.

3.3 Detailed Description of the Existing Stream Channel and the Existing Structures

The locations of the features discussed below along the existing stream channel are identified in Drawing LW14-821-01-P-0500-006 Site Layout with Existing Stream Structures in Volume 4 of this EIAR. Photos are attached in the following figures and in Appendix A of this report.

The stream entering the site from the western boundary at Knockharley is a 1st order tributary of the River Nanny. The stream is not salmonid. It flows from the west in an easterly direction. The stream emerges from a 1.0 m diameter circular concrete culvert at the western boundary Ch 5454m, as shown in Figure 3.1 and Figure 3.2. The culvert is approximately 4-5m long. The stream flows into an open channel just upstream of the location of the proposed screening berm, as shown in Figure 3.3. Downstream views of the stream channel from the proposed screening berm toe are provided in Figures 3.4 and 3.5.

Figure 3.1: View of existing culvert at western boundary perimeter fence at Ch. 5454

Figure 3.2: Downstream view of existing 1 m diameter culvert at western boundary perimeter fence at Ch. 5454

Figure 3.3: Looking upstream at stream channel from Ch 5363

Figure 3.4: Looking downstream at stream channel from Ch 5363

Figure 3.5: Stream channel downstream of Ch 5363

Approximately 342 m downstream of the western perimeter fence, the stream is carried in a structure under an existing laneway. The existing structure is an old stone culvert approximately 2 m wide and 1.5 m high and 3-4 m long, as shown in Figures 3.6 and 3.7 (HECRAS identifier Ch 2621). The proposed stream diversion will bypass this structure.

Figure 3.6: Existing culvert Ch 5113

Figure 3.7: Upstream view of existing stone culvert Ch 5113

A box culvert of 1.2 m wide, 1.4 m high and 3.5 m long exists at the eastern perimeter boundary fence, as shown in Figure 3.8.

Figure 3.8: View of existing culvert at eastern perimeter fence Ch 4695

It is proposed to place a flood compensation culvert berm just upstream of this culvert at CH4814. The new culvert will be installed in the proposed berm across the Knockharley stream (required to maintain existing access). The culvert will provide compensatory upstream flood provision for a 1:1000-year storm event albeit that 1:100-year flows will pass with minimal upstream impacts. The proposed culvert under the screening berm will see the removal of the insitu culvert. Views upstream and downstream of the proposed location of the screening berm are shown in Figures 3.9 and 3.10.

Figure 3.9: Looking upstream from existing culvert at Ch 4695

Figure 3.10: Looking downstream from existing culvert at Ch 4695

There is also an existing box culvert 2.1 m wide and 1.5 m high at the crossing of the access road into the site at Ch 3709.

An existing structure is located at the downstream end of the proposed stream diversion which will route the stream around the proposed biological waste treatment facility (Ch 2621). This structure has a shut off facility and stream flows can be diverted from here into the attenuation pond in the event of an accidental spillage entering the stream. The structure is 2 m wide, 2.4 m high and 9 m long.

Existing stone arch bridges occur along the route of the stream downstream of the site boundary. The dimensions of these structures are detailed in Table 3.1 and photographs are provided in Appendix A. These structures were all entered into the model of the existing stream channel.

Table 3.1: Dimensions of existing structures downstream of the site

HECRAS Chainage Identifier (m)	Location	Distance downstream from Site boundary (km)	Form	Span (m)	Rise (m)
1603	Crossing R150	0.683	Stone arch bridge	3.5	2.0
1100	Local Forked Road 1st Structure	1.186	Twin stone arch bridges	2.0 (each)	1.6 (each)
1072	Local Forked Road 2nd Structure	1.214	Stone arch bridge	2.45	1.74
8	Crossing cul de sac laneway	2.278	Stone arch bridge with main arch and smaller arch 22.7 m apart centre to centre	Main arch 3.76 Small arch 0.9	Main arch 1.42 Small arch 0.45

3.4 Design Standards

3.4.1 The Office of Public Works

The Office of Public Works (OPW), was consulted 25th October 2016 regarding the location of the proposed culverts and stream diversion locations. In response the OPW indicated that there are no maintainable channels adjacent to the Knockharley Landfill site.

The design of watercourse crossings will be subject to the approval of the OPW, under Section 50 of the Arterial Drainage Act, 1945. The following standards are required by the OPW:

- Minimum culvert size: 900 mm
- Minimum freeboard for bridges: 300 mm
- Recommended design flood standards for culverts and bridges:
  - 100-year flood
  - Increase flood flow by 20 % as an allowance for Climate Change
  - Increase flows by a factor of 1.6, where there are existing drainage schemes upstream

Section 50 application will be made to the OPW at detail design stage.

3.5 Hydrological Assessment

The design 100-year return period flood was calculated using the procedures set out in Flood Studies Report (FSR, 1975) (the 6-variable equation), the Flood Studies Supplementary Report (FSSR, 1978) (the 3-variable equation for small catchments of area less than 20 km^2) and the Institute of Hydrology Report No. 124 (IOH, 1994) (the 3-variable equation for small catchments of area less than 25 km^2) at 6 No. locations along a reach length of 5.46 km of the Knockharley Stream as it flows through the site at Knockharley and downstream to meet the River Nanny. There are no known Drainage Schemes upstream of the site, maintained by the Local Authority, therefore the factor of 1.6 as discussed in Section 3.4.1 is not relevant to this site.

The course of the stream was examined from Discovery Series (1:50,000 mapping) and from survey information. Where the stream characteristics STMFRQ and S1085 cannot be determined, the 6-variable equation cannot be used.

Hence only the two methods (3-variable equations FSSR and IOH) are used in this case. The stream characteristic SAAR is provided from Met Éireann. The SOIL parameter is determined from FSR Soil maps.

In the above methods, the mean annual flood for the catchment (Qbar) is first calculated using the catchment characteristics in the corresponding 3-variable equations. The resulting Qbar is then multiplied with a regional factor of 1.96 to obtain the 100-year flood. This 100-year flood is then multiplied by a design factor (standard error factor), which is 1.5 in the case of the FSSR equation, and 1.65 for the IOH Report No. 124 equation. The highest Q100 values thus obtained from different methods is adopted as the design 100-year flood.

Results of the hydrological calculations, including a 20% increase for climate change as recommended in current OPW guidelines, are summarised Table 3.2.

In the revised model of the Knockharley Stream, the model was also run for the 1 in 1000-year flood flow in the pre-development and post-development scenarios, to establish if there are any breaches in the stream course and to investigate the source of the 1 in 1000 year return period flooding as indicated in the OPW PFRA mapping. The hydraulic model, shows that the stream's water level exceeds that of both bank levels and causes out of bank flooding, in the vicinity of the proposed flood compensation culvert.

Table 3.2: Hydrological Assessment of Knockharley Stream

Location	HECRAS Chainage Station Identifier	Catchment area in km²	Q100 - FSR 6-variable equation, m³/s	Q100 - FSSR 3-variable equation, m³/s	Q100 in IOH Report 124, 3-variable equation, m³/s	Adopted design Q100 m3/s	Q100 Design Flow including 20% allowance for Climate Change m³/s	Q1000 Design Flow including 20% allowance for Climate Change m³/s
1	5455	1.77	-	1.234	1.264	1.264	1.517	2.012
2	4769	2.19	-	1.501	1.528	1.528	1.833	2.432
3	2897	4.40	-	2.852	2.843	2.852	3.422	4.539
4	1615	7.80	3.131	4.829	4.732	4.829	5.795	7.687
5	1112	8.74	3.357	5.362	5.236	5.362	6.434	8.535
6	15	10.20	3.728	6.181	6.008	6.181	7.417	9.838

3.6 Hydraulic Analysis

A hydraulic analysis of the capacity of the existing stream was carried out using the river modelling software HECRAS and summary results are presented in Table 3.3.

The average bed slope of the Knockharley Stream as calculated using surveyed sections, was 0.00468. Manning's roughness value for the natural channel was taken as n = 0.04 and overbank is taken as n = 0.06.

Hydraulic analysis of the stream channel is based on the procedure suggested in Floodplain Modelling Using HEC-RAS 2003.

The information provided from the surveyed cross-sections of the stream channel, including the surveys of the existing structures along the route of the stream, as described in Section 3.3, were entered into the software and a model of the stream was then run.

Results of the hydraulic model using HEC-RAS showed that the existing stream channel and the structures were mostly capable of passing the 100-year flood.

The cross-sections at the 6 No. locations surveyed were entered progressing downstream from Ch 5455 to Ch 0. The last location surveyed at Ch 0 is 688 m upstream of the confluence of the stream with the River Nanny.

The 1 in 100-year and the 1 in 1000-year design flows with an allowance for climate change of 20% were entered into the model with flow changes indicated as the catchment increases downstream, as shown in Table 3.2.

An existing culvert under the laneway (Ch 5113) was omitted from the analysis for this run of the model as it will be removed when the final phases of the landfill are in place.

The model was run for the existing scenario and the proposed scenario, which incorporates the stream diversion at the north-western corner of the landfill site and proposed flood compensation culvert at located at the north-eastern corner of the site. The stream diversion over a length of 171m, increases the flow path by approximately 8m. The length of stream channel for diversion has adequate capacity to contain the design flood flow. Therefore, the proposed new cross-section for the stream diversion will remain as existing and the stream will be diverted into the stream diversion chamber as before. The stream diversion will alter the chainage identifiers upstream in the model, increasing each one by 8 m, however for simplicity in comparing results between the existing and proposed development, at different node points the node labels in results Table 3.3 remain unchanged.

The Surface Water Management Plan (see Volume 2 Chapter 12 Surface Water Appendix 12-2) outlines the operation of the proposed new surface water holding pond and attenuation lagoon serving runoff from the "Northern" catchment. The proposed development contribution to the ponds encompasses an area of 139ha. The maximum outflow from the ponds for a 100-year storm will be less than that of the greenfield runoff rate. In order to adopt a conservative approach, the greater flow from the greenfield runoff for the existing scenario, which does not account for the reduction in surface water flows intercepted in the attenuation pond, was therefore used in the HECRAS hydraulic modelling. The details of the 1 in 100-year and 1 in 1000-year flows input in the model of the stream for the two scenarios are set out in Table 3.2 above.

It was observed in the HECRAS hydraulic model that the channel was flowing to almost full capacity just upstream of the location for a proposed new culvert, at Ch 4814. Out of bank flow was also observed upstream of the proposed culvert with the 1 in 1000-year flow. The access road is set above the flood level. The stream was flowing to full capacity (with no out of bank flow) along the length of the location proposed for the stream diversion. Further downstream at Ch 1112, both banks overflowed upstream of the structures at the forked road, with the left bank overflowing between the structures, the second structure here provided adequate capacity to contain the flow. The last structure at Ch 8 indicated over bank flow to the left bank of the main channel, spilling over and through the smaller arch in the bridge structure, providing flood relief.

The results of the hydraulic analysis are consistent with an observed history of poor drainage at the site and the evidence of alluvium which is pronounced at certain points along the route of the Knockharley Stream.

Analyses concluded the following:

- A 900 mm culvert will hydraulically pass 1:100 year storm events through the culvert with little or no increase in upstream levels at CH 4814
- An orifice placed eccentrically at the head of the culvert (diameter 825 mm approximately and subject to detailed design) will restrict 1:1000-year flood events and provide flood compensation storage of approximately 7,977 m^3 with an upstream head of 60.5 mAOD details of which are presented in Volume 2 Chapter 12 Surface Water Section 12.5 of this EIAR.
- Whilst hydraulically a 900 mm culvert will accommodate a 1:100-year flood event, the culvert will be oversized with clear opes of 1500 mm to accommodate possible otter activity.

The raised water levels within the site are not of concern as these areas are not proposed to be developed and any development close to these areas will be protected by clay berms. Reductions in water levels were observed in the model upstream of the stream diversion chamber and at the bridges downstream of the site. This is largely as a result of transferring the natural outfall for part of the site downstream where the outfall from the development is proposed from the pond and as a result of the outfall from the pond being a controlled outfall. This will have the effect of reducing any existing flood risk downstream of the site.

A summary of the hydraulic analysis before and after the proposed works for 1:100 and 1:1000 storm events with reference to the surveyed sections and structures is presented in Table 3.3 over.

Table 3.3: Results of Hydraulic Analysis

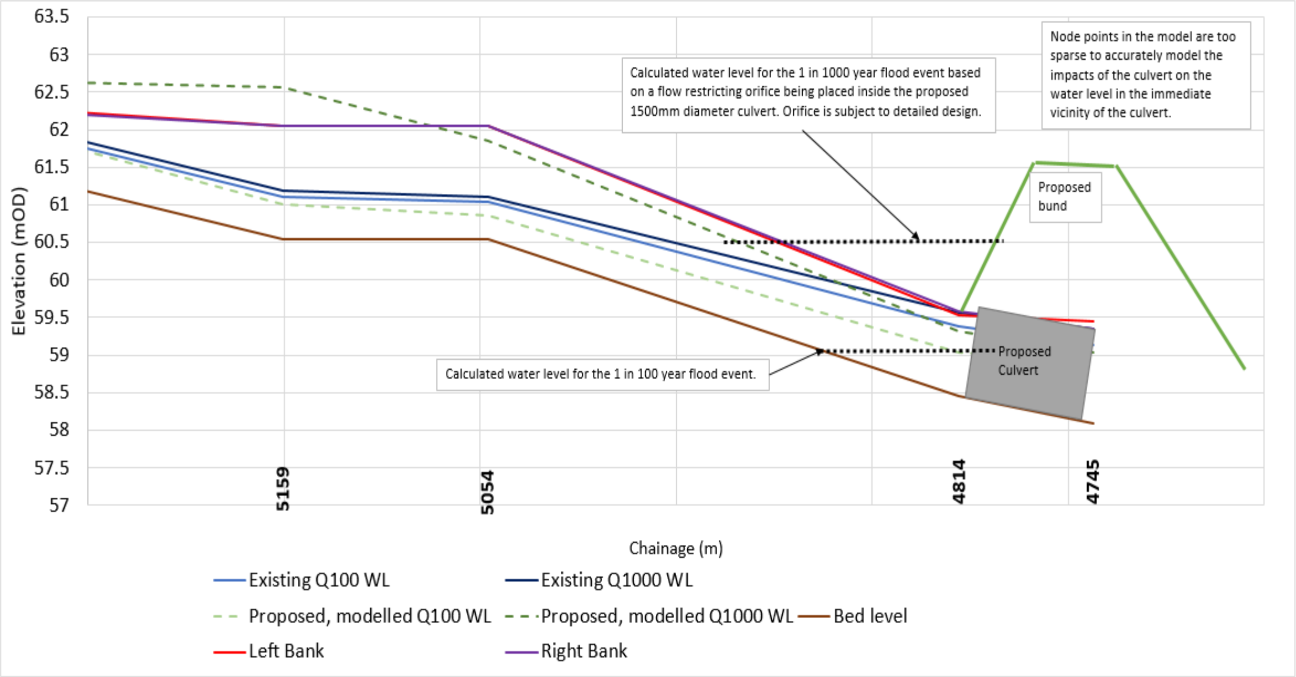
River Sta	Description	1 in 100 year flood event			1 in 1000 year flood event		
		Water surface elevation (mOD)		Change in water level (m)	Water surface elevation (mOD)		Change in water level (m)
		Existing Scenario	Proposed Scenario		Existing Scenario	Proposed Scenario	
5500*		63.94	63.94	0	64.39	64.39	0
5499*		Culvert			Culvert		
5494*	Downstream of existing culvert at western perimeter	63.64	63.64	0	63.86	63.86	0
5408*		62.71	62.77	0.06	62.79	62.72	-0.07
5159*		61.11	61	-0.11	61.19	62.57	1.38
5054*		61.04	60.84	-0.2	61.1	61.85	0.75
4814	Flood Compensation Culvert	59.39	59.028***	-0.362	59.56	60.5**	0.94
4745		59.13	58.92	-0.21	59.35	59.04	-0.31
4736		58.66	58.66	0	58.75	58.75	0
3755		58.25	58.25	0	58.4	58.4	0
3754		Culvert			Culvert		
3737		57.63	57.63	0	57.67	57.67	0
2942		53.5	53.5	0	53.81	53.81	0
2622		52.7	52.7	0	53.23	53.23	0
2621		Culvert			Culvert		
2612		52.68	52.69	0.01	53.23	53.23	0
1615		48.25	48.25	0	48.09	48.09	0
1603		Culvert			Culvert		
1569		48.13	48.13	0	47.94	47.94	0
1112		46.14	46.14	0	46.67	46.67	0
1100		Culvert			Culvert		
1074		46.08	46.08	0	46.47	46.47	
1072		Culvert			Culvert		
1067		45.17	45.17	0	45.3	45.3	0
15		38.35	38.35	0	38.63	38.63	0
8		Culvert			Culvert		
0		38.07	38.07	0	38.17	38.17	0

*chainage increases by 8m as a result of the stream diversion for the proposed scenario
Proposed Scenario has a 825mm diameter orifice in the flood compensation culvert at chainage 4814 to achieve a storage level of 60.5mOD in a 1 in 1000 year flood.

** Based on top water level required to achieve compensatorary storage

*** Reduced water level due to the removal of culvert downstream

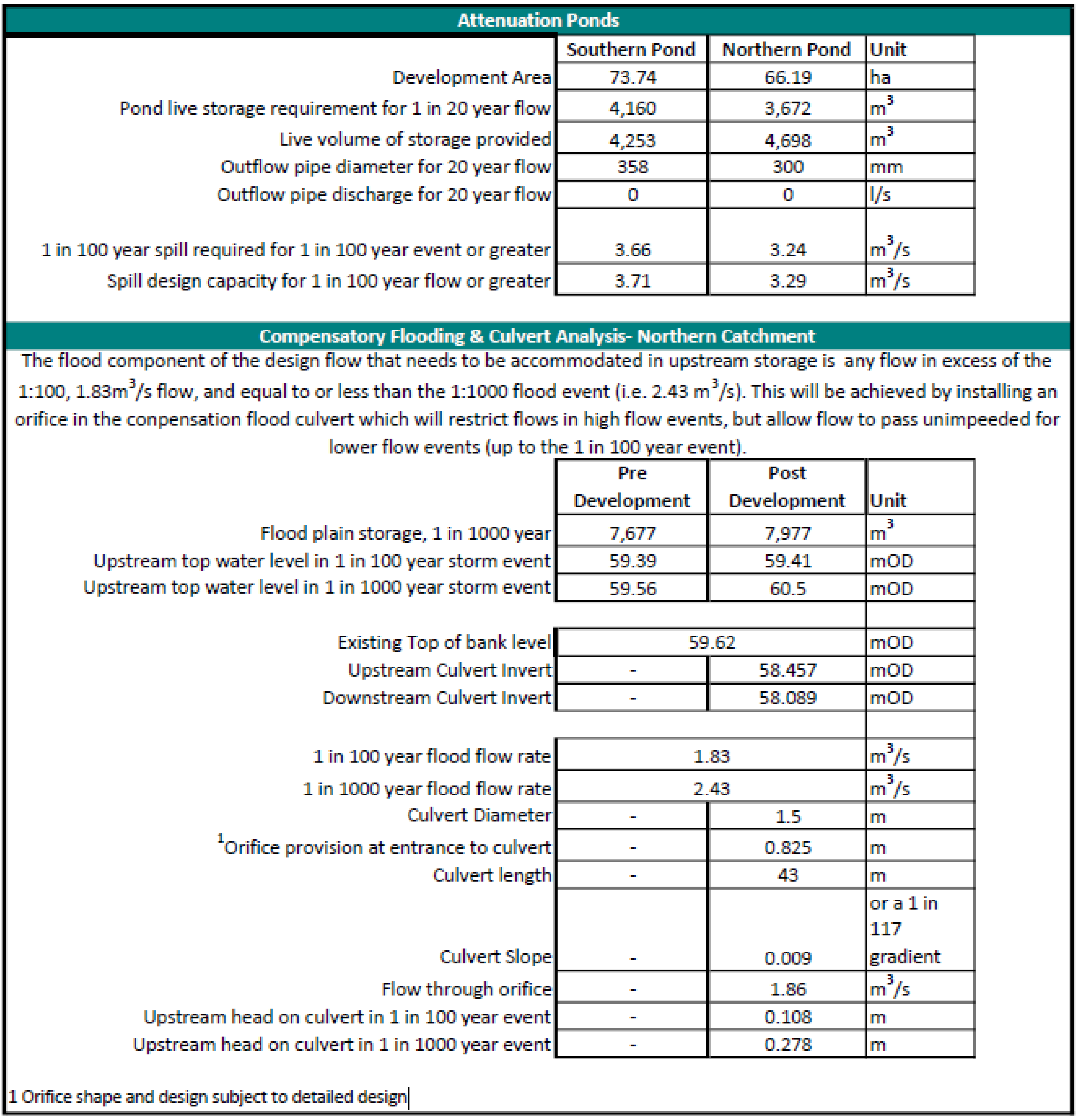
Refer to Appendix 12.4 of the EIAR for calculation set.



3.7 Summary of Hydraulic Criteria

A summary of design criteria including culvert and water level details for the pre- and post construction development is presented below in Table 3.4.

Table 3.4: Summary of Hydraulic Criteria



Attenuation Ponds

	Southern Pond	Northern Pond	Unit
Development Area	73.74	66.19	ha
Pond live storage requirement for 1 in 20 year flow	4,160	3,672	m^3
Live volume of storage provided	4,253	4,698	m^3
Outflow pipe diameter for 20 year flow	358	300	mm
Outflow pipe discharge for 20 year flow	0	0	l/s
1 in 100 year spill required for 1 in 100 year event or greater	3.66	3.24	m^3/s
Spill design capacity for 1 in 100 year flow or greater	3.71	3.29	m^3/s

Compensatory Flooding & Culvert Analysis- Northern Catchment

The flood component of the design flow that needs to be accommodated in upstream storage is any flow in excess of the 1:100, 1.83m^3/s flow, and equal to or less than the 1:1000 flood event (i.e. 2.43 m^3/s). This will be achieved by installing an orifice in the conpensation flood culvert which will restrict flows in high flow events, but allow flow to pass unimpeeded for lower flow events (up to the 1 in 100 year event).

	Pre Development	Post Development	Unit
Flood plain storage, 1 in 1000 year	7,677	7,977	m^3
Upstream top water level in 1 in 100 year storm event	59.39	59.41	mOD
Upstream top water level in 1 in 1000 year storm event	59.56	60.5	mOD
Existing Top of bank level	59.62		mOD
Upstream Culvert Invert	-	58.457	mOD
Downstream Culvert Invert	-	58.089	mOD
1 in 100 year flood flow rate	1.83		m^3/s
1 in 1000 year flood flow rate	2.43		m^3/s
Culvert Diameter	-	1.5	m
[1]Orifice provision at entrance to culvert	-	0.825	m
Culvert length	-	43	m
Culvert Slope	-	0.009	or a 1 in 117 gradient
Flow through orifice	-	1.86	m^3/s
Upstream head on culvert in 1 in 100 year event	-	0.108	m
Upstream head on culvert in 1 in 1000 year event	-	0.278	m

1 Orifice shape and design subject to detailed design

4. CULVERT AND STREAM DIVERSION DETAILS

4.1 Location

The location of the proposed culverts and the proposed permitted stream diversion are shown in Drawing LW14-821-01-P-0500-006 Site Layout with Existing Stream Structures in Volume 4 of this EIAR.

4.2 Dimensions

Taking all the background information, design standards and otter related environmental considerations into account the proposed dimensions for the culverts are set out in Table 4.1.

Table 4.1: Proposed Culvert Dimensions

Culvert Reference	Form	Size (m) Pipe diameter	Length (m)	Invert Level U/S (Streambed Level)	Invert Level D/S (Streambed Level)	Culvert Slope (1:X)
Compensation Culvert and embankment to the east of the site.	Pipe	1.5 m with 875 mm orifice subject to detailed design at upstream inlet	43	58.457	58.089	117

The dimensions for the proposed stream diversion are set out in Table 4.2.

Table 4.2: Permitted Stream Diversion Dimensions

Reference	Form	Average Size Width (m) x height (m)	Length (m)	Invert Level U/S (Streambed Level)	Invert Level D/S (Streambed Level)	Slope (1:X)
Stream Diversion	Trapezoidal Channel	1 in 1 side slopes, top width 3m, bottom width 1.m	171	60.55	59.524	167

4.3 End Details

The culvert will have vertical headwalls at both ends and the invert and sides of all watercourses at the entrance and outfalls of culverts will be protected from scour.

The upstream and downstream ends of the proposed stream diversion will have splayed transitions with stone bed and side slope protection to mitigate against erosion.

5. POST-WORKS

5.1 Flood Risk

Based on the FT assessment of the catchment, and the hydraulic analysis carried out, it is not anticipated that the risk of flooding in the catchment area for 1:100-year storm events will increase significantly as a result of the proposed diversion/culverting of the Knockharley Stream, or that any properties or dwellings will be adversely affected beyond present risk levels.

The lands in the vicinity of the site have not been identified by the OPW as 'Benefitting Lands'. There are no known Drainage Schemes upstream of the site, maintained by the Local Authority. Historically flooding has occurred downstream of the confluence of the Knockharley Stream with the River Nanny at Balrath cross roads (See OPW Flood Risk Assessment replicated in Figure 12-5 Volume 2 Chapter 12 Surface Water Section 12.5 of this EIAR). The hydraulic model of the Knockharley Stream does not indicate that any increase in flood risk would occur at that location as a result of the proposed works for a 1:100-year flood event. Conversely, the controlled outflow from the attenuation pond at the development indicates that a lag is introduced in the system which will result in a slight decrease in flood flows running downstream. The stream to be diverted/culverted is a 1st order tributary of the River Nanny.

The proposed culvert is designed with flood attenuation in mind and is sized to throttle pass flow from a 1 in 1000-year flood event. In these events the upstream end of the culvert will be surcharged, activating a designated flood compensation storage area onsite, and therefore not causing increase of flood downstream of the site. The stream length to be diverted will match the cross section of the existing channel at this location. The diverted channel will pass a flow from a 100-year flood without surcharging and therefore not cause any restriction in the stream channel. The 1 in 1000-year flow exceeds the top of bank but remains within the confines of the stream's secondary banks. Details of flood compensation proposals are presented in Volume 2 Chapter 12 Surface Water Section 12.5 of this EIAR.

The surface water drainage outflow from the permitted and proposed developments in the "Northern" catchment will pass through a holding pond, be attenuated in an attenuation lagoon and discharged via a wetland for the non-stabilised, inert, stabilised cells and the IBA facility and therefore will not increase the runoff to the watercourse. Land drains will be provided around the perimeter of the site at the toe of screening berms to intercept overland flows from neighbouring lands and from the screening berms.

5.2 Maintenance

Maintenance requirements will be minimised due to the large internal dimensions of the culverts and the provision of access for maintenance alongside the stream diversion.

A 10m buffer between the streams banks and the proposed development footprint has been provided so as not to impact on access to the watercourse for maintenance purposes by the OPW.

Appendix A

Photographs

Plate 1: Looking upstream from structure crossing R150

Plate 2: Upstream view of structure crossing R150

Plate 3: Downstream view of structure crossing R150

Plate 4: Looking downstream from structure crossing R150

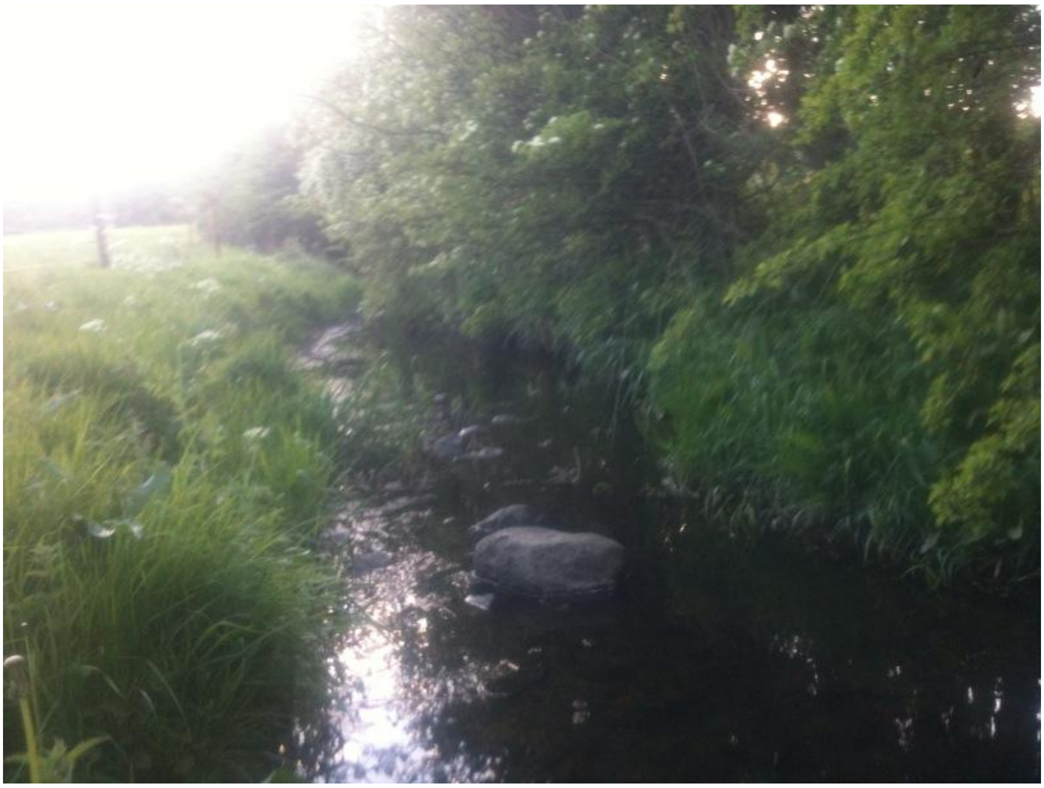


Plate 5: Looking upstream from 1st structure at local forked road

Plate 6: Upstream view of 1st structure twin arch bridge at local forked road

Plate 7: Downstream view of 1st structure twin arch bridge at local forked road

Plate 8: Looking downstream from 1st structure at local forked road

Plate 9: Upstream view of 2nd structure single arch bridge at local forked road

Plate 10: Downstream view of 2nd structure single arch bridge at local forked road

Plate 11: Looking upstream of main channel from structure through cul de sac laneway

Plate 12: Upstream view of main arch at structure through cul de sac laneway

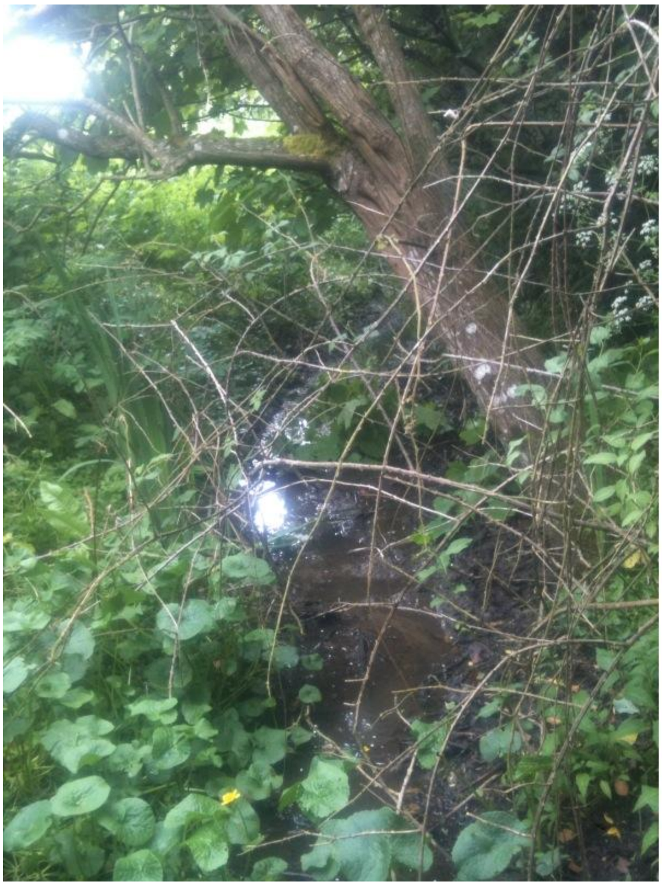


Plate 13: Looking upstream of secondary channel from smaller arch of structure through cul de sac laneway

Plate 14: Upstream view of smaller arch at structure through cul de sac laneway

Plate 15: **Downstream view of smaller arch at structure through cul de sac laneway**

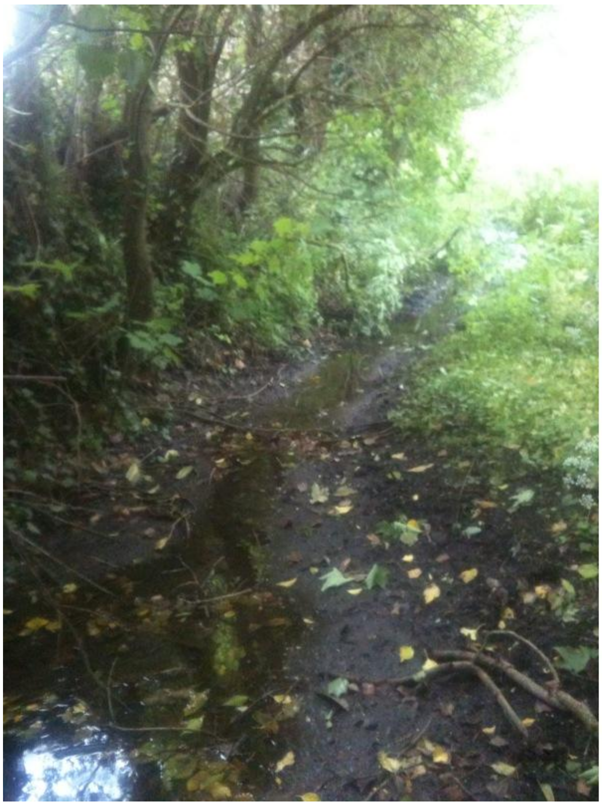


Plate 16: **Looking downstream of secondary channel from smaller arch of structure through cul de sac laneway**

Appendix 14.1

Surrounding Lands Field Inspection, Archaeological & Historical Background, Fieldwork and Cartographical Analysis

Appendix 14.1: Receiving Environment

General Archaeological and Historical Background

During the Mesolithic period (*c*. 7,000–4,000 BC) people existed as hunters/gatherers, living on the coastline, along rivers and lakesides. They used flint and other stones to manufacture sharp tools and locating scatters of discarded stone tools and debris from their manufacture can sometimes identify settlements. Their impact on the landscape was minimal, and the limited amount of evidence includes the remains of timber houses and primitive stone tools. In Meath, the Rivers Boyne and Blackwater were the most important means of travel and Mesolithic period settlements were concentrated on their banks (Meath County Council 2013, Volume 2, Appendix 7, 11).

In 1998 excavation at Moynagh Lough, Brittas, County Meath focused on an area of Late Mesolithic activity sealed beneath an Early Medieval crannog. Artefactual evidence included three polished stone axeheads, six spearheads of slaty sandstone, five elongated pebbles, nine hammerstones and two polishing stones. Approximately 2,000 pieces of chert, flint and other stone were recovered from the site. A single shallow pit exposed in isolation during archaeological testing in 2001, at Kilsharvan, County Meath, had upon analysis a radiocarbon determination *c*. 5,060–4,800 BC, dating it to the later Mesolithic (www.excavations.ie). Late Mesolithic conical, woven basketry fish-traps were discovered during archaeological excavations at Clowanstown, County Meath (Clancy 2009, 40-41). A Mesolithic fishing platform and Neolithic burnt mounds were revealed near the centre of a former lough. Five mounds were located at the western edge of a raised bog and a mooring was identified by the position of six substantial stakes around the landward side of the former lough. This possibly provided a structure to fish from as well as a potential mooring for a dugout canoe. Radiocarbon determinations from wood samples returned a date range of between 5,000–4,000 cal BC (www.excavations.ie).

The population became more settled during the Neolithic period (*c*. 4,000-2,400 BC) with a subsistence economy based on crop growing and stock-raising. This period also saw changes in burial practices, and a tradition of burying the dead collectively and carrying out of cremations emerged. Neolithic monuments from County Meath include portal, passage and wedge tombs. Some of the most recognisable Neolithic monuments in Ireland are located at *Brú na Bóinne*. The megalithic tombs, which date from *c*. 3,000 BC, belong to the Neolithic period and are classified as passage tombs. They occupy the high ground on ridges in an area densely covered by archaeological remains. This archaeological zone is to a large extent bounded by the River Boyne to the south and to the north by its tributary, the River Mattock.

The Bronze Age (*c*. 2,400-600 BC) is characterised by the introduction of metalworking technology to Ireland and coincides with many changes in the archaeological record, both in terms of material culture as well as the nature of the sites and monuments themselves. Though this activity has markedly different characteristics to that of the preceding Neolithic period, including new structural forms and new artefacts, it also reflects a degree of continuity. During this period knowledge of metalworking was acquired resulting in changes in material culture such as the introduction of metal tools and artefacts as well as the introduction of a highly decorated pottery called Beaker pottery. In addition to changes in material culture, there were changes in burial rite from communal megalithic tombs to single burial in cists. These communities were responsible for the vast communal burial grounds such as the famous passage graves to be found at the Bend of the Boyne and the 30 cairns scattered over two hills at *Slieve na Calliagh* dating from *c*. 3,500 BC. Bronze Age monuments from County Meath include standing stones, stone pairs, cairns, barrows and *fulachta fiadh,* which are one of the most numerous monument types in Ireland with over 4,500 examples recorded (Waddell 2005, 174). The number and importance of prehistoric structures in County Meath is considered to exceed that of any other part of Ireland; high quality remains are most in evidence in the Boyne Valley, Hill of Tara and Loughcrew Hills.

A ring-ditch (RMP ME032-063003) is recorded in Burtonstown townland, approximately 2 km south east of the landfill site boundary. There is no further information recorded on this site in the National Monument's Service database (www.archaeology.ie). An additional two ring-ditches (RMP ME032-063001 and RMP ME032-063002) are also recorded in Burtonstown townland, approximately 120 m east, at their nearest point, of RMP ME032-063003.

Ring-ditches are circular or near circular features usually measuring less than 10m in diameter and which are frequently recorded through the use of aerial photography.

The function of these monuments is unclear as they may be the remains of ploughed out barrows, round houses or modern features and, as such, may date to any period from prehistory onwards.

During the Iron Age (*c*. 600 BC-400 AD) new influences came into Ireland which gradually introduced the knowledge and use of iron, although for several centuries bronze continued to be widely used. The Iron Age in Ireland however is problematic for archaeologists as few artefacts dating exclusively to this period have been found, and without extensive excavation it cannot be determined whether several monument types, such as ring-barrows or standing stones, date to the Bronze Age or Iron Age. Most knowledge for this period stems from Irish folklore, the epic poems and legends of warrior kings and queens that are traditionally believed to be Celtic in origin.

The Early Medieval period (*c*. 400-1169 AD) is depicted in the surviving sources as entirely rural, characterised by the basic territorial unit known as *túath.* Walsh (2000, 30) estimates that there were at least 100, and perhaps as many as 150, kings in Ireland at any given time during this period, each ruling over his own *túath.* Many sites in County Meath are said to have specific associations with St. Patrick. In particular the Hill of Slane was the site of the lighting of the first Paschal Fire by St Patrick in 432 AD, in defiance of King Leoghaire and pagan tradition. A number of St. Patrick's followers established churches and monasteries throughout County Meath, such as that founded by St. Erc at Slane and that at Trim by St. Loman. St. Patrick placed St. Cianán over the first Church in Duleek in the 5th century, and prior to his death in 489 AD he was credited with building the first stone church in Ireland. The first monastery said to have been founded by St. Patrick was that at Donaghmore (Meath County Council 2013, Volume 2, Appendix 7, 13).

The new religious culture brought changes in settlement and agricultural patterns. The ringforts and associated field patterns of the Early Medieval period indicate a life largely based on grazing. During this turbulent period roughly circular defensive enclosures known as ringforts were constructed to protect farmsteads. They were enclosed by an earthen bank and exterior ditch and ranged from approximately 25m to 50m in diameter. The smaller sized and single banked type (univallate) was more than likely home to the lower ranks of society, while larger examples with more than one bank (bivallate/trivallate) housed the more powerful kings and lords. They are regarded as defended family homesteads and the extant dating evidence suggests they were primarily built between the 7th and 9th centuries AD (Stout 1997, 22-31). The ringfort is considered to be the most common indicator of settlement during the Early Medieval period. The most recent detailed study (*ibid*., 53) has suggested that there is an approximate total of 45,119 potential ringforts or enclosure sites throughout Ireland.

An unclassified ringfort (RMP ME026-030) is recorded in Realtoge townland, approximately 1.3 km west of the landfill site boundary. It is noted (www.archaeology.ie) this possible ringfort was identified on Lidar, but no further information on its likely extent, character or condition is recorded.

RMP ME032-007 is the site of a ringfort located approximately 1.8 km south of the landfill site boundary in Danestown townland. It takes the form of a raised oval area defined by the remains of an earthen bank measuring 41 m east north east/west south west x 34 m north north west/south south east, with an external fosse and outer bank. An entrance and causeway are located at the south west corner of the site.

An enclosure (RMP ME026-013) is recorded approximately 2 km west of the landfill site boundary in Brownstown townland. It takes the form of a sub-circular area measuring 40 m east/west x 36 m north/south defined by a fosse. The fosse is almost obliterated on the east side and the original entrance may have been there. The monument is set within a large tree-ring.

Enclosures belong to a classification of monument whose precise nature is unclear. Often, they may represent ringforts, which have either been damaged to a point where they cannot be positively recognised or are smaller or more irregular in plan than the accepted range for a ringfort. An Early Medieval date is in general likely for this site type, though not a certainty.

The Early Medieval period is also characterised by the foundation of a large number of ecclesiastical sites throughout Ireland in the centuries following the introduction of Christianity in the 5th century. The early churches tended to be constructed of wood or post-and-wattle. Between the late 8th and 10th centuries mortared stone churches gradually replaced the earlier structures. Many of the sites, some of which were monastic foundations, were probably originally defined by an enclosing wall or bank similar to that found at coeval secular sites. This enclosing feature was probably built more to define the sacred character of the area of the church than as a defence against aggression.

An inner and outer enclosure can be seen at some of the more important sites; the inner enclosure surrounding the sacred area of church and burial ground and the outer enclosure providing a boundary around living quarters and craft areas. Where remains of an enclosure survive it is often the only evidence that the site was an early Christian foundation.

A church (RMP ME026-014) and graveyard (RMP ME026-014001) are recorded in Brownstown townland, approximately 1.7 km south west of the of the landfill site boundary. The church is recorded (www.archaeology.ie) as being located towards the top of the north east-facing slope of a hill. A church at Brun is listed in the ecclesiastical taxation (1302-06) of Pope Nicholas IV. At the Suppression in 1540 the rectory, or office of parish priest, with 20 acres was vested in St. Mary's Cistercian abbey in Dublin, and Edward Dowdall of Broniston was a witness at an inquiry. According to Ussher (1622) the church and chancel were ruined. Dopping's Visitation (1682-85) states the parish church of St. Michael at Brownstown was unrepaired since 1641 and that it was not enclosed. In 1640 the parish of Brownstown, consisting of the townlands of Brownstown and Realtoge, amounted to almost 700 acres and was the property of Nicholas Dowdall. A large stone house at Brownstown is the only item recorded on the Down Survey (1656-58) parish map and its terrier or commentary.

The grass-covered foundations of an east/west building (internal dimensions 13.35 m east/west x 5.75 m north/south) with possible doorways towards the west end of the north and south walls is within a neglected sub-rectangular graveyard (dimensions *c*. 40 m north/south x *c*. 40 m east/west). The graveyard has a small number of headstones dating from 1786 to 1934. Cogan (1862-70) records that the chancel arch stood 20 feet (*c*. 6 m) from the east end of the church and that there was a tomb of Catherine Plunkett, daughter of Mathew Plunkett, baron of Louth, which would date to *c*. 1700. This tomb has not been identified however.

A church (RMP ME032-006), graveyard (RMP ME032-006001) and tomb (RMP ME032-006002) are recorded approximately 1.4 km from the southern boundary of the landfill site in Kentstown townland. The church of the "*vill de Kent*" is listed in the ecclesiastical taxation (1302-06) of Pope Nicholas. Ussher (1622) describes the church as ruined and the chancel as indifferently repaired. Dopping (1682-85) says the church was unrepaired since 1641 and it was not enclosed (www.archaeology.ie). The present Church of Ireland church was built *c*. 1750 when it became the head of Union with the parishes of Danestown and Ballymagarvey. It is within a sub-rectangular graveyard, measuring *c*. 55 m north/south x *c*. 38 m east/west at north and *c*. 45 m east/west at south, defined by masonry walls, but there is no evidence of an earlier structure. The mid-14th century effigy of Sir Thomas de Tuite carved in low relief with a Latin inscription in gothic lettering along the long sides is displayed in the present church.

A church (RMP ME032-008), graveyard (RMP ME032-008001) and font (RMP ME032-008002) are located in Danestown townland, approximately 1.95 km south of the landfill site boundary. The parish church of Danestown is within a sub-rectangular graveyard measuring *c*. 65 m north east/south west x *c*. 30 m north west/south east at north east and *c*. 48 m north east/south west at south west. It is defined by a stone-faced earthen bank approximately 4-5 m wide. The inscriptions of many of the headstones have been published. Three pieces of window sill are used as grave-markers, and the head of an ogee-headed window and pieces of window tracery are in the graveyard. Inside the entrance on the north side of the graveyard is part of a font.

A font (RMP ME032-005) is currently located in Kentstown townland, approximately 1.5km south of the landfill site boundary. The font from Timloole church (RMP ME032-013) was moved to the Roman Catholic church at Kentstown, *c*. 5km to the west, shortly after the Catholic church was built. The limestone octagonal font with chamfered under-panels and a circular flat-bottomed basin is resting on an octagonal sandstone base. The English inscription in Roman letters running on all the sides below the rim reads: THIS / FANT / STONE WAS / BWYLDE / D BY ROBA / RE HOLI /WOD AN / DNI. 1597 / HE BEYN / GE RROCT /OR.

The commencement of Viking raids at the end of the 8th century and their subsequent settlement during the following two centuries marked the first ever foreign invasion of Ireland. Viking settlement evidence is scarce and has been found in Dublin and Waterford, however excavations there have revealed extensive remains of the Viking towns. Outside these towns understanding of Viking settlement is largely drawn from documentary and place-name evidence. In addition to Dublin and Waterford, documentary sources provide evidence for the Viking foundation of the coastal towns of Limerick, Wexford and Cork (Edwards 2006, 179).

Other indirect evidence which suggest Viking settlement, or at least a Norse influence in Ireland, is represented by upwards of 120 Viking-age coin hoards, possible votive offerings of Viking style objects and the assimilation of Scandinavian art styles into Irish design. Whilst the initial Viking raids would have been traumatic, the wealth and urban expansion brought into the country as a result of Viking trading would have eventually benefited the Gaelic Irish and the cultural assimilation in some parts would have been significant.

In the 9th century County Meath suffered from invasions by the Danes. Turgesius sailed up the River Boyne in 838 and after a period of devastation, often directed at the church, set up his regime and rule near Tara. The Danes however continued their attacks until 980 when they were defeated at Tara. During their period of power, the Viking invaders promoted a more commercial and urbanised lifestyle, and the founding of towns and villages grew apace after the Norman invasion (Meath County Council 2013, Volume 2, Appendix 7, 13).

The arrival of the Anglo-Normans in Ireland towards the end of the 12th century caused great changes during the following century. Large numbers of colonists arrived from England and Wales and established towns and villages. They brought with them new methods of agriculture which facilitated an intensification of production. Surplus foods were exported to markets all along Atlantic Europe which created great wealth and economic growth. Results of this wealth can be seen in the landscape in the form of stone castles, churches and monasteries.

The county of Meath was granted to Hugh de Lacy, by Henry II, to hold by the service of 50 knights. Under the Normans the system of landownership was a manorial one with towns and villages established around castles. The town of Trim was the centre of Norman power in County Meath. Kells was also prominent as a Norman fortification, although most of the remains from that period have not survived.

The political structure of the Anglo-Normans centered itself around the establishment of shires, manors, castles, villages and churches. In the initial decades after the Anglo-Norman invasion a distinctive type of earth and timber fortification was constructed- the motte and bailey. Mottes were raised mounds of earth topped with a wooden or stone tower while the bailey was an enclosure, surrounded by an earthen ditch with a timber palisade, used to house ancillary structures, horses and livestock. There are 24 motte and baileys and 42 mottes recorded in County Meath (www.archaeology.ie).

In certain areas of Ireland however Anglo-Norman settlers constructed square or rectangular enclosures, now termed moated sites. Their main defensive feature was a wide, often water-filled, fosse with an internal bank. As in the case of ringforts, these enclosures protected a house and outbuildings usually built of wood. They appear to have been constructed in the latter part of the 13th century, although little precise information is available. There are 22 moated sites recorded in County Meath (www.archaeology.ie).

More substantial stone castles followed the motte and bailey and moated sites in the 13th and 14th centuries. Tower houses are regarded as a late type of castle and were erected from the 14th to early 17th centuries. Their primary function was defensive, with narrow windows and a tower often surrounded by a high stone wall (bawn). An Act of Parliament of 1429 gave a subsidy of £10 to "*liege*" men to build castles of a minimum size of 20 ft in length, 16 ft in breadth and 40 ft in height (6 m x 5 m x 12 m). By 1449 so many of these £10 castles had been built that a limit had to be placed on the grants. The later tower houses were often smaller, with less bulky walls and no vaulting. There are 58 tower houses recorded in County Meath (www.archaeology.ie).

The present tower at Trim Castle was completed by William Peppard in 1220 AD. Combined with the massive curtain walls, gates and associated buildings, it is the largest castle in Ireland. More modest than Trim were the baronial castles of Dardistown, Killeen and Dunsany (Meath County Council 2013, Volume 2, Appendix 7, 15).

The 14th century throughout north west Europe is generally regarded as having been a time of crisis, and Ireland was no exception. Although the Irish economy had been growing in the late 13th century, it was not growing quickly enough to support the rapidly expanding population, especially when Edward I was using the trade of Irish goods to finance his campaigns in Scotland and Wales. When the Great European Famine of 1315-17 arrived in Ireland, brought about by lengthy periods of severe weather and climate change, its effects were exacerbated by the Bruce Invasion of 1315-18.

Manorial records which date to the early 14th century show that there was a noticeable decline in agricultural production. This economic instability and decline was further worsened with the onset of the Bubonic Plague in 1348 AD.

Before the Tudors came to the throne the kings of England were also the kings of western France and so, during the 14th and 15th centuries, the various lords who ruled in Ireland were largely left to themselves. The Tudor conquest however brought a much greater interest in the affairs of Ireland. They wanted to put a stop to the raids of the Gaelic Irish on areas under English rule. To do this, they ruthlessly put down any rebellions and even quashed inter-tribal feuds. English settlers were then brought in to settle their lands. The first of these plantations occurred in the mid-16th century in what is now Laois and Offaly. After the Desmond rising in Munster in 1585 AD came another plantation, and parts of south western Tipperary were planted at that time.

From 1593 to 1603 there was a countrywide war between the Gaelic Irish, who were supported by the French, and the Elizabethan English. The Irish were finally defeated and with the "*Flight of the Earls*" from Rathmullan, County Donegal in 1607, Ulster, which had previously been independent of English rule, was planted.

Expansion in the agricultural sector following a period of economic growth in Ireland from the mid-1730s led to rising prices and growth in trade. This increase in agricultural productivity resulted in growth in related industrial development throughout the country.

The proposed development area is located in Knockharley and Flemingstown townlands, which are in the barony of Duleek Lower and parish of Kentstown. Lewis (1837, Vol. II, 38) notes that the parish consisted of 2,455 statute acres, that the soil was good and that there was no waste land or bog. Lewis records Slane (*ibid*., 561) as containing 896 inhabitants and 143 houses.

Toponyms

Table 15-5: Translation or Explanation of Townland Names from within the Proposed Development Area

Townland	Derivation / Meaning
Knockharley	Knockharley translates from *Cnoc Urlaithe* as Hurley's Hill. It is referred to as *Knockerc* (Erc's Hill) in the Civil Survey, with Erc being a saint associated with Slane
Flemingstown	Possibly named after the Norman Fleming family

Summary of Previous Fieldwork in the Study Area

Reference to Summary Accounts of Archaeological Excavations in Ireland (www.excavations.ie) has shown that seven fieldwork projects have been carried out in Knockharley townland, the location of the proposed development. All fieldwork programmes were directly associated with the phased development of Knockharley landfill site, of which the current proposed development is related. Of the seven projects, only one failed to reveal features or artefacts of archaeological significance. Of the remaining, test trenching in 1999 revealed evidence of a possible previously unrecorded below-ground circular enclosure. Test trenching in 2004 along the line of the access road leading to the landfill site off the N2 Dublin-Derry road revealed a series of small pits and a well, located approximately 200m west of the N2 carriageway. Further test trenching and monitoring in 2004 revealed a deer trap, a burnt mound or *fulacht fiadh*, a dark linear feature with small pits containing burnt stone, several small pits with burnt stone, a small burnt spread which may have been a *fulacht fiadh* and a possible pit and stone spread. Five areas were excavated in 2004 and these revealed linear spreads, numerous small pits and a spread of burnt stone. Monitoring in 2006 revealed five features of archaeological significance taking the form of irregular spreads of clay, a stone feature and stone-filled pits. These features were subsequently excavated in 2010.

In addition, fieldwork carried out in 2016 within the landfill site and immediately west of the proposed lined cell revealed a possible truncated *fulacht fiadh* or burnt spread with associated pit features, four closely related pit features with burnt stone and clay and a small linear feature with a pit which was also filled with burnt stone and clay.

No fieldwork projects are recorded as having been carried out in Flemingstown townland.

Topographical Files of the National Museum of Ireland

Information on artefact finds and excavations from County Meath is recorded by the National Museum of Ireland. Location information relating to such finds is important in establishing prehistoric and historic activity in the study area. There are no entries recorded in the Topographical Files for Knockharley or Flemingstown townlands, the location of the proposed development.

An Ogham stone (NMI Reference 1970:6) was found in a field near Senealschtown townland in Painestown townland. A polished stone axehead (NMI Reference 1978:139) was also recovered from Painestown townland. It is noted that it was found many years ago in a bog and close to a spread of antlers. A stone axe (no NMI Reference) was found on the north eastern side of the outer ditch of a ringfort (RMP ME026-011) in Realtoge townland. The ringfort is located approximately 3.2 km west of the landfill site boundary. A bronze vessel (NMI Reference 1944:871) was found in a bog in Thomastown townland by workmen cutting turf in 1944.

Cartographic Analysis

Ordnance Survey Map First Edition 1:10,560 1837 (figure 14-1)

A townland and parish boundary form the majority of the northern border of the landfill site, and also part of the north eastern boundary. A townland boundary is recorded along all of the western and southern borders of the site. A townland boundary will be truncated by construction of the lined cell. Research suggests that:

"*hoards and single finds of Bronze Age weapons, shields, horns, cauldrons and gold personal objects can all be shown to occur on boundaries*" (Kelly 2006, 28).

Three or possibly four small presumably vernacular structures are recorded in the extreme northern end of the development area on the First Edition Ordnance Survey map but outside the land take required for the construction of landscaping berms or stream diversion. A farm lane leading to five small roofed structures as recorded on the First Edition map will be truncated at its northern end by the creation of a landscaping berm and stream diversion.

There are no archaeological, architectural or cultural heritage features recorded on the First Edition 1:10,560 map within the area of proposed land take.

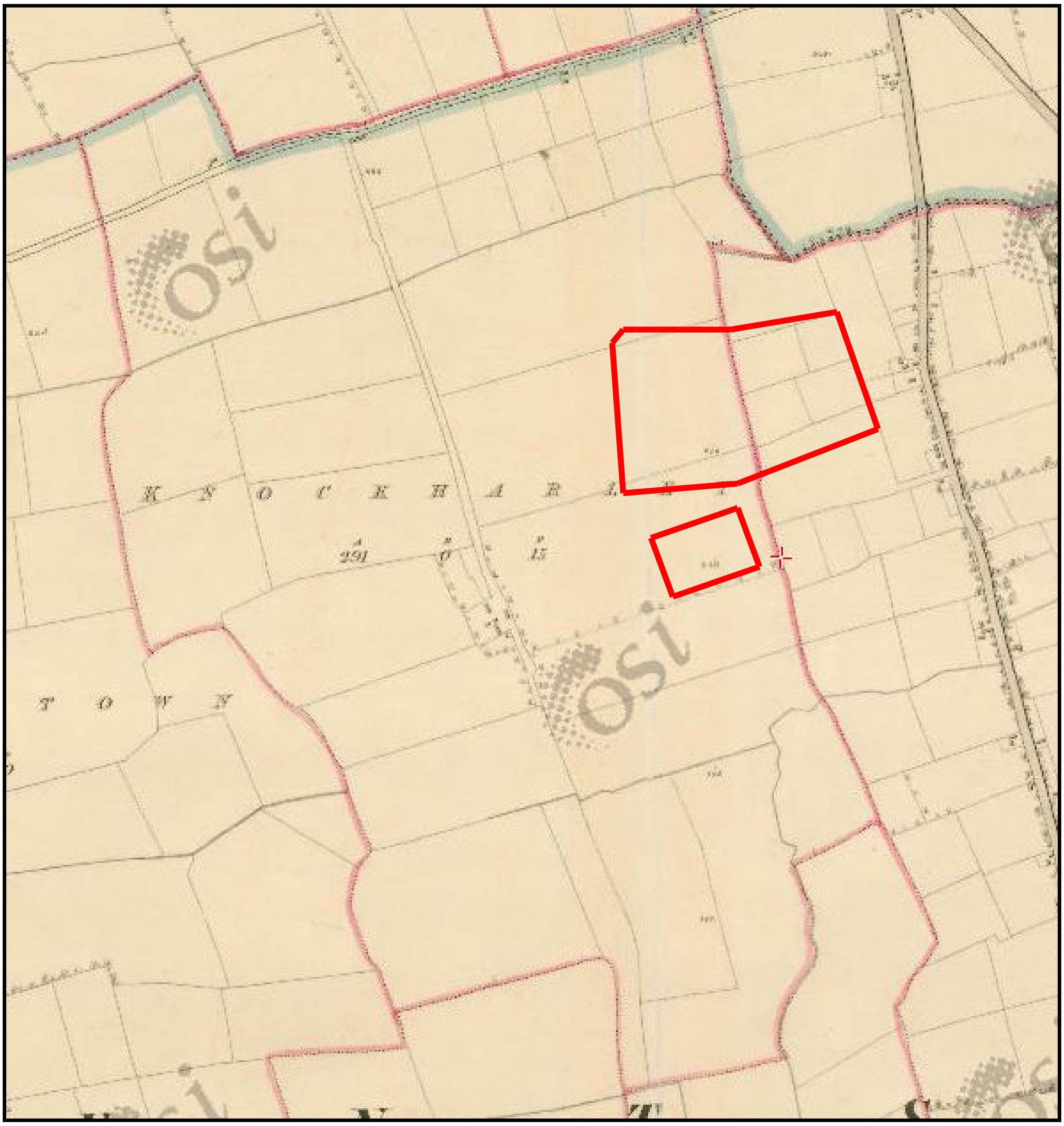


Figure 14-1: First Edition Ordnance Survey map 1:10,560 (1837) showing wider landscape of the landfill site and location of the lined cell, leachate lagoon and additional treatment infrastructure

Ordnance Survey Map Third Edition 1:10,560 1907-1911 (figure 14-2)

Five small structures are recorded in the extreme northern end of the development area on the Third Edition Ordnance Survey map in the location where three or possibly four structures were noted on the First Edition map. Again, these features are outside the area of land take required for construction of the landscaping berms and stream diversion.

There are no archaeological, architectural or cultural heritage features recorded on the Third Edition 1:10,560 map within the area of proposed land take.

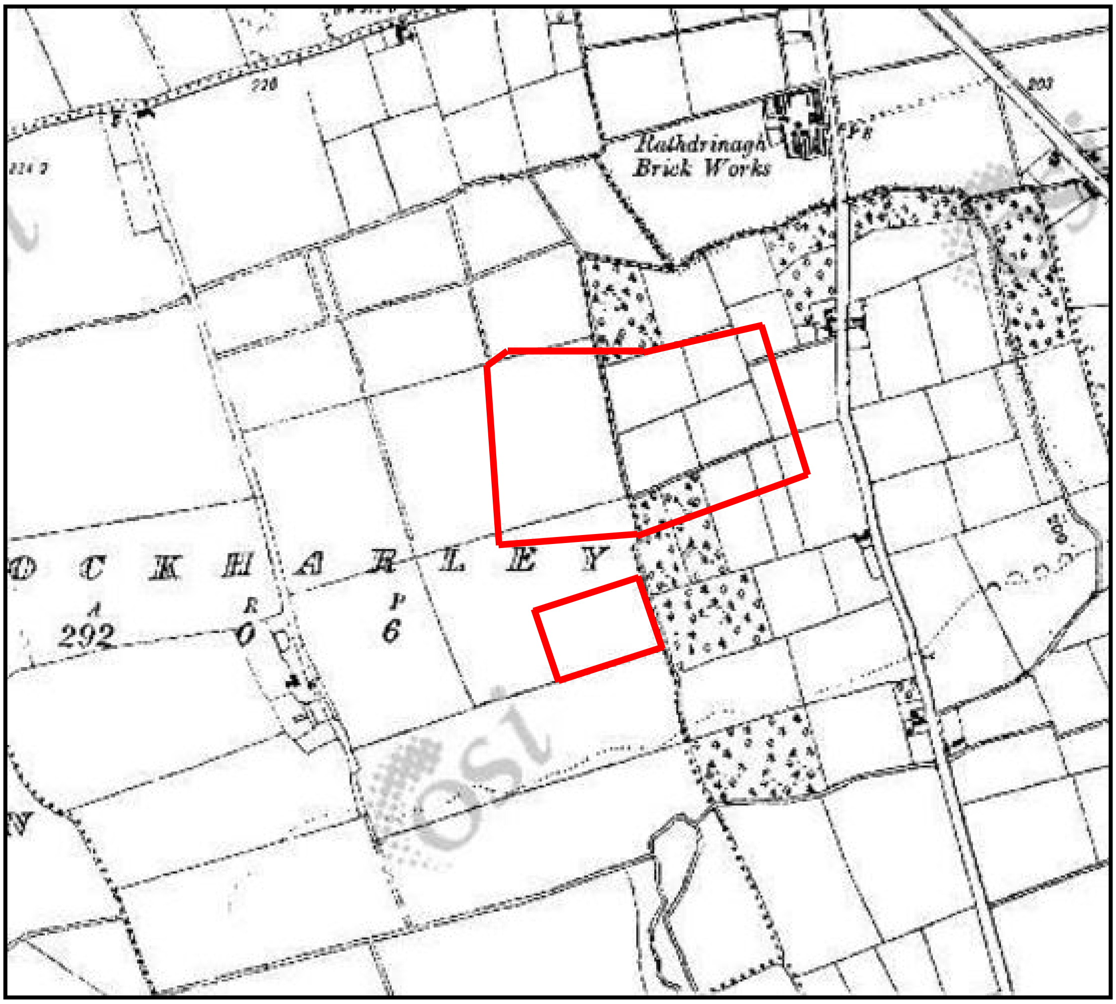


Figure 14-2: **Third Edition Ordnance Survey map 1:10,560 (1907-1911) showing location of the lined cell, leachate lagoon and additional treatment infrastructure**

Ordnance Survey Map First Edition 1:2,500 1908-1911 (figure 14-3)
Five small roofed structures are again recorded in the extreme northern end of the development area in the location where five structures were also noted on the Third Edition map. A well is shown in this general area on the First Edition 1:2,500 Ordnance Survey map, but again outside all areas of proposed land take.

There are no archaeological, architectural or cultural heritage features recorded on the First Edition 1:2,500 map within the area of proposed land take.

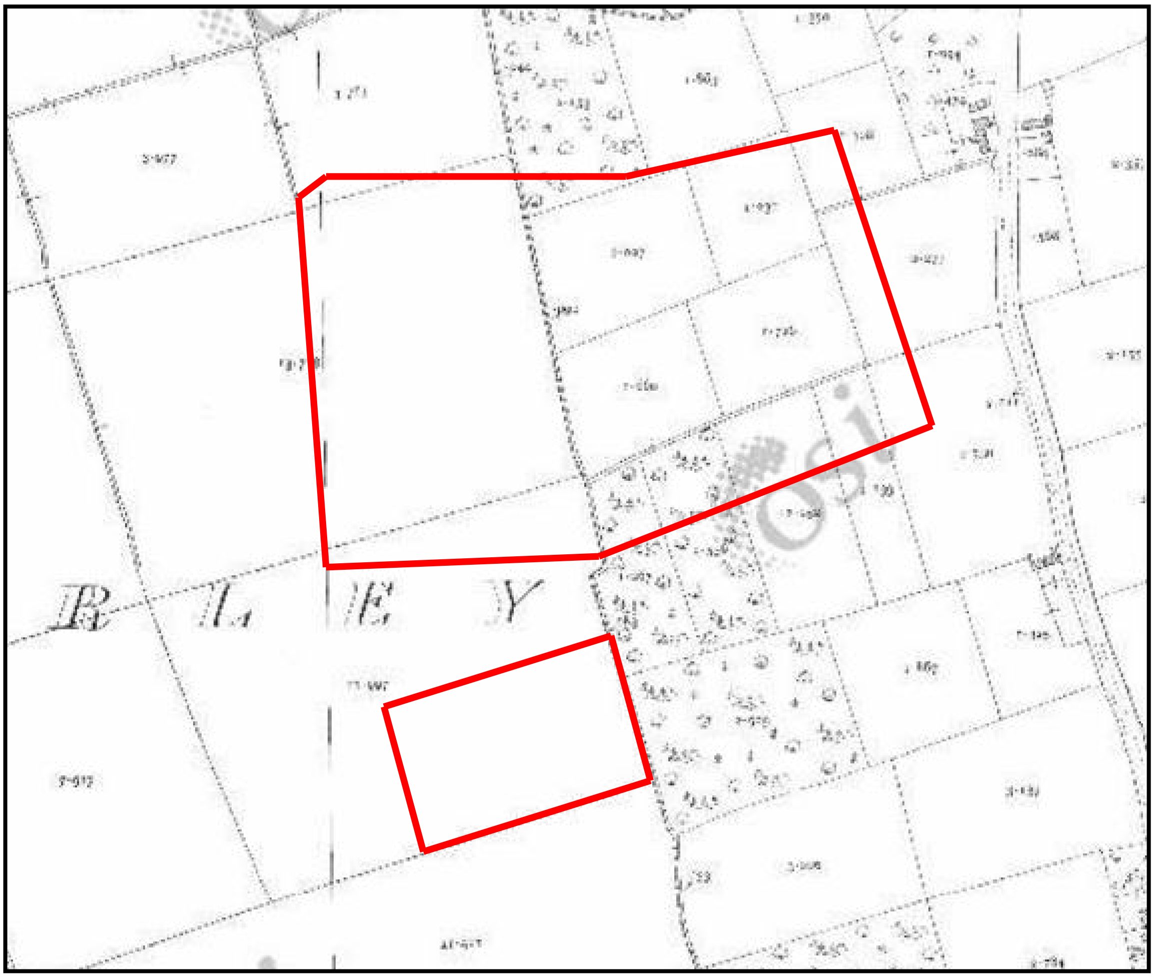


Figure 14-3: **First Edition Ordnance Survey map 1:2,500 (1908-1911) showing location of the lined cell, leachate lagoon and additional treatment infrastructure**

Aerial Photography

Aerial photographs held by Ordnance Survey Ireland (www.maps.osi.ie) were consulted to look for the presence of previously unrecorded archaeological or architectural remains within the proposed development area.

No groundworks associated with the existing landfill facility are recorded on the 2000 aerial photograph, and this shows the landscape of the development area as consisting of green fields with mature field boundaries.

There are no trees recorded on either the 2000 or 2005 aerial photographs along the northern, western or southern boundaries of the landfill site as there are today.

More recent aerial photography (www.bing.com/maps) records a similar landscape to that which was noted during the walkover survey.

There was no evidence of any archaeological, architectural or cultural heritage features recorded on aerial photographs within any areas of the proposed land take.

County Development Plan

Meath County Development Plan 2013-2019
It is an Objective (CH OBJ 7) of Meath County Council to:

"protect archaeological sites and monuments, underwater archaeology, and archaeological objects, which are listed in the Record of Monuments and Places, and to seek their preservation in situ (or at a minimum, preservation by record) through the planning process" (Meath County Council 2013, 218).

There are no RMP sites within the proposed development area or the 1 km study area.

It is an Objective (CH OBJ 13) of Meath County Council to:

"*protect all structures (or, where appropriate, parts of structures) within the county which are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest and which are included in the Record of Protected Structures*" (*ibid*., 221).

There are no Protected Structures within the proposed development area or the 1 km study area.

Field Inspection Results

The field inspection sought to assess the site, its previous and current land use, the topography and any additional environmental information relevant to the report. The site visit took place on 11th August 2016 and weather at the time of the visit was dry and bright.

The location of the proposed IBA cell area immediately east of the existing landfill consists of parts of three flat fields and a wooded area to the east, all of which are enclosed by mature field boundaries. The area of land take required for the leachate lagoon and additional treatment infrastructure adjacent to the existing lagoon and the biowaste facility was shown to be flat with short grass.

In addition to the proposed development, land surrounding the areas of land take but which does not form part of the development was also walked and visually assessed, in an attempt to gain information on the wider landscape. No archaeological features or artefacts were recorded in these areas.

No archaeological, architectural or cultural heritage features were revealed within any areas of proposed land take or the surrounding landscape as a result of carrying out the walkover survey.

Plate 14-1: Location of IBA cell area, looking west

Plate 14-2: Location of IBA cell area, looking north

Plate 14-3: Location of screening berm at western end of development area, looking west

Plate 14-4: Location of screening berm at western end of development area, looking south