Final Draft BAT Guidance Note on Best Available Techniques for the Waste Sector: Landfill Activities

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1. INTRODUCTION

1.1 GENERAL

This Guidance Note is one of a series issued by the Environmental Protection Agency (EPA), which provides guidance on the determination of Best Available Techniques (BAT) and is intended to be used by: -

- applicants seeking integrated Pollution Prevention and Control (IPPC) licences under part IV of the Environmental Protection Agency Acts, 1992 to 2007,
- existing Integrated Pollution Control (IPC) Licensees, whose licence is to be reviewed under the Environmental Protection Agency Acts, 1992 to 2007,
- applicants seeking Waste licenses under Part V of the Waste Management Acts 1996 to 2010,
- existing Waste Licensees, whose licence is to be reviewed under Waste Management Acts 1996 to 2010.

This Guidance Note should not be construed as negating the statutory obligations of operators of installations/facilities or requirements under any other enactments or regulations.

1.2 BAT GUIDANCE NOTE STRUCTURE

This Guidance Note has been structured as follows:

Section	Details
1	Introduction
2	Interpretation of BAT
3	Sectors Covered by this Guidance Note
4	Process Description, Risks to the Environment and Control Techniques
5	Best Available Techniques for Landfill Activities
6	BAT Associated Emission Levels
7	Compliance Monitoring
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Appendix 1	Summary of Landfill Directive Technical Requirements
Appendix 2	Environmental Quality Standards
Appendix 3	References
Appendix 4	Glossary
Appendix 5	Abbreviations

Where relevant, references are made to other detailed guidance; such as the reference documents (BREF) published by the European Commission, Environmental Protection Agency Guidance Notes for Noise in Relation to Scheduled Activities, and the determination of BAT should be made giving regard to these.

The information contained in this Guidance Note is intended for use as a tool to assist in determining BAT for the specified activities.

Regard should be had to the Landfill Manual series issued by the Environmental Protection Agency, which include the most up to date criteria and procedures for the selection, management, operation and termination of use of landfill sites.

2. INTERPRETATION OF BAT

2.1 STATUS OF THIS GUIDANCE NOTE

This Guidance Note will be periodically reviewed and updated as required to reflect any changes in legislation and in order to incorporate advances as they arise.

Techniques identified in this Guidance Note are considered to be current best practice at the time of writing. The EPA encourages the development and introduction of new and innovative technologies and techniques, which meet BAT criteria and looks for continuous improvement in the overall environmental performance of the sector's activities as part of sustainable development.

2.2 INTERPRETATION OF BAT

BAT was introduced as a key principle in the IPPC Directive, 96/61/EC. This Directive has been incorporated into Irish law by the Protection of the Environment Act 2003. To meet the requirements of this Directive, relevant Sections of the Environmental Protection Agency Act 1992 and the Waste Management Act 1996 have been amended to replace BATNEEC (Best Available Technology not Entailing Excessive Costs) with BAT.

Best available techniques (BAT) is defined in Section 5 of the Environmental Protection Agency Acts, 1992 to 2007, and Section 5(2) of the Waste Management Acts 1996 to 2010 as the "most effective and advanced stage in the development of an activity and its methods of operation, which indicate the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent or eliminate or where that is not practicable, generally to reduce an emission and its impacts on the environment as a whole" where:

B ***'best'*** in relation to techniques, means the most effective in achieving a high general level of protection of the environment as a whole

A ***'available techniques'*** means those techniques developed on a scale which allows implementation in the relevant class of activity under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced within the State, as long as they are reasonably accessible to the person carrying on the activity

T **'*techniques*'** includes both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned.

The range of BAT associated emission levels specified in Section 6 indicate those that are achievable through the use of a combination of the process techniques and abatement technologies specified as BAT in Section 5. The licensee must demonstrate to the satisfaction of the Agency, during the licensing process, that the installation/facility will be operated in such a way that all the appropriate preventative measures are taken against pollution through the application of BAT and justify the application of other than the most stringent ELV in the range.

At the installation/facility level the most appropriate techniques will depend on local factors. A local assessment of the costs and benefits of available options may be needed to establish the best option. The choice may be justified on the basis of:

- the technical characteristics of the installation/facility;
- the geographical location of the installation/facility;

- local environmental considerations;
- the economic and technical viability of upgrading the existing installation/facility.

The overall objective of ensuring a high level of protection for the environment as a whole will often involve making trade-off judgments between different types of environmental impacts, and these judgments will often be influenced by local considerations. On the other hand, the obligation to ensure a high level of environmental protection including the minimisation of long-distance or transboundary pollution implies that the most appropriate techniques cannot be set on the basis of purely local considerations.

The guidance issued in this Note in respect of the use of any technology, technique or standard does not preclude the use of any other similar technology, technique or standard that may achieve the required emission standards.

2.3 BAT HIERARCHY

In the identification of BAT emphasis is placed on pollution prevention techniques rather than end-of-pipe treatment.

The IPPC Directive 2008/1/EC and the Environmental Protection Agency Acts 1992 to 2007 (Section 5(3)), require the determination of BAT to consider in particular the following, giving regard to the likely costs and advantages of measures and to the principles of precaution and prevention:

(i) the use of low-waste technology,

(ii) the use of less hazardous substances,

(iii) the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate,

(iv) comparable processes, facilities or methods of operation, which have been tried with success on an industrial scale,

(v) technological advances and changes in scientific knowledge and understanding,

(vi) the nature, effects and volume of the emissions concerned,

(vii) the commissioning dates for new or existing activities,

(viii) the length of time needed to introduce the best available techniques,

(ix) the consumption and nature of raw materials (including water) used in the process and their energy efficiency,

(x) the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it,

(xi) the need to prevent accidents and to minimize the consequences for the environment, and

(xii) the information published by the Commission of the European Communities pursuant to any exchange of information between Member States and the industries concerned on best available techniques, associated monitoring, and developments in them, or by international organisations, and such other matters as may be prescribed.

As well as the landfill disposal of waste, other ancillary activities may take place on a landfill facility such as composting, recycling, leachate treatment and landfill gas management. This Guidance Note covers only landfilling and directly connected

activities, i.e., leachate treatment and landfill gas management. Other activities, such as composting, are to be covered by different BAT notes. Where an application is made that covers more than one activity on the same site, all relevant BAT Guidance Notes applicable to the activities should be considered by the applicant before an application is submitted.

3. SECTOR COVERED BY THIS GUIDANCE NOTE

This Guidance Note covers the following sectors:

- Landfill activities: Inert, Non-hazardous and Hazardous.
- Typically those activities coming within the scope of the EU Landfill Directive 1999/31/EC.
- Landfill activities carried out under Class 11.1 of the Environmental Protection Agency Acts, 1992 to 2007.
- Activities set out in Table 3.1 below:

Table 3.1: Prescribed Landfill Activities covered by this Guidance Note

Waste Management Acts 1996 to 2010: Schedule 3 and 4 Classes covered by this Guidance Note
3rd Schedule 1. Deposit on, in or under land (including landfill). 4. Surface impoundment, including placement of liquid or sludge into pits, ponds or lagoons. 5. Specially engineered landfill, including placement into lined discrete cells that are capped and isolated from one another and the environment. 9. Permanent storage, including emplacement of containers in a mine. 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. Note: There is provision for Classes 6 and 7, but they should only be applied for in particular cases where there are other landfill associated processes / pre-processes on-site, such as waste stabilisation. **4th Schedule** 2. Recycling or reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes). 4. Recycling or reclamation of other inorganic materials. 10. The treatment of any waste on land with a consequential benefit for an agricultural activity or ecological system 11. Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule. 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. Note: These Classes include activities associated with landfill, such as use of inert material in restoration.

This BAT Note does not cover waste soil recovery facilities.

The guidance in this BAT note may not be appropriate in all circumstances where there is landfill or underground disposal of wastes derived from mining or other activities, some of the principal differences being that such wastes are usually homogenous, mineral in character and delivered/placed hydraulically. The EU Directive on the management of wastes from the extractive industry, the EU BAT document on mining wastes management and the Waste Management (Management of Waste from the Extractive Industries) Regulations (S.I. No. 566 of 2009) should be consulted in such circumstances. It should be noted that the Extractive Waste Regulations deal with the management of waste from the extractive industries only. Situations involving landfill or deposit of mixed wastes (i.e., extractive wastes and other waste types) are covered by the Landfill Directive and guidance in this BAT note will apply. It may also be the case that some of the BAT guidance in the note may not be directly applicable to ash monofills such as peat and coal ash sites.

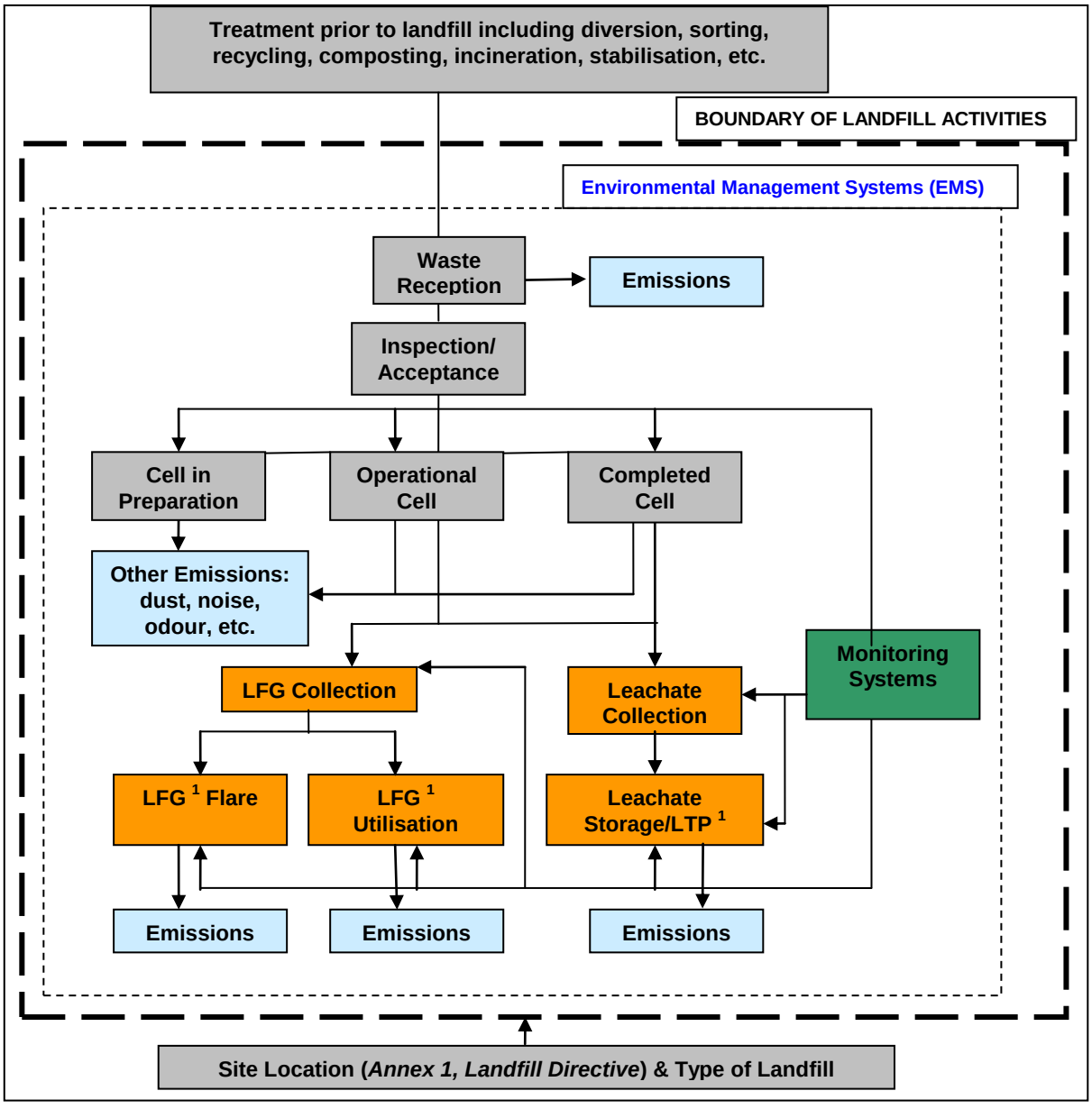
4. PROCESS DESCRIPTION, RISK TO THE ENVIRONMENT AND CONTROL TECHNIQUES

4.1 DESCRIPTION OF PROCESS

4.1.1 Overview of Waste Landfill Activity

The landfilling process and associated activities covered by this Guidance Note are summarised in Figure 4.1. The EPA Landfill Manuals provide further details of these.

Figure 4.1: Summary of a Landfill Activity



[1] LFG – landfill gas; LTP - leachate treatment plant

In accordance with the EU waste hierarchy, landfill is the least preferred waste management solution and must be preceded by prevention, reuse, recycling and incineration with energy recovery.

A landfill is essentially an engineered waste disposal facility used for the deposit of waste on, in or under land. All waste received at a landfill must be treated or separated as per Articles 5 & 6 of the Landfill Directive. The standard of pre-treatment required for municipal waste prior to acceptance for disposal at landfill shall be as set out in any relevant technical guidance issued by the EPA [2].

Materials entering the facility are delivered to a reception and handling area where other waste management activities may also take place (refer to BAT Note for Waste Transfer and Materials Recovery, etc.). Following checking and acceptance, the waste is transported to the disposal point. The landfill development activity is phased and, at any one time, cells can be under preparation, in operation or in the process of restoration. In assessing BAT, consideration must therefore be given to both the spatial and temporal nature of the activity.

In certain classes of landfill, waste may decompose over time and change in nature. Therefore, where relevant, the provision of measures to control emissions from the products of decomposition, including leachate and landfill gas, forms an integral part of the activity.

4.1.2 The Landfill

4.1.2.1 The Landfill Directive

The Landfill Directive defines three classes of landfill:

- Inert;
- Non-hazardous; and
- Hazardous.

The determination of BAT will be dependent on the class of landfill. Only wastes falling within the categories of waste permitted for that class of landfill may be accepted. Definitions of these broad categories of waste are given in Article 2 of the Landfill Directive:

> **"*Inert waste*"** means 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.
>
> **"*Non-hazardous waste*"** means waste, which is not classified as hazardous waste and may include municipal waste.
>
> ***"Hazardous waste"*** means any waste which is covered by *Article 1(4)* of *Council Directive 91/689/EEC.*

While landfilling may be described as a process activity, the site location and facility design of a new landfill is paramount to the ability of applying BAT to the operations. The following paragraphs summarise the requirements set out in Annex 1 of the Landfill Directive which must be considered when determining BAT for a Landfill facility. The EPA Landfill Manuals

[2] Guidance includes the EPA technical guidance document on *Municipal Solid Waste – Pre-treatment & Residuals Management, An EPA Technical Guidance Document - 2009.*

on Site Design, Site Operation and Investigation for Landfills should be referred to for detailed design guidance, as should any relevant technical guidance issued by the EPA in relation to site selection and the standard of pre-treatment required for municipal waste.

4.1.2.2 Site Location

In selecting a suitable location for a landfill, the basic requirement is that it will not cause environmental pollution (Section 40(4) WMAs 1996 to 2010), taking into account the characteristics of the location and the control measures to be employed. Landfill operators should refer to any guidance on site selection issued by the EPA . To determine the suitability of a location the applicant must, among other things:

- Consider the distance from the boundary of the site to residential and recreational areas, waterways, water bodies and other agricultural or urban sites.
- Take account of any relevant Regional Waste Management Plans or Development Plans.
- Identify any groundwater, coastal water or nature protection zones in the area.
- Investigate the geological and hydrological conditions, and identify the corresponding Groundwater Protection Response code for landfills in the area, i.e., R2, R3, R3[2], etc. (as per Geological Survey of Ireland and EPA guidelines).
- Consider the risk of flooding, subsidence, landslides on site.
- Consider the protection of the nature and cultural heritage in the area.
- Undertake a site investigation (the site investigation will also establish a baseline status for the land to enable closure and aftercare criteria to be set).
- Identify the potential environmental effects and risks.
- Determine if emission control measures can prevent the developed site posing a serious environmental risk during its operation.
- Take account of the EPA *Guidance on the Authorisation of Discharges to Groundwater*, 2011.

4.1.2.3 Buffer Zones

In selecting a landfill site or the configuration of a landfill footprint, the distance between the maximum extent of waste disposal activities (actual landfilling) and sensitive receptors in any given area is generally referred to as a buffer zone or set-back distance. Guidance on site selection is given in the Landfill Directive and an applicant should consider any guidance on site selection issued by the EPA. Separation distances between landfilling operations and potentially sensitive receptors need consideration (protected habitats, houses, institutions, etc.). However, as the environmental setting of each potential landfill site is likely to have its own individual characteristics, the need for a buffer zone and the extent of that zone must be considered on a site-specific basis having regard to available guidance on relevant site issues, the nature and scale of the landfilling, and associated risks. That said, the minimum desirable set-back distance for a greenfield [3] landfill facility that proposes to accept a significant proportion of potentially odour forming wastes is considered to be 750m from a sensitive receptor. Lesser distances may be appropriate for facilities accepting pre-treated/stabilised municipal wastes (minimal biodegradables and other odour-forming wastes) and inert waste landfills: these should be examined on a site specific basis. However, for such facilities a minimum set-back distance of 200m would usually be

[3] Greenfield in this context is a new landfill facility or a significant new expansion on an existing landfill facility.

expected for greenfield [4] facilities of this type so as to mitigate any nuisance potential. Set-back distance exceptions may be appropriate in cases where the landfill may be 'tied' to a location (e.g., brownfield site remediation, existing IPPC installation).

The applicant should also have to consider whether nuisance attenuation measures such as screening mounds and fences or woodland strips within the site boundary would provide additional support to the separation distances. The careful sequencing of cell development and construction of such attenuation measures needs to be considered so as to ensure sufficient time for development of planted measures. Without prejudice to site-specific circumstances, the requirement for such measures would likely reduce in a staged manner as the separation distance (between landfill and sensitive receptors) increases. The applicant should also consider locating particularly disruptive activities (e.g., noise or odour generation) away from sensitive receptors and consider appropriate operating times. In this respect, careful consideration should be given to the location of activities that may give rise to windblown nuisance, e.g., dust, litter, noise, aerosols, odour.

4.1.2.4 Design Considerations

When considering facility design, applicants should refer to the EPA Waste Licensing Guidance Note for Applicants and the EPA Landfill Manuals – Landfill Site Design. The licensee or operator of the facility should also carry out a risk assessment to determine if the activity should have a firewater retention facility. Should such a facility be required a risk management plan should be implemented and containment should be put in place. Further information/guidance can be found in the Agency's Draft Guidance Note to Industry on the requirements for Fire Water Retention Facilities.

Key design issues that need to be addressed when determining BAT are summarised in Table 4.1 below.

Table 4.1: Key Site Location and Design Issues for Landfill Facilities

Consideration	Design Issue
The nature and quantity of waste	This directly affects environmental control measures
Water control	Rainfall, surface water runoff and groundwater protection
Protection of soil and water	Selection of type of liner system
Stability	Stability of the site base, liner system, waste mass and capping
Development aspects	Facility design, planning and applied processes, construction, operation, closure and aftercare
Monitoring requirements	Provision and installation of monitoring points within and outside the facility
Landfill afteruse	Compatibility with the proposed afteruse
Landfill phasing	Operational and restoration requirements, location of facility infrastructure
Leachate management	Leachate collection system and

[4] Greenfield in this context is a new landfill facility or a significant new expansion on an existing landfill facility.

Consideration	Design Issue
	treatment/disposal facility
Landfill gas control	Potential for gas migration, gas collection, gas burning/utilisation
Environmental nuisance	(a) during construction, e.g., noise, dust, mud
Environmental nuisance	(b) during operation, e.g., noise, odours, dust, litter, birds, vermin and fires
Environmental nuisance	(c) during closure

4.1.3 Environmental Management Systems, EMS

The manner in which a facility is managed is a critical element in ensuring emissions from a landfill are minimised. Therefore management of facilities must ensure that:

- Staff are competent to manage and operate the facility, i.e., a Fit and Proper Person.
- There is an environmental management system in place to ensure standards are maintained, including incident and complaints management procedures.
- A training element is incorporated in to the environmental management system.

Facilities should consider the implementation of an accredited environmental management system (EMAS or ISO14001 for example) to minimise the impacts of the activity on the environment.

4.1.4 Waste Acceptance

The nature of the waste deposited in a landfill and the way in which that waste is handled can have a significant effect on the potential for a landfill facility to cause pollution or harm to health.

Controlling the waste input to the facility is one of the most important operational matters. Reference should be made to Annex II of the Landfill Directive and Council Decision 2003/33/EC on establishing criteria and procedures acceptance of waste, as may be appropriate. It is essential that measures be implemented to ensure that only wastes for which the facility is designed and which is permitted by the licence are deposited and contain at least the following items:

- Measures in place to fully document the wastes arriving onsite.
- Clear criteria for the reception of wastes.
- Clear measures to deal with rejected waste.

Waste material containing animal by-products shall be required to conform to all relevant requirements of the Animal By-products Regulations and conditions as set by the Department of Agriculture Fisheries, and Food.

4.1.5 Landfill Activities

Refer to the Agency Landfill Manuals for descriptions of site design, operational practices, waste handling onsite, leachate and landfill gas management and monitoring.

4.2 RISKS TO THE ENVIRONMENT

The risks to the environment from any industry, or specific facility/installation within the sector, will depend on the raw materials used and the processes employed. Consumption of energy and water, emissions to air, water and land, and waste treatment are likely to be of concern in all circumstances. Risks to the environment are primarily associated with emissions from an activity. The term "emission" is defined in the Waste Management Acts (WMA) 1996 to 2010 and Environmental Protection Agency (EPA) Acts 1992 to 2007, Section 3, to mean:

Any direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources in the installation into the air, water or land, and includes: -

- An emission into the atmosphere of a pollutant within the meaning of the Air Pollution Act, 1987.
- The release of a greenhouse gas or a precursor of a greenhouse gas into the atmosphere.
- A discharge of polluting matter, sewage effluent or trade effluent within the meaning of the Local Government (Water Pollution) Act 1977, to waters or sewers within the meaning of that Act.
- Noise (note that the definition of noise includes vibration).
- Waste.

The underlying objective of BAT is to eliminate or reduce emissions from processes. Emissions, and hence environmental pollution, can be eliminated or reduced by:

- Proper design of the facility.
- Effective management of the facility.
- The selection of appropriate processes, technologies and facility operations.

The following sections examine the potential emissions from landfill activities to air, water and land. Each section is sub-divided into potential emissions from inert, non-hazardous and hazardous landfills.

4.2.1 Potential Emissions to Air

Emissions to air of landfill gas can occur as either process gases from abatement plant or fugitive emissions from waste degradation. These can be effectively managed to minimise fugitive emissions, e.g., covering waste with cover material to minimise fugitive landfill gas emissions, effective gas collection, or controlling combustion conditions on a flare or utilisation plant.

Consideration must be given to existing ambient background conditions as well as relevant Air Quality Standards set either under the Irish Air Quality Standards Regulations 2002 (S.I. 271 of 2002 which has replaced S.I. 244 of 1987) or the EU Framework Directive on Air Quality (96/62/EC) and its Daughter Directives (1999/30/EC and 2000/69/EC).

4.2.1.1 Inert Landfill

Potential emissions to air arising from inert landfills include:

- Dust from wastes and operational/engineering activities.
- Vehicle emissions.

4.2.1.2 Non-Hazardous Landfill

Potential emissions to air arising from non-hazardous landfills include:

- Odour from waste.
- Odour from leachate/contaminated surface water.
- Odour from unloading operations.
- Odour from landfill gas.
- Direct emission of landfill gas.
- Combustion/oxidation products from flaring landfill gas, utilisation of landfill gas, and biological treatment of landfill gas.
- Dust from wastes and from operational/engineering activities.
- Vehicle emissions.

4.2.1.3 Hazardous Landfill

- Potential emissions to air and elimination/control techniques guidance will be similar to those set out for non-hazardous landfills above. However, there may be other emissions risks to air including fugitive VOCs, asbestos fibres, etc.

4.2.2 Potential Emissions to Water (including Groundwater) & Land

4.2.2.1 Inert Landfill

Potential emissions to water (including groundwater) arising from inert landfills include:

- Suspended solids.
- Run-off – during construction.
- Run-off – during operations.
- Fuels/oils, etc.
- Run-off following completion of landfill.

4.2.2.2 Non-Hazardous Landfill

Potential emissions to water (including groundwater) arising from non-hazardous landfills inter alia:

- Leachate – raw, arising from landfill degradation.
- Leachate – treated.
- Treated leachate to sewer.
- Suspended solids.
- Run-off – (a) during construction.
- Run-off – (b) during operations.
- Run-off – (c) following completion of landfilling operations.
- Landfill gas – dissolved methane.
- Landfill gas – condensate from collection.
- Effluents (e.g., including metals, organic compounds, oxygen demand, ammoniacal nitrogen, sulphate).
- Fuels/oils, etc.
- Biological organisms/pathogens (not normally significant).
- Run-off following completion of landfill.

4.2.2.3 Hazardous Landfill

- Potential emissions to water and elimination/control techniques guidance will be similar as set out for non-hazardous landfills above.

4.2.3 Potential Nuisance Related and Other Emissions

4.2.3.1 Inert Landfill

Potential emissions to the environment include:

- Noise.
- Mud on to public roads.

4.2.3.2 Non-Hazardous Landfill

Potential emissions to the environment include:

- Noise.
- Mud on to public roads.
- Pests – Birds, vermin, flies.
- Litter.

4.2.3.3 Hazardous Landfill

As for non-hazardous landfill.

4.2.4 Environmental Liabilities

A key element to understanding and managing environmental risk at a landfill facility is the carrying out of an environmental liabilities risk assessment for known and unknown liabilities (incl. aftercare phase), and the financial provision for same. Regard should be had to the Environmental Liabilities Directive 2004/35/EC. Non-inert landfills fall within the scope of the EU Directive on environmental liability with regard to the prevention and remedying of environmental damage (2004/35/EC). This Directive became legally effective on 30th April 2007. The European Communities (Environmental Liability) Regulations, S.I. No. 547 of 2008, came into force in Ireland on 1 April 2009.

Consideration must be given to the EPA guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision (EPA, 2006).

4.2.4.1 Closure and Aftercare

The Landfill Directive (Article 10) requires that there is sufficient financial provision to cover the cost of closure and aftercare for a period of at least 30 years. For facilities that are to accept only inert, pre-treated or monolithic type wastes with minimal landfill gas and leachate forming potential, a site-specific assessment will be required to determine the most appropriate aftercare period (for financial provision purposes). In the Irish context, adequate financial provision is required for at least 30 years and possibly for 50 years and longer in the case of facilities accepting (or which have accepted) appreciable quantities of leachate and gas forming wastes. The requirement of financial provision for a specified period does not free a licensee of responsibility for excess environmental cost that may arise during this period or indeed thereafter. It should also be noted that, in the case of hazardous waste landfill facilities there is no end date for financial liabilities and aftercare. Hazardous waste usually does not degrade or diminish in risk and so the aftercare requirements should be in perpetuity.

4.2.4.2 Restoration and Aftercare

Restoration is a process that will return a site to a condition suitable for the selected afteruse. Restoration includes the installation of pollution control and monitoring infrastructure, the spreading of soil or suitable recovered or recycled materials, final landform construction, landform construction works and aftercare.

Aftercare involves any measures that are necessary to be taken in relation to the facility for the purposes of preventing environmental pollution following the cessation of landfill activities at the facility and the capping and restoration of the site. The length of this aftercare period will vary from site to site and the licence holder remains responsible for the aftercare until the Agency accepts the surrender of the waste licence (Waste Management Acts 1996-2010, S48).

Reference should be made to the Agency's guidance on Landfill Restoration and Aftercare (EPA 1999), and guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision.

4.2.4.3 Maintenance of Environmental Pollution Control Systems

Until the EPA accepts surrender of the licence, the licence holder/operator is responsible for environmental management of the facility. During aftercare the licence holder/operator must ensure that the following pollution control systems are maintained and remain effective:

- the landfill gas control system (including monitoring for fugitive VOCs at surface of capped cells);
- the leachate collection, treatment and disposal system;
- the landfill cap;
- groundwater monitoring;
- slope stability; and
- all above ground components such as gas wellheads, leachate pumping manholes and monitoring boreholes.

4.3 CONTROL TECHNIQUES

4.3.1 Introduction

As explained in Section 2, this Guidance Note identifies BAT and it represents the requirements expected of any new activity covered by the Note, and ultimately the requirements expected of existing facilities by July 2009 (refer to Article 14(c) of the Landfill Directive), but does not include requirements which may form part of the granting of a licence for a specific site (e.g., buffer zones, site location, etc.).

The existing or possible measures for eliminating, reducing and controlling emissions at a landfill facility are described in this section. These range from relatively simple measures (e.g., dust control) to complex techniques (e.g., landfill liner stability).

4.3.2 Techniques for Prevention and Minimisation of Resource Consumption

4.3.2.1 Use of Energy

Energy Efficiency

The Waste Management Acts 1996 to 2010 require that permitted installations should be operated in such a way that energy is used efficiently. Landfill facilities use relatively small quantities of energy in comparison to large process industries. However, the applicant still needs to demonstrate that the energy is used efficiently.

The main uses of energy on a waste transfer facility are:

- Heating, lighting and power in facility buildings;
- Power to facility equipment such as wheel wash, weighbridge, pumps, treatment processes, lighting, etc.
- Fuel to power vehicles.

The applicant should quantify the energy consumption at the facility by the source of energy, i.e., electricity, gas, fuel and energy from waste (e.g., landfill gas utilisation).

The applicant should demonstrate that in the design of the facility, energy efficiency has been considered, including measures such as:

- The use of basic, low cost physical energy efficiency techniques, e.g., gravity feed systems.
- The consideration of energy saving opportunities in process buildings, control rooms and offices required for the activity, e.g., insulation.

The applicant should demonstrate that purchasing, operating and maintenance procedures optimise the energy use by the facility by:

- Ensuring energy efficient equipment is purchased, including lighting, pumps, etc.
- Ensuring equipment is serviced and maintained regularly.
- Ensuring equipment is switched off when not in use.
- Ensuring on-site vehicle movements are minimised and engines are switched off when not in use.
- Reviewing equipment requirements on a regular basis.
- Setting time of operation of high-energy equipment to off-peak periods, where possible.
- Setting key performance indicators on an annual basis.

The applicant should review energy consumption on an annual basis and examine options for:

- optimisation of energy supply, for example, use of landfill gas generated by waste disposal to generate heat/power; and
- optimising/reducing energy consumption.

Refer to the Agency's *Guidance Note on Energy Efficiency Auditing,* 2003.

Many of the aspects of energy efficiency are likely to be delivered through management techniques and operating and maintenance procedures, which overlap and form part of the environmental management system (EMS) for the activity.

Energy Utilisation

Under the requirements of the Landfill Directive the operator must assess the potential for utilising landfill gas produced on site and if appropriate make outline proposals for its utilisation. The ability of a facility to produce gas that can be utilised is dependent on:

- the type of waste accepted at the facility (therefore the requirement for energy utilisation principally applies to landfill accepting biodegradable waste);
- the volume of waste and the rate and type of degradation within the facility: and
- the size of the facility.

The applicant should regularly monitor and determine when suitable levels are available to allow the gas to be utilised as per the Agency Landfill Manuals.

4.3.3 Raw Materials

The Waste Management Acts 1996 to 2010 require that licensed installations should be operated in such a way that materials are used efficiently.

4.3.3.1 Waste as the Raw Material

Within the activities included under the IPPC Directive, waste management is a unique activity. For example in the case of a landfill facility the majority of the raw material brought to the site of the activity is residual waste. Providing that recovery/pre-treatment [5] has been undertaken prior to delivery to the disposal point, there is little opportunity – other than in landfill construction projects - to further prevent or recover waste once it enters the landfill. Therefore, the requirement to describe the raw materials relates to the quantity and nature of waste(s) which will be disposed of and any ancillary materials that will be used on the facility. Prevention measures should be focused on the emissions from the facility, e.g., leachate and landfill gas, in addition to the waste that has been deposited at the facility. Recovery measures should be focused on employing waste usefully in landfill construction (recycled aggregates, compost for restoration, etc.).

4.3.3.2 Materials and Products

In selecting materials and products, such as engineering materials, cover materials (e.g., soils; composted material), construction materials (e.g., clay, drainage stone), fuel for machinery (e.g., diesel), water (e.g., for wheel washing), pesticides for fly control, etc., the applicant should:

- demonstrate the steps which have been, or are being taken to reduce the use of materials (in particular non-renewal raw materials);
- demonstrate the steps that have been taken to source secondary material alternatives;
- maintain a detailed inventory of raw materials used on the facility, including:
    - the quantities used or expected to be used.
    - justify the continued use of any substance for which there is a less hazardous alternative, where applicable.

[5] Treatment shall reflect the requirements of the Landfill Directive and/or, as relevant, published EPA technical guidance, e.g., *Municipal Solid Waste – Pre-treatment & Residuals Management, An EPA Technical Guidance Document – 2009.*

4.4 TECHNIQUES FOR PREVENTION AND MINIMISATION OF EMISSSIONS

4.4.1 Design Criteria

The type of design features selected for landfill will have a direct effect on the releases of pollutants both at the design and build stage and the operational phase. The design aspects for the three classes of landfill are provided in the EPA Landfill Manuals (Site Design), and in Annex I of the Landfill Directive. They are therefore not dealt with here.

The techniques used to eliminate, reduce and control emissions during landfill operation are described in the following sections.

4.4.2 Prevention of Emissions to Groundwater

4.4.2.1 Management Techniques

- Refer to EPA Landfill Manual series - (e.g., Landfill Site Design and Landfill Operational Practices), Annex I of the Landfill Directive and the EPA *Guidance on the Authorisation of Discharges to Groundwater*, 2011.
- For landfill facilities, particularly those to be located in a sensitive 'R' [R2 to R4] setting (GSI-designation) [6], certain additional groundwater management procedures may be required including, for example, some of the following:
    - The applicant should put in place procedures to ensure that the lining system is not damaged prior to and during the emplacement of waste and in particular the first layer of waste. Measures must also be taken to ensure that continuing emplacement of waste does not compromise stability of the lining system.
    - The applicant should put in place clean-up procedures and procedures to ensure that spillages are contained/minimised. This should include a procedure for proper disposal of contaminated rainwater.
    - The integrity of any bunds should be monitored on a regular basis (minimum of every 3 years).
    - Maintenance of lower head of leachate on cell floor (e.g., 0.5m).
    - Enhanced leachate collection & removal system including for example greater density of collection drains, or designed falls of >1:50 on the primary collection drains, etc.
- For all landfill sites, trigger levels need to be agreed and set for groundwater quality, based on the specific hydrogeological conditions of the area, taking into account the direction and gradient of groundwater flow. When trigger levels are breached the operator must ensure that corrective measures are implemented to prevent any significant adverse environmental effects. The minimum number of wells shall be three; one upgradient and two downgradient. For additional information on trigger levels reference should be made to the Agency's Landfill Monitoring Manual.

The indirect discharge of uncontaminated storm water to groundwater via percolation is acceptable in principal, subject to prior assessment and approval.

4.4.2.2 Control Techniques

The following control techniques are used, as appropriate, at landfills for the prevention of emissions to groundwater:

[6] Groundwater Protection Responses

- Landfill Lining & Capping.
- Installation of a leachate collection & removal system.
- Management of leachate head on floor of waste cell.
- Collection and control of landfill gas condensate.
- Surface water drainage – diversion.
- Groundwater diversion – barriers, piling cut-offs, grouting.
- Groundwater lowering – well field.
- Groundwater drainage blankets.
- Hardstanding/Bunded Areas.
- All valves on fixed or mobile tanks should be securely locked when not in use, to prevent vandalism and unauthorised use and /or valves being left open.
- Mobile tanks should not be left out overnight on the landfill and should be locked away in a secure surfaced/bunded area.
- Security/locking of groundwater monitoring wells.
- Daily inspection of lagoons, tanks and bunds for leaks.

4.4.3 Minimisation of Leachate Emissions

Without adequate controls, leachate has the potential to cause significant pollution of groundwater or surface waters and become a nuisance due to odour. A landfill should be designed so as to minimise the generation of leachate and the possibility of it escaping from the site. The quantity and nature of leachate varies considerably, being influenced by the nature of the waste, compaction, use of cover and weather/rainfall. The following techniques are applicable to hazardous and non-hazardous landfills.

4.4.3.1 Management Techniques

Several aspects of landfill operation can influence the amount of leachate generated:

- The active fill area should be kept as small as practicable, with maximum of 25 metres x 25 metres (width x length) and slope of 1:3, unless where specifically agreed by the Agency.
- The use of good compaction, and daily and intermediate cover to reduce the level of water infiltration and hence the quantity/quality of leachate produced.
- The applicant should put in place procedures to ensure that the capping system is not damaged by the placement of the soil restoration layers or the construction of environmental control systems, e.g., landfill gas or leachate pipework and associated manholes.
- Leachate Recirculation. This engineering practice reduces the volume of effluent for treatment and assists in accelerating the degradation/stabilisation of the waste in the landfill however leachate recirculation may only be considered in engineered, lined cells where suitable leachate collection systems, leachate level monitoring is in place and the lined cell is capped to the satisfaction of the Agency.
- The applicant should develop procedures to ensure that the capping system is not damaged by long-term settlement. A comprehensive monitoring and repair programme should be initiated to ensure the integrity of the capping layers.
- Adherence to the waste acceptance procedures and inspection of waste procedures.

4.4.3.2 Control Techniques

The following control techniques are used at landfills for the minimisation of leachate emissions:

- Using soil, recovered or recycled materials or artificial cover materials to reduce infiltration of rainfall into the deposited waste, whilst operating restricted active area.
- Provide extraction system to enable removal of leachate for treatment and/or disposal.
- Monitoring of the depth and composition of leachate accumulating within the fill.
- Capping and restoring any completed area of the landfill as soon as possible.
- Leachate that has been removed from the landfill must be managed and shall undergo an appropriate level of treatment before it can be discharged to the environment.
- Adequate leachate storage facilities (appropriately sized).
- Covering of leachate storage facilities.
- Any on-site leachate treatment facility should be constructed and operated to appropriate design standards. Any aeration in leachate lagoon should be subsurface aeration.
- Diversion and collection of uncontaminated storm water for discharge or appropriate use from lined areas awaiting waste placement.

4.4.4 Minimisation of (Potentially Contaminated) Storm Water Emissions

Surface water management is required not only to minimise the generation of leachate by preventing surface water infiltration into the waste body but also to minimise the potential transport of contaminants from the landfill. The surface water management system should be designed to collect and control the water volume resulting from a specified duration and return period and to detect adverse environmental impacts arising from landfill activities. Guidance on the design of on-site surface water collection systems can be found in the Agency's Landfill Manual: Landfill Site Design.

4.4.4.1 Management Techniques

Management techniques, such as the following, can help to minimise the potential for contaminated storm water emissions:

- Appropriate capping.
- Appropriately designed surface water collection systems.
- Separation of process and non-process areas.

4.4.4.2 Control Techniques

Control techniques, such as the following, can help to minimise the potential for emissions of contaminated storm water:

- Surface water monitoring.
- Settlement ponds/ grit traps/swales.
- Cut-off valves or other containment mechanisms for use in the event of contamination.
- Use of SCADA (Supervisory Control And Data Acquisition) continuous monitoring system.

- Use of appropriate restoration profiles.
- Suitable landfill restoration and aftercare plans.

4.4.5 Management of Landfill Gas Emissions

Landfill gas management systems are required to prevent uncontrolled escape of gas from the landfill facility.

- Minimise landfill gas production potential by pre-treating the waste prior to acceptance for landfilling.
- Prevent landfill gas from migrating through the ground in both gaseous and dissolved states and prevent emissions of methane to the atmosphere.
- Manage odour risks/nuisance.
- Prevent condensate build-up in gas collection network.
- Use of horizontal and vertical gas collection pipework in the waste body.
- Carry out regular balancing of gas wells.
- Collect all landfill gas and, where feasible, utilise it to produce energy.
- Where energy generation from landfill gas is not possible, it should be burned in an enclosed flare with a minimum temperature of 1,000^{o}C and a retention time of 0.3 seconds.
- Regularly monitor and balance gas extraction wells.
- Use the relevant management and control techniques outlined in Sections 4.4.6.2.
- The management and control techniques contained in the EPA Landfill Site Design Manual are applicable to hazardous and non-hazardous landfills.
- Follow the hierarchy of landfill gas treatment options: (i) landfill gas utilisation for energy recovery, (ii) enclosed flaring, (iii) venting with open flaring as odour control measure.
- Use automatic alert system to notify of utilisation plant failure, where applicable.
- Backup power system for enclosed flares.
- Manage condensate to prevent emissions.

It is intrinsically difficult to regularly measure emissions from landfill gas control equipment. Common problems include:

- Temporal variation in combustion by-products.
- Discriminating between NO and NO_2.
- Over estimation of NOx and under estimating of SO_2.
- Temperatures above the normal operating range of most standardised monitoring equipment.
- Stack design does not facilitate standardised monitoring procedures.

The principal process being regulated is the oxidation, or combustion, of methane to carbon dioxide. Other minor gas components are also destroyed during this process. The emission limit values set out in terms of the major gas components are oxides of carbon and nitrogen. Other compounds, such as sulphur cannot be controlled by combustion as they relate directly to the composition of the gas generated in the landfill. This can vary

depending on the waste decomposing; however inlet gas scrubbing is generally not required, as normal sulphur concentrations do not warrant the technology provision.

4.4.6 Minimisation of Air Emissions

4.4.6.1 Dust/Fine Particulates (PM_{10} and $PM_{2.5}$)

Dust (including ash) has the potential to cause significant nuisance to neighbours and may pose a risk to the health of those working on, visiting or living close to the site. Fine particulate (PM_{10} and $PM_{2.5}$) impact is generally restricted to very fine waste types or very fine dust generated during construction phases.

Management Techniques

The following management techniques are used at landfills for the minimisation of dust and fine particulates:

- The operational procedures and the working plan should set out the design and operational considerations and requirements to minimise and control potential nuisances from dust.
- Detailed procedures of the pre-clearance, receipt and handling and/or refusal of dusty waste should be drawn up and used when a facility is permitted to accept such waste.
- The effectiveness of the design and operational provisions should be reviewed as part of the site monitoring; the annual environmental report and the sites EMS procedures.

Control Techniques

The following control techniques are used at landfills for the minimisation of dust and fine particulates:

- Dusty waste may be pre-treated (conditioned) using water – sometimes a 'wetting agent' needs to be incorporated. Alternatively the waste might only be accepted if it is bagged.
- All waste containing asbestos must be treated as a 'Hazardous Waste' as defined in the Waste Management Acts 1996 to 2010, where the concentration of asbestos exceeds the threshold concentration (0.1%). The Landfill Directive, Article 6 (c) (iii) allows for hazardous wastes which are stable and non-reactive, to be accepted at non-hazardous landfills, provided it is deposited in a separate cell in specifically limited quantities. This is likely to enable suitably packaged/pretreated bonded asbestos waste to continue to be landfilled at appropriate sites. Reference should be made to Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills, where criteria are given for acceptance of hazardous waste, including construction materials containing asbestos, at landfills for non-hazardous waste. Reference should also be made to the EPA technical guidance on the landfilling of Asbestos Waste (EPA, 2006).
- Prompt compaction after discharge from the vehicle delivering the waste, followed by covering with suitable material (natural or artificial cover materials) to sufficient depth.
- Provision of spray equipment around active tipping area if dusty waste is a regular problem.
- Use of paved site roads where appropriate.
- Regular sweeping of surfaced site roads.

- Regular spraying of site roads.
- Avoidance of placing waste during unfavourable meteorological conditions.
- Seeding of capped surfaces.
- Seeding of soil stockpiles.
- Planting trees, etc., to act as a barrier prior to waste acceptance.
- Covering of waste vehicles/containers entering and leaving the site.

4.4.6.2 Odour

Offensive odours arise at landfill site from a number of sources particularly:

- Malodorous wastes.
- Landfill gas.
- Leachate.

The control of odours needs to be proactive and good landfill practices can greatly reduce odours emanating from a site. This is applicable to hazardous and non-hazardous landfills.

Management Techniques

The following management techniques are used to minimise odour risk at landfills:

- Pre-treatment of odour forming waste.
- Operation of appropriate waste acceptance procedures.
- Preparation & operation of an Odour Management Plan.
- Regular review of landfill gas measurement and management protocols.
- Effective management of cell phasing and size.
- Regular monitoring of capped areas (interim and final) for fugitive VOC emissions.

Control Techniques

The following techniques are used at landfills for the control of odours:

- Minimisation of open tipping face area.
- Prompt replacement, compaction and covering of wastes.
- For a greenfield [7] landfill facility accepting a significant proportion of potentially odour forming wastes, provision of a buffer distance of 750m between the landfill footprint and any sensitive receptor. The buffer distance may be decreased on a case by case basis. (Refer to Section 4.1.2.3 above and any landfill site selection guidance issued by the Environmental Protection Agency).
- Provision of landfill gas collection and management infrastructure prior to waste emplacement.
- Restriction of loads known to be particularly odorous and immediate burial of odorous wastes.
- Restrict tipping activities during periods of adverse weather conditions.
- Upgrading and sealing of sump covers.

[7] Greenfield in this context is a new landfill facility or a significant new expansion on an existing landfill facility.

- Aeration of leachate storage areas.
- Improvements in landfill gas collection, venting and combustion systems.
- Monitoring and regular balancing of gas extraction wells.
- Use of horizontal and vertical gas extraction wells.
- Use of horizontal gas collection pipe work in active cell.
- Use of gas extraction pipework to maintain negative air pressure within the body of gas producing waste.
- Use of gas collection pipework at the top of the cell side slopes.
- Regular balancing of gas fields and condensate management.
- Use of auxiliary fuel in landfill gas flare systems to support gas combustion.
- Condensate removal.
- Covering of leachate lagoons.
- Use of appropriate materials for daily, interim and final cover/capping.
- Use of gas barrier layer along interface of filled cell and new cell (sacrificial).
- During periods when the rate of landfill gas production alone is insufficient to allow the operation of landfill gas combustion equipment, the use of auxiliary fuels should be considered.
- Covering or burial of waste excavated during the installation of leachate or landfill gas management systems.
- Odour Management Plan including walk-over VOC survey (PID/FID, quarterly)
- The use of odour neutralising sprays/aerosols at times when either climatic or waste acceptance site monitoring indicates heightened risk to identified receptors (for example inversions or calms).
- Use of odour neutralising additives in wastes during transport from transfer station to landfill site.

4.4.7 Minimisation of Litter, Noise, Birds, etc.

4.4.7.1 Litter

Litter causes a negative visual impact and can cause significant nuisance to those neighbouring a facility, and can in certain circumstances lead to harm of wildlife or livestock. Good litter control is proactive and can greatly reduce the escape of litter.

Elimination Techniques

The use of techniques such as the following may be used to help eliminate loose litter at landfills:

- Segregation (pre-landfill) of waste to remove light recyclable fraction from the waste stream.
- Pre-sorting of waste prior to deposit at the landfill.
- Bailing of waste.

Control Techniques

The following measures may be used to control litter at landfills:

- Using appropriate cover materials and quantities to ensure that deposited waste is held in place - more frequent application of cover may be required during high winds or in exposed areas.
- Use of a sheltered working face in windy conditions, provided only one working face in operation at any one time.
- Keeping working face to a minimum. Maximum working face of 25 metres x 25 metres (width x length) and slope of 1:3, unless where specifically agreed by the Agency.
- Strategically placed mobile catch fences close to the tipping area or on the nearest downwind crest.
- Temporary banks and bunds immediately adjacent to the tipping area.
- Permanent catch fences and netting to trap windblown litter.
- Full enclosure of the tipping area within a mobile litter net system.
- Closure of the facility to specific or all waste types may be appropriate when conditions are particularly adverse.
- Provision of perimeter planting/ landscaping to reduce wind impacts.
- Provision of a 'buffer' zone between the catch fencing and the facility perimeter.
- Daily litter picking/nuisance inspections.

4.4.7.2 Noise

On a landfill facility noise can be either:

- Ongoing, i.e., the operation of equipment and vehicles during the construction and operation of the site; or
- Intermittent, i.e., gas cannons for bird scaring and blasting which are inherently noisy or pulsing tones such as vehicle reversing signals.

Control Techniques

Noise control techniques at landfills can include the following:

- Construct permanent acoustic screening bunds around working areas and at the facility perimeter.
- Construct a buffer zone between the facility and the external environment.
- Fit silencing equipment to operational plant and equipment.
- Selection of equipment that conforms to EU Noise Standards.
- Use of acoustic screens around fixed/mobile plant and equipment.
- Use buildings to contain inherently noisy fixed plant and equipment.
- Prediction of noise impact at specified noise sensitive locations, using standardised sound power levels for construction plant.

- Locate noisy and tonal plant, such as flares, utilisation plants and leachate pumping stations, away from residential locations, taking into consideration the topography of the site and surrounding areas.
- Limiting activities with noise potential to certain hours.
- Assessment of severity of noise impact on residential areas due to a new development.
- Taking a proactive approach with residents regarding noise from the activities.

4.4.7.3 Vehicle Emissions

Management Techniques

The applicant should put in place procedures such as the following:

- Procedures to ensure that vehicles are well maintained and operating efficiently.
- As part of assessing the energy efficiency of the facility the applicant should put in place procedures to review fuel use by all vehicles on sites.

Control Techniques

The following techniques may help to control vehicle emissions:

- Regular servicing and maintenance of vehicles.
- Engines are switched off when the vehicles are not in use.
- Minimising on-site vehicle movements.

4.4.7.4 Birds

Management Techniques

Bird control techniques should be carefully planned taking into account the species likely to be affected. Measures that can be used to mitigate bird nuisance include the following:

- The employment of good landfill practice, with prompt disposal and compaction of waste, working in small active areas and progressive covering of waste, use of fully enclosed mobile net systems together with the use of bird scaring techniques.

There are advantages and disadvantages to all bird scaring techniques and the degree of effectiveness can be assessed from experience. Measures involving loud sounds or distress calls can cause noise nuisance and may scare desirable species living in the vicinity off the site. Birds of prey can be effective and have minimal consequential environmental impact. The effectiveness of any method deteriorates with time and will need to be changed regularly.

Control Techniques

The following control techniques are used:

- Pre-treatment of organic/biodegradable waste.
- Effective covering of waste, particularly wastes that may contain potential sources of food.
- Flying birds of prey over the site from dawn to dusk.
- Bird shaped kites mimicking birds of prey.

- Shell crackers-containing flare and banger.
- Scarecrows - fixed or mobile.
- Amplified recording of bird distress calls (species specific).
- Electronic sounds imitating calls of distress.
- Bird corpses or dummies.
- All-enveloping net or taut wires over the landfill site.

4.4.7.5 Vermin & Insects

Management Techniques

The following may be considered in relation to nuisance caused by vermin and insects at landfills:

- Nuisance due to flies is associated with wastes that have not been collected for an extended period. The site operator/manager should be aware of the likelihood of these wastes and plan the site operations accordingly. If the occurrence of these wastes is a regular problem the site operator/manager may need to consider prohibiting such waste if it gives rise to a disproportionate nuisance and cause of complaint. Waste acceptance procedures should address such issues.
- Care should be taken to ensure that the use of insecticides does not cause environmental pollution, such as the contamination of watercourses, or endanger protected species of fauna.
- Rodents can be attracted to meat-containing and cooked food wastes, therefore the site operator/manager should be aware of the likelihood of these wastes being delivered by certain hauliers, and plan the site operations according. Prompt covering of wastes can help to reduce rodent infestation.

Control Techniques

The following control techniques may be used in relation to nuisance caused by vermin and insects at landfills:

- Pre-treatment of organic/biodegradable waste.
- Prompt emplacement, compaction and covering of wastes in defined cells.
- Prompt burial of waste with the potential to attract vermin and flies, such as food wastes (especially animal by-products if accepted at the facility) and tannery wastes.
- Use pest-control specialists to control vermin levels.
- Treat infested areas, such as exposed faces and flanks, with insecticide.
- Covering or burial of waste excavated during the installation of leachate or landfill gas management systems.

4.4.7.6 Mud

Control Techniques

Mud on site roads at landfills may be controlled in the following ways:

- Regular sweeping of surfaced site access roads.

- Provision and regular maintenance of site roads.
- Use of effective wheel cleaning or vehicle washing equipment.
- Sufficient distance between wheel wash and facility exit.
- Regular inspection of internal and external roads.
- Use of dedicated site vehicles.

5. BEST AVAILABLE TECHNIQUES FOR LANDFILL ACTIVITIES

5.1 LANDFILL TYPE

The type of landfill (i.e., hazardous, non-hazardous, inert) and the quantities of waste that are to be accepted has a major impact on the potential emission to air, water and ground.

5.2 PRIMARY REQUIREMENTS

BAT for the handling and disposal of waste at a landfill includes the following primary measures:

- Financial provision for environmental liabilities (known and unknown), including restoration and aftercare. Refer to Section 4.2.4 of this document.
- Landfill design for each type of landfill and operation as per the Landfill Directive including:
    - water control;
    - leachate management;
    - an appropriate landfill lining system;
    - an appropriate landfill capping system;
    - appropriate measures for the prevention & management of landfill gas.
- Construction Quality Assurance (CQA) for construction of landfill lining systems.
- An Environmental Management System (EMS) that incorporates the following features:
    - Management and Reporting Structure;
    - Schedule of Environmental Objectives and Targets;
    - Annual Environmental Report (AER);
    - Landfill Environmental Management Programme (LEMP);
    - Documentation System;
    - Corrective Action Procedures;
    - Awareness and Training Programme;
    - Communications Programme;
    - Waste acceptance procedure (including minimum pre-treatment and BMW diversion requirements); and
    - Waste management system for all incoming wastes and wastes on-site.
- Appropriate storage and handling of construction materials, consumables and wastes.
- Emissions management.

5.3 ENVIRONMENTAL LIABILITIES

BAT in respect of provision of adequate financial indemnity/security to address the liabilities associated with accidents (unforeseen events/unknown liabilities), as well as for the provision of security for closure and aftercare is as set out in Section 4.2.4.

5.4 DISCHARGES TO WATER

BAT for the discharge of effluent and/or storm water either directly to surface water or to sewer as trade effluent will be dependant on the site specific situation. The treatment required will be dependent on the proposed emission discharge concentrations. Treatment provisions would typically include silt traps/oil interceptors for surface run-off but may require biological or physico-chemical treatments for leachate and for the removal of specific contaminants, dependent on facility operations and the discharge receptor.

Waste water at landfill facilities originates from the landfill, such as contaminated rainfall run-off, leachate and landfill gas condensate and from ancillary activities and site infrastructure, such as drainage from the site, wheel wash and hard standing areas.

Storm waters arise as rainfall runoff from areas of the site not used for the handling and storage of waste, clean roof runoff, etc.

5.4.1 Discharges to Surface Water

The following is BAT for discharges to surface water:

- Only roof-water and water from undisturbed unpaved areas (not in landfill footprint and not used for the handling or storage of waste) are appropriate for direct discharge to surface waters.
- No untreated trade effluent shall be discharged direct to surface water.
- Other surface water discharges must as a minimum be passed through an interceptor (I.S. EN 858-2:2003 Part 2), or in the case of construction areas where solids can build up in storm water runoff, they may be discharged through settlement lagoons or reed bed systems.
- The provision of infrastructure to allow for isolation and monitoring of surface water discharges.
- The management and control techniques listed in Section 4.4.4.

The appropriate Inland Fisheries Ireland office should be consulted in relation to the fisheries status of local waters or where in-stream works have to be carried out.

5.4.2 Discharges to Sewer

The following is BAT for discharges to sewer:

- Final effluent quality must meet standards set by the receiving Water Services Authority, to adequately treat the wastewaters it receives, or the Agency. The Agency may apply more stringent ELVs than those suggested by the Water Services Authority, if it so considers. The Urban Wastewater Treatment Regulations specify discharge quality parameters to prevent significant discharges of harmful substances.

5.4.3 Discharges to Groundwater

The Groundwater Directive (80/68/EEC) has been enacted in Ireland through the Protection of Groundwater Regulations 1999 (S.I. 41/1999), and the Local Government (Water Pollution) (Amendment) Regulations 1999 (S.I. No. 42 1999). Reference should also be made to the requirements of EU Groundwater Directives (80/68/EEC and 2006/118/EC) and to the EPA *Guidance on the Authorisation of Discharges to Groundwater*, 2011.

BAT for discharges to groundwater is to:

- Prohibit direct emissions to groundwater of effluents containing certain hazardous substances (List I), and to apply strict controls to prevent indirect emissions of substances scheduled in List II of the Directive.
- Subject to prior assessment, any proposal for placing of waste on ground that may lead to a discharge of specific listed substances to groundwater.
- Maintain an inventory of authorisations given for direct discharge of List II substances to groundwater.
- Remove risks of emissions to groundwater through appropriate controls such as containment, bunding, etc., as described in Sections 4.4.2, 4.4.3 and 4.4.4.
- Provide groundwater monitoring to enable early detection of any contamination of groundwater that may arise from the facility and the setting of trigger values and upper limits.

5.4.4 Leachate Effluent

Subject to prior assessment and authorisation, discharge from leachate treatment plants may enter either surface watercourses or sewers or be recirculated in lined cells at the landfill. BAT is to control leachate effluent using the management and control techniques outlined in Section 4.4.3.

5.5 EMISSIONS TO AIR

5.5.1 Fugitive Air Emissions

These include gas emissions to soils surrounding the waste body, the open atmosphere and within buildings. Emissions arise due to the degradation of waste and the possible migration of evolved gases through a control barrier such as a liner or cap. BAT is to prevent these emissions by application of good landfill gas management and control techniques as outlined in Section 4.4.5.

5.5.2 Process Gas Emissions

Separate ELVs have been prepared for enclosed landfill gas flares and landfill gas utilisation plants as they emit different ranges of gases and under optimum conditions achieve different levels.

BAT is to:

- Pre-treat waste to remove/reduce biodegradables.
- Selection of appropriate cell sizes.
- Maintenance of negative air pressure in the landfill gas extraction wells.

- Use of horizontal and vertical gas extraction wells.
- Use of appropriate materials for temporary cover, interim and final capping.
- Regular monitoring of landfill extraction well field, balancing of wells and elimination of non-design condensate traps.
- Use of horizontal landfill gas collection pipework at the top of the side wall riser (beneath cap).
- Provide landfill gas management systems as outlined in Section 4.4.5.
- Control the combustion conditions of enclosed flares, in terms of the carbon monoxide concentration, temperature and retention time by ensuring that combustion occurs at 1,000°C with a product retention time of 0.3 seconds within the combustion zone.

5.5.3 Odours

BAT for odour emissions is to ensure that odours shall not result in significant impairment of amenities or the environment beyond the site boundary. Specifically BAT is to:

- For a greenfield [8] landfill facility accepting a significant proportion of potentially odour forming wastes, provide a buffer distance of 750m between the landfill footprint and any sensitive receptor. The buffer distances may be decreased on a case by case basis. (Refer to Section 4.1.2.3 above and landfill site selection guidance issued by the Agency).
- Develop and operate of an Odour Management Plan.
- Minimise the open tipping face area, with maximum of 25 metres x 25 metres (width x length) and slope of 1:3, unless where specifically agreed by the Agency.
- Promptly compact and cover wastes with appropriate daily/weekly/intermediate or final cover.
- Immediately bury odorous wastes.
- Restrict tipping activities during periods of adverse weather.
- Upgrade and seal of sump covers.
- Aerate leachate storage areas.
- Improve landfill gas collection, venting and combustion systems.
- Consider the use of auxiliary fuels during periods when the rate of landfill gas production alone is insufficient to allow the operation of landfill gas combustion equipment.
- Cover or bury of waste excavated during the installation of leachate or landfill gas management systems.
- Use odour neutralising sprays/aerosols at times when either climatic or waste acceptance site monitoring indicates heightened risk to identified receptors (for example inversions or calms).
- Regular surface walk over VOC surveys of capped areas.
- Measures identified in Section 5.5.2 as appropriate.

[8] Greenfield in this context is a new landfill facility or a significant new expansion on an existing landfill facility.

5.5.4 Noise

This Guidance Note does not cover noise emission sources. For guidance on measures in relation to noise, have regard to the EPA *Guidance Note for Noise in Relation to Scheduled Activities*, 2nd Edition, 2006, and any other guidance on noise issued by the EPA.

5.5.5 Vibration

Vibration emissions may arise where a landfill is developed on the site of a quarry where blasting is still being carried out. However, generally emission level values for vibration do not apply for landfilling activity.

6 BAT ASSOCIATED EMISSION LEVELS

6.1 EMISSION LEVELS FOR DISCHARGES TO SURFACE WATER

The following table, Table 6.1 sets out emission levels that are achievable using BAT for wastewater treatment. However establishing emission limit values within a licence for direct discharges to surface water from wastewater/leachate treatment plant and storm water discharges must ensure that the quality of the receiving water is not impaired and that the current Environmental Quality Standards (EQS) are not exceeded.

Table 6.1: BAT Associated Emission Level Values for Emissions to Surface Water *

Constituent Group or Parameter Note 1	Emission Levels	Percentage Reduction
pH	6 - 9	–
Toxicity Note 2	10 TU	–
BOD_5	25mg/l	>91 - 99% Note 4
Suspended Solids	25 - 35mg/l	–
Total Ammonia (as N)	10mg/l	–
Total Nitrogen (as N) Note 3 & 5	15mg/l	>80% Note 4
Total Phosphorus (as P) Note 5	2mg/l	>80% Note 4
Metals	Note 6	–
Priority Substances (as per Water Framework Directive)	Note 6	–
Other	Note 6 & 7	–

* All values refer to daily averages based on a 24-hour flow proportional composite sample, except where stated to the contrary and for pH, which refers to continuous values. Levels apply to effluent prior to dilution by uncontaminated streams, e.g., storm water, cooling water, etc.

* Temperature measured downstream of a point of thermal discharge must not exceed the unaffected temperature by more than 1.5^{o}C in salmonid waters and 3^{o}C in cyprinid waters (Freshwater Fish Directive 79/659/EEC).

Note 1: Trigger levels may be put on surface water discharge from settling ponds for parameters such as pH, TOC and conductivity in an EPA licence.

Note 2: The number of toxic units (TU) = 100/x hour EC/LC50 in percentage vol/vol so that higher TU values reflect greater levels of toxicity. For test regimes where species death is not easily detected, immobilisation is considered equivalent to death.

Note 3: Total Nitrogen means the sum of Kjeldahl Nitrogen, Nitrate N and Nitrite N.

Note 4: Reduction in relation to influent load.

Note 5: Limits will depend on the sensitivity of the receiving waterbody.

Note 6: BAT associated emissions levels are highly dependent on production process,

wastewater matrix and treatment. These parameters shall be considered on a site-specific basis when setting emission limit values.

Note 7: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing) (Amendment) Regulations, 2004.

6.2 EMISSION LEVELS FOR DISCHARGES TO SEWER

All discharges to sewer are subject to approval from the Water Services Authority. Compliance with the Water Framework Directive (2000/60/EC) is required where relevant. BAT for discharges to sewers is dealt with in Section 5.4.2.

6.3 EMISSION LEVELS FOR AIR EMISSIONS

6.3.1 Fugitive Air Emissions

These include gas emissions to soils surrounding the waste body, the open atmosphere and within buildings. Emissions arise due to the degradation of waste and the possible migration of evolved gases through a control barrier such as a liner or cap.

Emission Level values are presented in Table 6.2 below.

Table 6.2: Fugitive Air Emissions

Constituent Group or Parameter	Concentration/Trigger Levels
Methane	1% v/v or (20% Lower Explosive Limit) Note 1
VOC (surface emissions)	≥50ppmv average over capped area or ≥100ppmv instantaneous reading on open surfaces within the landfill footprint or ≥500ppmv around all identified features
Carbon Dioxide	1.5% v/v
Total Dust Deposition	240 - 350 mg/m^2/day

Note 1: Measured in any monitoring borehole, building on or adjacent to the facility, service duct, or manhole.

6.3.2 Emissions from Landfill Gas Flares and Utilisation Plants

Emission Level Values for landfill gas flares and utilisations plants are presented in Table 6.3 below.

Table 6.3: Emission Level Values for Landfill Gas Flares and Utilisations Plants Note 1

Constituent Group or Parameter	Flare (enclosed)	Utilisation Plant
NOx	150 mg/m^3	500 mg/m^3

Note 1: If thermal input exceeds 50MW Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants would apply.

7. COMPLIANCE MONITORING

The methods proposed for monitoring the emissions from these sectors are set out below. Licence requirements may vary from those stated below due to site location considerations, sensitivity of receiving waters, and scale of the operation. Reference should also be made to the Agency's Landfill Monitoring Manual.

7.1 OPERATIONAL MONITORING

Monitoring is required to be carried out as detailed in the Landfill Manuals (publish by the EPA) and as determined by the EPA, taking account of the nature, magnitude and variability of the emission and the reliability of the control techniques. Operational monitoring typically includes:

- In-situ weather station.
- SCADA which typically covers the following:
    - Leachate levels in cells.
    - Leachate pumps.
    - Enclosed flare run-time.
    - Landfill Gas Engine/Utilisation Plant run-time.
    - Weather.
    - Storm water discharges (pH, TOC, conductivity).
    - Landfill gas levels in flares/engines.

7.2 MONITORING OF EMISSIONS TO AIR

- Sampling periodically, as determined by the EPA, taking account of the nature, magnitude and variability of the emission and the reliability of the control techniques.
- Periodic monitoring for other parameters as determined by the EPA.

7.3 MONITORING OF AQUEOUS EMISSIONS

- Establish existing conditions prior to start-up, of key emission constituents, and salient flora and fauna.
- Daily, or where deemed necessary, continuous monitoring of flow and volume. Continuous monitoring of pH. Monitoring of other relevant parameters as deemed necessary by the Agency (such as BOD, COD, metals, etc.), taking account of the nature, magnitude and variability of the emission and the reliability of the control techniques.
- Monitoring of influent and effluent from the wastewater treatment plant to establish percentage BOD reduction and an early warning of any difficulties in the waste water treatment plant, or unusual loads.

- The potential for the treated effluent to have tainting and toxic effects should be assessed and if necessary measured by established laboratory techniques.
- Periodic biodegradability checks where appropriate on effluents to municipal waste treatment plants, both prior to start-up and thereafter.

7.4 MONITORING OF EMISSIONS TO GROUNDWATER

There should be no deliberate direct or indirect emissions of landfill leachate to groundwater. Monitoring should be in accordance with the EPA *Guidance on the Authorisation of Discharges to Groundwater*, 2011. A minimum of one upgradient and two downgradient groundwater sampling wells are required to verify this (per hectare of leachate forming placed waste).

7.5 MONITORING OF WASTE

- The recording in a register of the types, quantities, date and manner of disposal/recovery of all wastes.
- Waste composition information, determined on the basis of any relevant guidance issued by the EPA [9].
- Leachate testing of sludges and other material as appropriate being sent for landfilling.
- General characterisation testing and acceptance of waste must be based on the three-level hierarchy, of Level 1: Basic characterisation, Level 2: Compliance testing, and Level 3: On-site verification, as detailed in Annex II of the Landfill Directive 1999/31/EC, and Council Decision 2003/33/EC.

7.6 MONITORING OF NOISE EMISSIONS

- Noise monitoring should be carried out in accordance with the *Guidance Note for Noise in Relation to Scheduled Activities*, 2nd Edition, 2006, at a frequency as specified by the Agency.

[9] For example: *Municipal Solid Waste – Pre-Treatment and Residuals Management: An EPA Technical Guidance Document*, EPA, 2009, and associated protocols.

APPENDICES

APPENDIX 1

Summary of Landfill Directive Annexes (Technical Requirements)

Annex I: General

Location – in relation to sensitive receptors, including: residential & recreation areas, waterways, water bodies, agriculture, urban site; groundwater, coastal water, nature protection zones; geological & hydrogeological conditions; flooding, subsidence, landslides, avalanches; nature and cultural heritage

Water control and leachate management – measures to control and prevent water from entering waste and to collect and treat contaminated water/leachate

Protection of soil and water – measures for lining and sealing the landfill to prevent pollution of soil, groundwater or surface water and ensure efficient collection of leachate

Gas control – measures to control the accumulation and migration of landfill gas and its collection, treatment and use

Nuisances and hazards – measures to minimise nuisances and hazards from odours & dust emissions; wind-blown materials; noise & traffic; birds, vermin & insects; formation of aerosols; fires; mud and dirt

Stability – measures to ensure stability of the waste mass and avoidance of slippages

Barriers – security and access measures

Annex II: Waste Acceptance Criteria and Procedures

General principles for acceptance of waste at the various classes of landfill

Procedures for testing and acceptance of waste

Guidelines for waste acceptance procedures

Sampling of waste

Annex III: Control and Monitoring Procedures in Operation and Aftercare Phases

Meteorological data – data to be collected and frequency of readings

Emission data – for leachate sampling, monitoring of surface water, gas monitoring including frequency and parameters for monitoring

Protection of groundwater – sampling, monitoring parameters and trigger levels

Topography of the site – waste composition and settlement data for the landfill body

APPENDIX 2
Environmental Quality Objectives

Environmental Quality Standards (EQS)

These are generally mandatory standards which have been set at European or National level, in order to limit the concentration of pollutants in the environmental media in question. EQSs exist for air and for water bodies. Statutory limits exist for some of the substances emitted to air and water likely to be relevant to this Guidance Note.

EQSs for water relate to the maximum allowable concentrations of prescribed substances in specified classes of water bodies. For example EQSs for surface water are specified in European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) and EQSs for groundwater are specified in European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010). These maxima are the benchmarks against which the quality of the receiving environment can be controlled to enable the environmental quality objective for a particular water body to be achieved.

Therefore an EQS can form the basis for establishing emission level values for point source emissions. Applicants are required to consider existing EQSs when assessing their proposed or existing emissions to the environment. Direct discharges from a facility should not result in any EQS being compromised and must also be in line with recognised BAT for the facility. In certain cases even the application of BAT at a facility may lead to an exceedance of the relevant EQS, for example where already high background levels exist in the receiving environment. In such cases the Emission Level Values may have to be reduced on a site specific basis, in order to ensure that the mandatory Environmental Quality Standards are met.

Emission Level Values (ELV)

Emission level values (ELVs) can be determined either from existing EQSs or from established international references and standards, which currently are considered to be achievable through the application of BAT.

APPENDIX 3
REFERENCES

Legislation

- Environmental Protection Agency Acts 1992 to 2007
- Protection of the Environment Act 2003
- Local Government (Water Pollution) Act 1977
- European Community (1980). Council Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances. (OJ L20, 26/01/80). [amended by 85/208/EC (OJ L89, 29/03/85); 87/144/EC (OJ L57, 27/02/87); 2000/60/EC (OJ L 327, 22/12/00)]
- Protection of Groundwater Regulations 1999 (S.I. No. 41 of 1999)
- Local Government (Water Pollution) (Amendment) Regulations 1999 (S.I. No. 42 of 1999)
- European Communities (Quality of Salmonid Waters) Regulations, 1988. (S.I. No. 293 of 1988)
- European Communities (Quality of Surface Water Intended for the Abstraction of drinking Water) Regulations, 1989. (S.I. No. 294 of 1989)
- Council Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life. (OJ L327, 22/12/00)
- Local Government (Water Pollution) Act 1990, Stationery Office, Dublin
- Water Quality (Dangerous Substances) Regulations, 2001. (S.I. No. 12 of 2001)
- European Community (1991). Council Directive 91/689/EEC on hazardous waste. (OJ L377, 31/12/91)
- Waste Management Acts 1996 to 2010
- European Communities (Amendment of Waste Management (Licensing Regs 2000), 2002), (S.I. No. 337 of 2002)
- European Communities (Licensing of Incinerators for Hazardous Waste) Regulations 1998. (S.I. No. 64 of 1998)
- European Community (2000). Council Directive 2000/76/EC on the incineration of waste. (OJ L 332, 28/12/00)
- European Community (1999). Council Directive 1999/31/EC on the landfill of waste. (OJ L182, 16/7/99)
- EU Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills
- European Community (2008). Council Directive 2008/1/EC concerning integrated pollution prevention and control. (OJ L24, 29/01/08)

- European Community (2006). Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration. (OJ L 372, 27.12.2006, p. 19)
- European Community (2004). Directive 2004/35/EC on the European parliament and of the Council of 21 April 2004 on the environmental liability with regard to the prevention and remedying of environmental damage. (OJ L 143, 30.4.2004, p. 56)
- European Community (2006). Directive 2006/21/EC of the European Parliament and of the Council on 15th March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC. (OJ L 102, 11.4.2006, p. 15)
- Air Pollution Act No.6 of 1987
- Air Pollution (Air Quality Standards) Regulations, 2002 (S.I. No. 271 of 2002) - (replaces S.I. 244 of 1987)
- European Community (1996) Council Directive 96/62/EC on ambient air quality assessment and management (OJ: L296/55/96) & Daughter Directives 1999/30/EC and 2000/69/EC
- Wildlife Act 1976 and Wildlife (Amendment) Act 2000, and Regulations made there under
- European Communities (Natural Habitats) Regulations, 1997(S.I. No. 94 of 1997) & Amendments
- European Communities (Conservation of Wildbirds) Amendment Regulations, 1997. (S.I. No. 210 of 1997)
- Fisheries Acts (1959 to 2000)
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009)
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)

EPA Publications / Guidance

- Environmental Protection Agency, Department of the Environment and Local Government, Geological Survey of Ireland 1999 Groundwater Protection Schemes
- Environmental Protection Agency, Department of the Environment and Local Government, Geological Survey of Ireland 1999 Groundwater Protection Responses for Landfills
- EPA (Environmental Protection Agency) 1997 Environmental Quality Objectives and Environmental Quality Standards - The Aquatic Environment – A Discussion Document.
- EPA (Environmental Protection Agency) 2006 Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision.
- EPA (Environmental Protection Agency) 1995 Guidance Note for Noise in Relation to Scheduled Activities
- EPA (Environmental Protection Agency) 1995 Landfill Manuals – Investigations for Landfills
- EPA (Environmental Protection Agency) 2003 Landfill Manuals – Landfill Monitoring 2003)
- EPA (Environmental Protection Agency) 1997 Landfill Manuals – Landfill Operational Practices
- EPA (Environmental Protection Agency) 1997 Waste Disposal Activities (Landfill Sites) – Application Form
- EPA (Environmental Protection Agency) 1999 Landfill Manuals – Landfill Restoration and Aftercare
- EPA (Environmental Protection Agency) 2000 Landfill Manuals – Landfill Site Design
- EPA (Environmental Protection Agency) 2006 Technical Guidance on The Landfilling of Asbestos Waste (web resource)
- EPA (Environmental Protection Agency) 2009 *Municipal Solid Waste – Pre-treatment & Residuals Management – An EPA Technical Guidance Document*.
- EPA (Environmental Protection Agency) 2001 Parameters for Water Quality, Interpretation and Standards
- EPA (Environmental Protection Agency) 1999 Waste Licensing – Draft Guidance on Environmental Management Systems and Reporting to the Agency
- EPA (Environmental Protection Agency) 2003 Guidance Note on Energy Efficiency Auditing.
- EPA (Environmental Protection Agency) 2006 Guidance Note for Noise in Relation to Scheduled Activities, 2nd Edition, 2006.
- EPA (Environmental Protection Agency) 2011 Guidance on the Authorisation of Discharges to Groundwater.

APPENDIX 4
GLOSSARY

Terms

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 landfill activities at the facility and the capping and restoration of the site.

Afteruse: the use to which a landfill is put following restoration.

Baseline monitoring: monitoring in and around the location of a proposed facility so as to establish background environmental conditions prior to any development of the proposed facility.

BAT: Best Available Techniques as defined in Article 2(11) of IPPC Directive.

Biochemical oxygen demand (BOD): 5 day Biochemical Oxygen Demand.

Biodegradable: means waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and cardboard, etc.

Biodegradable Municipal Waste (BMW): means the biodegradable component of municipal waste. Biodegradable municipal waste is typically composed of food and garden waste, wood, paper, cardboard and textiles. Approximately 69% of municipal waste (household, commercial & cleansing waste) managed in Ireland in 2009 was biodegradable.

Biological Treatment: means composting, anaerobic digestion, mechanical-biological treatment or any other biological treatment process for stabilising and sanitising biodegradable waste, including pre-treatment processes.

Biowaste: means household, commercial or industrial waste of an organic or putrescible character.

Bunding/berm: a dike or mound usually of clay or other inert material used to define limits of cells or phase or roadways; or to screen the operation of a landfill from adjacent properties; reducing noise, visibility, dust and litter impacts.

Capping: the covering of a landfill, usually with low permeability material (Landfill cap).

Chemical oxygen demand (COD): Chemical Oxygen Demand.

Condensate: the liquid, which forms within gas pipework due to the condensation of water vapour from LFG.

Daily cover: is the term used to describe material spread (about 150mm if soil, recovered or recycled material) over deposited waste at the end of every working day.

Direct discharge: introduction into groundwater of substances in Lists I or II without percolation through the ground or subsoil (i.e., via a swallow hole or borehole).

Downgradient: the direction towards which groundwater or surface water flows. Also referred to as downslope.

Effluent: a liquid, which flows from a process or system.

Emission: meaning assigned by the EPA Act of 1992.

Flare unit: a device used for the combustion of landfill gas thereby converting its methane content to carbon dioxide.

Groundwater: means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.

Hazardous landfill: landfill that accepts only hazardous waste that fulfils the criteria set out in Article 6 of 'Council Directive 1999/31/EC on the landfill of waste'.

Indirect discharge: introduction into groundwater of substances in Lists I or II after percolation through the ground or subsoil.

Inert landfill: landfill that accepts only inert waste that fulfils the criteria set out in the Agency's manual 'Waste Acceptance'.

Intermediate cover: refers to placement of material (minimum 300mm if soil used) for a period of time prior to restoration or prior to further disposal of waste.

Landfill Gas (LFG): all gases generated from the landfilled waste.

Leachate collection and removal system: engineered system to draw leachate to a central point for removal, with the purpose of minimising the accumulation and depth of leachate on the liner.

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.

List I/II substances: as listed in the EC Directives 76/464/EEC and 80/68/EEC and amendments.

Lower explosive limit (LEL): the lowest percentage concentration by volume of a mixture of flammable gas with air, which will propagate a flame at 25ºC and atmosphere pressure.

Municipal Solid Waste (MSW): means household waste as well as commercial and other waste which, because of its nature or composition, is similar to household waste. It excludes municipal sludges and effluents.

Non-hazardous landfill: landfill that accepts waste that fulfils the criteria set out in Article 6 of 'Council Directive 1999/31/EC on the landfill of waste'.

Phasing: progressive use of the landfill area so that construction, operation (filling) and restoration can occur simultaneously in different parts of the site.

PM_{10}: Particles <10µm in diameter.

$PM_{2.5}$: Particles <2.5µm in diameter.

Receiving water: a body of water or a watercourse which for the time being is dry, flowing or otherwise, such as a stream, river, lake, estuary or sea, into which water or wastewater is discharged.

Residual Waste: means the fraction of collected waste remaining after a treatment step, which generally requires further treatment or disposal.

Restoration: works carried out on a landfill site to allow planned afteruse.

Sensitive Receptor: Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or area of high amenity that for its proper enjoyment requires the absence of odour or noise at nuisance levels.

Total organic carbon (TOC): Total Organic Carbon.

Treatment / pre-Treatment: Includes, 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, the achievement or exceedance of which requires certain actions to be taken by the licensee.

Vent: refers to system provided in a landfill to permit the escape to atmosphere of gases and vapours generated by deposited waste during biodegradation.

Void space: space available to deposit waste.

Waste Water: Waste Water has the meaning given in the Water Services Act, 2007.

Appendix 5
Abbreviations

BAT	Best Available Techniques
BATNEEC	Best Available Technology Not Entailing Excessive Cost
BREF	BAT reference – sector notes being produced by the European Commission
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ELV	Emission Level Value
EMS	Environmental Management System
EPA	Environmental Protection Agency
EQO	Environmental Quality Objective
EQS	Environmental Quality Standard
FID	Flame Ionisation Detector
IPPC	Integrated Pollution Prevention and Control
LEMP	Landfill Environmental Management Programme
PID	Photo Ionisation Detector
ppmv	Parts per million by volume
S.I.	Statutory Instrument
VOC	Volatile Organic Compounds
WMA	Waste Management Act