

Technical Guidance Note

IPPC S5.02

Guidance for the Landfill Sector Technical requirements of the Landfill Directive and Integrated Pollution Prevention and Control (IPPC)



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Record of changes

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Issue 1	June 2001	Initial issue
Issue 2	September 2001	Comments from internal consultation
Issue 3	November 2001	Updated Odour and Noise sections
Issue 3a	November 2001	Amendments to Groundwater provisions

Note:

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Executive Summary

This guidance has been produced by the Environment Agency for England and Wales in collaboration with the Northern Ireland Environment and Heritage Service (EHS)¹. Together these are referred to as “the Regulator” in this document. Its publication follows consultation with industry, government departments and non-governmental organisations.

What is IPPC

Pollution Prevention and Control (PPC) is a regulatory system that employs an integrated approach to control the environmental impacts of certain industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single permitting process. To gain a permit, operators will have to show that they have systematically developed proposals to apply the 'Best Available Techniques' (BAT) and meet certain other requirements, taking account of relevant local factors.

The Agencies intend to implement PPC to:

- protect the environment as a whole;
- promote the use of “clean technology” to minimise waste at source ;
- encourage innovation, by leaving significant responsibility for developing satisfactory solutions to environmental issues with industrial operators; and
- provide a “one-stop shop” for administering applications for permits to operate.

Once a permit has been issued, other parts of PPC come into play. These include compliance monitoring, periodic permit reviews, variation of permit conditions and transfers of permits between operators. PPC also provides for the restoration of industrial sites when the permitted activities cease to operate.

This Guidance

The Landfill Directive ([see Reference 1](#)) was implemented in July 2001. The Landfill (England & Wales) Regulations 2001 are due to be brought in by the Autumn of 2001 under the PPC regime. This document lays down the standards and expectations in the UK (England and Wales and Northern Ireland) for the techniques and standards that need to be addressed to satisfy the relevant regulations and the PPC Regulations 2000 ([see Reference 2](#)).

The aims of this Guidance

The aims of this Guidance are to:

- identify the technical requirements of the LFD and the options available to meet these requirements i.e. the BAT options);
- provide a clear structure and methodology which Operators should follow during the PPC application process, to ensure that all aspects of the LFD and IPPC and relevant Regulations have been addressed;
- minimise the effort by both Operator and Regulator during the permitting of a landfill installation by use of a clear structure and methodology;
- provide an arrangement of information which allows the reader to find, either within the document or as is more likely to be the case, to be directed to other technical guidance documents associated with the sector, where the relevant guidance can be found.
- improve the consistency of applications by ensuring that all relevant issues are addressed;
- increase the transparency of the permitting process by having a structure in which the Operators response to each issue, and any departures from the standards, can be seen clearly;
- provide a summary of the BAT techniques for pollution control and UK experience which are relevant in the UK context expressed, where possible, as clear indicative standards and which need to be addressed by Applicants;

¹ In Northern Ireland, legislation implementing the IPPC Directive is not yet in place, and there are also significant differences in waste legislation and planning legislation. Further information on the interfaces between IPPC and other legislation concerning waste in Northern Ireland will be included in revisions to this guidance. In the mean time, contact Environment and Heritage Service for further information.

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1 INTRODUCTION

1.1 Understanding the Landfill Directive and PPC

Objectives of the Landfill Directive

The Landfill Directive 1999/31/EC (LFD) (see Reference 1) introduces measures on waste and landfills to prevent or reduce negative effects on the environment. In particular pollution of surface water, groundwater, soil, air and also on the global environment with respect to emissions of landfill gas as well as risk to human health during the whole life cycle of the landfill.

Pollution, Prevention and Control

Implementation of the LFD requirements in England and Wales will take place under the Landfill Regulations 2001 (see Reference 2) which operates under the Pollution Prevention and Control (PPC) Act 1998 (see Reference 3), which implements the EC Directive 96/61 on IPPC (see Reference 4). PPC is a regulatory system that employs an integrated approach to control the environmental impacts of certain industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single permitting process. To gain a Permit, Operators will have to show that they have systematically developed proposals to apply the 'Best Available Techniques' (BAT) and meet certain other requirements, taking account of relevant local factors.

The objectives of PPC and LFD are complementary and the reasons for implementing the LFD in this way include:

- A set of regulations and accompanying guidance giving increased consistency and clarity of interpretation and application of the Directive.
- Incorporating landfills into an integrated environmental protection regime .
- Economies of scale to be achieved by avoiding the need to duplicate effort on operating and maintaining two regimes for landfill sites with the corresponding need for two sets of guidance and training.

Readers should refer to the Department of the Environment, Transport and the Regions (DETR) document *The Implementation of Council Directive 1999/31/EC* (see Reference 5) and *Implementation of Council Directive 1999/31/EC on the Landfill of Waste, Second Consultation Paper* (see Reference 6) for further explanation on the reasons for implementing the LFD in this way. Further information on the overall system of PPC, together with Government policy and more detailed advice on the interpretation of the Regulations, can be found in the Department of the Environment, Transport and the Regions (DETR) document *IPPC: A Practical Guide* (see Reference 7).

PPC and landfill

The LFD applies to all existing landfills and IPPC to those receiving more than 10 tonnes of waste in any day or with a total capacity of more than 25 000 tonnes (but excluding landfills taking only inert waste). Operators of existing landfills are required to submit a Site Conditioning Plan (SCP) by 16 July 2002. This must include information on how the site will comply with the requirements of the LFD Directive, and any corrective measures to be taken for this purpose. The Regulator has produced guidance for the preparation of conditioning plans (see Reference 8) and this should be read in conjunction with this document.

Best Available Techniques

Essentially BAT requires measures to be taken to prevent or, where this is not practicable, to reduce emissions. That is, if emissions can be reduced further, or prevented altogether, at reasonable cost (the balance of cost against benefit or prevention of harm), then this should be done irrespective of whether any environmental quality standards are already being met. It requires us not to consider the environment as a recipient of pollutants and waste, which can be filled up to a given level, but to do all that is practicable to minimise the impact of industrial activities. The BAT approach is, in this respect, a precautionary one.

LFD and BAT

Article 1(2) of the LFD states that the technical requirements of the IPPC Directive will be fulfilled by compliance with the requirements of the LFD. Where there is a requirement arising from PPC and a specific LFD requirement covering the same matter, the LFD takes precedence. For example, under PPC there is a requirement to include BAT based emission limit values or equivalent parameters or technical measures and if necessary, the Permit is to include appropriate requirements ensuring the protection of soil and ground water. Annex I of the LFD contains specific requirements to limit the emission of landfill gas and requirements for the protection of soil and ground water (bottom liners etc.). The effect of Article 1(2) of the LFD is that these specific Annex I requirements are deemed to satisfy the general PPC requirements in relation to emissions to air and to ground water. If, however there is a PPC requirement with no corresponding specific LFD requirement, then the PPC requirement will apply. For example, PPC requires that installations must be operated in such a way that energy is used efficiently. There is no corresponding specific provision in the LFD and therefore the PPC requirement will apply.

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LFD and the Groundwater Directive

It should be noted that BAT for landfill is also determined by the requirements of the Groundwater Directive (see Section 2.4). Protection of groundwater obligations may mean that for some landfills provision for pollution prevention and control may go beyond BAT in order to meet environmental quality standards with respect to groundwater. The supporting technical guidance is being updated (for example Reference 41 and will contain the detailed guidance Operators will require in relation to the technical requirements of LFD. This illustrates an important role of this guidance note in that it is an overarching document which indicates to the reader what is considered to be BAT for the LFD where detailed technical guidance can be found.

Technical Guidance

While it is important that the minimum standards specified by the LFD are met, Regulators encourage the development and introduction of new and innovative techniques which meet the BAT criteria and are looking for continuous improvement in the overall environmental performance of the process as a part of progressive sustainable development. The application of BAT to landfill however requires several qualifying factors. First of all, much of the pollution control measures associated with a landfill are permanent i.e. the liner and cannot be upgraded in situ to reflect the development of improved, available techniques. The emphasis has to therefore be on correct design and implementation measures. This does not however preclude implementation of improved standards at subsequent phases of development of the landfill.

Departures from BAT may therefore be justified on the grounds of the technical characteristics of the installation concerned, its geographical location and the local environmental conditions but not on grounds of individual company profitability. Further information on this can be found in the *Guide for Applicants* (see Reference 9).

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1.2 Making an Application (New Installations)

The wider obligations for waste management are set out in Article 4 of the Waste Framework Directive (see Reference 10) and expressed in the relevant objectives in Schedule 4 of the Waste Management Licensing Regulations 1994 (or the equivalent regulations in Northern Ireland, see Appendix 2), also have to be taken into consideration. These are as follows:

- a) *“ensuring the waste is recovered or disposed of without endangering human health and without using process or methods which could harm the environment and in particular without:*
- i risk to water, air, soil, plants or animals; or*
 - ii causing nuisance through noise or odours; or*
 - iii adversely affecting the countryside or places of special interest.*
- b) *Implementing, as far as material, any plan made under the plan-making provisions.”*

Operators should identify any development plans made by the local planning authority including any waste local plan, and comment on the extent to which the proposals accord with the contents of any such plan.

Section 4 requires an assessment of the overall environmental impact of the installation. Part of the assessment is whether the installation is likely to have a significant effect on a European Site in the UK and if it is, provide an assessment of the implications of the installation for that site, for the purposes of the Conservation (Natural Habitats etc) Regulations 1994 (SI 1994/2716).

European Sites are defined in Regulation 10 of the Habitats Regulations to include Special Areas of Conservation (SACs); sites of community importance (sites that have been selected as candidate SAC by member states and adopted by the European Commission but which are not yet formally classified; and Special Protection Areas (SPAs). It is also Government policy (set out in PPG 9 on nature conservation) that potential SPAs and candidate SACs should also be considered to be European Sites for the purposes of Regulation 10.

Information on the location of European Sites and their conservation objectives is available from:

English Nature (01733 455000), <http://www.english-nature.org.uk>

Countryside Council for Wales (01248 385620), <http://www.ccw.gov.uk>

Scottish Natural Heritage (0131 447 4784) <http://www.snh.org.uk>

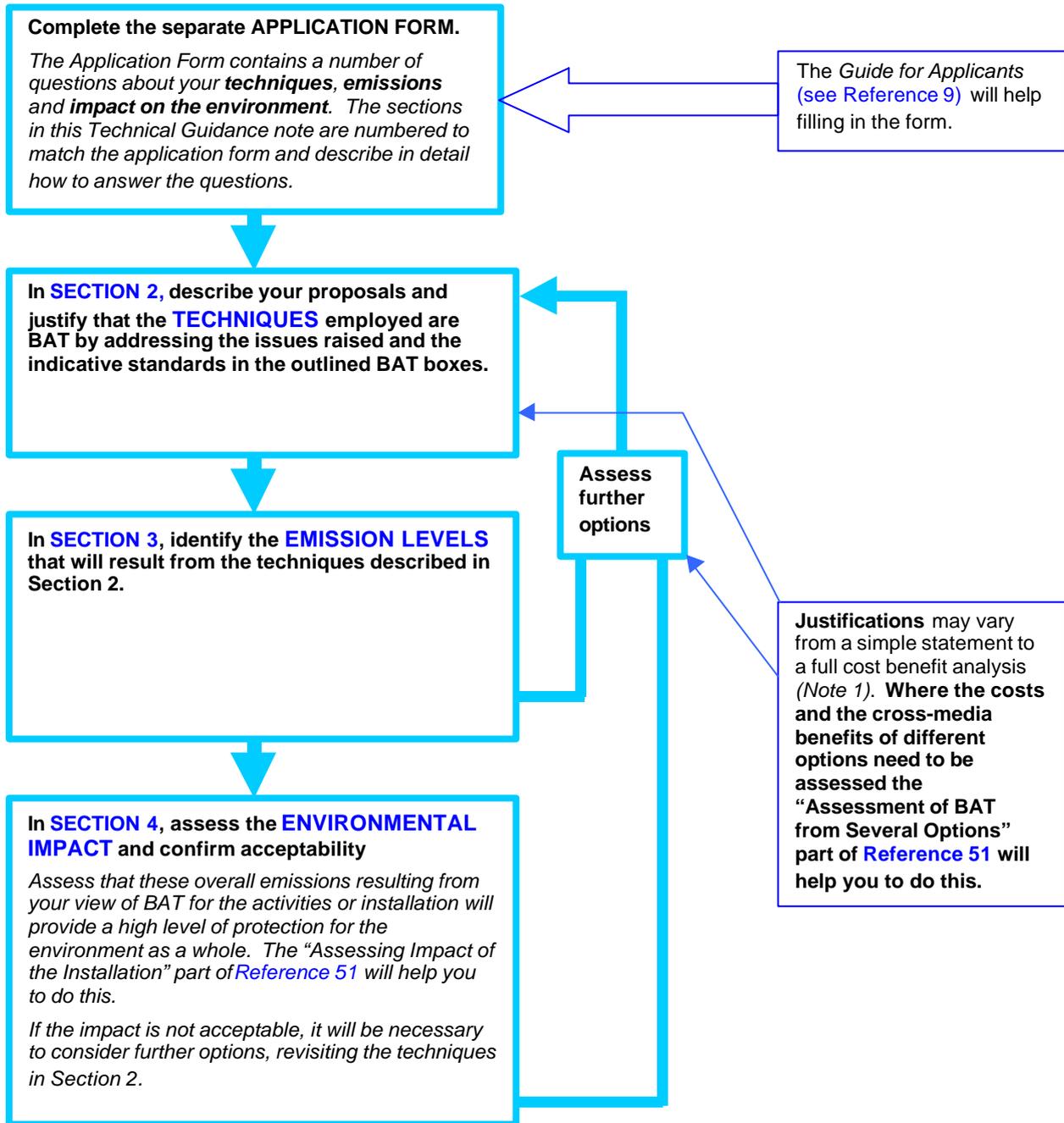
Joint Nature Conservation Committee (01733 866852) <http://www.jncc.gov.uk>

The Regulator will need to consider the Operator's initial assessment and if it concludes that the installation is likely to have a significant effect on a European Site, then the Regulator will need to carry out an “appropriate assessment” of the implications of the installation in view of that site's conservation objectives. Because the Regulations impose a duty on the Regulator to carry out these assessments, it cannot rely on the Operator's initial assessments, and therefore the Regulator must be provided with any relevant information upon which the Operator's assessment is based. See the Regulators' information pack on the Habitats Regulations¹¹.

Note that in many cases, the impact of the Habitats Regulations will have been considered at the planning application stage, in which case the Regulator should be advised of the details.

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Figure 1 - Making an Application



Note 1 The amount of detail needed to support the application should be sufficient to support the applicant’s contention that either the conditions of the guidance have been met or an alternative measure has been justified. The level of detail should be commensurate with the scale of the operation and its ability to cause pollution. An applicant is not required to supply detail that could not reasonably be expected to contribute to a decision to issue a permit.

Note 2 The contents of the outlined BAT boxes in Sections 2, 3 and 4, and additional blank tables etc., are available electronically on the Agency’s Website, for the assistance of applicants.

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1.3 Installations Covered by this Guidance

This Guidance covers all landfills (for definition see glossary) including those which fall outside the IPPC Regime (non-IPPC landfills).

Landfills which fall outside the IPPC Regime (non- IPPC landfills)

- landfills receiving less than 10 tonnes per day or with a total capacity of less than 25,000 tonnes;
- all landfills taking only inert waste.

The above landfills will require PPC Permits although they will not have to meet all of the requirements of the IPPC Directive just those of the Landfill Directive.

The installation includes the main activities as stated above and associated activities which have a technical connection with the main activities and which may have an effect on emissions and pollution. They may include, as appropriate:

- storage and handling of waste for disposal and raw materials
- pre-treatment of waste for disposal
- liner installation
- landfill gas and leachate system installation
- waste for disposal, acceptance, emplacement and compaction
- landfill gas management and flaring
- leachate management and treatment
- the control and abatement systems for emissions to all media
- power plants
- landfill capping
- landfill aftercare.

However, the impact of the activities on the environment may be wider than just the on-site activities. This Guidance and the PPC Regulations, cover issues downstream of the installation i.e. the final disposal of leachate generated but not disposed of at the site.

Advice on the extent of the physical site which is contained within the installation, for example split sites, is given in *IPPC Part A(1) Installations: Guide for Applicants* (see [Reference 9](#)). Operators are advised to discuss this issue with the Regulator prior to preparing their application. Particular examples relevant to the landfill sector would be:

- a site which includes a leachate treatment system that treats leachate arising from more than one landfill site; or
- a gas utilisation plant that uses landfill gas generated from more than one landfill.

Where associated activities are carried out in conjunction with the main activities and are not covered in this guidance note (e.g. hazardous waste treatment), reference should be made to:

- other relevant PPC Technical Guidance Notes and,
- other relevant guidance notes issued under EPA 1990
- where appropriate, the Secretary of State's Guidance for Local Authority Air Pollution Control. (NB In Northern Ireland this guidance is produced by the Department of the Environment).

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1.4 Review Periods

PPC Permits can be reviewed or varied at any time. However, the Landfill Regulations impose a requirement on Regulators to review Permits in certain specific circumstances such as where monitoring indicates a significant adverse environmental effect. In addition, Regulators are required to review the conditions of Permits “periodically”.

The review period for the landfill sector is every four years, as required by the Groundwater Directive (see Reference 12).

The need for updating any of the information, or for completely re-issuing this Guidance, will be assessed:

- prior to the bulk of activities in the above categories in this sector coming up for review;
- following technological advances or other advances in knowledge relevant to this sector.

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1.5 Key Issues for the Landfill Sector

The key issues for the landfill sector mostly relate to meeting the requirements of the LFD, as specified in Section 1. The following sections briefly describe the key issues for the landfill sector.

Landfill classification (see Reference 12)

Article 4 of the LFD requires each landfill to be classified as one of the following:

- landfill for hazardous waste;
- landfill for non-hazardous waste;
- landfill for inert waste.

The Directive sets out particular types of waste that must no longer be landfilled. The dates by which many of these restrictions take effect vary according to whether the site that is the subject of the application is a new or existing landfill. A summary of these bans and how they apply to new and existing sites is set out in the table below.

Banned Waste	New sites	Existing Hazardous sites	Existing Non – hazardous sites	Existing Inert sites
Liquid Waste	July 2001	July 2002	July 2002 – 2007 ¹	July 2002 – 2007 ¹
Waste, which in the conditions of landfill is corrosive, oxidising, highly flammable or flammable	July 2001	July 2002	July 2002 ²	July 2002 ²
Infectious Hospital and Clinical Waste arising from medical or veterinary establishments; chemical substances arising from R&D or teaching activities which are not identified &/or are new & whose effect on man &/or the environment are not known (e.g. laboratory residues).	July 2001	July 2002	July 2002 ²	July 2002 ²
Whole used tyres	July 2003	July 2003	July 2003 ³	July 2003 ³
Shredded Tyres	July 2004 (HW) July 2006 (NHW / I)	July 2004 ⁴	July 2006 ³	July 2006 ³
Waste that doesn't meet the acceptance criteria	July 2001	July 2002	July 2002 – 2007 ¹	July 2002 – 2007 ¹
End of Co-disposal	July 2001	July 2004	July 2002	July 2002

Notes

1. For an individual site the ban will come into effect when the site receives a PPC permit. Note: Non-Hazardous and Inert sites cannot take *hazardous* liquids after July 2002
2. These substances are hazardous waste, any site taking these wastes in July 2002 will be classified as a hazardous site, the bans apply to hazardous sites in July 2002 therefore these substances cannot be landfilled at any site beyond July 2002.
3. For an individual site the ban will come into effect when the site receives a PPC permit but no sooner than July 2003 (whole tyres) July 2006 (shredded tyres)
4. A hazardous waste site can only accept hazardous waste site after July 2004. Tyres are not hazardous waste.

Further information on the classification of landfill sites is detailed in Regulatory Guidance note 1: Classification of Landfill Sites¹³.

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Waste treatment prior to landfill (see Reference 14)

Article 6 (a) requires that most waste is treated prior to the waste being landfilled. Treatment is defined as “the physical, thermal, chemical or biological processes, including sorting, that change the characteristic of the waste in order to:

- reduce its quantity, or
- reduce its hazardous nature, or
- facilitate its handling, or
- enhance its recovery.”

This requirement does not extend to inert waste for which treatment is not technically feasible or to any other waste for which such treatment would not contribute to the objectives of the LFD.

Waste pre-treatment and minimisation are further discussed in [Section 2.2](#).

Water control and leachate management

Groundwater ingress

Groundwater should be prevented from entering the landfilled waste (see [section 2.3.1](#)).

Pollution of surface water

Precipitation coming into contact with waste will become contaminated (leachate) and will have to be treated prior to discharge. A control system may be required during the operational and post-closure phases to prevent this. All discharges to surface water systems require a discharge consent.

Pollution of groundwater

Leachate has the potential to contaminate groundwater. The LFD gives minimum requirements for the protection of water. It should be noted that BAT for landfill is also determined by the requirements of the Groundwater Directive (see [Section 2.4](#)). Protection of groundwater obligations may mean that for some landfills provision for pollution prevention and control may go beyond BAT in order to meet environmental quality standards with respect to groundwater.

Leachate treatment

Any excess leachate generated within the landfill may require treatment. This could include the installation of an on-site Leachate Treatment Plant. Options for leachate treatment are described in [Section 2.3.2](#).

Pollution of soil

The release of leachate and the migration of landfill gas into the environment beyond the containment system are potential issues associated with the landfill sector.

Pollution of air

Atmospheric impacts

The release of landfill gas into the atmosphere is an issue with unique relevance to the landfill sector. Both carbon dioxide and methane, the main constituents of landfill gas are both considered greenhouse gases and may contribute to global warming. The LFD requires the collection and utilisation or flaring of landfill gas.

Dust

Particulates (dust) may be released to the air and be transported to surrounding areas. Agency guidance on the monitoring of dust is in preparation⁴⁶.

Odour

Decomposing waste, landfill gas and leachate all emit unpleasant odours. Measures need to be taken to prevent offensive odours from reaching human receptors off the site. The Agency has produced guidance on the regulation of odour at facilities licensed under the Waste Management Licensing Regulations (see [Reference 15](#)). Much of this will be relevant to sites with PPC permits.

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Risk to human health

If not adequately managed, landfill waste has the potential to harm human health. Examples include:

- landfill gas - flammability/explosiveness;
- impacts on sources of potable water from uncontrolled release of leachate;
- direct contact with waste.

Accident risk

Accident risk is inherent when dealing with waste and in particular hazardous waste. Wastes are heterogeneous in nature and any failure in the management of the waste from the process of characterisation and checking of wastes, to discharge of the waste at the tipping area, will significantly increase the risk from unwanted reactions which could result in for example fire. Other accident scenarios include slippage through poor slope stability and overflow or spillages from for example the leachate management system.

Noise and vibration

Vehicles bringing waste to the site and plant used in the emplacement and compaction of the waste may cause noise and vibration in excess of “normal” background levels. The Agency has produced guidance on the control and monitoring of noise at sites licensed under the waste management licensing regulations (see Reference 16). Much of this guidance will be relevant to sites with PPC permits.

Litter

Wind-blown litter is a potential issue associated with landfill sites. During the emplacement of waste consideration should be given to the site conditions to control the release of litter into other parts of the site. It may be necessary to discharge the waste under controlled conditions. The Agency is preparing guidance on this topic (see Reference 17).

Vermin and pest

Landfill sites have the potential to attract scavengers such as birds, rodents and other small mammals and insects. These are often considered as nuisance and may also spread disease.

Visual impact

The location of a landfill is an important consideration. The visual impact of a landfill will usually be assessed as part of the planning process. Neither the LFD nor the PPC Regulations consider visual impact.

Environmental monitoring

In order to demonstrate that the landfill is not having a negative effect on the surrounding environment, it is necessary for the Operator to ensure environmental monitoring is undertaken using an appropriate scope and frequency (see References 18 and 19).

After-use

There are many potential uses for restored landfills, but consideration of the proposed after-use is required during the application for the site. The design of the site and the environmental management systems incorporated into the landfill need to take into account of the proposed after-care, since above ground environmental management systems and site access issues have a direct impact on after-use.

Guidance

There are numerous guidance documents that have been produced that are specific to the landfill sector. Many of these incorporate the requirements of the LFD and the PPC Regulations. These guidance documents are referenced in the relevant sections, throughout this guidance.

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1.6 Summary of Releases

This table considers all classifications of landfill: inert, non-hazardous and hazardous and does not distinguish between the different classifications. The following list of potential releases is based on pollutants listed in Schedule 5 of the PPC Regulations with additions specifically relevant to the landfill sector. It is a requirement of the PPC Regulations that reporting is mandatory for the following parameters. For non-PPC landfills, the list should be used as a tool when undertaking impact assessments.

	SOURCE		RELEASES							
	Landfill Development	Operational Phase	Operational Phase Post-Closure Phase	Landfill construction	Waste acceptance/waste storage	Waste emplacement	Waste pre-treatment	Biodegradation process	Landfill gas flare / utilisation plant	Leachate treatment facility
Sulphur dioxide & other sulphur compounds (H ₂ S)							A W	A W L	A	
Oxides of nitrogen (NO ₂ , NO ₃)								A W	A	W
Ammoniacal Nitrogen (NH ₄)								W		W
Carbon monoxide							A		A	
Carbon dioxide [A	A L	A	
Methane							A	A L	A	
Volatile organic compounds					A	A	A	A		
Metals & their compounds							W	W L		W
Dust	A	A	A	A	A	A	A			
Bio-aerosols	A	A	A	A	A	A	A			
Asbestos (suspended particulates, fibres)					A	A	A			
Cyanides							W	W		W
Polychlorinated dibenzodioxins & polychlorinated dibenzofurans									A	
Organohalogen compounds and substances that may form such compounds							W	WA		W
Hydrocarbons and bioaccumable organic toxic substances							W	W		W
Biocides and plant health products							W	W		W
Suspended solids							W	W		W
Phosphates & nitrates & other substances which contribute to eutrophication							W	W		W
Substances which have a unfavourable influence on the oxygen balance (measured as BOD, COD, DO)							W	W		W
Litter					L W	L W				

KEY: A – Release to Air, W – Release to Water, L – Release to Land

Note: Sub-surface landfill gas migration can lead to impacts on the surrounding land. Releases to air usually result in a subsequent, indirect emission to land and can therefore affect receptors in the locality.

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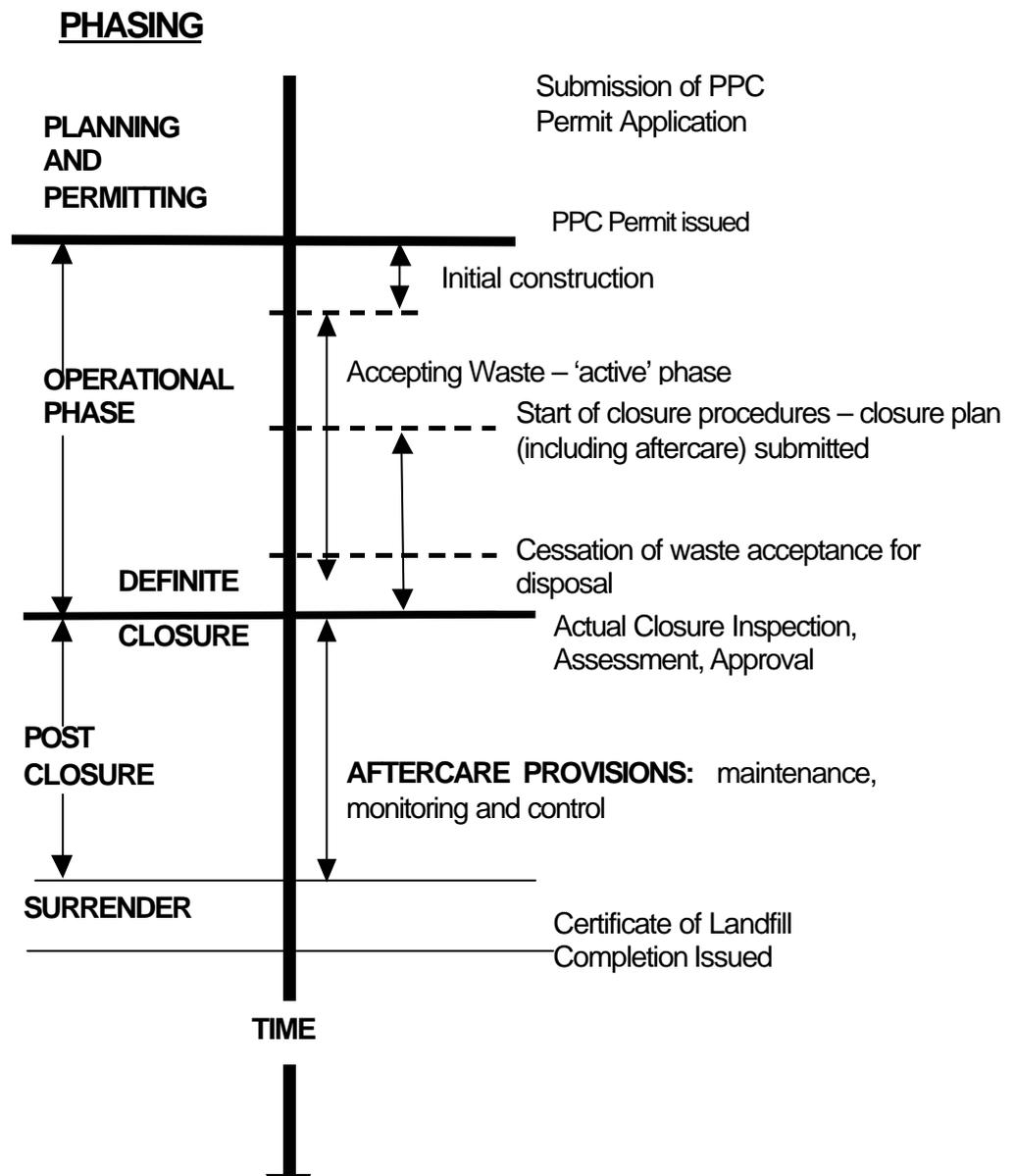
1.7 Overview of the Activities in this Sector

A landfill is defined in the LFD as:

“a waste disposal site for the deposit of the waste onto or into land (i.e. underground), including:

- internal waste deposit sites and permanent sites which is used for temporary storage of waste; *but excluding:*
- facilities where waste is unloaded in order to permit it's preparation for further transport for recovery, treatment or disposal elsewhere, storage of waste prior to recovery or treatment for a period less than three years as a general rule or storage of waste prior to disposal for a period of less than one year”.

The following diagram defines the different phases of landfill.



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This section provides a very brief description of landfill activities.

Landfill development

The development of a landfill requires the preparation of a conceptual plan for the development followed by planning application, the development of an assessment of the risks posed by the project including an environmental statement, PPC Permit application, site design including proposed site engineering and infrastructure, environmental monitoring plan, site closure and aftercare plan.

Waste pre-treatment (see Reference 14)

As a requirement of the LFD, waste treatment may have been met “upstream” of the landfill. However, if no pre-treatment has been undertaken on the waste prior to being received at the landfill, to comply with the objectives of the LFD, it may be necessary to change the characteristics of the waste by physical, thermal, chemical or biological processes.

Waste acceptance (see Reference 20)

Annex II of the LFD describes general principles for the acceptance of waste into the various classifications of landfill. The LFD requires a basic characterisation of the waste prior to delivery to the site, and compliance testing and on-site verification on arrival at the site.

Operational controls

During the operational phase of the landfill, measures will need to be taken to minimise the effects of litter, noise, odour and dust on the surrounding environment. Many of the activities in the Landfill sector are required to ensure such effects are minimised.

Landfill gas management

Landfill gas is a generic term used to describe the gaseous components generated through microbial degradation and/or by chemical reaction/volatilisation consequent to the disposal of the waste to the landfill. The LFD requires that landfill gas is collected for all landfills receiving biodegradable waste, and that the collected landfill gas must be treated and used. If the collected gas cannot be used to produce energy it must be flared.

Leachate management

Leachate is the result of water that has percolated through the waste and has become contaminated. The composition of the leachate will depend on many factors including the waste types. Measures should be taken to prevent precipitation, surface water and groundwater from entering the waste. Leachate collected from the landfill requires treatment to the appropriate standard required for its discharge.

Closure and aftercare

After the “active” phase of the landfill, it is necessary to continue to manage the site. Environmental monitoring should continue until such times that the Regulator is prepared to accept surrender of the PPC Permit. The LFD indicates that financial provisions should be made to allow after-care to continue for a minimum of thirty years. It is likely that for many sites this time period will be considerably longer.

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1.8 Economic Aspects

Since the implementation of the Environmental Protection Act (EPA) 1990 and the Waste Management Licensing Regulation 1994 the landfill industry has made continuous progress towards improving environmental protection standards.

This is evident in the quality of the engineering of landfill sites with Construction Quality Assured containment, positive leachate management and active landfill gas control. Other controls introduced by the EPA 1990 were those of the requirement to demonstrate that the Operator is a fit and proper person (FAPP), is technically competent and is making adequate financial provision to discharge obligations under a licence.

More recently the Environment Agency published its Library of Licence Conditions, which aimed to standardise the approach to the licensing of landfill facilities and set requirements for the development, operation, closure and post closure phases of a landfill life cycle.

The Landfill Tax Regulations introduced in 1996 have affected the types of wastes sent for landfill. Certain waste types, which were either usable in the landfill operational phase e.g. inert materials or degradable material, previously disposed at landfill sites are no longer disposed of in such a manner. The recovery and reuse of materials has become more common. There has also been an obvious trend for the merger and/or acquisition processes to form larger operating companies offering greater resources and geographical coverage for the disposal of waste.

These influences on the assessment of the justification of landfilling for waste streams have meant that new landfill sites have become less common. Essentially waste producers are critically reviewing the choice of disposal route and the need for disposal. In parallel, landfill site Operators are required to justify their landfill design and operations on environmental impact grounds.

Article 10 of the LFD requires that all the costs involved in the setting up, operation and post closure provisions of a landfill site shall be met by the gate fees levied by the Operator.

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2 TECHNIQUES FOR POLLUTION CONTROL

This section summarises the requirements and indicative standards which the operator must address in making an application. This document and the Main Technical Guidance listed below or subsequently issued by the Agency, is considered to represent BAT for the Landfill Sector. In demonstrating the use of BAT the Operator should keep the following general principles in mind.

- If articles of the LFD apply then these indicate BAT and take precedence.
- There should be evidence in the application that consideration has been given to the possibility of preventing the release of harmful substances and only where prevention is not practicable should consideration be given to reducing emissions which may cause harm.
- For landfill, this places the emphasis on:
 - design, build, operating measures and quality assurance for pollution control infrastructure such as liners and leachate and gas collection systems.
 - waste acceptance procedures.
- All available options should be reviewed and it should be demonstrated that the selected combination of primary process and abatement equipment satisfies the Regulations.

Within this section the various sub-sections are arranged in a consistent manner to guide the Operator through the requirements of the Application. The elements within each sub-section are as follows.

1. A restatement of the relevant question from the PPC Permit application form with a brief explanation of the landfill issues to be addressed in answering the question.
2. The techniques and measures that must be addressed in demonstrating the use of BAT. A distinction is made between BAT indicated by compliance with the articles in the LFD and BAT as required under IPPC.

For all landfills

BAT as represented by compliance with the specific articles of the LFD is contained within a shaded BAT box;

IPPC Landfills

BAT under IPPC, without specific LFD articles is contained within an unshaded BAT box

3. The information that the Operator should supply with the PPC Permit application and any information that may be required at a later date. No distinction is made between the information requirements for new and for existing sites although it should be recognised that the SCP for an existing site will have addressed many of the relevant issues.
4. Sources of further guidance and information for assessing BAT. This document and those guidance documents listed as Main technical Guidance are considered to represent BAT. General information is listed as Supporting Reference Information.

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2.1 Management Techniques

It is a requirement that the management of the landfill site is controlled by a person who is a "Fit and Proper Person". This includes a component whereby the management of the specified waste management activity that is or is to be carried out is in the hands of a technically competent person.

In addition to this requirement, an effective system of management is a key technique for ensuring that all appropriate pollution prevention and control techniques are delivered reliably and on an integrated basis. The Regulators strongly support the operation of environmental management systems (EMSs). An Operator with such a system will find it easier to complete not only this section but also the technical/regulatory requirements in the following sections.

The Regulators recommend that the ISO 14001 standard is used as the basis for an environmental management system. Certification to this standard and/or registration under EMAS (EC Eco Management and Audit Scheme) (OJ L168, 10.7.93) are also strongly supported by the Regulator. Both certification and registration provide independent verification that the EMS conforms to an assessable standard. EMAS now incorporates ISO 14001 as the specification for the EMS element. For further details about ISO 14001 and EMAS contact British Standards Institute (BSI) and the Institute of Environmental Management and Assessment (IEMA) respectively.

The steps required in this and subsequent sections may help the Operator to make good any shortfalls in their management system. An effective EMS will help the Operator to maintain compliance with regulatory requirements and to manage other significant environmental impacts. While the requirements below are considered to be BAT for IPPC, they are the same techniques as required in a formal EMS and are also capable of delivering wider environmental benefits. However, it is information on their applicability to IPPC that is primarily required in this Application.

Application Form
Question 2.1

Provide details of your proposed management techniques.

With the Application the Operator should:

1. Describe their management system to demonstrate how it meets the "**Requirements for an effective management system**" below. The description should make clear who holds responsibility for each of the requirements. The second column explains where in the application the response to each requirement is best dealt with to avoid duplication. Copies of all procedures are not needed, but examples may be included in your application.
2. If you are certified to ISO 14001 or registered under EMAS (or both), you may provide a statement derived from certification records/assessments to support your application.
3. Further specific management procedures are dealt with under the appropriate section on the remainder of the document. It is recommended that you understand all the requirements of the application before completing this section, as many management issues are dealt with in other sections.
4. The type of management system employed will depend upon the scale and complexity of the operations undertaken. The Operator should demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements below, or by justifying departures (as described in Section 1.2 and in the Guide for Applicants) or alternative measures.

Indicative BAT Requirements

The Operator should have a management system in place for the activities which delivers the requirements given below.

Requirement for an effective management system	How delivered for IPPC
1. Clear management structure and allocated responsibilities for environmental performance, in particular meeting the aspects of the IPPC Permit	Describe in this section who has allocated responsibilities
2. Identification, assessment and management of significant environmental impacts	By responding to the requirements in Question 2.1 of the Application
3. Compliance with legal and other requirements applicable to activities impacting on the environment	Compliance with the Permit satisfies this requirement

BAT for management techniques

Cont.

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BAT for management techniques (cont.)

4. Establishing an environmental policy and setting objectives and targets to prevent pollution, meet legal requirements and continually improve environmental performance	The Applicant should make proposals in response to each of Sections 2.2 to 2.12 . These proposals may be incorporated within the Permit improvement programme
5. Environmental improvement programmes to implement policy objectives and targets	
6. Establish operational controls to prevent and minimise significant environmental impacts	By responding to the requirements in Sections 2.2 to 2.7, 2.11 and 2.12 in the Application
7. Preventative maintenance programmes for relevant plant and equipment – method of recording and reviews	Describe system here. List procedures in Section 2.2
8. Emergency planning and accident prevention	By responding to the requirements in Section 2.8 in the Application
9. Monitoring and measuring performance Identify key indicators of environmental performance and establish and maintain a programme to measure and monitor indicators to enable review and improvement of performance	Describe in this Section
10. Monitoring and control systems: <ul style="list-style-type: none"> To ensure that the installation functions as intended; To detect faults and unintended operations; To detect slow changes in environmental performance to trigger preventative maintenance. 	By responding to the requirements in Section 2.10 in the Application
11. Training Provision of adequate procedures and training for all relevant staff (including Contractors and those purchasing equipment and materials), which should include: <ul style="list-style-type: none"> a clear statement of the skills and competencies required for each job; awareness of the regulatory implications of the Permit for the activity and their work activities; awareness of all potential environmental effects from operation under normal and abnormal circumstances; prevention of accidental emissions and action to be taken when accidental emissions occur; implementation and maintenance of training records; Expertise required depends on the activities being carried out. However, both technical and managerial staff upon whom the installation's compliance depends need sufficient qualifications, training and experience for their roles. This may be assessed against any industry sector standards or codes of practice	To be described in this Section confirming that training for each of the areas covered by Sections 2.2 to 2.3 and 2.5 to 2.10 are covered
12. Communication and reporting of incidents of actual or potential non-compliance and complaints Actions taken in response, and about proposed changes to operations.	Describe in this Section
13. Auditing Regular, (preferably) independent, audits to check that all activities are being carried out in conformity with these requirements. All of these requirements should be audited at least once per year	Describe in this Section

Cont.

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BAT for management techniques (cont.)

<p>14. Corrective action to analyse faults and prevent recurrence</p> <p>Define responsibility and authority for handling and investigating non-conformance, taking action to mitigate any impacts caused and for initiating and completing corrective and preventive action</p> <p>Recording, investigating, taking corrective action and preventing recurrence, in response to environmental complaints and incidents</p>	<p>Describe in this Section how this is dealt with for each of Sections 2.2 to 2.3 and 2.5 to 2.10 as appropriate</p>
<p>15. Reviewing and Reporting Environmental Performance</p> <p>Senior management review environmental performance and ensure appropriate action taken where necessary to ensure that policy commitments are met and that policy remains relevant. Review progress of the Management Programmes at least annually.</p> <p>Incorporate environmental issues in all other relevant aspects of the business, insofar as they are required by IPPC, in particular:</p> <ul style="list-style-type: none"> • the control of process change on the installation; • design and review of new facilities, engineering and other capital projects; • capital approval; • the allocation of resources; • planning and scheduling; • incorporation of environmental aspects into normal operating procedures; • accounting for environmental costs against the process involved rather than as overheads. <p>Report on environmental performance, based on the results of management reviews (annual or linked to the audit cycle), for:</p> <ul style="list-style-type: none"> • information required by the Regulator; and • effectiveness of the management system against objectives and targets, and future planned improvements. <p>Report externally preferably via public environmental statement</p>	<p>Describe in this Section</p> <p>Describe in this Section</p> <p>This will become a Permit requirement</p> <p>Describe in this Section</p> <p>Describe in this Section</p>
<p>16. Managing documentation and records</p> <p>List the core elements of the EMS (policies, responsibilities, procedures etc) and links to related documentation in order to be able to control, locate and update documentation.</p> <p>Describe how environmental records and results of audits and reviews are identified, maintained and stored</p>	<p>Describe in this Section</p>
<p>17. Design and Construction Quality Assurance</p> <p>Design and Construction Quality Assurance is a key management technique for the construction of the individual elements of the landfill installation. All relevant elements of the installation shall be designed in accordance with recognised standards, methodologies and practices, and these process must be documented to a level to provide and adequate audit trail.</p> <p>Designs should be developed using a risk based approach.</p>	

Cont.

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BAT for management techniques (cont.)

<p>Designs should consider:</p> <ul style="list-style-type: none"> • the context of the element under consideration. • the purpose of the designed elements and the environments in which they are to be situated. • the selection of materials and products. • the design life of the elements. • their installation. • operational and maintenance requirements. • health and safety issues. • the cost implications. <p>Designs should be prepared to a sufficient level of detail, to allow them to be easily interpreted and constructed. Where possible construction should be carried out using commonly available techniques, and where this is not possible sufficient detail should be provided to allow alternative approaches to be considered.</p> <p>Designs should be clearly set out using drawings and specification, supported by calculations and method statements where appropriate.</p> <p>A Construction Quality Assurance (CQA) Plan should be prepared, which details the assurance and validation process for relevant elements of the installation. The CQA Plan and relevant details must be prepared by a competent and suitably qualified person.</p> <p>The CQA Plan should cover the selection and construction of all elements of engineered containment system. These elements would include the following:</p> <ul style="list-style-type: none"> • earthworks formation and sub-grade; • mineral/soil liners; • drainage blanket • geosynthetic liners; • protection systems; • capping and restoration.. <p>Leachate drainage/collection layer:</p> <ul style="list-style-type: none"> • Collection sumps and pipework; • Extraction facilities (extraction points/pumps/pipework); • Distribution pipework and mains; • Re-circulation facilities (blankets, injection systems, soakaways, trenches etc); • Leachate treatment facilities and infrastructure); • Leachate monitoring facilities. • Gas collection and abstraction systems: • Engineered gas control systems; • Landfill Gas Flares; • Landfill Gas Utilisation Plants. <p>Other control systems or techniques:</p> <ul style="list-style-type: none"> • Surface water drainage/collection measures; • Storage /attenuation ponds and/or lagoons; • Pumping systems; • Distribution pipework and mains; • Interceptors; • Soakaway systems; • Surface water monitoring facilities; • Surface water disposal and discharge arrangements; 	<p>Describe in Section 2.3.1.</p> <p>Describe in Section 2.3.1.</p> <p>Describe in Section 2.3.2.</p> <p>Describe in relevant Section</p>
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Cont.

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BAT for management techniques (cont.)

<ul style="list-style-type: none"> • Interfaces with other parts of the installation e.g. capping and restoration. <p>The CQA Plan should refer to method statements, specifications, calculations, risk assessments, details and drawings, and should include the procedures for:</p> <ul style="list-style-type: none"> • selection of material; • handling, storage and installation; • testing (conformance and performance) and inspection; • validation process. <p>An independent competent and suitably qualified person must supervise on a full time basis the construction of the elements of the installation.</p>	
<p>18. Following completion of the construction works a CQA Validation report will be prepared by a competent and suitably qualified person. The report shall provide validation by the competent and suitably qualified person that all works subject to CQA procedures have been carried out in accordance with the approved design specifications and method statements. The Validation report must include:</p> <ul style="list-style-type: none"> • brief details of the construction activities. • construction quality assurance records. • conformance test results undertaken in accordance with the CQA Plan. • as built drawings of the constructed works. <p>Details of the qualifications and experience of the competent persons involved with the above CQA activities should be provided to the Regulator for approval prior to commencement of the work.</p>	

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2.2 Materials Inputs

The operation of a landfill involves the acceptance and emplacement of incoming landfill waste for disposal and the use of raw and auxiliary materials to minimise the adverse environmental effects of the main activities. Both of these can be regarded as materials inputs to the landfill but they will be treated in substantially different ways. The guidance below recognises these differences and provides separate sections for the management of the incoming landfill waste (Section 2.2.3) and raw materials used in the operation of the landfill (Section 2.2.1 and 2.2.4) and Materials used in the construction, lining and capping of a landfill should not be regarded as materials inputs. They can be more properly defined as forming part of the abatement systems (e.g. for landfill gas and leachate) and discussion of the selection and use of materials in these systems is left to the appropriate sections of this note.

2.2.1 Waste for disposal

Waste for disposal, for the purposes of this section, is any incoming waste being brought onto the site to be placed in the landfill.

Application Form
Question 2.2 (part 1)

Identify the wastes for disposal

With the Application the Operator should:

1. Identify and quantify the waste streams which you intend to receive;
2. Set out proposed procedures for waste acceptance, sampling and testing;
3. Set out proposed procedures for dealing with non-conforming wastes;
4. Identify shortfalls in information or justifications for not using the above measures.

Indicative BAT Requirements

1. The following wastes shall not be accepted in a landfill
 - a) Liquid waste;
 - b) Waste which, in the conditions of landfill, is explosive, corrosive, oxidising, highly flammable or flammable, as defined in Annex III to Directive 91/689/EEC; Hospital and other clinical wastes arising from medical or veterinary establishments, which are infectious as defined (property H9 in Annex III) by Directive 91/689/EEC and waste falling within category 14 (Annex I.A) of that Directive;
 - c) Whole used tyres after 16 July 2003, excluding tyres used as engineering material, and shredded used tyres after 16 July 2006 (excluding in both instances bicycle tyres and tyres with an outside diameter above 1400 mm (dates to be confirmed by DETR));
 - d) Any other type of waste which does not fulfil the acceptance criteria determined in accordance with Annex II.
2. Measures shall be taken in order that:
 - a) Only waste that has been subject to treatment is landfilled. This provision may not apply to inert waste for which treatment is not technically feasible, nor to any other waste for which such treatment does not contribute to the objectives of this LFD, as set out in Article 1, by reducing the quantity of waste or the hazards to human health or the environment;
 - b) Only hazardous waste that fulfils the criteria set out in accordance with Annex II is assigned to a hazardous landfill;
 - c) Landfill for non-hazardous waste may be used for:
 - i Municipal waste
 - ii Non-hazardous waste of any other origin, which fulfil the criteria for the acceptance of waste at landfill for non-hazardous waste set out in accordance with Annex II;
 - iii Stable, non-reactive hazardous wastes (e.g. solidified, vitrified) with leaching behaviour equivalent to those of the non-hazardous wastes referred to in point (ii), which fulfil the relevant acceptance criteria set out in accordance with Annex II. These hazardous wastes shall not be deposited in cells destined for biodegradable non-hazardous waste.
 - d) Inert landfill sites shall only be used for inert waste

Cont.

BAT for the acceptance of landfill waste
Landfill Directive Article 11, Annex II

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BAT for the acceptance of landfill waste (cont.)
 Landfill Directive Article 11, Annex II

Waste for disposal acceptance criteria and procedures

- The composition, leachability, long-term behaviour and general properties of a waste to be landfilled must be known as precisely as possible. Waste acceptance at a landfill can be based either on lists of accepted or refused waste, defined by nature and origin, and on waste analysis methods and limits values for properties of the waste to be accepted.

Criteria for acceptance at a specific class of landfill must be derived from considerations pertaining to:

- protection of the surrounding environment in particular groundwater and surface water;
- protection of the environmental protection systems e.g. liners and leachate treatment systems;
- protection of the desired waste-stabilisation processes within the landfill;
- protection against human health hazards.

Examples of waste property-based criteria are:

- requirements on knowledge of total composition;
- limitations on the amount of organic matter in the waste;
- requirements or limitations on the biodegradability of the organic waste components;
- limitations on the amount of specified, potentially harmful/hazardous components in relation to the above mentioned protection criteria;
- limitations on the potential and expected leachability of specified, potentially harmful/hazardous components in relation to the above mentioned protection criteria;
- ecotoxicological properties of the waste and the resulting leachate.

The following measures should be taken:

Pre-acceptance

- Before delivery of the waste to the installation, the Operator should be able to show, by means of appropriate documentation that the waste can be accepted at the site, according to the conditions of the Permit, and that it fulfils the acceptance criteria set out in Annex II.

At the time of delivery, or at the first in a series of deliveries, provided the type of waste remains unchanged, the Operator should show by comparison between documentation held by the Operator and that accompanying the waste, that the waste can be accepted at the site, according to the conditions of the Permit, and that it fulfils the acceptance criteria set out in Annex II.

Waste reception and acceptance

- Checking of the waste documentation, including those documents required by Article 5(3) of Directive 91/689/EEC and, where they apply, those required under Council Regulation EEC No 259/93 of 1 February 1993 on the supervision and control of shipments of waste into and out of the European Community.

Visual inspection of the waste at the entrance and point of deposit and, as appropriate, verification of the conformity with the description provided in the documentation submitted by the holder.

If representative samples have to be taken in order to implement Annex II, point 3, level 3, the results of the analyses shall be kept and the sampling shall be in conformity with Annex II point 5. These samples shall be kept at least one month.

Keeping a register of the quantities and characteristics of the waste deposited including, indicating the origin, date of delivery, identity of the producer or collector in the case of municipal waste and in the case of hazardous waste, the precise location on the site. This information shall be made available to the competent national and Community authorities when requested for statistical purpose.

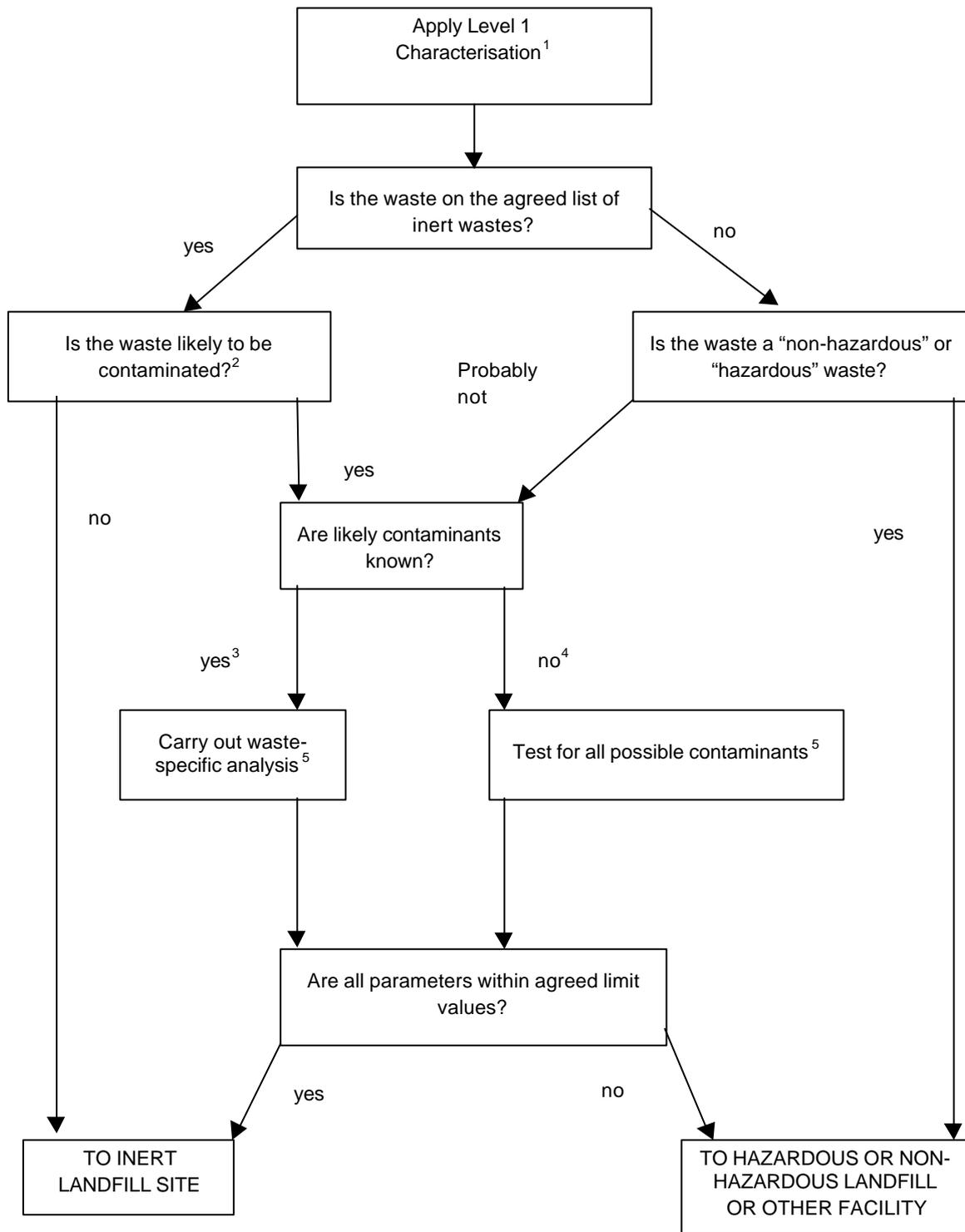
The Operator of the landfill shall always provide written acknowledgement of the receipt of each delivery accepted on the site.

If waste is not accepted at the landfill, the Operator shall notify without delay the Regulator of the non-acceptance of the waste.

Cont.

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The following flowchart describes the processes used for the acceptance of waste



- i) What is the appearance of the waste; what is known about the process producing the waste; how variable is the process/waste?
- ii) Is the waste from a consistent process (e.g. glass manufacture) (e.g. Q3, Q8, Q9, Q10, Q11) or a variable process (e.g. screening of construction waste) (e.g. Q12, Q13, Q14, Q15).
- iii) Waste from a consistent source e.g. slag.
- iv) Waste from a variable or one-off source e.g. contaminated soil. Results will determine need for level 2 and 3 characterisation.

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BAT for the testing and acceptance of landfill waste (cont.)
 Landfill Directive Annex II

Procedures for testing and acceptance

6. **Level 1 Basic Characterisation** - This constitutes a thorough determination, according to standardised analysis and behaviour testing methods, of the short and long-term leaching behaviour and/or characteristic properties of the waste.

Level 2 Compliance Testing - This constitutes periodical testing by simpler standardised analysis and behaviour testing methods to determine a waste complies with the Permit conditions and/or specific reference criteria. The tests focus on key variables and behaviour identified by basic characterisation.

Level 3 On-site Verification - This constitutes rapid check methods to confirm that a waste is the same as that which has been subject to compliance testing and that which is described in the accompanying documents. It may merely consist of a visual inspection of a load of waste before and after unloading at the landfill site.

Basic waste acceptance procedures and criteria will eventually be provided by revision to Annex II of the LFD. More detailed guidance on waste acceptance procedures and criteria will be provided by the Regulator (see below and [Reference 20](#)). In the interim before the revision of Annex II is complete, you should refer to Section 4 of Annex II of the LFD and the Regulator guidance.

Sampling of waste

7. Until a European Sampling Standard has been approved, where sampling of waste is undertaken it should be carried out in accordance with the draft CEN Standard on Waste Sampling, available from the Regulator ([see Reference 21](#)).

8. The Operator should demonstrate that:

- there is a system in place to verify that waste delivered to the site complies with the Permit conditions - checking documentation, waste inspection, sampling and testing;
- there is a system in place to record the quantity, nature, origin of the waste (this information should already be available as part of Waste Management Licence requirements for existing installations but may need to conform with the forthcoming Waste Statistics Regulations);
- there are procedures for dealing with non-conforming waste;
- there is a system in place to maintain records of any waste sent off-site;
- there are adequate facilities for implementing the above requirements.

Certain wastes will be banned from acceptance at landfills in accordance with a phased approach set out by Article 5.3. The Operator should consider this when making an application.

Main technical guidance

- Guidance on Interim National Waste Acceptance Procedures ([see Reference 20](#));
- Regulatory Guidance Note 1: Classification of Landfill Sites ([see Reference 13](#));
- Guidance on Waste Treatment Requirements of Article 6a of the Landfill Directive ([see Reference 14](#)).
- Guidance for Operators on Preparing a Landfill Site Conditioning Plan ([see Reference 8](#));
- Guidance on the Development and Operation of Landfill Sites ([see Reference 22](#)).

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2.2.2 Waste for restoration

Waste for restoration, for the purposes of this section, is any incoming waste being brought onto the site for the purposes of capping and restoration

Application Form
Question 2.2 (Part 2)

Identify the wastes you intend to use for restoration and capping use.

With the Application, the Operator should:

1. Identify and quantify the waste streams which you intend to receive;
2. Set out the proposed procedures for waste acceptance, sampling and testing;
3. Set out the proposed procedures for non-conforming wastes;
4. Describe storage provisions

Waste reception and acceptance

5. Visual inspection of the waste at the entrance and point of deposit and, as appropriate, verification of the conformity with the description provided in the documentation submitted by the holder.

Keeping a register of the quantities and characteristics of the waste deposited including, indicating the origin, date of delivery, identity of the producer or collector. This information shall be made available to the competent national authority when requested. The Operator of the landfill shall always provide written acknowledgement of the receipt of each delivery accepted on the site.

If waste is not accepted at the landfill, the Operator shall notify without delay the Regulator of the non-acceptance of the waste.

Supporting reference information

- Guidance on the Restoration of Landfill Sites (see Reference 23).

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2.2.3 Raw and auxiliary materials selection

This section looks at the selection of raw materials used in the operation of the landfill, while [Section 2.2.4](#) describes the techniques to minimise their use. In this section landfill waste as a potential substitute for raw material and raw materials used in the operation of the landfill are considered separately.

Application Form
Question 2.2 (part 1)

Identify the raw and auxiliary materials, other substances and water that you propose to use.

With the Application, the Operator should:

1. Supply the list of principal raw materials with available information on environmental impact and alternatives;
2. Supply the current or proposed position with regard to any alternatives above;
3. Identify shortfalls in information or justifications for not using available alternatives.

Indicative BAT Requirements

1. While the Operator would be expected to maintain a detailed inventory of raw materials used on-site, a list of the materials used, which have the potential for significant environmental impact, should be supplied with the application. This list should include:
 - the chemical composition of the materials where relevant;
 - the quantities used;
 - the fate of the material and environmental impact where known (e.g. degradability, bioaccumulation potential, toxicity to relevant species);
 - any reasonably practicable alternative raw materials which may have a lower environmental impact including, but not be limited to, any alternatives described in the existing technical guidance (the substitution principle).
2. Generic information about materials, and grouping information of those of a similar type, is normally adequate rather than listing every commercial alternative used. A common sense approach to the level of detail should be used, ensuring that any material that could have a significant effect on the environment is included. Product data sheets should be available on-site.
3. The Operator should justify, in the application, (e.g. on the basis of impact on product quality), the continued use of any substance for which there is a less hazardous alternative.
4. The Operator should have procedures by which the awareness of new developments and their implications will be achieved.
5. The Operator should have quality assurance procedures for the control of the content of raw materials.

Examples of likely raw materials used in the operation of a landfill and possible selection techniques for these materials are given in the table below.

Raw material	Selection techniques/comments
Vermin control / insecticides / pesticides	<ul style="list-style-type: none"> • manufacturers specification • consider biodegradability
Fuels	<ul style="list-style-type: none"> • see Section 2.7.
Leachate treatment - dosing, anti-foam, biological solutions, etc.	<ul style="list-style-type: none"> • as recommended by process designer of treatment facility • consider potential impact on receiving water • consider biodegradability
Other raw materials required for engineering e.g. aggregate for roads, etc.	<ul style="list-style-type: none"> • seek to substitute with waste for disposal (e.g. hardcore, construction and demolition waste)

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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2.2.4 Materials input minimisation

Within the Landfill Sector there are two areas of materials input that may be minimised, the incoming landfill waste for disposal and the raw and auxiliary materials.

2.2.4.1 Landfill waste minimisation

The LFD requires the pre-treatment of waste prior to being landfilled, but does not specify that volume reduction of the waste quantity is a necessary element of the pre-treatment. The nature of the waste for disposal will influence the pre-treatment process and the pre-treatment will, in most instances, occur prior to the delivery of the waste. Thus, the landfill Operator will have little, or no, influence over the minimisation of the quantity of waste sent for landfill disposal.

2.2.4.2 Raw and auxiliary material minimisation

Nearly all of the raw and auxiliary materials used in the operation of a landfill are required to minimise the adverse effects on the environment. Therefore the minimisation of such materials may be inappropriate and may indeed result in the failure of the objectives set out in the LFD. It is therefore suggested that, although consideration should be given to minimising the use of materials required for abatement techniques, the Operator should ensure that the integrity and ability of the abatement systems are not compromised.

The Operator should consider the use of landfill wastes, where applicable, on-site (i.e. inert wastes for cover, internal roads,

Application Form
Question 2.2 (Part 2)

Identify the raw and auxiliary materials, other substances and water that you propose to use.

With the Application, the Operator should:

1. Identify the main opportunities for the minimisation of raw and auxiliary materials;
2. Describe the proposed methods for ensuring the minimisation of raw and auxiliary materials.

Indicative BAT Requirements

1. The Operator should analyse the use of raw materials, assess the opportunities for reductions and provide an action plan for improvements.
2. Using this information, opportunities for improved efficiency, changes in process and waste reduction should be generated and assessed and an action plan prepared for the implementation of waste minimisation projects.

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2.2.5 Water use

In comparison to many other processes subject to the PPC Regulations, the Landfill Sector is not a significant consumer of water. Though not currently practised in the UK, the addition of water to waste to accelerate stabilisation through enhanced biodegradation could involve a significant water use.

Typical current water uses at landfill sites may include, but are not limited to:

- dust suppression on internal roads;
- during construction of engineered liner (if moisture content of clay liner is not high enough);
- wheel washing installations;
- cleaning of plant and other site vehicles;
- cooling of plant, where applicable;
- odour control systems;
- human consumption for personnel hygiene, sanitary uses and drinking;
- laboratory use, where applicable (hazardous waste sites);
- fire extinguishing purposes;
- adding to waste to promote degradation and chemical stabilisation.

For many of the above uses, water can be sourced from surface water run-off stored in lagoons or ponds within the site. Although if the water is potentially contaminated, analysis should be undertaken prior to using water on areas not within the containment system. Where possible, precipitation falling within the site should be collected and stored in contained lagoons to be used for the above purposes.

For some of the above uses i.e. human consumption, laboratory, odour control systems; it may be necessary to use mains water. Water use for these purposes should be kept to a minimum.

Application Form
Question 2.2 (part 3)

Identify the raw and auxiliary materials, other substances and water that you propose to use.

With the Application, the Operator should:

1. Supply information on the proposed position with regard to all significant water usage.

Indicative BAT Requirements

1. Water use should be minimised within the BAT criteria for the prevention or reduction of emissions and commensurate with the prudent use of water as a natural resource. The constraints on reducing water use beyond a certain level should be identified by each Operator, as this is usually installation-specific.
2. The principles for reducing the use of fresh water are:
 - reducing the gross requirements for water;
 - recycling water, in as many positions as possible.
3. The Applicant should note that since a integrated approach to pollution should be taken, there is a potential conflict of issues with regard to minimising the use of water and ensuring adequate control measures are in place (i.e. dust suppression).

Recycling principles

4. For many of the above uses recycling in not practical (i.e. dust suppression, construction purposes). However, evaluation of the scope for water recycling should be undertaken.

BAT for water efficiency

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Engineered containment

2.3 The Main Activities and Abatement

This section covers the construction phase of the site and the “active” phase during which waste is accepted at the site. Consideration of the waste acceptance criteria and procedures, waste emplacement, environmental monitoring, leachate control and treatment, surface water management, groundwater management and landfill gas management.

2.3.1 Engineered control systems

The elements of the control systems should be designed, constructed and validated, following construction, to demonstrate that each part of the installation minimises the risks to air, land and water.

Engineered control systems include both the basal areas and side slopes of the landfill void and the capping and restoration of the final waste profiles.

Application Form
Question 2.3

Describe the proposed engineered control systems for the installation

With the Application, the Operator should:

1. Provide the proposed design (and supporting details) and CQA Plan for the engineered control systems;
2. Identify any issues which may be critical.

Indicative BAT Requirements

Water control & leachate management

1. Appropriate measures shall be taken with respect to the characteristics of the landfill and the meteorological conditions, in order to:
 - control water from precipitations entering into the landfill body,
 - prevent surface water and/or groundwater from entering into the landfill waste,
 - collect contaminated water and leachate. If an assessment based on consideration of the location of the landfill and the waste to be accepted shows that the landfill poses no potential hazard to the environment, the competent authority may decide that this provision does not apply.

The above provisions may not apply to landfill for inert waste.

Protection of soil & water

2. The landfill must be situated and designed so as to meet the necessary conditions for preventing pollution of the soil, groundwater or surface water and ensuring efficient collection of leachate as and when required according to the above. Protection of soil, groundwater and surface water is to be achieved by a combination of geological barrier and bottom liner during the operational/active phase and by the combination of a geological barrier and top liner during the passive/post closure phase.

Geological barrier (attenuation layer)

3. The geological barrier is determined by geological and hydrogeological conditions below and in the vicinity of the site providing sufficient attenuation capacity to prevent a potential risk to soil and groundwater.

The landfill base and sides shall consist of a mineral layer which satisfies hydraulic conductivity and thickness requirements with a combined effect in terms of protection of soil, groundwater and surface water at least equivalent to the one resulting from the following requirements:

- landfill for hazardous waste: $k \leq 1.0 \times 10^{-9}$ m/s; thickness ≥ 5 m;
- landfill for non-hazardous waste: $k \leq 1.0 \times 10^{-9}$ m/s; thickness ≥ 1 m;
- landfill for inert waste: $k \leq 1.0 \times 10^{-7}$ m/s; thickness ≥ 1 m.

Cont.

BAT for Engineered Control Landfill Directive Article 9 and Annex I

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Engineered control

Where the geological barrier does not naturally meet the above conditions it can be completed artificially and reinforced by other means giving equivalent protection. An artificially established geological barrier should be no less than 0.5 m thick.

Where an artificial geological barrier is established it must be ascertained that the geological substratum, is sufficiently stable to prevent settlement as a result of the landfill load that may cause damage to the barrier.

Leachate collection and bottom sealing

4. In addition to the geological barrier described above a leachate collection and sealing system must be added in accordance with the following principles so as to ensure that leachate accumulation at the base of the landfill is kept to a minimum:

<u>Landfill Category</u>	<u>Non hazardous</u>	<u>Hazardous</u>
Artificial sealing liner	required	required
Drainage layer > 0.5m	required	required

Surface sealing (engineered cap & restoration)

5. If the Regulator after consideration of the potential hazards to the environment finds that the prevention of leachate formation is necessary, a surface sealing may be prescribed. Recommendations for surface sealing are as follows:

<u>Landfill category</u>	<u>Non hazardous</u>	<u>Hazardous</u>
Gas Drainage layer	Required	Not required
Artificial sealing liner	Not required	Required
Impermeable Mineral Layer	Required	Required
Drainage Layer > 0.5 m	Required	Required
Top soil cover > 1 m	Required	Required

If on the basis of an assessment of environmental risks taking into account, in particular, Directive 80/68/EEC the Regulator has decided, in accordance with the above that collection and treatment of leachate is not necessary or it has been established that the landfill poses no potential hazard to soil, groundwater or surface water, the requirements given above may be reduced accordingly. In the case of landfills for inert waste these requirements may be adapted by national legislation.

6. The Operator should describe the measures and procedures proposed to prevent or reduce fugitive emissions to water and land. This should include, but is not limited to, the measures described above.
7. Consideration should be given to the setting and location of the site and assessment of the risks associated with the site as set out in [Section 4.1](#).
8. Appropriate measures shall be taken to prevent surface water and/or groundwater from entering into the landfilled waste, for example measures shall be taken to intercept surface water by means of cut off ditches.
9. The Operator should justify where any of the measures are not employed. There are two possible reasons:
- if a risk assessment, that considers the location of the site and the waste to be deposited, demonstrates that leachate collection is unnecessary then the Regulator may decide that the lining of the landfill is unnecessary; or
 - if a risk assessment demonstrates that an alternative design will not lead to an unacceptable discharge of leachate or gas in either the short or the long-term. Designs and CQA Plans should be prepared to meet the requirements as set in [Section 2.1](#).

Main technical guidance

- Guidance on the Development and Operation of Landfill Sites ([see Reference 23](#));
- Additional Guidance for Hazardous Waste Sites ([see Reference 23](#));
- Guidance on the Monitoring of Leachate, Groundwater and Surface Water under the Landfill Directive ([see Reference 18](#));
- Guidance on Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Trigger Levels ([see Reference 25](#)).

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Leachate management

Supporting reference information

- Interim guidance on the use of geomembranes in landfill engineering (see Reference 26);
- Interim guidance on non-woven protector geotextiles for landfill engineering (see Reference 27);
- Interim guidance on the geophysical testing of geomembranes for landfill engineering (see Reference 28);

2.3.2 Leachate management

Leachate is defined by the LFD as any liquid percolating through the deposited waste and emitted from or contained within a landfill.

Leachate composition is dependant on the waste type accepted at the waste and the age of the waste. Thus landfills for hazardous waste will produce different leachate to landfills for non-hazardous waste. Inert landfills should not produce any leachate.

The LFD bans liquid waste from landfill sites and requires appropriate measures to control precipitation entering the landfilled waste and prevent groundwater, surface water from entering it. These provisions do not have to be applied to landfills for inert waste, although surface water management techniques may be required to control the quality of surface water at any inert site.

All contaminated water and leachate collected from the landfill will require treatment to the appropriate standard necessary for their discharge.

Application Form
Question 2.3 (cont.)

Describe the proposed techniques and measures to prevent and reduce emissions of leachate.

With the Application, the Operator should:

1. Provide an assessment of the risks posed by the landfill leachate.
2. Provide the Leachate Management Plan which should include the proposed leachate management system details and procedures (and any supporting details) and the leachate, surface water and groundwater monitoring and sampling plans and the proposed trigger levels for groundwater monitoring .
3. Identify any site-specific issues and the proposed control systems.
4. Identify shortfalls in information or justifications for not using the above measures .

Indicative BAT Requirements

1. The Landfill Permit shall state the requirements for landfill preparation, operation and monitoring including contingency plans.
2. Appropriate measures will be taken with respect to the characteristics of the landfill and the meteorological conditions, in order to:
 - Control water from precipitation entering the landfill body;
 - Prevent surface water and/or groundwater from entering into the landfilled waste;
 - Collect contaminated water and leachate. If an assessment based on consideration of the location of the landfill and the waste to be accepted shows that the landfill poses no potential hazard to the environment, the Regulator may decide that this provision does not apply.
 - Treat contaminated water and leachate collected from the landfill to the appropriate standard prior to discharge.

The above provisions may not apply to landfill for inert waste.

3. In addition to a geological barrier a leachate collection and sealing system must be added in accordance with the following principles so as to ensure that leachate accumulation at the base of the landfill is kept to a minimum:

Leachate collection and bottom sealing

<u>Landfill Category</u>	<u>Non hazardous</u>	<u>Hazardous</u>
Artificial sealing liner	required	required
Drainage layer >μ 0.5 m	required	required

Cont.

BAT for Leachate Management Landfill Directive Article 9 and Annex I

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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Leachate management

BAT for Leachate Management (cont.)

4. If the Regulator after consideration of the potential hazards to the environment finds that the prevention of leachate formation is necessary, a surface sealing may be prescribed. Recommendations for surface sealing are as follows:

<u>Landfill Category</u>	<u>Non hazardous</u>	<u>Hazardous</u>
Gas Drainage layer	Required	Not required
Artificial sealing liner	Not required	Required
Impermeable Mineral Layer	Required	Required
Drainage Layer > 0.5 m	Required	Required
Top soil cover > 1 m	Required	Required

If on the basis of an assessment of environmental risks taking into account, in particular, the Groundwater Directive 80/68/EEC the Regulator has decided, in accordance with the above that collection and treatment of leachate is not necessary or it has been established that the landfill poses no potential hazard to soil, groundwater or surface water, the requirements given above may be reduced accordingly. In the case of landfills for inert waste these requirements may be adapted by national legislation.

5. The Operator should describe the measures proposed, used or which are being provided at the site to collect contaminated water and leachate, and to treat and dispose of it to prevent or reduce fugitive emissions to water and land. This should include, but is not limited to, the measures described above.

6. The Operator should justify where any of the measures are not employed and, where appropriate, set out the plans for improving the existing measures to meet the prescribed standards laid out above.

7. In accordance with **Annex I, Section 2, third indent**, the Regulator may decide, upon the basis of an assessment (provided by the operator) of the location of the site and the wastes to be taken, that there is no need to collect leachate, and that a landfill liner may not be required. See [Sections 4.1, 2.3.1 and 2.3.5](#) on landfill location, engineered control and surface water management.

General techniques

Leachate management plan

8. A leachate management plan should developed to set out the proposed management techniques and measures, and should include the following:

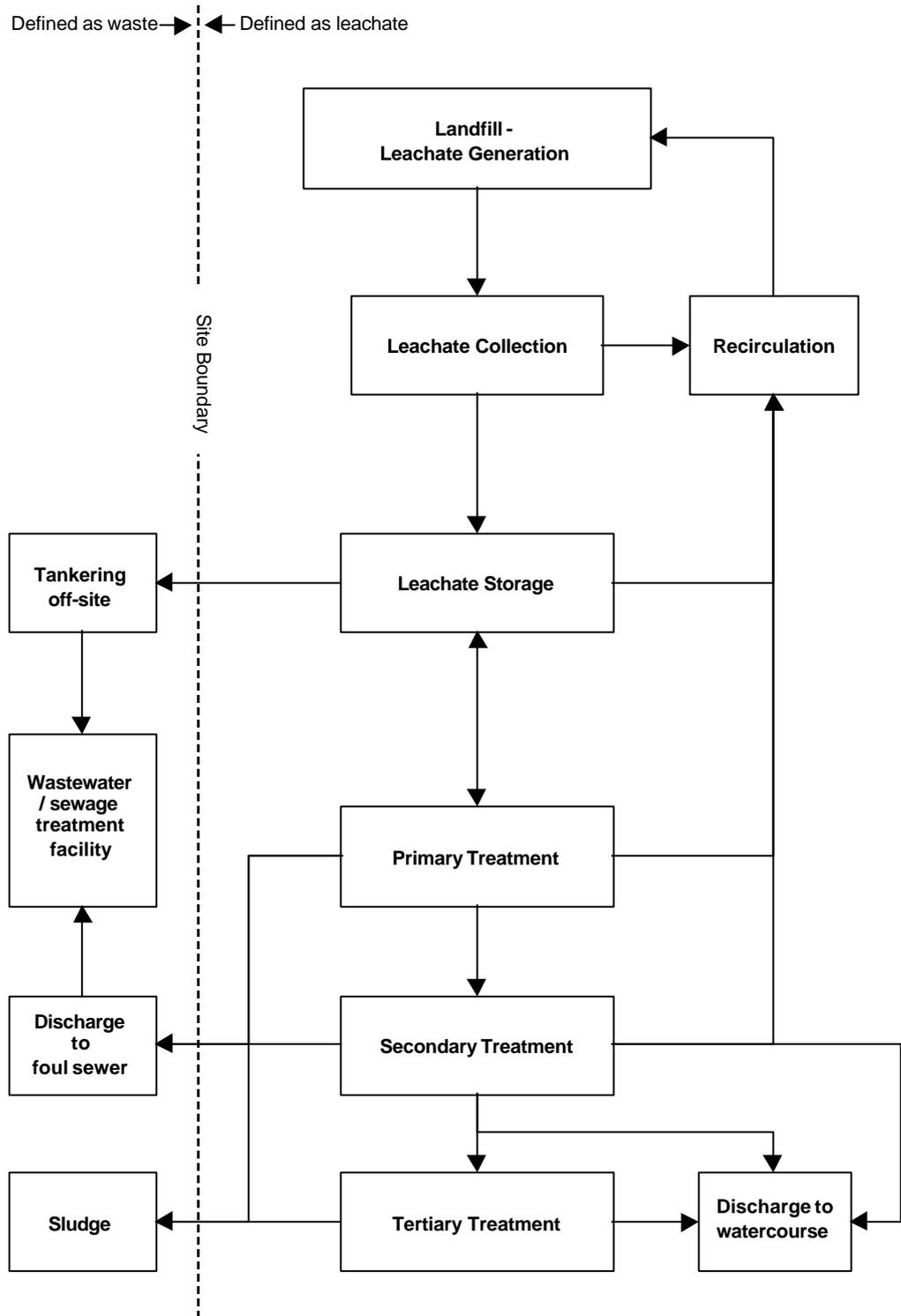
- the designs and CQA Plan;
- water balance ([also see Section 2.10.3](#));
- details of engineered systems;
- extraction and collection methods and procedures;
- connection pipework configurations and alignments;
- details of the mechanical control systems;
- details of leachate treatment methods;
- details of leachate disposal and discharge methods and routes;
- associated operational techniques for leachate management bunds/cover/capping etc;
- temporary leachate management systems;
- details of system monitoring, during pre-operational, operational, closure and after care phases (volume, meteorological conditions and quality)
- details of control strategies, including phasing of operations and re-circulation;
- operation, inspection and maintenance procedures;
- leachate, surface water and groundwater Monitoring and Sampling Plan including proposed groundwater trigger levels and contingency plans, should these trigger levels be approached/breached.

Cont.

INTRODUCTION		TECHNIQUES		EMISSIONS			IMPACT			
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Leachate management

The following flow chart sets out the key elements for leachate management.



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Leachate management

Leachate treatment

9. In some cases only the most rudimentary of treatment processes are required and the leachate can be discharged practically direct to sewer. Depending on the volume and quality of leachate generated, on site treatment options include:
 - Physico-chemical treatment including air stripping of ammonia, activated carbon adsorption, reverse osmosis, evaporation oxidation, coagulation, flocculation and settling;
 - Attached growth processes - trickling or percolating filters, rotating biological contractors;
 - Anaerobic treatment;
 - Reed bed system.
10. Irrespective of whether leachate is treated on or off site, the Operator should describe the measures and procedures in place and proposed to treat contaminated water and leachate to the appropriate standard required prior to discharge. This description should include, but is not limited to, the measures described below:
 - a description of the wastewater treatment system for the activity including any off site treatment where appropriate;
 - the identification of the main chemical constituents of the treated effluent (including the make-up of the COD) and assessment of the fate of these chemicals in the aquatic environment. This applies whether treatment is on or off-site;
 - contingency plans for leachate management in the event of breakdown of various components.
11. For leachate containing Red List Substances and was previously subject to a referral under the Water Industry Act 1991, special measures will be required:
 - To ensure that the probability of sewer bypass, via storm/emergency overflows or at intermediate sewage pumping stations, is acceptably low;
 - action plans in the event of bypass, e.g. knowing when bypass is occurring, rescheduling activities such as cleaning or even shutting down when bypass is occurring.
 - a suitable monitoring programme is in place for discharged leachate, taking into consideration the potential inhibition of any downstream biological processes and actions planned for any such event.
12. All emissions to surface water require a discharge consent from the Agency.
13. Where effluent is treated by pumping to an off-site at a sewage treatment works a Trade Effluent Consent or Agreement is required from the Water Utility

Main technical guidance:

- Additional Guidance on Hazardous Waste Sites ([see Reference 24](#));
- Guidance on the Development and Operation of Landfill Sites ([see Reference 22](#));
- Guidance on the Monitoring of Leachate, Groundwater and Surface Water under the Landfill Directive ([see Reference 18](#)).
- Guidance on hydrogeological risk assessment for landfills and the derivation of groundwater trigger levels ([see Reference 25](#)).

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Landfill gas

2.3.3 Landfill gas management

Any landfill accepting biodegradable wastes has the potential to generate landfill gas. Landfill gas may comprise many different gases, but methane (~65% v/v) and carbon dioxide (~35% v/v) are the major constituents. Landfill gas management should be considered at all three types of sites, including inert sites, although the extent of management may only entail monitoring.

It is anticipated that hazardous landfills may not generate typical landfill gas comprising methane and carbon dioxide unless they receive biodegradable hazardous waste. Hazardous landfills may have the potential to generate a different composition of landfill gas (e.g. VOCs) depending on the nature of the hazardous waste. Alternative methods of managing gas at such sites may be required where utilisation or flaring are not appropriate due to the composition of the gas.

Consideration of the following potential point source emissions and fugitive emissions from the landfill should be considered. In general they comprise:

- landfill gas flares (composition will differ after combustion reaction);
- landfill gas utilisation plant (composition will differ after combustion reaction);
- sub-surface migration;
- fugitive emissions from waste (where the capping layer has not been installed);
- emissions from capped areas;
- Permanent and fixed elements of the installation should be designed, constructed and validated, following construction, to demonstrate that each part of the installation minimises the risks to air, land and water.

Operational procedures and practices should be developed to minimise the impacts from landfill gas.

Application Form
Question 2.3 (cont.) **Describe the landfill gas management plan for the installation**

With the Application, the Operator should:

1. Provide the Landfill Gas Risk Assessment;
2. Provide the Landfill Gas Management Plan which should include the proposed landfill gas management system details and procedures (and any supporting details) and the gas sampling and monitoring plan;
3. Identify any site-specific issues and the proposed control systems.

Indicative BAT Requirements

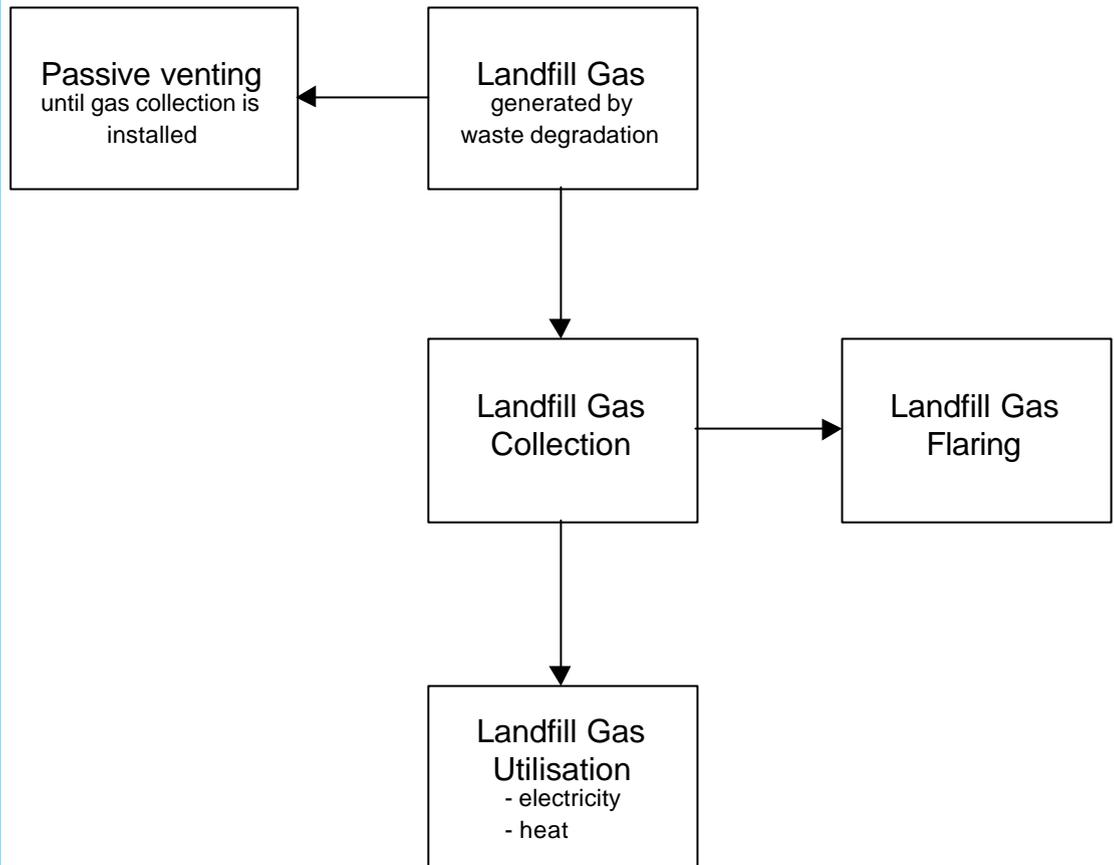
1. Appropriate measures shall be taken in order to control the accumulation and migration of landfill gas.
2. Landfill gas shall be collected from all landfills receiving biodegradable waste and the landfill gas must be treated and used. If the gas collected cannot be used to produce energy, it must be flared.
3. The collection, treatment and use of landfill gas as described above must be carried out in a manner which minimises damage to or deterioration of the environment and risk to human health.
4. The LFD also recommends the inclusion of a gas drainage layer within the capping system installed at all non-hazardous landfills, this is further discussed in [Section 2.3.1](#).
5. Other techniques described elsewhere in this document may also provide additional supporting information. Consideration should be given to [Sections 4.1 and 2.3.1](#) regarding Location and Engineered Containment.
6. Landfill gas collection maybe required for inert landfills depending on the quantity and quality of gas present. Irrespective of whether gas is collected from an inert landfill techniques may need to be considered to monitor landfill gas, particularly at existing inert landfills.
7. The Operator should describe the measures and procedures in place and proposed to prevent or reduce fugitive and point source emissions to air and/or land. This should include, but is not limited to, the measures described above.

Cont.

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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Landfill gas

The following flow chart sets out the main elements of landfill gas management.



Landfill Gas Management Plan

8. A landfill gas management plan should be developed to set out the proposed management techniques and measures, and should include the following:

- Gas collection and control
 - the designs and CQA Plan;
 - details of engineered containment (liners and caps);
 - types and locations of gas wells;
 - connection pipework configurations and alignments;
 - details of the mechanical control systems;
 - details of system monitoring, during pre-operational, operational, closure and after care phases;
 - Landfill Gas Action Plan (to include trigger values and remedial actions).
 - details of control strategies additional to collection and flaring or utilisation (methane oxidation, , gas barriers). It should include measures to collect and control landfill gas where there is insufficient methane to support combustion;
- Gas utilisation and or flaring
 - details of the proposed management of landfill gas utilisation plant or flare;
 - operation, inspection and maintenance procedures;

Main technical guidance

- Guidance on the Management of Landfill Gas (see Reference 19);
- Additional Guidance on Hazardous Waste Sites (see Reference 24);
- Guidance on the Development and Operation of Landfill Sites (see Reference 12);
- Interim guidance on the use of geomembranes in landfill engineering (see Reference 26).

Supporting reference information

- Interim internal technical guidance for the best practice flaring of landfill gas (see Reference 29).

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Site infrastructure

2.3.4 Site infrastructure

Permanent and fixed elements of the site infrastructure should be designed, constructed and validated, following construction, to demonstrate that each part of the installation minimises the risks to air, land and water.

Application Form
Question 2.3 (cont.)

Describe the proposed installation infrastructure

With the Application, the Operator should:

1. Provide the proposed infrastructure design;
2. Provide Risk Assessments where this is agreed with the Regulator;
3. Identify any site specific issues and the proposed control systems.

Indicative BAT Requirements

1. The Landfill Permit shall state the requirements for landfill preparation, operation and monitoring including contingency plans
2. The Operator should describe the current or proposed site infrastructure and any provisions included to prevent or reduce any fugitive emissions to water, air or soil.
3. The Operator should justify where any of the measures are not employed and, where appropriate, set out the plans for improving the existing measures to meet the prescribed standards laid out above.
4. See [Sections 4.1, 2.3.1, 2.3.2 and 2.3.5](#) on landfill location, engineered control and leachate management and surface water management.

General techniques

Design

5. All relevant elements of the installation shall be design in accordance with recognised standards, methodologies and practices, and these processes must be documented to a level to provide an adequate audit trail.
6. Designs should be developed using a risk-based approach where appropriate.
7. Designs should consider:
 - the context of the element under consideration;
 - the purpose of the designed elements and the environments in which they are to be situated;
 - the selection of materials and products;
 - the design life of the elements;
 - operational and maintenance requirements;
 - health and safety issues.
8. Designs should be prepared to a sufficient level of detail, to allow them to be easily interpreted and constructed. Where possible construction should be carried out using commonly available techniques, and where this is not possible sufficient detail should be provided to allow alternative approaches to be considered.
9. Designs should be clearly set out using drawings and specification, supported by calculations (where appropriate) and method statements.

Cont.

BAT for site infrastructure:
[Landfill Directive Article 9](#)

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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Site infrastructure

BAT for site infrastructure: (cont.)

10. The timing of the installation and of the elements of the site infrastructure surface should be considered in the details submitted with the application. This is particularly important in respect to any temporary measures which may be implemented prior to installation of the permanent control systems.
11. The infrastructure elements specific to the management of the site includes the following:
 - Roads and hardstanding areas;
 - Wheel washing facilities;
 - Weighbridges;
 - Waste reception and storage areas;
 - Foul and surface water drainage systems;
 - Storage facilities for fuel and chemicals;
 - Services, e.g. power, water;
 - Site control offices;
 - Site security.
12. The Operator should justify where any of the measures are not employed with particular reference to Site Conditioning Plan requirements⁸. Designs should be prepared to meet the requirements as set out in [Section 4.1](#).
13. Appropriate measures should be provided to ensure adequate control of the reception, handling and storage facilities for the incoming waste and ancillary operations. This would include provision hardstanding areas, drainage systems and fuel or other storage facilities/areas.

Control structures

14. Consideration should be given to the following:
 - the sources, direction and destination of all installation drains and ditches should be established and recorded;
 - the sources, direction and destination of all subsurface pipework should be established and recorded;
 - all sumps and storage vessels should be identified;
 - systems should be engineered to ensure leakages from pipes etc. are minimised and where these occur, can be readily detected, particularly where hazardous (e.g. listed) substances are involved;
 - in particular, secondary containment and/or leakage detection should be provided for such subsurface pipework, sumps and storage vessels;
 - an inspection and maintenance programme should be established for all subsurface structures, e.g. pressure tests or CCTV.

Surfacing

15. Surfacing requirements are
 - a description of the design (#), construction and condition of the surfacing of all operational areas should be provided;
 - there should be an inspection and maintenance programme of all impervious surfaces and spill containment kerbs;
 - justification should be given where operational areas, (particularly those for waste reception and storage), have not been equipped with:
 - an impervious surface;
 - spill containment kerbs;
 - sealed construction joints;
 - connection to a sealed drainage system.

(# Relevant information may include as appropriate: capacities; thicknesses; falls; material; permeability; strength/reinforcement; resistance to chemical attack; inspection and maintenance procedures; and quality assurance procedures.)

Cont.

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/ abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Site infrastructure

BAT for site infrastructure (cont.)

Bunds

16. Bunds should be provided for all tanks containing liquids whose spillage could be harmful to the environment. Bunds should:
 - be impermeable and resistant to the stored materials;
 - have no outlet (i.e. no drains or taps) and drain to a blind collection point;
 - have pipework routed within bunded areas with no penetration of contained surfaces by pipes or ducts;
 - be designed to catch leaks from tanks, or fittings;
 - have a capacity of 110% of the largest tank or 25% of the total tankage, whichever is the greater;
 - be subject to regular visual inspection and any contents pumped out or otherwise removed under manual control after checking for contamination;
 - where not frequently inspected, be fitted with a high-level probe and an alarm as appropriate;
 - have fill points within the bund where possible or otherwise provide adequate containment;
 - have a routine programmed visual inspection of bunds including water testing where structural integrity is in doubt.
17. The Operator should justify where any of the measures are not employed with particular reference to Site Conditioning Plan requirements (see Reference 8). Designs should be prepared to meet the requirements as set out in [Section 4.1](#).
18. Designs should include method statements, specifications, calculations, risk assessments; details and drawings which assist in the management of the installation should also be evaluated.
19. If there is any doubt, the degree of detail required should be established in pre-application discussions.
20. There are no further issues identified for this sector.

Main technical guidance

- Additional Guidance on Hazardous Waste Sites ([see Reference 24](#));
- Guidance on the Development and Operation of Landfill Sites ([see Reference 22](#));
- Guidance on the Monitoring of Leachate, Groundwater and Surface Water under the Landfill Directive ([see Reference 18](#)).

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Surface water management

2.3.5 Surface water management

Operators should ensure they have a Surface Water Management Plan to control the production, collection and disposal of surface water so as to prevent pollution to the environment.

A surface water management system will also serve to minimise the production of leachate by controlling waters from precipitation and surface run-off from entering the waste body. This aspect of surface water management is covered in [Section 2.3.6](#).

During the aftercare phase a surface water management system will need to be incorporated into the final restored landform.

Application Form
Question 2.3 (cont.)

Describe the surface water management for the installation

With the Application, the Operator should:

1. Provide a Risk Assessment.
2. Provide the Surface Water Management Plan which should include the proposed surface water management system details and procedures (and any supporting details).
3. Identify any site specific issues and the proposed control systems.
4. Identify shortfalls in information or justifications for not using the above measures.

Indicative BAT Requirements

1. The Landfill Permit shall state the requirements for landfill preparation, operation and monitoring including contingency plans for groundwater monitoring.

Water control and leachate management

2. Appropriate measures shall be taken, with respect to the characteristics of the landfill and the meteorological conditions, in order to:
 - control water from precipitations from entering the landfill body
 - prevent surface water entering into the landfilled waste.

Protection of soil and water

3. A landfill must be situated and designed so as to meet the necessary conditions for preventing pollution of surface water.

4. The Operator should describe the current or proposed measures and procedures in place and proposed to prevent or reduce emissions to surface water. This should include, but is not limited to, the measures described below. The Operator should justify where any of the measures are not employed and, where appropriate, set out the plans for improving the existing measures to meet the prescribed standards laid out above.
5. See [Sections 4.1, 2.3.1 and 2.3.2](#) on landfill location, engineered control and leachate management.

Surface Water Management Plan

6. A Surface Water Management Plan should be developed to set out the proposed management techniques and measures, and should include the following:
 - the designs and CQA Plan;
 - water balance;
 - details of engineered systems;
 - collection methods and procedures;
 - pipework configurations and alignments;
 - details of the mechanical control systems;

Cont.

BAT for surface water management:
[Landfill Directive Article 9 and Annex I](#)

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Surface water management

BAT for surface water management (cont.)

- details of surface water treatment methods (where appropriate);
- details of surface water disposal and discharge methods and routes;
- associated operational techniques for surface water management bunds/cover/capping etc;
- temporary surface water management systems;
- details of system monitoring, during pre-operational, operational, closure and after care phases (volume, meteorological conditions and quality);
- details of the measures to be incorporated to ensure the segregation of surface water from contaminated waters;
- details of control strategies, including phasing of operations;
- operation, inspection and maintenance procedures;
- Surface Water Action Plan (to include trigger values and remedial actions).

Main technical guidance:

- Additional Guidance on Hazardous Waste Sites ([see Reference 24](#));
- Guidance on the Development and Operation of Landfill Sites ([see Reference 22](#));
- Guidance on the Monitoring of Leachate, Groundwater and Surface Water under the Landfill Directive ([see Reference 18](#));
- Interim guidance on the use of geomembranes in landfill engineering ([see Reference 26](#));
- Interim guidance on non-woven protector geotextiles for landfill engineering ([see Reference 27](#)).

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Waste discharge

2.3.6 Waste discharge and emplacement

Application Form
Question 2.3 (cont.)

Describe the proposed techniques and measures for waste discharge and emplacement

With the Application, the Operator should:

1. Identify the proposed methods and procedures for waste discharge and emplacement
2. Identify shortfalls in information or justifications for not using the above measures.

Indicative BAT Requirements

1. The emplacement of waste on the site shall take place in such a way as to ensure stability of the mass of waste and associated structures, particularly in respect of avoidance of slippages.
2. Waste should be discharged prior to placement in the appropriate operational areas, in a manner that prevent the releases, including dusts, litter and odour.
3. Waste should be placed in the appropriate operational areas, to ensure stable compacted wastes surfaces and slopes.

General techniques

4. Appropriate control measures will include:
 - Ensuring appropriate methods/procedures are in place to protect the abatement systems barriers/liners, monitoring and control structures for leachate and landfill gas within the site during waste discharge, placement and compaction.
 - Check that the first layers of waste are selected and inspected during placement to ensure that these do not cause damage to the installed barriers and liners.
 - Check that the final layers of waste are selected and inspected during placement to ensure that these do not cause damage to the final capping.
 - Use of appropriate handling and compaction plant and techniques.
 - Ensuring that wastes requiring specific disposal methods are handled in such a manner as not to give rise to unstable ground or surface conditions, odours, litter, dust or other nuisances.
 - Procedures and facilities to deal with the discharge of waste in adverse weather conditions which may give rise to the production of airborne materials such as litter or dust.
 - Defining the maximum and minimum gradients for the working face, intermediate slopes and the final slopes of the landform.
 - Planning the operations sufficiently in advance.
 - Defining the size of the operational area to accommodate the placement of waste.
 - The use of appropriate site procedures for the movement/transportation of waste, handling and compaction techniques.
 - Procedures to record and document incidents.
 - Ensure adequate communication between the waste reception area and the operational area of the landfill.

Main technical guidance

- Guidance on the Development and Operation of Landfill Sites ([see Reference 22](#));

BAT for waste discharge and emplacement
Landfill Directive Article 3, Annex I

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Abatement to air

2.3.7 Abatement of point source emissions to air

2.3.7.1 Nature of the emissions

The most significant emission to air from landfill operations will be that of landfill gas and the emissions associated with the treatment or use of this gas. However, there are also emissions associated with the operation of the landfill and these must be properly assessed and abated where necessary. The management of landfill gas is covered in [Section 2.3.3](#). In this section guidance is provided on the abatement of other air emission sources. Control of odour is covered in [Section 2.3.9](#).

Application Form
Question 2.3 (cont.)

Describe the proposed installation activities and the proposed techniques and measures to prevent and reduce arisings and emissions of substances and heat.

With the Application, the Operator should:

1. List the potential point source releases to air;
2. Describe the techniques for abating each release point;
3. Justify on BAT grounds the abatement techniques selected or proposed;
4. Quantify residual releases;
5. Identify any issues which may be critical.

Indicative BAT Requirements

1. The Operator should describe the measures in place and proposed to prevent or reduce point source emissions to air.

Guidance

2. Point source emissions, other than those associated with landfill gas, are not expected to be a significant issue in the landfill sector. They must however, be considered to ensure that an appropriate degree of environmental protection is provided, particularly with relation to prescribed substances.

Sources

3. The Operator should assess his process and list and analyse all emission sources to air. The most significant sources and guidance for their abatement include:
 - **Mobile plant used for emplacement and covering of the waste and pumps.** Although IPPC strictly applies only to stationary units, Operators would be expected, as a matter of good environmental practice and in accordance with environmental management system requirements to purchase and operate mobile plant with a high degree of environmental performance.
 - **Plant used to generate heat, steam or electricity at the site.** Where there is power or heat generation on site involving combustion other guidance may also be relevant.

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Abatement to air

2.3.8 Abatement of fugitive emissions to air

The most significant potential fugitive emission to air from landfill operations will be that of landfill gas and the emissions associated with the treatment or use of this gas. However, there are also emissions associated with the operation of the landfill and these must be properly assessed and abated where necessary. The management of landfill gas is covered in [Section 2.3.3](#). The prevention and control of odour is covered in [Section 2.3.9](#). In this section guidance is provided on the abatement of other air emission sources. This section also considers the release of aerosols.

Application Form	Describe the proposed installation activities and the proposed techniques and measures to prevent and reduce arisings and emissions of substances and heat.
Question 2.3 (cont.)	

With the Application, the Operator should:

- List the potential fugitive releases to air;
- Describe the techniques for preventing, minimising or abating each release point;
- Justify on BAT grounds the abatement techniques selected or proposed;
- Quantify residual releases;
- Identify any issues which may be critical.

Indicative BAT Requirements

- The Operator should describe the measures in place and proposed to prevent or reduce fugitive emissions to air.

Guidance

- Fugitive emissions may be more significant than point source emissions in the landfill sector. The management of fugitive emissions associated with landfill gas is addressed in [Section 2.3.3](#). Similarly the prevention and control of litter is addressed in [Section 2.3.11](#). Other possible sources of fugitive emissions and guidance for their abatement include:
 - Dust generation during vehicle movements.** Wheel and road cleaning (avoiding transferring pollution to water and wind) and damping sprays will significantly reduce emissions.
 - Dust generation during waste emplacement and covering.** Procedures for the emplacement and covering of waste should follow BAT as laid out in [Section 2.3.6](#) to minimise the generation and release of dusts.
 - Dust generation during landfill construction.** Procedures for the landfill construction as laid out in [Section 2.3.1](#) should aim to minimise the generation and release of dusts.
 - VOC releases from fuel storage.** Fuel should be stored in tanks with vent systems chosen to minimise breathing emissions, e.g. pressure/vacuum valves.

Aerosols

- Sources of aerosols released to air, include:
 - Leachate **recirculation**: there are several methods of leachate recirculation, but some techniques involve spraying the leachate over the top of the waste;
 - odour abatement**: most odour control system work by mixing a concentrated odour masking or abatement solution with water and spraying as aerosol around the source of the odour.

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Odour

2.3.9 Odour

The objectives of PPC and LFD are complementary with respect of odour and can be summarised as being to prevent harm in the form of offence to man's senses, or annoyance.

Odour is typically associated with trace components in landfill gas, the handling of odorous wastes and inadequate emplacement and covering of biodegradable wastes. Given the fugitive nature of odour emissions, emphasis should be given to preventative measures relating to landfill gas management (see [section 2.3.3](#)) and waste acceptance and emplacement (see [sections 2.2.1 and 2.3.6](#)).

Application Form
Question 2.3 (cont.)

Describe the main activities generating odour and/or sources of odour, the location of the nearest odour-sensitive receptors, describe any relevant environmental surveys which have been undertaken and the techniques for controlling odorous emissions.

With the Application, the Operator should provide:

1. *Information relating to sensitive receptors*
 - Type of receptor, location relative to the odour sources and, where undertaken, describe the findings of any assessment of the impact of odorous emissions on the receptors.
 - Details of any routine monitoring undertaken to assess odour exposure of receptors
 - An overview of any complaints received, what they relate to (source or particular operation) and remedial action taken.
 - A description or copy of any conditions or limits put in place by any regulatory authority which relate to the receptors (e.g. relating boundary fence or beyond)
2. *A description of the types of odorous substances deposited/disposed of and generated (intentional and fugitive (unintentional));*
 - wastes have to be treated before landfill, which in turn should limit wastes which are inherently odorous.
 - the description should make the distinction between wastes which are inherently odorous where the impact is likely to be more immediate and those wastes which may give rise to odour because of microbiological action in the landfill (organic or inorganic).
3. *A description of the point, linear or area sources of release.*
4. *A structured odour management plan including:*
 - Control measures to prevent or control odour.
 - A demonstration/justification that there will not be an odour problem from the emissions under normal conditions.
 - A description or copy of any conditions or limits put in place by any regulatory authority which relate to the prevention of minimisation of odour.
 - Identification of the actions to be taken in the event of abnormal events or conditions which might lead to odour, or potential odour problems.
 - An understanding of the impact in the event of abnormal events or conditions, for example the failure of a landfill gas flare. This may require modelling the dispersion of odours under such circumstances.
 - Monitoring undertaken.
 - Communication with for example local residents if an odour problem arises or is likely to arise.

Indicative BAT Requirements

1. Measures will be taken to minimise nuisances and hazards arising from the landfill through emissions of odours.
2. Where a landfill operation has a low environmental impact with respect to odour (for example by virtue of its remoteness from sensitive receptors), the Operator may seek to justify in accordance with BAT criteria (see [section 1.1](#)), deviation from measures stated in this section.

BAT for the control of odour

Landfill
Directive Article
9(c), 12 (b)
Annex I (5)

Cont.

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Odour

3. In order to reduce the release of odorous compounds and their impact at sensitive receptors, the minimisation of odour should be considered in relation to:
 - the types of wastes;
 - site layout;
 - engineering aspects of the operation;
 - management procedures;
 - and the day-to-day operational practices.
4. A regular odour impact assessment should be undertaken. The impact assessment should cover a range of reasonably foreseeable odour generation and receptor exposure scenarios and the effect of different mitigation options. Assessment should include point sources (for example vents and flares) as well as linear or area sources (tipping faces, cracks in the cap etc.).

Odour control techniques – good practice

The following landfill-specific techniques should be used to prevent or minimise odorous releases from the site. Odour control is not a once-off activity and requires a constant re-evaluation of control techniques and this should form part of the odour management plan.

5. Waste Acceptance
 - materials which promote the generation of gases should be excluded. For example, wastes with a high sulphate or sulphide content should be excluded.
 - co-ordination between the gatehouse and operators at the tipping face should take place where known odorous wastes are to be deposited.
 - excavation of waste or removal of cover during for example the installation of gas wells, or for other operational needs, may give rise to odours,
6. Covering of wastes.
 - Tipping areas should be kept as small as possible to minimise the effects of wind.
 - Waste must be covered as soon as possible.
 - On areas of intermediate capping, the degree of capping should be sufficient to prevent the possible release of odours. After the initial tipping and compacting it is likely that the odours will tend to become more characteristic of anaerobic degradation/landfill gas. This phase should coincide with an increase in gas abstraction capacity (see [section 2.3.3](#))
7. Landfill Gas management
 - Certain odorous trace compounds in landfill gas have low odour thresholds. These include organo-sulphur compounds, cyclic compounds, aromatic hydrocarbons, esters and carboxylic acids, which derive from microbial interactions.
 - An effective landfill gas management plan (see [Section 2.3.3](#)) in conjunction with good operational practice (i.e. not leaving odorous waste uncovered) will significantly prevent such releases. Providing full containment of the waste, including temporary and/or phased capping of the site, in addition to incorporating an active landfill gas control system are essential gas control measures. Point source emissions such as those from landfill gas flares should be considered in the selection and assessment of the control system.
 - Landfill gas control systems are not expected to generate significant point source emissions if well constructed, operated and maintained.
 - Passive venting during the early operational stages may give rise to odours and active extraction systems should be installed to minimise the release of uncontrolled landfill gas emissions. The passive venting time period should be minimised.
8. Leachate management
 - Odour from a leachate treatment plant should, in most cases, be manageable to prevent offensive odours beyond the boundary of the site. An enclosed treatment operation is desirable where the proximity of the operation to receptors is likely to cause nuisance.
 - Leachate sumps/wells should be effectively sealed (retaining access for monitoring and maintenance) or extracted to abatement equipment.

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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9. Monitoring
- *Standard*
 - Recording or gathering of weather conditions, for example atmospheric pressure and stability (inversions), rainfall, wind speed and direction and air temperature.
 - Checks on gas abstraction rates, integrity of pipe-work and other relevant infrastructures, filters, adequacy of capping etc should form part of monitoring or periodic inspection by trained persons
 - *Reactive*
 - Olfactory "sniff testing" at the boundary or at some location which is representative of sensitive receptors.
 - Collection and analysis of air samples to identify odour sources.

Main technical guidance

- *Odour Assessment and Control – Guidance for Regulators and Industry* (see Reference 30).
- Interim Guidance on the Flaring of Landfill Gas (see Reference 29);
- Guidance on the Management of Landfill Gas (see Reference 19);
- IPPC General Guidance on Odour (see Reference 31).

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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Birds, vermin & insects

2.3.10 Birds, vermin and insects

Application Form Question 2.3 (cont.) Describe the proposed techniques and measures to prevent and control birds, vermin and insects

With the Application, the Operator should:

1. Provide information on the potential impact of birds, vermin and insects, identifying any specific local issues, provide the proposed preventative and control measures for the abatement of nuisance from birds, vermin and insects at the landfill. This should include a monitoring plan.

Indicative BAT Requirements

1. Measures must be taken to minimise nuisances and hazards arising from the landfill through birds, vermin and insects.

General techniques

2. The following techniques should be considered, but may not be limited to the following:
 - adequate compaction during waste emplacement, ensuring rapid waste emplacement;
 - use of bird abatement techniques such as intermittent gas cannons, pre-recorded distress calls, kites, helium balloons, birds of prey. Such techniques may be rendered ineffective due to habituation and therefore a selection of techniques should be used accordingly to ensure their individual effectiveness;
 - placement of daily cover material if necessary;
 - use of intermediate cover, as required;
 - ensuring previously employed waste is not disturbed, exposed or moved;
 - regular visual inspections of the site;
 - regular visits by pest control contractors.

Other considerations

3. Where the landfill is in the vicinity of an aerodrome (as defined by the Civil Aviation Authority (CAA)) there may be a requirement from the CAA or the Ministry of Defence to ensure adequate means of bird control. In such cases the use of totally enclosed netting systems should be considered at the time of the application should a Risk Assessment indicate.
4. All wild birds and their nests and eggs are protected under the Wildlife and Countryside Act 1981. Therefore no lethal action should be embarked on without taking into account the Wildlife and Countryside Act 1981.

Main technical guidance

- Guidance on the Development and Operation of Landfill Sites (see Reference 22);
- Additional Guidance on Hazardous Waste Sites (see Reference 24);
- Guidance on the Waste Treatment Requirements of Article 6a of the Landfill Directive (see Reference 14);
- Guidance for Operators on Preparing a Landfill Site Conditioning Plan (see Reference 8);
- Aerodrome Bird Control (CAP 680) (see Reference 32).

BAT for the control of birds, vermin and insects
Landfill Directive Articles 9(c) Annex I (5)

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Control of litter

2.3.11 Prevention and control of litter

Application Form
Question 2.3 (cont.)

Describe the proposed the proposed techniques and measures to prevent litter.

With the Application, the Operator should:

1. Provide a litter risk assessment detailing prevailing winds and potential receptors and identifying any particular local issues;
2. provision of a litter management plan and action plan.

Indicative BAT Requirements

1. Measures must be taken to minimise nuisances and hazards arising from the landfill through wind blown materials.
2. Measures should be incorporated to prevent litter escaping from the site, to prevent harmful accumulations within the site with respect to pollution control systems and to prevent serious visual detriment to the local amenity.

General techniques

3. Measures to minimise nuisances and hazards arising from the landfill through litter may include, but are not limited to, the following:
 - consideration of prevailing wind direction and strength and the proximity of receptors when designing the filling development and sequence, this may require a risk assessment approach;
 - instructions to ensure incoming waste remains sheeted, until immediately prior to emplacement;
 - installation of permanent and mobile litter fences around the active area;
 - provision of an emergency tipping area to allow discharge of light waste within a secure litter enclosure during adverse weather; this may be a permanent fixture or mobile;
 - consideration should be given to the installation of temporary bunds immediately adjacent to tipping area;
 - adequate compaction during waste emplacement;
 - adequate plant on active phase for placement, compaction and covering of waste;
 - ensuring the adequate supply of daily and intermediate cover material; this may include soil, hessian sheeting or other appropriate material;
 - daily meteorological monitoring, as described in [Section 2.10](#), as part of the daily and weekly operations;
 - regular inspections and collection of litter around the site boundary and beyond; specifically, ditches, haul roads, water courses;
 - deployment of additional temporary personnel to collect litter, as deemed necessary from inspections and monitoring;
 - instructions to ensure the full discharge of a vehicle discharging waste at the site, to prevent any waste retained in the vehicle after tipping being subsequently released;
 - closure of site to specific or all waste types during adverse weather conditions.

Main technical guidance

- Guidance on the Development and Operation of Landfill Sites ([see Reference 22](#));
- Guidance for Operators on Preparing a Landfill Site Conditioning Plan ([see Reference 8](#));
- IPPC General Guidance on litter ([see Reference 33](#)).

BAT for the prevention and control of litter
Landfill Directive Annex I, Article 9(c)

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials inputs	Activities/abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation issues

Control of dirt and mud

2.3.12 Prevention and control of dirt and mud

Application Form
Question 2.3 (cont.)

Describe the proposed techniques and measures to prevent and control dirt and mud.

With the Application, the Operator should:

1. Provide details of the measures you intend to provide for your site to ensure that dirt originating from the site is not dispersed onto public roads and the surrounding land.

Indicative BAT Requirements

1. Measures shall be provided to ensure that dirt originating from the site is not dispersed onto public roads and the surrounding land;

- provision and maintenance of hardcored or otherwise hard surfaced site roads;
- sufficient run off on surfaced site roads prior to any wheel wash facilities;
- provision and maintenance (e.g. regular water changes for wet systems) of wheelwash equipment;
- supervision of the use of wheelwash to ensure that vehicles use the equipment correctly;
- monitoring of site road between final wheel wash and public roads;
- monitoring of public roads'
- use of road sweepers on all metalled site roads.

Main technical guidance

- Guidance on the Development and Operation of Landfill Sites ([see Reference 22](#)).

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials Inputs	Activities/ abatement	Ground water	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation Issues

Groundwater

Groundwater protection legislation

2.4 Emissions to Groundwater

The Groundwater Regulations for the UK came into force on 1 April 1999. APPC Permit will be subject to the following requirements under these Regulations.

- i. It shall not be granted at all if it would permit the direct discharge to groundwater of a List I substance (Regulation 4(1)) (except in limited circumstances – see note 1 below).
- ii. If the Permit allows the disposal of a List I substance or any other activity which might lead to an indirect discharge to groundwater (see note 2 below) of a List I substance then **prior investigation** (as defined in Regulation 7) is required and the Permit shall not be granted if this reveals that indirect discharges of List I substances to groundwater would occur and in any event conditions to secure prevention of such discharges must be imposed (Regulation 4(2) and (3)).
- iii. In the case of List II substances, Permits allowing direct discharges or possible indirect discharges cannot be granted unless there has been a prior investigation and conditions must be imposed to prevent groundwater pollution (Regulation 5).
- iv. The Regulations contain further detailed provisions covering **surveillance** of groundwater (Regulation 8); conditions required when direct discharges are permitted (Regulation 9); when indirect discharges are permitted (Regulation 10); and review periods and compliance (Regulation 11).

The principles, powers and responsibilities for groundwater protection in England and Wales, together with the Agency's policies in this regard, are outlined in the Environment Agency's document "*Policy and Practice for the Protection of Groundwater*" (PPPG)³⁴. This outlines the concepts of vulnerability and risk and the likely acceptability from the Agency's viewpoint of certain activities within groundwater protection zones. Guidance on the Hydrogeological Risk Assessment for Landfills and the Derivation of Groundwater Trigger Levels²⁵ (in preparation) explains the assessment of the risk to groundwater that will be required under the **Prior Investigation** and provides information on terms such as **Prior Investigation, Requisite Surveillance and Permanently Unsuitable for other uses**.

Note 1 The Regulations state that, subject to certain conditions, the discharges of List I substances to groundwater may be authorised if the groundwater is "permanently unsuitable for other uses". Advice must be sought from the Regulator where this is being considered as a justification for such discharges.

Note 2 List I and List II refer to the list in the Groundwater Regulations and should not be confused with the similar lists in the Dangerous Substances Directive.

Application Form Question 2.4 **Identify if there may be a discharge of any List I or List II substances and if any are identified, explain how the requirements of the Groundwater Regulations 1998 have been addressed.**

With the Application the Operator should:

- 1. Confirm that no direct or indirect emissions to groundwater of List I or List II substances are likely from the installation, or
- 2. Where there are such releases, provide the information, the risk assessment (having agreed the input parameters previously with the Agency) and surveillance arrangements to be provided.

Under these Regulations the Permit may not be granted if the situation is not satisfactory, therefore, with the application, the Operator should supply information on list I and list II substances and if necessary, prior investigation and surveillance information:

Meeting the requirements of the Groundwater Regulations

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Groundwater

List I and List II substances in the Groundwater Regulations

List I

- 1.-(1) Subject to sub-paragraph (2) below, a substance is in list I if it belongs to one of the following families or groups of substances:
 - (a) organohalogen compounds and substances which may form such compounds in the aquatic environment;
 - (b) organophosphorus compounds;
 - (c) organotin compounds;
 - (d) substances which possess carcinogenic, mutagenic or teratogenic properties in or via the aquatic environment (including substances which have those properties which would otherwise be in list II);
 - (e) mercury and its compounds;
 - (f) cadmium and its compounds;
 - (g) mineral oils and hydrocarbons;
 - (h) cyanides.
2. A substance is not in list I if it has been determined by the Regulator to be inappropriate to list I on the basis of a low risk of toxicity, persistence and bioaccumulation.

List II

- 1.-(1) A substance is in list II if it could have a harmful effect on groundwater and it belongs to one of the families or groups of substances:
 - (a) the following metalloids and metals and their compounds:

Zinc	Tin	Copper
Barium	Nickel	Beryllium
Chromium	Boron	Lead
Uranium	Selenium	Vanadium
Arsenic	Cobalt	Antimony
Thallium	Molybdenum	Tellurium
Titanium	Silver	
 - (b) biocides and their derivatives not appearing in list I;
 - (c) substances which have a deleterious effect on the taste or odour of groundwater, and compounds liable to cause the formation of such substances in such water and to render it unfit for human consumption;
 - (d) toxic or persistent organic compounds of silicon, and substances which may cause the formation of such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances;
 - (e) inorganic compounds of phosphorus and elemental phosphorus;
 - (f) fluorides;
 - (g) ammonia and nitrites
- (2) A substance is also in list II if:
 - (a) it belongs to one of the families or groups of substances set out in paragraph 1(1) above;
 - (b) it has been determined by the Regulator to be inappropriate to list I under paragraph 1(2); and
 - (c) it has been determined by the Regulator to be appropriate to list II having regard to toxicity, persistence and bioaccumulation.
- 3.-(1) The Secretary of State may review any decision of the Regulator in relation to the exercise of its powers under paragraph 1(2) or 2 (2).
- 3.-(2) The Secretary of State shall notify the Regulator of his decision following a review under sub-paragraph (1) above and it shall be the duty of the Regulator to give effect to that decision.
- 4.- The Regulator shall from time to time publish a summary of the effect of its determinations under this Schedule in such manner as it considers appropriate and shall make copies of any such summary available to the public free of charge.

Hazardous waste landfills have the potential to contain both List I and List II substances, depending on the nature of the landfilled hazardous waste. The leachate from most non-hazardous waste landfills is likely to contain List II substances. The most likely List I substances include mercury, cadmium, mineral oils and hydrocarbons and herbicides (i.e. Mecoprop).

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2.5 Handling Wastes Produced by Landfill

This Section deals with waste produced as a result of the operational phase of the landfill site (N.B. the handling of incoming landfill waste is considered in [Section 2.3.6](#)). Rejected wastes are not considered in this section since the procedure for waste rejection is detailed in [Section 2.2.3](#). Waste arisings from the construction of the site (e.g. cut-offs from geomembrane, packaging materials, wastes from on-site offices, etc.) would normally be deposited on site. As they are not removed off site consideration of such material is not addressed further in this section.

Application Form
Question 2.5

Characterise and quantify each waste stream and describe the proposed measures for waste management storage and handling.

With the Application, the Operator should:

1. Identify and quantify the likely waste streams;
2. Identify the proposed handling arrangements;
3. Identify shortfalls in information or justifications for not using the above measures.

Indicative BAT Requirements

Wastes from on-site facilities

1. On-site facilities at landfills can vary from temporary portable cabins to established buildings containing regional offices, mess-rooms, laboratories, wash/shower rooms and workshops and housing several personnel. Waste from such premises may include, but is not limited to the following:
 - general office waste, e.g. waste paper;
 - waste food-stuffs and associated packaging;
 - laboratory wastes, e.g. unused chemicals, empty containers, waste samples;
 - wastes associated with manual work undertaken at the site, e.g. packaging for parts, oily rags, empty containers, used oil, etc;
 - other wastes associated with the operation of the site, including abatement, monitoring or treatment, not considered above (other than the containment system), e.g. empty containers, disposable PPE, etc.

Some of the above wastes may be directly disposed of at the landfill. However, under the LFD co-disposal is prohibited (from July 2004) and therefore the Operator must ensure that the type of waste can be accepted at the landfill. Certain wastes from facilities at hazardous landfills would have to be taken to non-hazardous sites and vice versa. Particular attention should be undertaken when disposing of chemical waste.

3. As with all installations, recycling should be undertaken wherever possible, this could include paper recycling, can and glass recycling or re-use of containers, where applicable.
4. Depending on the expected operational life of the landfill installation, the on-site facilities are likely to be connected to the mains sewer, where applicable, or septic tank. With the latter, a suitable system should be installed that is contained and is relatively easy to remove following the closure of the site, to enable surrender of the Permit.
5. Waste should be stored in suitable containers. For laboratory wastes this may include the requirement to store wastes in suitable containers marked accordingly.

Cont.

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General Techniques for Quantification, Storage and Handling

6. General techniques include the following:
- A system should be maintained to record the quantity, nature, origin and where relevant, the destination, frequency of collection, mode of transport and treatment method of any waste which is disposed of or recovered (this should already be available as part of Waste Management Licence).
 - Wherever practicable, waste should be segregated and the disposal route identified which should be as close to the point of production as possible.
 - Records should be maintained of any waste sent off-site (Duty of Care).
 - Storage areas should be located away from watercourses and sensitive boundaries, e.g. adjacent to areas of public use, and protected against vandalism.
 - Storage areas should be clearly marked and signed and containers should be clearly labelled.
 - The maximum storage capacity of storage areas should be stated and not exceeded. The maximum storage period for containers should be specified.
 - Appropriate storage facilities should be provided for special requirements such as for substances that are flammable, sensitive to heat or light etc., and incompatible waste types should be kept separate.
 - Containers should be stored with lids, caps and valves secured and in place. This also applies to emptied containers.
 - Storage containers, drums etc. should be regularly inspected.
 - Procedures should be in place to deal with damaged or leaking containers.
 - All appropriate steps to prevent emissions (e.g. liquids, dust, VOCs and odour) from storage or handling should be taken.

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2.6 Waste Recovery or Disposal

Waste produced by the landfill, as described in [Section 2.5](#), will require recovery or disposal. Most of the waste streams will require disposal since recovery is not applicable. However, the application for a PPC Permit requires the Applicant to explain why the recovery of the waste streams characterised in Question 2,5 is technically and economically impossible.

Application Form Question 2.6 *Describe how each waste stream is proposed to be recovered or disposed of; and if you propose any disposal, explain why recovery is technically and economically impossible and describe the measures planned to avoid or reduce any impact on the environment.*

With the Application, the Operator should:

1. Identify the proposed disposal or recovery arrangements;
2. Describe the proposed position with regard to all of the above measures;
3. Identify shortfalls in information or justifications for not using the above measures.

Indicative BAT Requirements

Leachate recovery or disposal

1. Leachate as defined by Section 2.5, is not considered a waste until it is discarded by the Operator. However, the applicant should describe the proposed methods for the disposal of leachate. The disposal method may depend on the quantity of leachate generated and whether an on-site treatment facility is installed. Leachate treated to a standard permitted by the discharge consent and agreed with the Regulator can be discharged to sewer. Untreated leachate will require tankering off site and the proposed technique for the recovery of leachate and transferring into the tankers should be described. Methods for the recirculation and treatment of leachate is not required in the Applicant's response to Question 2.6, since this should have previously been addressed in Question 2.3. There is nothing to suggest that is technically or economically viable to recover leachate.

Waste from on-site facilities

2. As with any office or other workplace, there are measures that should be taken in order to minimise the volume of waste being disposed and to maximise the volume that is recovered or recycled. Applicants should describe the proposed techniques for recycling of waste streams, where possible. It is not likely that there will be waste streams which can be recovered or reused within the facilities.

General

3. The Regulator is required, in setting Permit conditions, to take account of certain general principles including that the installation in question should be operated in such a way that "waste production is avoided in accordance with Council Directive 75/442/EEC on waste; and where waste is produced it is recovered, or where this is technically or economically impossible it is disposed of, while avoiding or reducing the impact on the environment". The objectives of the National Waste Strategies should also be considered.
4. In order to meet this requirement the Regulator needs Operators to describe, in respect of each waste stream produced by the installation, whether the waste in question is to be recovered or disposed of, and if a disposal option is planned, to justify why recovery is "technically and economically impossible" together with "the measures planned to avoid or reduce any impact on the environment".
5. Whether waste disposal is likely to be restricted by the implementation of the LFD should also be considered.
 - The Operator should demonstrate that the chosen routes for recovery or disposal represent the best environmental option
6. It should be noted that landspreading will take place under the Waste Management Licensing Regulations 1(3) and 17 Schedule 3 para 7 and the Operator should have a plan and justification for this use (see also MAFF good practice guides). (For Northern Ireland the Codes of Practice are issued by the Department of Agriculture and Rural Development (DARD).)

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2.7 Energy

Energy efficiency is not covered by the LFD. The landfill sector is not considered to be a significant energy user and the opportunity for significant energy efficiency is limited.

BAT for energy efficiency under the PPC Regulations will be satisfied provided the Operator meets the basic energy requirements below.

Further guidance is given in the Energy Efficiency Guidance Note (see Reference 35).

Application Form Question 2.7 - **Provide a breakdown of the energy consumption and generation by source, the associated environmental emissions and describe the proposed measures for energy efficiency.**

The requirements of this section are basic, low cost, energy standards.

With the Application the Operator should:

1. Provide the following Energy consumption information:

Energy consumption information should be provided in terms of delivered energy and also, in the case of electricity, converted to primary energy consumption. For the public electricity supply, a conversion factor of 2.6 should be used. Where applicable, the use of factors derived from on-site heat and/or power generation, or from direct (non-grid) suppliers should be used. In the latter cases, the Applicant shall provide details of such factors. Where energy is exported from the installation, the Applicant should also provide this information. An example of the format in which this information should be presented is given in Table 2.1 below. (Note that the Permit will require energy consumption information to be submitted annually)

Energy source	Energy consumption		
	Delivered, MWh	Primary, MWh	% of total
Electricity*			
Gas			
Oil			
Other (Operator to specify)			

* specify source.

2. Provide associated environmental emissions (this is dealt with in the Operator's response to Section 3.1.)
3. Describe the current or proposed position with regard to the basic, low cost energy requirements.

Indicative BAT Requirements

1. Operating, maintenance and housekeeping measures should be in place
2. Basic, low cost, physical techniques should be in place to avoid gross inefficiencies;
3. Provide an energy efficiency plan which identifies all techniques relevant to the installation and the extent to which these have been employed.

BAT for energy

Table 2.1 - Example breakdown of delivered and primary energy consumption

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2.8 Accidents and their Consequences

IPPC requires as a general principle that necessary measures should be taken to prevent accidents that may have environmental consequences and to limit those consequences. This section covers general areas of any installation operations, which have the potential for accidental emission. General management requirements are covered in [Section 2.1](#). For accident management, there are three particular components:

- **identification of the hazards** posed by the installation/activity;
- **assessment of the risks** (hazard x probability) of accidents and their possible consequences;
- implementation of **measures to reduce the risks** of accidents, and contingency plans for any accidents that occur.

Application Form
Question 2.8

Describe your documented system proposed to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

With the Application the Operator should:

1. Describe the current or proposed position with regard to all of the measures below;
2. Identify shortfalls in information or justifications for not using the measures below;
3. Identify any issues which may be critical.

Indicative BAT Requirements

1. The landfill shall be operated in such a manner that the necessary measures are taken to prevent accidents and limit their consequences
2. A structured accident management plan should be submitted to the Regulator which should:
 - a. **identify the hazards** to the environment posed by the installation. Particular areas to consider may include, but should not be limited to, the following:
 - transfer of incoming waste for disposal and substances (e.g. loading or unloading from or to tanks / lagoons);
 - release of leachate;
 - uncontrolled migration of landfill gas;
 - fire;
 - explosion (mixing of incompatible wastes);
 - slippage;
 - overfilling of tanks / lagoons;
 - failure of plant and/or equipment (e.g. over pressure of vessels and pipework, blocked drains);
 - failure of containment (e.g. bund and or overfilling of drainage sumps);
 - failure to contain firewater;
 - making the wrong connections in drains or other systems;
 - preventing incompatible substances coming into contact;
 - emission of an effluent before adequate checking of its composition has taken place;
 - vandalism.

Cont.

BAT for prevention and control of accidents

Landfill Directive
Article 9

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BAT for control of accidents (cont.)

- b. Assess the risks** - having identified the hazards, the process of assessing the risks can be viewed as addressing six basic questions:
1. what is the estimated probability of their occurrence? (Source frequency);
 2. what gets out and how much? (Risk evaluation of the event);
 3. where does it get to? (Predictions for the emission – what are the pathways and receptors?);
 4. what are the consequences? (Consequence assessment – the effects on the receptors);
 5. what are the overall risks? (Determination of the overall risk and its significance to the environment);
 6. what can prevent or reduce the risk? (Risk management – measures to prevent accidents and/or reduce their environmental consequences).

The depth and type of assessment will depend on the characteristics of the installation and its location. The main factors which should be taken into account are:

- the scale and nature of the accident hazard presented by the installation and the activities;
- the risks to areas of population and the environment (receptors);
- the nature of the installation and complexity or otherwise of the activities and the relative difficulty in deciding and justifying the adequacy of the risk control techniques.

c. Identify the techniques necessary to reduce the risks including:

The Operator should:

1. Identify possible hazards and consequences;
2. Identify safeguards; and
3. Define contingency plans.

The Operator should describe techniques to prevent accidents and minimise their environmental consequences including, but not limited to, the techniques described below.

N.B. This section has a significant overlap with Section 2.3, which describes the main activities and abatement techniques used in the landfill sector.

Example hazards and safeguards/contingency plans for landfill installations are:

- Incoming landfill waste acceptance procedures to identify wastes which are not suitable for disposal at the landfill.
- Prevention of spillages - installation of containment bunds around storage tanks (i.e. fuel, etc.) to a minimum required capacity.
- Personnel training and clear guidance on specific accident scenarios (e.g. extinguish fires or allow them to burn).
- Leachate treatment:
 - The Operator should have identified the major risks associated with the leachate treatment plant and have in place, and supply copies with the application, procedures which minimise the risks and which deal with these events if they occur, including reducing load if necessary.
- Contamination of surface waters by runoff from waste storage areas:
 - Storage in specified areas on impermeable pavement, with sealed drainage system. Limit on maximum storage times to reduce potential for biodegradation. Storage of unsorted wastes within enclosed building or of segregated wastes in enclosed containers;
 - Storage in specified areas on impermeable pavement, with sealed drainage system;
 - Storage in specified areas on hardstanding.
- Fire:
 - Prevent hot or smouldering waste from placement in the landfill. Add water to smouldering/hot waste prior to disposal or allow to cool prior to placement;
 - No smoking to be allowed on the site unless in designated areas;
 - Plant to have automated fire protection equipment and the required fire prevention to be available across the site, including any on-site facilities;

Cont.

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- Ensure that a system of hot work Permits is in place and ensure that such work is carried out away from landfill gas vents;
- Ensure effective landfill gas control to prevent ingress of air into the gas management system.
- Contamination of surface water, or breach of leachate/surface water discharge consent limits:
 - Implementation of waste acceptance and control systems, including assessment of wastes prior to delivery, on site inspection and waste handling protocols.
- Slope Stability:
 - Placing waste in layers and ensure procedures are in place to check waste is stable;
 - Ensure large objects crushed and void space is minimised;
 - Ensure waste is not placed on slopes with an incline greater than 30% if possible;
 - Ensure plant being used to compact the waste is consistent with the compaction requirements.
- Release of dust (fume) beyond the installation boundary:
 - Undertake operations involving commercial, industrial and unsorted wastes within enclosed building, with ventilation. Implementation of dust suppression measures including water sprays/sprinkler systems.
- Security
 - installation of security systems to prevent unauthorised access, damage and vandalism;
 - gates to be locked outside operating hours.
- Illegal dumping
 - system of control in place to detect and discourage illegal dumping in the site.

Main technical guidance

- Guidance on the Development and Operation of Landfill Sites ([see Reference 22](#)).

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2.9 Noise and Vibration

The objectives of PPC and LFD are complementary with respect of noise and vibration and can be summarised as being to prevent harm in the form of offence to man's senses, or annoyance.

Application Form
Question 2.9

Describe the main sources of noise and vibration (including infrequent sources); the nearest noise sensitive locations and relevant environmental surveys which have been undertaken; and the proposed techniques and measures for the control of noise.

With the Application the Operator should:

1. **Identify the main sources of noise and vibration** that fall within the boundary of the landfill, providing the following information for each source (for example – vehicle, landfill gas utilisation):
 - whether continuous or intermittent;
 - the type of emission – aural or vibrational – and its characteristics (e.g. impulsive, tonal elements or other distinguishing feature such as clatter, hiss, screech),
 - the hours of operation;
 - its contribution to overall site noise emission (categorise each as high, medium or low if there is no available supporting numerical data);
 - the location of fixed plant within the installation on a scaled map (where appropriate this can be combined with the requirement in (3) below to identify sensitive receptors); and
 - The type of mobile plant including all vehicles, earthmovers, crushers, screens etc. and their areas of operation, including haul roads and disposal areas.

A common sense approach needs to be adopted in determining which sources to include. The ones which need to be considered are those which may have an impact on the local environment and lead to annoyance.

2. **Infrequent sources of noise and vibration** not included above, (such as infrequently operated/seasonal operations, cleaning/maintenance activities, on-site deliveries/collections/transport or out-of-hours activities, emergency generators, alarms and reversing beepers). Provide the information as required for main sources in (1), above, for each infrequent source. (Horizontal Noise Guidance H3, Part 1, Section 2.2 gives guidance on which sources should be included).
3. **Identify the noise-sensitive sites** and receptors (typically dwellings, parkland and open spaces which are regularly used by the public – schools, hospitals and commercial premises may be, depending upon the activities undertaken there) and any other points/boundary where conditions have been applied by Local Authority officers or as part of a planning consent, relating to:
 - (a) the local environment:
 - provide an accurate map or scaled plan showing grid reference, nature of the receiving site, distance and direction from the landfill boundary. The location of existing or proposed noise barriers should also be included.
 - (b) conditions/limits imposed which relate to other locations (i.e. boundary fence or surrogate for nearest sensitive receptor):
 - any planning conditions imposed by the Local Authority relating to noise and vibration;
 - other conditions imposed by agreements, e.g. limits on operating times, technologies etc;
 - any requirements of any legal notices etc relating to noise and vibration; and
 - any complaints that have been received within the past 3 years and the outcome of any investigations into those complaints.
 - (c) the noise environment:
 - background noise level, if known (day/night/evening) $L_{A,90,T}$;
 - specific noise level (day/evening/night) $L_{A,eq,T}$; and/or
 - ambient noise level (day/evening/night) $L_{A,eq,T}$, as appropriate;
 - vibration data which may be expressed in terms of the peak particle velocity (ppv) in $mm\ s^{-1}$ or the vibration dose value (VDV) in $m\ s^{-1.75}$.

The noise sensitive sites may not always be the nearest to the landfill. Parklands and open spaces etc may be noise sensitive by virtue of their use for leisure or similar activities, or if they are designated Sites of Special Scientific Interest or similar.

Information needed to determine BAT for noise and vibration (cont.)

Cont.

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For noise the terms above are given the meaning as defined in BS4142:1997 "Method for rating industrial noise affecting mixed residential and industrial areas", and to which reference should be made for a full description. For vibration, the appropriate standard is BS6472:1992 "Evaluation of human exposure to vibration in buildings "1 to 80 Hz". In very general terms "background" is taken to be the equivalent continuous A-weighted noise remaining when the source under investigation is not operational, averaged over a representative time period, T. The "ambient" level is the equivalent continuous A-weighted combination of all noise sources far and distant, including the source under investigation and "specific noise" is the equivalent continuous A-weighted noise level produced by the source under investigation as measured at a selected assessment point. Both are averaged over a time period, T. BS4142: 1997 gives advice on the appropriate reference periods. **"Worst case" situations and impulsive or tonal noise should be accounted for separately and not "averaged out" over the measurement period.** The Horizontal Noise Guidance Part 2 gives advice on how to determine background noise levels..

4. **Details of any environmental noise measurement surveys**, noise modelling work or any other noise measurements undertaken relevant to the environmental impact of the landfill, identifying:
 - the purpose/context of the survey;
 - the locations where measurements were taken;
 - the source(s) investigated or identified; and
 - the outcomes.
5. Identify any specific local issues and proposals for improvements.
6. Describe the current or proposed position with regard to the techniques below, any in (Part 2 of this note), or any others which are pertinent to the landfill.
7. Demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements, by justifying departures (as described in Section 1.2 and in the A1 Guide for Applicants) or alternative measures;

Indicative BAT Requirements

1. Measures shall be taken by the Operator to minimise nuisances and hazards arising from the landfill through noise and traffic.
2. The Operator should employ basic good practice measures for the control of noise. These include adequate maintenance of any parts of plant or equipment whose deterioration may give rise to increases in noise (including the maintenance of plant and equipment, buildings as well as specific noise attenuation measures associated with plant, equipment or machinery).
3. The Operator should employ such noise control techniques to ensure that the noise from the installation does not, in the view of the regulator, give rise to reasonable cause for annoyance at sensitive receptors. It is suggested that a starting point for considering numerical levels should be a free field rating level ($L_{A,r,T}$) of 50dB by day and a façade rating level of 45dB by night. Day and night should be clearly defined, but day is suggested as being 07:00 to 23:00 and night 23:00 to 08:00.

There is evidence however to suggest that the setting of absolute levels can lead to difficulties. Consequently the setting of levels linked to the background, with an overriding safeguard of absolute levels to ensure a baseline of good practice, is considered to be most appropriate.

The aim should be to set Rating Levels ($L_{A,r,T}$), as defined in BS4142 : 1997, from an installation at the numerical value of the Background Sound Level ($L_{A90,T}$), but there are several reasons why departures from this approach could be justified:

- a) Setting a less stringent standard
 - Remote location with no noise sensitive receptors;
 - Temporary or short term problems such as construction or engineered liner emplacement;
 - A well established landfill operation with no significant history of noise problems; and/or
- b) More stringent standard
 - Tonal or other acoustic characteristics;
 - A tranquil area that requires preservation;
 - Creeping background, see Section 2.5.6 of Guidance Note H3: Part 1 – Regulation and Permitting; and/or
 - A large area affected.

BAT for noise and vibration
Landfill Directive Article 9 (c), Annex I

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BAT for noise and vibration (cont.)

Cont.

The Operator should provide justification where Rating Levels from the installation exceed the numerical value of the Background Sound Level ($L_{A90,T}$) at the noise sensitive receptors.

- In some circumstances “creeping background” (Section 2.5.6, Guidance note H3: Part 1) may be an issue. Where this has been identified in pre application discussions the Operator should employ such noise control techniques as are considered to be appropriate to minimise problems of to an acceptable level within the BAT criteria.
- Noise surveys, measurement, investigation (which can involve detailed assessment of sound power levels for individual items of plant) or modelling may be necessary for either new or existing installations depending upon the potential for noise problems. Operators may have a noise management plan as part of their management system, or this may be specified as a Permit condition. More information on such techniques is given in Guidance Note H3: Part 2).

Noise control techniques – examples of good practice

The Operator is under an obligation to comply with the principles of BAT. In many cases the measures required to achieve BAT may be very site specific but the following gives some indication of good practices (BAT) to prevent or minimise noise from the site:

- construction of sound bunds/barriers around the “active” cell, further information is contained in BS 5228 1997³⁷;
- regular and effective maintenance by trained personnel of plant material;
- training of site personnel in the need to minimise noise;
- modification of existing plant to reduce noise;
- replacement of older site plant with modern quieter designs (this may also improve energy efficiency);
- siting of noisy equipment way from receptors and accounting for prevailing wind direction;
- where short term noisy operations have to be undertaken, there often has to be a trade off in terms of a higher noise level for a shorter period versus less noise but of longer duration. For example during site preparation, working longer hours, or using more plant (or larger plant) may be preferable if it results in noisy operations being completed in a much shorter time.
- early notification of local residents or at least inform them in advance of work being started, likely timescale and telephone number if disturbance occurs.
- regular maintenance of the access roads to repair “pot-holes”; this serves to significantly reduce noise generated by empty vehicles;
- Operators should ensure disposal of waste is not permitted outside of the agreed operating hours specified in the Permit.

Noise monitoring

Monitoring of noise should undertaken at a frequency agreed with the Regulator, based on the risk assessment, (see also [Section 2.10](#)). Permit conditions or other requirements relating to monitoring should normally make reference to the relevant British Standard and to specified measurement positions to enable accurate and repeatable measurements to be taken. See Guidance Note H3: Part 2.

Main technical guidance

- Guidance on the Development and Operation of Landfill Sites ([see Reference 22](#));
- Internal Guidance for the Regulation of Noise at Waste Management facilities under the Waste Management Licensing Regulations ([see Reference 16](#));
- Environment Agency, Horizontal Guidance Note IPPC H3 Noise Guidance Part I Regulation and Permitting. Consultation Draft (Date) ([see Reference 39](#)).

Supporting Reference Information

- BS 5228: 1997 ([see Reference 37](#));
- BS4142 : 1997

BS5228 : 1997 Part 1 Section 8.5 advises that it is not possible to provide detailed guidance on determining whether or not noise and vibration from a site will constitute a problem in a particular situation. It then discusses a number of factors that are likely to influence the acceptability of site noise. In particular it states “In some cases a particular characteristic of the noise, for example the presence of impulses or tones, may make it less acceptable than might be concluded from the level expressed in terms of LAeq. In certain circumstances it may be appropriate to apply a weighting, or character correction, of 5dB(A) to the source of intermittent, tonal or impulsive noise as specified in the assessment of industrial noise BS4142 : 1990” The relevant part of the 1990 BS4142 has been

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repeated, almost unchanged in the 1997 version of BS4142. Hence it is considered appropriate to use the rating level of the noise, as defined in BS4142 : 1997 as the key parameter for assessment

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2.10 Monitoring

This section describes monitoring and reporting requirements for emissions to all environmental media. Guidance is provided for the selection of the appropriate monitoring methodologies, frequency of monitoring, compliance assessment criteria and environmental monitoring.

Application Form
Question 2.10

Describe the proposed measures for monitoring emissions including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

With the Application the Operator should:

1. Describe the current or proposed position with regard to all of the requirements above, for emissions monitoring, environmental monitoring, process monitoring (where environmentally relevant) and monitoring standards employed;
2. Identify shortfalls in information or justifications for not using the listed requirements;

2.10.1 Environmental monitoring plan

The operator shall submit a monitoring and sampling quality control plan for Regulator approval.

Indicative BAT Requirements

1. Operators shall take measures in order that control and monitoring procedures in the operational phase meet at least the following requirements:
 - the Operator of a landfill shall carry out, during the operational phase a control and monitoring programme as specified in Annex III (detailed below).
 - the Operator shall notify the Regulator of any significant adverse environmental effects revealed by the control and monitoring procedures and follow the decision of the Regulator on the nature and timing of the corrective measures to be taken. These measures shall be undertaken at the expense of the Operator.
 - the quality control of the analytical operations of the control and monitoring procedures and/or of the analyses referred to below are carried out by competent laboratories.
2. To determine whether the landfill is having a negative effect on the environment it is necessary for the Operator to ensure sufficient monitoring of the environment. The Operator should meet the following requirements:
 - a monitoring plan, which should be developed from the conceptual plan of the site and refined as knowledge of the hydrogeological and geological setting of the site increases. It should detail the position and construction of monitoring points, the frequency and scope of the environmental monitoring, a sampling plan, sampling methodology, sampling equipment standards and analytical standards;
 - the quality control of the analytical operations of the control and monitoring procedures and/or of waste sampling analyses shall be carried out by competent laboratories;
 - the Operator must notify the Regulator of any significant adverse environmental effects revealed by the control and monitoring programme and follow the decision of the Regulator on the corrective measures to be taken;
 - monitoring procedures for meteorological data, water, leachate and gas emissions, and the topography of the landfill body;
 - the Operator must report, at least once a year, all monitoring results and their interpretation to the Regulator.
3. The Regulator guidance on landfill monitoring introduces the concept of the site monitoring plan. This should detail the proposed monitoring regime. All new sites are required to submit a site monitoring plan with a PPC Permit application. Existing sites are required to compile a CP, which should include a monitoring plan, in accordance with Article 14 of the LFD. For existing Waste Management Licence holders, your response to each point on the PPC Permit application may cross reference to the appropriate section of the supporting information as long as the previous information adequately addresses conditions of the LFD.

Cont.

BAT for monitoring Landfill Directive Article 12, Annex III (3)

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4. Generally monitoring should be undertaken during commissioning, start-up, normal operation, closure and after-care phases unless the Regulator agrees that it would be inappropriate to do so. Monitoring of any installations located at the landfill, such as leachate treatment plants, landfill gas utilisation plants, should also be included.

Emissions monitoring

5. Within the landfill sector emissions should include landfill gas and leachate (until discharge from the site), other "emissions" such as noise, odour, flare emissions, litter and dust are covered in [Section 2.3](#).

Monitoring should continue throughout the operational and post-closure phases, until the surrender of the Permit. The frequency and scope of the monitoring will depend on site-specific conditions, although minimum requirements as specified in the LFD are detailed below.

Where monitoring shows that substances are not emitted in significant quantities, consideration can be given to a reduced monitoring frequency.

2.10.2 Landfill gas

- Monitoring of landfill gas should be undertaken at all installations within this sector
- Gas monitoring must be representative for each section of the landfill
- This should include monitoring of in-waste gas boreholes, perimeter boreholes (beyond the installation), landfill gas utilisation equipment, landfill gas flares (where applicable) and monitoring of landfill gas emissions from the landfill body
- The LFD states that potential gas emissions should be measured monthly during the operating phase and six-monthly during the after-care phase, although the efficiency of gas extraction system must be checked regularly
- As a minimum, atmospheric pressure, methane, carbon dioxide and oxygen should be recorded
- Other gases (H₂S, H₂) should be measured, as required, according to the composition of the waste deposited.

Perimeter landfill gas monitoring

6. As described above, landfill gas monitoring should be undertaken in boreholes around the perimeter of the landfill. These should be spaced at intervals dictated by the proximity to receptors.

As a minimum, atmospheric pressure, methane, carbon dioxide and oxygen should be recorded. Other gases should be measured, as required, according to the composition of the waste deposited.

2.10.3 Meteorological monitoring

7. The Leachate management plan ([Section 2.3.2](#)) requires the inclusion of a water balance for the landfill. Where a water balance is used the following data is collected daily from the installation:
- volume of precipitation;
 - temperature, minimum and maximum, at 14:00 hr CET;
 - direction and force of prevailing wind;
 - evaporation (using a lysimeter or other suitable methods);
 - atmospheric humidity at 14:00 hr CET;
 - other meteorological data deemed significant (ground conditions).

The actual meteorological data required is likely to be set in the permit. The operator will be required to record whether the data is obtained from a local meteorological station or from site monitoring, as this information is required for the three yearly report to the European Commission on the implementation of the LFD.

Cont.

BAT for landfill gas monitoring:
Landfill Directive Annex III (3)

BAT for Meteorological Monitoring
Landfill Directive Annex III (2)

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BAT for leachate monitoring:
Landfill Directive Annex III (3)

2.10.4 Leachate

- Sampling of leachate must be collected at representative points
- Sampling and measuring volume and composition of leachate must be performed separately at each point at which leachate is discharged from the site
- (Ref: General Guidelines on Sampling Technology, ISO 5567-2 1991)
- Leachate volume should be monitored at monthly intervals during the operating phase, although the frequency could be adapted on the basis of the morphology of the landfill
- Leachate composition must be analysed quarterly during the operational phase and every six months during the after-care phase.
- The parameters to be measured and the substances to be analysed vary according to the composition of the waste deposited, they must be laid down in the Permit document and reflect the leaching characteristics of the wastes.
- Leachate levels in the waste should be measured weekly
- Volumes of leachate being treated, being taken off site, or being recirculated should be recorded.

The need should be considered for:

- groundwater - where it should be designed to characterise both quality and quantity/flow and take into account short and long-term variations in both. Monitoring will need to take place both up-gradient and down-gradient of the site;
- surface water - where consideration will be needed for sampling, analysis and reporting for upstream and downstream quality of the controlled water;
- air, including odour and dust;
- land contamination, including vegetation, and agricultural products;
- noise.

Where environmental monitoring is needed, the following should be considered in drawing up proposals:

- determinants to be monitored, standard reference methods, sampling protocols;
- monitoring strategy, selection of monitoring points, optimisation of monitoring approach;
- determination of background levels contributed by other sources;
- determination of trigger levels, where applicable (this particularly applies to groundwater);
- uncertainty for the employed methodologies and the resultant overall uncertainty of measurement;
- quality assurance (QA) and quality control (QC) protocols, equipment calibration and maintenance, sample storage and chain of custody/audit trail;
- reporting procedures, data storage, interpretation and review of results, reporting format for the provision of information for the Regulator.

The definition of the significant environmental effects and significant change, in the context of monitoring data, will be given in forthcoming Regulator guidance.

2.10.5 Surface water monitoring

8. The following applies to surface water monitoring
- Sampling of surface water, if present, must be collected at representative points.
 - For each surface water body monitored which is under flow, not less than two points should be provided, one upstream and one downstream of the site.
- The volume and composition of the surface water must be monitored quarterly during the operational phase and every six months during the after-care phase.

Bat for Surface Water monitoring:
Landfill Directive Annex III (3)

Cont.

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BAT for groundwater monitoring:
Landfill Directive Annex III (4)

2.10.6 Groundwater monitoring

Sampling

9. The measurements must be such to provide information on groundwater likely to be affected by leachate, with at least one groundwater monitoring point up gradient (inflow region) and two groundwater monitoring points down gradient (outflow region) of the site.

Sampling must be carried out at the minimum of three locations before the filling operations commence in accordance with ISO 5667, Part 11, 1993.

Monitoring

10. The parameters to be analysed in the samples taken must be derived from the expected composition of the leachate and groundwater quality in the area. In selecting the parameters for analysis account should be taken of mobility in the groundwater zone. Parameters could include indicator parameters in order to ensure an early recognition of change in water quality.

The levels of groundwater must be recorded at least six-monthly intervals during the operational and after-care phases, although if fluctuating levels are present the frequency must be increased.

The groundwater composition must be recorded at a site-specific frequency. The frequency must be based on possibility for remedial actions between two samplings if a trigger level is reached (i.e. the frequency must be determined on the basis of knowledge and the evaluation of the velocity of the groundwater flow. When a trigger level is reached (see below) verification is necessary by repeating the sampling. When the level has been confirmed, a contingency plan, laid down in the Permit must be followed.

Trigger levels

11. Significant adverse environmental effects should be considered to have occurred in the case of groundwater, when an analysis of a groundwater sample shows a significant change in water quality. A trigger level must be determined taking account of the specific hydrogeological formations in the location of the landfill and groundwater quality. The trigger level must be laid down in the Permit whenever possible.

The observations must be evaluated by means of control charts with established control rules and levels for each down gradient well. The control levels must be determined from local variations in groundwater quality.

2.10.7 Topography of the landfill

12. The LFD requires the structure and composition of the landfill body to be recorded annually

This must include surface occupied by waste, volume and composition of the waste, methods of depositing, time and duration of depositing and calculation of the remaining capacity

The settling behaviour of the landfill should also be surveyed at least annually during the operating and after-care phases.

BAT for Monitoring of the Landfill Topography
Landfill Directive Annex III (2)

2.10.8 Monitoring for fugitive aerial emissions including dust

See Section 2.3.8.

Other monitoring

13. Other monitoring required may include the following:
- regular visual inspection of haul roads for excessive dust and/or debris;
 - regular visual inspections for litter;
 - regular visual inspection around areas of fuel storage (integrity of bunds), other potential spillages on the infrastructure/haul road;
 - regular olfactory monitoring, including consideration of current meteorological conditions;

Cont.

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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The following process variables have potential environmental impact and should be considered in this sector. The Operator should confirm that this is so or justify any alternative arrangements:

- any leachate treatment facility located with the site boundary;
- landfill gas management system, including utilisation plant and/or flare;
- energy consumption across the site, including any plant at the site, in accordance with the energy plan (see Section 2.7).
- noise and vibration monitoring - see Section 2.9 and Reference 27;
- dust and particulate monitoring;
- monitoring pests and vermin, including birds;
- visual inspection of the waste at the entrance and at the point of deposition, periodic sampling of waste streams, register of the quantities and characteristics of waste landfilled (see Section 2.3).

Environmental monitoring (beyond the installation)

14. The Operator should consider on the basis of risk, the need for environmental monitoring to assess the effects of emissions to controlled water, groundwater, air or land, or emissions of noise or odour.

Environmental monitoring will be required when:

- there are vulnerable receptors;
- the emissions are a significant contributor to an Environmental Quality Standard (EQS) which may be at risk;
- the Operator is looking for departures from standards based on lack of effect on the environment;
- there is a need to validate modelling work;
- a trigger level is approached or exceeded.

Reporting of monitoring data

15. At a frequency to be determined by the Regulator, and in any event at least once a year, the Operator shall report, on the basis of aggregated data, all the monitoring results to the Regulator for the purpose of demonstrating compliance with the Permit conditions and increasing the knowledge on waste behaviour in the landfill.

Under IPPC all Operators must report to the Regulator, without delay, of any incident or accident that is causing or may cause significant pollution.

The reporting should not just provide basic data, but also demonstrate whether they are meeting the conditions of the Permit. This may include showing they are not exceeding ELVs, that they are monitoring using the required techniques and that they have the necessary management systems in place.

Monitoring standards (standard reference methods)

Equipment standards

The Environment Agency is introducing its Monitoring Certification Scheme (MCERTS) to improve the quality of monitoring data and to ensure that the instrumentation and methodologies employed for monitoring are fit for purpose. These have not been developed for landfill at this stage. MCERTS standards are under development to cover manual stack emissions monitoring, portable emissions monitoring equipment, ambient air quality monitors, water monitoring instrumentation, data acquisition and Operators' own arrangements such as for installation, calibration and maintenance of monitoring equipment, position of sampling ports and provision of safe access for manual stack monitoring.

16. As far as possible, Operators should ensure their monitoring arrangements comply with the requirements of MCERTS, where available, e.g. using certified instruments and equipment, and using a registered stack testing organisation etc. Where the monitoring arrangements are not in accordance with MCERTS requirements the Operator should provide justification and describe the monitoring provisions in detail. See Environment Agency Website for listing of MCERTS equipment.

Cont.

BAT for reporting of monitoring data:
[Landfill Directive Article 9 PPC Regulations](#)

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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The following should be described in the application indicating which monitoring provisions comply with MCERTS requirements or for which other arrangements have been made:

- monitoring methods and procedures (selection of Standard Reference Methods);
- justification for continuous monitoring or spot sampling;
- reference conditions and averaging periods;
- measurement uncertainty of the proposed methods and the resultant overall uncertainty;
- criteria for the assessment of non-compliance with Permit limits and details of monitoring strategy aimed at demonstration of compliance;
- reporting procedures and data storage of monitoring results, record keeping and reporting intervals for the provision of information to the Regulator;
- procedures for monitoring during start-up and shut-down and abnormal process conditions;
- drift correction calibration intervals and methods;
- the accreditation held by samplers and laboratories or details of the people used and the training/competencies.

Sampling and analysis standards

17. The analytical methods given in [Appendix 1](#) should be used in this sector. In the event of other substances needing to be monitored, standards should be used in the following order of priority:
- Comité Européen de Normalisation (CEN).
 - British Standards Institution (BSI).
 - International Standardisation Organisation (ISO).
 - United States Environmental Protection Agency (US EPA).
 - American Society for Testing and Materials (ASTM).
 - Deutsches Institute für Normung (DIN).
 - Verein Deutscher Ingenieure (VDI).
 - Association Française de Normalisation (AFNOR).

A series of updated Guidance Notes covering this subject is currently in preparation and is listed under the main technical guidance below. This guidance specifies manual methods of sampling and analysis that will also be suitable for calibration of continuous emission monitoring instruments. Further guidance relevant to water and waste is available from the publications of the Standing Committee of Analysts shown below:

- National Sampling Procedures Manual, 1998 - Volume 25. Quality management system for environmental sampling.
- Standing Committee of Analysts, 1996 -General principles of sampling waters and associated materials 1996.
- ISO 5667: Water Quality Sampling.

If in doubt the Operator should consult the Regulator.

Main technical guidance:

The following current technical guidance should be consulted:

- Guidance on the Monitoring of Leachate, Groundwater and Surface Water under the Landfill Directive ([see Reference 18](#));
- Guidance on the Management of Landfill Gas ([see Reference 19](#));
- Guidance on Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Trigger Levels ([see Reference 25](#));
- Regulatory Guidance Note 1: Classification of landfill sites ([see Reference 13](#));
- Protocol for the monitoring of surface emissions of Landfill Gas ([see Reference 40](#));
- Protocol for the monitoring of emissions to atmosphere from Landfill Gas Engines ([see Reference 41](#));
- Protocol for the monitoring of emissions to atmosphere from Landfill Gas Flares ([see Reference 42](#));
- Environment Agency M14 Monitoring of Particulate Matter in Ambient Air around Waste Facilities. In preparation ([see Reference 46](#)).

Supporting reference guidance

- Regulator guidance introducing relationship with Water Framework Directive (2001) ([see Reference 43](#));
- Interim Internal Technical Guidance for Best Practice Flaring of Landfill gas ([see Reference 29](#)).

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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2.11 Site Closure, After-care and Completion

Application Form
Question 2.11

Describe the proposed measures, upon definitive cessation (definite closure) of activities, to avoid any pollution risk and return the site of operation to a satisfactory state (surrender) (including, where appropriate, measures relating to the design and construction of the installation).

With the Application the Operator should:

1. Describe the proposed position with regard to all of the measures below;
2. Identify shortfalls in information or justifications for not using the listed requirements.

Indicative BAT Requirements

1. In accordance with the Permit the Operator of the landfill must take measures to ensure that a landfill or part of it shall start the closure procedure:
 - when the relevant conditions of stated in the Permit are met; or
 - under the authorisation of the Regulator, at request of the Operator; or
 - by reasoned decision of the Regulator.

A landfill or part of it may only be considered as definitely closed after the Regulator has carried out a final on-site inspection, has assessed all the reports submitted by the Operator and has communicated to the Operator its approval for closure. This shall not in any way reduce the responsibility of the Operator under the conditions of the Permit;

After a landfill has been definitely closed, the Operator shall be responsible for the maintenance, monitoring and control in the aftercare phase for as long as may be required by the Regulator, taking into account the time during which the landfill could present hazards.

The Operator shall notify the Regulator of any significant adverse environmental effects revealed by the control procedures and shall follow the decision of the Regulator on the nature and timing of the corrective measures to be taken.

For as long as the Regulator considers that a landfill is likely to cause a hazard to the environment and without prejudice to any Community or national legislation as regards liability of the waste holder, the Operator of the site shall be responsible for monitoring and analysing landfill gas and leachate from the site and the groundwater in the vicinity of the site in accordance with [Section 2.10](#).

Operators must ensure that the estimated costs of the closure and after-care of the site for a period of at least 30 years are covered by the price charged to be charged for the disposal of any type of waste in the site.

Steps to be taken at the design and build stage of the activities

2. For identification of the various phases of a landfill, see the diagram in section 1.7. Closure should be considered at the design stage of any new development to increase the ease and security of the closure. For existing installations, where potential problems are identified, a programme of improvements should be put in place. Designs should ensure that:
 - underground tanks and pipework (except the landfill gas control system) are avoided where possible (unless protected by secondary containment or a suitable monitoring programme);
 - there is provision for the draining and clean-out of tanks, lagoons and pipework prior to dismantling;
 - site offices are provided, which are easily dismantled or removed;
 - lagoons are designed with a view to their eventual clean-up;
 - insulation is provided, if applicable, which is readily dismantled without dust or hazard;
 - materials are used which are readily recyclable (where this does not conflict with operational or other environmental objectives).

Cont.

BAT for closure, after-care and permit surrender
[Landfill Directive, Articles 8 & 13](#)

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
Management	Materials Inputs	Main Activities	Abatement & control	Waste	Energy	Accidents	Noise	Monitoring	Closure	Installation Issues

2.11.1 Site closure and aftercare plan

BAT for closure, after-care and permit surrender (cont.)

1. A site closure and aftercare plan should be developed to demonstrate that the installation can be maintained to avoid any pollution risk prior to the surrender of site when it no longer poses a risk to the environment. The plan should be kept updated as material changes occur. Common sense should be used in the level of detail, since the order and timing of the closure of the various parts of the installation will affect the final plans. However, even at an early stage, the closure plan should include:

- procedures for ensuring final waste levels are achieved;
- access and site security issues once site is closed;
- proposed restoration plan;
- aftercare monitoring plan (see below);
- aftercare maintenance plan;
- decommissioning plan including removal of redundant facilities such as leachate and landfill gas plant and cleaning and backfilling of wells and lagoons.

The restoration plan must include the proposed after use (i.e. agricultural or public amenity), proposed planting, landscape design, the timing of the restoration, and procedures to ensure final waste levels will be achieved.

The restoration plan will depend on the proposed after-use of the site. A number of different land-uses may be considered; these may include pasture and arable land, amenity or nature conservation. Consideration must be given to the protection of above-ground environmental management systems that have the potential to be vandalised if the public are to be allowed access to the site.

Regular inspections and maintenance must be undertaken at the site, at a minimum the following should be undertaken regularly:

- inspection of site perimeter fence and entrance gates, any damage to the security fencing should be repaired as soon as it is practicably possible;
- inspection of "above-ground" components of landfill, including monitoring boreholes, pipework, well-heads;
- inspection and maintenance of public access features, if applicable;
- inspection and maintenance of leachate treatment and landfill gas plant;
- inspection of the topography of the landfill - serious differential settlement may lead to the need for maintenance of the cap and restoration layers to avoid ponding at the surface and an increase in the risk of infiltration through the cap.

Post-closure monitoring plan

2. A post-closure environmental monitoring plan must be submitted to the Regulator prior to the definite closure of the site, detailing the scope and frequency of the proposed environmental monitoring and reporting. As a minimum, the following should be considered:

- landfill gas control system monitoring, including management and maintenance of any gas utilisation plant or flare;
- landfill gas perimeter monitoring, in boreholes external to the waste;
- groundwater and surface water monitoring;
- leachate monitoring;
- monitoring sampling protocols, analytical methods;
- post-closure settlement survey.

Surrender

3. In accordance with the PPC Regulations, the Regulator must be satisfied in relation to the site that it has been returned to a satisfactory condition in order to accept the surrender or partial surrender. An assessment of the site must be provided with the application for surrender. This will identify any changes in the condition of the site as described in the application for the PPC Permit and steps that have been taken to avoid pollution risks at the site.

Cont.

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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The assessment of whether or when the site can be considered to present no risk to the surrounding environment, as required by Article 13 of the LFD, should be based on an assessment of the risks associated with the installation. The risk assessment should be based on monitoring data collected from the pre-development to closure phases. The criteria for assessing completion will be based on the site specific monitoring data, on other risk assessments produced at the time of the application (which should consider the requirements for completion), and on objectives agreed with the Regulator at the time of preparing the post-closure monitoring plan.

When the Operator and the Regulator are agreed that the landfill no longer poses a risk to the environment an application for a Permit surrender should be made.

Main technical guidance

- Guidance note on the preparation of a site closure plan ([see Reference 44](#));
- Guidance on the Restoration of Landfill Sites ([see Reference 23](#)).
- Guidance on landfill completion ([see Reference 45](#));
- Guidance on the Monitoring of Leachate, Groundwater and Surface Water under the Landfill Directive ([see Reference 18](#));
- Guidance on the management of landfill gas ([see Reference 19](#)).

INTRODUCTION		TECHNIQUES			EMISSIONS			IMPACT		
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2.12 Installation-wide Issues

In some cases it is possible that actions that benefit the environmental performance of the overall installation will increase the emissions from one Permit holder's activities. For example, the utilisation of landfill gas may give rise to increased emissions from the plant, but will dramatically reduce the total emissions from the whole installation, in addition to providing a method of generating energy.

Application Form
Question 2.12

Where you are not the only Operator of the installation, describe the proposed techniques and measures (including those to be taken jointly by yourself and other Operators) for ensuring the satisfactory operation of the whole installation.

With the Application the Operator should:

1. Identify the essential communication needs between the Permit holders;
2. Identify any apparent opportunities for further interactions between the Permit holders;
3. Identify shortfalls in the information provided and justification.

Indicative BAT Requirements

1. Where there are a number of separate Permits forming the installation (particularly where there are different Operators), the Operator should identify any installation wide issues whereby the performance of the overall installation may be improved by interactions between the Operators. The possibilities will be both sector and site-specific; and include:
 - communication procedures between the various Permit holders; in particular those needed to ensure that the risk of environmental incidents is minimised;
 - benefiting from the economies of scale to justify the installation of a plant;
 - the combining of leachate/effluent to justify a combined or upgraded effluent treatment plant;
 - the combining of gas flaring/energy generation plant;
 - the avoidance of accidents from one activity which may have a detrimental knock-on effect on the neighbouring activity;
 - land contamination from one activity affecting another.

BAT for installation wide issues

3 EMISSIONS

3.1 Emissions Inventory

Given the diverse nature of landfills it is not considered appropriate to apply emission benchmarks as is required for other sectors under the PPC Regime. Instead, for the Landfill Sector it is a requirement to produce an emissions inventory, without the benchmarks.

Application Form
Question 3.1

Describe the nature, quantities and sources of foreseeable emissions into each medium (which will result from the techniques proposed in Section 2).

Emissions monitoring

With the Application the Operator should:

1. Provide a table of significant emissions of substances (except noise, vibration, odour or heat which are covered in their respective sections) that will result from the proposals in Section 2 and should include, preferably in order of significance:
 - substance (see table in [Section 1.6](#));
 - source, including height, location, efflux velocity and total gas or water flow;
 - media to which it is released;
 - any relevant EQS or other obligations;
 - proposed emissions normal/max expressed, as appropriate ([see Section 3.2](#)), for:
 - mass/unit time,
 - concentration (and total flow),
 - annual mass emissions,
 - statistical basis (average, percentile etc.);
 - notes covering the confidence in the ability to meet the benchmark values (where stated);
 - if intermittent, the appropriate frequencies;
 - plant loads at which the data is applicable;
 - whether measured or calculated (the method of calculation should be provided).

The response should clearly state whether the emissions are current emission rates or those planned following improvements, and should cover emissions under both normal and abnormal conditions for:

- point source emissions to surface water, groundwater and sewer;
- waste emissions ([refer to Sections 2.5 and 2.6](#));
- point source emissions to air;
- significant fugitive emissions to all media;
- abnormal emissions from emergency relief vents, flares etc.

For waste, emissions relate to any wastes removed from the installation, or disposed of at the installation under the conditions of the Permit. Each waste generated at the landfill installation should have its composition determined and the amounts expressed in terms of cubic metres or tonnes per month.

3.2 Standards and Obligations

In addition to meeting the requirements of BAT, there are other national and international standards and obligations that must either be safeguarded through the IPPC Permit or, at least, taken into account in setting Permit conditions. This is particularly the case for any EC based EQSs. The most likely of these to be relevant in this sector are referred to under the appropriate substance. **The extracts from standards are, however, quoted for ease of reference; the relevant and most up to date standards should be consulted for the definitive requirements.**

EC based EQ standards

IPPC: A Practical Guide (see Reference 7) explains how these should be taken into account and contains an annex listing the relevant standards. (See Appendix 2 for equivalent legislation in Northern Ireland). They can be summarised as:

Air Quality

Statutory Instrument 1989 No 317, Clean Air, The Air Quality Standards Regulations 1989

Statutory Instrument 2000 No 928, Environmental Protection, England, The Air Quality (England) Regulations 2000

Scottish Statutory Instrument 2000 No 97, Environmental Protection, The Air Quality (Scotland) Regulations 2000

Statutory Instrument 2000 No 1940 (W. 138), Environmental Protection, Wales, The Air Quality (Wales) Regulations 2000.

Water Quality

Directive 76/464/EEC on pollution Caused by Dangerous Substances Discharged to Water, contains two lists of substances. List I relates to the most dangerous and standards are set out in various Daughter Directives. List II substances must also be controlled. Annual mean concentration limits for receiving waters for List I substances can be found in SI 1989/2286 and SI 1992/337 the Surface Water (Dangerous Substances Classification) Regulations. Values for List II substances are contained in SI 1997/2560 and SI 1998/389. Daughter Directives cover EQS values for mercury, cadmium, hexachlorocyclohexane, DDT, carbon tetrachloride, pentachlorophenol, aldrin, dieldrin, endrin, isodrin, hexachlorobenzene, hexachlorobutadiene, chloroform, 1,2-dichloroethane, trichloroethane, perchloroethane and trichlorobenzene. (Note: these lists are not the same as those given in the Groundwater Directive (80/68/EEC).

Other waters with specific uses have water quality concentration limits for certain substances. These are covered by the following Regulations:

- SI 1991/1597 Bathing Waters (Classification) Regulations
- SI 1992/1331 and Direction 1997 Surface Waters (Fishlife) (Classification) Regulations
- SI 1997/1332 Surface Waters (Shellfish) (Classification) Regulations
- SI 1996/3001 The Surface Waters (Abstraction and Drinking Water) (Classification) Regulations

Future likely changes include:

Some air and water quality standards are likely to be replaced by new standards in the near future.

The (Draft) Solvents Directive on the limitation of emissions of VOCs due to the use of organic solvents in certain activities and installations.

Other standards and obligations

Hazardous Waste Incineration Directive

Waste Incineration Directive (Draft)

Large Combustion Plant Directive

Reducing Emissions of VOCs and Levels of Ground Level Ozone: a UK Strategy

Water Quality Objectives – assigned water quality objectives to inland rivers and water courses (ref. Surface (Rivers Ecosystem) Classification

The UNECE convention on long-range transboundary air pollution

The Montreal Protocol

4 IMPACT

4.1 Assessment of Overall Impact

The Operator should assess that the emissions resulting from the proposals for the activities/installation will provide a high level of protection for the environment as a whole, in particular having regard to EQSs etc, revisiting the techniques in Section 2 as necessary.

Application Form
Question 4.1

Provide an assessment of the potential significant environmental effects (including transboundary effects) of the foreseeable emissions.

With the Application the Operator should:

1. Provide detailed assessments in the context of the setting of the site, proposed design and operational practices;
2. Identify shortfalls in information, procedures and control techniques and/or justification for current measures;
3. Identify any issues which may be critical.

Assessment steps

4. Provide a description, including maps as appropriate, of the receiving environment to identify the receptors of pollution. The extent of the area may cover the local, national and international (e.g. transboundary effects) environments as appropriate.

Landfill location

5. When considering the location of a new landfill it is necessary to consider the site in terms of its local context. This will be undertaken as part of the planning process. Most proposals for landfill sites will need to be accompanied by an Environmental Impact Assessment (EIA) ([see References 47 and 48](#)). The production of an EIA should be part of the ongoing process of assessing the impacts from the proposed site and should form the basis of the preparation of the PPC Permit Application. Where a planning permission already exists, it may not necessarily follow that there will be no need for further assessment in relation to location and groundwater issues.

6. The location of a landfill must take into consideration requirements relating to:
 - The distances from the boundary of the site to residential and recreation areas, waterways, water bodies and other agricultural or urban sites.
 - The existence of groundwater, coastal water or nature protection zones in the area.
 - The geological and hydrogeological conditions in the area.
 - The risk of flooding, subsidence, landslides or avalanches on the site.
 - The protection of the nature or cultural patrimony in the area.

The landfill can be authorised only if the characteristics of the site with respect to the above-mentioned requirements, or the corrective measures to be taken indicate that the landfill does not pose a serious environmental risk.

General techniques

Assessment

7. All relevant elements of the installation shall be assessed in accordance with recognised standards, methodologies and practices, and these process must be documented to a level to provide an adequate audit trail.

The approach to the assessment process should be discussed with the Regulator before the application is submitted.

Assessments should be developed using a risk-based approach to reflect the severity of the potential consequences of the identified hazards.

Cont:

Assessments should consider:

- the context of the elements under consideration;
- the purpose of the elements and the environments in which they are to be situated;
- the potential impact of the elements on the location issues raised within the LFD;

and should be conducted within the framework of the Guidelines for Environmental Risk Assessment and Management (see Reference 49).

Assessments should be prepared to a sufficient level of detail, to allow them to be easily interpreted and evaluated. Where possible these should be carried out using commonly available techniques, and where this is not possible sufficient detail should be provided to allow alternative approaches to be considered. The Regulator would hope to advise the local authority on the scope of the assessment at the planning application stage.

Where appropriate, the assessment processes should consider alternative solutions and should review the preferred option in detail.

Assessments should be prepared by a competent and suitably qualified person.

Emissions should be identified, together with receptors and the pathways by which the receptors may be affected. Receptors include: areas of human population including noise or odour sensitive areas, flora and fauna (i.e. Habitat Directive sites, special areas of conservation, SSSI or other sensitive areas), and watercourses (e.g. ditches, streams, brooks, rivers), air including the upper atmosphere, landscape, material assets and the cultural heritage.

Carry out an assessment of the potential impact of the total emissions from the activities on these receptors. Guidance on the Assessment of Risk at Landfills (see Reference 50), BPEO Assessment Methodology for IPC and "IPPC Environmental Assessment and Appraisal of BAT (see Reference 51) provide guidance a systematic method for doing this and will also identify where modelling needs to be carried out, to air or water, to improve the understanding of the dispersion of the emissions. The assessment will include comparison (see Section 3.2) with:

- community EQS levels;
- other statutory obligations;
- non statutory obligations;
- environmental action levels (EALs) and the other environmental and regulatory parameters defined in the LFD.

Consider whether the responses to Sections 2 and 3 and this assessment adequately demonstrate that the necessary measures have been taken against pollution, in particular by the application of BAT, that no significant pollution will be caused. Where there is uncertainty about this, the measures in Section 2 should be revisited as appropriate to make further improvements.

Where the same pollutants are being emitted by more than one permitted activity on the installation the Operator should assess the impact both with and without the neighbouring emissions.

Main technical guidance

- Guidance on the Development and Operation of Landfill Sites (see Reference 22);
- Additional Guidance for Hazardous Waste Sites (see Reference 24);
- Guidance on the Monitoring of Leachate, Groundwater and Surface Water under the Landfill Directive (see Reference 18);
- Guidance on the Management of Landfill Gas (see Reference 19);
- Guidance on Hydrogeological Risk Assessment for Landfills and the Derivation of Groundwater Trigger Levels (see Reference 25);
- Interim guidance on the use of geomembranes in landfill engineering (see Reference 26);
- Interim guidance on non-woven protector geotextiles for landfill engineering (see Reference 27);
- Interim guidance on the geophysical testing of geomembranes for landfill engineering (see Reference 28);
- Internal Guidance for the Regulation of Noise at Waste Management facilities under the Waste Management Licensing Regulations (see Reference 16);
- Guidance on the Assessment of Risk at Landfills (see Reference 50).

Supporting reference information

- Interim internal technical guidance for the best practice flaring of landfill gas (see Reference 29);

REFERENCES

For a full list of available Technical Guidance see Appendix A of the *Guide for Applicants* or visit the Environment Agency Website <http://www.environment-agency.gov.uk>. Many of the references below are being made available free of charge for viewing or download on the Website. The same information can also be accessed via the SEPA web site <http://www.sepa.org>, or the NIEHS web site www.ehnsi.gov.uk. Most titles will also be available in hard copy from The Stationery Office (TSO). Some existing titles are not yet available on the Website but can be obtained from TSO.

1. Council Directive 1999/31/EC on the Landfill of Waste Official Journal of the European Union L162 16 July 1999 pp1-19.
2. The Landfill Regulations (England & Wales) 2001.
3. The Pollution Prevention and Control Act 1999.
4. Council Directive 96/61/EC on Integrated Pollution Prevention and Control Official Journal of the European Union L257 10th October 1996 pp26-40.
5. The Implementation of Council Directive 1999/31/EC on the Landfill of Waste, DETR, October 2000; Consultation Paper on the Implementation of Council Directive 1999/31/EC on the Landfill of Waste (Scottish Executive, February 2001); [N.I. equivalent??].
6. Implementation of Council Directive 1999/31/EC on the Landfill of Waste, Second Consultation Paper. DEFRA, August 2001.
7. IPPC: A Practical Guide (DETR for England and Wales).
8. Environment Agency, Guidance for Operators on Preparing a Landfill Site Conditioning Plan (2001).
9. IPPC Part A(1) Installations: Guide for Applicants.
10. Council Directive 75/442/EEC on Waste as amended by Council Directive 91/156/EEC. Official Journal of the European Union, L78, 26th March 1991, pp32-37.
11. Environment Agency, Habitats Regulations Review Information Pack (October 2001)
12. Council Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances. Official Journal of the European Union L20, 26th January 1980, pp43-48.
13. Environment Agency, Regulatory Guidance Note 1: Classification of Landfill Sites (September 2001).
14. Environment Agency, Guidance on Waste Treatment Requirements of Article 6a of the Landfill Directive (2001).
15. Environment Agency, Internal Guidance for the Regulation of Odour at Waste Management Facilities under the Waste Management Licensing Regulations. At external consultation, July 2001.
16. Environment Agency, Internal Guidance for the Regulation of Noise at Waste Management Facilities under the Waste Management Licensing Regulations. Autumn 2001.
17. Environment Agency, Internal Guidance for the Regulation of Litter at Waste Management Facilities under the Waste Management Licensing Regulations. In preparation.
18. Environment Agency, Guidance on the Monitoring of Leachate, Groundwater and Surface Water under the Landfill Directive (2001).
19. Environment Agency, Technical Guidance on the Management of Landfill Gas (2001).
20. Environment Agency, Guidance on Interim National Waste Acceptance Procedures (2001).
21. CEN Draft Standard on the Sampling of Waste PrEn***** (September 2001).
22. Environment Agency, Guidance on the Development and Operation of Landfill Sites (2001).
23. Environment Agency, Guidance on the Restoration of Landfill Sites (2001).
24. Environment Agency, Additional Guidance for Hazardous Waste Sites (2001).
25. Environment Agency, Guidance on Hydrogeological Risk Assessment for Landfills and the Derivation of Groundwater Trigger Levels (2001).
26. Environment Agency, Interim Guidance on the Use of Geomembranes in Landfill Engineering (February 1999).
27. Environment Agency, Interim Guidance on Non-Woven Protector Geotextiles for Landfill Engineering (February 1999).
28. Environment Agency, Interim Guidance on the Geophysical Testing of Geomembranes for Landfill Engineering (March 1999).
29. Environment Agency, Interim Internal Technical Guidance for Best Practice Flaring of Landfill Gas (September 2001).
30. Environment Agency, Scottish Environment Protection Agency & the NI Service for the Environment & Heritage. Odour Assessment and Control – Guidance for Regulators and Industry (date), publisher.

REFERENCES

31. Environment Agency, IPPC General Guidance on Odour ().
32. Aerodrome Bird Control (CAP 608).
33. Environment Agency, IPPC General Guidance on Litter.
34. Environment Agency, Policy and Practice for the Protection of Groundwater (PPPG) (1998) The Stationery Office ISBN 0-11-310145 7, under revision.
35. Guidance note on Energy Efficiency.
36. Assessment and Control of Environmental Noise and Vibration from Industrial Activities.
37. BS Noise
 - BS 5228 1997
 - BS 4142 1997
38. Department of Local Government, Transport and the Regions, Minerals Planning Guidance no 11 Controlling and Mitigating the Environmental Effects of Minerals Extraction in England Consultation Draft May 2000.
39. Environment Agency, Environment Agency, Horizontal Guidance Note IPPC H3 Noise Guidance Part I Regulation and Permitting. Consultation Draft (Date)
40. Environment Agency Protocol for the monitoring of surface emissions of Landfill Gas. In preparation
41. Environment Agency. Protocol for the monitoring of emissions from Landfill Gas Engines. In preparation
42. Environment Agency. Protocol for the monitoring of emissions from Landfill Gas Flares. In preparation.
43. Environment Agency, guidance introducing relationship with Water Framework Directive (2001)
44. Environment Agency, Guidance note on the Preparation of a Site Closure Plan) (2001).
45. Environment Agency, Guidance on Landfill Completion (2002).
46. Monitoring Guidance:
 - Environment Agency, M1 *Sampling facility requirements for the monitoring of particulates in gaseous releases to atmosphere* (March 1993) The Stationery Office (?) ISBN 0-11-752777-7;
 - Environment Agency M2 *Monitoring emissions of pollutants at source* (January 1994) ISBN 0-11-752922-2;
 - Environment Agency M3 *Standards for IPC Monitoring Part 1: Standards, organisations and the measurement infrastructure* (August 1995) ISBN 0-11-753133-2;
 - Environment Agency M4 *Standards for IPC Monitoring Part 2 : Standards in support of IPC Monitoring* (1998).
 - Environment Agency M14 *Monitoring of Particulate Matter in Ambient Air around Waste Facilities.* (2002).
47. SI 1999 No 293. The Town & Country Planning (Environmental Impact Assessment)(England & Wales) Regulations.
48. DETR circular 02/99: Environmental Impact Assessment (1999).
49. DETR, The Environment Agency & The Institute for Environment and Health. *Guidelines for Environmental Risk Assessment and Management*, HMSO, Norwich. ISBN 0-11-753551-6.
50. Environment Agency, Guidance on the Assessment of Risk at Landfills (2002).
51. Assessment methodologies:
 - Environment Agency E1 BPEO Assessment Methodology for IPC
 - Environment Agency H1 Environmental Assessment and Appraisal of BAT (in preparation).
52. European Commission Decision (2001/118/EC) amending Decision 2000/532/EC as regards the list of wastes. Official Journal of the European Communities, L47 pp1-32.
53. Commission of the European Communities Directive (91/689/EEC) on Hazardous Waste. Official Journal of the European Communities, L377 pp20-27.

ABBREVIATIONS

BAT	Best Available Techniques
BAT Criteria	The criteria to be taken into account when assessing BAT as outlined in this document.
BOD	Biochemical Oxygen Demand
CHP	Combined heat and power plant
COD	Chemical Oxygen Demand
EMS	Environmental Management System
ETP	Effluent treatment plant
ITEQ	International Toxicity Equivalents
NIEHS	Northern Ireland Environment and Heritage Service
SECp	Specific Energy Consumption
SEPA	Scottish Environmental Protection Agency
SS	Suspended solids
STW	Sewage treatment works
TOC	Total Organic Carbon
TRS	Total reduced sulphur
VOC	Volatile organic compounds

GLOSSARY OF TERMS

Applicant	Any person who applies for a PPC Permit for a landfill.
BAT	<p>'Best Available Techniques' - A term defined by the PPC Regulations as 'the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally reduce emissions and the impact of the environment as a whole.'</p> <p>BAT definitions:</p> <p>'best' means the most effective techniques for achieving a high level of protection for the environment as a whole;</p> <p>'available techniques' means techniques developed on a scale which allows them to be used in the relevant industrial sector, under economically and technically viable conditions, taking account of the cost and the advantages. The techniques do not have to be used or produced in the UK, as long as they are reasonably accessible;</p> <p>'techniques' includes both technology and the way the installation is designed, built, maintained, operated and decommissioned.</p> <p>For Landfills BAT is outlined in this document, the main technical guidance listed in this document and any other guidance the Regulator produces in order to assist the operator with the identification of BAT for landfills.</p>
Biodegradable Waste*	Any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and paperboard.
Completion	The point when aftercare maintenance and monitoring is completed to such a level that the surrender test is met.
Definite closure	The point at which the Agency inspects the site and approves closure (normally when the landfill has stopped taking waste for disposal).
Existing (installation)	Landfill sites that have already been granted a Waste Management Licence or PPC Permit or otherwise operational prior to the transposition of the LFD into UK law on 16 July 2001 and require a Site Conditioning Plan to be submitted to the Regulators by 16 July 2002.
FAPP	<p>Fit and Proper Person - The requirement of the Operator. The test for determining if someone is a FAPP considers:</p> <ul style="list-style-type: none"> • whether the person or any other relevant person has been convicted of environmental offences; • whether the person responsible for managing the activity is technically competent; and • whether the person who holds or is to hold the Permit has made, or intends or is in a position to make, financial provisions adequate for discharging the obligations that might arise from the Permit in relation to the waste activity.
Hazardous waste*	Any waste which is covered by Article 1.4 of the Council Directive 91/689/EEC on hazardous waste. This defines hazardous waste as waste featuring on a list (see Reference 52) drawn up on the basis of Annexes I and II to Directive 91/689/EEC (see Reference 53), which must have one or more of the properties listed in Annex III of the same.
Inert waste*	Any waste which does not undergo 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 which is likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater.
Installation	Within the landfill sector, an installation is defined as the landfill and any associated process directly involved in the physical process of landfilling the waste.
Landfill Gas*	All the gases generated from the landfill waste.
Landfill*	<p>A waste disposal site for the deposit of waste onto or into land, including:</p> <ul style="list-style-type: none"> • internal waste disposal sites, and • a permanent site (i.e. more than 1 year) that is used for temporary storage of waste, but excluding: • facilities where waste is unloaded in order to permit its preparation for further transport for recovery, treatment or disposal elsewhere, and • storage of waste prior to recovery or treatment for a period less than three years as a general rule, or • storage of waste for a period less than one year prior to disposal

Leachate*	Any liquid percolating through the deposited waste and emitted from or contained within a landfill.
New (installation)	Landfill sites which have not been operational before 16 th July 2001 or have not been granted a Waste Management Licence or a PPC Permit before the transposition of the LFD into UK law on 16 July 2001.
Non-hazardous waste*	Any waste not covered by the 'hazardous waste' definition. This includes waste defined as inert.
Operational phase	Includes the installation of the engineering containment system, the active phase (i.e. when the site is accepting waste), and the installation of the capping system, up until the point of definite closure.
Operator*	The person who has control over the operation of the installation.
Permit	A set of conditions agreed between the Operator and the Regulator which must be adhered to until a time when the Permit is surrendered (see below).
Post-closure phase	The point after definite closure, where the landfill has stopped accepting waste for disposal.
Regulator	Generic term used to include the Environment Agency in England and Wales, the Scottish Environment Protection Agency in Scotland and the Environment and Heritage Service in Northern Ireland.
Site conditioning plan	A report required by the Regulator for all existing landfill sites to detail how they intend to comply with the requirements of the LFD under the PPC Regulations.
Surrender	The point at which the Permit holder has completed aftercare maintenance to such a level that it is accepted by the Regulator that the landfill is no longer a risk to the environment.
Treatment*	A physical, thermal, chemical or biological processes, including sorting that change the characteristics of the waste in order to reduce its quantity or hazardous nature, facilitate its handling or enhance recovery.
Waste*	Any substance or object which is covered by Article 1 (a) of the Council Directive 75/442/EEC (see Reference 6). This defines waste as any substance or object in the categories set out in Annex I (of the same) which the holder discards or intends or is required to discard.

* as defined by LFD

APPENDIX 1 - SOME COMMON MONITORING AND SAMPLING METHODS

Table A1.1: Measurement methods for common substances to water (excluding leachate)

Determinand	Method	Detection limit Uncertainty	Valid for range mg/l	Standard
Suspended solids	Filtration through glass fibre filters	1 mg/l 20%	10-40	ISO 11929:1997 EN872 Determination of suspended solids
COD	Oxidation with dichromate	12 mg/l 20%	50-400	ISO 6060: 1989 Water Quality- Determination of chemical oxygen demand
BOD ₅	Seeding with microorganisms and measurement of oxygen content	2 mg/l 20%	5-30	ISO 5815: 1989 Water Quality Determination of BOD after 5 days, dilution and seeding method EN 1899 (BOD 2Parts)
AOX	Adsorption on activated carbon and combustion	-- 20%	0.4 – 1.0	ISO 9562: 1998 EN1485 – Determination of adsorbable organically bound halogens.
Tot P				BS 6068: Section 2.28 1997 Determination of phosphorus –ammonium molybdate spectrometric method
Tot N				BS 6068: Section 2.62 1998 – Determination of nitrogen Part 1 Method using oxidative digestion with peroxydisulphate BS EN ISO 11905
pH				SCA The measurement of electric conductivity and the determination of pH ISBN 0117514284
Turbidity				SCA Colour and turbidity of waters 1981 ISBN 0117519553 EN 27027:1999
Flow rate	Mechanical ultrasonic or electromagnetic gauges			SCA Estimation of Flow and Load ISBN 011752364X
Temperature				
TOC				SCA The Instrumental Determination of Total Organic Carbon and Related Determinants 1995 ISBN 0117529796 EN 1484:1997
Fatty Acids				Determination of Volatile Fatty Acids in Sewage Sludge 1979 ISBN 0117514624
Metals				BS 6068: Section 2.60 1998 – Determination of 33 elements by inductively coupled plasma atomic emission spectroscopy
Chlorine				BS6068: Section 2.27 1990 – Method for the determination of total chlorine: iodometric titration method
Chloroform Bromoform				BS 6068: Section 2.58 Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods
Dispersants Surfactants Anionic Cationic Non-ionic				SCA Analysis of Surfactants in Waters, Wastewaters and Sludges ISBN 01176058 EN 903:1993 (Used for anionic surfactants)
Pentachloro-Phenol				BS5666 Part 6 1983 – Wood preservative and treated timber quantitative analysis of wood preservatives containing pentachlorophenol EN 12673:1997 (used for chlorophenol and polychlorinated phenols)
Formaldehyde				SCA The determination of formaldehyde, other volatile aldehydes and alcohols in water
Phosphates and Nitrates				BS 6068: Section 2.53 1997 Determination of dissolved ions by liquid chromatography
Sulphites and sulphates				BS 6068: Section 2.53 1997 Determination of dissolved ions by liquid chromatography
Ammonia				BS 6068: Section 2.11 1987 – Method for the determination of ammonium: automated spectrometric method
Grease and oils	IR absorption	0.06 mg/kg		SCA The determination of hydrocarbon oils in waters by solvent extraction IR absorption and gravimetry ISBN 011751 7283

Table A1.2: Measurement methods for air emissions

Determinand	Method	Avg'ing time Detection limit Uncertainty	Compliance criterion	Standard
Formaldehyde	Impingement In 2,4 dinitro-phenyl-Hydrazine HPLC	1 hour 1 mg/m ³ 30%	Two samples taken. Each result below limit after subtraction of measurement uncertainty	NIOSH
Ammonia	Ion Chromatography	1 hour 0.5mg/m ³ 25%		US EPA Method 26
VOCs Speciated	Adsorption Thermal Desorption GCMS	1 hour 0.1 mg/m ³ 30%		BS EN 1076:Workplace atmospheres. Pumped sorbent tubes for the determination of gases and vapours. Requirements and test methods.
Chloroform	Absorption on activated carbon solvent extraction. GC analysis	1 hour 1 mg/m ³ 20%		MDHS 28 Chlorinated hydrocarbon solvent vapours in air (modified)
Oxides of Sulphur	UV fluorescence automatic analyser	1 hour 1 ppm 10%	95% of hourly averages over a year below specified limit	ISO 7935 (BS6069 Section 4.4) Stationary source emissions-determination of mass concentrations of sulphur dioxide CEN Standard in preparation
	Wet sampling train Ion chromatography	1 hour 1 mg/m ³ 25%	Two samples taken. Each result below limit after subtraction of measurement uncertainty	ISO 7934 (BS6069 Section 4.1) Method for the determination of the mass concentration of sulphur dioxide-hydrogen peroxide/barium perchlorate method

Measurement uncertainty is defined as total expanded uncertainty at 95% confidence limit calculated in accordance with the Guide to the Expression of Uncertainty in Measurement, ISBN 92-67-10188-9, 1st Ed., Geneva, Switzerland, ISO 1993.

See also Monitoring Guidance⁴⁴.

APPENDIX 2 - EQUIVALENT LEGISLATION IN SCOTLAND & NORTHERN IRELAND

The legislation referred to in the text is that for England and Wales. The following are the equivalents for Scotland and Northern Ireland.

**Table A.2.1 -
Equivalent
Legislation**

<i>England and Wales</i>	<i>Scotland</i>	<i>Northern Ireland</i>
PPC Regulations (England and Wales) 2000	PPC (Scotland) Regulations 2000; SI 200/323	
Waste Management Licensing Regulations SI:1994 1056	Waste Management Licensing Regulations SI:1994 1056	No NI equivalent
The Water Resources Act 1991	COPA 1974 (S30A-30E equiv to Part III WRA91) Natural Heritage (Scotland) Act 1991 (Part II equiv to Part I WRA91)	The Water (NI) Order 1999
SI 1989 No 317: Clean Air, The Air Quality Standards Regulations 1989	SI 1989/317: Clean Air, The Air Quality Standards Regulations 1989	The Air Quality Standards Regulations (Northern Ireland) 1990. Statutory Rules of Northern Ireland 1990 No 145
SI 1997 No 3043: Environmental Protection, The Air Quality Regulations 1997	SSI 2000/97 The Air Quality (Scotland) Regs	No NI equivalent
SI 1989 No 2286 and 1998 No 389 the Surface Water (Dangerous Substances Classification) Regulations. (Values for List II substances are contained in SI 1997/2560 and SI 1998/389)	SI 1990/126 Surface Water (Dangerous Substances) (Classification) (Scotland) Regs	Surface Waters (Dangerous Substances) (Classification) Regulations 1998. Statutory Rules of Northern Ireland 1998 No 397 SI1991/1597:
SI 1991/1597: Bathing Waters (Classification) Regs.	SI 1991/1609 Bathing Waters (Classification) (Scotland) Regs	The Quality of Bathing Water Regulations (NI) 1993
SI 1992/1331 and Direction 1997 Surface Waters (Fishlife) (Classification) Regs.	SI 1997/2471 Surface Waters (Fishlife) (Classification) Regs	The Surface Water (Fishlife) (Classification) Regulations (NI) 1997
SI1997/1332 Surface Waters (Shellfish) (Classification) Regs.	SI 1997/2470 Surface Waters (Shellfish) (Classification) Regs	The Surface Water (Shellfish) (Classification) Regulations (NI) 1997
SI1994/2716 Conservation (Natural Habitats etc) Regulations 1994	SI 1994/2716 Conservation (Natural Habitats etc) Regs	Conservation (Natural Habitats etc) Regulations (Northern Ireland) 1995
Control of Major Accident Hazards Regulations 1999 (COMAH)	SI 1999/743 Control of Major Accident Hazards Regs	Control of Major Accident Hazard Regulations (Northern Ireland) 2000