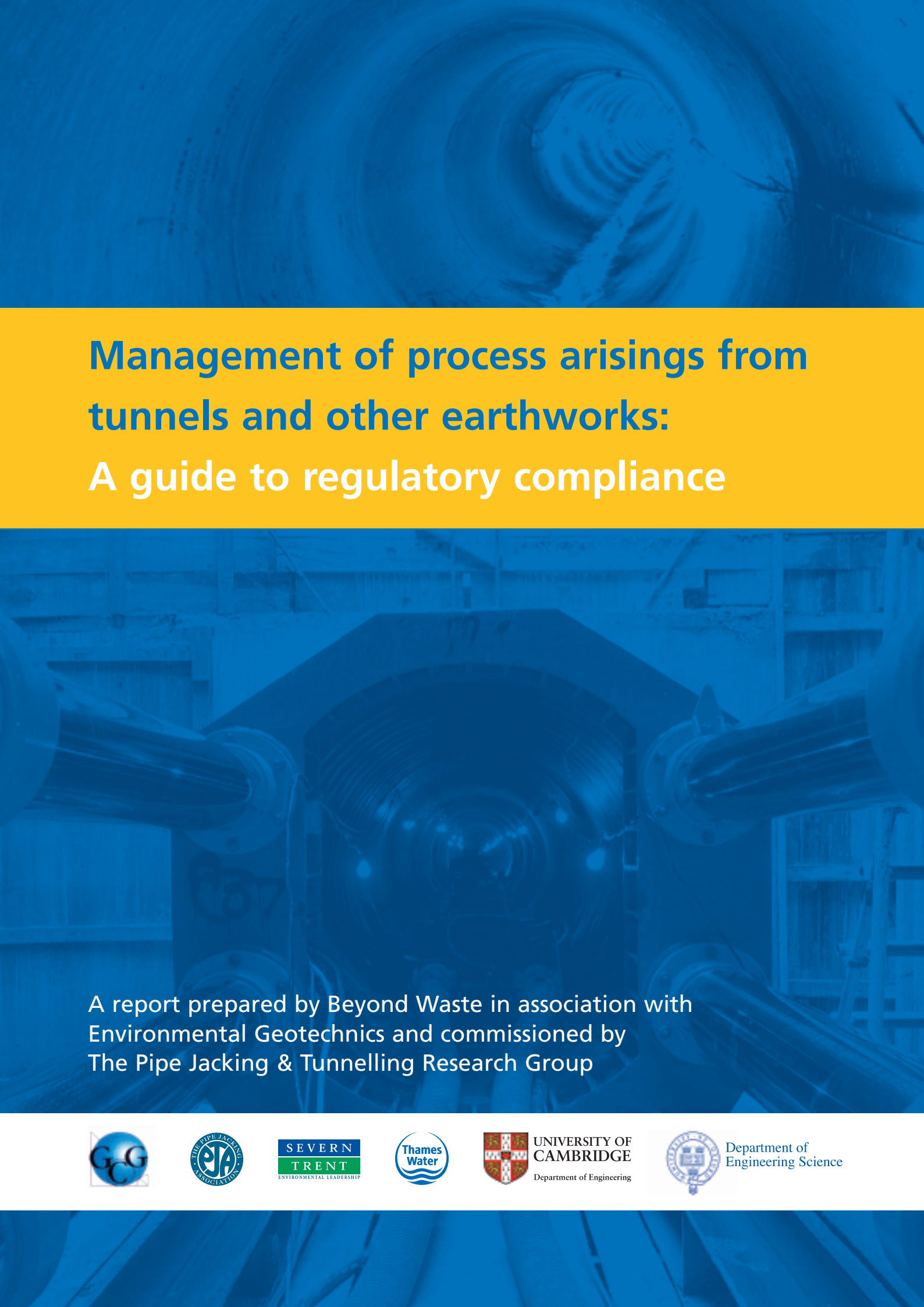

Management of process arisings from tunnels and other earthworks: A guide to regulatory compliance

A report prepared by Beyond Waste in association with Environmental Geotechnics and commissioned by The Pipe Jacking & Tunnelling Research Group

GCG

The Pipe Jacking Association

Severn Trent Environmental Leadership

Thames Water

University of Cambridge Department of Engineering

Department of Engineering Science

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Disclaimer

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PIPE JACKING AND TUNNELLING RESEARCH GROUP

The Pipe Jacking and Tunnelling Research Group was formed in 1986 by the Pipe Jacking Association to co-ordinate research into pipe jacking and tunnelling. The group brings together representatives from industry and academia and its role is to act as a lead co-ordinator for the management of research into a broad range of industry issues. The group seeks to identify issues and areas for research and work with selected research contractors to obtain funding from research councils and industry partners. The Pipe Jacking Association has contributed over £300,000 directly to the research projects listed below.

Current members of the Group are:

- Geotechnical Consulting Group
- Pipe Jacking Association
- Severn Trent Water
- Thames Water
- University of Cambridge Department of Engineering
- University of Oxford Department of Engineering Science

Co-opted member:

- Sud Chemie

Research carried out by the Pipe Jacking Association and the Pipe Jacking and Tunnelling Research Group

Project	Contractor	Completed
Pipe Jacking: State of the Art Review (PJA)	CIRIA	1983
Laboratory model testing of pipes and packing materials	Oxford University	1989
Monitoring of full-scale pipe jacks on active sites	Oxford University	1992
Further site monitoring of pipe jacks and ground movements	Oxford University	1996
Finite Element Analysis and model testing of pipes	Oxford University	1996
Prototype testing of improved micro-tunnelling pipes	Oxford University	1997
Mitigating the disruption caused by utility street works (PJA)	TRL	2001
Soil conditioning and lubrication for pipejacking	Oxford University	2001
Soil conditioning and lubrication in tunnelling, pipejacking and microtunnelling	Oxford /Cambridge Universities	2005
Slurry management and disposal of semi-liquid spoil (Scoping study)	CIRIA/Newcastle University	2005
Management of process arisings from tunnels and other earthworks	Beyond Waste/Environmental Geotechnics	2005

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G Monteith	(Barhale Construction)
A Moss	(Delta Civil Engineering)
R Slocombe	(Herrenknecht)

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EXECUTIVE SUMMARY

Environmental considerations now exert major controls on construction processes both from a technology selection and project cost point of view. A particular environmental challenge for the pipe jacking and tunnelling industries relates to the management of the excavated arisings from tunnel works in general and from slurry tunnelling (the most widely used procedure for small projects) and earth pressure balance (EPB) tunnelling in particular. This is largely due to their high moisture content. While these arisings may be reused as a virgin material, in practice, much material has been landfilled.

The stage-wise implementation of the EU Landfill Directive with its progressive ban on the disposal of liquid wastes to landfill coupled with the escalating price of landfill is acting as a catalyst to change management practices. Under the directive, disposal of hazardous liquid waste to landfill is now banned and disposal of all liquids to landfill will be banned by 2008. If any spoil is so wet as to be classified as liquid then disposal to landfill will not be permitted. If cement or similar materials are added to wet arisings to solidify them it is necessary to consider whether the elevation of pH could render the resulting material a hazardous waste.

This report is a response from the pipe jacking and tunnelling industries to the challenge of the Directive. Its primary purpose is to set out the legislation relating to the management of arisings from tunnelling works. To provide a context, the report first develops estimates of the annual quantities of arisings from the two main types of tunnelling procedure used for pipe jacking, slurry tunnelling and earth pressure balance tunnelling. Indicative moisture contents of the arisings are also developed. The materials contain significantly more water than would be present in an in-situ soil – thus making them potentially difficult to manage. The quantities of arisings from pipe jacking operations are shown to be very small from a UK perspective and indeed, even if they were all regarded as waste, they would represent just 0.05% of waste produced by construction and demolition activities when compared with national arisings data.

The report then addresses the current legislative framework for management of materials that may be deemed to be waste. It highlights opportunities and threats to the industry and seeks to lay out clearly and concisely a step by step route map to enable producers to navigate through the complex web of legislation to achieve regulatory compliance. A word of warning however, waste management legislation is in a constant state of evolution and hence this report represents a snap shot of the situation reflecting the current understanding at the time of reporting (May 05).

The project was funded by the Pipe Jacking & Tunnelling Research Group but we believe the content is relevant across the construction and related industries. We commend it to all readers with an interest in securing the future of the sector.

FOREWORD

This guide is intended to provide the pipe jacking and tunnelling community with guidance on the management of materials arising from the pipe jacking and tunnelling processes. The principal audience of the report is the community itself – to ensure compliance with the diverse regulatory requirements relating to management of material when it becomes waste and importantly also to encourage the community to think about how waste produced from their activities might be minimised. The guide may be of wider interest to other players in the construction and demolition field as well as the regulatory bodies themselves.

As the report identifies materials arising from the sector's activities are relatively small in volume and relatively benign in nature. However, we are also seeing a tightening of regulatory requirements, which impinge on the industry to a significant extent. If arisings cannot be managed and disposed of somehow ultimately the processes could grind to a halt.

In order to ensure that the arisings from tunnelling operations are not automatically considered as waste and hence subject to the full weight of the regulatory requirements, the terms used to describe the materials generated during the tunnelling process need to be chosen carefully. This may mean a departure from previously accepted terminology. For example Environment Agency Guidance states "that recycling is something, which is only carried out on waste." [1] Hence care should be taken in the use of the term 'recycle' or even 'reuse' when referring to the further use of a material for a different purpose. Providing the holder has not decided to discard an item or material then it remains a useable 'product' (See Section 7.2.1).

A glossary of 'non-waste' terms for what otherwise might loosely be referred to as the waste from tunnelling processes therefore needs to be developed. The first few entries are below and are used throughout this report.

Waste Associated Term	New term
Spoil from the tunnelling machine	Process arisings
Note: The OE dictionary defines spoil as "a waste material brought up during the course of an excavation or a dredging or mining operation." Process arisings implies that the material is retained as part of an overall process and hence may not be declared waste until it has been ejected from the process. This guide addresses the issue of defining the process boundary in a subsequent section.	
Waste disposal	Material management
Note: The use of the term 'disposal' automatically classifies a material as waste.	
Cleaned slurry after passage through solid/liquid separation plan	Returned slurry from the solid/liquid separation plant
Note: Promotes the idea of cyclic use and avoids suggestion that the slurry is 'contaminated'	

All use of the term 'contaminated' should be avoided in relation to process arisings unless the arisings have genuinely been contaminated with contaminants such as lubricating oils, fuels or materials that may be classed as hazardous.

The intention here is not to avoid the proper regulatory processes but to ensure that the optimal route through to compliance is identified for any arisings such that the regulatory controls encountered are proportionate to the risk posed by the materials concerned.

1 A Simple Guide To Assist Community Sector Reuse/Refurbishment Organisations In Complying With Waste Regulations. Produced By The Environment Agency And The Community Waste Sector – November 2003.

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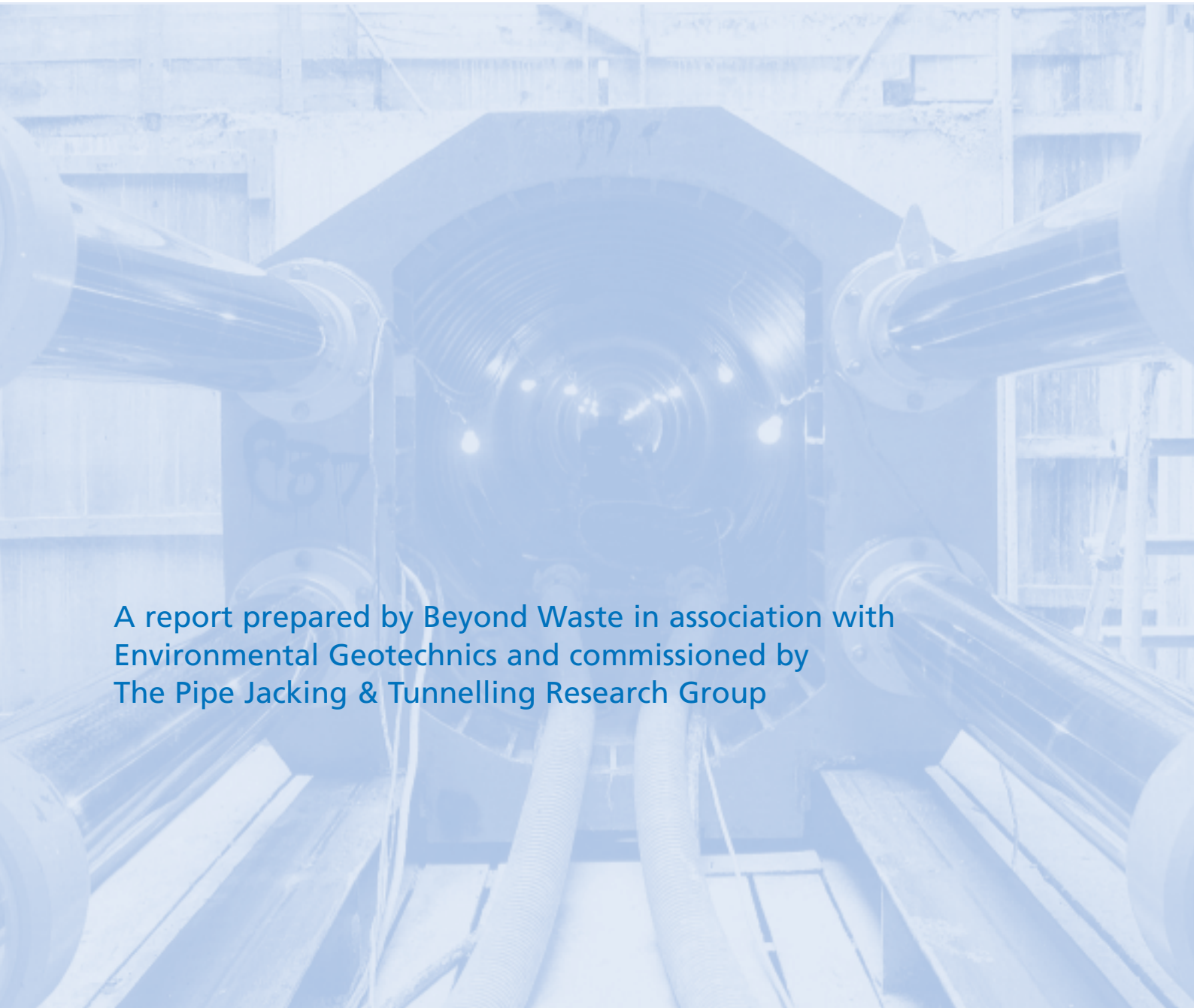

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1 INTRODUCTION

This is the final report for the project on tunnelling arisings management.

Sections 2 to 6 set out the basics of the tunnelling processes, the materials that may be used, the quantities of process arisings that can be expected from small diameter tunnelling in the UK and the division of these arisings between solids and water from the ground and from the tunnelling process itself.

Sections 7 to 9 set out the legal framework for management of process arisings.

2 TUNNELLING TECHNIQUES FOR WET GROUND

The Pipe Jacking Association (PJA) publication, "An introduction to pipe jacking and microtunnelling design", identifies a range of excavation methods for wet ground as shown in Table 1

When tunnelling in wet ground, that is at or below the groundwater level, it is necessary to limit or prevent groundwater entry into the tunnel. From Table 1 the five principal approaches to achieving this are:

1) Sealed face using slurry for process arisings conveyance;
2) Sealed face with earth pressure balance;
3) Chemical stabilisation of the ground using grouts;
4) Dewatering with deep wells or wellpoints;
5) Air pressure to counteract water pressure.

Process arisings from natural ground stabilised by cement or chemical grouts require special consideration in relation to their future management or use. This may require specific advice from the manufacturer of the grout. It should be noted that many stabilisation grouts are markedly alkaline (for example, sodium silicate and cement) and this can be a cause for concern as regards classification of the material for use or management of the material as a waste.

Table 1 Pipe Jacking Excavation Methods For Wet Ground
(Soil Types: Wet Cohesive; Wet Non-Cohesive; Wet Mixed And Fill Conditions)

Excavation method	Pipeline Internal Diameter	Length	Ground Support	Remarks
Open hand shield	900-3000mm	Generally up to 200m	Chemical stabilisation Suspension grouts Well points Deep wells	Subject to ground conditions, depth, inter-jacks, lubrication and economics
Cutter boom shield	–	–	–	Not applicable
Backacter	1200-3000mm	Generally up to 500m	Chemical stabilisation Suspension grouts Well points Deep wells	Subject to ground conditions, depth, inter-jacks, lubrication and economics
TBM	900-3000mm	Generally up to 500m	Chemical stabilisation Suspension grouts Well points Deep wells	Subject to ground conditions, depth, inter-jacks, lubrication and economics
Slurry machine	900-3000mm	Generally up to 500m	In-built method	Subject to inter-jacks, lubrication and economics
Earth pressure balance	900-3000mm	Generally up to 500m	Partially in-built plus: Chemical stabilisation Suspension grouts Well points, Deep wells	Limited by water pressure head, inter-jacks, lubrication and economics
Air pressure shield	2000-3000m	Generally up to 500m	In-built method	Subject to inter-jacks, lubrication and economics
Microtunnelling	150-900mm	Generally up to 250m	Dependent on type of machine	Subject to inter-jacks, lubrication, economics and guidance system

3 THE SLURRY TUNNELLING PROCESS

As a tunnelling machine excavates soil at the tunnel face, the process arisings must be transported to the surface for management. In a slurry tunnelling machine, this is achieved by using a slurry as a carrier. This slurry circulates in a continuous loop from the tunnelling machine to the solid/liquid separation plant and back to the machine. The various stages of the process are:

1. returned slurry is pumped to the machine;
2. in the machine, the process arisings are incorporated into the slurry;
3. the soil laden slurry is pumped to the surface separation plant;
4. in the solid/liquid separation plant, solids are separated out;
5. the slurry, after separation, is returned to the machine.

The principal role of the slurry is to carry the cut soil from the excavation face to a separation plant which is normally located on the surface. In this role, the slurry is a carrying fluid – carrying the soil from the tunnel excavation face to the separation plant where the soil is removed and the slurry then returned to the face. The slurry is designed to operate in a closed loop and is repeatedly 'recycled' through the tunnelling machine and separation plant.

3.1 Slurry Components, Density And Flow Rate

In many grounds, the initial slurry will be simply water. In use, it will pick up fines from the excavated ground and will become somewhat more viscous and denser than water. In other grounds – especially where the ground is rather coarser it may be necessary to add bentonite clay to the slurry to improve its ability to seal the face. In fine soils, proprietary chemicals may be added to the slurry to limit soil dispersion and prevent the slurry becoming too viscous and dense.

Typically, the density of the slurry returned to the machine will be less than about 1.05 t/m^3. If this density cannot be achieved in the separation plant then build up of fines in the slurry is likely to occur.

The slurry flow rate must be matched to the tunnelling machine design. The pipeline from the tunnelling machine to the separation plant is typically at least 100 mm in diameter and the flow velocity has to be at least 1.5 m/s to ensure satisfactory soil conveyance. This combination of flow velocity and pipe diameter gives a minimum flow rate of about 100 m^3/hr. However, in practice, higher flow rates are used to prevent clogging of the face of the tunnelling machine and typically flow rates will be in the range 150 to 250 m^3/hr.

3.2 Slurry Processing

Removal of the transported solids from the slurry is an integral part of slurry tunnelling operations. In coarse soils, this may be relatively straightforward but problems with the separation of silts and clays (in general material finer than about 100 microns) can be a limiting factor to the use of slurry machines.

Typically, a solid/liquid separation plant will involve three elements: a coarse or scalping screen, a hydrocyclone / dewatering screen combination unit and a fines removal system such as a centrifuge or filter belt press. A typical schematic diagram for the separation plant is shown in Figure 1 on page 11. It should be noted that separation plants can vary significantly between projects.

The openings of the coarse screen will depend on the particle size expected of the tunnelled soil. Typically, the screen might have an opening of 5 to 10 mm and may be protected by a heavier, coarser pre-screen.

The hydrocyclone/dewatering screen unit typically consists of one or more hydrocyclones mounted over a dewatering screen (smaller hydrocyclones can remove finer solids, they have a finer cut, but are more easily blocked). Often a single large and one or more small hydrocyclones will be used. The size of the small hydrocyclones, and therefore their cut, may be limited by the opening of the coarse screen. The underflow orifice of hydrocyclones is easily blocked by oversize material and the smaller the hydrocyclone the smaller the underflow orifice.

The hydrocyclones concentrate the soil solids into their underflow by centrifugal action and this concentrate is discharged onto the dewatering screen where a cake should build up. The dewatering screen is vibrated so as to move the solids along the screen to a discharge point. The material that first builds on the screen will be coarser than the screen opening but finer material will become trapped in the voids of this coarser material so that the combination of screen plus bed provides a system that can remove material significantly finer than the screen openings. This requires that a reasonable bed of soil builds up on the screen – the presence of some appropriately sized material is essential to the effective operation of the plant. Typically, the bed will be a few centimetres deep though this will depend on the plant used and the operating conditions. If there is insufficient material in the concentrated underflow from the hydrocyclones then the combination of hydrocyclones and dewatering screen will not be effective and only material coarser than the screen opening will be removed.

The hydrocyclone/dewatering screen unit is designed to 'recycle'; the underflow from the coarse screen drops into a divided tank from which the hydrocyclones draw their feed and to which they return their cleaned overflow.

In fine soils or in mixed grounds where the face includes a significant amount of fines, it will be necessary to include a fines separation device in the separation circuit. For small diameter tunnelling machines, this usually will be a centrifuge. For larger machines and/or major projects, one or more filter belt presses sometimes are used. The problem with both centrifuges and filter belt presses is that they cannot take the full flow from the tunnelling machine. Centrifuges and filter belt presses therefore are operated off-line to the main flow circuit and are used to 'polish' the slurry and prevent accumulation of fines in the circuit. Because of the limited flow capacity of centrifuges they may be kept running after tunnelling is complete for the day – the running time for the centrifuge may be greater than that for the tunnelling machine.

3.3 Liquid Slurry Management

At the end of a project, some slurry will remain in the system and a management procedure for this remaining slurry is necessary. Current procedures include:

- Extended centrifuge treatment (with the addition of flocculants) to convert the slurry to effectively water and a centrifuge paste. The water then may be discharged to foul sewer with a trade effluent consent. Discharge to sewer is not considered in this guide.
- As the slurry is basically a suspension of natural soil in water with a small amount of treatment chemicals it may be possible to manage it by application to land.
- If the slurry cannot be treated to allow discharge of the water fraction to sewer or spread on land it may be solidified by the addition of cement or other solidification material to produce a solid mass that may be landfilled – though the solidified material will have to meet waste acceptance criteria for the appropriate class of landfill if it is to be consigned to landfill. Re-use of the solidified material may be difficult if it is classed as waste (see later).

4 EARTH PRESSURE BALANCE (EPB) TUNNELLING

In some grounds, the excavated material may be removed from the tunnelling machine by a screw conveyor. However, the pressure in the face of the machine must be related to the earth pressure so as to prevent the inward movement of the soil in the tunnel face. This requires that a plug of soil is developed in the screw. In wet and permeable grounds,

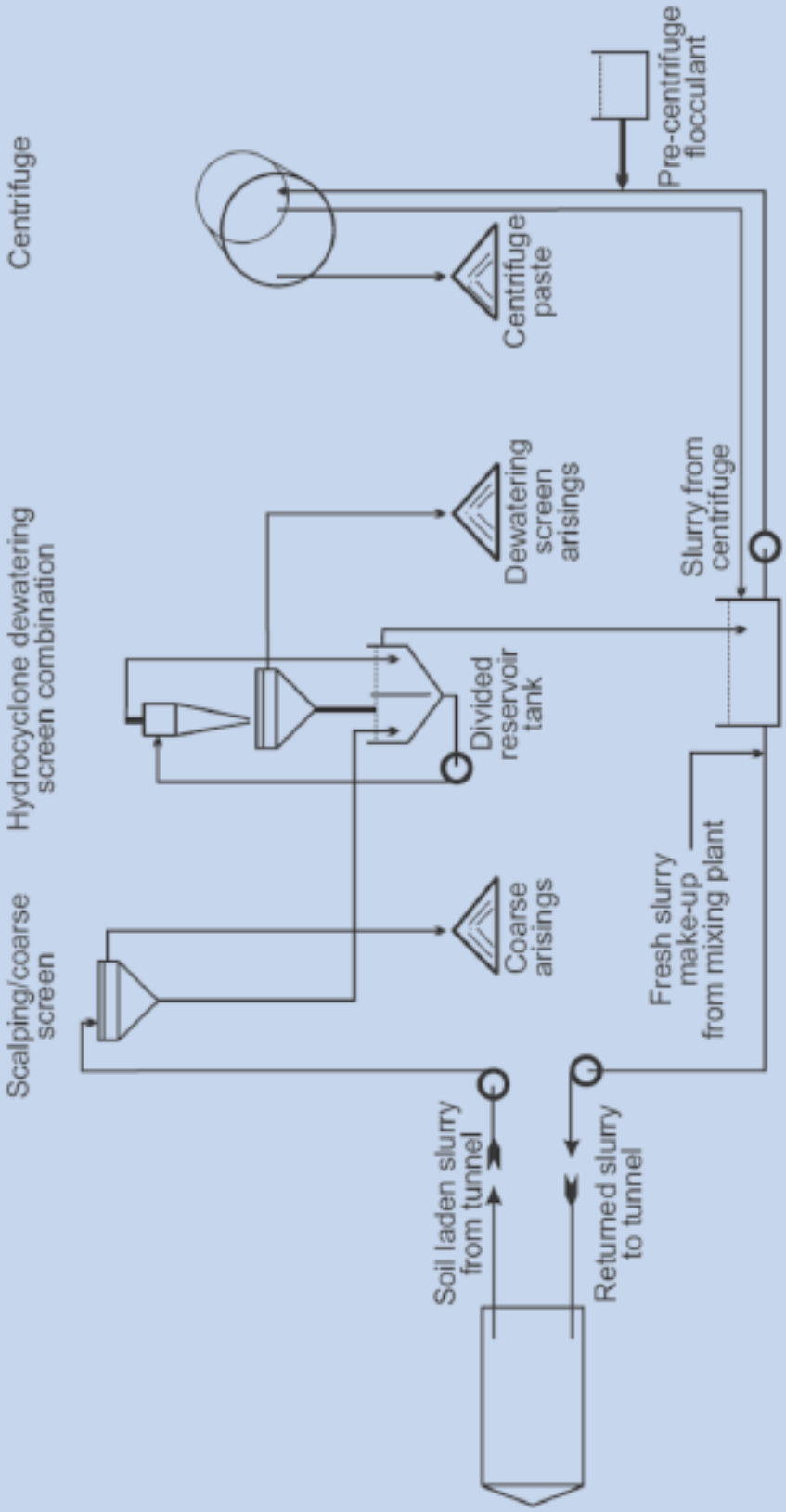

Figure 1 Schematic diagram of soil separation plant

this plug of soil must also prevent the uncontrolled escape of groundwater. Hence the presence of this plug of material is essential to the tunnelling operation.

It may be possible to form the necessary plug with the soil naturally present in the ground – especially if it includes a significant proportion of cohesive material. In other soils it can be necessary to modify the soil with chemical additives – typically water-soluble polymers which work synergistically with the fines to produce a conditioned soil. In non-cohesive soils such as sands, foam may be used in place of polymers.

Earth pressure balance (EPB) tunnelling may be used on larger diameter tunnels, as soil must be removed mechanically, along the tunnel, after discharge from the screw conveyor (rather than pumped in a slurry).

5 QUANTITIES OF SOIL AND PROCESS ARISINGS

At a meeting of the project steering group on 30 September 2004, members of the group estimated the amount of pipe jacking that was undertaken in the UK per year. An initial estimate of 5 km of 1.8 m outside diameter pipe jack was proposed. This gives a soil volume of 12,700 m^3/year or mass of perhaps 22,300 tonnes/year. After some discussion, this was revised to 30,000 tonnes/year. This is the 'input' of soil. The 'output' of process arisings produced by the tunnelling process is greater than this because the process arisings from the tunnelling have an average moisture content higher than that of the soil in the ground. Treatment chemicals also may be added but quantities are likely to be small compared with the quantity of soil – though they may have important impacts on the management of the process arisings. It also was estimated that the distribution of excavation procedure between slurry tunnelling and EPB tunnelling was 95% by slurry and 5% by EPB machine.

In order to quantify the process arisings from pipe jacking and small diameter tunnelling operations the tables in Appendix 1 have been prepared. These show some example figures and assumptions for soil type and separation plant performance. It must be emphasised that these are indicative figures only. It would appear that size distributed efficiency data (grade efficiency data) are not available for the separation plant used by the pipe jacking and tunnelling industry and refinement of the figures using existing separation plant computer simulation procedures is not practicable at the present time.

The results of the calculations are summarised in Table 2 below (see also Table 9 of Appendix 1).

Table 2 Summary Of Estimated Annual Soil Excavation Data And Process Arisings (Combined Output From Slurry Tunnelling and EPB machines)

Summary of soil excavated and process arisings for management	Soil excavated		Process arisings generated		Extra material generated per year	
	Mass Tonne	Volume m3	Mass Tonne	Volume m3	Mass Tonne	Volume m3
Solids	20,690	7,807	20,690	7,807	0	0
Water	9,310	9,310	15,722	15,722	6,411	6,411
Total process arisings	30,000	17,118	36,411	23,529	6,411	6,411
Solids content	69%		57%			
Per cent extra material					21%	37%

Table 2 shows that because of water in the process arisings, the amount of process arisings to be managed may be perhaps 21% greater than the weight of soil excavated or 37% over the volume excavated. As a result, although the total mass of soil excavated may be of the order of 30,000 tonne/year, the quantity of process arisings generated per year may be of the order of 36,400 tonne/year (it should be noted that the slurry separation plant and EPB performance figures may be relatively optimistic and the actual quantity of process arisings may exceed the excavated soil quantity by a significantly greater margin).

In overall waste management terms the quantity of process arisings generated by pipe jacking and small diameter tunnelling is relatively modest although of course a major issue for the industry – especially as some of the process arisings may be very wet.

5.1 Process Arisings From A Single Project

A single pipe jacking or small diameter tunnelling project may last perhaps two to three months with perhaps 500 to 750 tonnes of soil excavated per month and a total of 1,500 tonnes for the whole job. For a slurry tunnelling project the quantity of process arisings generated may be over 17% greater than this by mass or 30% by volume (see Appendix 1, Table 10). For an EPB machine the amount of process arisings generated will be very significantly greater than the amount of soil (97% by mass, 170% by volume – see also Appendix 1, Table 10).

5.2 The Nature Of The Process Arisings

As discussed above the process arisings from pipe jacking and small diameter tunnelling machines will include arisings from each of the separation stages:

5.2.1 Process arisings from coarse scalping screens

From the example figures set out in Appendix 1, Table 6, 7% by mass (5% by volume) of process arisings produced from slurry tunnelling might be from the coarse scalping screen. As this material is relatively coarse, the amount of water adhering to it will be small and the moisture content may be quite low, perhaps 10% if the material is non-porous gravel. Moisture contents may be higher if the coarse process arisings are porous material for example, clay or mudstone chippings. Management of this material will be relatively straightforward and its further use is to be preferred. For example, if it were free from adhering clay and did not contain soft material (e.g. lumps of cut clay), it could be used as aggregate. This raises issues regarding aggregate levy which is dealt with in Section 8.4. If not, options for use include: restoration on inert sites (landfill tax exempt), use on landfills (landfill tax exempt), use under an exemption as part of a construction project, use on an existing site as a fill material – always assuming that the material is appropriately free from contamination *(See Later)*.

5.2.2 Process arisings from the dewatering screens

From the example figures in Appendix 1, Table 6, 58% by mass (51% by volume) of process arisings produced from slurry tunnelling might be from the dewatering screens. This is a substantial proportion of the process arisings produced. If there is a significant amount of sand or coarse silt in the tunnel face the process arisings may be useable as a construction soil. If the face contains finer material, process arisings may be rather wetter – perhaps a moisture content of 60 to 70%.

If the screens are operating effectively management of this material can be relatively straightforward and again use is to be preferred.

However, dewatering screens cannot always be operated effectively. For effective operation, there must be sufficient coarse material to build a bed on the screen and this bed must be sufficiently permeable to allow dewatering. In regulatory terms this suggests that the presence of coarse material is an integral part of the operation and hence it is not a waste at this point.

A soil with only clay and silt-sized fines may pass through the screens largely untreated and as a consequence overloading of the slurry with fines may occur.

Screens also can be overloaded, the bed becomes too thick and dewatering becomes inefficient so that wet process arisings plus slurry are discharged from the screen.

5.2.3 Process arisings from the fines removal equipment

From Appendix 1, Table 6, 36% by mass (44% by volume) of process arisings produced from slurry tunnelling might be removed in the fines unit. This will be a wet and difficult material. Often it will be a sticky (viscous) semi-fluid. If vibrated, for example, in transport it may liquefy and/or some of the liquid content may be liberated.

The fines paste is difficult to further dewater unless it can be spread and allowed to dry naturally. It is the most difficult fraction of process arisings requiring management. It also should be noted that in some grounds the fines removal equipment may not remove sufficient fines to prevent their build up in the slurry. If this occurs, fines-rich slurry may have to be removed (bled) from the circuit. Formerly this would have been dealt with as liquid waste.

5.3 Drying Of Wet Process Arisings

On occasion and with clement weather conditions, process arisings may be left to dry prior to subsequent management. Storage of the process arisings can raise questions in relation to licensing of the storage site if the material is deemed to be a waste.

6 MATERIALS USED IN THE TUNNELLING PROCESS

A wide range of materials may be used on a tunnelling project and therefore may be represented in the material generated. These may be divided into those that are derived from the general construction and mechanical processes on the site (e.g. use of mechanical plant), and those specific to the tunnelling process. Waste from offices, from washing and toilet facilities should be managed through proper contractor's practice and is not considered in this guide.

6.1 General Construction And Plant

This may include:

- Spilled and/or contaminated fuel oils
- Lubricating oils and greases (residual)
- Coolants e.g. antifreeze liquids and water contaminated with any of the materials used on site or vehicle wash-down etc.
- Used spill kits for hydrocarbons and other chemicals
- Cement powder (residual)
- Hardened cement and concrete (residual)

6.2 Chemicals Used In The Tunnelling Process

Treatment chemicals may be added at several locations in the tunnelling process:

1) at the face to reduce torque – e.g. foams;
2) as additives to the lubricants injected around the pipes – there may be some leakage into the tunnel face;
3) in slurry machines as additives to change the properties of the slurry, e.g. to inhibit the dispersion of fines and so prevent overly dense/viscous slurries developing;
4) in a slurry separation plant as a pre-treatment (coagulation and flocculation) prior to centrifuge or filter belt press treatment;
5) in EPB machines to improve the flow or plug formation in the screw conveyor;
6) to dry process arisings from the slurry separation plant or from an EPB machine to facilitate easier management;
7) grout to treat loose or difficult ground which is then excavated by the machine.

Concentrations of treatment chemicals (e.g. organic polymers) in a tunnelling slurry or treated soil from an EPB machine generally will be small and are unlikely to exceed about 1% by weight of water and can be much less. Thus if, for example, the process arisings are very wet and consist of equal quantities (by mass) of excavated soil and a slurry, the overall treatment chemical content of the process arisings is unlikely to exceed 0.5%.

Coagulants and flocculants added prior to centrifuging may be added at doses of a few grams per dry tonne of process arisings (equivalent to a few ppm).

Also, it should be noted that many of the treatment chemicals will bind strongly to fine soils; indeed they may be designed to do so. Therefore the leachable chemical content of the process arisings may be less than the amount of chemicals added (though allowance will need to be made for organics naturally present in the soil).

Bentonite clay may be added as a slurry forming material. It is a natural clay, but it may have been treated with sodium carbonate and small amounts of organic polymers. Concentrations may range up to about 5% depending on the source and quality of the clay. In use it may be necessary to add further sodium carbonate to maintain the clay in the sodium form. Sodium bicarbonate may be added if cement is present in the slurry.

Soil containing grouts used for ground treatment will require special consideration as quantities of treatment chemicals are likely to be much greater than in any other process arisings. For example, the quantity of grout injected into a ground to strengthen or water tighten it may be perhaps 5 to 30% of the volume of soil.

Arisings other than soil from the tunnelling process may include:

- Bentonite;
- Hardened cement (e.g. from cement grout);
- Proprietary grouts;
- Empty bags and drums (e.g. treatment chemical, cement, bentonite or grout containers).
- There also may be some hydrocarbon contamination of the process arisings through leakage of hydraulic oils and greases.

6.3 pH

Many of the treatment chemicals tend to be of near neutral pH and thus their use should not generate concerns about the pH of the resulting process arisings. However, some caution is necessary as discussed in the following sections.

6.3.1 High pH

- sodium bentonite typically will have a pH in the range 9.5 to 10.5. Thus, pipe lubricants and bentonite based slurries may have pHs of up to about 10.5. Specially formulated lubricants may have higher (or lower) pHs;

- fresh concrete or cement grout will have a pH of about 13.5 thus cement containing process arisings can have a high pH;
- if a machine drives through concrete (e.g. weak concrete at a shaft entry/exit the process arisings will be of potentially high pH;
- silicate based grouts are of high pH and excavation through silicate grouted soil will give high pH process arisings;
- some slurry forming polymers perform better at high pH so alkalis may be added to the slurry.

6.3.2 Low pH

Excavation in peat can produce low pH process arisings. pH values may be as low as 3 though 4 to 5 is more typical.

Many deep clays contain some pyrite (iron sulphide). On exposure to air, the pyrite can oxidise to sulphuric acid and sulphates. In the ground, the soil may be of near neutral pH but after exposure to atmospheric oxygen the pH may reduce significantly.

6.3.3 Handling Hazardous Materials

The Environment Agency hosted NetRegs website includes the following advice

> "A 'Safety Data Sheet' must accompany any material supplied to you that has potentially hazardous properties. The Safety Data Sheet gives information on how chemicals should be handled, stored and disposed of. If a Safety Data Sheet does not accompany the delivery, contact the supplier and ask for it. Suppliers who fail to provide adequate information for the safe use of their products are in breach of the law.
>
> Materials that have hazard labels and are controlled by COSHH should be signed out of your storage area and signed back in after use regardless of the quantity left in the container. This also applies to materials signed out for use on remote sites."

http://www.environment-agency.gov.uk/netregs/processes/366713/

This web based resource also provides outline guidance for the sector. This is reproduced in Appendix 2.

7 LEGAL FRAMEWORK

7.1 Legal Context

The guide covers legislation that is applicable to the UK as a whole. However, this has been implemented in different ways between England and Wales, Scotland and Northern Ireland. The guide applies to the England and Wales legal situation as the default. While the general principles are common, contractors working in Scotland and Northern Ireland should seek specific advice from the local regulator (Scottish Environmental Protection Agency and DoE Environment and Heritage Service Northern Ireland respectively). [2]

7.2 Is the material waste?

'Waste' is defined in Article 1(a) of the Waste Framework Directive as *"any substance or object … which the holder discards or intends, or is required to discard".*

The Directive defines 'THE HOLDER' as being either the producer or the person now in possession of the object. This is important because it is the holder's decision or intention that is fundamental in deciding whether something has been or will be discarded. Where the holder is not the producer the intention or actions of the original producer are also relevant.

In contracting situations the producer is normally taken to be the tunnelling contractor. The holder could either be the tunnelling contractor or a main contractor or even the client for the project. Current practice is that the tunnelling contractor is responsible for the arisings as waste.

The Government issued guidance on the interpretation of the definition of waste in 1994 (Government Circular 11/94, Annex 2). However, since then there have been a number of judgements by the European Courts and our national Courts on the interpretation of the definition, which are not reflected in the Government's guidance. The Government is revising that guidance to take these judgements into account. However the Government defers to the courts as the final arbiter of the meaning of law.

The courts have identified various factors, which are relevant, and others, which are less relevant, in determining whether or not something is waste. However, most of these factors are only indicative and the Courts tend to emphasise that each decision must be made based on all the facts of the case before it whilst having regard to the aim of the

2 Basic Guidance for management of waste for the sector is given on the Environment Agency hosted NetRegs website – this is reproduced in Appendix 2.

Directive: the protection of human health and the environment against harmful effects caused by the collection, transport, treatment, storage and tipping of waste. That having been said, the findings of specific cases are having increasingly profound effects on the application of the law across the board so the specific nature of judgements should not be taken to mean they do not have wider application.

A recent example is the *Van de Walle* judgement which suggests that material insitu is waste if it has become contaminated whereas previously the view has been taken that material needs to have been excavated before it could be deemed waste. This judgement has profound implications for the identification of the holder of the waste because of course if the interpretation applies widely it would mean the land owner would be the keeper of the waste in the first instance and any subsequent operations involving the material would be viewed as waste management operations. A summary of the most significant judgements is included at Appendix 3. [3]

7.2.1 Has the item been 'discarded'?

This requires that the intention of the holder be determined. 'THE HOLDER' is the producer or the 'person in possession'. Has that person discarded the item, or are they intending to or being required to discard it?

While this guide provides guidance on interpretation ultimately it is the responsibility of THE HOLDER to determine whether they are handling waste. While the Environment Agency, as the authority responsible for enforcing waste management legislation in England and Wales, may advise of its opinion as to whether or not something is waste, it is possible to take a different view. Ultimately it is a matter for the courts to decide.

The Environment Agency has produced some guidance [4] on the matter which outlines a number of useful points (fundamentals) as follows:

1. Just because someone else has a use for an item does not mean that it is not waste.
2. Just because money changes hands for the item does not mean that it is not waste.
3. Just because an item doesn't work and needs repair does NOT mean that it IS waste.
4. The more that has to be done to an item to make it suitable for use then the more likely it is to be waste.
5. Recycling is something which is only carried out on waste

Step 1: Explore the scope for defining the waste producer through the contract.

7.3 If the material is classed as waste at which point is it deemed to become waste?

- At the tunnel face?
- When suspended in the slurry?
- When subjected to processing to remove it from the tunnelling cycle?
- When deposited as a solid/semi solid?

This is an important question as it determines the process boundary. So for example, if the material was deemed to have been discarded at the tunnel face then all subsequent processing may be subject to waste management licensing legislation. It may be more desirable to extend the process boundary to cover the full operation so that the material is deemed to be waste (if it is so deemed) only once it has left the site of production.

In the case of tunnelling arisings the presence of material at the face can perform a function in the tunnelling operations and hence it could be argued that at this point the material has not been discarded. It is only at the point at which the material has been removed from the process and a determination made as to whether it would be of any subsequent use that the material would then be deemed to be waste. The determination as to whether the material is or is not waste may depend on the consistency (wetness) of the material at this time.

Step 2: Determine the process boundary and establish when the material arising would be deemed to be discarded.

7.4 Under What Circumstances Might It Cease To Be Waste?

A further important question is that once a material is deemed to be waste under what circumstances might it cease to be waste?

Case law suggests that the waste must have been subject to a 'recovery operation'.

3 The European Commission document entitled ***"Towards a thematic strategy on the prevention and recycling of waste"*** *recognised the difficulties that the definition of waste can pose and indicated its willingness to enter into debate on the issue. There is work ongoing on this point.*

4 A Simple Guide To Assist Community Sector Reuse/Refurbishment Organisations In Complying With Waste Regulations. The Environment Agency & The Community Waste Sector – Nov 2003.

What constitutes a recovery operation in this case?

Recovery operations are defined in the Waste Framework Directive and the meaning has been further defined by Case Law at the European Court of Justice. See Appendix 3 for outline criteria that would qualify a process as a recovery operation.

7.5 Waste Management Options

If a material has been classed as waste, consideration needs to be given to the management options available.

The Government Waste Strategy 2000 presents a hierarchy of waste management options as follows:

1. Reduction
2. Reuse
3. Recycling & Composting
4. Recovery including thermal processing
5. Disposal

Applying the hierarchy to the management of tunnelling waste a number of options emerge. These are further expanded upon below.

7.5.1 Reduction

The opportunities to reduce production of arisings are limited in a tunnelling environment as the process necessarily requires the conversion of insitu material into loose material. However as stated above there is still some scope to avoid the material being defined as waste by extending the process boundary such that the material does not become classed as waste. The only viable reduction method identified once it is a waste is to reduce the water content of the arisings.

Step 3: Consider all opportunities to reduce the quantity of waste requiring management.

A producer is required to provide a written description of the nature of the waste to go for onward management. This description must provide as much information as someone else might need to handle the waste safely. It must describe the waste by reference to the appropriate 6 digit code/s in the European Waste Catalogue (EWC) (See Section 8.2.2). The EWC is intended to provide a method of identifying the type of waste according to the process or industries from which they arise. The code assigned may determine the management routes available particularly if the code applies to inert or potentially hazardous waste.

As is the case for tunnelling arisings where there is no specific code it is necessary to identify the code that achieves the 'best fit'. The most appropriate Chapter for tunnelling arisings would be under Chapter 17 (Construction and Demolition Wastes (including excavated soil from contaminated sites). Within this the most appropriate code would appear to be:

> 17 05 SOIL (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES), STONES AND DREDGING SPOIL
>
> 17 05 03* soil and stones containing dangerous substances
>
> 17 05 04 soil and stones other than those mentioned in 17 05 03

The presence of an asterisk allows for the possibility of the waste being hazardous. Classification as hazardous waste imposes additional regulatory burdens and is to be avoided if possible.

The Environment Agency Guidance [5] that gives its interpretation of the classification of hazardous waste states in the case of Chapter 17.05 that:

> "These categories include such a broad range of potentially hazardous wastes that they should be considered under all the hazards H1 to H14.
>
> If the chemical constituents of the waste are unknown, it should be treated as hazardous unless tested."

Definitions of the hazards H1 to H14 can be found in the Agency's Technical Guidance.

Hence a precautionary approach is proposed with a presumption to a Chapter 17.05 waste that is unknown being classed as hazardous if there is any reason to indicate the waste may be hazardous unless the full range of testing has been applied. This means that particular care should be taken if tunnelling in potentially contaminated conditions, with the need to ensure that any additives [6] or spillages do not render the waste hazardous.

5 Environment Agency Technical Guidance WM2: Hazardous Waste: Interpretation of the definition and classification of hazardous waste (June 2003).

6 The Environment Agency Guidance WM2 states on additives in relation to drilling muds: "Many "recipes" for drilling muds are unique to the company or individual in charge of the operation: it is difficult to be prescriptive about likely hazards. Even supposedly "low toxicity" water-based muds may contain ecotoxic additives (H14). If the chemical constituents of the mud are unknown, any additives should be assessed to determine any potential hazard".

Step 4: Determine Appropriate Classification of Waste

7.5.2 Reuse

For unavoidable arisings (re)use is, in principle, the most desirable outcome. Essentially natural material is being excavated which is then used for purposes for which other materials would otherwise have to be used. Examples of this include:

- Use on-site – where for example, engineering fill is required and a materials balance has been undertaken. If it is simply deposited on the site, this may constitute disposal by landfill under which circumstances a formal permit would be required. It is unlikely that this would be a favoured option under these circumstances. The key here is to avoid the material being classed as waste or demonstrating that the use of the material may be classed as a recovery operation.
- Use elsewhere via sale as product. The viability of this option depends on whether the material is classed as waste and if so that it has been subject to a recovery operation and so is no longer to be classed as waste. As the definition of waste suggests, a key determinant is the intention of producer. So it may be argued that if there was premeditation concerning the use of the material once it had been extracted for example, if a material is excavated and sold on, it may not be deemed to be waste at all. However, if the material is simply given away then it may be deemed to be waste as it might be implied that the intention of the producer is to discard it. Just because a receiver may have a use for the waste does not mean that it is not waste. As one judgement put it "one man's waste may be another man's treasure".*

This would normally require identifying receivers that are prepared to pay the 'market rate' for such material as an alternative to primary materials. If it is to be used for infill purposes the existence of planning permission for the development may also provide evidence of legitimacy.

Storage on-site pending disposal for longer than one year could be construed to constitute a disposal by landfill requiring a full permit. 'Storage' for an indefinite period would likely to be deemed to be abandonment and may render those responsible liable to prosecution for illegal waste disposal and possibly a requirement to remove the waste.

Step 5: Review contract arrangements such that opportunities for reuse of material arisings can be legitimately considered to enable use as a product.

7.5.3 Recovery

This would cover use elsewhere in a recovery operation exempt from waste management licensing. The Waste Management Licensing Regulations 1994 include specific exemptions from licensing for the application of certain waste to land under particular circumstances and subject to certain controls. These are known as the Paragraph 7 (spreading on agricultural land), 9 (land restoration) and 19 exemptions (golf courses and transport facilities etc). The full text is reproduced in Appendix 4. These have been revised recently and more formal registration procedures have been introduced.

From 1st October 2005 if you wish to rely on such an exemption you must seek registration from the Environment Agency. This will require you to obtain, complete and submit a form along with:

(a) a notice of relevant particulars and such other information as the authority reasonably requires in relation to the activity;
(b) such plans and other documents as the authority reasonably requires;
(c) specify the quantity of waste to be disposed of or recovered; and
(d) a cheque to cover a registration fee.

The registration is renewable on an annual basis with payment of an annual fee.

There is a fine line between reuse of tunnelling arisings for fill etc and the use of tunnelling waste in recovery operations and in practice they may amount to very similar activities. However if the material is classed as tunnelling waste the operator should notify the Environment Agency of the activity and go through the necessary registration procedure.

Although an activity may be exempt from licensing, it is still subject to statutory controls to prevent environmental pollution and harm to human health. It is an offence to carry out an exempt activity without it being registered or to carry out an activity in breach of registration obligations.

** The Government funded Waste & Resources Action Programme (WRAP) has undertaken some pioneering work developing Quality Protocols for the production of aggregates from inert waste. The Quality Protocols provide a route for producers of recycled and secondary aggregates to demonstrate that their product has been fully recovered and is no longer a waste.*

7.5.4 Disposal

The principal disposal route open for tunnelling spoil is to landfill.

At the landfill it may be deemed suitable for use in restoration or for operational purposes e.g. cover. In these circumstances it is possible that it may be exempt from landfill tax (See Section 8.3).

7.5.4.1 Classes of landfill

The EU Landfill Directive was adopted in 1999. It introduces a system of landfill classification. Essentially three classes of landfill are being created:

- Inert landfill that may only accept specified inert wastes that meet the relevant waste acceptance criteria;
- Non hazardous waste landfill that may accept municipal waste, other non-hazardous wastes (including inert wastes) and, in certain circumstances, stable, non-reactive hazardous wastes within a separate cell;
- Hazardous waste landfill that may only accept wastes classified as hazardous under the Hazardous Waste Directive and that meet the relevant Waste Acceptance Criteria.

This system is being progressively introduced and by October 2007 it is expected that all landfill sites will have been categorised under the regime.

Since July 2004 hazardous waste may be disposed only to sites classed as hazardous waste landfills or where specific cells for stable hazardous waste have been created in non hazardous waste landfills.

How Landfill Classification May Affect Disposal Of Process Arisings

Inert Waste

Waste may only be accepted at a landfill for inert waste if it appears in the Table below or meets the limit values for waste acceptable at landfills for inert waste given in Table 3 of Appendix 5.

Providing the process arisings remain uncontaminated they would be expected to fall within the EWC Category 17 05 04 and hence should not require testing.

Table 3: Waste that May be Accepted at Inert Waste Landfills Without Testing

EWC Code	Description	Restrictions
10 11 03	Waste glass based fibrous materials	Only without organic binders
15 01 07	Glass packaging	
17 01 01	Concrete	Selected C&D waste only
17 01 02	Bricks	Selected C&D waste only
17 01 03	Tiles and ceramics	Selected C&D waste only
17 01 07	Mixtures of concrete, bricks, tiles and ceramics	Selected C&D waste only
17 02 02	Glass	
17 05 04	Soil and stones	Excluding topsoil, peat; excluding soil and stones from contaminated sites
19 12 05	Glass	
20 01 02	Glass	Separately collected glass only
20 02 02	Soil and stones	Only from garden and parks waste; Excluding top soil, peat

Note C&D = construction and demolition

Waste Acceptance Criteria (WAC)

Where the waste type is not listed the particular waste requiring disposal must not exceed the leaching limit values and other criteria specified in the Regulations (see Appendix 5). Providing the inert waste is uncontaminated by any other materials, then it may be accepted at an inert landfill.

For non hazardous waste landfills, there are no leaching limit values set. The primary requirement is to ensure that the waste is not hazardous waste. In view of the wide range of non-hazardous wastes, permits may limit the wastes to be accepted on a site-specific basis. Non hazardous liquids can only be accepted at non hazardous landfill sites, and then only until 2007 (but see Section 7.5.4.2).

For hazardous waste landfills, there is a Hazardous Waste List [7]. If the waste is on this list, it then needs to be considered against leaching limit values and other criteria.

Testing

Inert waste specified in Table 3 may be accepted at inert waste landfills without testing provided the waste is –

(a) from a single stream waste of a single waste type (except where different waste types from the list in Table 3 are accepted together);
and
(b) is from a single source.

If there is suspicion of contamination or doubt that the waste meets the leaching criteria the waste should be properly tested. If such testing reveals contamination or the presence of other materials or substances such as metals, asbestos, plastics or chemicals, the waste must not be accepted at a landfill for inert waste if the extent of the contamination is such as to increase the risk associated with the waste sufficiently to justify its disposal in other classes of landfill.

For potentially contaminated inert waste and all non inert waste, the waste producer is responsible for ensuring that basic characterisation of the waste has taken place to establish its key characteristics. In particular, details of the chemical composition and leaching behaviour of the waste are required.

Once the waste is characterised, the producer should consider the ways in which the waste might be managed in accordance with the waste hierarchy, whether this be future reduction of waste produced, reuse, recovery or lastly disposal.

Where disposal by landfill is the identified option for all or part of the waste, the producer should consider appropriate treatment options, identify the landfills that may be able to accept the waste and establish whether the waste will meet the WAC (where applicable). All of the properties of the waste appropriate to the applicable WAC must be known and PERIODICALLY CHECKED to ensure that those properties have not changed.

7.5.4.2 Prohibition on liquids (by March 2008)

Regulation 9 of the Landfill Regulations (England & Wales) 2004 provides that the operator of a landfill shall not accept certain wastes, including: *"any waste in liquid form (including waste waters but excluding sludge)"*. This is due to come into effect for non-hazardous liquids in October 2007. Many non-hazardous landfill sites may have pre-existing licence or permit conditions controlling the acceptance of liquid wastes and so you should always check the individual Waste Management Licence or Permit.

An extract from DEFRA's interpretative guidance on the Directive is set out below. It should be emphasised this is subject to the same caveat as all DEFRA guidance – it is not definitive and ultimately is for the courts to decide on a case-by-case basis.

> "Wastes in liquid form are prohibited from landfill due to the potential problems caused by their propensity to flow and be mobile within a landfill.
>
> In the absence of a definition in the Landfill Directive and bearing this purpose in mind, wastes in liquid form, specifically in the context of landfills, should be regarded as:
>
> *i) Any waste that near instantaneously flows into an indentation void made in the surface of the waste; or*
> *ii) Any waste load containing free draining liquid substance in excess of 250 litres or 10% of the load volume, whichever represents the lesser amount.*
> *iii) "Free draining" means a liquid as defined in (i), irrespective of whether that liquid is in a container.*
>
> The first of these interpretations can be used to distinguish between liquids and sludges. A waste that flows only slowly, rather than near instantaneously, into an indentation void will be a sludge (or possibly a fine-grained solid) and therefore not prohibited by regulation 9(1)(a).
>
> The second interpretation should be used where liquids are known to be present in small amounts in a generally solid waste, or are adventitious in a waste. An example of the former might be cartons of milk or juice in mixed commercial waste. The latter would include liquid that has drained or been squeezed from components of the waste, and/or rainwater that has fallen in the waste container."

7 Commission Decision 2000/532/EC as amended by Commission Decisions 2001/118/EC, 2001/119/EC and 2001/573/EC.

The interpretative guidance goes on to state:

> "Where a liquid is used as an aid to facilitate the transport of waste to the landfill, usually by pipeline, and the liquid is subsequently removed then this may not amount to the acceptance of waste in a liquid form. Each such case will, however, be treated on its merits."

DEFRA have advised that the determination of whether tunnelling slurry is acceptable at landfill will be down to local Environment Agency officers who may consult the Head Office. You are advised to contact your local landfill operator to check whether they are willing to accept the material. While there is shared responsibility for compliance with the Directive/Regulations from the point of view of characterisation it can be argued that providing you have asked the question and received a confirmation it is the responsibility of the landfill operator to ensure it does not accept waste outside the terms of its permit or licence.

7.5.5 Pre-treatment

A general requirement for all waste disposed of to landfill to be subject to treatment comes into effect by 30 October 2007. Any potential treatment must fulfil all the following three criteria (but need only meet one of the four objectives of the third point):

1) It must be a physical/thermal/chemical or biological process including sorting.
2) It must change the characteristics of the waste.
3) It must do so in order to:
   a) reduce its volume, or
   b) reduce its hazardous nature, or
   c) facilitate its handling, or
   d) enhance its recovery.

Inert waste is exempted from the treatment requirement where *treatment is not technically feasible*. The Agency view is that such a decision can only be made following a thorough evaluation of the treatment options.

Where a waste to be landfilled is already the product of a waste treatment and in such circumstances, it is not necessary to further treat the residue prior to landfill. The key requirement is that the waste is subjected to a process that meets the three-point test (e.g. it changes its characteristics and some element of the waste is recovered) following identification that it is waste under the Waste Framework Directive. Also, it is not necessary for the purposes of the regulations that the treatment take place outside the site of production, or that all wastes currently landfilled receive further treatment.

In the case of tunnelling arisings deemed to be waste, it would be possible to determine that the waste has already been treated by virtue of it having been generated from the liquid/ solid separation plant. Alternatively if the point of waste determination was to be at the point of discharge of the solid from the solid/liquid separation plant then demonstrating that the industry is considering dewatering options could suffice as a justification for treatment not being technically feasible.

The Regulations also provide that the treatment may not be required if it is non-inert waste and treatment would not reduce its quantity or the hazards that it poses to human health or the environment. The Agency view is that in most cases, there is likely to be a treatment that will achieve such a reduction. Any decision not to treat requires a producer to demonstrate that a thorough evaluation of the treatment options has been undertaken.

Action: Waste producers are advised to liaise with landfill operators to confirm whether the treatment requirement yet applies to their landfill, and to advise them what treatment has, or might have been applied or any reasons why treatment is considered unnecessary. Written information regarding treatment should be contained on or with the Duty of Care transfer note.

It is expected that the Duty of Care provisions of the Environmental Protection Act 1990 and related Code of Practice will be amended to reinforce this requirement.

8 ASSOCIATED REGULATORY REQUIREMENTS

8.1 The Duty of Care

The Environmental Protection Act places a duty on all producers and handlers of waste to 'take reasonable measures to prevent the unauthorised deposit, treatment or disposal of waste'. Failure to comply with the Duty of Care is an offence. The Duty implies four key obligations on waste producers:

1. **CHECK** that materials are packaged appropriately and robustly to prevent escape from your control or the control of anyone else.

   Inspect the waste and the receiving vehicle where it has been loaded prior to transport.

2. **CHECK** that anyone receiving your waste is authorised to do so. Authorised persons include those who hold a waste management licence, Pollution Prevention and Control (PPC) Permit or operate under an exemption from the need for a licence. You should check that the waste management licence has not been suspended or partially revoked and that they are not in breach of the conditions of that licence, permit or exemption. Authorised persons for transport of waste are registered as waste carriers with the Environment Agency.

   Ask to see the registration certificate and/or licence / permit / exemption. Contact the local Environment Agency office to check.

3. **CHECK** that the person or business to whom you transfer your waste is authorised to deal with your particular type of waste by undertaking checks and audits.

   Ask to see the registration certificate and/or licence / permit. Contact the local Environment Agency office to check.

4. **Provide** a transfer note to accompany the waste. The transfer note, to be completed and signed by both persons involved in the transfer, must include:

   - What the waste is and how much there is?
   - What sort of containers it is in?
   - The time, date and location the waste was transferred.
   - The names and addresses of both persons involved in the transfer.
   - Whether the person transferring the waste is the producer of the waste.
   - Details of which category of authorised person each one is. If the waste is passed to someone for authorised transport purposes, you must say which of those purposes applies.
   - If either or both persons is a registered waste carrier and the certificate number.
   - If either or both persons has a waste management licence or PPC permit and the licence or permit number or the reasons for any exemption from the requirement to register or have a licence.
   - Where appropriate, the name and address of any broker involved in the transfer of waste.

The written description must provide as much information as someone else might need to handle the waste in accordance with his or her own Duty of Care. It must describe the waste by reference to the appropriate 6 digit code/s in the European Waste Catalogue (EWC).[8]

Ensure a properly completed transfer note is provided that accurately describes the waste and any special precautions that need to be taken in its handling.

Repeated transfers of the same kind of waste between the same parties can be covered by one transfer note for up to a year.

Keeping the papers: both persons involved in the transfer must keep copies of the transfer note and the description of the waste for at least two years If you are using a single transfer note for repeated transfers of the same kind of waste between the same parties then copies of such paperwork must be kept for two years from the last date during the one year period for which the note is valid i.e. three years from when the note was signed. A copy of the transfer note must also be made available to the Environment Agency or Waste Collection Authorities if requested.

Retain the transfer note on a central register as you may need to account for a movement. See Waste Management, the Duty of Care: a Code of Practice (HMSO) for further details.

8.2 Special Waste

If the waste has certain hazardous properties then it may be 'Special Waste'. Special Waste is waste that is potentially hazardous or dangerous, which may require extra precautions during handling, storage, treatment or disposal. Controlled waste is defined as 'Special' if it is listed with a six digit code in Part 1 of Schedule 2 of the Special Waste Regulations 1996 (SWR), and contains substances at or above a threshold level giving the waste one or more of the 14 hazardous characteristics listed opposite:

8 The requirement to refer to the code is contained in the Landfill Regulations 2002.

Table 4: Characteristics That Render a Waste Hazardous

Explosive	Infectious
Oxidising	Teratogenic (causes birth defects)
Flammable and highly flammable	Mutagenic (causes genetic changes)
Irritant	Ecotoxic
Harmful	Substances and preparations that; (a) release toxic or very toxic gases (b) after disposal can produce a hazardous characteristic
Toxic	
Carcinogenic	
Corrosive	

Note: Even if the waste stream is not identified in Part 1 of Schedule 2, **it may still be Special Waste** if the waste displays one of the hazardous properties listed below at concentrations above the given threshold, or in the case of highly flammable liquids, has a flash-point below 21°C.

Table 5: Properties That May Render a Waste Special

Hazardous Property	Additional information	Threshold
Highly flammable		Liquid with a flash-point of 21°C or less
Irritant	Risk phrases R36-R38	20%
Irritant	Risk phrase R41	10%
Harmful		25%
Very toxic		0.1%
Toxic		3%
Carcinogenic	Category 1 or 2	0.1%
Corrosive	Risk phrase R34	5%
Corrosive	R35	1%

Threshold levels for the other hazardous properties, where applicable, are provided in guidance produced by the Environment Agency. Physical or chemical testing of the waste may be required to determine some hazardous properties, e.g. flammable. For further information see WM1: Special Waste available from HMSO.

Whilst most tunnelling additives are non-hazardous, COSHH sheets should be checked in relation to chemicals with particular reference to content. Information contained on the Safety Data Sheet (SDS) that accompanies material/chemicals received onto your site will also help you to determine if your waste is 'Special'.[9] If in doubt, the Environment Agency or a specialist waste management contractor should be able to advise.

The Requirements

Wastes that are identified as 'Special' are tracked by the Environment Agency through a consignment note system to ensure that they are responsibly managed from their point of origin until they reach a suitably licensed or exempt facility to be recovered or disposed.

Before Special Waste is moved, the Environment Agency must be notified. This is done by completing a consignment note that must contain a unique code provided by the Environment Agency. It must also include the details of the premises and parties involved with the movement and an accurate description of the waste. The Environment Agency must be pre-notified, at least 3 working days and not more than one month before the waste is moved.

9 The Environment Agency Guidance WM2 states on additives in relation to drilling muds: "Many "recipes" for drilling muds are unique to the company or individual in charge of the operation: it is difficult to be prescriptive about likely hazards. Even supposedly "low toxicity" water-based muds may contain ecotoxic additives (H14). If the chemical constituents of the mud are unknown, any additives should be assessed to determine any potential hazard".

Certain types of Special Waste movements are **exempt from pre-notification**. These include the second and subsequent movements of the same type of waste moving from the same producer to the same disposal/recovery facility (where the first movement has been pre-notified and transported) Special Wastes moved between sites belonging to the same corporate body where that waste is to be stored prior to disposal/recovery and where the site receiving the waste holds a suitable licence/permit/exemption to receive the waste.

Note that these movements will still require use of a consignment note to accompany their movement.

8.2.1 Replacement of the Special Waste Regulations (SWR)

The SWR are due to be revoked and replaced by the Hazardous Waste Regulations on 16 July 2005. The Regulations will include the following requirements:

- Producers of Hazardous Waste to register the premises where the hazardous waste is produced with the Environment Agency and pay a fee.
- Hazardous waste producers to retain records including details of quantities and destination of any hazardous wastes moved off site.
- A consignment note system will still be in place but the Agency will no longer have to be pre-notified of each waste movement.
- Hazardous waste will have to be separated from 'non-hazardous waste', where this is 'technically and economically practical'.

The terminology will change, and the term 'Special Waste' will be superseded by the term 'Hazardous Waste'. It will also mean that in some cases waste will be classed as 'Hazardous' for the first time. The regulations work with the European Waste Catalogue providing an index of different types of wastes and defining what category each type of waste belongs in, which then determines how the waste is regulated, charged, monitored and inspected.

8.2.2 The European Waste Catalogue 2000/532/EC ('EWC')

The European Waste Catalogue (EWC) classifies waste by its origins. There are 20 categories (referred to as Chapters) and many of these relate to specific sectors. Hazardous wastes are identified either as 'absolute entries' in which case they should be regarded as hazardous regardless of their actual properties, or as 'mirror entries', in which case they may or may not be hazardous depending on the properties of the specific waste stream under consideration. The latter applies to construction and demolition waste which may be contaminated with hazardous substances.

8.3 LANDFILL TAX

Landfill tax applies to all waste disposed of by way of landfill. The tax liability falls on the landfill operator but the cost is passed on to customers.

The tax is chargeable by weight and there are two rates:

- A lower rate of £2 per tonne applies to those inactive (or inert) wastes listed in the Landfill Tax (Qualifying Material) Order 1996, the relevant extract of which is set out in Appendix 6; and
- A standard rate that applies to all other taxable waste. This is currently £15 per tonne but due to rise by £3 per tonne each year until 2012.

The principal arisings from pipe jacking would qualify as inactive waste as it is naturally occurring rock or soil, or constitutes water carrying inactive waste materials providing it is not contaminated with other chemicals.

Discounting Water

Landfill tax is not payable on water added to waste under the following circumstances.

- has been added to allow transportation for disposal; or
- has been used for the extraction of minerals; or
- has arisen or been added or both, in the course of an industrial process.

However, water must be 25 per cent or more of the waste, by weight. This equates to 33% by dry weight of soil.

HM Customs & Excise has now confirmed that water added to soil in a slurry tunnelling machine should not be taxable by virtue of it being added in the course of an industrial process – though it will be subject to landfill operator's disposal charges. To claim exemption an application form should be obtained from the Landfill Tax Helpdesk. If Customs are satisfied that the application qualifies for discounting, they will send written approval to the waste producer and the nominated landfill site operator(s). [10]

10 HM Customs & Excise, Notice LFT1, A General Guide to Landfill Tax, February 2000.

Exemption of Material for Use on Landfill

If you can demonstrate to HM Customs & Excise's satisfaction that you did not discard material used in site engineering, it will not be subject to tax. Evidence for this could include invoices to show that the material was bought by the landfill operator from a business whose principal activities include supplying it (in other words, who demonstrably had no intention to discard the material).

Inactive (or inert) waste which is used for the purposes of restoring a landfill site or part of a landfill site may qualify for exemption under certain conditions. **Therefore it would be worth checking with your disposal contractor if he is proposing to charge you landfill tax whether the material will in fact be disposed of to landfill or qualify for an exemption.**

Exemption of Material Ex Processing Plant

Landfill site operators can apply to operate a tax-free area if they intend to carry out recycling of waste (which includes composting). If waste is processed before its disposal to landfill and the process changes it into a useable material, the original producer's intention is no longer relevant. The landfill tax liability is determined by the intention of the recycler, as evidenced by the nature of the transaction.

8.4 AGGREGATES LEVY

The aggregates levy is a tax on primary sand, gravel and rock that is dug from the ground or dredged from the sea. The tax was introduced in April 2002 to address the environmental damage caused by these business activities. Operators must pay a tax of £1.60 per tonne of sand, gravel or rock. However aggregate arising from utility trenching, highways excavation, navigational dredging and building construction is specifically exempted.

HM Customs and Excise has advised that the above exemption would apply where arisings come from:

- work undertaken in the course of installation or maintenance of pipes for utilities i.e. gas, electricity or water that follow the line of an existing or proposed highway; or
- the footprint of a building and laying of any connected pipes and cables; or
- the highway / footprint sub-base (previously used for construction purposes).

However the exemption does not hold if installing or maintaining an industrial pipeline to transport a commodity such as oil.

The impact of this measure on tunnelling spoil may be indirect – that where tunnelling spoil might displace primary aggregates it will make the use of tunnelling spoil more attractive.

9. DECISION FRAMEWORK

The previous chapters have detailed the legal requirements that may apply at times to process arisings from the tunnelling process. This chapter seeks to present the key decisions in a logical progression to aid in the identification of the optimal route to compliance.

STEP ONE: DETERMINE IF THE MATERIAL IS A WASTE

Test: Q1: Has the material been discarded? (see Section 7.2.1) [11]

Action: Check Contract documentation, determine if the circumstances of production require the material for other purposes.

Tip: Look to utilise materials arising from tunnelling for other purposes when planning a job. If possible do it onsite, if not enter into contracts for supply of material elsewhere at the 'going rate'.

STEP TWO: WHEN HAS THE MATERIAL BECOME WASTE?

Test: Q1: At the face? Q2: At the solids discharge point? Q3: At the point of removal from site? (See Section 7.3)

Action: Assess at which point the material ceases to be of use.

Tip: The later this can be delayed the less the arisings get caught in regulation.

Once the material is waste….

11 'If no' then material may be treated as non-waste. Note its handling and storage may still be subject to certain controls.

STEP THREE: DETERMINE WHAT TYPE OF WASTE IT IS – INERT, NON HAZARDOUS OR HAZARDOUS?

Test: Q1: Is it uncontaminated homogenous material? (See Section 7.5.4.1)
Q2: Has it got any biodegradeable material mixed with it?
N = move to Q3.
Y = Non hazardous (See Section 7.5.4.1)
Q3: Does the waste either have an absolute or mirror entry in the EWC?
N = then non hazardous or inert.
Y = if absolute consign as hazardous.
Q4: If a mirror entry exists does the waste have any known hazardous properties or contain dangerous substances?
N = non hazardous or inert.
Y = does the waste have any of the hazardous properties H1 to H14.

Action: Assign EWC Code (See Section 8.2.2).
Sample and analyse if necessary.

Tip: Segregate your waste as far as possible.
- Ensure that any potential contaminants are kept securely and that any spillages/leakages are dealt with quickly and the residues cleared and contained.
- Seek to ensure that tunnelling arisings are kept separate from topsoil or vegetation on the site.
- When tunnelling in proximity to saline environments check carefully to ensure that intrusion of saline water does not occur.
- When tunnelling in potentially contaminated soil carry out site investigations or be prepared to separate arisings for analysis.

STEP FOUR – DETERMINE APPROPRIATE MANAGEMENT ROUTE

Q1: If it is inert, is it suitable for use as infill onsite? (See Section 7.5.2)

Test: The material should be 'suitable for use' both in terms of chemical composition and physical properties.

Action: Ensure relevant checks are made and records kept of these procedures.
Produce material balance for site in advance of tunnelling.

Tip: Check to ensure that receiving site is not subject to any statutory designations and site has requisite planning permission.

If it is not inert can it be treated to remove any contaminants? (See Section 7.5.4.1)

Test: Assess presence of contaminants and ease of removal.
HM Customs & Excise suggest that you may ignore the presence of an incidental amount of active waste in a mainly inactive load as long as it does not lead to any potential for pollution.

Action: Ensure relevant checks are made.

Inert to recycling for screening and reuse (See Section 7.5.3)

Inert to exempt site (See Section 7.5.3)

Test: The material should be 'suitable for use' both in terms of chemical composition and physical properties.

Action: Ensure Environment Agency is notified of activity.

Tip: Providing the material is 'suitable' there is no restriction on the moisture content of material for use in exemptions.

Inert to inert-only landfill

Test: Is the type of waste listed or within the leaching limit values and other criteria specified in the Regulations (see Appendix 5).
Ban on liquids – any waste that near instantaneously flows into an indentation void made in the surface of the waste.

Action: Sample and analyse if not listed.
Check with landfill operator/ contractor that waste is acceptable in the condition in which it will be delivered. (See Section 7.5.5)

Tip: Segregate waste onsite.
Remove topsoil and vegetation for separate disposal if present onsite.

Inert to non hazardous waste landfill site for engineering/ restoration purposes – tax free (See Section 8.3)

Inert to hazardous waste landfill site for engineering/ restoration purposes – tax free (See Section 8.3)

Test: Ensure waste is free from any organic/biodegradable material unless to be used for restoration.

Non-inert to non-hazardous landfill site & hazardous to hazardous waste landfill site.

Must not be liquid waste.

Test: Any waste that near instantaneously flows into an indentation void made in the surface of the waste.

Tip: Leave wet material to drain as much as possible before despatch to landfill. Be aware that solids can separate out in transit and that release of the liquid whilst in transit could be in breach of Duty of Care. Consider making provision to drain off excess liquid at receiving site.

Check with landfill operator/ contractor that waste is acceptable in the condition in which it will be delivered.

STEP 5: COMPLETE NECESSARY PAPER WORK

Complete Duty of Care note confirming if treated or not.

Complete and retain consignment note

APPENDIX 1

Pipe jacking and small diameter EPB tunnelling Example figures for arisings

Performance examples for Slurry and EPB tunnelling machines and associated solid/liquid separation plant

Slurry machine parameters

Machine data		Units	Comments
Tunnel outside diameter	1.8	m	Typical average value
Machine advance rate	2	m/hr	Average, peak may be 10 m/hr
Volume of soil excavated	5.1	m^3/hr	
Slurry flow rate into face	200	m^3/hr	Range typically 150 to 250 m^3/hr
Density of slurry input to face	1.05	t/m^3	Typical value, plant performing satisfactorily

Table 1 Assumed data for an average pipe jack or small diameter tunnelling project

Notes:
Figures in italics are data estimates and may be varied.
In any table, figures in bold are developed from figures in earlier tables other figures are calculated within the table.
Percentages are shown in both mass and volume columns.
Percentages in a mass column are by mass and in a volume column by volume.

Soil parameters

Soil data for 1 m3 excavated	Mass, t	Volume, m^3	Density, t/m^3
Soil grains	1.21	0.46	2.65
Water in soil	0.54	0.54	1.00
Total soil	1.75	1.00	1.75
Soil moisture content	45%		

Note: It is assumed that the soil is saturated with an average moisture content of 45%.
This would be a soil with a significant amount of fines.
Moisture content may vary very significantly within and between drives.

Table 2 Possible average properties of soil

Soil excavated

Soil excavated per hour	Mass, t	Volume, m^3	Density, t/m^3
Solids in soil	**6.2**	2.3	**2.65**
Water in soil	2.8	2.8	1.00
Total mass of soil excavated	**8.9**	5.1	1.75

Combining machine data and soil data.

Table 3 Soil excavated per hour

Slurry parameters: slurry to face

Returned slurry to face	Mass, t	Volume, m^3	Density, t/m^3
Solids in slurry	16.1	6.1	**2.65**
Water in slurry	193.9	193.9	1.00
Total slurry	210.0	**200.0**	**1.05**

Slurry is assumed to be cleaned to a density of 1.05, i.e. it has some remaining soil fines.
Slurry loss to the ground is ignored as example is for a fine soil, though face could be mixed.

Table 4a Returned Slurry flow

Slurry from face

Soil laden slurry outflow from face/hour	Mass, t	Volume, m^3	Density, t/m^3
Solids in slurry	**22.2**	**8.4**	**2.65**
Water in slurry	**196.7**	**196.7**	1.00
Total slurry	**218.9**	**205.1**	1.07

Soil laden slurry is cleaned slurry plus water and solids from soil.

Table 4b soil laden slurry flow

Solid/liquid separation plant performance plant parameters

Solid/liquid separation plant performance by mass			
Separation unit	Coarse screen	Dewatering screen	Centrifuge
Per cent passing	90%	21.4%	0%
Per cent removed in unit	10%	68.6%	21.4%
Solids content of treated arisings	90%	70%	35%

These are example figures, actual values will vary considerably between soils and solid/liquid separation plants

Table 5 Simplified performance of separation units in overall solid/liquid separation plant

Solid/liquid separation plant	Primary screen			Dewatering screen			Centrifuge			Total arisings		
	Mass, t	Volume, m^3	Density, t/m^3	Mass, t	Volume, m^3	Density, t/m^3	Mass, t	Volume, m^3	Density, t/m^3	Mass, t	Volume, m^3	Density, t/m^3
Solids in arisings	**0.9**	0.3	**2.65**	**6.1**	2.3	**2.65**	**1.9**	0.7	**2.65**	8.9	3.4	**2.65**
Water in arisings	**0.1**	0.1	1.00	**2.6**	2.6	1.00	**3.5**	3.5	1.00	6.3	6.3	1.00
Total arisings	1.0	0.4	2.27	8.7	4.9	1.77	5.4	4.3	1.28	15.2	9.6	1.58
Solids content of treated arisings	90%			70%			35%			59%		
Moisture content	11%			43%			186%			70%		
Split between separation units	7%	5%		58%	51%		36%	44%		100%	100%	

The total arisings are assumed to be the sum of arisings from each solid/liquid separation unit

Table 6 Quantities of arisings removed per hour in each unit of the solid/liquid separation plant

Earth pressure balance machine parameters

EPB Machine	Output from screw conveyor		
	Mass, t	Volume, m^3	Density, t/m^3
Solids in arisings	**6.2**	2.3	**2.65**
Water in arisings + added water	11.4	11.4	1.00
Total arisings	17.6	13.7	1.28
Arisings solids content	35%		
Moisture content	186%		

The only variable in this table is the assumed solids content of arisings
35% solids content in the arisings has been suggested as a typical value
This implies significant mixing of soil and groundwater and/or water introduced with EPB conditioning additives

Table 7 Possible performance characteristics for an EPB machine

Total soil excavated and arisings per year

Proportion by machine type over a year	
Slurry machine	95%
EPB machine	5%

Soil excavated per year	Mass, t	Volume, m³	Density, t/m³
Solids in soil	**20690**	7807	**2.65**
Water in soil	9310	9310	1.00
Total soil excavated per year	30000	17118	1.75

Arisings to be managed per year	Slurry machine			EPB machine			Total arisings		
	Mass, t	Volume, m³	Density, t/m³	Mass, t	Volume, m³	Density, t/m³	Mass, t	Volume, m³	Density, t/m³
Solids in arisings	**19655**	7417	**2.65**	**1034**	390	**2.65**	20690	7807	**2.65**
Water in arisings	13801	13801	1.00	1921	1921	1.00	15722	15722	1.00
Total arisings	**33456**	21218	1.58	**2956**	2312	1.28	36411	23529	1.55
Solids content of treated arisings	59%			35%			57%		

Table 8 Total arisings combining data from earlier tables

Analysis of arisings per year	Soil excavated		Arisings for management		Extra material generated	
	Mass, t	Volume, m³	Mass, t	Volume, m³	Mass, t	Volume, m³
Solids	**20690**	**7807**	**20690**	**7807**	0	0
Water	9310	**9310**	**15722**	**15722**	6411	6411
Total arisings	**30000**	**17118**	**36411**	**23529**	6411	6411
Solids content	69%		57%			
Per cent extra					21%	37%

These are indicative figures but show the key importance of solid/liquid separation plant performance – water removal

Table 9 Summary showing overall extra arisings because of extra water in arisings above that in soil in ground

Comparison of quantities of soil excavated and arisings from Slurry and EPB tunnelling

Material	Soil to be excavated		Slurry tunnelling		EPB tunnelling	
	Mass, t	Volume, m3	Mass, t	Volume, m3	Mass, t	Volume, m3
Solids	**1.21**	**0.46**	**1.21**	**0.46**	**1.21**	**0.46**
Water	**0.54**	**0.54**	**0.85**	**0.85**	**2.24**	**2.24**
Total arisings	**1.75**	**1.00**	**2.06**	**1.30**	**3.45**	**2.70**
Solids content	69%		59%		35%	
Per cent extra			17%	30%	97%	170%

Note: comparisons are per cubic metre of soil excavated by the machine

Table 10 Comparison of Soil excavated and Arisings produced or Slurry tunnelling and EPB tunnelling

APPENDIX 2
Extract of Sectoral Guidance from NetRegs

http://www.environment-agency.gov.uk/netregs/processes/366720/
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Tunnelling, Pipejacking and Shaft Sinking – Waste

Guidelines

Any substance or object that you discard, intend to discard or are required to discard is waste and as such is subject to a number of regulatory requirements. Be aware that the term 'discard' has a special meaning. Even if material is sent for recycling or undergoes treatment in house, it can still be waste.

Mandatory Requirements

- The Duty of Care requires that you ensure all waste is stored and disposed of responsibly, that it is only handled or dealt with by individuals or companies that are authorised to deal with it and that a record is kept of all wastes received or transferred through a system of signed Waste Transfer Notes. For further information on your obligations under the Duty of Care, use the link in the 'See Also' box.
- If you are working as a sub contractor and the Main Contractor is arranging for the disposal of waste that you produce, you are still responsible for those wastes under the Duty of Care.
- Be aware that spoil or other materials from your works can be considered waste if you discard, intend to discard or are required to discard them. Once discarded, waste must be transported in accordance with the Duty of Care.
- If you are transporting your own waste which is either construction or demolition waste you will need to be registered as a waste carrier with your Environmental Regulator.
- Whether discarded material (waste) that has undergone treatment in a screening plant, centrifuge or other similar system remains subject to waste management licensing is dependent on a number of factors, including whether it has undergone a complete recovery operation. For each case, you should consult with your local environmental Regulator for an opinion.
- Be aware that any material that contains greater than 0.1% by volume of hydrocarbon will need to be disposed of as Special Waste. This can include tunnel spoil and bentonite that are in close contact with equipment that may be leaking. Consider having samples laboratory tested prior to disposing of this material.
- If the material that you are handling has hazardous properties, it may need to be dealt with as 'Special Waste.'
- If you intend to discard containers, an assessment must be made as to whether they are Special Waste. Containers may be Special Waste if they contain residues of hazardous or dangerous substances/materials. If the residue is 'Special', then the whole container is Special Waste.

Good Practice

- Ensure that wagons removing slurry from your site are fitted with tailgate seals and, that the handles on the tailgate are fully engaged before it leaves the site.
- Label all waste skips – make it clear to everyone which waste type should be disposed of in that skip.
- Segregate the types of waste produced on your site. Try to identify opportunities for reducing the quantity of wastes produces, opportunities for reuse of materials on site and for recycling.
- Be aware that materials requiring treatment or recycling such as scrap metal, either on your premises or elsewhere, are likely to be waste and will be subject to the Duty of Care.

APPENDIX 3
European Court of Justice Judgments: The Definition of Waste

There follows a summary of ECJ Judgments relating to the Definition of Waste as it applies in the UK. Inevitably this is constantly evolving body of law. The listing covers the key cases up to December 2004 and is extracted from the DEFRA Consultation Paper bringing agricultural waste and non mineral mining and quarrying waste under direct regulatory control.

Zanetti – Federal Republic Of Germany

4.1 On 28 March 1990 the European Court of Justice (ECJ) delivered the following judgments in Joined Cases C-206/88 and C-207/88 ***(Vessoso and Zanetti*** [1990] 2 LMELR 133) and C-359/88 ***(Zanetti and Others)***:-

(a) "The concept of waste, within the meaning of Article 1 of Directive 75/442/EEC and Article 1 of Directive 78/319/EEC154, is not to be understood as excluding substances and objects which are capable of economic re-utilization. The concept does not presume that the holder disposing of a substance or object intends to exclude all economic reutilization of the substance or object by others."

(b) "National legislation which defines waste as excluding substances and objects which are capable of economic re-utilization is not compatible with Council Directives 75/442 and 78/319."

4.2 In a judgment delivered on 10 May 1995 the ECJ held that their finding on ***Zanetti*** was not affected by the amendments made to Directive 75/442/EEC by Council Directive 91/156/EEC (Case C-422/92 ***Commission of the European Communities v Federal Republic of Germany***, paragraphs 22-23).

Tombesi – Savini

4.3 On 25 June 1997 the ECJ delivered its judgment on Joined Cases C- 304/94, C-330/94, C-342/94 and C-224/95 (Criminal proceedings against ***Euro Tombesi and Others).*** In doing so, the ECJ held that:-

"The concept of 'waste' in Article 1 of Council Directive 75/442/EEC of 15 July 1975 on waste, as amended by Council Directive 91/156/EEC of 18 March 1991, referred to in Article 1(3) of Council Directive 91/689/EEC of 12 December 1991 on hazardous waste and Article 2(a) of Council Directive Regulation (EEC) No 259/93 of 1 February 1993 on the supervision and control of shipments of waste within, into and out of the European Community, is not to be understood as excluding substances and objects which are capable of economic reutilization, even if the materials in question may be the subject of a transaction or quoted on public or private commercial lists. In particular, a deactivation process intended merely to render waste harmless, landfill tipping in hollows or embankments and waste incineration constitute disposal or recovery operations falling within the scope of the above-mentioned Community rules. The fact that a substance is classified as a re-usable residue without its characteristics or purpose being defined is irrelevant in that regard. The same applies to the grinding of a waste substance."

Wallonie

4.4 On 18 December 1997 the ECJ delivered its judgment on Case C-129/96 ***(Inter-Environnement Wallonie v Région Wallonne).*** In doing so, the ECJ held that in relation to the question on the definition of waste:-

"A substance is not excluded from the definition of waste in Article 1(a) of Council Directive 75/442, as amended, by the mere fact that it directly or indirectly forms an integral part of an industrial production process".

ARCO Chemie

4.5 On 15 June 2000 the ECJ delivered its judgment on Joined Cases C-418/97 and C-419/97 (ARCO Chemie Nederland Ltd etc). In doing so, the ECJ held that in relation to the question on the definition of waste:-

Case C-418/97

"1. It may not be inferred from the mere fact that a substance such as LUWA-bottoms undergoes an operation listed in Annex IIB to Council Directive 75/442/EEC of 15 July 1975 on waste, as amended by Council Directive 91/156/EEC of 18 March 1991, that that substance has been discarded so as to enable it to be regarded as waste for the purposes of that Directive.

2. For the purpose of determining whether the use of a substance such as LUWA-bottoms as a fuel is to be regarded as constituting discarding, it is irrelevant that that substance may be recovered in an environmentally responsible manner for use as fuel without substantial treatment.

3. The fact that that use as fuel is a common method of recovering waste and the fact that that substance is commonly regarded as waste may be taken as evidence that the holder has discarded that substance or intends or is required to discard it within the meaning of Article 1(a) of Directive 75/442, as amended by Directive 91/156. However, whether it is in fact waste within the meaning of the directive must be determined in the light of all the circumstances, regard being had to the aim of the directive and the need to ensure that its effectiveness is not undermined.

4. The fact that a substance used as fuel is the residue of the manufacturing process of another substance, that no use for that substance other than disposal can be envisaged, that the composition of the substance is not suitable for the use made of it or that special environmental precautions must be taken when it is used may be regarded as evidence that the holder has discarded that substance or intends or is required to discard it within the meaning of Article 1(a) of that Directive. However, whether it is in fact waste within the meaning of the directive must be determined in the light of all the circumstances, regard being had to the aim of the directive and the need to ensure that its effectiveness is not undermined."

12 The Waste Management (England and Wales) Regulations 2005 A Consultation Paper December 2004. http://www.defra.gov.uk/corporate/consult/agwaste-regs/consultation.pdf

Case C-419/97

"1. It may not be inferred from the mere fact that a substance such as wood chips undergoes an operation listed in Annex IIB to Directive 75/442, as amended by Directive 91/156, that that substance has been discarded so as to enable it to be regarded as waste for the purposes of the Directive.

2. The fact that a substance is the result of a recovery operation within the meaning of Annex IIB to that Directive is only one of the factors which must be taken into consideration for the purpose of determining whether that substance is still waste, and does not as such permit a definitive conclusion to be drawn in that regard. Whether it is waste must be determined in the light of all the circumstances, by comparison with the definition set out in Article 1(a) of Directive 75/442, as amended by Directive 91/156, that is to say the discarding of the substance in question or the intention or requirement to discard it, regard being had to the aim of the Directive and the need to ensure that its effectiveness is not undermined.

3. For the purpose of determining whether the use of a substance such as wood chips as a fuel is to be regarded as constituting discarding, it is irrelevant that that substance may be recovered in an environmentally responsible manner for use as fuel without substantial treatment.

4. The fact that that use as fuel is a common method of recovering waste and the fact that that substance is commonly regarded as waste may be taken as evidence that the holder has discarded that substance or intends or is required to discard it within the meaning of Article 1(a) of Directive 75/442, as amended by Directive 91/156. However, whether it is in fact waste within the meaning of that Directive must be determined in the light of all the circumstances, regard being had to the aim of the Directive and the need to ensure that its effectiveness is not undermined."

Palin Granit Oy

4.6 On 18 April 2002 the ECJ delivered its judgment on Case C-9/00 ***(Palin Granit Oy and Vehmassalon kansanterveysty_n kuntayhtymän hallitus).*** In doing so, the ECJ held that-

"1. The holder of leftover stone resulting from stone quarrying which is stored for an indefinite length of time to await possible use discards or intends to discard that leftover stone, which is accordingly to be classified as waste within the meaning of Council Directive 75/442/EEC of 15 July 1975 on waste.

2. The place of storage of leftover stone, its composition and the fact, even if proven, that the stone does not pose any real risk to human health or the environment are not relevant criteria for determining whether the stone is to be regarded as waste."

Mayer Parry Recycling Ltd

4.7 On 19 June 2003 the ECJ delivered its judgment on Case C-444/00 ***(Mayer Parry Recycling Ltd).*** In doing so, the ECJ held that:-

"1. `Recycling' within the meaning of Article 3(7) of European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste is to be interpreted as not including the reprocessing of metal packaging waste when it is transformed into a secondary raw material such as material meeting the specifications of Grade 3B, but as covering the reprocessing of such waste when it is used to produce ingots, sheets or coils of steel.

2. That interpretation would be no different if the concepts of 'recycling' and 'waste' referred to by Council Directive 75/442/EEC of 15 July 1975 on waste were taken into account."

AvestaPolarit Chrome Oy

4.8 On 11 September 2003 the ECJ delivered its judgment on Case C-114/01 ***(AvestaPolarit Chrome Oy).*** In doing so the ECJ held that:-

"1. In a situation such as that at issue in the main proceedings, the holder of leftover rock and residual sand from ore-dressing operations from the operation of a mine discards or intends to discard those substances, which must consequently be classified as waste within the meaning of Council Directive 75/442/EEC of 15 July 1975 on waste, as amended by Council Directive 91/156/EEC of 18 March 1991, unless he uses them lawfully for the necessary filling in of the galleries of that mine and provides sufficient guarantees as to the identification and actual use of the substances to be used for that purpose.

2. In so far as it does not constitute a measure of application of Directive 75/442, as amended by Directive 91/156, and in particular Article 11 of that directive, national legislation must be regarded as other legislation within the meaning of Article 2(1)(b) of that directive covering a category of waste mentioned in that provision, if it relates to the management of that waste as such within the meaning of Article 1(d) of Directive 75/442, and if it results in a level of protection of the environment at least equivalent to that aimed at by that directive, whatever the date of its entry into force."

Mario Antonio Saetti and Andrea Frediani (Petroleum Coke)

4.9 On 14 January 2004 the ECJ delivered its judgment on Case C-235/02 ***(Mario Antonio Saetti and Andrea Frediani).*** In doing so, the ECJ held that:-

"Petroleum coke which is produced intentionally or in the course of producing other petroleum fuels in an oil refinery and is certain to be used as fuel to meet the energy needs of the refinery and those of other industries does not constitute waste within the meaning of Council Directive 75/442/EEC of 15 July 1975 on waste, as amended by Council Directive 91/156/EEC of 18 March 1991."

Van de Walle (Contaminated Soil)

4.10 On 7 September 2004 the ECJ delivered its judgment on Case C-1/03 ***(Paul Van de Walle, Daniel Laurent, Thierry Mersch and Texaco Belgium SA).*** In doing so, the ECJ held that:-

"Hydrocarbons which are unintentionally spilled and cause soil and groundwater contamination are waste within the meaning of Article 1(a) of Council Directive 75/442/EEC of 15 July 1975 on waste, as amended by Council Directive 91/156/EEC of 18 March 1991. The same is true for soil contaminated by hydrocarbons, even if it has not been excavated. In circumstances such as those in the main proceedings, the petroleum undertaking which supplied the service station can be considered to be the holder of that waste within the meaning of Article 1(c) of Directive 75/442 only if the leak from the service station's storage facilities which gave rise to the waste can be attributed to the conduct of that undertaking."

Antonio Niselli

4.11 On 11 November 2004 the ECJ delivered its judgment on Case C-457/02 ***(Antonio Niselli).*** In doing so, the ECJ held that:-

"1. The definition of 'waste' in the first subparagraph of Article 1(a) of Council Directive 75/442/EEC of 15 July 1975 on waste, as amended by Council Directive 91/156/EEC of 18 March 1991 and by Commission Decision 96/350/EC of 24 May 1996, cannot be construed as covering exclusively substances or objects intended for, or subjected to, the disposal or recovery operations mentioned in Annexes IIA and IIB to that Directive or in the equivalent lists, or to which their holder intends or is required to subject them.

2. The meaning of 'waste' for the purposes of the first subparagraph of Article 1(a) of Directive 75/442, as amended by Directive 91/156 and by Decision 96/350, is not to be interpreted as excluding all production or consumption residues which can be or are reused in a cycle of production or consumption, either without prior treatment and without harm to the environment, or after undergoing prior treatment without, however, requiring a recovery operation within the meaning of Annex IIB to that Directive."

APPENDIX 4

Extracts of The Waste Management Licensing Regulations 1994 (SI 1994 No. 1056)

17. (1) Subject to the following provisions of this regulation and to any conditions or limitations in Schedule 3, section 33(1)(a) and (b) of the 1990 Act shall not apply in relation to the carrying on of any exempt activity set out in that Schedule.

(2) In the case of an exempt activity set out in paragraph 4, 7, 9, 11, 13, 14, 15, 17, 18, 19, 25, 37, 40 or 41 of Schedule 3, paragraph (1) above only applies if-

(a) the exempt activity is carried on by or with the consent of the occupier of the land where the activity is carried on; or
(b) the person carrying on the exempt activity is otherwise entitled to do so on that land.

Action: Ensure that you are authorised to carry out the activity on the land or as Duty of Care check that the person to whom you have passed your waste for this purpose is authorised to do so.

(3) Unless otherwise indicated in Schedule 3, paragraph (1) above does not apply to the carrying on of an exempt activity insofar as it involves special waste.

Action: Ensure that the waste would not be classed as hazardous. If you believe it may be hazardous it will be necessary to sample the waste.

(4) Paragraph (1) above only applies in relation to an exempt activity involving the disposal or recovery of waste by an establishment or undertaking if the type and quantity of waste submitted to the activity, and the method of disposal or recovery, are consistent with the need to attain the objectives mentioned in paragraph 4(1)(a) of Part I of Schedule 4.

Action: Ensure that the activity will not give rise to any environmental problems, as this may invalidate the exemption and render you liable to enforcement action.

Registration in connection with exempt activities

18. (1) Subject to paragraph (7) below, it shall be an offence for an establishment or undertaking to carry on, after 31st December 1994, an exempt activity involving the recovery or disposal of waste without being registered with the appropriate registration authority.

Action: Notify the local Environment Agency office of the activity as follows:
(a) the name and address of the establishment or undertaking;
(b) the activity which constitutes the exempt activity; and
(c) the place where the activity is carried on.

This does not necessarily have to be in advance of commencement.

It is also advisable to seek the approval of the Planning Authority if the activity is not covered by an existing permission.

(7) The preceding provisions of this regulation shall not apply in the case of an exempt activity to which paragraph 7(3)(c) of Schedule 3 applies, but the appropriate registration authority shall enter in its register the particulars furnished to it pursuant to that provision.

Action: Where the waste is being applied to land for agricultural or ecological benefit the following information needs to be provided to the local Environment Agency office:

(a) the establishment or undertaking's name and address, and telephone or fax number (if any);

(b) a description of the waste, including the process from which it arises;

(c) where the waste is being or will be stored pending spreading;

(d) an estimate of the quantity of the waste or, where there are to be repeated applications, an estimate of the total quantity of waste to be spread during the next six months; and

(e) the location, and intended date or, where there are to be repeated applications, the frequency, of the spreading of the waste.

SCHEDULE 3

Regulations 1(3) and 17

ACTIVITIES EXEMPT FROM WASTE MANAGEMENT LICENSING

7. (1) The spreading of any of the wastes listed in Table 2 on land which is used for agriculture.

(2) The spreading of any of the wastes listed in Part I of Table 2 on-

(a) operational land of a railway, light railway, internal drainage board or the National Rivers Authority; or

(b) land which is a forest, woodland, park, garden, verge, landscaped area, sports ground, recreation ground, churchyard or cemetery.

Table 2

PART I

Waste soil or compost.
Waste wood, bark or other plant matter.

PART II

Deleted as not applicable

(3) Sub-paragraphs (1) and (2) above only apply if-
(a) no more than 250 tonnes or, in the case of dredgings from inland waters, 5,000 tonnes of waste per hectare are spread on the land in any period of twelve months;
(b) the activity in question results in benefit to agriculture or ecological improvement; and
(c) where the waste is to be spread by an establishment or undertaking on land used for agriculture, it furnishes to the waste regulation authority in whose area the spreading is to take place the particulars listed in sub-paragraph (4) below-
(i) in a case where there is to be a single spreading, in advance of carrying out the spreading; or
(ii) in a case where there is to be regular or frequent spreading of waste of a similar composition, every six months or, where the waste to be spread is of a description different from that last notified, in advance of carrying out the spreading.

(4) The particulars referred to in sub-paragraph (3)(c) above are-
(a) the establishment or undertaking's name and address, and telephone or fax number (if any);
(b) a description of the waste, including the process from which it arises;
(c) where the waste is being or will be stored pending spreading;
(d) an estimate of the quantity of the waste or, in such a case as is mentioned in sub-paragraph (3)(c)(ii) above, an estimate of the total quantity of waste to be spread during the next six months; and
(e) the location, and intended date or, in such a case as is mentioned in sub-paragraph (3)(c)(ii) above, the frequency, of the spreading of the waste.

9. (1) Subject to sub-paragraph (3) below, the spreading of waste consisting of soil, rock, ash or sludge, or of waste from dredging any inland waters or arising from construction or demolition work, on any land in connection with the reclamation or improvement of that land if-
(a) by reason of industrial or other development the land is incapable of beneficial use without treatment;
(b) the spreading is carried out in accordance with a planning permission for the reclamation or improvement of the land and results in benefit to agriculture or ecological improvement; and
(c) no more than 20,000 cubic metres per hectare of such waste is spread on the land.

Action: If it is intended to rely on this exemption it is recommended that the Planning Authority and Environment Agency be consulted on these points at an early stage as they often become points of contention which may threaten the viability of the activity.

(2) The storage, at the place where it is to be spread, of any such waste which is intended to be spread in reliance upon the exemption conferred by sub-paragraph (1) above.
(3) Sub-paragraph (1) above does not apply to the disposal of waste at a site designed or adapted for the final disposal of waste by landfill.

13. (1) The manufacture from-
(a) waste which arises from demolition or construction work or tunnelling or other excavations; or
(b) waste which consists of ash, slag, clinker, rock, wood, bark, paper, straw or gypsum, of timber products, straw board, plasterboard, bricks, blocks, roadstone or aggregate.

(2) The manufacture of soil or soil substitutes from any of the wastes listed in sub-paragraph (1) above if-
(a) the manufacture is carried out at the place where either the waste is produced or the manufactured product is to be applied to land; and
(b) the total amount manufactured at that place on any day does not exceed 500 tonnes.

(3) The treatment of waste soil or rock which, when treated, is to be spread on land under paragraph 7 or 9, if-
(a) it is carried out at the place where the waste is produced or the treated product is to be spread; and
(b) the total amount treated at that place in any day does not exceed 100 tonnes.

(4) The storage of waste which is to be submitted to any of the activities mentioned in sub-paragraphs (1) to (3) above if-
(a) the waste is stored at the place where the activity is to be carried on; and
(b) the total quantity of waste stored at that place does not exceed-
(i) in the case of the manufacture of roadstone from road planings, 50,000 tonnes; and
(ii) in any other case, 20,000 tonnes.

Comment: This may be applicable to the process arisings from the solid/liquid separation plant in the event that the point of production of waste is determined to be prior to its removal from the slurry and where the waste is being used subsequently.

19. (1) The storage on a site of waste which arises from demolition or construction work or tunnelling or other excavations or which consists of ash, slag, clinker, rock, wood or gypsum, if-
(a) the waste in question is suitable for use for the purposes of relevant work which will be carried on at the site; and
(b) in the case of waste which is not produced on the site, it is not stored there for longer than three months before relevant work starts.

(2) The use of waste of a kind mentioned in sub-paragraph (1) above for the purposes of relevant work if the waste is suitable for use for those purposes.

(3) *Deleted as not applicable*

(4) In this paragraph, "relevant work" means construction work, including the deposit of waste on land in connection with-

(a) the provision of recreational facilities on that land; or

(b) the construction, maintenance or improvement of a building, highway, railway, airport, dock or other transport facility on that land, but not including either any deposit of waste in any other circumstances or any work involving land reclamation.

Comment: This is the most widely used exemption as it is least restrictive.

APPENDIX 5:

Extract of The Landfill (England and Wales) (Amendment) Regulations 2004 (SI 2004 No. 1375)

Wastes acceptable without testing at landfills for inert waste

10. (1) Subject to sub-paragraph (2), waste of the types set out in Table 1 may be accepted without testing at landfills for inert waste provided the waste is –

(a) from a single stream waste of a single waste type (unless different waste types from the list in Table 1 are accepted together); and

(b) is from a single source.

(2) Waste referred to in sub-paragraph (1) must be tested where there is suspicion of contamination or doubt that the waste meets the definition of inert waste in regulation 2 or the criteria in paragraph 11.

(3) If such testing reveals contamination or the presence of other materials or substances such as metals, asbestos, plastics or chemicals, the waste must not be accepted at a landfill for inert waste if the extent of the contamination is such as to increase the risk associated with the waste sufficiently to justify its disposal in other classes of landfill.

Table 1

EWC Code	Description	Restrictions
10 11 03	Waste glass based fibrous materials	Only without organic binders
15 01 07	Glass packaging	
17 01 01	Concrete	Selected C&D waste only[(a)]
17 01 02	Bricks	Selected C&D waste only[(a)]
17 01 03	Tiles and ceramics	Selected C&D waste only[(a)]
17 01 07	Mixtures of concrete, bricks, tiles and ceramics	Selected C&D waste only[(a)]
17 02 02	Glass	
17 05 04	Soil and stones	Excluding topsoil, peat; excluding soil and stones from contaminated sites
19 12 05	Glass	
20 01 02	Glass	Separately collected glass only
20 02 02	Soil and stones	Only from garden and parks waste; Excluding top soil, peat

[(a)] Selected construction and demolition waste (C & D waste): with low contents of other types of materials (like metals, plastic, organics, wood, rubber, etc). The origin of the waste must be known.

No C & D waste from constructions, polluted with inorganic or organic dangerous substances, e.g. because of production processes in the construction, soil pollution, storage and usage of pesticides or other dangerous substances, etc., unless it is made clear that the demolished construction was not significantly polluted.

No C & D waste from constructions, treated, covered or painted with materials, containing dangerous substances in significant amounts.

Limit values for waste acceptable at landfills for inert waste

11. The following limit values shall apply to waste accepted at landfills for inert waste other than waste which may be accepted without testing under paragraph 10 –
(a) the limit values for leaching set out in Table 2; and
(b) the limit values for total content of organic parameters set out in Table 3

Table 2

Component	Symbol	L/S = 10 l/kg Mg/kg dry substance
Arsenic	As	0.5
Barium	Ba	20
Cadmium	Cd	0.04
Total Chromium	Cr total	0.5
Copper	Cu	2
Mercury	Hg	0.01
Molybdenum	Mo	0.5
Nickel	Ni	0.4
Lead	Pb	0.5
Antimony	Sb	0.06
Selenium	Se	0.1
Zinc	Zn	4
Chloride	Cl-	800
Fluoride	F-	10
Sulphate[a]	SO42-	1,000
Phenol index	PI	1
Dissolved Organic Carbon[b]	DOC	500
Total Dissolved Solids[c]	TDS	4,000

[a] This limit value for sulphate may be increased to 6,000 mg/kg, provided that the value of C0 (the first eluate of a percolation test at L/S = 0.1 l/kg) does not exceed 1,500 mg/l. It will be necessary to use a percolation test to determine the limit value at L/S = 0.1 l/kg under initial equilibrium conditions.

[b] If the waste does not meet this value for Dissolved Organic Carbon (DOC) at its own pH value, it may alternatively be tested at L/S = 10 l/kg and a pH between 7.5 and 8.0. The waste may be considered as complying with the acceptance criteria for DOC, if the result of this determination does not exceed 500 mg/kg.

[c] The value for Total Dissolved Solids can be used alternatively to the values for Sulphate and Chloride.

Table 3

Parameter	Value mg/kg
Total Organic Carbon (TOC)[a]	30,000
BTEX compounds (benzene, toluene, ethyl benzene & xylenes)	6
Polychlorinated biphenyls (PCBs) (7 congeners)	1
Mineral oil (C10 to C40)	500

[a] In the case of soils, a higher limit value may be permitted by the Environment Agency, provided a Dissolved Organic Carbon value of 500 mg/kg is achieved at L/S 10 l/kg at the pH of the soil or at a pH value of between 7.5 and 8.0.

Limit values for polycyclic aromatic hydrocarbons (PAHs)

The Government has proposed in its most recent consultation on the draft Landfill (England and Wales) Regulations 2005 that the limit value of 100 mg/kg be added to Table 3 to cover the following PAHs in inert landfills:

- Naphthalene,
- Acenaphthylene,
- Acenaphthene,
- Anthracene Benzo(a)anthracene,
- Benzo(b)fluoranthene,
- Benzo(k)fluoranthene,
- Benzo(g,h,i)perylene,
- Benzo(a)pyrene,
- Chrysene,
- Coronene,
- Dibenzo(a,h)anthracene,
- Fluorene,
- Fluoranthene,
- Indeno(1,2,3-c,d)pyrene,
- Phenanthrene; and
- Pyrene

APPENDIX 6:
Extract from The Landfill Tax (Qualifying Material) Order 1996

Group	Description of material	Conditions
Group 1	Rocks and soils	Naturally occurring
Group 2	Ceramic or concrete materials	
Group 3	Minerals	Processed or prepared, not used
Group 4	Furnace slags	
Group 5	Ash	
Group 6	Low activity inorganic compounds	
Group 7	Calcium sulphate	Disposed of either at a site not licensed to take putrescible waste or in a containment cell which takes only calcium sulphate
Group 8	Calcium hydroxide and brine	Deposited in brine cavity
Group 9	Water	Containing other qualifying materials in suspension

Notes:

(1) **Group 1** includes clay, sand, gravel, sandstone, limestone, crushed stone, china clay, construction stone, stone from the demolition of buildings or structures, slate, topsoil, peat, silt and dredgings.

(2) **Group 2** comprises only the following:

(a) glass including fritted enamel, but excludes glass fibre and glass-reinforced plastic;
(b) ceramics including bricks, bricks and mortar, tiles, clay ware, pottery, china and refractories;
(c) concrete including reinforced concrete, concrete blocks, breeze blocks and aircrete blocks, but excludes concrete plant washings.

(4) **Group 3** comprises only the following:(a) moulding sands; (b) clays; (c) mineral absorbents; (d) man-made mineral fibres; (e) silica; (f) mica; (g) mineral abrasives.

(5) For the purposes of Note (4) above:

(a) moulding sands excludes sands containing organic binders;
(b) clays includes moulding clays and clay absorbents, including Fuller's earth and bentonite;
(c) man-made mineral fibres includes glass fibres, but excludes glass-reinforced plastic and asbestos.

(6) **Group 4** includes:

(a) vitrified wastes and residues from thermal processing of minerals where, in either case, the residue is both fused and insoluble;
(b) slag from waste incineration.

(7) **Group 5:**

(a) comprises only bottom ash and fly ash from wood, coal or waste combustion; and
(a) excludes fly ash from municipal, clinical, and hazardous waste incinerators and sewage sludge incinerators.

(8) **Group 6** comprises only titanium dioxide, calcium carbonate, magnesium carbonate, magnesium oxide, magnesium hydroxide, iron oxide, ferric hydroxide, aluminium oxide, aluminium hydroxide and zirconium dioxide.

(9) **Group 7** includes gypsum and calcium sulphate based plasters, but excludes plasterboard.

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