CORDAH RESEARCH

Cordah Research Limited,
Kettock Lodge,
Aberdeen Science and Technology Park,
Bridge of Don,
Aberdeen, AB22 8GU
Tel: +44 (0)1224 414215
Fax: +44 (0)1224 414250
Email: rsch@cordah.co.uk
Website: http://www.cordah.co.uk/

Research on the Re-use of Drill Cuttings Onshore

A Landfill Tax Credit Scheme Project sponsored by Shanks. Waste Solutions and Talisman Energy UK

Prepared by: Mike Smith, Anne Manning and Marianne Lang
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cn=Tim Curtis, ou=Corporate Environmental Services, o=Cordah Limited, c=UK
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Reason: Document is certified

Marianne Lang,
Project Manager

Gordon Picken,
Director

BMT

Member of the BMT Group of Companies

CONTENTS

Glossary

California Bearing Ratio (CBR)	The California Bearing Ratio test or CBR Test is a test for estimating the bearing value of road sub-bases and subgrades.
Drill Cuttings	Chips and small fragments of rock produced during drilling which are brought to the surface by the flow of the *drilling mud* as it is circulated. See also *treated drill cuttings*.
Drilling Mud	A special mixture of clay, water and chemical additives pumped downhole through the drillpipe and drillbit. Mud functions include cooling the rotating bit, lubrication of the drillpipe as it turns, carrying *drill cuttings* to the surface, serving as a plaster to prevent the wall of the borehole from crumbling or collapsing, provision of weight to prevent extraneous fluids entering the well bore and helping to control downhole pressures that may be encountered.
Oil Based Mud (OBM)	A *drilling mud* in which the solids are suspended in a hydrocarbon distillate rather than water. The oil phase included diesel until 1984 and Low Toxicity Oil Based Mud (LTOBM) since that date.
Synthetic Based Mud (SBM)	A *drilling mud* in which the solids are suspended in a synthetic oil rather than a distillate on mineral oil.
Treated drill cuttings	Drill cuttings that have been treated onshore to remove oil, water and some contaminant.
Water Based Mud (WBM)	A *drilling mud* in which the solids are suspended in water.

Abbreviations

BS	British Standard
COD	Chemical Oxygen Demand
CBR	California Bearing Ratio
DoE	Department of the Environment
DTI	UK Government, Department of Trade and Industry
EA	Environment Agency (England and Wales)
EC	European Commission
EU	European Union
ICRCL	Interdepartmental Committee on the Redevelopment of Contaminated Land
OBM	Oil Based Mud
OSPARCOM	Oslo and Paris Commission
SEPA	Scottish Environmental Protection Agency
SBM	Synthetic Based Mud
TCC	Thermal-mechanical Conversion and Cracking
WBM	Water Based Mud

1 Introduction

1.1 The Cuttings Issue

Traditionally, cleaned drill cuttings have been permitted to be discharged to the seabed. Two factors suggest that in future, however, there is likely to be a significant increase in the quantities of drill cuttings being brought back to shore:

- Current and future legislation will require operators to reduce the discharge to the seabed of certain types of drill cuttings; and

- The present debate on the fate of drill cuttings piles associated with the decommissioning of offshore structures may result in some deposited material being returned to shore for treatment and disposal.

Both of these issues could result in significant volumes of cuttings being brought back to shore (see Box 1), making it imperative to find suitable treatment and re-use options.

Box 1 Estimated tonnages of cuttings:

From ongoing drilling

Between 1986 and 1995, an average of 313 wells have been drilled in the North Sea each year (DTI, 1996). If drilling were to continue at this level of activity, and it is assumed that approximately 1,000 tonnes of cuttings are generated for each well, this means that over 300,000 tonnes of drill cuttings may be produced each year.

Present in cuttings piles on the seabed

Estimates of the weight of mud and cuttings in existing cuttings piles in the northern and central North Sea, based on data from 61 structures, are in the region of 1.4 million tonnes (Cordah, 1998). For all structures in the North Sea this figure is likely to be considerably greater. Research is currently being undertaken to determine the best option for handling cuttings on decommissioning. Retrieval of the cuttings from the seabed and treatment/disposal onshore has not been ruled out.

This report concentrates on identifying and assessing possible re-use options for cuttings resulting from current drilling operations. However these would generally be equally applicable to cuttings originating from the decommissioning of cuttings piles. Further background to current and impending legislative requirements is given below.

In line with the Paris and Oslo commission (PARCOM) decision 92/2, the UK has not discharged mineral oil contaminated cuttings into the sea since 1 January 1997. As a result of the introduction of these controls on the discharge of mineral oil-based cuttings, there has been an increase in the use of synthetic oil-based muds (SBM). Since then, however, concerns have been raised regarding the potential environmental impacts of some of these products, which may have similar effects to the mineral oil based muds (OBM). As a result an agreement was reached between the DTI and the operators to reduce the discharge of SBMs to zero by 31 December 2000.

In order to fulfil this target, all operators have had to develop phase-out strategies demonstrating how they intend to reduce their discharges by approximately 20% each year, from a 1996 baseline. These strategies are updated annually and resubmitted to the DTI for review. The objective of zero discharge of synthetic oil-based muds by the end of the year 2000 looks set to be achieved.

Operators have had to look at a number of alternatives to achieve a reduction of SBM discharges:

- use of water-based mud wherever technically feasible.
- use of ester-based muds, which although considered environmentally acceptable at present, may prove less acceptable in the future, pending further research.
- cuttings re-injection, which is only likely to be feasible in a limited number of cases where a suitable formation for re-injection can be identified.
- collection and shipping of OBM or SBM cuttings for re-use or disposal onshore. In addition, in certain environmentally sensitive areas of operation, there has been pressure to bring cuttings back to shore for re-use or disposal.

This last option has been used increasingly over the last few years, but to date few options have been found for the re-use of the cuttings onshore and the bulk of the material has been disposed of to land fill. With increasing pressure on landfill space and greater emphasis on sustainability, it is more and more important to find suitable recycling/re-use options.

A number of companies are developing technologies to treat and dispose of the cuttings that are brought ashore but none has been able to demonstrate credible plans for the large scale re-use of the cuttings. A variety of options, such as use in landfill construction, road construction, landscaping or as an additive in building materials, have been put forward but very little research has been undertaken to investigate the technical feasibility, environmental implications, economic viability or the possible liabilities for each of these options.

1.2 Aims of the Study

Talisman Energy UK Limited has commissioned Cordah Research to undertake initial investigations to identify possible routes for the re-use of these cuttings using the Landfill Tax Credit Scheme as a funding mechanism.

The objectives of the study are to:

- examine the legal implications of returning cuttings to shore (Section 2)
- collate information from a variety of technology providers on the possible treatment of drill cuttings (Section 3)
- review previous experience in the re-use of drill cuttings and examine the limitations on treatment methods and possible end-uses depending on the drilling mud system used (Section 4)
- compile a "register" of end-users for use by operators – the register includes a list of contacts, the volume and type of cuttings they are likely to accept and the liabilities involved (Section 5 and Appendix 2)
- identify areas for further research (Section 6)

1.3 Scope of the Study

Although the review of previous experience draws on data from the whole of the UK, the identification of potential end-users was focussed solely on the Aberdeen area.

For each possible end-user identified, a broad indication of environmental constraints and liabilities has been given, but it should be noted that no detailed environmental assessment of the individual options has been carried out at this stage. If a specific option is pursued it is recommended that a more detailed assessment is undertaken.

1.4 Methodology

The study was performed by carrying out a review of existing literature, contacting companies previously involved in treating or disposing of cuttings, holding discussions with operators and mud companies on the likely nature of the cuttings, and establishing contacts with likely end-users in the Aberdeen area.

2 Review of Existing Guidelines and Legal Implications

2.1 Untreated Drill Cuttings

Untreated OBM and SBM cuttings are considered as special waste and fall within the remit of The Special Waste Regulations (1996) (DoE, 1996). Untreated WBM cuttings are generally not categorised as special waste unless they originate from the reservoir section of the well and may as a result contain oil.

The 1996 Special Waste Regulations were made under the Environmental Protection Act of 1990, replacing the Control of Pollution (Special Waste) Regulations of 1980 and implementing the EC Hazardous Waste Directive (91/689/EEC as amended).

Special Waste is defined as controlled waste which is considered so dangerous or difficult to keep, treat or dispose of that special provision needs to be made by regulations (Section 62 of the Environmental Protection Act 1990). The DoE Circular 6/96 summarises this definition as covering:

- waste on an EU list of hazardous waste, displaying a hazardous property;
- non-listed wastes displaying certain of those hazardous properties;
- waste prescription-only medicines;

Untreated drill cuttings fall within the EU list of hazardous waste – as "Waste resulting from exploration, mining, dressing and further treatment of Minerals and Quarrying" (drilling muds and other drilling wastes). Waste appearing on this list is only classified as special waste if it also displays one or more of the hazardous properties listed in part II of Schedule 2 of the 1996 Regulations. The Hazardous properties are listed as H1-H14, where:

- H1 – Explosive Waste,
- H2 – Oxidant Waste,

- H3 – Flammable Waste,
- H4 and H8 – Corrosive or Irritant Wastes,
- H5 and H6 – Harmful or Toxic Wastes,
- H7 – Carcinogenic Waste,
- H9 – Infectious Wastes,
- H10 – Tetratogenic Wastes,
- H11 – Mutagenic Wastes,
- H12 – Wastes Producing Toxic Gases,
- H13 – Wastes liable to produce another hazardous substance after disposal
- H14 – Ecotoxic Wastes.

To establish whether waste displays any of the hazardous properties H1 to H14, Circular 6/96 provides some technical guidance which deals with the assessment of these 14 properties by reference to the known properties of the waste's components in the pure form or at reduced concentrations.

The main purpose of the 1996 Regulations is to provide an effective system of control which ensures that Special Wastes are soundly managed from their production to their final destination for disposal or recovery. A key feature of the Regulations is the consignment note system (modified from the 1980 Regulations) by which regulators (i.e. SEPA in Scotland, or EA in England and Wales) are given advance notice of special waste consignments. The purpose of this system is to:

- Inform the Agencies of special waste arisings and the arrangements for management of the waste
- Enable the regulators, if necessary, to intervene to prevent any mismanagement of the waste or environmental harm before it occurs
- Prevent illegal disposal

- Ensure all who handle special waste fulfil their statutory duty of care, in particular by ensuring waste descriptions are sufficient.

2.2 Treated Drill Cuttings

2.2.1 Introduction

The key constituents of OBM, SBMs and WBM contaminated cuttings are summarised in Table 2.1 below.

Table 2.1: Key Constituents of OBM, SBM and WBM Cuttings

OBM/SBM/WBM cuttings
Heavy Metals
Polynuclear Aromatic Hydrocarbon (PAH) components (OBM only)
Barium, Gypsum, Barites
Chlorides (including potassium chloride, sodium chloride, calcium chloride and magnesium chloride)
Clays (Bentonite, Kaolinities)
Additives (Biocides, scale inhibitors, corrosion inhibitors)

Before cuttings can be considered for re-use they must undergo treatment. A number of treatment technologies exist and these are discussed in section 3. Once treated, the pathway for end use or disposal will depend on the fulfilment of specific criteria set by SEPA. SEPA's criteria for treated cuttings cover such considerations as the leachability of heavy metals, chlorides, conductivity, and the Total Polyaromatic Hydrocarbons.

The construction industry also has criteria which the treated cuttings must fulfil and these are set by the British Standards Institution. For the construction industry the key issues of concern include sulphate content and the calcium chloride levels.

2.2.2 SEPA Standards

SEPA consider treated cuttings to be in the same category as contaminated soil and they rely on the EA's *Interim Guidance on the Disposal of "Contaminated Soil"* to ensure that their criteria are met. This document outlines the steps which must be followed to determine a pathway for the end use/disposal of "contaminated soil", in this case, treated cuttings.

1. **Hazard Assessment:** This is the preliminary step which must be undertaken and it entails identifying a suite of contaminants that need to be analysed.

2. **Risk Assessment:** Once the major contaminants of the treated cuttings have been identified through the *Hazard Assessment*, they are then analysed and related to target values for contaminants specified in the guidelines. These target values are categorised into three threshold levels - Upper Threshold, Lower Threshold, and the Leachate Quality Threshold (Table 2.2). The Upper and Lower Threshold values are set for the total concentration of each contaminant in the solid phase. They do not take into consideration the pollution potential of the material to water and it is for this reason that the Leachate Quality Threshold values are specified.

   - Upper Threshold: These values are derived from the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) Guidance Note 59/83 and take the threshold values for parks, playing fields and open spaces – these equating as the typical end-use for an "inert" landfill site. The Upper threshold values have not been provided for those elements that are not normally considered to be phytotoxic i.e. boron, nickel and zinc.

   - The Leachate Quality Threshold: The values given in table 2.2 for each contaminant are related to what would be acceptable as direct discharge to controlled waters in the vicinity of the disposal/end use site. These values are derived from the Surface water abstraction Directive 75/440/EEC and the Water Supply (water Quality) Regulations 1989, which incorporate EC Drinking Water Directive (80/778/EEC) into UK legislation. Where there is overlap between these two directive, the lowest value was selected as the threshold.

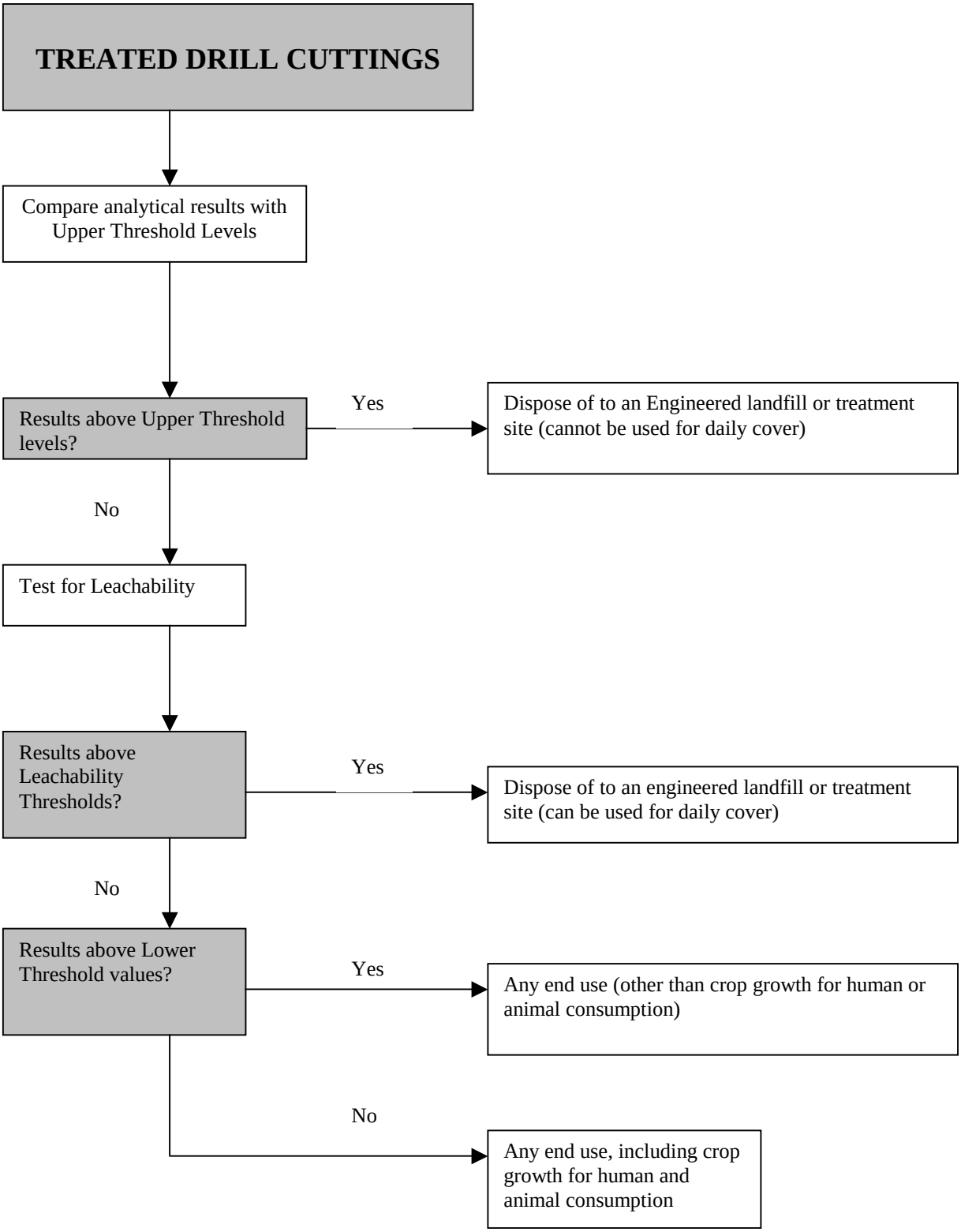
   - The Lower Threshold is based on the total concentrations and is used to identify "soils" (or treated cuttings) suitable for restoration or other uses leading to crop growth for human or animal consumption. As with the upper threshold levels, these levels are primarily derived from ICRCL Guidance Note 59/83 in this instance taking the figure for domestic gardens.

3. **Disposal Options:** Having compared values of contaminants with those specified under step 2, the final phase is the identification of a suitable end use or method for disposal. This is summarised in Figure 2.1.

Table: 2.2: Contamination Classification Thresholds for Disposal of Contaminated Soil (EA, 1997)

Determinand	TOTAL CONCENTRATIONS		
	Water soluble phase	***Solid Phase***	
	Leachate Quality Threshold (µg/l unless stated)	Lower Threshold Concentration (mg/kg air-dried sample)	Upper Threshold Concentration (mg/kg air dried sample)
pH	5.5-9.5	6-8	5-9
Toluene Extract	-	5000 (subject to special waste)	10000 (subject to special waste)
Cyclohexane Extract	-	2000 (subject to special waste)	5000 (subject to special waste)
Conductivity	1000us/cm	-	-
COD	30mg/l	-	-
Ammonia	.5mg/l	-	-
Arsenic	10	10	40
Cadmium	1	3	15
Chromium (total)	50	600	1000
Lead (total)	50	500	2000
Mercury	1	1	20
Selenium	10	3	6
Boron	2000	3	-
Copper	20	130	-
Nickel	50	70	-
Zinc	500	300	-
Cyanide (complex)	-	250	250
Cyanide (free)	50	25	25
Sulphate (SO_4)	150mg/l	2000	2000
Sulphide	150mg/l	250	250
Sulphur (free)	150 mg/l	5000	5000
Phenol	0.5	5	5
Iron	100	-	-
Chloride	200 mg/l	-	-
Polyaromatic Hydrocarbons	0.2	50	1000

Figure 2.1: The Identification of Disposal/End Use Options (EA, 1997)



2.2.3 Construction Industry Standards

In terms of both mass and volume, conventional concretes consist largely of aggregate, and British Standards exist to ensure that the quality of these materials is controlled. In most cases these aggregates are derived from mineral deposits which may contain minor constituents as the result of the geological processes by which they are formed (Shirley, 1987). For treated drill cuttings this also holds true – the composition of the cuttings will be a function of the rock through which the well was bored. Treated cuttings, however, will also contain constituents from the drilling process itself, as outlined in Table 2.1. The suitability of treated cuttings for aggregate use therefore, will depend on their overall constitution, and on the type of concrete being manufactured. The following provides a brief summary of the adverse reactions that can occur with some constituents that can be found within treated cuttings.

- **Chlorides:** Small quantities of natural chlorides such as sodium chlorides, have little effect on plain concrete except to enhance slightly its rate of hardening and accentuate any tendency to efflorescence. In reinforced concrete, however, the presence of chloride reduces the concrete's ability to protect the steel against corrosion.

- **Sulphates**: These are deemed undesirable for all types of concrete. Only barium sulphate has a solubility so low that it is suitable for inclusion in aggregate. All other sulphates are soluble to some extent and retard the setting of cement and the rate at which concrete hardens. Sulphates can also result in concrete 'cancer'.

- **Absorbant particles:** If an aggregate contains particles which are markedly weaker and more absorbent than the majority of the material this may cause problems where they underlie a concrete surface exposed to weather, as they may be frost-sensitive and cause unsightly 'popouts'.

- **Iron sulphides:** Iron sulphide particles are hard but chemically unstable. Unstable iron sulphide particles present near the surface of concrete will oxidise slowly on weathering, eventually forming brown stains which may be impossible to remove except by cutting out – aggregates containing these particles should therefore be avoided in work where the surface appearance is important.

The key British Standards for testing aggregates for these various impurities is BS 812. Other important considerations for meeting various BS standards include particle size and shape. Appendix 1 provides examples of BS specifications for building aggregates.

3 Technologies for the Treatment of Cuttings

3.1 Introduction

Prior to being re-used all cuttings will need to undergo some form of treatment onshore, in addition to the preliminary physical separation which is undertaken offshore in shale shakers/centrifuges.

There are several treatment technologies either currently in use or being developed. Treatment technologies generally rely on one of the following processes:

- onsite indirect thermal desorption;
- distillation;
- solvent extraction;
- combustion;
- stabilisation;
- biological treatment.

All of these methodologies have been developed for OBM and SBM cuttings as to date there has been very little demand for onshore treatment of WBM cuttings. In addition, as WBM cuttings do not contain any materials with an economic value on recovery (i.e. oil or synthetic based muds) the perception to date has been that there is no point in treating them. However, if WBM cuttings are brought to shore, they cannot be re-used without undergoing some form of treatment, in particular to reduce the high liquid content and salinity.

Each of these methods is discussed further in the following sections and summarised in Table 3.1. Information was obtained from existing reports as listed below and Aberdeen based companies were contacted directly to obtain further information.

Table 3.1 Summary of Available Technologies

Provider	Location	Process	Type of cuttings accepted	Volume treated to date/ treatment rate	Date Operations Started	Cost	Solid Waste
Onsite Indirect Thermal Desorption (Cordah, 1999)							
OnSite Technology	USA	Indirect thermal desorption	OBM, cuttings contaminated with gasoline, diesel, lubricant oil, crude oil and synthetic oil	Not known 2.5-5 tonnes per hour	Not known	Not known	Oil for re-use. Non-oily solids sent to landfill (contain salts and chemicals). Not classified as special waste.
Distillation (Cordah, 1999 and Rogaland Research, 1998)							
Burgess & Garrick	Peterhead	Thermal conversion and cracking, frictional grinding	OBM, SBM and WBM	Not known 1-4tonnes per hour	1985-99 in Shetland 1999 in Aberdeen	£180-£200 per tonne	Oil for re-use. Rock powder residue sent to landfill. Not classified as special waste. Possibilities of re-use in concrete
Maersk	Aberdeen	Thermal recovery	SBM WBM would be possible but very expensive	900 tonnes 2 tonnes per hour	March 1999	£130-200 depending on volume (more for WBM)	Oil for re-use. Fines, cuttings, paint sludge and filter cake used by local construction company (Les Taylor)

Provider	Location	Process	Type of cuttings accepted	Volume treated to date/ treatment rate	Date Operations Started	Cost	Solid Waste
Enviroco	Peterhead	Thermal recovery and post thermal process of sludge stabilisation	OBM, SBM, WBM	Not known	3rd quarter 1999	Currently £100 per tonne	Most cuttings likely to be landfilled directly or used in construction of landfills
Recovery Systems Limited	Lowestoft	Low temperature distillation	OBM, SBM	16,000 tonnes treated to date 2.5 tonnes per hour	1996		Oil for re-use Treated solids sent to landfill. Early attempts at re-use (cycle path, noise abatement, soil admix)
Enaco	Great Yarmouth	Thermal stripping/ chloride stripping	OBM	Not known	Not known		Oil for re-use Treated solids sent to landfill or re-used in small civil projects, potential problems with leaching of heavy metals. Not classified as special waste.
Tortech Limited, Torbed Technology	Southampton and Norway	Volatilisation	OBM	Not known 10 tonnes per hour	Not known		Treated solids sent to landfill. Not classified as special waste.

Provider	Location	Process	Type of cuttings accepted	Volume treated to date/ treatment rate	Date Operations Started	Cost	Solid Waste
Solvent Extraction (Rogaland Research, 1998)							
Scotoil	Aberdeen	Solvent extraction	OBM, SBM and WBM	7 tonnes per hour	Still being commissioned		Oil for re-use Treated solids, plan to contact local construction companies, details confidential
Combustion (Rogaland Research, 1998)							
Slovag Industriservice	Norway	Incineration	OBM	30,000 m^3/yr solid cuttings, 20,000 m^3/yr drilling muds	Not known		Inorganic product sent to landfill
Stabilisation (Rogaland Research, 1998)							
FBG Limited	Dorset/used by BP Wytch Farm	Stabilisation using pulverised fly ash	OBM	Not known 12-30 tonnes per hour	Not known		Stabilised solid waste, about twice the original volume, sent to landfill. Classified as special waste.

Provider	Location	Process	Type of cuttings accepted	Volume treated to date/ treatment rate	Date Operations Started	Cost	Solid Waste
Biological treatment (Cordah, 1999 and Rogaland Research, 1998)							
Taylors Industrial Waste Services	Aberdeen	Stabilisation using pulverised fly ash	OBM, SBM, WBM	Not known 20-30 tonnes per hour	Not known	£90-£120 per tonne	Stabilised solid waste, about twice the original volume, sent to landfill. Classification as special waste dependent on mud system used.
Soil recycling centre	Antwerp	Physical/chemical cleaning and bioremediation	OBM	35,000 tonnes per year			Sand suitable for construction. Filter cake sent to landfill
-	France	Land spreading	OBM	Experimental only Approximately 6 tonnes per hectare			Cuttings incorporated into soil

3.2 Onsite Indirect Thermal Desorption

This is a portable system which effectively vaporises hydrocarbons from contaminated soils and drill cuttings. The material is remediated on site to levels that can be used as fill. To date this technology has mainly been used in the USA and is not yet generally available in the UK.

3.3 Distillation

Distillation enables solids and liquids and the different constituents of liquid mixtures to be separated, relying on the fact that the constituents of liquid mixtures evaporate at different temperatures.

Two types of processes are available:

- Thermo-mechanical conversion and cracking (TCC) where the drill cuttings are subjected to distillation/cracking with water and oil being boiled off. In some cases the vapours are condensed to allow recovery;

- Thermal stripping which is carried out a lower temperature. This means the oil is not cracked and can be re-used.

The resulting treated cuttings can potentially be re-used although they may contain elevated concentrations of heavy metals and chloride salts. The latter can be removed through chloride stripping.

3.4 Solvent Extraction

Solvent extraction relies on mixing cuttings with a suitable solvent to form a fluid emulsion, which can then be distilled to allow separation. There is no thermal damage to the oil, which can therefore be re-used.

3.5 Combustion

Incineration has been used for the disposal of organic waste which is highly toxic, highly flammable and/or resistant to biological breakdown. The process normally leaves a solid residue or ash, which can be disposed of to landfill.

Energy requirements are directly related to water content and therefore costs for the incineration of materials such as drill cuttings could be high if the cuttings have a high water content.

Currently, there is only one company in Norway offering combustion treatment of cuttings and none in the UK.

3.6 Stabilisation

Chemical and physical stabilisation can be used to modify the cuttings into a more usable form or into less hazardous waste. This can be carried out by solidification, effectively encapsulating the waste into a solid mass to minimise the possibility of leaching. Organic polymers or inorganic additives can be used to improve the stability of the mass.

The main problem with such treatments is that may result in the total volume of waste increasing. However, they require minimal energy input and result in minimal emissions to air.

3.7 Biological Treatment

Biological treatment methods operate on the principle of microbial breakdown of the waste. Techniques include aerated lagoons, anaerobic digestion, stabilisation ponds and composting. The main aim of bio-remediation is to speed up the natural decomposition process by controlling oxygen, temperature, moisture and nutrient parameters. These techniques were primarily developed for treating polluted soil, sediments and groundwater.

Experiments have been conducted on the bio-degradability of OBM cuttings by spreading the cuttings on farmland in France (Ladousse *et al*, 1996). Heavy metal concentrations in the drill cuttings were well below levels authorised in France for spreading sludges from urban waste water treatment plants. After spreading, the field was ploughed, tilled and fertilised for corn crops. The biodegradation of hydrocarbons was not total and approximately 10% of the initial quantity of oil spread remained in the soil. No phyto toxic effects were observed on seed germination and sprouting but the corn and wheat crops did show a 10% decrease in yield. Fodder crops were unaffected.

The main advantage of biological treatment methods is that they are environmentally benign (minimal use of energy and few environmental emissions) and there are no significantly unfavourable consequences on soil fertility. However, the required low application rates (about 6 tonnes per hectare) mean that land requirements are very high.

Research by the Macauley Land Use Research Unit (Lilly *et al*, undated) has characterised the land in Scotland to identify land suitable for the spreading of sewage sludge. Only limited areas of land were identified as suitable, so that land spreading cannot be used as the only disposal method. In addition, with the implementation of the Urban Waste Water Directive (91/271 EEC) it is estimated that there will be a 100% increase in the volume of sewage sludge needing disposal on land. Sewage sludge is likely to take priority over cuttings for disposal by land spreading.

3.8 Availability of Treatment Facilities around Aberdeen

The only treatment facilities available in the Aberdeen area are those offered by:

- Burgess & Garrick
- Maersk
- Scotoil
- Enviroco

The Scotoil plant has not yet been commissioned, and Maersk has to date only handled SBM cuttings. The only plants which may be suitable for WBM cuttings would be Burgess & Garrick and Enviroco. Burgess & Garrick (personal communication, 1999) have indicated that they may be able to find a use for the cuttings as an additive to cement. Enviroco are likely to landfill the cuttings or use them for the construction of landfill cells.

Prior to being re-used the treated cuttings need to be certified as fulfilling a number of criteria set by SEPA and the construction industry. These include both SEPA requirements and the construction industry. Details of these requirements were described in Section 2.2.2 and 2.2.3.

Land-Drill Geotechnics (UK) Limited in Aberdeen currently carry out certification tests on behalf of Maersk. Once the cuttings have been certified Land-Drill contact potential users on behalf of Maersk and arrange for the transfer of cuttings.

4 Review of possible uses

4.1 Introduction

Since the UK ceased discharging mineral oil contaminated drill cuttings into the sea on 1 January 1997, attempts to reuse treated drill cuttings onshore have been made with varying degrees of success. Other, as yet, untried reuse options have also been identified. Reuse options investigated in this study are presented in Table 4.1 and a summary of findings are presented in this section.

Table 4.1 Reuse options

CONSTRUCTION	LANDSCAPING
• Concrete products	• Noise abatement mounds
• Coastal Defence	• Topsoil admix
• Land Reclamation	• Embankments
• Roads and Cycle Paths	• General fill material
• Pipe bedding	
• Landfill cells	

4.2 Construction

4.2.1 Concrete Products

Use in the construction industry as a concrete/cement mix aggregate has frequently been touted as a suitable reuse option for treated drill cuttings. During this study a number of construction companies expressed an interest in using the cuttings in this manner.

To identify more precisely which concrete products might be suitable, treated drill cuttings were analysed by the Concrete Technology Unit of the University of Dundee. Preliminary findings found the treated cuttings to be high in chlorides, barides and sulphates. High chloride levels make the cuttings unsuitable for steel reinforced concrete (see section 2). Barite is insoluble but also toxic and this toxicity will necessitate leachate testing of concrete products.

From these analyses the Concrete Technology Unit suggest that, subject to further testing, treated drill cuttings would be appropriate for use as a binder filler with Portland cement, in pre-cast units, as an activator or as an aggregate. A final report of the Concrete Technology Units findings is currently being prepared but further research would be required to confirm the findings of this preliminary evidence.

A cuttings processing facility, in partnership with a brick manufacturer, have previously attempted to manufacture bricks from treated cuttings. The first batch was successful but the quality of the bricks in the second batch was poor. The problem was thought to be in the variability of the cuttings geology found in the second batch of drill cuttings. The conclusion to the trial was therefore that given the unpredictable nature of the cuttings feedstock, their use in brick manufacture would be impractical (Duthrie, 1999. Pers comm.). Further research by the Concrete Technology Unit at the University of Dundee or a similar institution would be required to confirm the findings of this anecdotal evidence.

4.2.2 Coastal Defence

The maintenance of coastal integrity is often achieved through the construction of sea walls. The high salinity of treated drill cuttings has been identified as a restriction on some possible reuse options. Reuse in a saline environment would reduce or remove this restriction. Therefore, use as a concrete mix aggregate for sea wall structures is a reuse possibility.

Coastal defence is the responsibility of local councils. In Aberdeenshire, the Council mix their own concrete during sea wall construction. However, further research may be required to confirm the suitability of treated drill cuttings as a concrete mix aggregate for sea wall structures.

4.2.3 Land Reclamation

Land is commonly reclaimed from the sea during the development of coastal regions. This process involves the filling of cells previously isolated from the sea with a general fill material. Treated drill cuttings have been identified as a possible fill material for such developments. Aberdeenshire Council have expressed the view that this option is preferable to the reuse of cuttings as an aggregate mix in coastal defence (Smith, 1999 pers comm).

Aberdeenshire Council subcontract to obtain material for this purpose and MacIntosh are one of the key companies they use (Appendix 1).

4.2.4 Roads and Cycle Paths

The creation of roads and cycle paths can require a considerable volume of construction material. For example, a $5m^2$ area of surface construction would require approximately 1.8 tonnes of cuttings. Road and path construction have therefore been identified as possible reuse options for treated cuttings.

Waveney District Council have used treated drill cuttings as a filling material to build a cycle path along a disused railway line. The material was obtained from *Recovery Systems* in Lowestoft and was checked and cleared for use by the Environmental Agency and a soils engineer. During transit to site and the laying of the dry treated cuttings, however, heavy rain significantly increased the moisture content making compaction impossible. The path eventually became operable once the cuttings were spread to 1m thickness, flattened with 'type 1' crushed concrete and stabilised with stone rejects. The path was surfaced with asphalt. Figures 1 to 4 illustrate the stages in the path development. The cycle path has been positioned for over a year and so far it is stable but there remains doubt over its long-term stability. The cycle path project has two further phases planned but the council is unwilling to consider the further use of drill cuttings due to the problems encountered in Phase 1 (Bunn, 1999. Pers comm.).

During the course of this study Techno Terra, specialists in soil stabilisation and contamination control, were approached to assess the stability of drill cuttings taken from two different North Sea locations and treated at Recovery Systems.

To test the treated cuttings both samples were combined with 5% ordinary cement and 3% Diogen Plus, a material for treatment of colloidal solids. Water was added to the resulting mixture until the Optimum Moisture Content was reached. After a 28 day testing period the unconfined compressive strength of sample one was 1.5 MPa and sample two 1.3 MPa. A figure of 2.5 MPa would be expected for motorway construction. The 1.5 MPa strength for sample one was reached after 7 days and was expected to increase in strength by up to 60% by day 28. It is not known why no such increase occurred but it may be the result of sampling error (Trindall, pers comm, 1999).

Techna Terra are of the opinion that, on the basis of this preliminary testing, treated drill cuttings would be a suitable for non-specification work such as foot paths, cycle paths and car parks. They also think that the treated cuttings could be used in the construction of roads with adoptable standards. Whether a Council would permit their use will be dependent on the Council's policy. The Council may have chosen to adopt Highways Agency Standards in which case the surfacing material would need to meet these standards. Alternatively, it is common practice for Councils to have chosen not to adopt Highways Agency Standards and instead rule on a case by case basis as to the suitability of the surfacing material. The material strength obtained also appears to be above that required for road base construction work where a CBR of 15 is normally required (Trindall, pers comm, 1999).

Contact has been established with Sustrans, the charity responsible for the National Cycle Network. The possibility of them using drill cuttings was not dismissed (Roy, 1999. Pers comm.).

Fig 4.1: Placement of drill cuttings on disused railway line

Fig 4.2: Failure of cuttings to compact resulting in unstable, water logged surface

Figure 4.3: Placement of stone rejects to stabilise path

Fig 4.4: Final asphalt surface in place

4.2.5 Pipe bedding

Construction businesses commonly require material of 10mm particle size or less for use when bedding pipes.

Use of the material will be dictated by it meeting the legal regime described in Section 2 and the cost of material. At present pipe bedding material costs between £2 to £5 per tonne.

4.2.6 Landfill Cell Construction

Treated drill cuttings may be used within landfill sites to construct cell walls. The main advantage to this is that the cuttings are re-used within a controlled environment. However, landfill cell construction is perceived more as a form of disposal rather than re-use.

4.3 Landscaping

4.3.1 Noise abatement mounds

A noise abatement mound is essentially terrain landscaped to facilitate an increase in the attenuation of noise. Such mounds are commonly found alongside roads to limit noise pollution of adjacent settlements.

Treated drill cuttings have previously been used for noise abatement at a clay pigeon shooting site. The site needed a mound with dimensions of 3000m x 9m x 6m to ensure sufficient noise attenuation. This required approximately 2000 tonnes of material. The mound was built using processed drill cuttings from *Recovery Systems*, but ultimately failed the COD and electrical conductivity tests required by the Environment Agency. One test location also failed on iron content though the reason for this is unknown (Duthrie, 1999. Pers comm.).

Future use of treated drill cuttings in the construction of noise abatement mounds has not been ruled out. However, its usage will be subject to testing in accordance with the regulatory regime outlined in Section 2.

4.3.2 Topsoil Admix

It is common practise to increase the volume of topsoil used in landscaping through the addition of a lower grade of material commonly known as a an admix. Treated drill cuttings have been identified as a possible admix material.

The Environment Agency in England has previously approved treated drill cuttings for use as topsoil admix at a ratio of 5% treated cuttings to 90% topsoil. However, when undertaken in a commercial environment, such a small ratio of cuttings to topsoil proved to be financially and operationally impractical (Duthrie, 1999. Pers comm.).

Despite the identification of impracticalities associated with the reuse of treated drill cuttings as a topsoil admix, communications with landscape companies suggest that, subject to commercial and legislative constraints, this method of reuse remains a possibility.

4.3.3 Embankments in a Brackish Environment

In many coastal regions land requires protection from adjacent waters. This protection commonly takes the form of embankments and because of the high salinity content of treated drill cuttings this has been identified as a possible use for treated drill cuttings.

A project to raise embankment heights on the Norfolk Broads was identified as an ideal opportunity for the reuse of cuttings treated at the nearby Recovery Systems processing facility. However, the volumes required were so far in excess of those which could be provided by drill cuttings that their use was considered impractical and the project's engineering team ultimately choose to quarry their own material.

The use of treated drill cuttings in the construction of embankments in a brackish or saline environment will depend primarily on engineering requirements, on the volume required and the volume available. Approval for use will also be required from the regulatory authorities as detailed in Section 2. The example of the Norfolk Broads is clearly unique and it is likely that embankment construction in the Aberdeen area would be on a considerably smaller scale.

The requirement for suitable embankment construction material at the time treated cuttings are available can be ascertained in the first instance by reference to regional planning departments (Appendix 1).

4.3.4 Fill material

Landscaping projects frequently require quantities of fill material. Fill material is usually sourced at the site itself but occasionally it is necessary to import it.

Subject to legal constraints and cost, landscaping companies are receptive to the possible use of treated drill cuttings as a general fill material.

5 Investigation into Possible Uses in the Aberdeen Area

5.1 Introduction

Landscape and Construction companies within the Aberdeen area were identified and contacted to ascertain the potential market available for treated drill cuttings. Those contacted were asked about their interest in using the cuttings in the future, the likely quantities they were willing to accept and any constraints that they would have in using the treated cuttings.

5.2 Summary of Findings

A record of all the companies contacted who expressed an interest in reusing drill cuttings are summarised in Appendix 2. Details of end use, the quantities of cuttings likely to be accepted and the potential constraints on reuse have been identified where possible and are also listed in Appendix 2. Appendix 3 lists those companies who were contacted but who did not express an interest, together with other individuals and companies contacted during the course of this study.

5.2.1 Construction

About three quarters of those contacted expressed an interest in using the treated drill cuttings provided the materials met the pre-set British Standards (BS) of quality. The remainder of the companies contacted either had their own quarries or were simply unwilling to consider using a different raw material from their normal source.

For those companies that did express an interest, the main uses they considered are outlined in Table 5.1.

Table 5.1: Uses for Treated Cuttings within the Construction Industry

Concrete/cement mix	Pipe bedding material
General fill material/hardcore	Bitumus material

Most of the companies emphasised the necessity for the cuttings to be economically viable. Current costs of quarried material used in the industry ranged from £2 per tonne for virgin aggregate (i.e. rock excavated from the ground without further processing) to £5 per tonne for processed aggregate (i.e. crushed and graded). Transport to construction sites would

add on an additional 30 -40% to these respective costs (Kirk, 1999, pers comm.). Treated drill cuttings, therefore, would have to compete with these costs.

Aberdeenshire Council was also contacted to ascertain the potential of using treated cuttings in the manufacture of sea walls for coastal defence. Due to the severe attrition along the northern part of the East Coast, sea wall material is required to be as strong as possible. For this reason, the aggregate used for sea wall structures is predominantly a granite aggregate. The typical aggregate size used in concrete mixes is approximately 40mm. The main problems anticipated with using drill cuttings for this purpose would be that the material may be too soft to withstand the aggressiveness of the salt water and also the lack consistency between batches as a result of variations in rock type (Smith, 1999, and Osborne, 1999 pers comm.).

5.2.2 Landscaping

Of those Landscape companies contacted, about half expressed an interest in using treated cuttings, the remainder of the companies contacted were involved purely in the design aspect of landscaping. The main uses in which the companies were interested are given in Table 5.2.

Table 5.2: Uses for Treated Cuttings within the Landscaping Industry

Hard Landscaping (paving, road fill material)	Soft Landscaping (Fill material)
Top soil Admix	

Hard landscaping was deemed a more appropriate use by the majority of the companies. Use in soft landscaping was frequently discounted on the basis that the material used for this purpose is already available on the site and it is rare to have it imported.

5 Conclusions and Recommendations

5.1 Conclusions

- Cuttings re-use is only possible once the cuttings have been treated;
- Cuttings treatment technology is reasonably well developed for OBM and SBM cuttings;
- Only a few companies are capable of treating WBM cuttings;
- There are currently four treatment facilities in the Aberdeen area: Burgess & Garrick, Maersk, Enviroco and Scotoil;
- Treated cuttings are subject to two sets of standards depending on their final destination: EA/SEPA standards for disposal of contaminated soil, and construction industry standards for use in buildings, roads etc.;
- The main opportunities for re-use appear to be in the construction industry but the volumes likely to be required are relatively small;
- Economic viability is the main constraint on the re-use of drill cuttings. Companies will only consider re-using cuttings if the cost of treating them and transporting them to the site does not exceed that of the materials currently in use;
- Further problems have also been encountered in ensuring a consistent product is provided to the users. This is particularly important in the construction industry.

5.2 Recommendations for Further Research

Two key areas for further research have been identified:

- Examine the possibilities of grading treated cuttings after treatment to obtain a more consistent size and quality, which would aid use in the construction industry;
- Carry out a full life cycle analysis of disposal and re-use options taking into account all environmental impacts and risks. This should include a comparison of the impacts of discharging cuttings to the marine environment with the proposed re-use/disposal options onshore.

The report currently being prepared by the Concrete Technology Unit at the University of Dundee on the possibility of reusing treated drill cuttings in concrete and concrete products may make recommendations for further research in this area.

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APPENDIX 1

BS STANDARDS FOR BUILDING AGGREGATES

The following presents the requirements for four BS standards for Building aggregates.

1. **BS 882: 1983** ***British Standard Specification for Aggregates from natural sources for concrete*****:** This BS specifies the quality and grading requirements for aggregates obtained by processing natural materials for use in concrete. The following table, taken from the specification, details the grading requirements for *coarse aggregate*, which is defined as a) aggregate mainly retained on a 5.0mm BS test sieve, b) uncrushed gravel (coarse aggregate resulting from the natural disintegration of rock) c) crushed gravel, d) partially crushed gravel, e) crushed rock, f) blended coarse aggregate. *Fine aggregate* is defined as aggregate mainly passing a 5.0 mm BS test sieve.

BS882: Grading Requirements for Coarse aggregates

BS Sieve Size	**PERCENTAGE BY MASS PASSING BS SIEVES FOR NOMINAL SIZES**							
	Graded aggregate			**Single-sized aggregate**				
mm	**40 to 5mm**	**20mm to 5 mm**	**12mm to 5 mm**	**40mm**	**20mm**	**14mm**	**10mm**	**5mm**
50.0	100	-	-	100	-	-	-	-
37.5	90-100	100	-	85-100	100	-	-	-
20.0	35-70	90-100	100	0-25	85-100	100	-	-
14.0	-	-	90-100	-	-	85-100	100	-
10.0	10-40	30-60	50-85	0-5	0-25	0-50	85-100	100
5.0	0-5	0-10	0-10	-	0-5	0-10	0-25	45-100
2.36	-	-	-	-	-	-	0-5	0-30

2. **BS 1199: 1976** ***British Standard Specification for Sands for external renderings and internal plastering with lime and Portland Cement.*** This BS relates to naturally occurring sands, crushed stone sands and crushed gravel sands used for external rendering and internal plastering using mixes of lime and sand (with or without the addition of cement of gypsum plaster), cement and sand (with or without the addition of lime). The following table gives the various grading requirements, the left column gives the BS standard sieve types and the percentage by mass passing each sieve type.

BS 119: Grading Requirements of Sands for external renderings, internal cement and lime plastering

BS Test Sieve	PERCENTAGE BY MASS PASSING BS TEST SIEVES	
	Type A	**Type B**
mm	%	%
6.30	100	100
5.00	95-100	95-100
2.36	60-100	80-100
1.18	30 – 100	70-100
µm		
600	15-80	55-100
300	5-50	5-75
150	0-15	0-20
75	Not greater than 5	Not greater than 5

3. **BS 1200: 1976** ***British Standard Specification for Sands for mortar for plain and reinforced brickwork, blockwalling and masonry.*** This British standard relates to naturally occuring sands, crushed stone sands and crushed gravel sands used for mortars for brickwork (plain and reinforced) for building with clay or concrete blocks and for masonry. The following table gives the various grading requirements, the left column gives the BS standard sieve types and the percentage by mass passing each sieve type.

BS 1200 Sands for mortar for plain and reinforced brickwork, blockwalling and masonry.

BS Test Sieve	PERCENTAGE BY MASS PASSISING BS TEST SIEVES	
	Type S	TYPE G
mm		
6.3	100	100
5.00	98-100	98-100
2.36	90-100	90-100
1.18	70-100	70-100
µm		
600	40-100	40-100
300	5-70	20-90
150	0-15	0-25
75	0-5	0-8

Both *BS 1199* and *1200* specifications dictate that the sands should be "hard, durable, clean and free from adherent coatings, such as clay and from any appreciable amount of clay in pellet form." They also state that the sand should not contain "harmful materials such as iron pyrites, salts, coal or other organic impurities, mica, shale or similar laminated materials, or flaky or elongated particles in such a form or in sufficient quanity to affect adversely the hardening, strength or durability of the mortar nor, in addition to the above, for reinforced brickwork, any materials which might attack the reinforcement."

4. **BS 3797: 1990: *British Standard Specification for: Lightweight aggregates for masonry units and structural concrete*.** This BS specifies requirements for lightweight aggregates for masonry units and structural concrete. Lightweight aggregate is defined as an aggregate having a loose bulk density not more than 1200kg/m3 for fine aggregate or not more than 1000 kg/m3 for coarse aggregate. The following table outlines the grading requirements for fine aggregate for structural concrete.

BS 3797: Grading of Fine aggregate for structural concrete

BS Sieve Test	PERCENTAGE BY MASS PASSING BS TEST SIEVES	
	Grade L1	**Grade L2**
10mm	100	100
5.00mm	90 to 100	90 to 100
2.36mm	55 to 100	60 to 100
1.18mm	55 to 90	40 to 80
600µm	20 to 60	30 to 60
300 µm	10 to 30	25 to 40
150 µm	5 to 19	20 tom35

APPENDIX 2

COMPANIES EXPRESSING AN INTEREST IN TREATED CUTTINGS USE

The following pages provide a summary of those companies contacted who expressed an interest in the use of treated drill cuttings. Further information, such as quantities likely to be accepted and constraints, are also detailed.

SUMMARY OF COMPANIES CONTACTED

COMPANY	PRIMARY BUSINESS	CONTACT NAME	TELEPHONE NO.
Aberdeen Garden Design Service/Astell Associates	Hard and Soft Landscaping/Landscape Architects	Nigel Astell	01224 734146
Moray Landscapes	Grounds maintenance contractors	Mr McWatt	01542 841144
Roy Cowie Land Based Services	Hard and Soft Landscapers	Jake Dickie	01330 822871
Silver Birch Landscaping	Landscaping	Mr Henderson	01224 877284
ANB Building Supplies	Building suppliers	Norman McKay	01224 488500
Banchory Contractos	Builders	Alistair Duguid	01330 844767
Chap Construction (Chap Quarries)	Building and Civil Engineering Contractors and suppliers	Vince Kirk	01330 811771
Denburn Building Contractors Ltd	Builders	Wendy McKenzie	01224 705544

SUMMARY OF COMPANIES CONTACTED CONTD.

COMPANY	PRIMARY BUSINESS	CONTACT NAME	TELEPHONE NO.
Hunter Construction (Aberdeen) Ltd.	Construction Company	Jim Urquhart	01224 873363
MacIntosh	Civil Engineering Company	Niall MacIntosh	01330 860751
MTM Construction	Civil Engineering and Building contractors	Douglas Milne	01224 790888
Remac Construction Ltd	Building and Civil Engineering Contractors	Mr Rod McIntosh	01343 542989
Robertson Doric Precast	Structural Concrete Products Manufacturer	David McHardy	01224 704268
Waste Water Solutions Ltd.	Drainage Consultants and Contractors	Joyce Murison/Geordie Murison	01224 782700

COMPANY DETAILS AND REQUIREMENTS

Company:	**ABERDEEN GARDEN DESIGN SERVICE/ASTELL ASSOCIATED**
Primary Business:	Hard and Soft Landscaping/Landscape Architects
Contact Name:	Nigel Astell
Address:	Eastland, Maryculter, Aberdeen AB12 5FS
Telephone Number:	01224 734146
Fax Number:	
Expression of Interest:	Interested in using treated drill cuttings as a concrete/cement mix for use in paths, patios, walls etc.
Likely Quantities:	200 tonnes per year
Constraints:	Must be competitive with quarries regarding price and quality of material.

Company:	**MORAY LANDSCAPES**
Primary Business:	Grounds maintenance contractors
Contact Name:	Mr McWatt
Address:	Mill of Towie, Lintmill, Cullen Buckie, AB56 4TA
Telephone Number:	01542 841144
Fax Number:	01542 840280
Expression of Interest:	Would be interested in using the treated drill cuttings as a top dressing for footpaths and as road fill material. Discounted use for landscaping, as it is unusal to bring in fill material, - normally use material available on site
Likely Quantities:	Unable to specify
Constraints:	Would require a clean stone material – clay content builds in maintenance problem (i.e. mud). Requires a uniform size of 12-19mm or 6mm. Must be economically competitive.

Company:	**ROY COWIE LAND BASED SERVICES**
Primary Business:	Hard and Soft landscapers and Garden Maintenance
Contact Name:	Jake Dickie, Operations Manager
Address:	Unit 3, Tillybrake Ind. Est., Tillybrake Road, Banchory
Telephone Number:	01330 822871
Fax Number:	
Expression of Interest:	Interested in using treated drill cuttings as an open mix to add to top soil as a planting medium and a concrete/cement mix for paving, general construction, driveways etc.
Likely Quantities:	300-500 tonnes per year
Constraints:	Economics – would consider use only if undercuts cost of current raw material

Company:	**SILVER BIRCH LANDSCAPING**
Primary Business:	Landscaping
Contact Name:	Mr Henderson
Address:	59 Walker Rd., Torry, Aberdeen AB11 8DJ
Telephone Number:	01224 877284
Fax Number:	
Expression of Interest:	Interested in using treated drill cuttings as a top soil mix and a concrete/cement mix
Likely Quantities:	Approx. 50 tonnes per year
Constraints:	Economic – current supplies cost £5/tonne for sand and soil mix

Company:	*ANB Building Supplies*
Primary Business:	Building Suppliers
Contact Name:	Norman McKay
Address:	5 St Machar Road, Aberdeen
Telephone Number:	01224 488500
Fax Number:	
Expression of Interest:	Interested in using the treated drill cuttings as a concrete mix and for pipe bedding material
Likely Quantities:	Approx. 3000 tonnes per year
Constraints:	Must meet technical and economical requirements

Company:	**BANCHORY CONTRACTORS**
Primary Business:	Builders
Contact Name:	Alistair Duguid
Address:	The Minklets, Crathes, Banchory, AB31 5QQ
Telephone Number:	01330 844767
Fax Number:	01330 844788
Expression of Interest:	Buy in most of the material as a ready mix. Interested in using the treated drill cuttings – but did not feel that they would require enough volumes for a concrete mix to be a viable user. Could use as a general filling material, or for pipe bedding.
Likely Quantities:	Unable to specify
Constraints:	Sizings – must be 4 inches and down as general upfill material, 10mm for pipe bedding

Company:	**CHAP CONSTRUCTION (CHAP QUARRIES)**
Primary Business:	Building and Civil Engineering Contractors and suppliers
Contact Name:	Mr. Vince Kirk
Address:	Park Quarry, Drumoak, Aberdeen
Telephone Number:	01330 811771
Fax Number:	
Expression of Interest:	Interested in using treated drill cuttings as a general fillling material and as a cementatious mix.
Likely Quantities:	Up to 25,000 tonnes
Constraints:	Must meet BS standards and be economically viable.

Company:	**DENBURN BUILDING CONTRACTORS LTD**
Primary Business:	Builders
Contact Name:	Wendy McKenzie
Address:	Stewart House, 38 Ellon Road, Bridge of Don, Aberdeen
Telephone Number:	01224 705544
Fax Number:	
Expression of Interest:	Interested in using treated drill cuttings for a concrete/cement mix.
Likely Quantities:	Unable to specify
Constraints:	Must be compliant with BS standards

Company:	**HUNTER CONSTRUCTION (ABERDEEN) LTD.**
Primary Business:	Construction Company
Contact Name:	Jim Urquhart
Address:	Craigshaw Crescent, Aberdeen, AB12 3EW
Telephone Number:	01224 873363
Fax Number:	
Expression of Interest:	Interested in using treated drill cuttings as a concrete mix. If material was of irregular sizes, it could be used for pipe bedding works and sewerage works (10-20mm). Would be more interested in taking the material for this purpose then for a concrete/cement mix. Would also use the material as a general fill
Likely Quantities:	Unable to specify – up to 10 tonnes per month
Constraints:	Grading size would have to be up to 20mm. Sand and gravel must conform to BS grading parameters. Must be economically viable

Company:	**MacIntosh**
Primary Business:	Civil Engineering Company
Contact Name:	Niall MacIntosh
Address:	Brichmoss Depot, Westhill, Aberdeenshire, AB32 6XL
Telephone Number:	01330 860751
Fax Number:	
Expression of Interest:	Interested in using the treated cuttings as a general fill material
Likely Quantities:	Unable to specify
Constraints:	Must meet BS standards and be economically viable.

Company:	**MTM CONSTRUCTION**
Primary Business:	Civil Engineering and Building Contractors
Contact Name:	Douglas Milne
Address:	Blackburn Industrial Estate, Blackburn, Aberdeen,
Telephone Number:	01224 790888
Fax Number:	01224 790922
Expression of Interest:	Interested in using treated drill cuttings as concrete/cementatious mix.
Likely Quantities:	Unable to specify. If constraints are dealt with, could use thousands of tonnes of the material per year
Constraints:	The cuttings must be competitve in price with the materials they normally use (£2 -£5 per tonne). Would also have to ensure the cuttings would meet various specifications for the intended end use – i.e. BS standards and the requirements of the Architects themselves.

Company:	**REMAC CONSTRUCTION LTD**
Primary Business:	Building and Civil Engineering Contractors
Contact Name:	Mr Rod McIntosh (Technical Manager, Leith Engineering (Head Office of Remac Construction)
Address:	106 High Street, Elgin, EV30 1BW
Telephone Number:	01343 542989
Fax Number:	
Expression of Interest:	Foreseeable use for treated drill cuttings as a concrete mix and also as a bitumus material
Likely Quantities:	Unable to specify
Constraints:	Size ranges accepted range from 75 microns to 40mm. Key to use is consistency. Must meet BS standards

Company:	**ROBERTSON DORIC PRECAST**
Primary Business:	Structural Concrete Products Manufacturer
Contact Name:	David McHardy
Address:	Mundurno, Bridge of Don, Aberdeen
Telephone Number:	01224 704268
Fax Number:	01224 823897
Expression of Interest:	Interested in using the treated drill cuttings as a concrete mix.
Likely Quantities:	Subject to constraints, would be interested in acquiring ≥ 10,000 tonnes per year
Constraints:	Cuttings would have to meet the various BS Standards, size requirements (up to 20mm), would have to be economically viable. Concerned over sulphate content – their precast concrete units have lots of coloured finishes, sulphate may have effect on colours.

Company:	**WASTE WATER SOLUTIONS**
Primary Business:	Drainage Consultants and Contractors
Contact Name:	Joyce Murison/Geordie Murison
Address:	North Mains Quarry, Findon, Aberdeen, AB12 4SJ
Telephone Number:	01224 782700
Fax Number:	01224 784700
Expression of Interest:	Interested in using the treated drill cuttings as a pipe bedding material.
Likely Quantities:	Unable to specify
Constraints:	Must be cheaper then present material supplies (£2-£5 per tonne).

APPENDIX 3

Summary of other Companies contacted during the study

COMPANY	NAME	POSITION	TELEPHONE NO	COMMENT
Aberdeenshire Council	Alistair Smith	Coastal Defence Planner	01224 597058	Information on use of processed cuttings in coastal defence
Burgess and Garrick Oil Services	Brian Norris		01224 875 560	Information on treatment technology
DETR	Andrew Osborne	Civil Engineer	0171 8905313	Information on use of processed cuttings in coastal defence
Land-Drill Geotechnics	Sandy Stephen		01224 621 996	Information on testing requirements SEPA and construction industry
Maersk	George Anderson	Plant Manager	01224 896331	Information on treatment technology
Recovery Systems Limited	Donald Duthrie		01502 581 119	Information on treatment technology and re-use attempts

COMPANY	NAME	POSITION	TELEPHONE NO	COMMENT
Scotoil	Tom Bell		01224 571491	Information on treatment technology
	John Witherspoon		01224 571494	Information on companies interested in use of processed cuttings
Sustrans	John Roy	Engineer	01733 319981	Information on use of cuttings in cycle path project
Techna Terra	Barry Trindall		01442 252332	Tested processed drill cuttings for this study and manufactures soil stabilisation products
University of Dundee	Prof. Dhir		01382 344816	Possibility of re-using treated drill cuttings in concrete and concrete products
Waveney District Council	Norman Bunns	Engineer	01502 562111	Information on use of cuttings in cycle path project
Five Star Property Maintenance	Mr Anderson	Gardening Manager	01224 734146	Landscaping company contacted to determine whether interested in using processed cuttings – were not interested
JB Landscapes	John Bernard	Operations Manager	01224 824117	Landscape Design company. Contacted to determine whether interested in using processed cuttings – were not interested

COMPANY	NAME	POSITION	TELEPHONE NO	COMMENT
Keith Builders Merchants	-	-	01542 886222	Builders contacted to determine whether interested in using processed cuttings – were not interested
Lovie Ltd	Bill Lovie	Owner	01771 653777	Supplier of root zone soil, sand, gravel and aggregates. Contacted to determine whether interested in using processed cuttings – were not interested.
Mackland Precast	Silvia Took	Materials Buyer	01224 641423	Building suppliers contacted to determine intereste in using processed cuttings – were not interested