Enovert

Hafod Quarry Landfill Site

Restoration Plan

1. Site requirements

Hafod Quarry Landfill is currently an operational landfill (permit PP3139GB) with the earlier phases of development in the restoration phase. There are planning obligations upon Enovert to restore the site to enhance the local environment and to provide ecological benefit. There are certain areas of the site that already benefit from being classed as SSSI's and Special Areas of Conservation, so a high quality level of restoration at the site is imperative to keep these important accreditations.

Above the capping layer (that has been progressively installed) is a requirement for a minimum of 1 meter of soil forming material and 1.5 meters where trees are to be planted, in order to provide a suitable growing medium for a variety of habitats, as per plan CE-HF-0238-DW01a. This equates to 10,000m3 – 15,000m3 of soil per hectare, which, in turn, equates to as much as 28,000 tonnes per hectare. It's anticipated to receive up to 150,000 tonnes per annum. Historically, imported soils have been used for site restoration but soil is a finite resource and, in particular topsoil, is a valuable commodity. Wherever possible, Enovert is committed to the use of sustainable / recovered materials and as such it is intended that selected wastes be utilised in the restoration of the site. Without the importation of waste materials it would not always be possible to source the quantity or type of top soil materials required to meet Enovert's obligations and complete the restoration of the site. It has been proven in the past that the selective addition of certain waste types into the existing excavation soils, enhances the soil structure and nutrient availability, to produce improved growing conditions, particularly for trees planted as part of the restoration plan.

2. Waste types

Table 1 lists waste types which may be suitable for recovery and utilised for site restoration. The wastes have been assigned different categories (A-D), according to use in site restoration and these uses are detailed after the table.
For benefit statements for each of these wastes please see appendix B.

Table 1: Acceptable waste types

Waste Type	Category
01 01 02 Waste from non-metalliferous excavation	A, B
01 04 08 Waste gravel and crushed rocks	A, B
01 04 09 waste sand and clays	A
02 04 01 Waste soil from washing Beet	A
03 03 05 De-inked paper sludge and de-inked paper pulp	C
03 03 10 Fibre rejects	C
03 03 09 Lime Mud waste	C, D
17 01 01 Concrete	B
17 01 02 Bricks	B
17 01 03 Tiles and ceramics	B
17 01 07 Mixture of bricks, concrete, tiles and ceramics	B
17 05 04 Soil and stones	A
17 05 06 Dredging spoil	A
17 05 08 Track Ballast	A
19 05 03 Off specification compost	C
19 05 10 Fibre rejects	C
19 05 99 CLO from MBT	C
19 06 04 Digestate from the anaerobic treatment of municipal waste	C
19 06 06 Digestate from the treatment of vegetable and animal waste	C
19 08 02 Waste from de-sanding	A
19 08 05 Sludges from treatment of urban waste water	C
19 09 02 Sludges from water clarification	C
19 12 09 Minerals	A
19 12 12 CLO from MBT	C
19 13 02 Solid waste from soil remediation	A
19 13 04 Sludges from soil remediation not containing dangerous substances	A
20 02 02 Soil and stones	A

A – Bulk Fill material, B – Construction / Drainage materials, C – Organic Material, D – Liming Materials

Bulk Fill materials (A)

These materials will provide the bulk of the restoration layer. Typically, these wastes will be derived from remediation, bulk excavation, construction or other industrial projects and are low in organic content and other nutrients. Consequently for habitat creation and to provide a good substrate for growth they may need to be supplemented with additional materials.

Materials for tracks / hard-standing areas (B)

These materials would be for use on access tracks, areas of hard-standing (e.g. Car parks) and the surface dressing of footpaths (if required). They may also be utilized for drainage should a need arise.

Organic Wastes (C)

All organic matter, regardless of the source, can make a significant contribution to the physical structure of the soil to which it is applied. This can include the lowering of soil bulk density, an increase in soil moisture available to plant roots, an improvement in aggregate stability (and by implication greater resistance to erosion) and an increase in porosity, and consequently aeration, infiltration and drainage. From a biological perspective the addition of organic materials stimulates soil biological activity, which improves nutrient cycling and soil fertility. The organic matter content of materials varies considerably. Biosolids and paper mill crumble tend to have the highest organic matter content (around 50% dry weight) while others, such as compost and CLO have an organic matter content of between 8% and 40%.

The chemical benefits of most recycled organic materials are largely the result of their nitrogen and phosphate content, although levels of potash may be beneficial in some situations. Recycled organic matter may also contain useful levels of vital trace elements. The nutrient content of recycled organic materials varies considerably, as does the availability of the nutrients. The availability of nitrogen in particular may be a more relevant criterion than total nitrogen for determining application rates. Most recycled organic materials tend to have neutral or slightly alkaline pH which is a positive asset when soils on many degraded sites tend to be acidic. Lime-treated biosolids have a higher pH and a greater liming benefit. Benefits of an elevation in pH include an improvement in the buffering capacity of the soil and reduced bioavailability of certain contaminants, such as nickel and zinc.

Liming materials (D)

It is important, to maintain nutrient availability and to reduce the amount of potentially harmful substances available to plants, that the pH is maintained at optimal conditions. Over time, the addition of fertilisers, cropping and leaching can all have an effect on soil pH.

Also, due to the variable nature of waste materials for recovery, pH adjustment might be required. Liming can also be of benefit by stimulating the activity of heterotrophic organisms, improving soil structure and the stimulation of nitrogen fixing bacteria. These materials will be utilised if the need for lime addition into the soil is identified and each application will be justified and risk assessed.

3. Acceptance criteria

Material requiring initial analysis will only be acceptable if the waste is non-hazardous, of a type listed in Table 1 and the levels of contaminants and potentially toxic elements (PTE's) are below the parameters listed in Table 2.

Table 2 – Restoration material threshold of PTE's (Potentially toxic elements)

PTE	Maximum permissible concentration ($mgkg^{-1}$)
Zinc	690
Copper	345
Nickel	145
Cadmium	7
Lead	700
Mercury	5
Chromium	690
Selenium	6.5
Arsenic	35
pH	>5, <11.5
TPH	1000
PAH's	500

As this is the creation of a new soil profile, these limits have been determined using the maximum permissible average annual rate of PTE addition over 10 years, as set out in The Sludge (Use in Agriculture) Regulations 1989. For the calculations, an average soil profile of 1.2 meters was used, with a bulk density of 1.8. Details are provided in Table 3 below.

Table 3: Calculation of PTE values.

PTE	mgkg-1	Quantity (te)/ hectare	Total mg	Total Kg/hectare	Maximum permissible average annual rate of PTE addition over 10 years
Zn	690	21600	14904000	14.904	15
Cu	345	21600	7452000	7.452	7.5
Ni	145	21600	2980800	3.132	3
Cd	7	21600	151200	0.1512	0.15
Pb	700	21600	15120000	15.12	15
Hg	5	21600	108000	0.108	0.1
Cr	690	21600	14904000	14.904	15
Mo	9	21600	194400	0.1944	0.2
Se	6.5	21600	140400	0.1404	0.15
As	35	21600	756000	0.756	0.7

In addition to the above, organic (category C) materials will be tested for available N, P and K prior to addition, to ensure suitability and loading of nutrients. Testing for hydrocarbons on organic material can be difficult, due to interferences so, unless contamination is suspected due to site history, visual or olfactory evidence, these wastes will not be required to have TPH or PAH testing.

The following waste types will not require analysis, however, they still need to be physically suitable and not contain, or be suspected of containing, contamination.

01 04 08	Gravel and crushed Rocks
10 12 08	Waste ceramics, bricks, tiles and construction products (after processing)
10 13 14	Waste Concrete
17 01 01	Concrete
17 01 02	Bricks
17 01 03	Tiles and ceramics
17 01 07	Mixtures of bricks, tiles and ceramics not containing hazardous substances
20 02 02	Soil and Stones (From gardens and parks)

From material accepted under previously agreed plans, it can be shown the maximum limits on PTE's as shown above result in a soil profile with levels of PTE's below those set out in the sludge regulations. If it's found those limits are exceeded then the figures in Table 2 will be adjusted accordingly.

3.1 Improvement of previously tipped soils

In cases where soils have been tipped previously, there might be a requirement for improvement by the addition of organic material and to increase the amount of available nutrients. The requirement will be determined by sampling and application rates determined from the results. Should further applications be required, the rates of application will be science based and in accordance with applicable guidance, such as the sludge regulations.
It is anticipated that application rates of organic material for poor quality existing soils will be in the region of 1000-2000 cum/Ha.

4. Waste Acceptance Procedures

All waste will only be accepted in accordance with Enovert's waste acceptance procedures, which form part of the environmental management system. A copy of these can be found in Appendix C.

All wastes destined for Enovert sites are assessed centrally by a qualified, competent person.
If the material is deemed to be acceptable (under this plan) it will be issued a unique disposal authorisation (DA) number be set up on the Gatehouse weighbridge system, which includes relevant information to enable acceptance at site, including a description of the waste, EWC codes, customer and producer details.

Upon arrival at the weighbridge, the customer will present a transfer note, detailing as a minimum; customer, waste producer, waste description, EWC code, sic code and DA number. These details will be checked against those already on the weighbridge software, along with a visual inspection of the waste (if possible). The vehicle will then be weighed and directed to the correct tipping location on site.

Restoration materials will be tipped in their final location and spread using appropriate plant, typically a LGP dozer. Any potentially odorous material will be incorporated into the soil profile immediately after placement to minimise the risk of amenity issues. In addition, no organic material will be placed:

- Within 10m of any watercourse.
- Within 500m of any SSSI or RAMSAR site without prior approval from the regulator.
- Within 50m of any residential property.

Wastes will be visually inspected at the tipping location by suitably trained personnel and any potential non-conformances (visual contamination, hydrocarbon odours / staining, etc…) will be reported immediately to site management.

Compliance Sampling.

At the time of setting up a waste stream on the weighbridge software, the frequency of compliance sampling will be entered. This will be determined by factors such as quantity and variability of the waste but will not be less than one sample per thousand tonnes of waste (1 in 50 loads).

Samples will be sent to an independent laboratory for analysis and the results reviewed by a competent person, against the parameters set out in this plan.

Non-Conforming loads

Vehicles will only be allowed to tip if the waste stream has been assessed and assigned a valid disposal authorisation (DA) number on the weighbridge software and a transfer note is provided.

If a load is found to contain non-conforming materials, or contamination is suspected then site management will be informed and the Waste Solutions Department contacted.

Upon assessment from a competent person, unsuitable material may ultimately be rejected from site, or diverted to the landfill (if acceptable) with the applicable rate of landfill tax being applied.

If a load has already been tipped when any non-conforming or suspect material is discovered (for example, material buried within a load which might only be observed when plant spreads the material) then the material will be quarantined pending assessment and investigation.

If compliance sampling shows a breach of the limits set out in this plan, then the customer will be required to investigate, which depending upon the results of the investigation and the severity of the breach, may lead to the waste stream being suspended or the frequency of compliance sampling being increased.

Contingency – other scenarios

In the event of materials being unable to tip for other reasons, e.g. Inclement weather or breakdown, customers will be contacted to prevent deliveries. Any material en-route or already at site will be tipped at a suitable location where potential for any run-off or contamination will be minimised.

Appendix A – Site Restoration Scheme plan

Appendix B - Benefit Statements

01 Waste resulting from Exploration, Mining, Quarrying and Physical and Chemical Treatment of Minerals

01 04 08 Waste gravel and Crushed Rocks

01 04 09 Waste sands and clays

These wastes are likely to include materials such as overburden from quarrying operations and reject materials, such as off specification clay.

Benefits

- Provide a good substrate and fill material to achieve the required restoration contours, habitat creation and landscaping.

Potential risks

- These wastes are likely to have a low nutritional value as a growing medium.

02 Wastes from agriculture, horticulture, forestry, hunting and fishing, food preparation and processing

02 04 01 Waste soil from washing Beet

Benefits

- Good bulk fill material
- Provide substrate for habitat landscaping and creation

Potential risks

- Low nutritional value
- Potential to introduce pests.

03 03 Wastes from pulp, paper and cardboard production and processing

03 03 05 De-inked paper sludge and de-inked paper pulp

03 03 09 Lime Mud waste

Paper sludge is the residue from the preparation of recycled paper prior to its re- use in the paper production process, it may also be from the processing of virgin fibre from a variety of fibre sources such as wood or cotton. Paper sludge contains short cellulose fibres which are not suitable for use in paper production, sludge from recycling also contains printing inks and mineral components such as kaolin, talc, and calcium carbonate. The de-inking and bleaching process means paper sludge can vary in colour, it is typically light grey through to blue-grey but other colours such as pink are possible depending on the types of paper used in the recycling process.

The ink residue from the recycling process is the primary source of PTEs in the sludge, however for many types of paper the PTE content of ink has been significantly decreased over the past 15 years to comply with the food packaging regulations and sludge now contains fewer PTEs.

Potential benefits:

- Good liming value
- Provides a good supply of nutrients, particularly for phosphorus, potassium and sulphur
- Organic matter providing soil conditioning properties such as porosity, moisture retention, structural stability and improve soil bulk density
- increase biological activity in the soil
- improve the size of the microbial and faunal population.

Potential risks:

- High surface application rates to grassland may cause smothering and stock rejection
- This waste stream tends to have a C:N ratio which may cause nitrogen lock up - Nitrogen could be added to sludges to prevent this.
- paper sludge can contain PTEs particularly copper in de-inking sludges from the printing inks
- Organic contamination
- Potential for odours
- Deterioration of soil structure can be caused by elevated sodium content (>2,500 mg/kg) in certain paper sludges.

17 Construction and demolition wastes (including soil from contaminated sites)

17 05 04 Soil and stones

Benefits

- Provide a substrate for creating habitats
- Increase soil depths above cap to agreed levels

Possible risks

- Sub-soil has a low organic content
- Possible PTE's
- Possible contamination from other sources, eg. Invasive plants or pathogens

17 05 06 Dredging spoil

Benefits

- Can supply organic material.
- Can be a good supply of nutrients in the form of organically bound nitrogen and phosphate.

Possible risks

- Potential for PTE's
- High suspended solids in run-off

19 Wastes from waste management facilities

19 01 18 Pyrolysis wastes not containing dangerous substances

Benefits

- Good source of carbon
- Contains nutrients NPK and trace elements
- Good moisture retention
- Good soil conditioning material

Possible risks

- Potentially dusty
- May contain variable amounts of PTE's

19 05 – Waste from the aerobic treatment of waste.

19 05 03 Off specification compost

Composting is a term used to describe the aerobic biodegradation of organic materials under controlled conditions of temperature and moisture. Compost may be produced in open windrows or in enclosed in vessel systems. Food waste must be composted in an in-vessel system and must be compliant with Animal By-Products Regulations (ABPR) as well as the relevant waste legislation. The end result of the composting process is a stable organic residue with high organic matter content and potentially significant quantities of nutrients. The breakdown of the organic material in the feedstock occurs as the compost heats up to its maximum temperature (>50°C) as a result of biological activity. This temperature must be reached to ensure the destruction of pathogens, after which the material must be allowed to mature for a period of several weeks. The final organic matter content of the compost depends largely on the length of this period of maturation; the longer the maturation, the lower the organic matter content. The feedstock must be turned regularly during this process to ensure that the treatment applies evenly throughout the windrow. In 2007-2008, 2.7 million tonnes of compost were produced in the UK; it is likely that this level of production will increase further in the future.

Benefits

- Excellent source of organic matter and a good soil conditioner
- Moderate levels of nitrogen, phosphorous and potassium.
- Low C:N ratio, giving a net release to the receiving crop

Potential risks

- May contain PTE’s or physical contamination
- Potential for odour
- Variation in composition

19 06 Waste from the anaerobic treatment of waste

19 06 04 Digestate from the anaerobic treatment of municipal waste

19 06 06 Digestate from the anaerobic treatment of vegetable and animal waste

Anaerobic digestion is a process whereby organic material is broken down by bacteria in a sealed environment without oxygen. There are two end products, namely biogas and digestate. Biogas may subsequently be used to generate electricity, for heating, transport fuel and fuel cells. Digestate is a nutrient-rich material that can be provided as separated fibre, separated liquor or whole digestate, which is a combination of the two; all forms of digestate can be applied to land. Green waste, food waste and mixed waste can be treated using anaerobic digestion.

Benefits

- Excellent source of organic matter and a good soil conditioner
- Moderate levels of nitrogen, phosphorous and potassium.
- Low C:N ratio, giving a net release to the receiving crop

Potential negative impacts

- May contain PTE’s or physical contamination
- Potential for odour
- Variation in composition

19 08 Wastes from waste water treatment plants

19 08 05 Sludges from treatment of urban waste water

Wastewater treatment works sludge is produced during the treatment of wastewater, and is either dewatered into a sludge cake or can undergo further treatment. This can include a number of complex treatment processes such as digestion, dewatering, thickening, composting, lime pasteurisation, or thermal drying, to produce a conventional or enhanced biosolids material. These treatment processes reduce the water content of the sewage sludge, reduce its ability to produce gas and render it virtually free from harmful organisms. The resultant biosolids are therefore easily transportable, less odorous and almost 100% pathogen free. Biosolids is a generic term used to describe the various forms of treated sludge. Biosolids are either conventionally treated or enhanced treated materials depending on the level of pathogen kill during the treatment process. They also have different physical characteristics; raw or digested sludge cake has a dry matter content of 25%; lime pasteurised sludge cake has a dry matter content of 40% and a higher pH content than other materials which are typically more or less neutral; sludge compost has a dry matter content of 60% and thermal dried granules or pellets have a dry matter content of 95%. The beneficial effects of recycling biosolids materials to reclaimed land are that it increases organic matter and water retention, improves drainage characteristics within the soil and provides soil nutrients essential for plant growth and land recovery.

Dewatered sludge (either in its raw or digested form) is the most common material used for land restoration within the UK. In 2007 53,000 tonnes (4%) were used directly in land reclamation in the UK out of approximately 1.4 million tonnes in total that were recycled to land. In 2008 the equivalent figures were 34,000 tonnes (3%) and 1.36 million tonnes. Most biosolids (77%) are used in the agricultural sector.

Benefits

- Excellent source of organic matter and a good soil conditioner
- Moderate levels of nitrogen, phosphorous and potassium.
- Low C:N ratio, giving a net release to the receiving crop

Potential risks

- May contain PTE's or physical contamination
- Potential for odour
- Variation in composition

19 09 Wastes from the preparation of water intended for human or industrial use

19 09 02 Sludges from water clarification
This can be split into two main categories, namely Coagulant sludges, which can be high in metals such as aluminium and iron, and natural sludges from the filtering of raw water.

Benefits

- Improve structure and drainage in heavy soil from the addition of grits and sands
- Increase soil depths above cap to agreed levels
- Reduce the need for soil imports to site
- Replace soils lost to erosion
- Addition of organic material into the soil
- Improved bulk density of existing soils at the receiving site

Possible risks

- Possible PTE's (Potentially toxic elements) or other dangerous substances, such as aluminium
- Potential for physical contamination (eg. Paper / plastic)
- Potential for iron staining on vegetation

19 12 Waste from the mechanical treatment of waste

19 12 09 Minerals

Benefits
Improve structure and drainage in heavy soil from the addition of grits and sands
Increase soil depths above cap to agreed levels
Reduce the need for soil imports to site
Replace soils lost to erosion

Possible risks
Possible PTE's (Potentially toxic elements) or other dangerous substances, such as oil
Potential for physical contamination (e.g. Paper / plastic)
Possible contamination from other sources, e.g. Invasive plants or pathogens
Potential for dust

19 12 12 Soil substitutes not containing dangerous substances (CLO from MBT)

Compost-like output (CLO) is a generic term used to describe organic-rich materials which have been derived from mixed municipal solid waste (MSW) feedstocks through some form of Mechanical Biological Treatment (MBT) to produce an organic-rich fraction. MBT is a very broad term encompassing many processes, or combinations of processes. These might include biological treatments such as composting and anaerobic digestion, as well as some form of mechanical processing to remove useable dry recyclables from the original feedstock, such as metal fragments, as well as shards of unwanted material such as glass and plastics.

The term CLO has come into common use specifically in reference to material derived from mixed waste feedstocks that have been treated biologically and is used to distinguish it from green compost derived from source segregated green waste materials.

Estimated production of CLO in the UK by 2010 is 583,500 tonnes (fresh weight) per year.

Benefits
Improve structure and drainage in heavy soil from the addition of grits and sands
Increase soil depths above cap to agreed levels
Reduce the need for soil imports to site
Replace soils lost to erosion
Addition of organic material into the soil
Improved bulk density of existing soils at the receiving site

Possible negative impacts
Possible PTE's (Potentially toxic elements) or other dangerous substances, such as oil
Potential for physical contamination (eg. Paper / plastic)
Possible contamination from other sources, eg. Invasive plants or pathogens
Potential for dust

19 13 Waste from soil and groundwater remediation

19 13 02 Solid waste from soil remediation

19 13 04 Sludges from soil remediation not containing dangerous substances

20 02 02 Soil and stones

Benefits

- Provide a substrate for creating habitats
- Increase soil depths above cap to agreed levels

Possible risks

- Sub-soil has a low organic content
- Possible PTE's
- Possible contamination from other sources, eg. Invasive plants or pathogens

Appendix C – Waste Acceptance Procedures