Ballymurtagh Landfill
Capping Works

CQA Validation Report

DOCUMENT CONTROL SHEET

Client	Wicklow County Council					
Project Title	Ballymurtagh Landfill Capping Works					
Document Title	CQA Validation Report					
Document No.	MDE0185Rp0003					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
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Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
F01	Final	Mark Mahon	C. Cahill		Carnegie House	February 2006

Consulting Engineers

Consulting Engineers

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1 INTRODUCTION

In August 2004 Wicklow County Council appointed Wills Brothers Ltd. to install the landfill capping system and undertake restoration works at Ballymurtagh landfill in accordance with Waste Licence 11-1. The works included the following:

- Regrading of the existing profile.
- Capping with a gas collection geocomposite layer, a barrier layer (Geosynthetic Clay Liner (GCL)) with a permeability of $<1x10^{-9}$m/s, subsoil and topsoil.
- Surface and subsurface drainage works and the construction of a storm water retention pond.
- The construction of a perimeter gas collection trench.
- Construction of 10x4m reinforced concrete slab to hold the landfill gas flare.

RPS Consulting Engineers were appointed by Wicklow County Council to supervise the works in accordance with Condition 4.14.2 of the Waste Licence and to validate (in accordance with Condition 4.14.3 of the Waste Licence and the EPA Landfill Manual on Site Design) the placement of the GCL in accordance with manufacturer's recommendations and the specification provided by RPS Consulting Engineers. During the period of these works, GCL was placed almost continuously from October 2004 to July 2005, where weather permitted. Checking and verification was undertaken by the Resident Engineer throughout this period. The verification of the GCL installation was based on routine inspection and ongoing technical supervision. Periodic visits to site were also made by the Geotechical Manager of the GCL suppliers (WTB Group), who was also available on an on-going basis for advice during the works.

This Validation Report details the CQA procedures and validates the installation of the GCL in accordance with Condition 4.14.3 of the Waste Licence.

2 METHODS OF INSPECTIONS

The CQA plan for the site had regard to the methods outlined in the GCL specification for the storage, placement and covering of the material to ensure quality during the works. The following steps were followed in implementing the CQA Plan:

- Verification that the technical details of proposed product and the accompanying method statements for GCL conform with the specification.
- Initial site visits and meetings with the Contractor to discuss proposals and method statements to ensure the capping system is placed in accordance with CQA procedures.
- Daily checking of Manufacturers Quality Control Certificates and cross-checking with the placed materials on site.
- Regular checking of GCL storage arrangements on site.
- Inspection of subgrade prior to placement of GCL.
- Inspection of the placement of liners and jointing of seams on site in accordance with manufacturer's recommendations.
- Inspection of cover material to ensure it conformed with the specification.
- Daily recording and documenting of weather conditions, plant used, site personnel, deliveries, site meetings. Details are available for inspection at landfill site office.
- Regular photographing of works.
- Daily preparation of Lining Layout Plan showing where panels were placed.

2.1 CONFORMANCE WITH SPECIFICATION

A specification for the GCL was supplied to Wills Bros. Ltd (WBL) as part of the Tender Documents to enable them to source a suitable product. The specification, which can be found in Appendix A, refers to the type of GCL required, product labelling, documentation, overlap lines, panel dimensions, storage, installation details, CQA and damage repair.

WBL proposed a GCL product Bentomat manufacturer by CETCO Europe Ltd. A method statement produced by CETCO was also provided which included manufacturers installation guidelines (see Appendix B). The GCL product proposed is manufactured in accordance with DIN EN ISO 9001.

Bentomat is a shear strength transmitting GCL. It is entirely needle punched through all layers, which develops high connection strength. Bentomat consists of bentonite powder embedded and sandwiched between two geotextiles. The bentonite swells and forms a low permeability seal upon contact with moisture. GCL seams are constructed by over lapping adjacent edges. A continuous fillet of granular sodium bentonite is applied along a defined zone on the underlying edge to enhance to seam. Bentomat has a mass per unit area of approximately 4,000g/m^2 and was approved by RPS Consulting Engineers on the basis that its properties conformed with the specification

Technical data was provided by WBL for Bentomat (see Appendix B) and it was recognised that CETCO Europe Ltd are a reputable company with extensive experience in the manufacture of GCL. Bentomat has been installed at a number of other landfills in Ireland as part of the installation of capping systems. The GCL proposed by Wills Bros. Ltd. was approved and work commenced on site in late October 2004.

2.2 CQA PROCEDURES

Prior to the placement of the GCL, WTB Geotechnic Ltd (suppliers of Bentomat) held a training course on-site for the Contractor and his staff on suitable methods to place the material and ways to avoid damaging the material. In addition RPS Consulting Engineers and Wicklow County Council met with WBL to agree CQA procedures during the lining works. The following points were agreed:

1. All delivery notes are to be copied to the Resident Engineer, who will file them at the Ballymurtagh Landfill site office.

2. Subgrade acceptance is to be signed off daily by the Resident Engineer prior to the placement of lining materials to ensure that the manufacturer's specification is met.

3. Roll packaging labels are to be removed from each roll before placement and filed at Resident Engineer's office.

4. CQA records are to be kept in accordance with CETCO.

5. Lining Layout Plan showing position and roll number of each placed roll is to be completed by the Resident Engineer and maintained on site.

6. Quality Control Certificates are to be submitted to RPS by WBL.

7. Quality Control Certificates are be cross referenced by RPS with roll packaging labels.

2.2.1 MANUFACTURERS QUALITY CONTROL CERTIFICATES

Quality Control Certificates from the manufacturer were received for the each of the rolls of GCL installed at Ballymurtagh Landfill. A Quality Control Certificate was issued for every load of Bentomat delivered to the site. A record was kept by RPS/Wicklow County Council of the roll numbers placed each day and the roll label was removed from the packaging prior to placement so that the roll number could be cross referenced with the manufacturers Control Certificates. A copy of all Quality Control Certificates, delivery notes and the CETCO Quality Control Test Frequency information was filed for record purposes. .

2.2.2 STORAGE ARRANGEMENTS ON-SITE

The GCL was stored in accordance with the specification provided by RPS and the manufacturers recommendations. Dedicated storage areas were selected in level, dry, well drained areas around the landfill, out of the direct line of traffic. GCL rolls were stored in a pyramid shape stacked no higher than

four rolls. The Bentomat wrapping was checked after transport and storage as well as during unloading. A large spreader bar, supplied by CETCO, was used to transport the rolls from the storage area to the placement site.

2.2.3 SUBGRADE ACCEPTANCE BEFORE PLACEMENT

Once the landfill was regarded, the Resident Engineer approved the subgrade condition to ensure that it was suitable for the placement of the GCL. Again acceptance criteria was in accordance with RPS specification and CETCO installation guidelines. Permission to proceed was given on the basis that subgrade acceptance forms were submitted by WBL prior to the placement of GCL each day. This involved the inspection of the subgrade by RPS prior to signing of the acceptance sheets.

The subgrade consisted generally of intermediate type cover material. It was generally smooth, well compacted and free of pooling water. It was also free of sharp and protruding stones and soil. However, where areas within the works consisted of exposed waste, which was significantly softer, a variety of solutions were found to ensure that subgrade acceptance was achieved. These included placement of shale, stone and geogrid, in various arrangements. All such areas have been marked on the lining layout plan of the site.

2.2.4 PLACEMENT OF LINER AND JOINTING

The GCL was placed in accordance with the Specification for GCL supplied by RPS and the method statement supplied by CETCO Ltd. The GCL was transported from the storage area to the placement area using a spreader bar (see figure 2). Lining works were only carried out in suitable dry weather conditions. Some wet weather delayed the GCL placement programme. The factory wrapping was removed just before installation. GCL was laid directly on the geocomposite gas collection layer. The edges of Bentomat were marked to indicate the overlap area. The spreader bar was positioned perpendicular to the slope and parallel to the anchor trench at the top. The Bentomat was rolled from this pole down the slope. Vehicular traffic not allowed on the placed Bentomat and walking on the GCL was kept to minimum. It was necessary in places, for limited vehicular traffic to traverse the subsoil. The recommended depth of subsoil was maintained in accordance with the manufacturer's specification. Due to rutting under traffic, a number of sections of GCL were damaged. These sections were exposed and replaced, as recorded on the lining layout plan, and photographic records. Rolls were cut to fit using carpet knives. All rolls were laid without folds and the overlaps were adhered to.

Figure 1: Onsite storage of GCL

Figure 2: Placement of GCL on top of geocomposite gas collection layer

Figure 3: Covering of GCL and geocomposites with subsoil

The placed GCL was inspected to ensure that overlaps were satisfactory and that there were no sharp objects sticking up through the gas collection layer and GCL. Subsoil cover was then placed over the GCL with the material being kept in front of the machine at all times to ensure that there was no direct contact between the machine and the GCL.

3 CONCLUSION

The GCL used as the low permeability layer in the capping of Ballymurtagh Landfill was Bentomat. The placement of the GCL was carried out by WBL and supervised by RPS Consulting Engineers assisted by Wicklow County Council. RPS were present on site continuously during the placement of the GCL and approved all of the work carried out by WBL. Quality control documentation including test certificates and related packing lists are supplied in the following appendices. The Lining Layout Plan showing the locations of all panels and repairs is maintained on-site for inspection. Photographic records are also maintained on site, showing daily placement of GCL, including seaming, horizontal & vertical penetrations, any damage repair and sealing against embedded structures.

RPS verify that the GCL placement works at Ballymurtagh Landfill were performed satisfactorily and to a standard consistent with EPA guidelines outlined in the Waste Licence and the EPA Manual on Landfill Design, and with RPS specification documentation.

APPENDIX A

GCL SPECIFICATION (RPS CONSULTING ENGINEERS)

APPENDIX 27/5AR: GEOSYNTHETIC CLAY LAYER

Scope

This specification covers the technical requirements for the furnishing and installation of the geosynthetic clay liner described herein. All materials used shall meet the requirements of this specification, and all work shall be performed in accordance with the procedures provided herein and will all project lines, grades, cross-sections, and dimensions shown on the contract drawings.

Definitions

For the purposes of this specification guideline, the following terms are defined below:

Geosynthetic Clay Liner (GCL). A factory-manufactured hydraulic barrier consisting of sodium bentonite clay supported by geotextiles held together by needling, stitching, or adhesives.

Geomembrane. An essentially impermeable geosynthetic composed of one or more geosynthetic sheets.

Geotextile. Any permeable textile used with foundation, soil, rock, earth, or any geotechnical engineering related material as an integral part of a human-made project, structure, or system.

Minimum Average Roll Value. The minimum average value of a particular physical property of a material, for 95 percent of all of the material in the lot.

Overlap. Where two adjacent GCL panels contact, the distance measuring perpendicular from the overlying edge of one panel to the underlying edge of the other.

REFERENCES

ACC 1010 "Free Swell Determination"

API 13A/13B "Specification for Drilling-Fluid Materials"

ASTM D 4632 "Test Method for Grab Breaking Load and Elongation of Geotextiles"

ASTM D 4643 "Determination of Water (Moisture) Content of Soil by the Microwave Oven Method"

ASTM D 5084 "Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter"

ASTM D 5261 "Test Method for Measuring the Mass per Unit Area of Geotextiles"

ASTM D 5321 "Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method"

USP/NF-XVII "Bentonite Swelling Power"

UNIT PRICES

Measurement will be made of the total surface area in square metres covered by the GCL as shown on the contract drawings. Final quantities will be based on as-built conditions. Allowance will be made for GCL in anchor and drainage trenches but no allowance will be made for waste, overlap, or materials used for the convenience of the Contractor. GCL installed and accepted will be paid for at the respective contract unit price submitted in the Bill of Quantities.

SUBMITTALS

Prior to commencement of the Works, the Contractor shall furnish the following information:

- Plan showing the proposed layout of the GCL panels over the area of installation.
- GCL manufacturer's material specification including relevant quality control and quality assurance data showing that the qualifications of Section 1.6 of this specification have been achieved.
- At the Engineer's request:

1. A representative sample of the GCL, suitable for testing.
2. A project reference list consisting of the principal details of at least ten projects totalling at least 1 million square metres in size.

Upon shipment, the Contractor shall furnish the following:

- GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the **materials supplied for the project** are in accordance with the requirements of this specification.
- Manufacturer's warranty covering materials and workmanship of the GCL.

QUALIFICATIONS

The GCL Manufacturer must have produced at least 0.5 million square metres of GCL, with at least 0.25 million square metres installed.

The GCL Installer must provide to the Engineer satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the GCL will be installed in a competent, professional manner.

CONSTRUCTION QUALITY ASSURANCE (CQA)

The Contractor shall be required to carry out the Works to a CQA Plan prepared by the Engineer and agreed with the Contractor prior to commencement of the Works. The Contractor will also be required to carry out his own CQC procedures to ensure that the materials are placed, installed, tested, repaired and protected in accordance with the Manufacturers instructions and with the CQA Plan.

Testing of the GCL, as necessary to support the CQA effort, shall be performed by a third party laboratory retained by the Contractor and independent from the GCL manufacturer and installer. The laboratory must be able to show that they have recent experience of testing GCL products in accordance with the relevant codes.

Products

The GCL shall consist of a layer of dry or pre-hydrated natural sodium bentonite clay encapsulated between two polypropylene geotextiles. Prior to using an alternate GCL, the Contractor must furnish independent test results demonstrating that the proposed alternative material meets all requirements of this specification, and must obtain prior approval of the alternative GCL by the Engineer.

MATERIALS

The GCL and its components combined shall have the following properties:

- Bentonite to consist of Natural Sodium Bentonite
- Geotextiles to consist of woven or non-woven polypropylene
- Permeability not less than 1 x 10^{-11}m/s
- Minimum thickness of 6mm
- Mass per unit area not less than 4,000g/m^2

No additives shall be allowed to the bentonite unless the supplier can demonstrate the nature, suitability and long term durability of the additive. In all cases the final decision regarding acceptability shall be made by the Engineer.

Where the geotextile is held to the surface of the bentonite by adhesives, i.e. it is neither stitched or needle-punched, the supplier shall confirm in writing and provide calculations as required that the GCL is capable of exhibiting sufficient angle of internal friction when hydrated not to act as a slip-plane for any other materials placed above or below the GCL. The use of additional reinforcing geotextiles above or below the GCL to provide sufficient angle of internal friction on the side slopes shall be allowed subject to calculations provided and subject to the final decision of the Engineer.

The following Manufacturers test data shall be provided to the Engineer and these results will form the basis for the final decision by the Engineer as to the acceptability of the GCL.

Material	European Test Method	ASTM Test Method	Minimum test Frequency	Report Value
Montmorillonite Content	VDG P69/XRD		50 tonnes	Minimum and average
Cation Exchange Capacity (CEC)	Methylene Blue	D837	50 tonnes	As above
Swell Index/Free swell of clay	Mass/Area	D5890	50,000 tonnes	As above
Fluid Loss of Clay		D5891	50,000 tonnes	As above
Mass per unit area of geotextiles	EN965/ISO9864	D5261	20,000 m2	Typical and MARV(1). Also minimum/maximum /average values
Mass per unit area of bentonite	EN965/ISO9864	D5933	20,000 m2	
Thickness of finished GCL	DIN53855	D5199	20,000 m2	
Mass per unit area of finished GCL	EN965/ISO9864	D5933	5,000 m2	
Mass per unit area of finished GCL	EN965/ISO9864	D5933	5,000 m2	
Index Flux	DIN18130-1	D5887	25,000m2	Max value

(1) .MARV = Minimum Average Roll Value

GCL Panel Dimensions

The minimum acceptable dimensions of full-size GCL panels shall be 4m wide and 30m long. "Short" rolls (those manufactured to a length greater than 20m but less than 30m) are a necessary by-product of the GCL manufacturing process, but will only be allowed at a rate no greater than 5 per truckload or every 5,000 square metres, whichever is less.

SEAM OVERLAP LINES

A 150mm "lap" line and a 225mm "match" line shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap. Lines shall be printed in easily visible, non-toxic ink.

PRODUCT DOCUMENTATION

The manufacturer shall provide the Engineer or other designated party with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the manufacturer such as the QA/QC Manager, Production Manager, or Technical Services Manager. The QA/QC certifications shall include:

- GCL lot and roll numbers (with corresponding shipping information).
- Manufacturer's test data for raw materials used in GCL production, including, at a minimum, mass/area data and tensile data demonstrating compliance with the testing frequencies and performance parameters shown in Table 1.
- Manufacturer's test data for finished GCL product demonstrating compliance with the testing frequencies shown in Table 1.

PRODUCT LABELLING

Prior to shipment, the GCL manufacturer shall affix a label to each roll identifying the following characteristics:

- Product identification information (manufacturer name and address, brand name, product code).
- Lot number and roll number.
- Roll length and width.
- Total roll weight.

PACKAGING

The GCL shall be wound around a cardboard core 4 inches in diameter to facilitate handling. The core is not intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

All rolls shall be labelled and bagged in packaging that is resistant to photo-degradation by ultraviolet (UV) light.

SHIPPING AND HANDLING

The GCL material shall be delivered, stored and handled strictly in accordance with the Manufacturer's requirements and recommendations. The Contractor shall provide adequate measures for protecting the material at all stages of the work from all clauses, including weather conditions, until completion of the contract

The manufacturer assumes responsibility for initial loading and shipping of the GCL. Unloading, on-site handling, and storage are the responsibility of the installer or other designated party.

A visual inspection of each roll should be made as it is unloaded to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

The party responsible for unloading the GCL should contact the manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment to be utilized.

STORAGE

Storage of the GCL rolls shall be the responsibility of the installer. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry, and well drained.

Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks or by use of the dunnage shipped between rolls. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

EARTHWORKS

The surface upon which the GCL is installed shall be prepared and compacted in accordance with the manufacturer's requirements. All surfaces to be lined shall be smooth and free of debris, roots and sticks, and sharp rocks larger than 50mm. At a minimum, the level of compaction should be such that no rutting is caused by installation equipment or other construction vehicles.

In applications where the GCL will be subjected to a hydraulic head that exceeds the confining stress, subgrade surfaces consisting of granular soils or gravel may not be acceptable due to their large void fraction. In these applications, the subgrade soils should possess a particle size distribution such that at least 80 percent of the soil is finer than 0.2mm (#60 sieve).

Immediately prior to GCL deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no sharp irregularities or abrupt elevation changes shall exist in the subgrade.

The project CQA Inspector shall certify subgrade acceptance before GCL placement.

It shall be the installer's responsibility thereafter to indicate to the Engineer any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements list in A, B and C above.

At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated in accordance with the project plans. The trench shall be excavated **and approved** by the CQA Inspector prior to the GCL placement. No loose soil shall be allowed at the bottom of the trench, and no sharp corners or protrusions shall exist anywhere within the trench.

GCL Placement

Placement of the GCL shall be conducted in accordance with the manufacturer's recommendations and with the direction provided herein. Any deviations from these procedures must be pre-approved by the Engineer.

During start-up of the GCL installation, an agent or representative of the Manufacturer shall provide **on-site** assistance and instructions to the Contractor and Engineer regarding the appropriate installation techniques.

The use of equipment capable of freely suspending the GCL roll is required. A spreader bar and core pipe are also required for supporting the roll and allowing it to unroll freely. The core bar and spreader bar shall not bend or flex excessively when a full roll is lifted.

GCL panels shall be placed with the white side (non-woven geotextile) facing down. On sloped areas exceeding a steepness of 4H:1V, the long dimension of all panels shall be oriented parallel to the slope, and the ends of these panels shall be secured in an anchor trench in accordance with the details shown on the Drawings. Panels placed on flat areas require no particular orientation. Panels should be placed from the highest elevation to the lowest within the area to be lined, to facilitate drainage in the event of precipitation. Panels should be placed free of tension or stress yet without wrinkles or folds. It is not permissible to stretch the GCL in order to fit a designated area. Panels shall not be dragged across the subgrade into position except where necessary to obtain the correct overlap for adjacent panels.

Panels may be placed in any weather conditions except for heavy rain and high wind. The following parameters shall be recorded by the Contractor during the installation:-

- Precipitation.
- Relative humidity
- Air temperature
- Wind speed
- Temperature or sheet surface.

A record of the above shall be submitted by the Contractor to the Engineer on a day to day basis as installation proceeds.

The Contractor shall unwrap and install only as much GCL in one working day as can be covered with the geosythetic (drainage) layer or minimum 300mm subsoil. In no case shall the GCL be exposed to the elements at the end of the day and a temporary waterproof sheeting should be placed over any exposed areas of GCL at the end of each working day.

GCL PANEL SEAMING

All GCL seams shall be formed by executing a bentonite-enhanced overlap to ensure that a continuous seal is achieved between panels.

A 150mm to 225mm overlap should exist at seam locations. The lap line and match lines printed on the panels shall be used to assist in obtaining this overlap. The edges of the GCL panels should be adjusted to smooth out any wrinkles, creases, or “fishmouths” in order to maximise contact with the underlying panel.

After the overlying panel is placed, its edge shall be pulled back to expose the overlap zone. Any soil or debris present in the overlap zone or entrapped in the geotextiles shall be removed. A fillet of granular bentonite shall then be poured in a continuous manner along the overlap zone (between the edge of the panel and the 150mm line), at a rate of at least 0.3kg per linear metre. This process shall be conducted in accordance with the Manufacturer’s CQA plan.

On gently sloping areas (gentler than 4H:1V) where seams may be placed across the slope, overlaps should be “shingled” so as to prevent flow into the seam.

DAMAGE REPAIR

Any damage in the form of cuts or tears in the GCL shall be identified and repaired by the installer by cutting a patch from unused GCL and placing it over the affected area.

The damaged area should be removed of all dirt and debris. A patch of GCL shall be cut to fit over the damaged area and to extend one foot in all directions around it. Accessory bentonite shall then be placed around the perimeter of the affected area at the rate of 0.6kg per linear metre, and the patch shall be placed over the damage. An epoxy-based adhesive shall be used to keep the patch in position during backfill operations.

DETAIL WORK

Detail work, defined as the work necessary to seal the liner to pipe penetrations, foundation walls, drainage structures, spillways, and other appurtenances, shall be performed as recommended by the GCL Manufacturer.

Placement of Overlying Materials

No vehicles should be driven directly on the GCL until the proper thickness of cover has been placed. Care should be taken to avoid damaging the GCL by making sharp turns or pivots with equipment.

Precautions shall be taken to prevent damage to the GCL during placing and installation of the HDPE geomembrane and geotextile by restricting heavy equipment traffic. Unrolling the geosynthetic can be accomplished through the use of lightweight, rubber-tired equipment such as a 4-wheel all-terrain

vehicle (ATV). This vehicle can be driven directly on the GCL, provided that ATV makes no sudden stops, starts, or turns.

Any leading edge of panels left uncovered shall be protected at the end of the working day with a waterproof sheet, which is adequately secured with sandbags or other ballast.

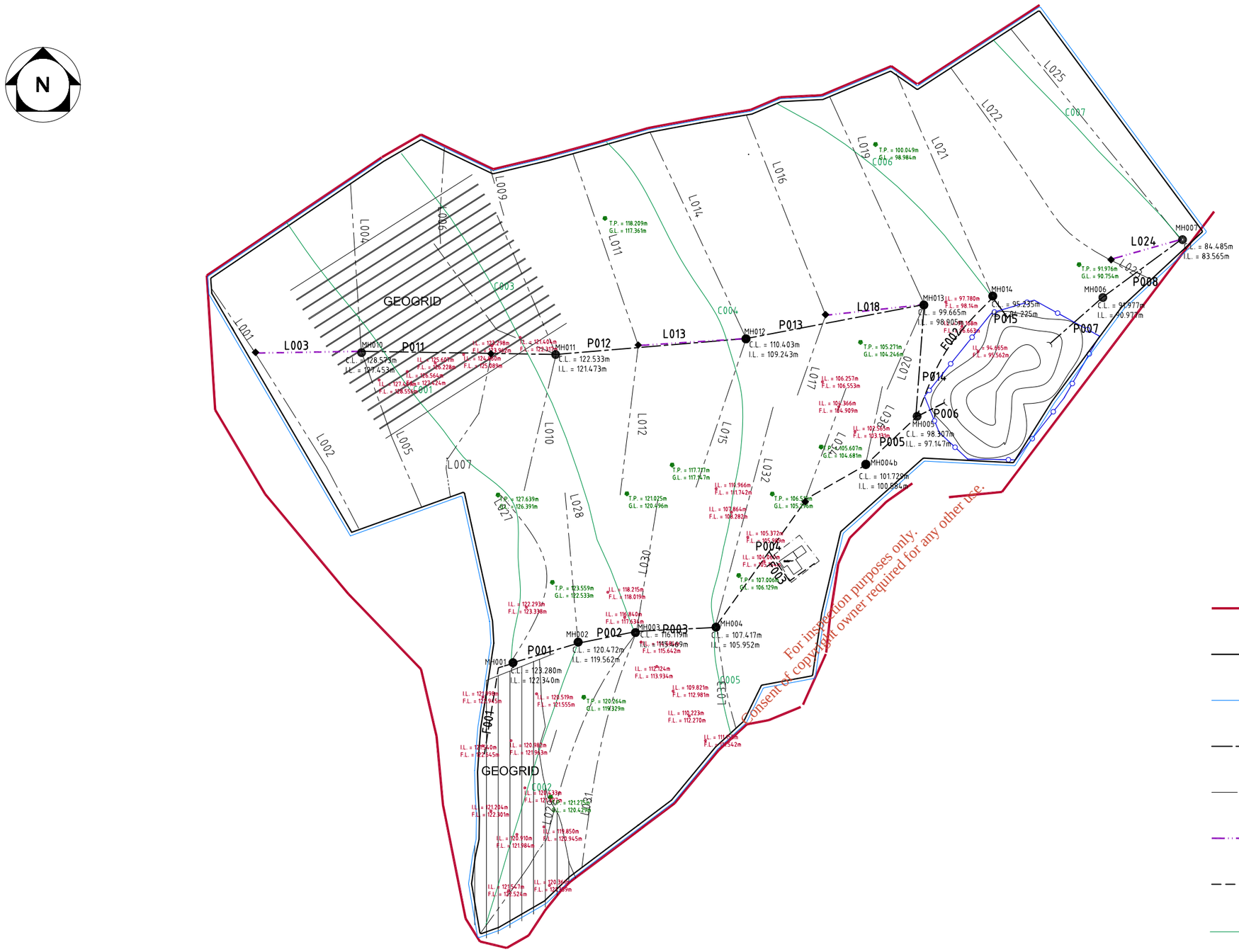
APPENDIX B

CETCO METHOD STATEMENT & TECHNICAL DATA

APPENDIX C

QUALITY CONTROL TEST FREQUENCY INFORMATION

DELIVERY NOTES AND QUALITY CONTROL CERTIFICATES



Site Boundary

Gas Trench

Anchor Trench

Carrier Drain

Land Drain

Land Drain Interc.

French Drain

Contour Drains

New Fencing

NOTES

1. Verifying Dimensions.
   The contractor shall verify dimensions against such other drawings or site conditions as pertain to this part of the work.
2. Existing Services.
   Any information concerning the location of existing services indicated on this drawing is intended for general guidance only. It shall be the responsibility of the contractor to determine and verify the exact horizontal and vertical alignment of all cables, pipes, etc. (both underground and overhead) before work commences.
3. Issue of Drawings.
   Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg, dxf etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors arising from the use of these files, either by human error by the recipient, listing of un-dimensioned measurements, compatibility issues with the recipient's software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.
4. Datum: Ordnance Survey Datum, Malin Head

No.	Date	Drn. / Chk.	Amendment / Issue	App
R01	Aug.'10	RH / CC	As-Built Issue	CC

Client: Wicklow County Council, County Buildings, Wicklow, Co. Wicklow

Drawn By	Checked By	Approved By	Date
RH	CC	CC	Aug.'10

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Project: **Ballymurtagh Landfill**

Drawing Status	Sheet Size	Scale
FINAL	A3	NTS

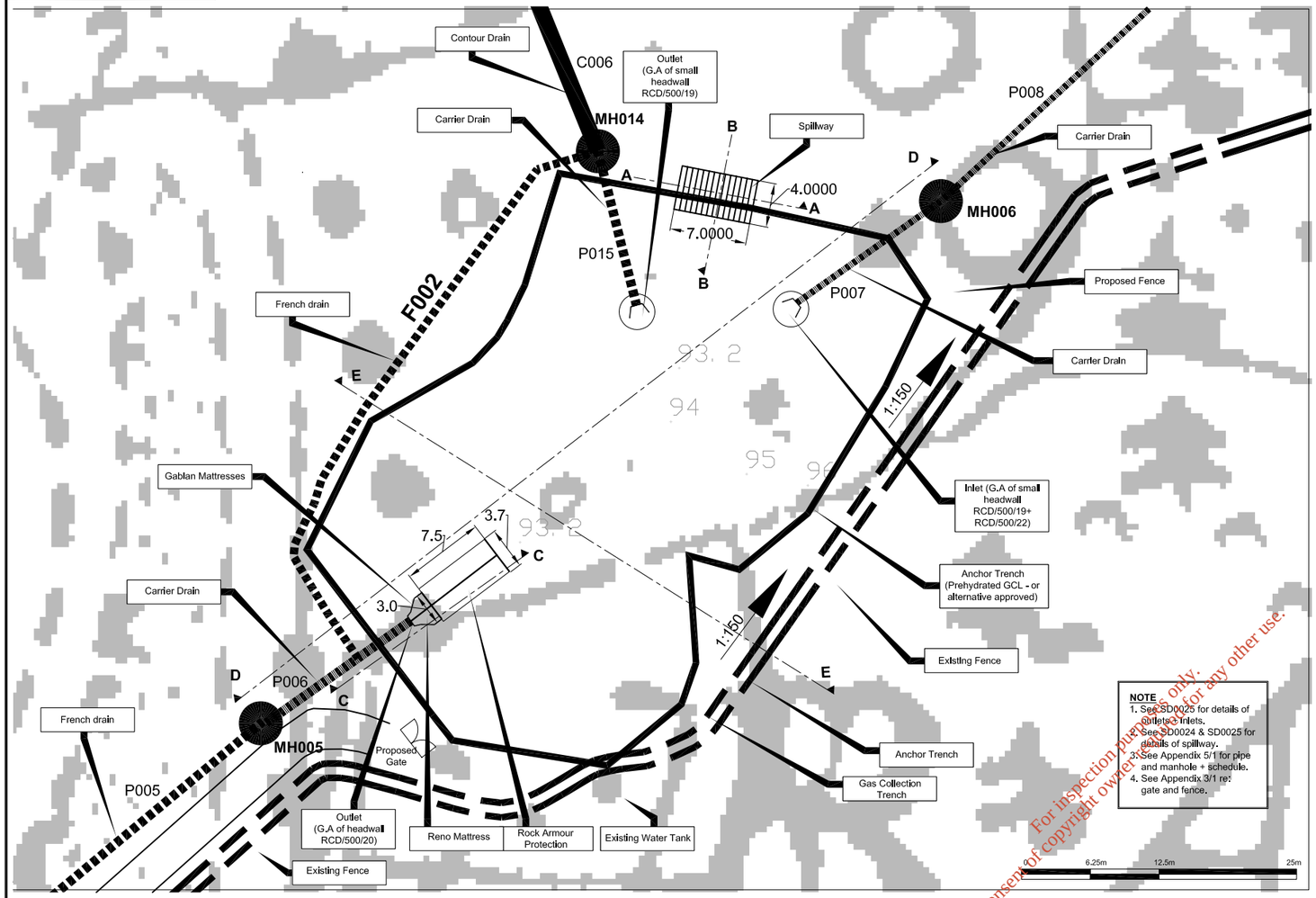
Drawing Number: MDE0046/FG0007

Rev: F01

Title: MAP 12 CAPPING SYSTEM AS BUILT LAYOUT

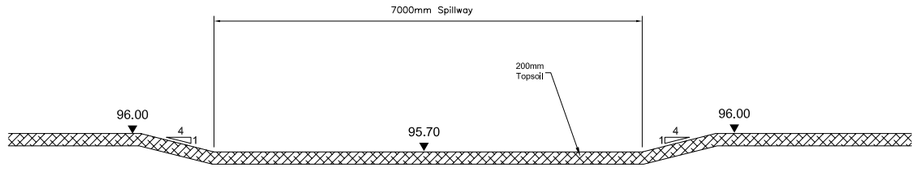
Mde0046FG0007F01 As Built & Levels.dwg

A1 | File No: mde0185DG0021

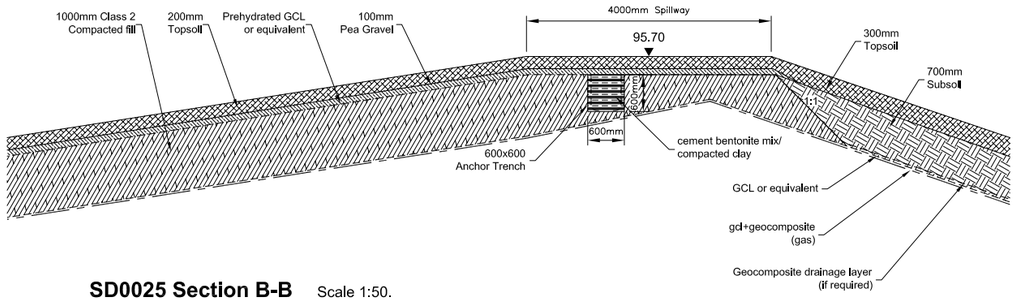


PLAN Scale 1:250

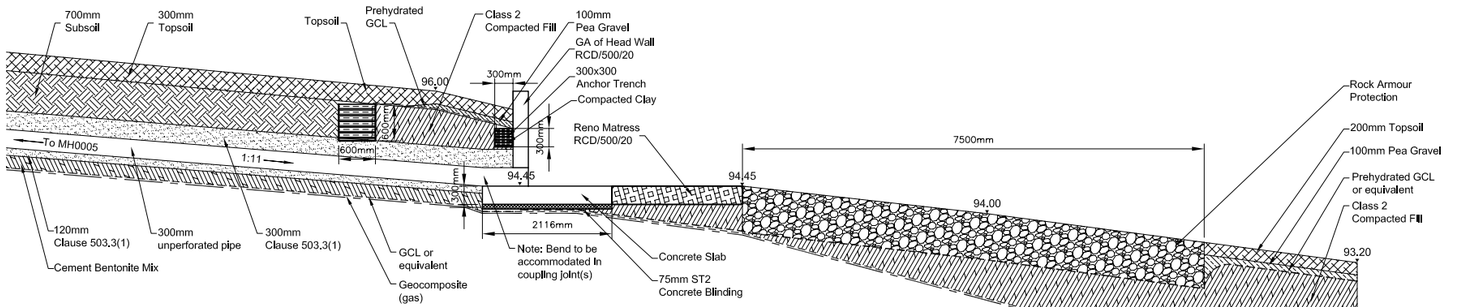
NOTE
1. See SD0025 for details of outlets & inlets.
2. See SD0024 & SD0025 for details of spillway.
3. See Appendix 5/1 for pipe and manhole + schedule.
4. See Appendix 3/1 re: gate and fence.



SD0024 Section A-A Scale 1:50.



SD0025 Section B-B Scale 1:50.



SD0026 Section C-C Scale 1:50.

NOTE
1. Prehydrated GCL to be anchored under concrete slab of headwall.
2. Rock Armour Protection to be mean diameter of 350mm or mean weight of 58Kg + min. thickness of 0.7m. Materials to be agreed with Engineer.
3. Min 300mm cover over anchor trench.
4. Small headwalls are to be Constructed similar to SD0025 + having regard to RCD/500/19 + RCD/500/22.

Client:

Wicklow County Council
County Buildings,
Wicklow,
Co. Wicklow.

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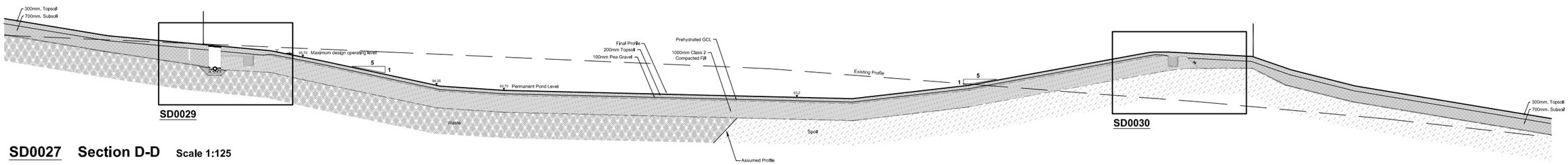
No.	Date	Drn. Chk.	Amendment / Issue	App.
C01	Sep'04	RH CC	Issue for Construction	LO'T
B01	May'04	RH CC	Issue for Tender	LO'T
A01	Apr'04	RH CC	Issue for Approval	LO'T

Project: Ballymurtagh Landfill Capping & Restoration Works

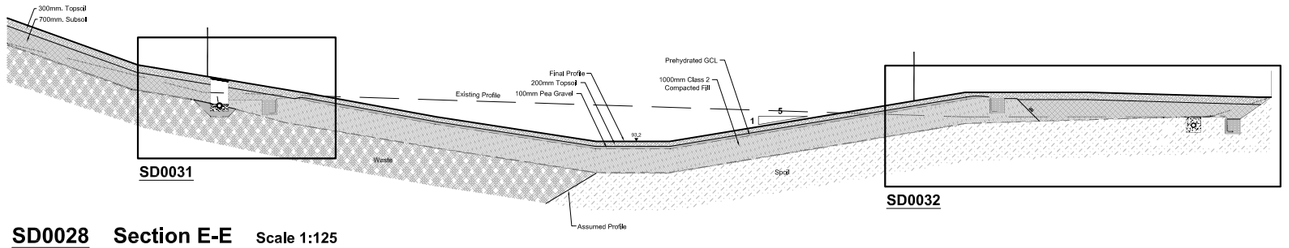
Title: MAP 13 STORM WATER RETENTION POND (Sheet 1 of 2)

Drawn by:	MM	Job No: mde0185	
Checked by:	CC	File No: mde0185DG0021	
Approved by:	LO'T	Drg. No: DG0021	Rev: C01
Scale:	As shown		
Date:	March,'04		

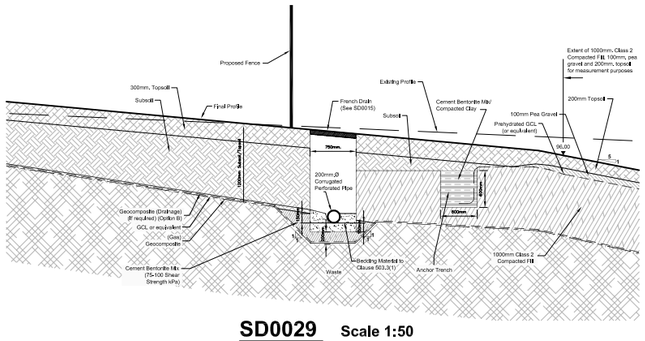
A1 | File No: mde0185DG0017



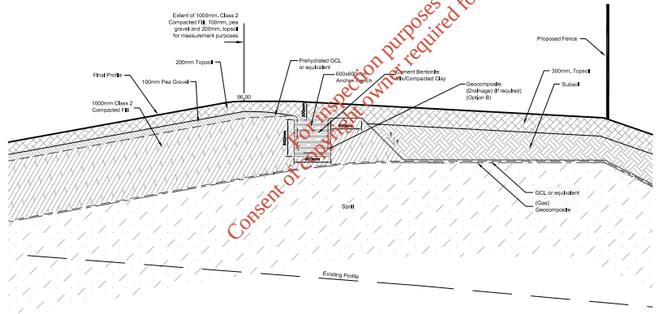
SD0027 **Section D-D** Scale 1:125



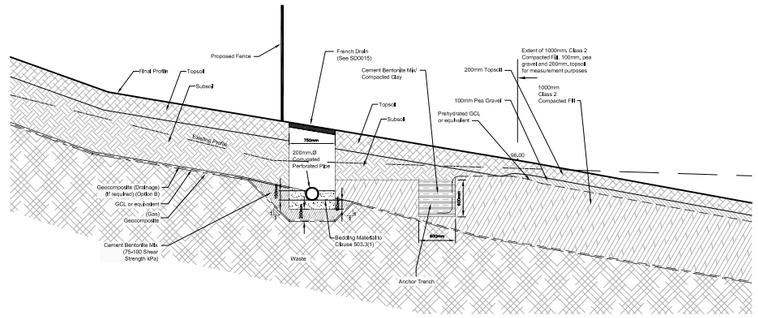
SD0028 **Section E-E** Scale 1:125



SD0029 Scale 1:50



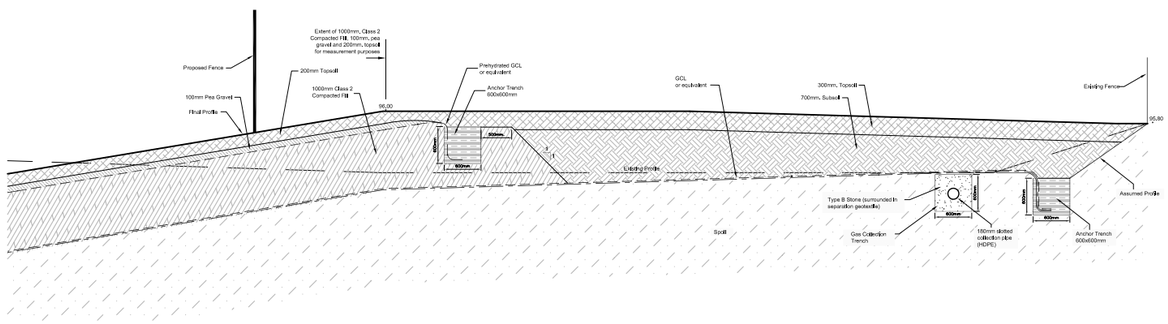
SD0030 Scale 1:50



SD0031 Scale 1:50

NOTE:

1. See DG0021 for section locations.
2. The Contractor shall use prehydrated gcl as appropriate for water retention (or similar approved).
3. The bank height on the south eastern boundary of the site varies. The contractor shall regrade the final profile to a gradient of 1:150 to ensure adequate run-off or as agreed with the engineer.
4. Waste/spoil interface position is assumed (see Appendix 6/1).



SD0032 Scale 1:50

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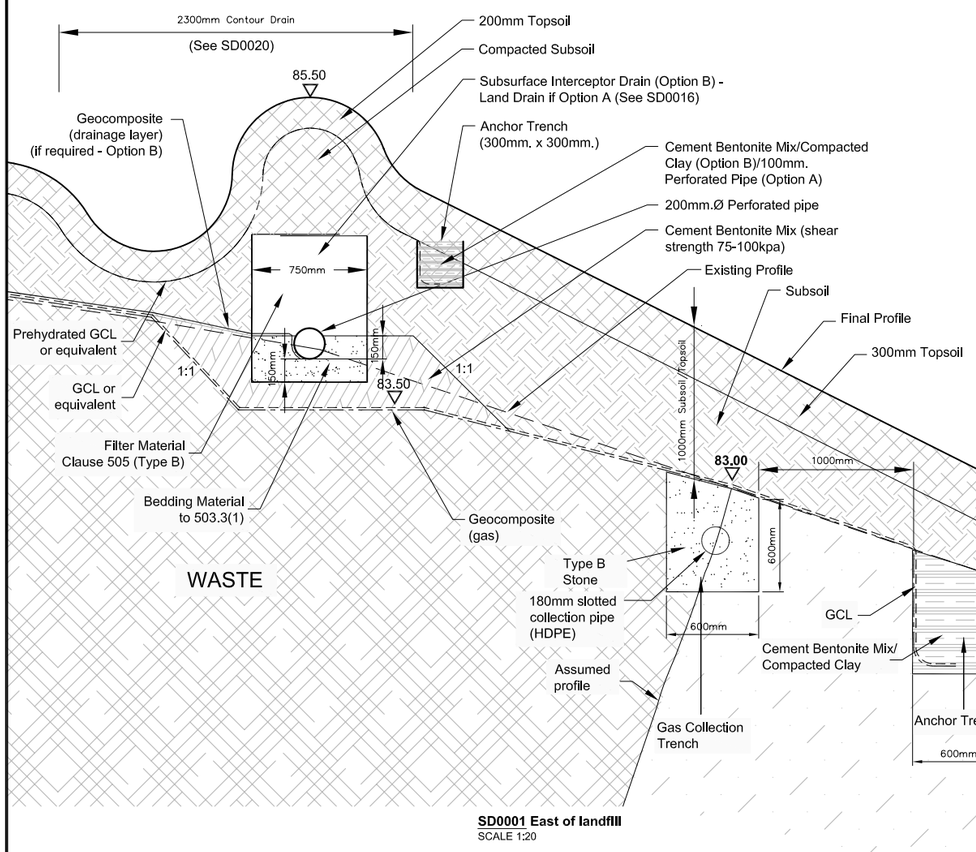
C01	Sep'04	BH / CC	Issue for Construction	LOT
B01	Apr'04	BH / CC	Issue for Tender	LOT
A01	Apr'04	MM / CC	Issue for Approval	LOT

Project: Ballymurtagh Landfill Capping & Restoration Works

Title: MAP 14 STORM WATER RETENTION POND (Sheet 2 of 2)

Drawn by:	M.M.	Job No:	mde0185
Checked by:	CC	File No:	mde0185DG0022
Approved by:	LOT	Drg. No:	DG0022
Scale:	As shown	Rev:	C01
Date:	March.'04		

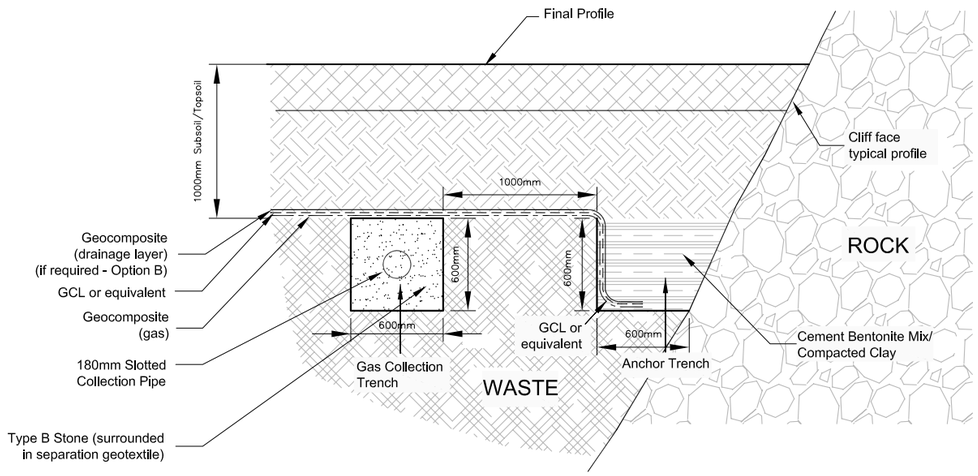
A1 | File No: mde0185DG0017



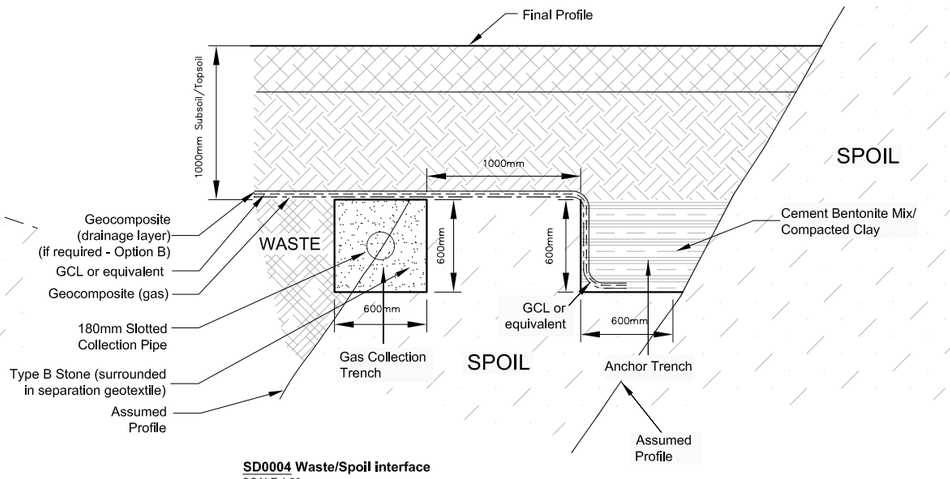
SD0001 East of landfill
SCALE 1:20

NOTE:

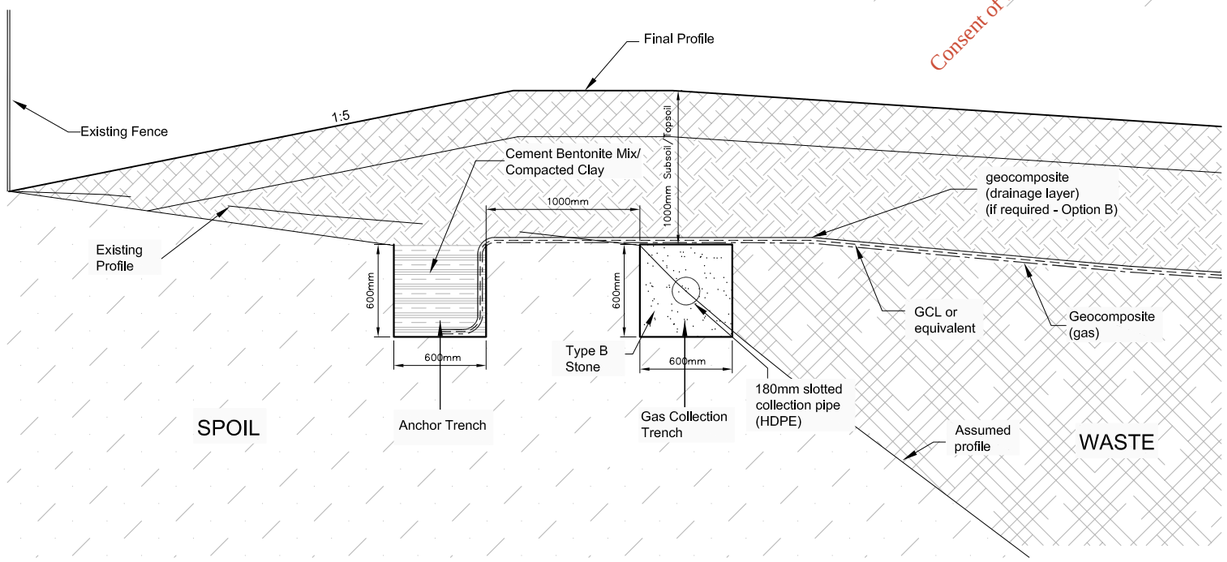
1. All works shown on this drawing to be carried out by main contractor.
2. See DG0004,12,13 for detail locations.
3. Gas Collection trench to be installed at waste/spoil interface where possible.
4. Anchor Trench to be installed 1m away from Gas Collection Trench.
5. See SD0009 + SD0010 on DG0019 for capping options.
6. Type B stone in gas collection trench to be surrounded in separation geotextile.



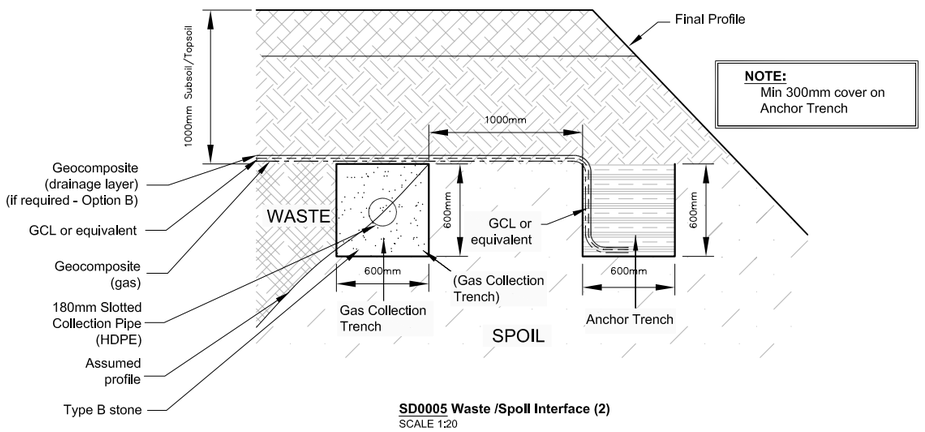
SD0003 Waste/Rock Interface
SCALE 1:20



SD0004 Waste/Spoil interface
SCALE 1:20



SD0002 West of landfill
SCALE 1:20



SD0005 Waste /Spoil Interface (2)
SCALE 1:20

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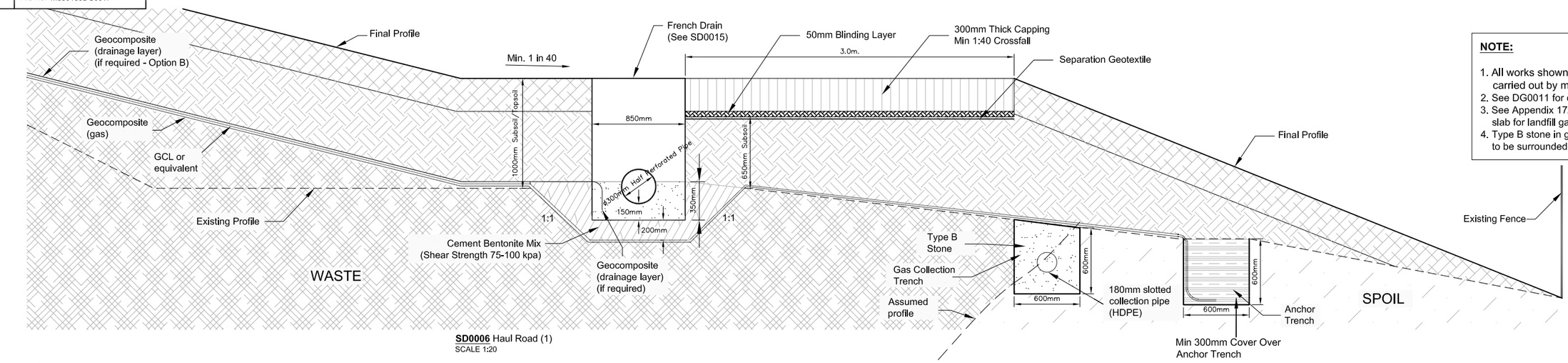
C01	Sep'04	BH / CC	Issue for Construction	LO'T
B01	May'04	BH / CC	Issue for Tender	LO'T
A01	Apr'04	BH / CC	Issue for Approval	LO'T

Project:
Ballymurtagh Landfill
Capping & Restoration Works

Title:
MAP 15
STANDARD DETAILS
(1 of 4)

Drawn by:	MM	Job No:	mde0185
Checked by:	CC	File No:	mde0185DG0017
Approved by:	LO'T	Drg. No:	DG0017
Scale:	1:20@A1	Rev:	C01
Date:	March,'04		

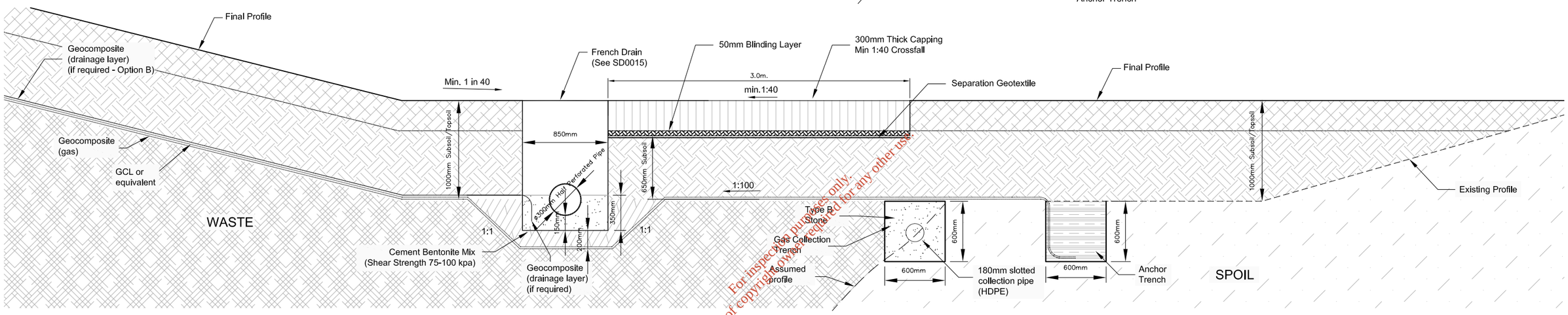
A1 | File No: mde0185DG0017



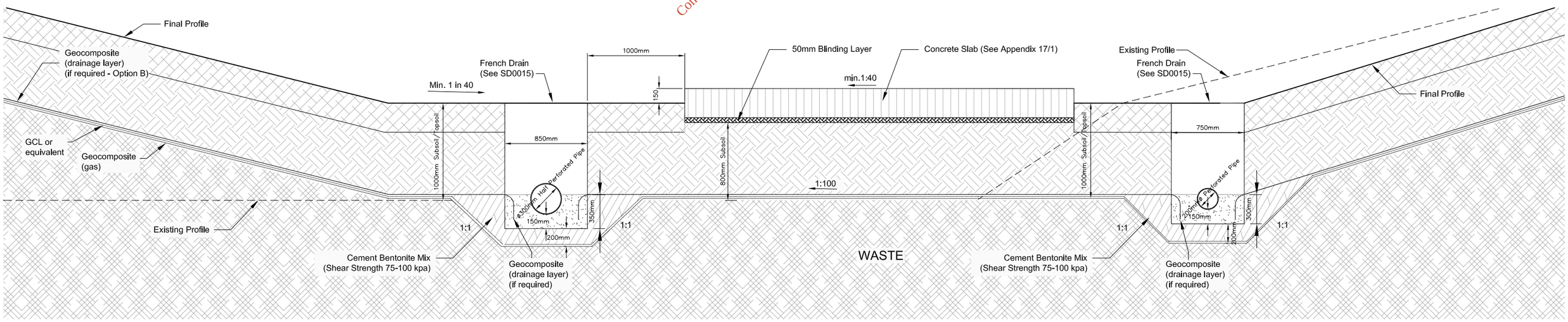
NOTE:

1. All works shown on this drawing to be carried out by main contractor.
2. See DG0011 for detail locations.
3. See Appendix 17/1 for details on concrete slab for landfill gas flare.
4. Type B stone in gas collection trench to be surrounded in separation geotextile.

SD0006 Haul Road (1)
SCALE 1:20



SD0007 Haul Road (2)
SCALE 1:20



SD0008 Flare Slab
SCALE 1:20

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B01	Apr'04	RH / CC	Issue for Tender	LO'T
A01	Apr'04	MM / CC	Issue for Approval	LO'T

Project:

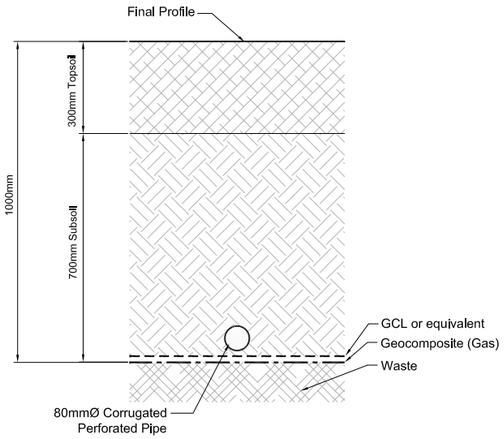
Ballymurtagh Landfill
Capping & Restoration Works

Title:

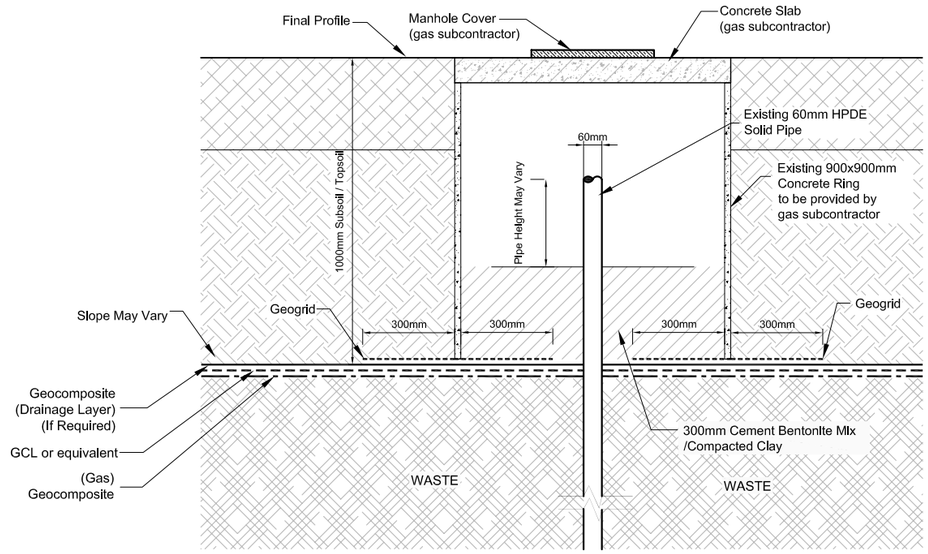
MAP 16
STANDARD DETAILS
(2 of 4)

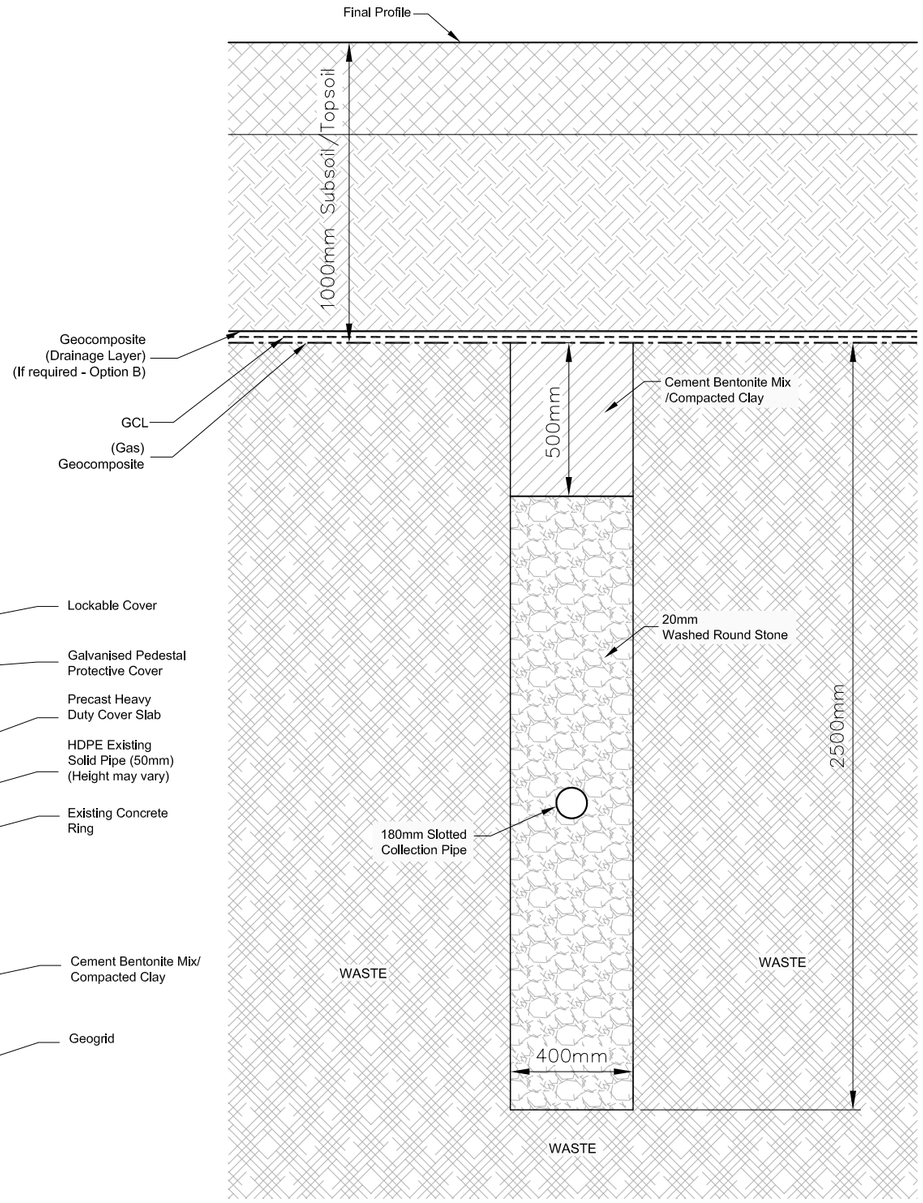
Drawn by:	MM	Job No:	mde0185
Checked by:	CC	File No:	mde0185DG0018
Approved by:	LO'T	Drg. No:	DG0018
Scale:	1:20@A1	Rev:	C01
Date:	March.'04		

A1 | File No: mde0185DG0017

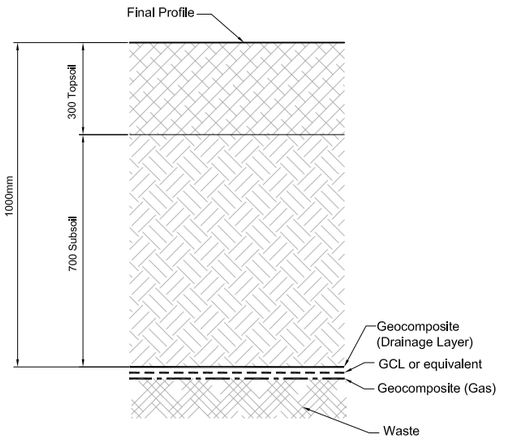


SD0009 CAPPING DETAILS
(SURFACE WATER DRAINAGE OPTION A - LAND DRAIN)
Scale 1:10



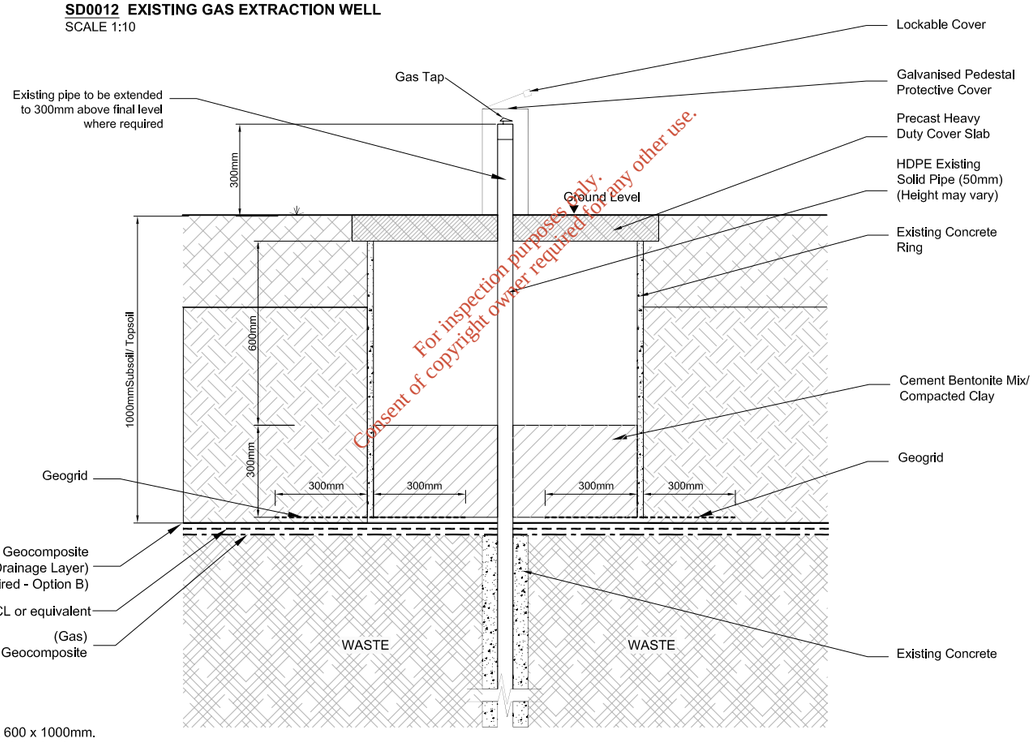


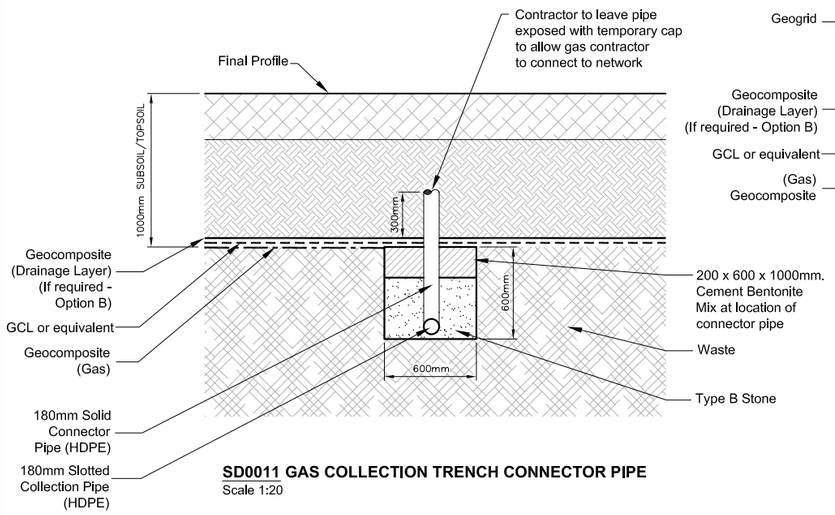
SD0013 HORIZONTAL GAS EXTRACTION WELL
Scale 1:10



SD0010 CAPPING DETAILS
(SURFACE WATER DRAINAGE OPTION B - GEOCOMPOSITE)
Scale 1:10

SD0012 EXISTING GAS EXTRACTION WELL
SCALE 1:10





SD0011 GAS COLLECTION TRENCH CONNECTOR PIPE
Scale 1:20

SD0014 MONITORING WELL
Scale 1:10

NOTE:
1. See DG0007 for locations of SD0011, SD0012 and SD0013.
2. See Appendix 29/2AR for details on incorporating existing gas extraction network into capping system, and for extent of work to be carried out by gas contractor.
3. See Appendix 29/1AR for details on incorporating existing monitoring well into capping system.
4. Type B Stone in gas collection trench to be surrrounded in separate geotextile.

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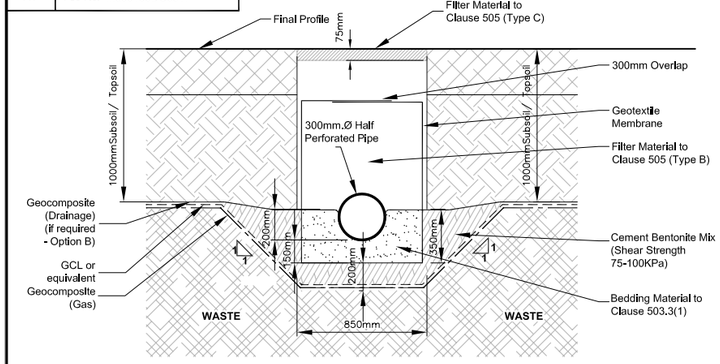
Project:
Ballymurtagh Landfill
Capping & Restoration Works

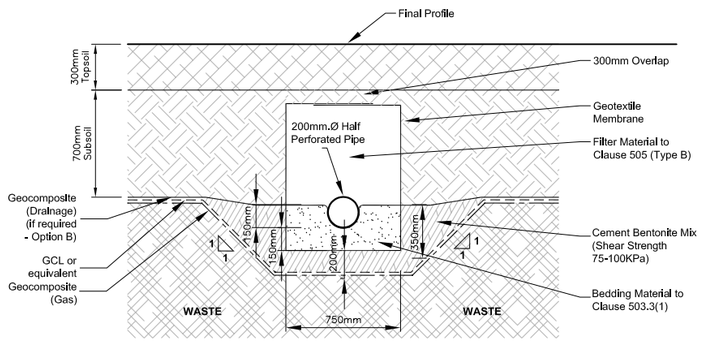
Title:
MAP 17
STANDARD DETAILS
(3 of 4)

Drawn by:	MM	Job No:	mde0185
Checked by:	CC	File No:	mde0185DG0019
Approved by:	LO'T	Drg. No:	DG0019
Scale:	As shown	Rev:	C01
Date:	March.'04		

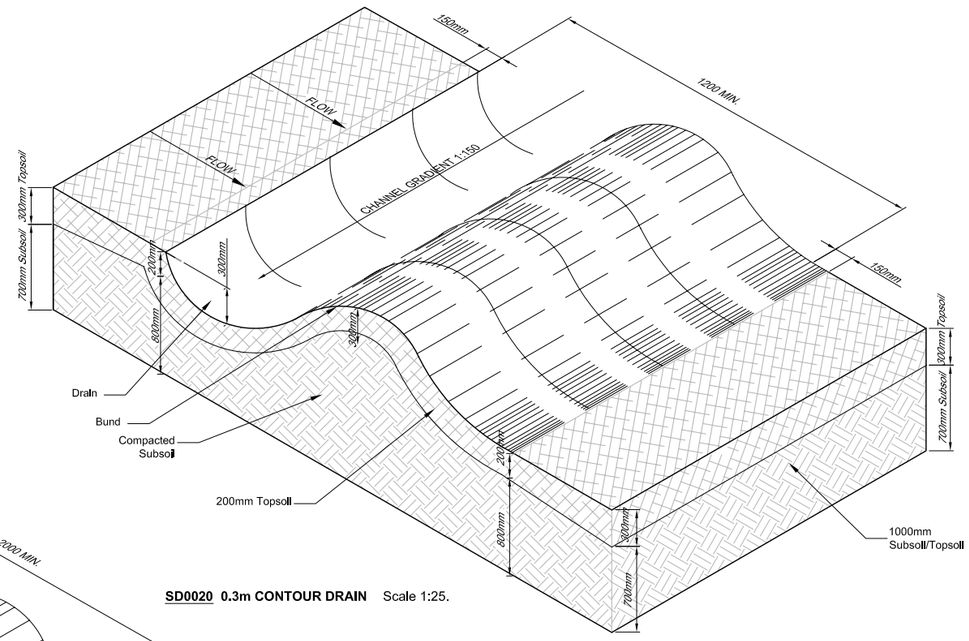
A1 | File No: mde0185DG0017



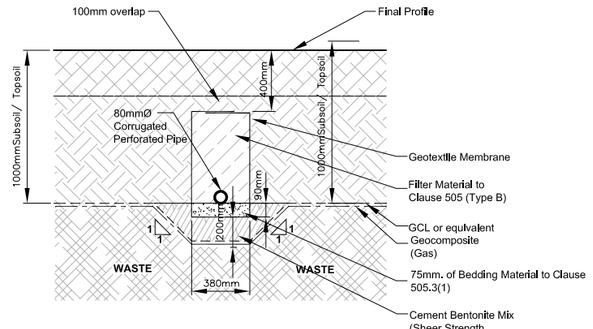
SD0015 **FRENCH DRAIN (a)** Scale 1:20



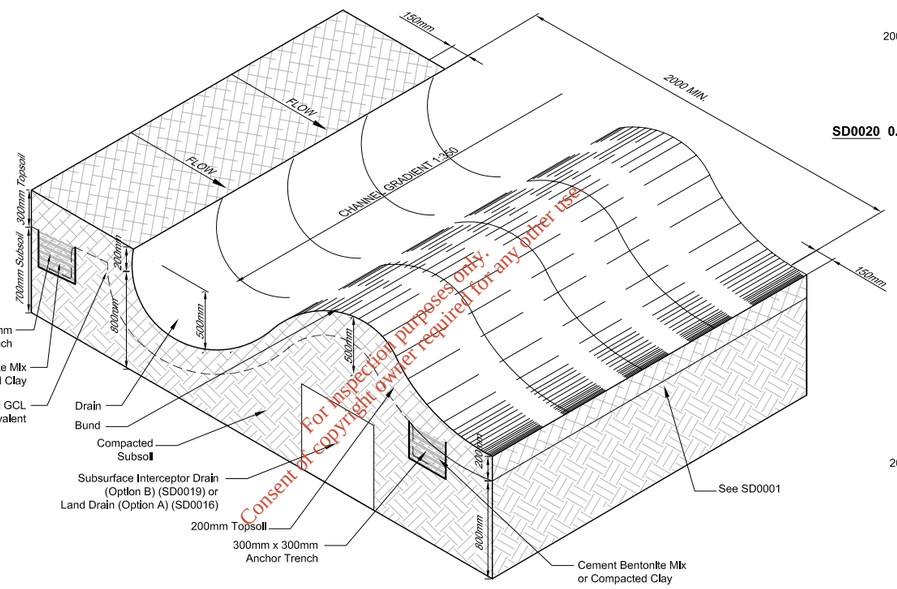
SD0019 **SUBSURFACE INTERCEPTOR DRAIN (S003 + S004 (DG0009))** Scale 1:20



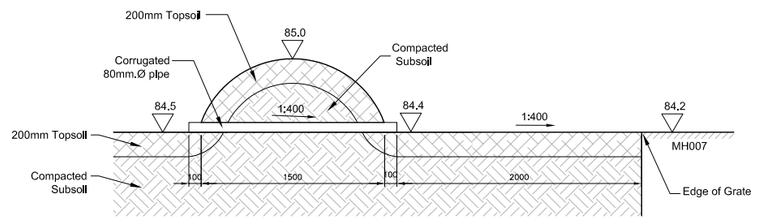
SD0020 **0.3m CONTOUR DRAIN** Scale 1:25.



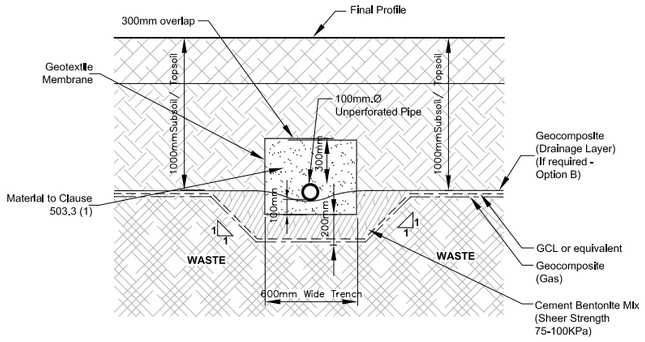
SD0016 **LAND DRAIN** Scale 1:20



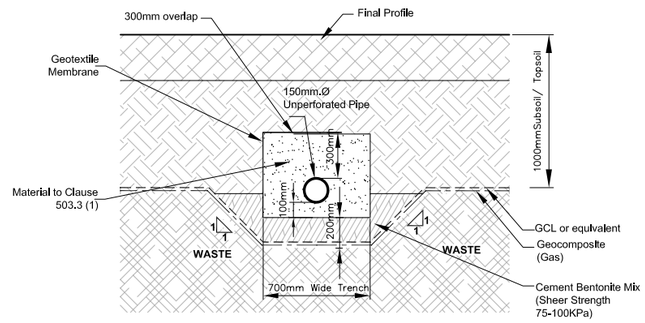
SD0021 **0.5m CONTOUR DRAIN** Scale 1:25.



SD0023 **Section A-A** Scale 1:25.



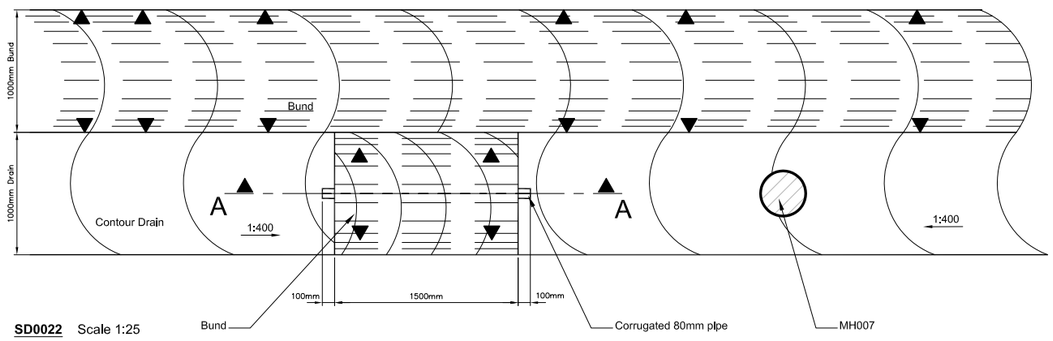
SD0017 **CARRIER DRAIN (MH0006-MH0007)** Scale 1:20



SD0018 **LAND DRAIN INTERCEPTOR** Scale 1:20

NOTE:

1. All other French drains (see DG0008, DG0009 & Appendix 5) to be constructed similar to SD0015 having regard to Type A RCD/500/1.
2. See DG0008 & DG0009 for locations of drains.
3. Land drain under the bund at the 0.5m contour drain (Option A only-see DG0009) to be constructed similar to SD0016 and fitted with 100mm corrugated perforated pipe.
4. Sub surface carrier drain (See DG0008) to be constructed similar to SD0018 having regard to Appendix 5/1.
5. All other carrier drains to be constructed similar to SD0017 having regard to Appendix 5/1.
6. See Appendix 5/1 for pipe schedule.
7. Subsurface Interceptor Drains S001 and S002 shall be constructed similar to SD0019 in a 700mm. wide trench with 255mm. bedding material to Clause 503.3(1).
8. Land Drains to be fitted with a 100mm. pipe shall be constructed in a 420mm. wide trench.



SD0022 Scale 1:25

Note:
Bund at 0.5m radius on down hill side to be profiled to a slope at 1:400

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B01	Apr'04	RH/CC	Issue for Tender	LO'T
A01	Apr'04	MM/CC	Issue for Approval	LO'T

Project:
Ballymurtagh Landfill
Capping & Restoration Works

Title:
MAP 18
STANDARD DETAILS
(4 of 4)

Drawn by:	MM	Job No:	mde0185
Checked by:	CC	File No:	mde0185DG0020
Approved by:	LO'T	Drg. No:	DG0020
Scale:	As shown	Rev:	C01
Date:	March.'04		