Enderby Relief Road (ERR) Leicestershire

Assessment of Landfill Gas Migration Impact from Enderby Warren Landfill (EWL)

17 December 2020

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Assessment of Landfill Gas Migration Impact from Enderby Warren Landfill (EWL)

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1. INTRODUCTION

1.1 Background

Environmental Resources Management Limited (hereafter referred to as 'ERM') was commissioned by The Trustees of Drummond Estates (hereafter referred to as 'Drummond') to provide an assessment of the impact to sensitive receptors from landfill gas migration associated with Enderby Warren Landfill (EWL), both during and after construction of the proposed Enderby Relief Road (ERR).

It is understood that Drummond is proposing construction of the ERR in order to reduce congestion within the centre of Enderby. The ERR will extend from the existing junction of Mill Hill and Warren Park Way beyond the currently adopted Warren Park Way in a north-easterly direction. It will proceed through the current SUEZ operated leachate and gas treatment compound associated with the EWL, north of Harolds Lane, onward through an area of woodland (Fox Covert) and then will form into a roundabout to the north of Warren Farm. Thereafter it will extend in a southerly direction and join the existing service road for the Phase I Lubbesthorpe Employment Land, prior to ultimately joining Leicester Lane.

A Location Plan is presented as Figure 1 and the proposed ERR route is shown on Figure 2 (Figures included in Appendix A). The BWB Traffic Regulation Order Plan (2 sheets ERR-BWB-HMK-8B-DR-D-1203_TRO Plan_S8-P2 & ERR-BWB-HMK-8B-DR-D-1204_TRO Plan_S8-P2) and Highway General Arrangement drawing (ERR-BWB-HGN-8B-DR-D-100) in Appendix F provide more detail.

Prior to commencement of construction of the road, a new leachate and gas treatment compound will need to be constructed immediately adjacent to EWL, largely on land currently forming Harolds Lane, with gas and leachate treatment infrastructure diverted/redirected accordingly.

1.2 Objectives

The key objectives of this Assessment of Landfill Gas Migration Impact are identified as follows:

- Summarise the current and historical land use, with particular focus on the history and characteristics of EWL, and the environmental setting in and around the proposed ERR;
- Derive a conceptual site model;
- Evaluate potential landfill gas migration linkages, both currently, during and post construction of the proposed ERR;
- Present a clear and concise assessment of the magnitude of risks posed by landfill gas migration to identified receptors as a result of construction of the ERR (construction and operation phases); and
- Set out the proposed design incorporating mitigation measures.

1.3 Approach

This Assessment of Landfill Gas Migration Impact has been undertaken following an area walkover and review of available data/previous reports which included:

- The British Geological Society's website (www.mapapps.bgs.ac.uk/geologyofbritain) (Ref. 1);
- EWL borehole logs received from the landfill operator SUEZ, included in Appendix B;
- Geological Investigation and Ground Gas Management Strategy, Lubbesthorpe, ERM, Draft Report, 27 February 2017, (Ref. 2) included in Appendix C;
- BWB Investigation Report, July 2019, included in Appendix D;
- Landfill Gas Risk Assessment Enderby Warren, Gregory Environmental Consulting Limited (GECL), February 2017, (Ref. 3) included in Appendix E; and

- BWB drawings prepared to support the scheme, included in Appendix F.

As part of the development of the scheme, meetings were held on 22nd August and 28th November 2019 at Blaby District Council's Narborough offices and attended by representatives of: Blaby District Council, the Environment Agency (EA), Mather Jamie, Andrew Hiorns Ltd, SUEZ (August meeting only), Infinis (August meeting only), ERM and BWB. The proposed development was discussed. Subsequently, substantive changes to the design have been made in relation to concerns raised by the EA and SUEZ in relation to gas risk. These include moving the alignment of the ERR north, with corresponding relocation of the treatment compound, along with an agreement to remove some receptors (i.e. residential properties), should the scheme proceed.

2. SITE AND AREA DESCRIPTION

2.1 Location

The proposed ERR will run to the north, east and southeast of the closed EWL. The EWL is located approximately 7km southwest of Leicester at National Grid Reference (NGR) SK 536 000. A Location Plan is included as Figure 1.

2.2 Site and Area Description

The footprint and surrounding areas of the ERR, as introduced in Section 1.1, are summarised below, with other key features indicated on Figure 2 in Appendix A.

Table 2.1 Proposed ERR Sections – Footprint and Surrounding Area Description

Section	Footprint and Surrounding Areas Description
Mill Hill/Warren Park Way	Junction improvements and then follows the existing adopted Warren Park Way. Various commercial / industrial properties (not considered further in this report).
Unadopted Warren Park Way to Roundabout	Extending beyond the currently adopted Warren Park Way in a north-easterly direction (following the route of the currently unadopted section of Warren Park Way and then north of Harolds Lane). This section of the road will run through the current SUEZ operated landfill leachate and gas treatment compound and then through the southerly part an area of woodland known as Fox Covert. To the north of the western half of the proposed road is a waste recycling collection and processing facility, with the rest of Fox Covert to the north of the eastern half. To the south is a phone mast and compound. To the east are other industrial properties.
Roundabout to Phase 1 Employment Land Service Road	A new roundabout, and associated slip-roads, located on agricultural land. Further agricultural land surrounds the proposed junction, with buildings of Warren Farm to the south southwest and The Keepers Cottage to the south, on land between the proposed road and EWL. The Warren Farm buildings include a two-storey farmhouse, The Keepers Cottage also being a two-storey residential property.
Phase 1 Employment Land to Leicester Lane	Extending south beyond The Keepers Cottage and to the east of Warren Cottages, is the service road through the Phase 1 Lubbesthorpe Employment Land and ultimately joining Leicester Lane. The Employment land comprises two large units and associated infrastructure. The surrounding area is agricultural land, with occasional woodland. Warren Cottages comprise two two-storey semi-detached residential properties.

3. ENVIRONMENTAL SETTING

3.1 Geology

Published sources (Ref. 1) indicate the following:

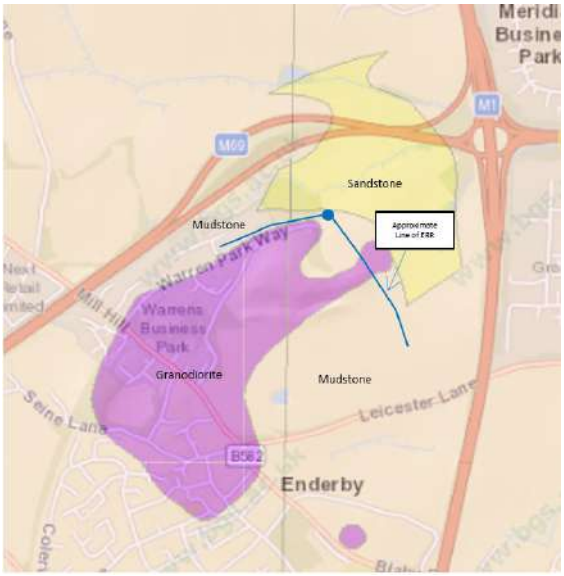
Table 3.1 Published Geology

Drift Deposits – Typically comprise glaciofluvial deposits (sand and gravel, with a fine grained layers of clay and silt) or diamicton (red pebbly clay and silty clay with rock fragments), where present, outside the footprint of the landfill.
The nature of deposition of these strata mean that they are not homogeneous and consistent in nature and mapped geological boundaries are unlikely to be accurate.

Bedrock (Solid) Deposits -
Triassic Mercia Mudstone bedrock, characterised by layers of mudstone, siltstone and sandstone (latter often in the form of lenses known as Skerrie bands).

The footprint of EWL is characterised by an Ordovician granodiorite pluton which extends to the south west of the landfill. It is the granodiorite pluton which was formerly quarried to form the void subsequently filled to form EWL, see *Section 4.* The outer margins of the landfill have remaining Granodiorite which has not been extracted.

The granodiorite pluton is likely to have a low rock matrix permeability, but the rock is known to be fractured, and this high fracture permeability will no doubt have been exacerbated by blasting in the quarry.



Notes:

Known episodes of site investigation works in the area include the following and are discussed in turn below:

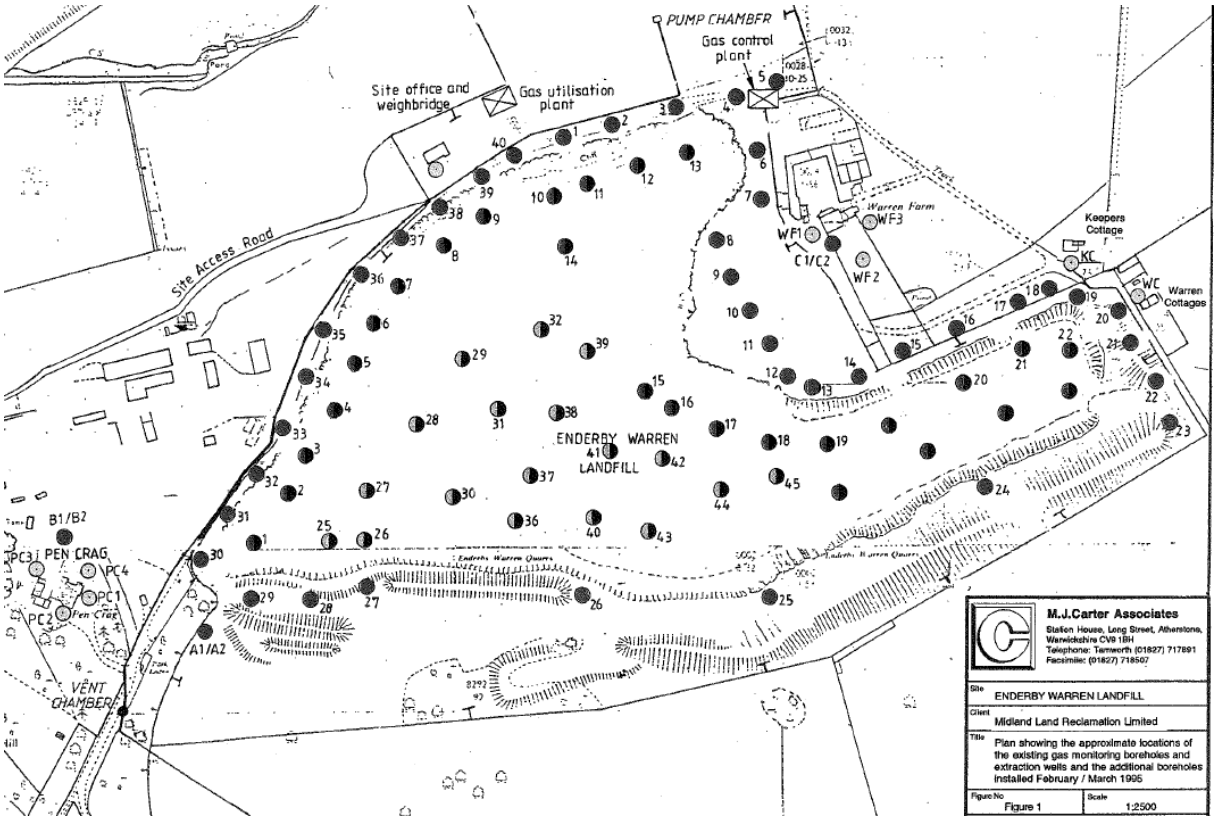
1. Boreholes completed by the operators of the landfill, currently SUEZ, in 1990 and 1995, hereafter referred to as the Enderby Warren Landfill (EWL) boreholes. Borehole logs received are included in Appendix B;
2. Lubbesthorpe Phase 1 Employment Area, as shown on Figure 2, in December 2016. This is reported in Ref. 2, included in Appendix C; and

3. Shallow boreholes completed along the existing Warren Park Way /Harolds Lane by BWB in July 2019. Extracts included in Appendix D.

EWL Boreholes

An extensive network of deep boreholes has been installed in and around the EWL, most notably in 1990 (BHs 1 to 45) and 1995 (adjacent to receptors sensitive to the overall landfill such as Warren Farm, Keepers Cottage, Warren Cottages and Pen Crag and denoted WF, KC, WC and PC etc.). The positions of these boreholes are shown in Figure 3 below. Extracts of all borehole logs received from SUEZ are included in Appendix B.

Figure 3 – EWL Boreholes Reviewed by ERM



ERM has reviewed all borehole logs received. Table 3.2 below, summarises those around the northern, eastern and western perimeter and adjacent to receptors sensitive to the overall landfill, including Pen Crag some distance away from the proposed ERR to the southwest.

Table 3.2 Summary of EWL Borehole Logs

Borehole Ref.	Simplified Log Description
KC1	Made Ground (Drillers Description) – Ground Level to 0.5m Silty Marl and Clay (Drillers Description) – 0.5m to 1.5m Silty, Sandy Clay (Glacial Deposits) – 1.5m to 2.3m Silty Clay (Mercia Mudstone Group) – 2.3 to >4.5m Borehole continued deeper as KC1A
KC1A	Made Ground – Ground Level to 0.8m Silty Marl and Clay (Drillers Description) – 0.8m to 1.2m Sandy, Silty Marl (Drillers Description, Probably Mercia Mudstone Group) – 1.2m to 2.7m

Borehole Ref.	Simplified Log Description
	Sandy, Shaly Marl (Drillers Description, Probably Mercia Mudstone Group) – 2.7m to 3.7m Silty Mudstone (Mercia Mudstone Group) – 3.7m to 4.9m Fresh Granodiorite, with fissures – 4.9m to > 12m
WC	Clay and Sand (Drillers Description) – Ground Level to 1.8m Granite Boulder Fill (Drillers Description) – 1.8m to 2.0m Highly weather Mudstone with some infilled fissures (Mercia Mudstone Group) – 2.0m to 5.05m Granodiorite – 5.05m to >10m (fissured to varying degrees throughout, with weathering decreasing with depth)
WF1	Clay and Silty Sandy marl (Drillers Description) (Possibly Glacial Deposits) – Ground Level to 5.0m Silty Marl (Drillers Description) - 5.0m to >20m Borehole continued deeper as WF1A
WF1A	No record - Ground Level to 4.5m Mudstone (Mercia Mudstone Group) – 4.5m to 9m Sandstone ((Mercia Mudstone Group) – 9.0m to 10m Mudstone (Mercia Mudstone Group) – 10m to 14.95m Sandstone ((Mercia Mudstone Group) – 14.85 to 17m Mudstone (Mercia Mudstone Group) – 17m to >20m
WF2A	Topsoil – Ground level to 0.3m Silty Clay (Drillers Description) – 0.3m to 2.0m Silty Clay (Glacial Deposits) – 2.0m to 4.65m Sandstone ((Mercia Mudstone Group) – 4.65 to 4.75m Mudstone (Mercia Mudstone Group) – 4.75m to 9.2m Granodiorite – 9.2m to >10.2m (weathering decreasing with depth)
WF3	Topsoil – Ground level to 0.35m Silty Marl (Drillers Description) – 0.35m to 1.0m Silty Clay (Glacial Deposits) – 1.0m to 3.7m Mudstone – 3.7m to 4.0m Clay (Drillers Description) – 4.0m to 5.3m Mudstone (Mercia Mudstone Group) – 5.3m to 11.85m Sandstone (Mercia Mudstone Group) – 11.85 to 12.5m Mudstone (Mercia Mudstone Group) – 12.5m to 18.5m Granodiorite - >20m
1	Boulder Clay/Red Marl (Drillers Description) - Ground Level to 9.4m Granite (Drillers Description) – 9.4m to >100m
2	Boulder Clay/Red Marl (Drillers Description) - Ground Level to 10.8m Granite (Drillers Description) – 10.8m to >100m
3	Boulder Clay/Granite Boulders (Drillers Description) - Ground Level to 4.0m Granite (Drillers Description) – 4.0m to >100m
4	Boulder Clay/Granite Boulders (Drillers Description) - Ground Level to 6.9m Granite (Drillers Description) – 6.9m to >100m
5	Hardcore, Boulder Clay and Granite Boulders (Drillers Description) - Ground Level to 6.9m Granite (Drillers Description) – 9.4m to >100m
6	Hardcore, Boulder Clay and Granite Boulders (Drillers Description) - Ground Level to 7.0m Granite (Drillers Description) – 7.0m to >100m
7	Hardcore, Boulder Clay and Granite Boulders (Drillers Description) - Ground Level to 7.0m Granite (Drillers Description) – 7.0m to >100m

Borehole Ref.	Simplified Log Description
14A	Hardcore and Boulder Clay (Drillers Description) - Ground Level to 1.2m Granite (Drillers Description) – 1.2m to >100m
15	Boulder Clay and Marl (Drillers Description) - Ground Level to 3.0m Granite (Drillers Description) – 3.0m to >100m
16	Boulder Clay and Marl (Drillers Description) - Ground Level to 9.0m Granite (Drillers Description) – 9.0m to >100m

Table 3.2 Summary of EWL Borehole Logs Continued

Borehole Ref.	Simplified Log Description
17	Topsoil, Boulder Clay and Marl (Drillers Description) - Ground Level to 11.0m Granite (Drillers Description) – 11.0m to >100m
18	Topsoil, Boulder Clay and Marl (Drillers Description) - Ground Level to 19.5m Granite (Drillers Description) – 19.5m to >100m
19	Boulder Clay and Marl (Drillers Description) - Ground Level to 19m Granite (Drillers Description) – 19.0m to >105m
20	Red Marl (Drillers Description) - Ground Level to 10.0m Granite (Drillers Description) – 10.0m to >105m
21	Red Marl (Drillers Description) - Ground Level to 8.0m Granite (Drillers Description) – 8.0m to >100m
22	Topsoil/Marl, with Boulders (Drillers Description) - Ground Level to 3.0m Granite (Drillers Description) – 3.0m to >100m
23	Topsoil, Boulder Clay (Drillers Description) - Ground Level to 2.85m Granite (Drillers Description) – 2.85m to >100m
30	Topsoil, Boulder Clay and Marl (Drillers Description) - Ground Level to 7.5m Granite (Drillers Description) – 7.5m to >100m
31	Topsoil, Sand and Marl (Drillers Description) - Ground Level to 16.5m Granite (Drillers Description) – 16.5m to >100m
32	Topsoil, Sand and Marl (Drillers Description) - Ground Level to 9m Granite (Drillers Description) – 9m to >100m
33	Red Marl and Boulders (Drillers Description) - Ground Level to 12.6m Granite (Drillers Description) – 12.6m to >100m
34	Red-Brown Marl Fill (Drillers Description) - Ground Level to 6m Grey Sandy Clay (Drillers Description) – 6m to 7m Red Marl (Drillers Description) – 7m to 18.15m Granite (Drillers Description) – 18.5m to >100m
35	Boulder Clay, Red Marl (Drillers Description) - Ground Level to 20m Granite (Drillers Description) – 20m to >100m
36	Concrete, Hardcore, Boulder Clay (Drillers Description) – Ground Level to 6.0m Granite (Drillers Description) – 6.0m to >100m
37	Hardcore, Granite Boulders and Boulder Clay (Drillers Description) - Ground Level to 5.8m Granite (Drillers Description) – 5.8m to >95m

Borehole Ref.	Simplified Log Description
38	Hardcore and Sandy Boulder Clay (Drillers Description) - Ground Level to 4.3m Granite (Drillers Description) – 4.3m to >95m
39	Hardcore, Sand and Boulder Clay (Drillers Description) - Ground Level to 3.0 m Granite (Drillers Description) – 3.0m to >95m
40	Hardcore, Sand and Granite Boulders (Drillers Description) - Ground Level to 2.8 m Granite (Drillers Description) – 2.8m to >95m
PC1	Made Ground – Ground Level to 1.0m Brown Marl (Drillers Description) – 1.0m to 1.4m Granodiorite - 1.4m to >10m (fissured to varying degrees throughout, with weathering decreasing with depth)
PC2	Made Ground – Ground Level to 0.7m Granodiorite - 0.7m to >10m (fissured to varying degrees throughout, with weathering decreasing with depth)
PC3	Made Ground – Ground Level to 0.5m Hard Granite (Drillers Description) - 0.5m to >10m
PC4	Made Ground – Ground Level to 2.0m Brown Sandy Marl (Drillers Description) – 2.0m to 3.3m Granodiorite - 3.3m to >10m (fissured to varying degrees throughout, with weathering decreasing with depth)

Although there are inconsistencies between the description in the logs (likely reflecting they are largely taken from drillers descriptions) the above indicates the general sequence to be thin Made Ground over superficial deposits (Glaciofluvial or Diamicton), comprising deposits of sandy silt and sandy silty clay (to varying degrees), giving way to Mercia Mudstone (weathered to clay/silt in upper layers). Fissured Granodiorite (described often as Granite) is present at depth in all locations apart from WF1/1A.

The above demonstrates that clay/clayey deposits are present in many locations either associated with superficial deposits or weather upper layers of Mercia Mudstone, and confirms shallow geology is highly variable.

Lubbesthorpe Phase 1 Employment Area Investigation 2016

ERM undertook an intrusive investigation on the proposed Lubbesthorpe Phase 1 Employment Area, as shown on Figure 2, in December 2016. This is reported in Ref. 2, included in Appendix C.

The investigation encountered competent, soft to firm, gravelly, clay at all locations across the site. The thickness of this uppermost layer varies between 1.0 m (BH03) and 6.0 m (BH05 and BH13).

Mudstone / weathered mudstone was encountered at each location, at depths between 1.8 m bgl (metres below ground level) (BH01) and 7.5 m bgl (BH04). Sandstone was identified, interbedded with the mudstone at BH01, BH02, BH03, BH04, BH06, BH12, BH13 and BH14 and the shallowest sandstone bed was encountered at 2 m bgl at BH16. Sandstone was not present in BH05, BH11, BH15 and BH16.

BWB Boreholes, July 2019

A series of 17 shallow boreholes were progressed along the existing Warren Park Way, and part of the then proposed alignment of the ERR (which aligned with Harolds Lane, rather than the more

northerly route now proposed), in July 2019. The report from this investigation is provided in Appendix D.

The primary objective of the investigation was to provide further information as to the shallow geology along the proposed ERR.

The investigation identified Made Ground in all locations up to 1.9 m bgl, where thickness was proved. Drilling was challenging, with many obstructions in the form of cobbles/boulders of granodiorite and limestone, thought to have been placed during construction of the access/haul road for the quarry to the south.

Clay was present in the majority of locations where Made Ground was penetrated, associated either with superficial deposits (interpreted to be Diamicton of the Oadby formation) or weathered Mercia Mudstone (interpreted as the Edwalton Member), with shallow horizons of gravel/sand encountered in two adjacent locations (DS09 and DS10).

Limited land gas monitoring was undertaken during the works, largely for ground worker safety and should not be considered as representing long term conditions. Elevated carbon dioxide concentrations were noted at DS02 (10.52%v/v at 0.8m bgl) and DS03 (6.1%v/v at 0.7m bgl), with a peak methane level recorded at location DS11 (0.3%v/v at 1.9m). No discernible gas flows were noted.

No visual or olfactory evidence of contamination was noted during the advancement of the borehole locations. No elevated gas readings were recorded on personal monitors during the works.

3.2 Hydrogeology

As described in Ref. 2, the superficial deposits are classed as a Secondary A aquifer. Secondary A aquifers are described by the Environment Agency as ‘permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers’.

The Mercia Mudstone Group has been classified as a Secondary B aquifer. Secondary B aquifers are described by the Environment Agency as predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers’.

The site is not located within a groundwater source protection zone and is not located within a groundwater nitrate vulnerable zone.

The ERM intrusive works undertaken in December 2016, reported in Ref. 2 and included in Appendix C, encountered perched groundwater in five of the six locations, between 6 m bgl and 8.8 m bgl corresponding with sandstone horizons. Shallower seepages were also observed. The large variation in groundwater depths was concluded to indicate that there is no continuous groundwater body underlying the site, and that the encountered groundwater is perched and predominantly located within the more permeable sandstone lenses.

3.3 Hydrology

As described in Ref. 2, the nearest surface water feature to the site, is a small unnamed pond, located within woodland approximately 160 m northeast of the site. This pond feeds a minor unnamed water course which flows towards the north.

4. ENDERBY WARREN LANDFILL

4.1 Landfill History and Pertinent Details

As detailed in Ref. 3, included in Appendix E, domestic waste deposition commenced at EWL under Leicestershire County Council (LCC) in 1981. SUEZ acquired the Site in 1991, continuing operations until December 2001.

The landfill is situated in the void of a former granodiorite quarry, excavated to a maximum depth of 80m. The site has a total area of approximately 8.3Ha.

All waste disposal operations were performed in an unlined quarry with almost sheer walls. The leachate produced by rainfall into the site was originally managed by the dilute and attenuate principle, considered acceptable practice at the time of licensing, with contaminants slowly leaching into the surrounding groundwater (which is not used as a potable water supply).

The Site was capped in 2007, incorporating installation of an extensive network of land gas and leachate collection pipework, associated with Environmental Permits 1 and 2 detailed below, leading to the SUEZ compound to the north of the landfill site, as shown on Figure 2.

There are currently three Environmental Permits associated with the landfill:

1. The landfill site originally operated under a waste management licence WML43366) and is now regulated under EPR/AP3993CV/V00). The site is operated by Midland Land Reclamation Ltd, a SUEZ Company;
2. The Enderby Leachate Treatment Plant, operated by SUEZ Recycling and Recovery Ltd., is permitted under EPR/RP3738ZK; and
3. The Enderby Generation Plant, operated by Novera Energy Generation No.2 Ltd. (now Infinis), is permitted under EPR/MP3734LU.

4.2 Previously Reported Landfill Gas Generation, Collection and Potential for Off-Site Migration

Extensive assessment of the landfill gas generation, collection and current potential for off-site migration has been undertaken by Gregory Environmental Consulting Ltd (GECL) in Ref. 3, included in Appendix E. This report presents the following:

- Landfill gas generation peaked in 2001, at the same time as the site closed to waste, and has been declining ever since;
- Landfill gas management is achieved at the site by a combination of active and passive systems. Landfill gas abstraction for utilisation and flaring is the active technology employed at the site for landfill gas control. The site is unlined and this means there is no passive barrier to assist in lateral migration management. SUEZ installed an engineered cap in 2007 to help manage the landfill gas collection at the site;
- Modelling suggests that potentially 60% of the landfill gas is captured by the active gas control system, and up to 27% is potentially lost through the sidewalls of the landfill. However, monitoring suggests that the number of lateral migration events annually has declined significantly with time, and particularly following engineered capping of the site. Furthermore, lateral migration modelling also demonstrates that the flux of gas on the sidewalls of the quarry is reducing year on year;
- Inspection of monitoring data from 1999 to the present day indicates that there is evidence of diffusive off-site gas migration in the, currently GECL assumed, unconfined situation. However, diffusion is concluded to be a low risk mechanism which is modelled to have an impact no further than 10m from the waste boundary. There is also evidence of advective off-site gas migration in the, currently GECL assumed, unconfined situation. Advection is considered a high-risk

mechanism which is modelled to potentially have an impact to at least 240m from the waste boundary;

- Overall, in the, currently GECL assumed, unconfined situation, land gas migration modelling concluded that 50% of migration would be to a distance of up to 35m from the waste boundary, with 5% of all migration events having the potential to migrate at least 240m;
- SUEZ manages the current risks by alarms in high risk residential properties identified in their monitoring reports, in addition to routine monitoring around the perimeter of entire landfill body;
- Gas migration through the granodiorite is considered to be through secondary fissure pathways of high permeability and porosity, in the unsaturated zone;
- Gas migration through the Mercia mudstone formation and superficial deposits are considered would be preferentially through sandstone lenses with a high matrix permeability, also in the unsaturated zone; and
- SUEZ's current risk assessment of the most sensitive nearby residential properties, see Section 5.1, which they monitor continuously, are that whilst the potential risks to these properties are high, the actual risks to these properties, based on the results of their ongoing monitoring, and their management systems, are actually low.

The Ref. 3 report also presents scenarios for off-site land gas migration in confined conditions, i.e. with hard surfacing reducing pathways to air. The report assimilates such confined conditions to those that will exist following development of the ERR and concludes that this could increase the risk to identified receptors. These conclusions, as well as those above for off-site migration in unconfined conditions, are discussed in subsequent sections of this report.

5. CONCEPTUAL MODEL, POTENTIAL LANDFILL GAS MIGRATION LINKAGE EVALUATION AND RISK ASSESSMENT

5.1 Introduction

The following sections develop a conceptual model by highlighting the identified receptors and the potential pathways by which landfill gas originating from the EWL (the source as described in Section 4 above) may migrate to them.

Thereafter, the potential for realisation of plausible linkages for off-site landfill gas migration is evaluated and assessed, both currently and post construction of the proposed ERR.

5.2 Identified Receptors

With reference to Section 2.2 and Figure 2, the following receptors have been identified which may be affected by off-site migration of landfill gas associated with construction of the ERR.

Table 5.1 – Identified Receptors – Current Situation

Receptor Number (as on Figure 2)	Receptor Name	Receptor Characteristics
Potentially Sensitive Receptors to Landfill Gas Migration:		
1	Farmhouse at Warren Farm	A two-storey detached residential property situated to the east of EWL approximately 60m from the landfill boundary at the nearest point. The proposed ERR alignment is approximately 110m to the north and 150m to the east.
2	The Keepers Cottage	A two-storey detached residential property situated to the north of EWL approximately 20m from the landfill boundary at the nearest point. The proposed ERR alignment is approximately 50m to the east. The property is surrounded by predominantly permeable surfacing, apart from several small outbuildings/driveways.
3	Warren Cottages	Two two-storey semi-detached residential properties situated to the east of EWL approximately 10m from the landfill boundary at the nearest point. The proposed ERR alignment is approximately 20m to the east. The property is surrounded by predominantly permeable surfacing, apart from several small outbuildings/driveways.
4	Park Lodge	A two-storey detached property located on Harolds Lane approximately 260m from the ERR and 40m from the EWL boundary at closest point.
5	Pen Crag	A large detached property and associated outbuilding used both for residential (self-contained flats) and businesses. Located about 240m from the ERR and 50m from EWL boundary.
Receptors not Identified as Sensitive (Based on Building Type, Distance, Construction etc.):		
6	Commercial / Industrial Facilities	Include: Waste Collection and Processing Facility - Situated to the north of EWL, across Warren Park Way, approximately 40m from the landfill at the nearest point. Comprises an area of approximately 1.4ha of hard surfacing, with a large warehouse building. An approximately 15m landscape strip exists between the facility and

Receptor Number (as on Figure 2)	Receptor Name	Receptor Characteristics
		Warren Park Way. The facility is located at a level approximately 5m lower than Warren Park Way. Warehouse/Light Industrial Facilities/offices – Situated to the southwest and northwest of EWL across Harolds Lane. The nearest building is approximately 15m across Harolds Lane from the EWL, with a landscaped strip and further landscaping also present. Lubbesthorpe Phase 1 Employment Land – Recently established to the east of ERR and comprises two large units and associated infrastructure.
7	Further Residential Properties	There are further, primarily modern construction, residential properties located approximately 200m southwest of the EWL on Harolds Lane /Ashton Drive, which are not considered to be likely to be influenced by EWL.
8	Farm Outbuildings / Barns	Farm buildings and hardstanding associated with Warren Farm between EWL and the proposed ERR, and to the south.
9	Phone Mast	Phone mast and associated infrastructure.

The most sensitive residential receptors (Nos. 1 to 3) are all situated close to the landfill boundary and between the EWL and proposed ERR alignment. Residential receptors Nos. 4 and 5 are also close to the EWL, albeit a considerable distance from the ERR.

The residential properties identified as No. 7 are a considerable distance from the EWL, even further from the ERR, and not considered to be sensitive receptors in the context of the assessment.

SUEZ has identified receptors Nos. 1, 2, 3, 4 and 5 at being at potential risk from landfill gas migration. Management of this risk is considered likely to become more difficult through time due to the changing properties of EWL as the waste continues to degrade (regardless of whether the ERR is constructed).

Drummond own the residential receptor properties Nos.1 to 5. At the request of SUEZ, and with the support of the EA, prior to construction of the ERR it is proposed to permanently vacate these properties, and hence remove the residential receptor risk.

5.3 Potential Pathways

Section 3.1 describes the mapped geology and that encountered during investigations in the vicinity of the EWL, on which the most sensitive receptors considered to be potentially affected by an increased landfill gas risk associated with construction of the ERR are situated. This indicates that the area is underlain by relatively inhomogeneous Superficial Deposits, with significant clay horizons. These, in turn, are underlain by bedrock of Mercia Mudstone, predominantly silt/mudstone and weathered to clay in upper layers, with some sandy horizons (known as Skerrie Bands) and/or Granodiorite, which has not been extracted.

The primary pathway for lateral off-site migration of land gas is considered to be via connected pore spaces, including sandy lenses/bands, and fractures/fissures in the unsaturated subsurface geology, primarily through advection (Ref. 3). The above observations lead to the conclusion that landfill gas is not presented with a clear and connected lateral pathway for migration through the subsurface. Furthermore, the extensive shallow clay layers, although acknowledged to be punctuated by sand/gravel layers in a limited number of places, indicate that the current situation is already somewhat confined from primary meteorological influences on advection (i.e. changes in atmospheric

pressure and rainfall), in the area of the proposed ERR. It should also be recognised that the existing Warren Park Way is surfaced with asphalt along the majority of its length.

5.4 Linkage Evaluation Summary and Risk Assessment

Notwithstanding the above, there is considered to be a plausible linkage for off-site landfill gas migration to the sensitive residential properties identified in *Table 5.1*. At the meeting on 28th November 2019 the EA presented SUEZ gas monitoring data showing landfill gas has been measured in boreholes adjacent to residential properties. There is a lesser plausible linkage to the industrial facilities (No. 6 in Table 5.1).

However, as introduced in Section 4.2, SUEZ's assessment of the most sensitive residential receptors, which they monitor continuously, is that, while the risks to these properties are high if not managed appropriately, the actual risks to these properties, based on the results of their ongoing monitoring and their management systems, are actually low in current conditions. The assessment of high risk somewhat contradicts the modelling results presented for the, currently CEGL assumed, unconfined situation presented in Ref. 3 and discussed in Section 4.2. Furthermore, it should be noted that this landfill gas migration modelling assumed highly conservative subsurface geology conditions with continuous and unsaturated strata, of consistent permeability and moisture content.

The Ref. 3 report also presents scenarios for off-site land gas migration in confined conditions, i.e. with hard surfacing reducing pathways to air. The report assimilates such confined conditions to those that will exist following development of the ERR and concludes that this could increase the risk to identified receptors. ERM are not in agreement with this conclusion as the extensive shallow clay layers indicate that the current situation is already somewhat confined from primary meteorological influences on advection (i.e. changes in atmospheric pressure and rainfall) in the area of the proposed ERR, as described in Section 5.3 above, and the relatively small hard surfaced area of the proposed road will not significantly add to the level of confinement. The updated alignment of the ERR is located a minimum of 20m north of the landfill boundary wall, further reducing the likely potential influence of the ERR on the EWL (see Highway General Arrangement – Quarry Wall Distance BWB drawing ERR-BWB-HGN-8B-DR-D-11_Highway General Arrangements_S2-P4 in Appendix F).

In summary, the review of available information leads to the assessment that the risk of impact to identified sensitive receptors, from landfill gas, both currently and after construction of the ERR, remains as Low. This assessment relies on the continuous operation of the SUEZ/Infinis gas extraction system, aligning with the SUEZ assessment of risk for the current situation, as detailed in Ref. 3, and it is not considered that the ERR will alter the status quo. It is however recommended that certain considerations are integrated into the final design and construction methodology, as outlined in the following section.

However, as identified in Section 5.2 above, SUEZ, supported by the EA, has requested that Drummond, prior to construction of the ERR, permanently vacate the sensitive residential properties comprising Nos. 1, 2, 3, 4 and 5 as noted in Table 5.1. This will eliminate the potential for a linkage of landfill gas from the EWL to these receptors. Drummond has agreed to this request.

5.5 ERR Design and Construction Considerations

The primary risks associated with land gas migration, outside the confines of the landfill, are considered to be associated with the construction phase (i.e. primarily associated with relocation of the gas/leachate extraction system). As outlined above, although the risks are considered to be Low, acknowledging ongoing management of landfill gas by SUEZ, it is considered prudent to incorporate certain design and construction measures/procedures to further mitigate against the potential for off-site migration after the ERR is built, i.e. during the operational phase.

These design and construction measures/procedures will be implemented in addition to the removal of residential receptors Nos. 1 to 5.

The proposed design and construction measures are outlined below.

5.5.1 Relocation of Treatment Compound

The existing leachate and gas treatment arrangements are shown on Figure 4 in Appendix A. The proposed ERR will pass directly through the treatment compound (see Figure 2 which shows ERR in relation to Harolds Lane, the existing compound is directly north of Harolds Lane).

As such, prior to construction of the ERR it will be necessary to construct a new treatment compound and divert incoming leachate and gas collection from the EWL accordingly. The proposed new arrangements, which have been discussed and agreed with SUEZ, are shown on Figure 5. All infrastructure will be located south of the ERR post construction other than the existing substation and a single monitoring location (BH41). No utilities associated with the treatment of gas or leachate will pass under the ERR other than electrical cables to the substation. In addition, the existing surface water runoff culvert beneath Harolds Lane, which takes rainwater into a soakaway area in Fox Covert, will be realigned and rebuilt under the ERR.

There are substantial benefits of the updated ERR alignment in comparison with previous iterations as there will be no changes required on the EWL area proper other than a realignment of the above ground pipe that transports leachate from the leachate tower the new Leachate Stripping Plant. At the request of SUEZ, the existing “quarry wall” adjacent to the new treatment compound will be demolished and replaced with a new fence, on the same alignment.

Similarly, the new treatment compound alignment does not overlap with the existing treatment compound, other than where leachate and gas pipes currently pass under Harolds Lane. As such it should be straightforward to construct the new plant before diverting incoming gas and leachate. The then obsolete former equipment, pipework etc. will be decommissioned (including the pumping station in Fox Covert). A single monitoring borehole, BH42, will need to be relocated (new location to be agreed with the EA) and the existing borehole decommissioned.

Reflecting the substantive changes that will occur, as described above, it will be necessary, working with the permit holders SUEZ and Infinis, and the EA, to vary (or surrender and reapply for) the three existing Environmental Permits that exist for the EWL, gas treatment and leachate treatment respectively. The EA’s Pre-Application Enhanced Advice service will be used. The current interaction between the permits is complex and the changes should create an opportunity to simplify arrangements going forward.

All design and implementation works associated with reconfiguring treatment arrangements will need to developed and agreed with the relevant stakeholders, including SUEZ, Infinis and the EA, and implemented under an agreed Construction Quality Assurance (CQA) Plan.

5.5.2 Construction Phase Mitigation Measures

In addition to construction of the new treatment compound there are other mitigation measure to be implemented during construction, as follows:

- **Gas Migration Through Services –** Without appropriate mitigation there is a limited potential for 1. migration of land gas into drainage features and service corridors along the newly constructed ERR, i.e. post construction or 2. for leakage of oxygen into the landfill to occur. The increased distance between the updated ERR alignment and landfill material (minimum 20m, see Highway General Arrangement – Quarry Wall Distance BWB drawing ERR-BWB-HGN-8B-DR-D-11_Highway General Arrangements_S2-P4 in Appendix F) reduces risk in comparison with earlier design iterations. In addition, this will be mitigated through encasing such pipes in concrete to prevent any leakage potential. Details are provided on drawing ERR-BWB-HDG-8B-DR-D-500_Highway Drainage Strategy_S8-P1 in Appendix F;
- **Monitoring Boreholes –** As shown on Figure 5, and described above, a single borehole (BH42) will require relocation prior to ERR construction works commencing in the vicinity of the compound. The existing borehole will need to be decommissioned.

- **Gas Migration Through Shallow Geology –** As described in this report, there are considerable deposits of, relatively impermeable, clay along the length of the proposed ERR. Furthermore, the extent of cut along the proposed road is limited (see cross sections show on drawings ERR-BWB-HGN-8B-DR-D-200_Illustrative Horizontal Design Strings_S8-P1 and ERR-BWB-HGN-8B-DR-D-130_Illustrative Cross-Sections_S8-P1). In addition, the degree of cut has reduced with the new alignment, compared with earlier versions. However, some limited relatively shallow permeable horizons (sand and/or gravel) have been encountered in certain locations in previous investigations. Where encountered, these should be "over-excavated" to a minimum depth of 1.0m below construction formation level and replaced with a low permeability material comprising either an engineered clay layer, placed in accordance with the Highways Specification (Series 600), concrete or a combination of both. Drawings showing typical construction details are provided as ERR-BWB-HDG-8B-DR-D-500_Highway Drainage Strategy_S8-P1 and ERR-BWB-HGT-8B-DR-D-650_Illustrative Long sections and Typical Sections_S8-P1 in Appendix F. Such an approach using engineered clay was agreed for the adjacent Lubbesthorpe Phase 1 Employment Land; and
- **Monitoring and Emergency Planning –** A thorough regime of land gas monitoring throughout the construction phase, in excavations and surrounding boreholes, should be developed during the construction phase, especially during excavation. Results should be communicated daily to SUEZ/Infinis in order that 'gas extraction balancing' can be undertaken as necessary. An associated robust emergency plan and working procedure should also be developed.

5.5.3 Operational Phase

- **Future Maintenance –** The realignment of the ERR and the repositioning of the treatment compound next to the EWL mitigates future maintenance issues represented by previous alignments. A duplicate ("spare") cable will be laid to the substation under ERR as a future proofing measure; and
- **Compound Access and Protection –** Two access routes to the compound are provided, along with one to the substation compound north of the ERR. The infrastructure in each compound is located some distance from the fence line with ERR to mitigate against potential for damage from vehicles leaving the ERR in an uncontrolled manner.

6. CONCLUSIONS AND RECOMMENDATIONS

In overall summary, the review of available information leads to the assessment that the risk of impact to identified sensitive receptors, from landfill gas, both currently and after construction of the ERR, remains as Low. This assessment relies on the continuous operation of the SUEZ/Infinis gas extraction system, aligning with the SUEZ assessment of risk for the current situation, and it is not considered that the ERR will alter the status quo, particularly reflecting the revised northerly alignment.

However, as a further risk mitigation measure, prior to construction of the ERR, it is proposed to permanently vacate the sensitive residential properties comprising 1, 2, 3, 4 and 5 as noted in *Table 5.1.* This will eliminate the potential for a linkage of landfill gas from the EWL to these sensitive receptors.

In addition, temporary and permanent design measures/procedures are proposed to ensure continuity of landfill gas extraction and mitigate against the creation of new preferential pathways during construction and operational phases of the ERR. These design and construction considerations are to be developed and agreed with all stakeholders, including SUEZ, Infinis and the Environment Agency, and implemented following an agreed Construction Quality Assurance (CQA) Plan.

Following completion of the ERR, relocation and reconfiguration of the treatment compound to adjacent to the EWL, and removal of the identified sensitive receptors, it is considered likely that the risk from EWL will have reduced, in comparison to the current situation.

APPENDIX A FIGURES

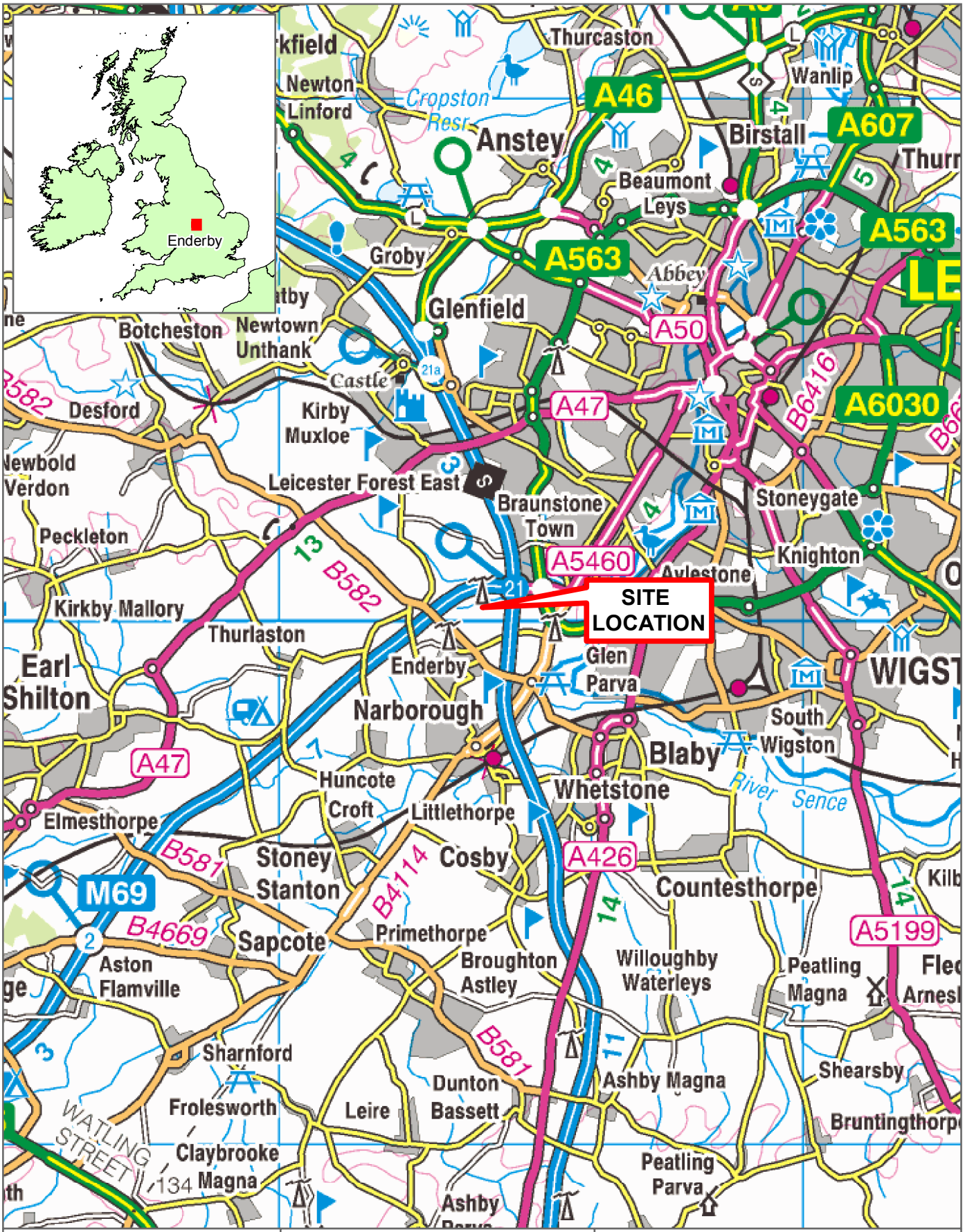


Figure 1
Site Location Plan
Enderby, Leicestershire

SIZE: A4	VERSION: A
SCALE: 1:100,000	DRAWN: MTC
PROJECT: 0417675	CHECKED: CR
DATE: 07/09/2017	APPROVED:

ERM

The Trustees of Drummond Estate

PROJECTION: British National Grid

Path: P:\Projects\0417675 Enderby Relief Road.CR\GIS\MAPS\0417675_SiteLocation_A01.mxd

Fox Covert Woodland

Harolds Lane

Warren Park Way

Harolds Lane

Woodland

Woodland

Lubbersthorpe Employment Land Phase 1

Leicester Lane

Potentially Sensitive Receptors to Landfill Gas Migration

1. Warren Farm - Farm House
2. The Keepers Cottage
3. Warren Cottages
4. Park Lodge (1 Harolds Lane)
5. Pen Crag (also sometimes known as Pencraig)

Receptors Not Identified as Sensitive (Due to Building Type, Distance etc.)

6. Commercial/Industrial Buildings
7. Residential Properties
8. Farm Outbuilding/Barn
9. Existing Phone Mast (Retained)

Proposed Enderby Relief Road

- Carrigeway
- Footpath/Cycleway
- Verge
- Phase I Employment Land Access Road (Already constructed and in use)
- Existing Roads
- Approximate Footprint of Enderby Warren Landfill

Note: All boundaries, fence lines and road alignments are approximate and shown for schematic purposes only.

0 20 40 60 80 100
Metres

N

SCALE: See Scale Bar	VERSION: A
SIZE: A3	DRAWN: MTC
PROJECT: 0417675	CHECKED: ADS
DATE: 16/12/2020	APPROVED:

Figure 2
Identified Potentially Sensitive Receptors to Landfill Gas Migration Impact
Enderby, Leicestershire

ERM

The Trustees of Drummond Estate

PROJECTION: British National Grid

Path: P:\Projects\0417675 Enderby Relief Road.CR\001_Dwgs\GIS\MAPS\Option8bv2\0417675_SensitiveReceptors_Option8bv2_A01.mxd

Pumping Station
Fox Covert Woodland
Engine
Substation
Flare
Gas Compressors & Boosters
Oil Tank
Meter House
Harolds Lane
BH3
BH41
BHEN02
Leachate Stripping Plant
BHEN01
Gas Pipe Entry Point
BH40
BH42
BH39
Gas Collection Manifold Chamber
Leachate Tower
BH38
BH37

- Monitoring Borehole
- Manhole
- Gas Collection Pipes to Manifold
- Leachate Collection Pipe
- Leachate Discharge Pipe to Pumping Station
- Leachate Discharge Pipe to Sewer
- Location of Equipment
- Compound Boundary
- SITA UK Ltd Ennerby Leachate Treatment Plant
- Novera Energy Ennerby Warren Generation Plant
- Existing Roads

Note: All boundaries, fence lines and road alignments etc are approximate and shown for schematic purposes only.

0 5 10 15 20 25
Metres

N

SCALE: See Scale Bar	VERSION: A
SIZE: A3	DRAWN: MTC
PROJECT: 0417675	CHECKED: ADS
DATE: 17/12/2020	APPROVED:

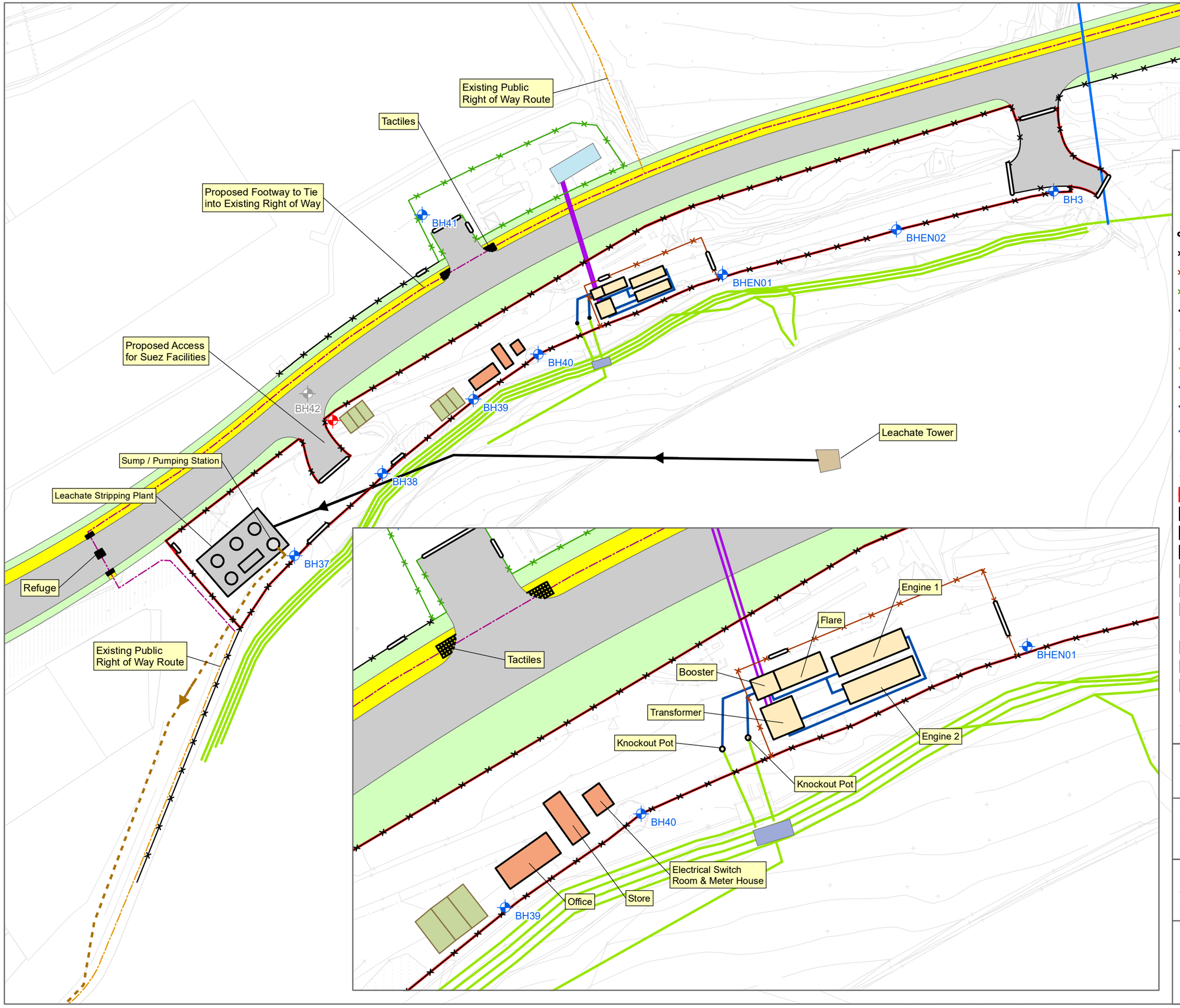
Figure 4
Existing Gas Extraction & Leachate Treatment Compound Arrangements - Schematic. Enderby, Leicestershire

ERM

The Trustees of Drummond Estate

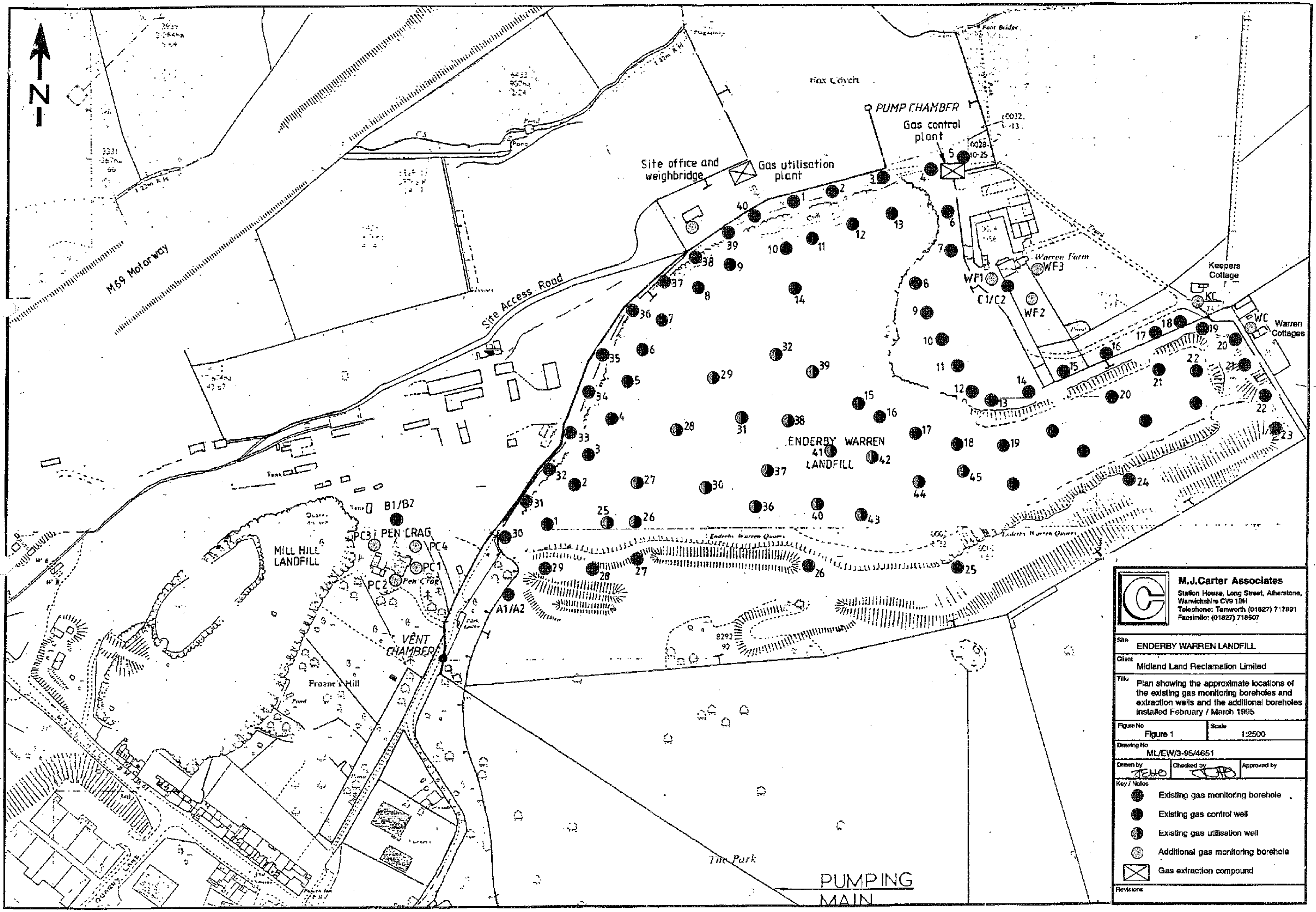
PROJECTION: British National Grid

Path: \\uklonsv04\Data\Manchester\Projects\0417675 Enderby Relief Road.CR\001_Dwgs\GIS\MAPS\Option8bv2\0417675_GasExtraction_LeachateTreatment_Option8bv2_A01.mxd



Path: \\uklonsv04\Data\Manchester\Projects\0417675 Enderby Relief Road.CR\001_Dwgs\GIS\MAPS\Option8bv2\0417675_EnderbyReliefRoad_Option8bv2_A01.mxd

APPENDIX B EWL BOREHOLE LOG EXTRACTS


N
M69 Motorway
Site Access Road
Site office and weighbridge
Gas utilisation plant
PUMP CHAMBER
Gas control plant
Fox Covert
Foot Bridge
Warren Farm
WF1
WF2
WF3
C1/C2
Keepers Cottage
KC
WC
Warren Cottages
ENDERBY WARREN LANDFILL
Enderby Warren Quarry
MILL HILL LANDFILL
PEN CRAG
Pen Crag
B1/B2
PC1
PC2
PC3
PC4
A1/A2
VENT CHAMBER
Froane's Hill
The Park
PUMPING MAIN
M.J.Carter Associates
Station House, Long Street, Atherstone, Warwickshire CV9 1BH
Telephone: Tamworth (01827) 717891
Facsimile: (01827) 718507
Site
ENDERBY WARREN LANDFILL
Client
Midland Land Reclamation Limited
Title
Plan showing the approximate locations of the existing gas monitoring boreholes and extraction wells and the additional boreholes installed February / March 1995
Figure No
Figure 1
Scale
1:2500
Drawing No
ML/EW/3-95/4651
Drawn by
Checked by
Approved by
Key / Notes
Existing gas monitoring borehole
Existing gas control well
Existing gas utilisation well
Additional gas monitoring borehole
Gas extraction compound
Revisions

Site Investigation Services

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TAMROCK DRILL OPEN HOLE

Daily Site Report

Borehole No. 1

Site Name ..... WARREN COTTAGES ENDERBY WARREN ..... Day WEDNESDAY Date 1-3-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	SPT 75 mm	SPT 75 mm	SPT 75 mm	SPT 75 mm	SPT 75 mm	SPT 75 mm
At start of days boring														
CLAY & SAND &	0.0													
GRANIT BOULDER FILL	1.80													
HARO MARL.	2.00													
HARO GRANITE	4.80													
At end of days boring	10.0		Is borehole completed Yes/No											

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	Boring/Casing Depth to m	Boring mm dia.	Casing mm. dia.
Water struck at									
Rose to									
Sealed off at									
Water added from									
Water added to							Were Piezometers Installed Yes/No		

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No..... TOTAL TIME			

CREW NAMES 1. 2.

REMARKS:— (Delays, weather, details of Standpipes etc.)

Signed S. BARTLE

SITE INVESTIGATION SERVICES
4, HIGH STREET,
FILLINGHAM, NR. GAINSBOROUGH
LINCOLNSHIRE DN21 5BW
TELEPHONE: 0427 668458 FAX: 0427 668077

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Daily Site Report

Borehole No. 1 OPEN HOLE + CORING.

Site Name KEEPERS COTTAGE Day MONDAY Date 27.2.95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	75 mm	75 mm	75 mm	75 mm	75 mm	75 mm
At start of days boring														
OPEN HOLE MADE UP	0.0													
SOFT BROWN SILTY MARLSTONE	0.50													
ROCK BAND	2.00													
VERY WEAK RED/BROWN SILTY MUDSTONE	2.10													
CORING 4½" AIR FLUSH														
1ST CORE 1.50 - 3.00 (1.30)														
2ND CORE 3.00 - 4.50 (NIL)														
At end of days boring	4.50		Is borehole completed											Yes/No

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm
Water struck at						
Rose to						
Sealed off at						
Water added from						
Water added to						

Boring/Casing	Depth to m	Boring mm dia.	Casing mm. dia.

Were Piezometers Installed Yes/No

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2.

REMARKS:– (Delays, weather, details of Standpipes etc.)

Signed .....

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Daily Site Report

Borehole No. 1A open hole 150 mm

Site Name KIRKPEAN COTTAGE Day TUESDAY Date 28-2-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm
At start of days boring														
SOIL & GRANITE BOULDERS	0.0													
SOFT BROWN SILTY MARL & CLAY	0.80													
SOFT RED/BROWN SANDY SILTY MARL.	1.20													
STIFF RED VERY SILTY SHALEY MARL.	2.70													
VERY WEAK GREY/RED VERY SILTY MARL HARD GRANITE.	3.70													
	4.80													
At end of days boring	12.0		Is borehole completed											Yes/NO

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	Boring/Casing Depth to m	Boring mm dia.	Casing mm. dia.
Water struck at									
Rose to									
Sealed off at									
Water added from									
Water added to							Were Piezometers Installed Yes/No		

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		
CREW NAMES 1.			
2.			
3.			

REMARKS:— (Delays, weather, details of Standpipes etc.)

Signed .....

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Daily Site Report

Borehole No. / TAMROCK DRILL OPEN HOLE

Site Name FARM YARD ENDERBY WARREN Day TUESDAY Date 28-2-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm
At start of days boring														
RED CLAY & SILTY SANDY MARL	0.0													
WEAK RED/BROWN & GREY SILTY MARL WITH SOFTER BANDS	5.00													
At end of days boring	20.0		Is borehole completed				Yes/No							

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	Boring/Casing Depth to m	Boring mm dia.	Casing mm. dia.
Water struck at	NONE								
Rose to									
Sealed off at									
Water added from									
Water added to							Were Piezometers Installed Yes/No		

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

Signed Rex. BATTLE.

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4, HIGH STREET,
FILLINGHAM, NR. GAINSBOROUGH
LINCOLNSHIRE DN21 5BW
TELEPHONE: 0427 668458 FAX: 0427 668077

Site Investigation Services

Member of the British Drilling Association. All drillers accredited.

Daily Site Report

Borehole No. 1A OPEN HOLE CORING 4½"

Site Name FARM HOUSE ENDSLEY WARREN Day MONDAY Date 6-3-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	75 mm	75 mm	75 mm	75 mm	75 mm
At start of days boring													
OPEN HOLE 125 mm.													
TOP SOIL	0.10												
SOFT BROWN SANDY SILTY	0.30												
MARL													
STIFF BROWN SILTY MARL MIXED	1.00												
WITH A LITTLE GRAVEL.													
STIFF REDDISH BROWN SILTY	3.50												
MARL													
CORING 4½" AIR FLUSH													
1ST RUN 3.50 - 4.00 NO RECOVERY													
At end of days boring	4.00		Is borehole completed Yes/No										

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm
Water struck at						
Rose to						
Sealed off at						
Water added from						
Water added to						

Boring/Casing	Depth to m	Boring mm dia.	Casing mm. dia.

Were Piezometers Installed Yes/No

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

DAYWORKS

DISMANTLE RIG & EQUIPMENT TO MOVE TO PENN CRAFT TO DRILL OUT & CLEAN & FLUSH OUT B/HOLE FOR B/HOLE CAMERA 10.30 – 15.30 5 HOURS

Signed E Gomm

SITE INVESTIGATION SERVICES
4, HIGH STREET,
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LINCOLNSHIRE DN21 5BW
TELEPHONE: 0427 668458 FAX: 0427 668077

Site Investigation Services

Member of the British Drilling Association. All drillers accredited.

Daily Site Report

Borehole No. 1A ROTARY CORING 412F

Site Name FARMHOUSE ENDSLEY LONDON Day TUESDAY Date 7-3-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	75 mm	75 mm	75 mm	75 mm	75 mm	75 mm
At start of days boring														
OPEN OUT HOLE BY REAMERING TO 6" DIAM 0 – 4·50.			Co		CORING			412 F AIR FLUSH						
VERY WEAK RED & GREY SILTY MARL.	4·50				2ND CORE			4·50 - 6·00 (0·35)						
					3RD CORE			6·0 - 7·50 (NIL)						
					4TH CORE			7·50 - 9·00 (NIL)						
STRONG LT GREY MUDSTONE	9·00				5TH CORE			9·00 - 10·50 (1·10)						
WEAK RED/BROWN MUDSTONE	10·0				6TH CORE			10·50 - 12·00 (0·90)						
WITH SOFT SILTY BANDS.					7TH CORE			12·0 - 13·50 (1·35)						
STRONG RED/BROWN MUDSTONE (FISSURED & BROKEN)	15·00				8TH CORE			13·50 - 15·00 (1·20)						
					9TH CORE			15·00 16·20 (1·20) BLOCKAGE						
DARK BROWN SILTY SANDY CLAY	17·00													
STRONG BROWN & GREEN MUDSTONE	18·20	APPROX			10TH CORE			16·20 - 17·50 (1·20)						
					11TH CORE			17·50 - 18·50 (1·0) BLOCKAGE						
					12TH CORE			18·50 - 20·0 (1·50)						
At end of days boring	20·0		Is borehole completed					Yes/No						

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	Boring/Casing Depth to m	Boring mm dia.	Casing mm. dia.
Water struck at	NO'								
Rose to									
Sealed off at									
Water added from									
Water added to							Were Piezometers Installed	Yes/No	

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

DAYWORKS CLEAN DOWN & WASH FARMYARD = 1½ HOURS

REAMER OUT 0 – 4·50 = ½ HOUR.

Signed E Gray

SITE INVESTIGATION SERVICES
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FILLINGHAM, NR. GAINSBOROUGH
LINCOLNSHIRE DN21 5BW
TELEPHONE: 0427 668458 FAX: 0427 668077

Garden - orchard?

Site Investigation Services

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Tamrock Drill Open Hole

Daily Site Report

Borehole No. 2

Site Name FARM YARD ENDSBY LOAMS Day MONDAY Date 1-3-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	SPT 75 mm	SPT 75 mm	SPT 75 mm	SPT 75 mm	SPT 75 mm	SPT 75 mm
At start of days boring														
SOFT RED/GREY SILTY MARL	0.0													
STIFF RED/GREY SILTY MARL	2.50													
WEAK LT BROWN & GREY MUDSTONE	4.50													
HARD GRANITE	11.0													
At end of days boring	16.0		Is borehole completed Yes/No											

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm
Water struck at	No					
Rose to						
Sealed off at						
Water added from						
Water added to						

Boring/Casing	Depth to m	Boring mm dia.	Casing mm. dia.

Were Piezometers Installed Yes/No

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

Signed Gary Bates

SITE INVESTIGATION SERVICES
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Daily Site Report

Borehole No. 2A CORING 412F

Site Name FARMHOUSE ENOUGH LINCS Day WEDNESDAY Date 8-3-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	75 mm	75 mm	75 mm	75 mm	75 mm
At start of days boring													
OPEN HOLE TOP SOIL	0.0												
FIRM BROWN SILTY CLAY	0.30			CORING 412F AIR FOAM.									
STIFF RED BROWN SILTY SANDY	2.00												
MARL & PEBBLES			1ST CORE FROM					2.50 – 3.30					(NIL)
GRANITE (POSSIBLE BOULDER)	4.30		2ND CORE FROM					3.30 – 4.70					(1.30)
VERY WEAK RED/GREY SILTY	4.70		3RD CORE FROM					4.70 – 6.20					(0.79)
MARL			4TH CORE FROM					6.20 – 7.70					(1.10)
SOFT BROWN VERY SANDY MARL	7.00		5TH CORE FROM					7.70 – 9.20					(1.20)
STRONG RED/BROWN MUDSTONE	7.40		6TH CORE FROM					9.20 – 10.20					(0.40)
HARD GREY/BROWN MUDSTONE	9.00												
WEAK/SOFT BECOMING DRILLING	9.30												
POSSIBLE SAND/GRAVEL (WEATHERED GRANITE)													
HARD GRANITE.	10.0												
At end of days boring			Is borehole completed										Yes/No

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm
Water struck at	NONE					
Rose to						
Sealed off at						
Water added from						
Water added to						

Boring/Casing	Depth to m	Boring mm dia.	Casing mm. dia.
Were Piezometers Installed Yes/No			

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

RIG STANDING WAITING FOR FARMER TO MOVE RIG TO NEXT B/HOLE 1200 TO 13.30 HOURS

Signed .....

SITE INVESTIGATION SERVICES
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Site Investigation Services

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Daily Site Report

Borehole No. 3 CORING 4½F

Site Name FARMHOUSE ENDSLEY LOVERSN Day WEDNESDAY Date 8-3-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm
At start of days boring														
HAND DUG TRIAL HOLE TO 1·0M														
TOP SOIL	0·0													
SOFT BROWN SILTY MARL WITH SMALL GRANITE COBBLES	0·35													
				CORING 4½F AIR FOAM										
STIFF RED/BROWN VERY SANDY MARL	1·00			1ST CORE FROM 2·50 - 4·00 (1·30)										
VERY SOFT SANDY CLAY (STICKY)	4·00			2ND CORE FROM 4·00 - 5·50 (NIL)										
STRONG RED/GREY MUDSTONE	5·30			3RD CORE FROM 5·50 - 7·00 (1·50)										
At end of days boring	7·00		Is borehole completed Yes/No											

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	Boring/Casing Depth to m	Boring mm dia.	Casing mm. dia.
Water struck at	NONE								
Rose to									
Sealed off at									
Water added from									
Water added to							Were Piezometers Installed Yes/No		

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

DAYWORKS HAND DIG TRIAL HOLE - 1HOUR

Signed .....

SITE INVESTIGATION SERVICES
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Daily Site Report

Borehole No. 3 Rotary Cores

Site Name FARM HOUSE ENDERBY WARREN Day THURSDAY Date 9-3-95

Description of Strata	Depth	Depth of Casing
At start of days boring	7.00	NONE
CORING 412F AIR FOAM.		
4TH CORE 7 - 8.50 (1.50)		
5TH CORE 8.50 - 10.0 (1.50)		
6TH CORE 10.0 - 11.50 (1.0)		
7TH CORE 11.50 - 13.0 (1.35)		
8TH CORE 13.0 - 14.50 (1.20)		
9TH CORE 14.50 - 16.0 (1.20)	FINISHED CORING	
WEAK RED/BROWN MUDSTONE	7.00	
VERY WEAK & FRIABLE MUDSTONE	10.80	
WEAK RED/BROWN MUDSTONE	11.0	
WEATHERED GRANITE/GRAVEL	15.80	
HARD GRANITE	16.40	
HARD RED/BROWN MUDSTONE	17.70	VERY SILTY RETURNS
HARD GRANITE	18.50	CLEAN RETURN
At end of days boring	20.0	

Depth (Samples/ SPT's) From (m)	To	Samples No.	Type	No. of Blows	Standard Penetration Test 0-150 mm	150-225 mm	225-300 mm	300-375 mm	375-450 mm	450-525 mm	75 mm
	CARRIES										
	RECEIVED										
	17 MAR 95										
	ACTION										
	CIRCULATE & TEST										
	THANKS TO ROCK HAMMER										
	OPEN HOLE										

Is borehole completed Yes/No

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm
Water struck at						
Rose to						
Sealed off at						
Water added from						
Water added to						

Boring/Casing		
Depth to m	Boring mm dia.	Casing mm. dia.

Were Piezometers Installed Yes/No

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

WAITING FOR TRACTOR TO PULL RIG OUT OF FIELD = 1 HOUR.

Signed .....

SITE INVESTIGATION SERVICES
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OPEN HOLE
6" ROCK HAMMER

Daily Site Report

Borehole No. 1

Site Name PENN CRASS ENDERBY WARREN Day THURSDAY Date 23-2-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm
At start of days boring														
GRAVEL/SAND/STONE FILL	0.0													
BROWN MARL	1.00													
HARD GRANIT	1.40													
WEAK BAND OR FISSULE	3.00													
HARD GRANIT	3.10													
VERY HARD	8.20	SLOW PROGRESS REDUCE TO 100MM												
		DRILL WITH 100 MM THEN REAMM OUT TO 6"												
At end of days boring	10.0		Is borehole completed				Yes/No							

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm
Water struck at	9.50					
Rose to	/					
Sealed off at						
Water added from						
Water added to						

Boring/Casing		
Depth to m	Boring mm dia.	Casing mm. dia.

Were Piezometers Installed Yes/No

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

ESTABLISH B/HOLE POSITIONS = 1 HOUR
REAMM OUT FROM 100MM TO 1.50 MM 2 HOURS
SUPPLY & CASE OFF WITH 5" WELL PIPE 1.50 METRES

Signed .....

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Daily Site Report

Borehole No. 2 OPEN HOLE 150MM ROCK HOLE

Site Name PENN CRASS ENDERBY WARREN Day FRIDAY Date 24-2-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm
At start of days boring														
GRAVEL TO SAND & GRANITE CHIPS	0.0													
HARD GRANIT	07.0													
VERY HARD ROCK	7.50													
		REDUCE TO 100MM DIAM												
		REAM OUT TO 150MM												
At end of days boring	10.0	1.0	Is borehole completed											Yes/No

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	Boring/Casing Depth to m	Boring mm dia.	Casing mm. dia.
Water struck at	3.50	STRONG.							
Rose to									
Sealed off at									
Water added from									
Water added to									
							Were Piezometers Installed Yes/No		

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES
1.
2.
3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

UNABLE TO START RIG & COMPRESSOR TILL 0930 HOURS REQUESTED BY TENNANT = 1½ HOURS

REAMED OUT 100MM TO 150MM = 2 HOURS

SUPPLY & INSTALL CASING TO 1.0M

Signed .....

SITE INVESTIGATION SERVICES
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Daily Site Report

Borehole No. 3 TAMROCK OPEN HOLE 150m

Site Name PENN CROSS ENDSLEY WARREN Day TUESDAY Date 28-2-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	75 mm	75 mm	75 mm	75 mm	75 mm	75 mm
At start of days boring														
CHIPPINGS & SOIL	0.0													
HARD GRANITE	0.50													
At end of days boring	10.0		Is borehole completed				Yes/No							

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	Boring/Casing Depth to m	Boring mm dia.	Casing mm. dia.
Water struck at	3.50								
Rose to									
Sealed off at									
Water added from									
Water added to							Were Piezometers Installed Yes/No		

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:– (Delays, weather, details of Standpipes etc.)

DAMAGED REMOVE FENCING HOLE RIG + COMPRESSOR = 1½ HOURS

Signed .....

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TAMROCK ROTARY OPEN HOLE 150 MM

Daily Site Report

Borehole No 4

Site Name PENN CROSS ENDERBY LEICESTER Day MONDAY Date 27-2-95

Description of Strata	Depth	Depth of Casing	Depth (Samples/ SPT's) From m	Depth (Samples/ SPT's) To m	Samples Ref. No.	Samples Type	Samples No. of Blows	Standard Penetration Test C or S	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm	Standard Penetration Test 75 mm
At start of days boring													
GRASS TO CLAY STONES	0·0												
METAL FILL													
VERY WEAK RED/BROWN SANDY MARL	2·00												
HARD GRANITE.	3·30												
At end of days boring	10·0		Is borehole completed Yes/No										

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	Boring/Casing Depth to m	Boring mm dia.	Casing mm. dia.
Water struck at	NONE								
Rose to									
Sealed off at									
Water added from									
Water added to							Were Piezometers Installed Yes/No		

Details of time spent	From	To	Time Hours
CHISELLING Etc (Details in "remarks")	m	m	
	m	m	
	m	m	
Awaiting Instructions	am pm	am pm	
Moving Position	BH.	BH.	
Piezometers/Standpipes (Details in "remarks")			
Rain/Breakdowns (Delays) " " "			
Boring (Including Casing and Sampling)			
Vehicle No.....	TOTAL TIME		

CREW NAMES 1. 2. 3.

REMARKS:— (Delays, weather, details of Standpipes etc.)

Signed .....

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4, HIGH STREET,
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SOUTH TYNE DRILLING — DAILY DRILL LOG — No. 2606

LOCATION ENDERBY	RIG No. STD 1.	BH No.	
CONTRACT No.	VEHICLE No. L757 JFU	DIAMETER	
TYPE OF DRILLING AUGERING	CREW T. MCCRINDLE	ANGLE	
DATE 16 - 12 94 FRI	T. DEAN	CASING DIAMETER	

OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION
		MOBILISED		DRILLING		RIG
	AND		EQUIPMENT			TO
	ENDERBY		WARREN		LANDFILL	SITE.

WATER LEVEL RECORDS

TIME				
DEPTH	OF HOLE			
	OF CASPING			
	OF WATER			

INSTALLATION DETAILS

INSTALLATION		
DRILLING		
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
BENTONITE		

SIGNED – CLIENTS REPRESENTATIVE

SIGNED – DRILLER T. MacCrindle

SOUTH TYNE DRILLING DAILY DRILL LOG No. 2607

LOCATION ENDERBY	RIG No. STD L	BH No. 1A
CONTRACT No.	VEHICLE No. L757 JFM	DIAMETER 12"
TYPE OF DRILLING AUGERING	CREW J. MACRINDLE	ANGLE 'V'
DATE 19-12-94 MON	T. DEAN	CASING DIAMETER

OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION
	MOVED		TO	B/H 1A		
AUGERING	12"	0-00	12.50	12.50		WASTE DRY
		12.50	—	—		OBSTRUCTION.
		B/H	ABANDONED			

WATER LEVEL RECORDS

TIME				
DEPTH	OF HOLE			
	OF CASP:G			
	OF WATER			

INSTALLATION DETAILS

INSTALLATION	—	
DRILLING	12.50 MT	
OBSTRUCTION	—	
MOVE & SET UP	1 MOVE	
STANDING	—	
CASING	—	
BENTONITE	—	

SIGNED – CLIENTS REPRESENTATIVE

SIGNED – DRILLER T. MacCrindle

SOUTH TYNE DRILLING DAILY DRILL LOG No. 2608

LOCATION	ENDERBY	RIG No.	STD 1.	BH No.	11.
CONTRACT No.		VEHICLE No.	L 267 JFU	DIAMETER	12"
TYPE OF DRILLING	AUGERING	CREW	J. MCCRINDLE	ANGLE	V
DATE	14-12-96 MON		T. DEAN	CASING DIAMETER	—

OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION
		MOVE	TO	B/H 11		
AUGERING	12"	0-00	22-00	22-00		WASTE (DRY)
		22-00	26-00	4-00		WASTE (DAMP)
		26-00	30-00	4-00		WASTE (WET)
		B/H	COMPLETE			
		INSTALLED	30 MTS OF			6" PIPE
		"	GRAVEL			
		"	BENTONITE			

WATER LEVEL RECORDS

TIME				
DEPTH OF HOLE				
DEPTH OF CASP:G				
DEPTH OF WATER				

INSTALLATION DETAILS

INSTALLATION	30 MTS	
DRILLING	30 MTS	
OBSTRUCTION	—	
MOVE & SET UP	1 MOVE	
STANDING	—	
CASING (AUTO)	29 MTS	
BENTONITE	2 BAGS	

SIGNED – CLIENTS REPRESENTATIVE

SIGNED – DRILLER T. Dean

SOUTH TYNE DRILLING DAILY DRILL LOG No. 2609

LOCATION ENDERBY	RIG No. STD 1	BH No. 2
CONTRACT No.	VEHICLE No. L757 JFU	DIAMETER 12"
TYPE OF DRILLING AUGERING	CREW J. McCRINDLE	ANGLE V
DATE 20-12-94 TUES	T. DEAN	CASING DIAMETER —

OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION
	MOVED		TO	B/H	2	
AUGERING	12"	0.00	8.50	8.50		WASTE (DRY)
		8.50	24.50	16.00		WASTE (WET)
		24.50	—	—		OBSTRUCTION.
		B/H	COMPLETE.			
	INSTALLED			22 MTS		OF 6" PIPE.
	"			GRAVEL		
	"			1 MT		BENTONITE.

WATER LEVEL RECORDS				
TIME				
DEPTH OF HOLE				
DEPTH OF CASP:G				
DEPTH OF WATER				

INSTALLATION DETAILS

INSTALLATION	22 MTS	
DRILLING	24.50 MTS	
OBSTRUCTION	—	
MOVE & SET UP	1 MOVE	
STANDING	—	
CASING GRAVEL	21 MTS	
BENTONITE	2 Bags.	

SIGNED – CLIENTS REPRESENTATIVE

SIGNED – DRILLER S. McCrindle

SOUTH TYNE DRILLING DAILY DRILL LOG No. 2611

LOCATION ENDERBY	RIG No. STD 1	BH No. 4
CONTRACT No.	VEHICLE No. L 757 JFU	DIAMETER 12"
TYPE OF DRILLING AUGERING	CREW J. McCRINDLE T. DEAN	ANGLE 'V'
DATE 21-12-94 WED		CASING DIAMETER

OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION
		MOVED	TO	B/H 4.		
AUGERING	12"	0.00	20.00	20.00		WASTE (DRY)
		20.00	27.00	7.00		WASTE (WET)
		27.00	—	—		OBSTRUCTION.
		B/H	COMPLETE.			
		INSTALLED		27 MTS	OF	6" PIPE
		"		GRAVEL		
		"		1 MT	OF	BENTONITE

WATER LEVEL RECORDS				
TIME				
DEPTH	OF HOLE			
	OF CASP:G			
	OF WATER			

INSTALLATION DETAILS

INSTALLATION	27 MTS	
DRILLING	27 MTS	
OBSTRUCTION	—	
MOVE & SET UP	1 MOVE	
STANDING	—	
CASING	—	
BENTONITE	2 BAGS	

SIGNED – CLIENTS REPRESENTATIVE

SIGNED – DRILLER J. McCrindle

SOUTH TYNE DRILLING — DAILY DRILL LOG — No. 2612

LOCATION	ENDERBY	RIG No.	STD 1.	BH No.	5
CONTRACT No.		VEHICLE No.	L 757 JFU	DIAMETER	12"
TYPE OF DRILLING	AUGERING	CREW	J. MCCRINDLE	ANGLE	'V'
DATE	21-12-94 WED		T. DEAN	CASING DIAMETER	—

OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION
	MOVED	TO	B/H 5			
AUGERING	12"	0.00	19.50	19.50		WASTE (DRY)
		19.50	24.50	5.00		WASTE (WET)
		24.50	30.00	5.50		SLURRY WASTE
		B/H	COMPLETE.			
	INSTALLED	30 MTS	OF	6" PIPE		
		GRAVEL				
		1 MT OF	BENTONITE			

WATER LEVEL RECORDS

TIME				
DEPTH	OF HOLE			
	OF CASP:G			
	OF WATER			

INSTALLATION DETAILS

INSTALLATION	30 MTS	
DRILLING	30 MTS	
OBSTRUCTION	—	
MOVE & SET UP	1 MOVE	
STANDING	—	
CASING	—	
BENTONITE	2 BAGS	

SIGNED – CLIENTS REPRESENTATIVE

SIGNED – DRILLER

SOUTH TYNE DRILLING DAILY DRILL LOG No. 2616

LOCATION	ENDERBY	RIG No.	STD. 1.	BH No.	7
CONTRACT No.		VEHICLE No.	L 757 JFU	DIAMETER	12"
TYPE OF DRILLING	AUGERING	CREW	J. McCRINDLE	ANGLE	'V'
DATE	10-1-95 / TUES		T. DEAN	CASING DIAMETER	—

OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION
		MOVED TO B/H 7				
AUGERING	12"	0·00	20·50	20·50		WASTE (DRY)
		20·50	28·00	7·50		WASTE (WET)
		28·00	—	—		OBSTRUCTION.
		B/H	COMPLETE.			
	INSTALLED	22 MTS	OF			6" PIPE
		11		GRAVEL		
		11		2 Bags		BENTONITE

WATER LEVEL RECORDS

TIME				
DEPTH	OF HOLE			
	OF CASP:G			
	OF WATER			

INSTALLATION DETAILS

INSTALLATION	22 MTS	
DRILLING	28 MTS	
OBSTRUCTION	—	
MOVE & SET UP	1 MOVE	
STANDING	—	
CASING	—	
BENTONITE	2 Bags	

SIGNED – CLIENTS REPRESENTATIVE

SIGNED – DRILLER

SOUTH TYNE DRILLING — DAILY DRILL LOG — No. 2618

LOCATION	ENDERBY	RIG No.	STD 1	BH No.	8
CONTRACT No.		VEHICLE No.	L 757 JFH	DIAMETER	12"
TYPE OF DRILLING	AUGERING	CREW	J. MCCRINDLE	ANGLE	'V'
DATE	11-1-95 / WED		T. DEAN	CASING DIAMETER	—

OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION
		MOVED	TO	B/H 8		
AUGERING	12"	0-00	19-00	19-00		WASTE (DRY)
		19-00	22-00	3-00		WASTE (DAMP)
		22-00	26-00	4-00		WASTE (WET)
		26-00	—	—		OBSTRUCTION
		B/H	COMPLETE			
		INSTALLED	27	MTS		OF 6" PIPE
		11	GRAVEL			
		2	2 BAGS			BENTONITE

WATER LEVEL RECORDS

TIME				
DEPTH	OF HOLE			
	OF CASP:G			
	OF WATER			

INSTALLATION DETAILS

INSTALLATION	27 MTS	
DRILLING	26 MTS	
OBSTRUCTION	—	
MOVE & SET UP	1 MOVE	
STANDING	—	
CASING	—	
BENTONITE	2 BAGS	

SIGNED – CLIENTS REPRESENTATIVE

SIGNED – DRILLER

Boreholes

1 — 40

1990

SOUTH TYNE DRILLING

DAILY DRILL LOG

63

(94)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 10
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE T. DEAN.	ANGLE
DATE 23-2-90 FRI		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	DUG	LMT	Trial	PIT	for Service
		WITH	Pneumatic	Drill.	
O/H	4½"	G/L	1.50	1.50	Topsoil, hardcore Granite Boulders.
		1.50	90.00	88.50	GRANITE.
		B/H	COMPLETE.		
	INSTALLED		87	MTS.	OF SLOTTED PIPE
	IN		3	MTS	OF PLAIN PIPE
			1	MT	BENTONITE SEAL
		CEMENT	B/H	COVER	IN
		Reinstated	Highway.		

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	Water	AT	33.00	MTS.
DEPTH OF WATER				

CASED TO 1.50 MTS

	FROM	TO
DRILLING	90.00 MTS	
OBSTRUCTION		
MOVE & SET UP		
~~STANDING~~ TRIAL PIT	1	
CASING	1.50 MTS	
~~DELAYS~~ INSTAL	90 MTS.	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

SOUTH TYNE DRILLING DAILY DRILL LOG 58 2(95)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 11
CONTRACT No.	VEHICLE No.	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE	ANGLE
DATE 22-2-90 / THURS	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	DUG WITH	1 MT	Trial Pneumatic Drill		Pit for Service.
O/H	4½	G/L	1.50	1.50	Tramac Hardware, Granite Boulders.
		1.50	100.00	98.50	GRANITE
		B/H COMPLETE.			
	INSTALLED			97	MTS OF SLOTTED PIPE.
				2	MTS OF PLAIN PIPE
				1	MT BENTONITE SEAL
		CEMENT B/H COVER.			
		Reinstated Highway.			
	MOVED TO	B/H 10			

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE	WET AT 30 MTS.		
	OF CASING	WATER AT 40 MTS.		
	OF WATER			

CASED TO 1.50 MTS

B/H WAS CUTTING DRY BELOW 41 MTS.
B/H STICKING.

	FROM	TO
DRILLING	100.00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + ROAD SIGN	
~~STANDING~~ Trial PIT	1	
CASING	1.50 MTS.	
~~DELAYS~~ INSTALL	99.00 MTS.	

Sheet 2 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER S. McCrindle.

SOUTH TYNE DRILLING

DAILY DRILL LOG

3 (96)

57

LOCATION ENDERBY/WARREN	RIG No. GRYPHON	BH No. 12.
CONTRACT No.	VEHICLE No.	DIAMETER 4 3/4"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE T. DEAN	ANGLE
DATE 22-2-90 / THURS		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		B/H	COMPLETE	AT 88.00 MTS.	
		INSTALLED	76 MTS	OF ~~PLAIN~~ SLOTTED PIPE.	
		"	3 MTS	OF PLAIN PIPE.	
			1 MT.	BENTONITE SEAL	
		CEMENT	B/H	COVER IN.	
		REINSTATED		HIGHWAY.	
		MOVED	TO	B/H 11	

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

	FROM	TO
DRILLING		
OBSTRUCTION		
MOVE & SET UP	I MOVE + ROAD SIGN	
STANDING		
CASING		
~~DELAYS~~ INSTALL	79 MTS.	

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

55

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 12.
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE.	ANGLE
DATE 21-2-90 / WED.	T. DEAN.	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		MOVED FROM B/H 27 TO B/H 12			
		Dug 1 MT. Trial Pit for SERVICES. WITH PNEUMATIC DRILL			
O/H	4¼	G/L	1-80	1-80	Tarmac, Hardcore, GRANITE BOULDERS
		1-80	88-00	86-20	GRANITE.
		B/H INCOMPLETE.			

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE	B/H WET AT 38.00 MTS			
DEPTH OF CASING				
DEPTH OF WATER	HEAVY WATER AT 52 MTS.			

CASED TO 2.00 MTS

B/H, VERY SOFT AND CAVING IN AT ABOUT 70.00 MTS.

Rods Fast in B/H 2 hrs. Getting rods out of B/H.

INSTALLATION DETAILS

	FROM	TO
DRILLING	88-00 MTS.	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + ROAD SIGNS	
~~STANDING~~ TRIAL PIT	1	
CASING	2.00 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER T. M. McC

SOUTH TYNE DRILLING

DAILY DRILL LOG

64

4 (98)

LOCATION ENDERBY WARREN	RIG No. DANDO	BH No. 13.
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE T. DEAN I. GIBB. J. BROGAN	ANGLE
DATE 21-2-90 SAT		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4 1/4"	33.00	100.00	77.00	GRANITE.
		B/H COMPLETE.			
	INSTALLED			97 MTS	OF SLOTTED PIPE
	1"			3 MTS	OF PLAIN PIPE
				1 MT	BENTONITE SEAL
		CEMENT		B/H	COVER IN.

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	WATER	AT	65.00 MTS	
DEPTH OF WATER				

INSTALLATION DETAILS

	FROM	TO
DRILLING	77.00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
~~DELAYS~~ INSTALL	100.00 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

(99)

SOUTH TYNE DRILLING

DAILY DRILL LOG

62

LOCATION ENDERBY/WARREN	RIG No. DANDO	BH No. 13
CONTRACT No.	VEHICLE No.	DIAMETER 4½
TYPE OF DRILLING ROTARY.	CREW J. MCCRINDLE T. DEAN J. BROGAN I. GIBB.	ANGLE
DATE 23-2-90 FRI		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½	G/L	1.50	1.50	MADE UP GROUND.
		1.50	33.00	31.50	GRANITE
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING				
DEPTH OF WATER				

CASED TO 1.50 MTS

INSTALLATION DETAILS

	FROM	TO
DRILLING	33.00	MTS
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	1.50	MTS
DELAYS		

Sheet 2 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

92

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 14A
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. MCCRINOLE. T. DEAN	ANGLE
DATE 23-3-90 FRI		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼"	35-00	100-00	65-00	GRANITE.
		B/H COMPLETE.			
INSTALLED			97 MTS OF SLOTTED PIPE		
			3 MTS OF PLAIN PIPE		
			1 MT BENTONITE SEAL		
		CEMENTED IN B/H COVER.			
6 hrs Standing Time					

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING	B/H WET AT	53-00 MTS	
	OF WATER			

	FROM	TO
DRILLING	65-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING	6 hrs -	
CASING		
DECARS HISTAU	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED DRILLER

SOUTH TYNE DRILLING

DAILY DRILL LOG

91

(101)

LOCATION ENDERBY / WARREN	RIG No. GRAHON.	BH No. 14A
CONTRACT No.	VEHICLE No. F331 KTN.	DIAMETER 4¼
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE. T. DEAN.	ANGLE
DATE 22-3-90 THURS		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVED FROM B/H 35 to B/H 14A					
O/H	4¼	G/L	1·20	1·20	Hardware and Bottle Plug.
		1·20	~~35~~·00	~~33~~·80	GRANITE.
		B/H	INCOMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

Jimmy damaged beyond repair 1 no. 8 bit. Any chance of recompense? £200 approx

CASED TO 1·50 MTS.

Broken granite from 31 MTS TO 33 MTS.

Replacing abandoned Hole.

Sheet 2 of 2.

	FROM	TO
DRILLING	35·00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING		
CASING	1·50	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

6 (102)

59

LOCATION ENDERBY/WARREN	RIG No. DANDO.	BH No. 15.
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE. T. DEAN. J. BROGAN I. GIBB.	ANGLE
DATE 22-2-90 / THURS		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼"	72.00	100.00	28.00	GRANITE.
		B/H COMPLETE.			
	INSTALLED			97 MTS	OF SLOTTED PIPE
	"			3 MTS	OF PLAIN PIPE
				1 MT	BENTONITE SEAL
		CEMENTED			B/H COVER
		MOVED	TO		B/H 14.

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

Sheet 1 of 2.

	~~FROM~~	~~TO~~
DRILLING	28.00	MTS
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING		
CASING		
~~DELAYS~~ INSTAL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER T. McCrindle

(103)

SOUTH TYNE DRILLING

DAILY DRILL LOG

56

LOCATION FENDERBY / WARREN	RIG No. DANDO	BH No. 15
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE. T. DEAN. J. BROGAN I. GIBB.	ANGLE
DATE 21-2-90 WED		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½	G/L	3-00	3-00	Boulder clay & Mud
		3-00	75-00	72-00	GRANITE.
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

CASED TO 3-00 MT.

INSTALLATION DETAILS

	FROM	TO
DRILLING	75-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	3-00 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER I Mitchell

SOUTH TYNE DRILLING

DAILY DRILL LOG

54

7/104

LOCATION ENDERBY / WARREN	RIG No. DANDO	BH No. 16.
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN J. BROGAN I. GIBB	ANGLE
DATE 20-2-90 TUES		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½	72-00	100-00	28-00	GRANIT.
		B/H	COMPLETE.		
	INSTALLED		97 MTS		OF SLOTTED PIPE
			3 MTS		OF PLAIN PIPE
			1 MT		BENTONITE SEAL
		CEMENTED		B/H	COVER.
	MOVED	TO	B/H	15.	

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

	~~FROM~~	~~TO~~
DRILLING	28-00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING		
CASING		
~~DELAYS~~ INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

52

(105)

LOCATION ENDERBY / WARREN	RIG No. DANDO	BH No. 16
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN, J. BROGAN I. GIBB	ANGLE
DATE 19-7-90 / MON		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4 1/4	G/L	9-00	9-00	BOULDER CLAY & MARL
		9-00	72-00	63-00	GRANITE.
		B/H			INCOMPLETE.

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

CASED TO 9-00 MTS.

	FROM	TO
DRILLING	72-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	9-00 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

(106)

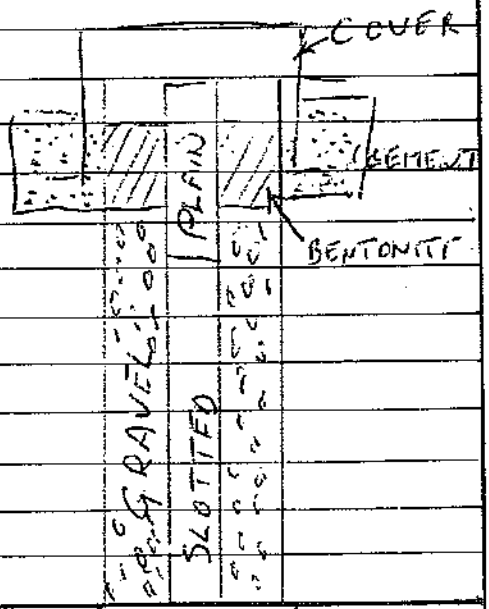
LOCATION ENDERBY / WARREN	RIG No. DANDO	BH No. 17.
CONTRACT No.	VEHICLE No.	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE. T. DEAN. J. BROGAN I. GIBB	ANGLE
DATE 26-2-90 / FRI.		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		INSTALLED		97 MTS	OF SLOTTED PIPE
		"		3 MTS	OF PLAIN PIPE
				1 MT	BENTONITE SEAL
		CEMENTED			B/H COVER.
		MOVED	TO		B/H 16.

WATER LEVEL RECORD

TIME			
DEPTH OF HOLE			
DEPTH OF CASING			
DEPTH OF WATER			

INSTALLATION DETAILS



	FROM	TO
DRILLING		
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING		
CASING		
~~DELAYS~~ INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

48

(107)

LOCATION ENDERBY/WARREN	RIG No. DANDO	BH No. 17
CONTRACT No.	VEHICLE No.	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. DEAN. J. BROGHAN. E. GIBB	ANGLE
DATE 25-2-90 / THURS		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
D/H	4½	40-00	100-00	60.00	GRANITE.
		B/H	COMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING				
DEPTH OF WATER				

INSTALLATION DETAILS

Rig Broken / Down.

	FROM	TO
DRILLING	60-00	MTS.
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

45 (108)

LOCATION ENDERBY / WARREN	RIG No. DANDO	BH No. 17
CONTRACT No.	VEHICLE No.	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN J. BROGAN I. GIBB	ANGLE
DATE 14-2-90 / WED		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½	G/L	11-00	11-00	Top Soil, Boulder Clay & Mud
		11-00	40-00	29-00	GRANITE
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

CASED TO 11-00 MTS

INSTALLATION DETAILS

	FROM	TO
DRILLING	40-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	11-00 MTS	
DELAYS		

Sheet 2 of 2

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

44

9 (109)

LOCATION ENDERBY / WARREN	RIG No. DANDO	BH No. 18
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE T. DEAN - J. BROGAN I GIBB.	ANGLE
DATE 14-2-90 / WED		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		INSTALLED		102	MTS OF SLOTTED PIPE
		"		3	MTS OF PLAIN PIPE
				1	MT BENTONITE SEAL.
		CEMENT			B/H COVER.
		MOVED	TO		B/H 17
		2 hrs	Standing		MACHINE MAKING
		ACCESS	TO		B/H 17.

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

	FROM	TO
DRILLING		
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING	2 hrs.	
CASING		
~~DELAYS~~ INSTALL	105 MTS	

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

41

(110)

LOCATION ENDERBY / WARREN	RIG No. DANDO	BH No. 18
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE T. DEAN / J. BROGAN I. GIBB	ANGLE
DATE 13-2-90 / TUES		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	33-00	105-00	72-00	GRANITE.
		B/H	COMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING	WET AT	65-00	MTS.
	OF WATER			

INSTALLATION DETAILS

	FROM	TO
DRILLING	72-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER

DRILLING

DAILY DRILL LOG

38

(111)

LOCATION ENDERBY / WARREN	RIG No. DANDO	BH No. L8
CONTRACT No.	VEHICLE No.	DIAMETER 6½"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE. T. DEAN. J. BROGAN I. GIBB	ANGLE
DATE 12-2-90 / MON		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	6½	G/L	19-50	19-50	Top Soil, Boulder Clay & red Marl
		19-50	33-00	13-50	GRANITE
		B/H	IN COMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

CASED TO 19-50 MTS.

INSTALLATION DETAILS

	FROM	TO
DRILLING	33.00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	19-50 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. Mccrindle.

(112)

SOUTH TYNE DRILLING

DAILY DRILL LOG

28 10

LOCATION ENDERBY/WARREN	RIG No. DANDO	BH No. 19
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. DEAN. J. BROGAN I. GIBB.	ANGLE
DATE 7-2-90 WED		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¾"	G/L	14.00	14.00	Boulder Clay & Marl.
		19.00	25.00	6.00	GRANITE
		B/H	INCOMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

CASED TO 19-00 MTS.

	~~FROM~~	~~TO~~
DRILLING	25-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	19-00 MTS	
DELAYS		

Sheet 2 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

(113)

SOUTH TYNE DRILLING

DAILY DRILL LOG

30

LOCATION ENDERBY / WARREN	RIG No. DANDO	BH No. 19
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. DEAN. J. BROGAN I. GIBB.	ANGLE
DATE 8-2-90 / THURS		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	25-00	105-00	80-00	GRANITE.
		B/H	COMPLETE.		
		INSTALLATION.			INCOMPLETE

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

	FROM	TO
DRILLING	80-00 MTS.	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

(114)

SOUTH TYNE DRILLING

DAILY DRILL LOG

33

LOCATION ENDERBY/WARREN	RIG No. DANDO		BH No. 19.
CONTRACT No.	VEHICLE No.		DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. DEAN. J. BROGAN F. GIBB		ANGLE
DATE 9-2-90 FRI			CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	INSTALLED			102	MTS OF Slotted Pipe
				3	MTS OF Plain Pipe.
			1 MT		Bentonite Seal.
		Cement	B/H		Cover.
	MOVED	TO	B/H	18.	

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	Water at 85 MTS.			
DEPTH OF WATER				

INSTALLATION DETAILS

	FROM	TO
DRILLING	—	
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING		
CASING		
DELAYS	1.25 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED DRILLER

SOUTH TYNE DRILLING

DAILY DRILL LOG

27

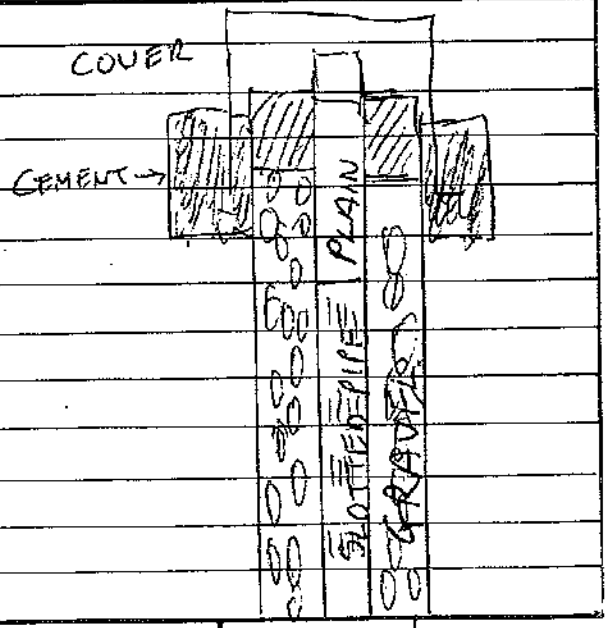
LOCATION ENDERBY/WARREN	RIG No. DANDO	BH No. 20
CONTRACT No.	VEHICLE No.	DIAMETER 4¼
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN J. BROGAN I. GIBB.	ANGLE
DATE 7-2-90 / WED		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	90-00	105-00	15-00	GRANITE
		B/H	COMPLETE.		
	INSTALLED			102 MTS	OF SLOTTED PIPE
				3 MTS	OF PLAIN PIPE
				1 MT.	Bentonite Seal.
		Cement	in.	B/H TOP	
	MOVED	TO	B/H	19.	

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS



	FROM	TO
DRILLING	15 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING		
CASING		
~~DELAYS~~ INSTAL	105 MTS	

Sheet 1 of 2

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. Mccrindle

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SOUTH TYNE DRILLING

DAILY DRILL LOG

26

LOCATION ENDERBY/WARREN	RIG No. DANDO	BH No. 20	
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"	
TYPE OF DRILLING ROTARY	CREW J. M°CRINDLE. T. DEAN I. GIBB J. BROGAN	ANGLE	
DATE 6-2-90 TUES		CASING DIAMETER 5"	

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	G/L	10-00	10-00	RED MARL
		10-00	90-00	80-00	GRANITE
		B/H	INCOMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

10-00 MTS CASING

	FROM	TO
DRILLING	90-00 MTS.	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	10-00 MTS.	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

SOUTH TYNE DRILLING

DAILY DRILL LOG

21

LOCATION ENDERBY WARREN	RIG No. DANDO	BH No. 21
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/2"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE. T. DEAN. J. BROGAN. I. GIBBS	ANGLE
DATE 4-2-90 SUN		CASING DIAMETER 5".

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/B	4½	G/L	8-00	8-00	RED MARL.
		8-00	100-00	92-00	GRANITE.

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING				
DEPTH OF WATER				

CASED TO 8-00 MTS

INSTALLATION DETAILS

	FROM	TO
DRILLING	100 MTS.	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	8-00 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

(118)

SOUTH TYNE DRILLING

DAILY DRILL LOG

23/21

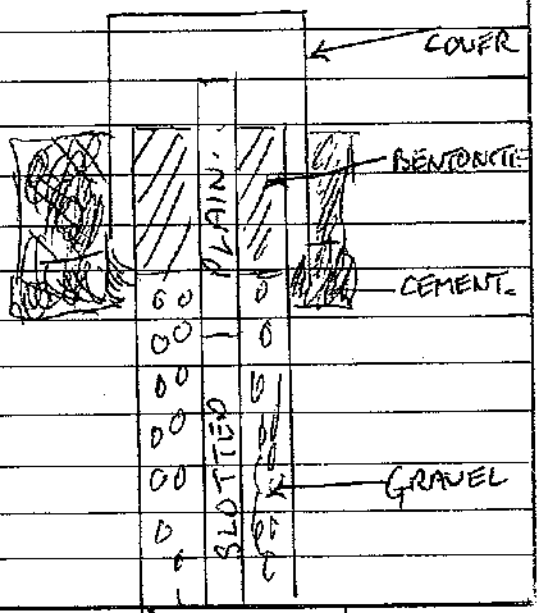
LOCATION ENDERBY/WARREN	RIG No. DANDO	BH No. 21
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN. J. BROGAN I. GIBB	ANGLE
DATE 5-2-90 MON.		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		B/H	TO	100 MTS.	
		INSTALLED		97 MTS	SLOTTED PIPE
				3 MTS	PLAIN PIPE.
		GRAVELLED	UP	B/H	
		BENTONITE	SEAL		
		CEMENT	TOP	COVER.	
	MOVED	FROM	B/H 21	TO	B/H 20.
	ACCESS TO	VERY POOR. CLEAR		/ 08 NEEDED ROAD.	

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS



	FROM	TO
DRILLING	/	
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING	4 hrs.	
CASING		
~~DELAYS~~ / INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER S. McCrindle.

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(119)

SOUTH TYNE DRILLING

DAILY DRILL LOG

16

LOCATION ENDERBY WARREN	RIG No. DANDO	BH No. 22
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW T. McKINDLE / T. DEAN	ANGLE
DATE 1-2-90 / THUR	J. BROGAN / I. GIBB	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVE TO B/H				22	
O/H	4 1/4	G/L	3-00		TOP SOIL & MARL WITH BOULDERS
		3-00	~~28-00~~ 28-00		GRANITE

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

CASED TO 3.00 MTS

SHEET 1 OF 2

SIGNED CLIENTS REPRESENTATIVE

SIGNED DRILLER YD

	~~FROM~~	~~TO~~
DRILLING	28.00 MTS	
OBSTRUCTION		
MOVE & SET UP	ONE MOVE	
STANDING		
CASING	3.00 MTS	
DELAYS		

SOUTH TYNE DRILLING

DAILY DRILL LOG

19/16.

120

LOCATION ENDERBY / WARREN	RIG No. DANDO	BH No. 22
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE / T. DEAN	ANGLE
DATE 2-2-90 / FRI	J. BROGAN / I. GIBB	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½"	28-00	100-00		GRANITE
		B/H COMPLETE.			
		INSTALLATION			INCOMPLETE.

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING				
DEPTH OF WATER				

INSTALLATION DETAILS

	~~FROM~~	~~TO~~
DRILLING	72 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS		

Sheet 2 of 2

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

(121)

SOUTH TYNE DRILLING

DAILY DRILL LOG

20/19/16.

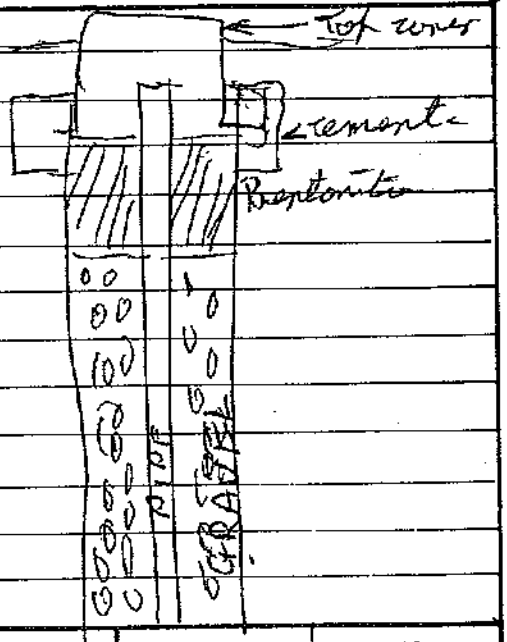
LOCATION ENDERBY/WARREN	RIG No. DANDO	BH No. 22.
CONTRACT No.	VEHICLE No.	DIAMETER 4½.
TYPE OF DRILLING DTH H	CREW J. MCLINDLE. T. DEAN. T. BROGAN J. GIBB	ANGLE
DATE 3-2-90 SAT		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	INSTALLED			97 MTS	of Slotted Pipe
		IN		3 MTS	of Plain Pipe.
		Gravelled up			
		Bentonite seal.			
			Cement Top cover.		
		MOVED	TO	B/H 21.	

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING				
DEPTH OF WATER				

INSTALLATION DETAILS



	FROM	TO
DRILLING		
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING		
CASING		
DELAYS INSTALL	100 MTS.	

1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McLindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

95

(122)

LOCATION ENDERBY WARREN	RIG No. GRYPHON	BH No. 23
CONTRACT No.	VEHICLE No. F 331 KTN.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. McC RINDLE T. DEAN	ANGLE
DATE 26-3-90 / MON		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVED FROM B/H 25 TO B/H 23.					
O/H	4 1/4	G/L	2.85	2.85	Top Soil, Boulders Clay
		2.85	100.00	97.15	GRANITE.
		B/H	COMPLETE.		
INSTALLED			97 MTS OF SLOTTED PIPE 3 MTS OF PLAIN PIPE 1 MT BENTONITE SEAL CEMENTED IN B/H COVER.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING	B/H DRY.		
	OF WATER			

CASED TO 3.00 MTS

INSTALLATION DETAILS

	FROM	TO
DRILLING	100 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING		
CASING	3 MTS	
~~DELAYS~~ INSTAL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

(123)

SOUTH TYNE DRILLING — DAILY DRILL LOG — 96 — 15

LOCATION ENDERBY/ WARREN	RIG No. GRYPHON	BH No. 24
CONTRACT No.	VEHICLE No. F331 KTN.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. OEAN	ANGLE
DATE 27-3-90 TUES		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVED		FROM B/H 23			TO B/H 24
O/H	4 1/4"	G/L	3.30	3.30	Top Soil e Boulder Clay
		3.30	100.00	96.70	GRANITE.
		B/H COMPLETE			
INSTALLED		97 MTS OF SLOTTED PIPE			
		3 MTS OF PLAIN PIPE			
		1 MT BENTONITE SEAL			
		CEMENTED IN B/H COVER.			

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE	B/H DAMP AT 90 MTS			
DEPTH OF CASING				
DEPTH OF WATER				

CASED TO 3.50 MTS

	FROM	TO
DRILLING	100 MT	
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING		
CASING	3.50 MTS	
~~DELAYS~~ INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER S. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

94

LOCATION ENDERBY WARREN	RIG No. GRYPITON	BH No. 25
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. DEAN.	ANGLE
DATE 25-3-90 SUN		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVED		FROM	B/H 26		TO B/H 25.
O/H	4¼	0/1	3.80	3.80	Top soil, Boulder Clay, red Marl.
		3.80	100.00	96.20	GRANITE.
		B/H	COMPLETE.		
INSTALLED			97 MTS		OF SLOTTED PIPE.
			3 MTS		OF PLAIN PIPE.
			1 MT		BENTONITE SEAL.
		CEMENTED	IN		B/H COVER.
	1½ HRS.	STANDING.			

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE	DAMP	AT 69 MTS.	
	OF CASING	Wet	AT 96 MTS.	
	OF WATER			

CASED TO 4 MTS.

	FROM	TO
DRILLING	100 MTS.	
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING	1½ hrs.	
CASING	4 MTS.	
~~DELAYS (LIST ON~~	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED DRILLER

SOUTH TYNE DRILLING

DAILY DRILL LOG

93

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 26
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE	ANGLE
DATE 21-3-90 / SAT.	T. DEAN.	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		MOVED FROM B/H 11A TO B/H 26.			
O/H.	4 1/4	G/L	5.90	5.90	Boulder Clay and Red Marl
		5.90	100.00	94.10	GRANITE.
		B/H	COMPLETE.		
	INSTALLED	97 MTS OF SLOTTED PIPE 3 MTS OF PLAIN PIPE 1 MT BENTONITE SEAL CEMENTED IN B/H COVER			

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE	DAMP	AT 52	MTS
	OF CASING	Wet	AT 60	MTS.
	OF WATER			

CASED TO 6.00 MTS.

	FROM	TO
DRILLING	100 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING		
CASING	6 MTS	
~~DELAYS~~ INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

53

15
(126)

LOCATION ENDERBY / WARREN	RIG No. GRYPITON	BH No. 27.
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE	ANGLE
DATE 20-2-90 / TUES	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	50-00	100-00	50.00	GRANITE.
		B/H	COMPLETE.		
	INSTALLED			97 MTS	SLOTTED PIPE
	"			3 MTS	PLAIN PIPE.
				1 MT	BENTONITE SEAL
		CEMENT	B/H		COVER.
		4 hrs	Standing	Farmer	
complaining	about	State	of	road.	

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

	FROM	TO
DRILLING	50-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING	4 hrs.	
CASING		
~~DELAYS~~ INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

51

(127)

LOCATION ENDERBY/WARREN	RIG No. GRYPHON	BH No. 27
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE
DATE 17-2-90 /SAT	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED	FROM	B/H	28	TO B/H 27
O/H	4 1/4	G/L	6.30	6.30	TOP SOIL, BOULDER CLAY MARL
		6.30	50.00	43.70	GRANITE
	B/H	INCOMPLETE.			

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	WATER	AT	30 MTS.	
DEPTH OF WATER				

CASED TO 6.50 MTS

INSTALLATION DETAILS

	~~FROM~~	TO
DRILLING	50-00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + ROAD SLIP	
STANDING		
CASING	6-50 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

DAILY DRILL LOG

50 (128)

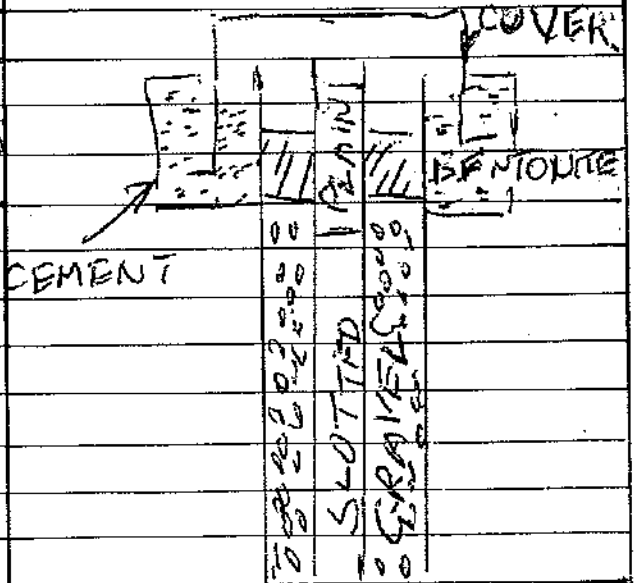
LOCATION ENDERBY/WARREM	RIG No. GRYPHON	BH No. 28.
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE	ANGLE
DATE 16-2-90 / FRI	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	25.00	100.00	75.00	GRANITE.
		B/H	COMPLETE.		
		INSTALLED		97 MTS	SLOTTED PIPE
		"		3 MTS	PLAIN PIPE
				1. MT.	BENTONITE SEAL
		CEMENTED	IN	B/H	COVER

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	WATER AT 42 MTS			
DEPTH OF WATER				

INSTALLATION DETAILS



	~~FROM~~	TO
DRILLING	75-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
~~DELAYS~~ INSTAL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

47 (129)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 28
CONTRACT No.	VEHICLE No.	DIAMETER 4¼
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE
DATE 25-2-90 / THURS	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	G/L	4-50	4-50	HARDCORE, BOULDER CLAY & MARL
		4-50	25-00	20-50	GRANITE
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

CASED TO 4-50 MTS.

Sheet 2 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

	FROM	TO
DRILLING	25-00 MTS.	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	4-50 MTS	
DELAYS		

SOUTH TYNE DRILLING

DAILY DRILL LOG

46 (130)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 29
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE
DATE 15-2-90 / THURS	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	50-00	100-00	50-00	GRANITE.
		B/H	COMPLETE		
		INSTALLED		94	MTS OF SLOTTED PIPE
		"		3	MTS OF PLAIN PIPE
				1	MT. BENTONITE SEAL
		CEMENT		B/H	COVER.
		MOVED TO		B/H	28.

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

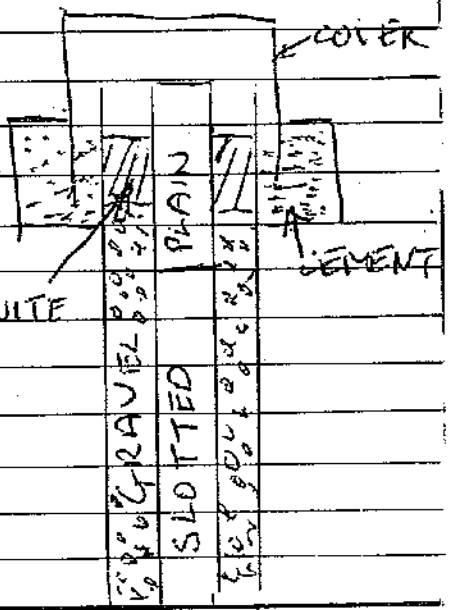
B/H COLASPENG, AT ABOUT 70 MTS.

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

INSTALLATION DETAILS



	FROM	TO
DRILLING	50-00 MTS	
OBSTRUCTION		
MOVE & SET UP	I MOVE + ROAD SITE	
STANDING		
CASING		
~~DELAYS~~ INSTALL	97-00 MTS	

SOUTH TYNE DRILLING

DAILY DRILL LOG

(131)

43

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No.	29
CONTRACT No.	VEHICLE No.	DIAMETER	4 1/4
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE	
DATE 14-2-90 / WED	T. DEAN	CASING DIAMETER	5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4 1/4	G/L	4.50	4.50	Top Soil, Boulder Clay, Red Marl.
		4.50	50.00	45.50	GRANITE.
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	B/H WET AT 35.00MTS			
DEPTH OF WATER				

INSTALLATION DETAILS

CASED TO 4.50 MTS.

Sheet 2 of 2.

	FROM	TO
DRILLING	50.00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	4.50 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

SOUTH TYNE DRILLING

DAILY DRILL LOG

42

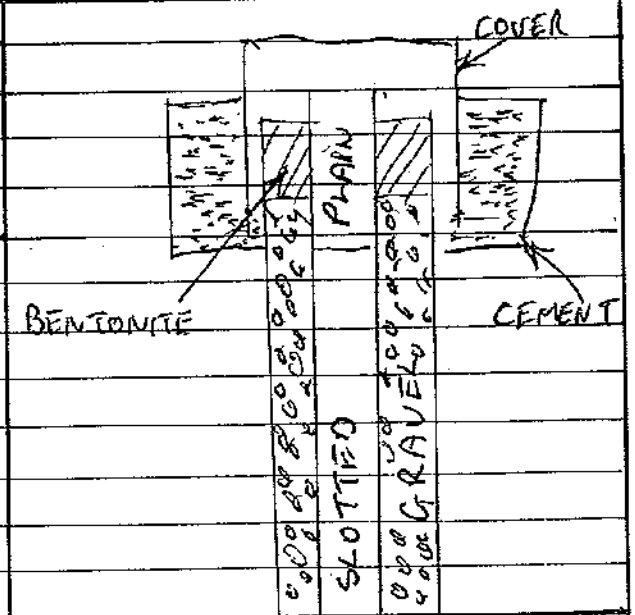
LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 30
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE	ANGLE
DATE 14-2-90 / WED	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼"	60-00	100-00	40-00	GRANITE.
		B/H COMPLETE.			
		INSTALLED		97 MTS	OF SLOTTED PIPE
		"		3 MTS	OF PLAIN PIPE
				1 MT.	BENTONITE SEAL
		CEMENT			B/H COVER.
		MOVED TO B/H 29			

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS



	FROM	TO
DRILLING	40·00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE +	ROAD SIGN
STANDING		
CASING		
~~DRAWS~~ INSTAL	100 MTS	

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

40 (133)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 30
CONTRACT No.	VEHICLE No.	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN	ANGLE
DATE 13-2-90 / TUES		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½	G/L	7-50	7-50	Top Soil, Boulder Clay and red. marl.
		7-50	60-00	52-50	GRANITE.
		B/H	INCOMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	B/H DRY			
DEPTH OF WATER				

CASED TO 7-50 MTS.

Broken Down for 2 hrs.

INSTALLATION DETAILS

	FROM	TO
DRILLING	60-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	7-50 MTS.	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

36 (134)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 31
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McGRINDLE	ANGLE
DATE 11/2/90	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		B/H	COLLAPSING.		
		ADVANCED CASING FROM 16.50 TO 14.50. CLEANED OUT B/H.			
		INSTALLED		9	7 MTS OF SLOTTED PIPE
		"		3	MTS OF PLAIN PIPE
			1 MT		BENTONITE SEAL
			CEMENT		B/H COVER
		MOVED	FROM B/H 31		TO B/H 32.

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

CASING 3MTS IN GRANITE.

	FROM	TO
DRILLING		
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING		
CASING	3 MTS.	
~~DELAYS~~ INSTAL	100 MTS.	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER T. McGrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

35

(135)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 31
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE	ANGLE
DATE 10-2-90 / SAT	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	30.00	100.00	70.00	GRANITE.
		B/H	COMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING	B/H WET AT	30.00 MTS	
	OF WATER			

INSTALLATION DETAILS

	FROM	TO
DRILLING	70.00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

34 (136)

LOCATION FINDERBY/WARREN	RIG No. Gyphon.	BH No. 31
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN	ANGLE
DATE 9-2-90 FRI.		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		MOVED	TO	B/H	31
O/H	5"	G/L.	16.50	16-50	Top soil sand and Red Marl.
	4¼	16.50	30.00	13.50	GRANITE
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

CASED TO 16.50 MTS.

INSTALLATION DETAILS

	FROM	TO
DRILLING	30.00 MTS.	
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING		
CASING	16.50.	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

39 (137)

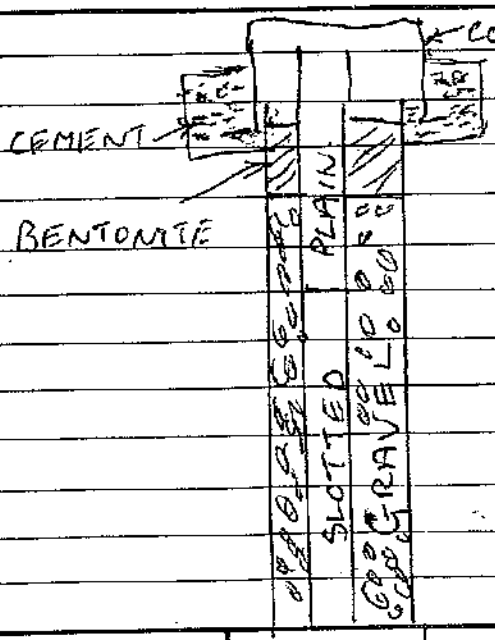
LOCATION ENDERBY / WARREN	RIG No. GRYPHON.	BH No. 32.
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE	ANGLE
DATE 13-2-90 / TUES.	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		INSTALLED		97 MTS OF SLOTTED PIPE	
		"		3 MTS OF PLAIN PIPE	
				1 MT. BENTONITE SEAL	
		CEMENT B/H COVER.			
		MOVED TO B/H 30.			
		1 hr. spent Removing Fence for ACCESS.			

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS



	FROM	TO
DRILLING		
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING	1 hr.	
CASING		
RETAINING	100 MTS.	

SIGNED CLIENTS REPRESENTATIVE

SOUTH TYNE DRILLING

DAILY DRILL LOG

37 (138)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 32
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE
DATE 12-2-90 / MON	T. DEAN.	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½	G/L	9-00	9-00	Top soil, RED/MARL & Boulders
		9-00	100-00	91-00	GRANITE.
		B/H COMPLETE.			

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING	WATER	AT 25-00 MTS.	
	OF WATER			

CASED TO 9-00 MTS

INSTALLATION DETAILS

	~~FROM~~	~~TO~~
DRILLING	100 MTS.	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING	9-00 MTS.	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McSmith

SOUTH TYNE DRILLING

DAILY DRILL LOG

32 (139)

LOCATION ENDERBY / WARREN	RIG No.	BH No. 33
CONTRACT No.	VEHICLE No.	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE J. BIZARDELEY T. DEAN D. HARPER	ANGLE
DATE 9-2-90 / FRI		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½	78-00	100-00	22-00	GRANITE
		B/H	COMPLETE.		
		INSTALLED		97 MTS	OF Slotted Pipe.
		"		3 MTS	OF Plain Pipe.
		1 mtr	Bentonite	Seal	
		Cement	B/H	Cover.	

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

	FROM	TO
DRILLING	22-00	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

(140)

LOCATION ENDERBY / WARREN	RIG No.	BH No. 33
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. DEAN T. BEARDSLEY D. HARPER	ANGLE
DATE 8-2-90 / THURS.		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4 1/4	62-00	78-00	16-00	GRANITE.

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING				
DEPTH OF WATER				

D.T.H.H. Struck Down Hole.

INSTALLATION DETAILS

	FROM	TO
DRILLING	16-00M	TS
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

29 (141)

LOCATION ENDERBY / WARREN	RIG No.	BH No. 33
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. BEARDSLEY T. DEAN. D. HARPER	ANGLE
DATE 7-2-90 / WED.		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/B	4 1/4	35.00	62.00	27.00	GRANITE.
		B/H	INCOMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

	FROM	TO
DRILLING	27-00	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

25 (142)

LOCATION ENDERBY/WARREN	RIG No.	BH No. 33
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN D. HARPER T. BEARDSLEY	ANGLE
DATE 6-2-90 TUES		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½"	G/L	12.60	12.60	RED MARL & Boulders.
		12.60	35.00	22.40	GRANITE.
		B/H	INCOMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

CASED TO 12.50 MTS.

Sheet 2 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

	FROM	TO
DRILLING	35.00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING	~~[illegible]~~	
CASING	12.50 MTS.	
~~DETAILS~~		

SOUTH TYNE DRILLING

DAILY DRILL LOG

24 (143)

LOCATION ENDERBY/WARREN	RIG No.	BH No. 34.
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN D. HARPER J. BEARDSLEY	ANGLE
DATE 6-2-90 TUES		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		INSTALLED		97 MTS	OF SLOTTED PIPE
		"		3 MTS	OF PLAIN PIPE
		GRAVELLED UP B/H			
		BENTONITE SEAL			
		CEMENT TOP.			
		MOVED TO B/H 33.			

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

	FROM	TO
DRILLING		
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING		
CASING		
~~DE~~INS INSTALL	100 MTS	

Sheet 1 of 2.

SIGNED CLIENT'S REPRESENTATIVE

SIGNED - DRILLER

SOUTH TYNE DRILLING

DAILY DRILL LOG

22/18 (144)

LOCATION ENDERBY / WARREN	RIG No. [redacted]	BH No. 34
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN. T. BEARDSLEY D. HARPER	ANGLE
DATE 5-2-90 MON		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼"	50-00	100-00	50-00	GRANITE.
		B/H	COMPLETE.		
		INSTALLATION			INCOMPLETE.

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

CORE BIT. U/S.
(BIT WEAR)

	FROM	TO
DRILLING	50 MTS.	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

18

(145)

LOCATION ENDERBY WARREN	RIG No.	BH No. 34
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. McRINDLE / T. DEAN	ANGLE
DATE 2-2-90 / FRI	T. BEARDSLEY / D'HARPER	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVED TO B/H 34 FROM B/H 55					
OPEN HOLE	4 1/2"	G/L	6-00	6-00	Turf & Red-Brown Marl Fill.
	"	6-00	7-00	1-00	Soft To Firm Grey Sandy clay
	"	7-00	18-15	11-15	RED MARL
	4 1/2"	18-15	50.00	31-85	GRANITE.
		B/A			INCOMPLETE.

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

CASED TO 16-00 MTS.

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED DRILLER

	~~FROM~~	~~TO~~
DRILLING	50 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING		
CASING	16 MTS	
DELAYS		

SOUTH TYNE DRILLING

DAILY DRILL LOG

90 (146) 26

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 35
CONTRACT No.	VEHICLE No. F331 KTN.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE. T. DEAN	ANGLE
DATE 22-3-90 / THURS		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½"	60.00	100.00	40.00	GRANITE.
		B/H	COMPLETE.		
INSTALLED			97 MTS		OF SLOTTED PIPE
	"		3 MTS		OF PLAIN PIPE.
			1 MT		BENTONITE SEAL.
		CEMENTED IN B/H COVER.			

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME			
DEPTH OF HOLE	B/H	DRY.	
DEPTH OF CASING			
DEPTH OF WATER			

	FROM	TO
DRILLING	40 MTS -	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
~~DEATS~~ INSTALL	100 MTS	

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

89 (147)

LOCATION ENDERBY/WARREN	RIG No. GRYPHON	BH No. 35
CONTRACT No.	VEHICLE No. F331 KTN.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE
DATE 21-3-90 WED	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVED FROM B/H 1 TO B/H 35					
O/H	4½	G/L	20.00	20.00	Boulder clay, Red Marl.
		20.00	60.00	40.00	GRANITE
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING				
DEPTH OF WATER				

INSTALLATION DETAILS

CASED TO 20-50 MTS

	FROM	TO
DRILLING	60-00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING		
CASING	20-50 MTS.	
DELAYS		

Sheet 2 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

88 (148)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 1
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. DEAN	ANGLE
DATE 21-3-90 WED.		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	70-00	100-00	30-00	GRANITE.
		B/H	COMPLETE		
INSTALLED			97 MTS OF SLOTTED PIPE		
			3 MTS OF PLAIN PIPE		
			1 MT. BENTONITE SEAL		
			CEMENTED IN B/H COVER.		

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	B/H DRY			
DEPTH OF WATER				

	FROM	TO
DRILLING	30-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS (MISTY)	100 MTS	

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

87 (149)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON.	BH No. 1
CONTRACT No.	VEHICLE No. F331 KTN.	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE.	ANGLE
DATE 20-3-90 / TUES	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVED		FROM	B/H	2. to	B/H 1
O/H	4¼	G/L	9.40	9.40	Boulder clay / Red MARL.
		9.40	70.00	60.60	GRANITE.
		B/H	INCOMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

CASED TO 9.50 MTS

	FROM	TO
DRILLING	70 MTS.	
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING		
CASING	9.50 MTS.	
DELAYS		

Sheet 2 of 2

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

86 (150)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 2.
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE
DATE 20-3-90 / TUES	T. DEAN.	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	60.00	100.00	40.00	GRANITE.
		B/H	COMPLETE.		
INSTALLED		97 MTS	OF		SLOTTED PIPE
"		3 MTS	OF		PLAIN PIPE
		1 MT	BENTONITE		SEAL
		CEMENTED	IN		B/H COVER

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

	FROM	TO
DRILLING	40.00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
~~DELAYS~~ INSTAL	100 MTS	

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

SOUTH TYNE DRILLING

DAILY DRILL LOG

85 (S1)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 2.
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE
DATE 19-3-90 / MON	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVED		FROM	B/H 3		TO B/H 2.
O/H	4½	G/L	10-80	10-80	Boulder Clay and Red Marl.
		10.80	60.00	49.20	GRANITE
		B/H	INCOMPLETE.		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE	DAMP	AT	44.50 MTS.
	OF CASING			
	OF WATER			

CASED TO 11-00 MTS

INSTALLATION DETAILS

	FROM	TO
DRILLING	60.00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE.	
STANDING		
CASING	11 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

29

SOUTH TYNE DRILLING

DAILY DRILL LOG

84 (152)

LOCATION ENNERDALE / WHARIEN.	RIG No. GRYPHON	BH No. 3
CONTRACT No.	VEHICLE No. F33 KTN	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN	ANGLE
DATE 15-3-90 THURS.		CASING DIAMETER 5

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED	FROM B/H 4	to B/H 3.		
O/H	4½	G/L	4-00	4-00	Boulder Clay / Gravels Boulders.
		4-00	100-00	96-00	GRANITE.
		B/H	COMPLETE		
INSTALLED			97 MTS OF SLOTTED PIPE		
			3 MTS OF PLAIN PIPE.		
			CEMENTED IN B/H COVER.		
		1 hr	Standby		

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	CASED	TO	4-00 MTS	
DEPTH OF WATER				

DAMP AT 62 MTS

INSTALLATION DETAILS

	FROM	TO
DRILLING	100 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE	
STANDING	1 hr.	
CASING	4-00	
DELAYS INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

83 (153) 30

LOCATION ENDERBY/WARREN	RIG No. GRYPHON	BH No. 4
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4¼
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN	ANGLE
DATE 14-3-90 WED		CASING DIAMETER 5

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED	FROM	B/H 5	TO	B/H 4.
Dug 1 MT Trial Pit for Borehole					with Pneumatic Drill
O/H	4¼	G/L	6.90	6.90	Hardcore. Boulder Clay and Granite boulders.
		6.90	100.00	93.10	GRANITE
		B/H	COMPLETE.		
INSTALLED		97	MTS		OF SLOTTED PIPE
"		3	MTS		OF PLAIN PIPE
		1	MT		BENTONITE SEAL
		CEMENTED IN B/H COVER			
Reinstated Highway.					

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING	B/H DAMP AT	97.00 MTS	
	OF WATER			

CASED TO 7.00 MTS

	FROM	TO
DRILLING	100.00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + ROAD SIGN	
~~STANDING~~ Trial Pit	1	
CASING	7 MT	
~~DELAYS~~ INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

82 (154)

LOCATION ENDERBY WARREN	RIG No. GRIFFON	BH No. 5
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE	ANGLE
DATE 13-3-90 TUES	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED	FROM B/H 6			TO B/H 5.
Dwg	1 unit	Trial Hit for	Services with		
	Pneumatic		Drill.		
O/H	4½	G/L	6.90	6.90	Augercore Boulder Clay and Igneous Boulders
		6.90	100.00	93.10	GRANITE.
		B/H	COMPLETE.		
INSTALLED	97	MTS	OF		Slotted Pipe
"	3	MTS	OF		Plain Pipe
	1	unit	Bentonite	Seal.	
	Cemented in		B/H COVER.		
	Reinstate		Highway.		

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME			
DEPTH OF HOLE	B/A DAMP AT	75 MTS	
DEPTH OF CASING	" WET AT	84 MTS.	
DEPTH OF WATER			

used TO 7.00 MTS.

	FROM	TO
DRILLING	100.00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE-Road Bogie	
~~STANDING~~ Trial Bit	1	
CASING	7 MTS	
~~DELAYS~~ WATER	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER

SOUTH TYNE DRILLING

DAILY DRILL LOG

32.

81 (155)

LOCATION ENDERBY/WARREN	RIG No. GRYPHON	BH No. 6
CONTRACT No.	VEHICLE No. F 331 KTN	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE T. DEAN	ANGLE
DATE 12-3-90 MON.		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
		MOVED FROM B/H 7 TO B/H 6.			
		DUG 1MT Trial Pit for Berries with Pneumatic Drill.			
O/H	4½	G/L	7-00	7-00	Hardcore, Boulders Clay and Granite Boulders
		7-00	100-00	93-00	GRANITE.
		B/H COMPLETE			
INSTALLED		97 MTS	OF SLOTTED PIPE		
"		3 MTS	OF PLAIN PIPE		
		1 MT	BENTONITE SEAL		
		CEMENTED IN B/H COVER.			
		Reinstated Highway.			

WATER LEVEL RECORD

TIME			
DEPTH OF HOLE			
DEPTH OF CASING			
DEPTH OF WATER	50m.	small amount	

CASED TO 7-00 MTS

INSTALLATION DETAILS

	FROM	TO
DRILLING	100-00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + Road Signs	
~~STANDING~~ Trial PIT.	1	
CASING	7 MTS	
~~DELAYS~~ INSTALL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER S. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

80 (ISC)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 7
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4¼"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN	ANGLE
DATE 11-3-90 SUN		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼"	15-00	100-00	85-00	GRANITE.
		B/H	COMPLETE.		
INSTALLED	"	97	MTS OF		SLOTTED PIPE
	"	3	MTS OF		PLAIN PIPE
	"	1	MT		BENTONITE SEAL
		CEMENTED IN B/H COVER			
		Reinstated Highway.			

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING	Water	at 53-00 MTS.	
	OF WATER			

	FROM	TO
DRILLING	85-00 MTS.	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
~~DEEPEN~~ INSTAL	100 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

79 (157)

LOCATION ENDERBY/WARREN	RIG No. GRYPHON	BH No. 7.
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4 1/4"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE
DATE 10-3-90 / SAT.	T. DEAN.	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED	FROM B/H 3B			TO B/H 7.
	Duty	1mt Trial Pneumatic	Put for		Service with Drill.
O/H	4 1/4	G/L	7-00	7-00	Hardcore Boulder Clay e Granite Boulders.
		7-00	15-00	8-00	GRANITE.

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

CASED TO 7-00 MTS.

Sheet 2 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

	FROM	TO
DRILLING	15-00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE-1 Rund Sign	
~~STANDING~~ Trial Pit	1	
~~CASING~~	7-00 MTS.	
DELAYS		

SOUTH TYNE DRILLING

DAILY DRILL LOG

78

JV (158)

LOCATION ENDERBY WARREN	RIG No. GRYPHON	BH No. 36
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE T. DEAN.	ANGLE
DATE 10-3-90 SAT.		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½	50-00	100-00	50-00	GRANITE
		B/H	COMPLETE		
INSTALLED			97	MTS	OF SLOTTED PIPE
	1"		3	MTS	OF PLAIN PIPE
			1	MT.	BENTONITE SEAL.
		CEMENTED IN B/H COVER.			
		Reinstated Highway.			

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

	FROM	TO
DRILLING	50-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
~~DELAYS~~ INSTAL	100 MTS	

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER S. Mccrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

77 (159)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 36
CONTRACT No.	VEHICLE No. F331 KTN.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN.	ANGLE
DATE 9-3-90 FRI.		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED FROM B/H 37 TO B/H 36.				
	Dug 1 HT Trial Pit for Services With Pneumatic Drill.				
O/H	4½	G/L	6.00	6.00	CONCRETE, HARDCORE, Boulder clay.
		6.00	50.00	44.00	GRANITE
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	WATER AT 40.00 MTS			
DEPTH OF WATER				

CASED TO 6.00 MTS.

INSTALLATION DETAILS

	FROM	TO
DRILLING	50.00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + Road Signs	
~~STANDING~~ TRIAL PIT	1	
CASING	6 MTS	
DELAYS		

Sheet 2 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

76 (160)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 37
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4½
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN	ANGLE
DATE 9-3-90 FRI		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	B/H		COLLAPSING.		CLEANED OUT
	B/H		4 Times.		
	INSTALLED		92 MTS OF SLOTTED PIPE		
	"		3 MTS OF PLAIN PIPE.		
			1 MT BENTONITE SEAL		
			CEMENTED IN B/H COVER.		
			Reinstated Highway.		
	4 hrs		Standing.		

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING				
DEPTH OF WATER				

	FROM	TO
DRILLING	—	
OBSTRUCTION		
MOVE & SET UP		
STANDING	4 hrs.	
CASING		
~~SELATS~~ INSTAL	95 MTS.	

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

74 (162)

LOCATION FINNERBY WARREN	RIG No. GRYPHON	BH No. 37
CONTRACT No.	VEHICLE No. F331 KTN.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE.	ANGLE
DATE 6-3-90 TUES	T. DEAN.	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED FROM B/H 38				to B/H 37.
Dug 1 pt. Trial Pit for Services. With Pneumatic Drill.					
O/H	4½	G/L	5-80	5-80	Hardcore, granite Boulders, and Boulder Clay.
		5-80	60-00	54-20	GRANITE.
		B/H	INCOMPLETE.		

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	B/H DRY.			
DEPTH OF WATER				

CASED TO 6-00 MTS

	FROM	TO
DRILLING	60-00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + Road Signs	
~~STANDING~~ Trial Pit	1	
CASING	6-00 MTS.	
DELAYS		

Sheet 2 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

75

(61)

LOCATION ENDERBY / WARREN.	RIG No. GRYPHON.	BH No. 37
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4¼
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE	ANGLE
DATE 9-3-90 THURS	T. DEAN	CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	60.00	95.00	35.00	GRANITE.
		B/H	COMPLETE		
		NO	INSTALLATION	YET.	

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	WATER	AT	73.50.	
DEPTH OF WATER				

	FROM	TO
DRILLING	35-00 M	TS
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

JTH TYNE DRILLING

DAILY DRILL LOG

73

36

(163)

LOCATION ENDERBY WARREN	RIG No. GRYPHON	BH No. 38
CONTRACT No.	VEHICLE No. F331 KTN	DIAMETER 4¼
TYPE OF DRILLING ROTARY.	CREW J. MCCRINDLE	ANGLE
DATE 6-3-90 TUES	T. DEAN.	CASING DIAMETER 5

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼	70-00	95-00	25-00	GRANITE.
		B/H	COMPLETE.		
INSTALLED			92 MTS		OF SLOTTED PIPE.
"			3 MTS		OF PLAIN PIPE
			1 MT.		BENTONITE SEAL
		CEMENTED	IN		B/H COVER
		Reinstated	Highway.		

WATER LEVEL RECORD

TIME		
DEPTH OF HOLE		
DEPTH OF CASING	Water at 73 MTS.	
DEPTH OF WATER		

INSTALLATION DETAILS

	FROM	TO
DRILLING	25-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING		
~~DELAYS~~ INSTALL	95 MTS	

Sheet 1 of 2.

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

(164)

SOUTH TYNE DRILLING

DAILY DRILL LOG

72

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 38
CONTRACT No.	VEHICLE No.	DIAMETER 4¼"
TYPE OF DRILLING	CREW J. McCRINDLE T. DEAN	ANGLE
DATE 5-3-90 MON		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED	FROM	B/H 39	TO	B/H 38
DUG Trial Pit for Services with Pneumatic Drill.					
O/H	4¼	G/L	4.30	4.30	Hardcore Sandy Boulder clay.
		4.30	70.00	65.70	GRANITE
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE	B/H DAMP AT 38.00MTS			
DEPTH OF CASING				
DEPTH OF WATER				

CASED TO 4.50 MTS

INSTALLATION DETAILS

	FROM	TO
DRILLING	70.00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + Rodd Begun	
~~STANDING~~ Trial Pit	1	
CASING	4.50 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

71

37 (165)

LOCATION ENDERBY / WARREN	RIG No. GRYPHON	BH No. 39
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. DEAN.	ANGLE
DATE 1-3-90 / THURS		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
MOVED		FROM	B/H 40		TO 39.
DUG		Trial Pit for Pneumatic Drill.			Services with.
O/H	4½"	B/L	3.00	3.00	HARDCORE, SAND, Boulder CLAY.
		3.00	95.00	92.00	GRANITE.
		B/H COMPLETE			
INSTALLED			92	MTS	OF SLOTTED PIPE
			3	MTS	OF PLAIN PIPE
			1	BT	BENTONITE SEAL
		CEMENT IN B/H COVER.			
		Reinstated Highway			

INSTALLATION DETAILS

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE	DAMP	AT	40	MTS.
DEPTH OF CASING	WET	AT	71.50	MTS.
DEPTH OF WATER				

CASED TO 3 MTS.

	FROM	TO
DRILLING	95 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE +	ROAD SIGNS
~~STANDING~~ TRIAL PIT	1	
CASING	3 MTS	
~~DELAYS~~ INSTRU	95 MTS.	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

SOUTH TYNE DRILLING

DAILY DRILL LOG

70 (166)

LOCATION ENDERBY/ WARREN	RIG No. GRYPHON.	BH No. 40
CONTRACT No.	VEHICLE No.	DIAMETER 4¼
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE T. DEAN	ANGLE
DATE 28-2-90 / WED		CASING DIAMETER 5'

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4¼"	70-00	95-00	25-00	Granite.
		B/H	COMPLETE		
INSTALLED				92 MTS	OF SLOTTED PIPE
				3 MTS	OF PLAIN PIPE.
				1 MT	BENTONITE SEAL.
		CEMENTED			B/H COVER IN.
		Reinstated			Highway.

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

INSTALLATION DETAILS

	FROM	TO
DRILLING	25-00 MTS	
OBSTRUCTION		
MOVE & SET UP		
STANDING		
CASING INSTALL		
~~DEEPS~~	MTS 95.	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle.

SOUTH TYNE DRILLING

DAILY DRILL LOG

69 (167)

LOCATION ENDERBY WARREN	RIG No. GRIPHON	BH No. 40
CONTRACT No.	VEHICLE No.	DIAMETER 4 1/4
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE T. DEAN	ANGLE
DATE 27-2-90 TUES		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	DUG.		1 MT		Trial Pit for Leaves;
	with Pneumatic Drill.				
O/H	4 1/2	G/L	2.80	2.80	Hardcore, sand and Granite Boulders.
		2.80	70.00	67.20	GRANITE.

WATER LEVEL RECORD

TIME				
DEPTH OF HOLE				
DEPTH OF CASING	WATER AT 52.00 MTS.			
DEPTH OF WATER				

CASED TO 3 MTS.

INSTALLATION DETAILS

	~~FROM~~	~~TO~~
DRILLING	70.00 MTS.	
OBSTRUCTION		
MOVE & SET UP		
~~STANDING~~ Trial Pit	1	
CASING	3 MTS	
DELAYS		

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER S. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

67 (168) 39

LOCATION ENDERBY WARREN	RIG No. GRYPHON	BH No. 8
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE. T. DEAN	ANGLE
DATE 25-2-90 SUN		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
O/H	4½	10-00	90-00	80-00	GRANITE.
		B/H	COMPLETE.		
	INSTALLED		87	MTS	OF SLOTTED PIPE
	"		3	MTS	OF PLAIN PIPE
			1	MT	BENTONITE SEAL
		CEMENTED	B/H	COVER/IN.	
		Reinstated	Highway.		
		MOVED	TO		B/H 40.

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE	DAMP	AT	37 MTS
	OF CASING	WET	AT	45 MTS.
	OF WATER			

INSTALLATION DETAILS

	FROM	TO
DRILLING	80.00 MT	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + ROAD SIGNS	
STANDING		
CASING		
~~DELAYS~~ INSTAL	90 MTS	

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SUBSURFACE DRILLING

DAILY DRILL LOG

66 (169)

LOCATION ENDERBY WARREN	RIG No. GRYPHON	BH No. 8.
CONTRACT No.	VEHICLE No.	DIAMETER 4½"
TYPE OF DRILLING ROTARY	CREW J. McCRINDLE. T. DEAN	ANGLE
DATE 24-2-90 SAT		CASING DIAMETER 5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED FROM			B/H 9	TO B/H 8.
	DUG 1 MT. WITH		Trial Pit Pneumatic		Pit for Services Drill.
O/B	4½"	G/L	2.00	2.00	Tourmaline, hornblende, granite Boulders.
		2.00	10.00	8.00	GRANITE.
		B/H	INCOMPLETE		

WATER LEVEL RECORD

TIME				
DEPTH	OF HOLE			
	OF CASING			
	OF WATER			

CASED TO 2.00 MTS.

INSTALLATION DETAILS

	FROM	TO
DRILLING	10.00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + ROAD SIGN	
~~STANDING~~ Trial Pit	1	
CASING	2.00 MTS	
DELAYS		

Sheet 2 of 2

SIGNED CLIENTS REPRESENTATIVE

SIGNED - DRILLER J. McCrindle

SOUTH TYNE DRILLING

DAILY DRILL LOG

65 (170)

LOCATION ENDERBY WARREN	RIG No. GRYPHON	BH No.	9.
CONTRACT No.	VEHICLE No.	DIAMETER	4½"-
TYPE OF DRILLING ROTARY	CREW J. MCCRINDLE T. DEAN	ANGLE	
DATE 24-2-90 SAT		CASING DIAMETER	5"

OPERATION	SIZE	FROM	TO	LENGTH	DESCRIPTION
	MOVED	FROM B/H 10			TO B/H 9.
	DUG WITH	1MT	Trial Pit Pneumatic		for Berries. DRILL
O/H	4½	G/L	2.00	2.00	Tarmac hardcore, GRANITE Boulders.
		2.00	90.00	88.00	GRANITE.
		B/H COMPLETE.			
	INSTALLED		87 MTS		OF SLOTTED PIPE.
	"		3 MTS		OF PLAIN PIPE
			1 MT		BENTONITE SEAL
		CEMENT	B/H		COVER IN.
	Reinstate	Highway.			

WATER LEVEL RECORD

TIME			
DEPTH OF HOLE			
DEPTH OF CASING	WATER	AT 35 MTS.	
DEPTH OF WATER			

Cased to 2.00 MTS

INSTALLATION DETAILS

	~~FROM~~	TO
DRILLING	90.00 MTS	
OBSTRUCTION		
MOVE & SET UP	1 MOVE + Road sign	
~~STANDING~~ Trial Pit	1	
CASING	2.00 MTS	
~~DELAYS~~ INSTALL	90.00 MTS	

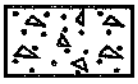
Sheet 1 of 2.

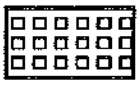
SIGNED CLIENTS REPRESENTATIVE

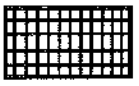
SIGNED - DRILLER J. McCrindle.

M. J. Carter Associates

Recommended symbols for soils and rocks (BS5930 : 1981)

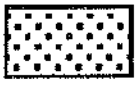
 Waste

 Backfill

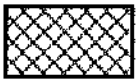
 Cement

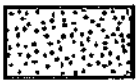
 Bentonite

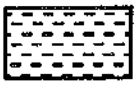
 Topsoil

 Granular filter

Soils

 Made ground

 Sand

 Clay

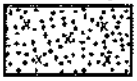
 Boulders and cobbles

 Silt

 Peat

 Gravel

Note: Composite soil types will be signified by combined symbols, e.g.

 Silty sand

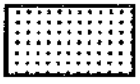
Rocks

 Chalk

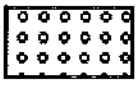
 Breccia

 Mudstone

 Limestone

 Sandstone

 Shale

 Conglomerate

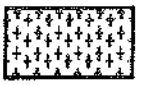
 Siltstone

 Ironstone

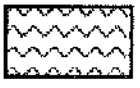
 Coal

Metamorphic **Igneous**

 Coarse-Grained



 Medium-Grained

 Fine-Grained

Symbols

▼ Rest water level

▽ Water strike

B Bulk sample

| Plain piping

J Jar sample

 Headworks

 Gas sampler

 Perforated casing

 Pneumatic piezometer

 Casagrande piezometer

100 Undisturbed 100mm diameter tube sample

Authorisation:  Date: 10/2/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: PC1
Sheet 1 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					1.00		MADE GROUND: Gravel, sand and stone fill (driller's description)			
					1.40		Brown marl (driller's description)			
					2.10		Highly weathered and fissured GRANODIORITE			
							Moderately weathered GRANODIORITE with tight or closed fissures, many orientations. At 3.58m, subhorizontal fissure with approximately 5mm aperture At 3.88m to 3.92m, subhorizontal tight fissure			
					4.20		Slightly weathered to fresh GRANODIORITE. Occasional tight or closed fissures. At 6.67m to 7.14m, diagonal and subvertical fissures with aperture of a few mm. At 7.97m, tight fissure			

GROUNDWATER

Date	am pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
23/02/95					9.50		
02/03/95				7.84			
06/03/95				4.86			
09/03/95				4.97			

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from 1.31m to 9.73m depth

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	10.0m

Start Date : 23/02/95
Finish date : 23/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: PC1
Sheet 2 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter							Slightly weathered to fresh GRANODIORITE. Occasional tight or closed fissures.			
					10.00		BASE OF BOREHOLE			

GROUNDWATER

Date	am pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
23/02/95					9.50		
02/03/95				7.84			
06/03/95				4.86			
09/03/95				4.97			

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from 1.31m to 9.73m depth

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	10.0m

Start Date : 23/02/95
Finish date : 23/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: PC2
Sheet 1 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					0.70		MADE GROUND: Gravel, sand and granite chips (driller's description)			
					1.30		Slightly weathered GRANODIORITE with subhorizontal and subvertical fissures with aperture of a few mm			
							Fresh GRANODIORITE with tight or closed subvertical and subhorizontal fissures, occasional diagonal fissures. At 3.21m to 3.33m, subhorizontal and subvertical fissures with aperture of a few mm. At 7.80m, subhorizontal fissure with aperture approximately 1mm Weathered bands at 3.50m, 4.00m, 4.86m and 7.00m			
					7.80		Fresh dark fine to medium grained GRANODIORITE. At 8.34m, 8.56m, 9.23m and 9.30m, tight subhorizontal fissures. At 8.34m, tight subvertical fissure. At 9.30m, subhorizontal fissure with aperture approximately 2mm			

GROUNDWATER

Date	am pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
24/02/95					3.50	Rapid inflow	
02/03/95				3.40			
06/03/95				1.20			
09/03/95				1.33			

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from 0.71m to 9.52m depth

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	10.0m

Start Date : 24/02/95
Finish date : 24/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: PC2
Sheet 2 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter							Fresh dark fine to medium grained GRANODIORITE. At 8.34m, 8.56m, 9.23m and 9.30m, tight subhorizontal fissures. At 8.34m, tight subhorizontal fissure. At 9.30m, subhorizontal fissure with aperture approximately 2mm			
					10.00		BASE OF BOREHOLE			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
23/02/95					3.50	Rapid inflow	
02/03/95				3.40			
06/03/95				1.20			
09/03/95				1.33			

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from 0.71m to 9.52m depth

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	10.0m

Start Date : 24/02/95
Finish date : 24/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: PC3
Sheet 1 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: E. Goring
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					0.50		MADE GROUND: Chippings and soil (driller's description) Hard granite (driller's description)			

GROUNDWATER

Date	am pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
28/02/95					3.50		
02/03/95				1.50			
09/03/95				2.30			

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : E. Goring

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	10.0m

Start Date : 28/02/95
Finish date : 28/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: PC3
Sheet 2 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: E. Goring
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter							Hard granite (driller's description)			
					10.00		BASE OF BOREHOLE			

GROUNDWATER

Date	am pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
28/02/95					3.50		
02/03/95				1.50			
09/03/95				2.30			

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : E. Goring

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	10.0m

Start Date : 28/02/95
Finish date : 28/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: PC4
Sheet 1 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					2.00		MADE GROUND: Grass on clay, stone and metal fill (driller's description)			
					3.30		Very weak reddish brown sandy mar (driller's description)			
					4.25		Highly weathered fissured GRANODIORITE			
							Fresh GRANODIORITE with many closed or tight subhorizontal and subvertical fissures. Slightly weathered bands at 5.65m, 5.89m, 6.12m, 6.45m and 7.10m			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							
02/03/95				2.40, odour of sewage			
06/03/95				1.32, odour of sewage			

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from 3.58m to 7.29m depth.
Cloudy water obscured picture below 7.29m.

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Open hole 150mm	10.0m

Start Date : 27/02/95
Finish date : 27/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: PC4
Sheet 2 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter							Fresh GRANODIORITE with many closed or tight subhorizontal and subvertical fissures. Slightly weathered bands at 5.65m, 5.89m, 6.12m, 6.45m and 7.10m.			
					10.00		BASE OF BOREHOLE			

GROUNDWATER

Date am pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling						
02/03/95			2.40, odour of sewage			
06/03/95			1.32, odour of sewage			

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from 3.58m to 7.29m depth.
Cloudy water obscured picture below 7.29m.

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Open hole 150mm	10.0m

Start Date : 27/02/95
Finish date : 27/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: KC1
Sheet 1 of 1
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					0.50		MADE GROUND: (driller's description)			
							Soft brown silty marl and clay (driller's description)			
	87				1.50		Stiff reddish brown silty sandy CLAY with fine to coarse gravel sized fragments of sandstone, quartzite and coal. Sandstone and granodiorite cobbles at 2.10m (glacial deposits)			
	0				2.30		Very stiff reddish brown with grey mottling silty CLAY with very weak mudstone lithorelicts. Some layers firm (Mercia Mudstone Group)			
					4.50		BASE OF BOREHOLE			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	1.50m
Rotary coring	4.50m

Start Date : 27/02/95
Finish date : 27/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: KC1A
Sheet 1 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					0.80		MADE GROUND: Soil and granite boulders (driller's description)			
					1.20		Soft brown silty marl and clay (driller's description)			
					2.70		Soft reddish brown sandy silty marl (driller's description) (probably Mercia Mudstone Group)			
					3.70		Stiff red very silty shaly marl (driller's description) (probably Mercia Mudstone Group)			
					4.90		Reddish brown silty MUDSTONE with grey lenses (Mercia Mudstone Group)			
					8.45		Fresh GRANODIORITE with vertical fissures at 4.96m, 5.15m to 5.38m, 5.41m to 5.76m, 6.25m to 7.00m, 7.50m to 8.00m, tight or with apertures up to 5mm. Weathered subhorizontal fissures at 6.11m to 6.31m, tight, and 8.18m, maximum aperture 7mm. Weathered zones at 7.85m and 8.18m to 8.44m			
							Fresh GRANODIORITE with occasional tight or closed fissures			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from 1.46m to 11.50m depth.

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	12.0m

Start Date : 28/02/95
Finish date : 28/02/95

M.J. Carter Associates **ROTARY CORE DRILLING RECORD**

Project: Enderby Warren | Client: Midland Land Reclamation Limited | Borehole Nº: KC1A
Sheet 2 of 2
Location: Leicester | Contractor: Site Investigation Services | Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					8.50		Fresh GRANODIORITE with occasional tight or closed fissures At 10.22m to 10.40m, weathered			
					12.00		BASE OF BOREHOLE			

GROUNDWATER

Date	am/pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from 1.46m to 11.50m depth.

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	12.0m

Start Date : 28/02/95
Finish date : 28/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren | Client: Midland Land Reclamation Limited | Borehole №: WC
Sheet 1 of 2
Location: Leicester | Contractor: Site Investigation Services | Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					1.80 2.00 5.05 5.90 7.85		Clay and sand (driller's description) Granite boulder fill (driller's description) (probably glacial deposits) Reddish brown with grey lenses highly weathered MUDSTONE with some infilled fissures (Mercia Mudstone Group) Highly weathered GRANODIORITE At 5.55m to 5.85m, fissures several orientations with maximum aperture 10mm Slightly weathered to fresh GRANODIORITE At 6.35m to 6.70m, fissures several orientations with maximum aperture 10mm At 6.75m to 7.80m, occasional tight or weathered fissures Fresh darker fine to medium grained GRANODIORITE Occasional tight joints			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							
06/03/95	Seepage at 3.55, 5.85 and 6.48			9.32			

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from ground level to 9.40m depth

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : G. Bartle

Type and Dia.	Depth
Rotary open hole 150mm	10.0m

Start Date : 01/03/95
Finish date : 01/03/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: WC
Sheet 2 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter							Fresh darker fine to medium grained GRANODIORITE Occasional tight joints			
					10.00		BASE OF BOREHOLE			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							
06/03/95	Seepage at 3.55, 5.85 and 6.48 9.32						

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by CCTV survey from ground level to 9.40m depth

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : G. Bartle

Type and Dia.	Depth
Rotary open hole 150mm	10.0m

Start Date : 01/03/95
Finish date : 01/03/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: WF1
Sheet 1 of 3
Location: Leicester
Contractor: Site Investigation Services
Logged By: G. Bartle
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					5.00		Red clay and silty sandy marl (driller's description) (possibly glacial deposits over residual soil)			
							Weak reddish brown and grey silty marl with softer bands (driller's description) (Mercia Mudstone Group)			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : G. Bartle

INSTALLATIONS

Plant : Rotary Drill
Crew : G. Bartle

Type and Dia.	Depth
Rotary open hole 150mm	20.0m

Start Date : 28/02/95
Finish date : 28/02/95

M.J. Carter Associates — **ROTARY CORE DRILLING RECORD**

Project: Enderby Warren | Client: Midland Land Reclamation Limited | Borehole Nº: WF1
Sheet 2 of 3
Location: Leicester | Contractor: Site Investigation Services | Logged By: G. Bartle
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					8.50		Weak reddish brown and grey silty marl with softer bands (driller's description) (Mercia Mudstone Group)			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : G. Bartle

INSTALLATIONS

Plant : Rotary Drill
Crew : G. Bartle

Type and Dia.	Depth
Rotary open hole 150mm	20.0m

Start Date : 28/02/95
Finish date : 28/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: WF1
Sheet 3 of 3
Location: Leicester
Contractor: Site Investigation Services
Logged By: G. Bartle
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					17.00		Weak reddish brown and grey silty marl with softer bands (driller's description) (Mercia Mudstone Group)			
					20.00		BASE OF BOREHOLE			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : G. Bartle

INSTALLATIONS

Plant : Rotary Drill
Crew : G. Bartle

Type and Dia.	Depth
Rotary open hole 150mm	20.0m

Start Date : 28/02/95
Finish date : 28/02/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: WF1A
Sheet 1 of 3
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter							No record			
	23				4.50		Reddish brown with grey patches, in places laminated, highly weathered MUDSTONE with small lenses of grey fine grained sandstone (Mercia Mudstone Group)			
	0									
	0									

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	4.50m
Coring	4.50-20.0m

Start Date : 07/03/95
Finish date : 07/03/95

M.J. Carter Associates — **ROTARY CORE DRILLING RECORD**

Project: Enderby Warren | Client: Midland Land Reclamation Limited | Borehole Nº: WF1A
Sheet 2 of 3
Location: Leicester | Contractor: Site Investigation Services | Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
	0						Reddish brown with grey patches, in places laminated, highly weathered MUDSTONE with small lenses of grey fine grained sandstone (Mercia Mudstone Group)			
					9.00 9.15					
	73						Reddish brown and grey mottled very porous calcareous fine grained SANDSTONE with solution cavities maximum 18mm x 18mm x 8mm lined with calcite. (Mercia Mudstone Group)			
					10.00		Grey weakly cemented fine grained SANDSTONE with occasional thick laminations of mudstone and medium grained sandstone. Vertical fissures with some calcite infill at 9.18m to 9.30m and 9.80m to 10.00m			
	33						Reddish brown with grey mottling MUDSTONE. At 10.00m to 12.40m many subvertical and diagonal planar closed fissures with black mottling on fissure surfaces. At 12.40m to 12.50m and 12.60m, vertical planar tight fissures with black mottling on surfaces and grey discolouration within approximately 3mm of surfaces. At 13.50m to 14.00m vertical, 14.30m to 14.95m vertical and 14.75m to 14.80m diagonal tight planar fissures with black mottling on surfaces. At 12.50m cavities maximum size 5mm with yellow discolouration, no infill (Mercia Mudstone Group)			
	90									
	80									
					14.95		Grey weakly cemented thinly bedded fine to medium grained SANDSTONE with porous horizons. Bedding plane fissures at 100mm to 150mm spacing At 16.10m to 16.20m mudstone (Mercia Mudstone Group)			
	100									
					16.20		Grey and pink thinly bedded weakly cemented coarse grained SANDSTONE. Bedding plane fissures at 100mm to 200mm spacing At 16.50m to 16.55m mudstone (Mercia Mudstone Group)			
	77									

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	4.50m
Coring	4.50-20.0m

Start Date : 07/03/95
Finish date : 07/03/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: WF1A
Sheet 3 of 3
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
	77				17.00		Reddish brown MUDSTONE At 17.50m to 19.00m, many planar tight or closed diagonal and horizontal fissures At 19.10m to 19.30m, planar tight diagonal fissure At 19.30m to 19.40m, many incipient fissures (Mercia Mudstone Group)			
	100									
	100				20.00		BASE OF BOREHOLE			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	4.50m
Coring	4.50-20.0m

Start Date : 07/03/95
Finish date : 07/03/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: WF2A
Sheet 1 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					0.30		TOPSOIL (driller's description) Firm brown silty clay (driller's description)			
	0				2.00		Firm reddish brown silty CLAY with occasional angular firm gravel sized fragments of coal and sandstone and rounded fragments of mudstone and quartz. At 4.30m to 4.45m granodiorite boulder (glacial deposits)			
	93				4.65 4.75		Grey medium grained SANDSTONE, strong, fissured (Mercia Mudstone Group)			
	47						Reddish brown MUDSTONE, with grey mottling. At 4.75m to 6.90m and 7.00m to 8.90m many planar tight fissures with black mottling on surfaces. At 6.90m to 7.00m grey calcareous mudstone with solution cavities maximum 10mm some lined with calcite (Mercia Mudstone Group)			
	73									
	80									

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres
Granodiorite continued to 16.00m in borehole WF2 adjacent to this borehole

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	2.50m
Rotary coring	2.50-10.20m

Start Date : 08/03/95
Finish date : 08/03/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: WF2A
Sheet 2 of 2
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
	80						Reddish brown MUDSTONE with grey mottling			
					9.20		Highly weathered GRANODIORITE, weak			
	40									
					10.00		Dark pink fresh GRANODIORITE			
					10.20		BASE OF BOREHOLE			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres
Granodiorite continued to 16.00m in borehole WF2 adjacent to this borehole

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	2.50m
Rotary coring	2.50-10.50m

Start Date : 08/03/95
Finish date : 08/03/95

M.J. Carter Associates — **ROTARY CORE DRILLING RECORD**

Project: Enderby Warren | Client: Midland Land Reclamation Limited | Borehole Nº: WF3 Sheet 1 of 3

Location: Leicester | Contractor: Site Investigation Services | Logged By: M. Cliff

Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter					0.35		TOPSOIL (driller's description)			
					1.00		Soft light brown silty marl with small granite cobbles (driller's description)			
	87						Stiff reddish brown silty CLAY with fine to coarse gravel sized fragments of sandstone, marl and quartz. Below 3.00m, very stiff (glacial deposits)			
					3.70					
	0				4.00		Reddish brown with a little grey mottling laminated highly weathered MUDSTONE (Mercia Mudstone Group)			
							Very soft sandy CLAY (driller's description)			
	100				5.30		Reddish brown MUDSTONE with many fissures At 5.50m to 5.60m grey porous calcareous fine grained sandstone			
					6.50		Reddish brown with grey patches MUDSTONE At 8.20m to 9.20m, 10.00m to 10.60m and 10.70m to 11.50m, many planar tight or incipient fissures with black mottling on surfaces At 8.45m to 8.50m fine grained sandstone			
	100									

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill

Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	2.50m
Rotary coring	2.50m-16.00m
Rotary open hole 100mm	16.00m-20.00m

Start Date : 08/03/95

Finish date : 08/03/95

M.J. Carter Associates — ROTARY CORE DRILLING RECORD

Project: Enderby Warren
Client: Midland Land Reclamation Limited
Borehole Nº: WF3
Sheet 2 of 3
Location: Leicester
Contractor: Site Investigation Services
Logged By: M. Cliff
Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
	100						Reddish brown with grey patches MUDSTONE At 8.50m to 9.20m, sandstone laminations. At 9.20m to 9.40m, grey calcareous mudstone. At 10.60m to 10.70m weakly cemented medium grained sandstone. At 10.70m calcareous mudstone (Mercia Mudstone Group)			
	67									
					11.85					
	90						Grey and dark pink thinly bedded medium to coarse grained SANDSTONE. Bedding plane fissures at approximately 100mm spacing (Mercia Mudstone Group)			
					12.50					
	80						Reddish brown with grey patches and lenses MUDSTONE At 13.50m to 14.50m occasional planar tight fissures. At 14.10m to 14.40m and 14.60m to 14.90m vertical planar tight fissures with black mottling on surface. At 15.00m to 15.10m diagonal planar tight fissure with black mottling on surfaces. (Mercia Mudstone Group)			
	80									
					15.80					
Open hole 100mm diameter							Reddish brown MUDSTONE with granodiorite boulders (Mercia Mudstone Group)			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	2.50m
Rotary coring	2.50m-16.00m
Rotary open hole 100mm	16.00m-20.00m

Start Date : 08/03/95
Finish date : 08/03/95

M.J. Carter Associates — **ROTARY CORE DRILLING RECORD**

Project: Enderby Warren | Client: Midland Land Reclamation Limited | Borehole Nº: WF3 Sheet 3 of 3

Location: Leicester | Contractor: Site Investigation Services | Logged By: M. Cliff

Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Discon.	Depth	Samples	Description	Borehole Installation	Reduced Level	Legend
Open hole at 100mm diamater							Reddish brown MUDSTONE with granodiorite boulders (Mercia Mudstone Group)			
					18.50		Fresh GRANODIORITE			
					20.00		BASE OF BOREHOLE			

GROUNDWATER

Date	am / pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)
No water ingress during drilling							

REMARKS

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres

Logged by : M. Cliff

INSTALLATIONS

Plant : Rotary Drill

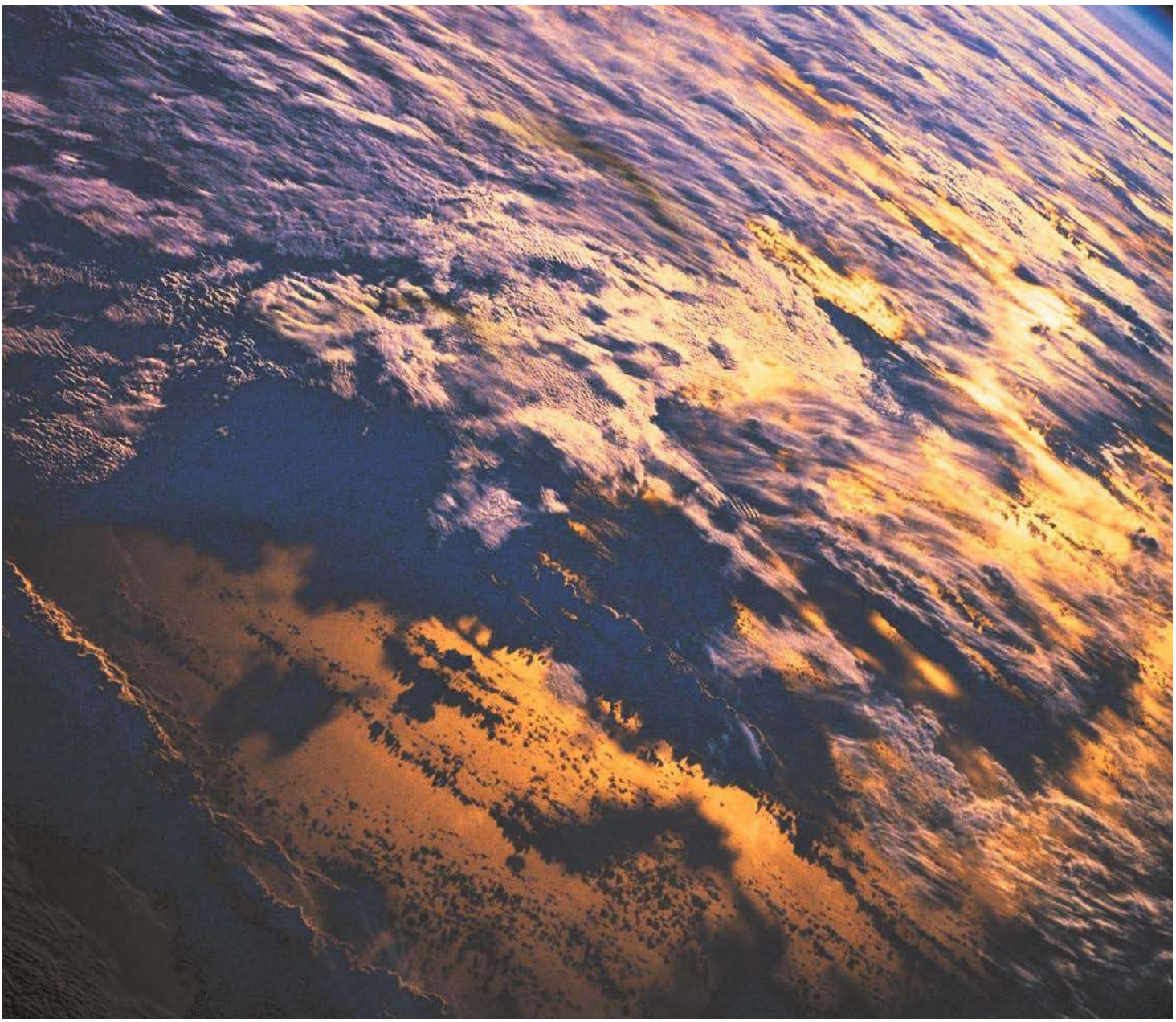
Crew : E. Goring, A. Jones

Type and Dia.	Depth
Rotary open hole 150mm	2.50m
Rotary coring	2.50m-16.00m
Rotary open hole 100mm	16.00m-20.00m

Start Date : 08/03/95

Finish date : 08/03/95

APPENDIX C GEOLOGICAL INVESTIGATION AND GROUND GAS MANAGEMENT STRATEGY, LUBBESTHORPE, ERM, DRAFT REPORT, 27 FEBRUARY 2017



Geological Investigation and Ground Gas Management Strategy, Lubbesthorpe, Leicester

Draft Report

27 February 2017

Goodman

Geological Investigation and Ground Gas Management Strategy, Lubbesthorpe, Leicester

Draft Report

February 2017

Project no. 0383453

Prepared by: Claire Illingworth Yurdakök

For and on behalf of
Environmental Resources Management

Approved by: Andrew Sykes

Signed:

Position: Partner

Date: 27th February 2017

CONTENTS

1 INTRODUCTION

1.1 TERMS OF REFERENCE

Environmental Resources Management Ltd (ERM) has been commissioned by Goodman to provide consultancy support in relation to landfill gas protection measures at the Lubbesthorpe Employment Land Phase I site (the 'site'), at Lubbesthorpe, Leicester, LE19 4AS, UK, located on *Figure 1*.

1.2 BACKGROUND

Goodman has purchased the site at Lubbesthorpe from Drummond and is developing two logistics / industrial units on the site. Outline planning permission has been granted for the scheme but a further detailed planning application is envisaged for the site with the layout as shown on the *Stephen George & Partners Drawing 10-101 P003 P1 "Site Plan"* (provided in *Figures Annex*)The land is currently in agricultural use and historical mapping shows this to be the sole land use for its mapped history. Preparation works have been undertaken at the site, including construction of a road access junction on Leicester Lane and archaeological surveys.

To the west of the site is the former Enderby Warren Landfill site which is owned by Suez (formerly Sita). The landfilling occurred in an exhausted quarry that excavated Grano-diorite igneous rock (South Leicestershire Diorite Complex) deposits (Diorite) and then received waste: it is understood to have ceased taking waste in 2001 and is capped. It is however actively gassing with active gas control, with energy generation, taking place as required by the Environmental Permit that exists for the site. Gassing is expected to continue for decades to come with the permit to remain until it has ceased and the site is shown by the operator to be fully stable. The landfill is unlined at the base and sides i.e. there is no low permeability base or wall protection to prevent migration of landfill gas (although the active gas management system should draw the majority of the gas to the surface for collection under normal operation).

As part of the planning application process undertaken by Drummond the potential impact of landfill gas on the Lubbesthorpe Employment Land development (Phase I and II, the latter north of the site) was evaluated by GRM Development Solutions (GRM) on behalf of Drummond (via Mather Jamie). This included a Site Appraisal[1] including site investigation in 2015 and a Gas Assessment Report[2] in 2016. These reports were used to achieve partial discharge of Planning Condition 24, which related to Landfill Gas Assessment, by the planning authority Blaby District Council (BDC).

As part of the purchase process Goodman asked ERM to undertake a high level review of the GRM reports in relation to the site in November 2015,

[1] New Lubbesthorpe Employment Zone, Site Appraisal for Mather Jamie. GRM Development Solutions, October 2015.

[2] Gas Assessment Report for New Lubbesthorpe Employment Zone. GRM Development Solutions, 22 July 2016.

January/February 2016 and August to October 2016. Some weaknesses were identified in relation to the conceptual model developed for the site by GRM, the design and frequency of gas monitoring, the conclusions of the July 2016 report etc.

It is understood that, in September to November 2016 the Environment Agency (EA) raised concerns that the landfill gas assessment report undertaken by GRM was not adequate. It is understood that Suez also raised concerns.

ERM was asked to provide support to Goodman in the form of discussions and a meeting with the EA and BDC, carrying out site investigation works and preparation of a Landfill Gas Management Strategy for the site.

1.2.1 Date Gaps / Weaknesses in Prior Works

The key issues identified by the EA were as follows.

- The geology beneath the development site was not adequately characterised by the GRM investigation works so as to understand the potential risk from lateral movement of landfill gas in any remaining Diorite or other potentially permeable strata – *the GRM conceptual site model assumes the landfill is shallow (circa 10m, it is reported by the EA to be approximately 50 to 60m deep) and adjacent to low permeability clay. If the Diorite extend under the site (which is not known – they are thought to have been "worked out" but this is not confirmed) then this could create a pathway for gas. Similarly permeable strata such as sandstone bands could exist in the Edwalton Member – Mudstone that is thought to exist under the site.*

- The GRM position that monitoring of shallow 3.5m wells on 6 occasions over 3 months is reported to show "worst case" conditions. However the EA challenged this as the active gas collection system on the landfill was operating when the monitoring was undertaken – *whilst the Environmental Permit holder is required to extract landfill gas for the lifetime of the permit it is the EA's position that it may temporarily cease operating due to power cuts, breakdowns etc. As gas generation begins to fall away a different gas management strategy will be needed which also may be less effective. This is not considered in the GRM assessment. The EA reported that existing properties adjacent to the landfill (e.g. Park Lodge, Pen Crag, Warren Farm, Warren Cottages, Keepers Cottage) have landfill gas monitors and that there is an Emergency Gas Action Plan in place in the event elevated readings are recorded. The EA also notes that the 3 month monitoring period (6 monitoring visits) used by GRM is unlikely to be adequate.*

1.2.2 Regulatory Meeting

A meeting took place at BDC offices on 8th December 2016 at which representatives from BDC, EA, Mather Jamie (on behalf of Drummond), Goodman and ERM attended. The weaknesses identified above were discussed and further information plus a strategy to address them was set out by ERM that included the following.

- Based on geological mapping, it is expected the Diorite does not extend under the proposed building footprints in the shallow soil (10m) but this is

not proven based on the information available. It is also possible that permeable strata (such as sandstone bands) could be present – *this reports includes the revision of the CSM making it robust and site specific.*

- Site investigation comprising 6 boreholes to 10m was undertaken at the site in the footprint of the proposed buildings (covering the two layouts currently defined) to determine the geology and enable the CSM to be determined (works commenced 12th December 2016) – *this work has now been completed, the results of which are presented within this report. In addition a further 6 boreholes were subsequently advanced in the southeast corner of the site and are reported here.*

- The information available based on the GRM investigation works shows the near surface geology at the site to comprise clay then mudstone. Such low permeability geology is helpful in preventing gas movement. Cross sections of the proposed cut and fill exercise for the development (which were shown at the meeting) show that, in the building footprints, fill is required rather than cut. This means that protective low permeability clay/mudstone strata are not to be removed during construction. Equally there is no piling or deep foundation excavations required on-site – *a geological investigation has been completed to prove the depth and thickness of low permeable strata underlying at the site, with higher investigation density within the 'cut' areas.*

- The buildings to be constructed are not like the existing properties in the vicinity of the landfill but rather would be modern low risk (Type D buildings as characterised in BS 8485:2015) buildings that would be constructed with gas protection measures as required. There will be no basements or cellars present in the buildings. There will be sewers, storm water drains and other services present on the development and these will need to be considered in context of gas risk and potential migration pathways – *covered in this report.*

- It is not possible to determine through monitoring what worst case gas conditions would be in the event that the Suez active gas collection system was not operating (as this would require the system to be switched off which might endanger nearby properties). This will be addressed by developing a robust CSM for the site in order to assess whether plausible migration pathways exists and, if so, what protection measures are appropriate – *the preparation of a robust CSM is presented in this report.*

- The potential protection measures that may be appropriate were discussed along with likely gas Characterisation Situation (CS) rating for the site under BS 8485:2015 – *the proposed gas protection measures are incorporated in this report.*

- It was concluded that ERM would take the information obtained from the works above to develop a robust CSM and Gas Management Strategy for the Phase I of the Employment Land. This would be provided to BDC and the EA as means of agreeing the gas protection measures needed. Following agreement then the works would then be implemented during construction phase and appropriate validation would enable the

appropriate planning condition to be discharged – *the report provides the gas management strategy.*

The EA commented that gas membranes are only as good as the construction methods and QA/QC measures adopted during installation. This was agreed and the construction process explained: the appointed contractor would be required to provide during tendering the proposed approach, methodologies, materials, subcontractors and independent validation party they would use. In addition ERM would review independently as Goodman's "policeman". It was noted that BDC Building Control would also visit the site and have a role in validating the works.

The meeting concluded with all parties expressing satisfaction as to the proposed approach and an offer from the EA to be actively involved (which was accepted). As such the EA has subsequently been regularly consulted during the investigation and strategy development process.

1.3 REPORT STRUCTURE

The remainder of the report is structured as follows:

- *Section* 2 – provides a factual summary of the site investigation and gas monitoring works
- *Section 3* – provides a summary of the geological and hydrogeological environmental setting, including the Conceptual Site Model for the site;
- *Section 4* – describes the development and implications in relation gas management;
- *Section 5* – provides a summary of the key findings, conclusions, and recommendations including a proposed gas management strategy

In addition, supporting information is contained within the following Figures and annexes:

- *Figure 1* – Site Location Plan
- *Figure 2* – Borehole Location Plan on Cut and Fill contours
- *Figure 3a* – Conceptual Site Model Pre Development Works
- *Figure 3b* – Conceptual Site Model Post Development Works
- *Figure 4* – Extent of Engineering Clay Layer
- *Stephen George & Partners Drawing 10-101 P003 P1 - Site Plan*

- *Annex A* – Borehole Logs
- *Annex B* – Gas monitoring Results

2 SUMMARY OF SITE INVESTIGATION AND GAS MONITORING WORKS

2.1 INTRODUCTION

Two phases of site investigations have been completed at the site by ERM. The initial investigation was undertaken between the 12th and 15th December 2016. The works included the drilling and installation of six boreholes across the site, and a single round of soil gas monitoring which took place on the 23rd December 2016.

An additional investigation took place between 26th and 31st January 2017, whereby a further six soils bores were advances across the proposed 'cut' area of the site. All ERM boreholes were decommissioned during this period.

Prior to commencement of the intrusive site works, a fieldwork Health and Safety Plan (HASP) was produced. Each intrusive investigation location was identified as being clear of services by *Subsight Surveys Ltd,* a specialist services tracing company.

2.2 INVESTIGATION STRATEGY

A total of twelve boreholes were advanced at the site during two phases of works, in order to evaluate subsurface conditions. The initial investigation was also completed to evaluate the potential presence of ground gas. The boreholes were advanced using a solid-stem, air-blown rotary sampler operated by *Geotron Ltd* to depths of up to 10 m below ground level (bgl). The rationale for the locations of the boreholes was to provide coverage in the footprint of the proposed buildings (covering the two layouts currently defined).

During the initial phase of work, each of the six boreholes (BH01 to BH06) were installed as monitoring wells using 50 mm pipe. Metal headworks were installed to approximately 0.5m above the ground surface at each location.

The rational for the second phase of works was to further understand the geological conditions at the site, including the presence and thickness of low permeable strata within the 'cut' area of the site; therefore no installations were completed within the second phase boreholes (BH11 to BH16).

The locations of the boreholes are presented in *Figure 2* and the geological logs and borehole installation details are presented in *Annex A.*

2.2.1 *Observed Sources of Impact*

No visual or olfactory evidence of impact to either the soil or groundwater was observed during fieldwork activities. No degradable organic matter, such as wood fragments, rootlets, decomposing vegetation or organic rich sediments, were encountered during the drilling works.

2.3 SOIL GAS MONITORING

One round of soil gas monitoring at the installed wells was undertaken on the 23rd December 2016. All gas monitoring wells were monitored using a GFM436 infra-red gas analyser for flow rate (l/hr), methane (CH_4), carbon dioxide (CO_2), oxygen (O2), carbon monoxide (CO), hydrogen sulphide (H2S) and air pressure.

The gas monitoring was undertaken during a period of relatively stable atmospheric pressures of between 1020 (during monitoring on 23rd December) and 1024 (the day before 22nd December) with pressures of 1021 recorded on the day following monitoring (24th December). Atmospheric pressure data was obtained from www.wunderground.com.

2.3.1 *Rationale*

In confined conditions, ground gas can accumulate to form an explosive and/or asphyxiating atmosphere. Methane is a flammable, colourless and odourless gas and is potentially explosive in the range 5% to 15% by volume, in the presence of oxygen of at least 13% by volume. In confined spaces, carbon dioxide can displace oxygen and accumulate to form asphyxiating conditions.

Ground gas concentrations were assessed against the guidance detailed within CIRIA report C665 "Assessing Risks Posed by Hazardous Ground Gases to Buildings", 2015 British Standard "Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings" BS 8485:2015.

The guidance identifies that the assessment of risks from ground gasses requires consideration of both gas concentrations and borehole flow rates whereby the combination of the two can be used to define a characteristic situation for a site based on the limiting borehole gas volume flow for methane and carbon dioxide known as the Gas Screening Value (GSV).

The GSV is calculated by multiplying the borehole flow rate (l/h) by the gas concentration (%). The maximum recorded methane concentration for each borehole was used in the calculation of the GSV for methane, as this will represent the 'acute risk' scenario which may occur from ingress of potentially explosive gas. The steady state carbon dioxide concentration is used in the calculation of the GSV for carbon dioxide, as this will represent the 'chronic risk' scenario, which may occur due to toxic effect.

Guidance on remedial measures that may be employed to control gas generation and migration is also provided within CIRIA report C665, BS 8485:2015.

The results from the soil gas risk assessment are represented in *Table 2.3*. For the purpose of risk assessment, a flow of 0.1 l/hr and concentrations of 0.1 % and 0.1 ppm (instrument detection limit) has been assumed, where no flow or detected readings were noted.

Table 2.3 Gas Results and Screening Risk Assessment

Borehole	Flow (L/hr)	Max CH_4 (%)	SS CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)	Gas Screening Value (L/hr)		Gas Hazard Potential* (CIRIA C665)
							CH_4	CO_2	
BH01	0.1	0.1	0.9	11.5	20	0.1	0.0001	0.0009	1 (Very Low)
BH02	0.1	0.1	0.8	18.1	10	0.1	0.0001	0.0008	1 (Very Low)
BH03	-3.4	0.1	0.3	19.9	0.1	0.1	-0.0034	-0.0102	1 (Very Low)
BH04	-0.1	0.1	0.6	19.4	0.1	0.1	-0.0001	-0.0006	1 (Very Low)
BH05	0.1	0.1	0.3	19.9	0.1	0.1	0.0001	0.0003	1 (Very Low)
BH06	3.4	0.1	0.5	19.4	0.1	0.1	0.0034	0.017	1 (Very Low)

Notes:
Max Maximum
SS Steady State

Based on the available limited monitoring results, it is considered that the risk to the future on site receptors via gas migration pathways from the site is very low and no gas protection would be necessary based on the data above.

However it is recognised that peak potential gas conditions would likely occur either in the event the active gas management system in the adjacent landfill failed or a sudden and substantial drop in atmospheric pressure. As these conditions cannot be monitored the assessment above is considered for information purposes only and the gas management strategy for the site is based on the CSM for the site plus precautionary protective measures.

3 ENVIRONMENTAL SETTING

3.1 INTRODUCTION

The following *Section* describes the site's location and environmental risk setting using literature-based information. It includes a description of the geology, hydrogeology and hydrology for the site which provides the physical background for the Conceptual Site Model set out in *Section 4*.

The following published information sources have been used to complete the environmental Site setting:

- British Geological Society's website; and http://mapapps.bgs.ac.uk/geologyofbritain/home.html?location=S21%201TZ
- Environment Agency webpage 'What's in Your Backyard?' http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

3.2 SITE LOCATION

The site is located off Leicester Lane, Enderby, Leicester, LE19 4SA, within undeveloped farmland. The site is predominately within a rural / agricultural setting, and is bordered by the M1 to the east. A former landfill is located 250 m to the west, which is managed by Suez Recycling and Recovery UK Ltd (Suez). A site location map is presented in *Figure 1*.

The current use of the site is as farmland. An archaeological survey conducted through Leicester University has recently been completed at the site. Current site activities are not anticipated to represent a significant risk of contamination.

3.3 SURROUNDING AREA

The immediate surrounding area is occupied as follows:

- *North*: agricultural fields and woodland, beyond which is the M69;
- *South:* directly adjacent to the south of the site is the development of a road access junction on Leicester Lane into the proposed commercial development area. This work is being conducted by Leicester County Council. Beyond Leicester Lane are agricultural land and fields;
- *East*: the M1 beyond which, are industrial and commercial properties including a hotel; and
- *West*: residential properties including a farm. Beyond which is a landfill, managed by Suez Environment.

The nearest residential properties are located immediately adjacent to the western boundary of the site.

Approximately 100 m to the west of the site is the former Enderby Warren Landfill site which is owned by Suez (formerly Sita). The location of the landfill is within a former quarry that excavated Grano-diorite igneous rock (South Leicestershire Diorite Complex) deposits (Diorite). The landfill is understood to have received waste between 1981 and 2001, with the majority of waste comprising of municipal waste collections from Leicester City & Blaby District Councils, and as such will contain a large volume of biodegradable waste, which can give rise to the production of landfill gas for a number of years.

The landfill has been capped; however it is actively gassing with active gas controls in place, which feeds into an energy generation system, as required by the Environmental Permit that exists for the landfill. Gassing is expected to continue for decades to come with the permit to remain until the gassing has ceased and the landfill is shown by the operator to be fully stable.

The landfill is unlined at the base and sides i.e. there is no known manufactured low permeability base or wall protection to prevent migration of landfill gas (although the active gas management system should draw the majority of gas to the surface for collection under normal operation). It is understood that the landfill is bounded by a high permeability, gas venting trench which is designed to vent any lateral migration but the depth of this trench is unknown (but will not extend to the full depth of the waste).

3.4 SITE HISTORY

The earliest historical map from 1885 identifies the site to be used for agricultural purposes until current day. The historical maps are presented GRM report (1).

3.5 GEOLOGY & HYDROGEOLOGY

3.5.1 Geology

Regional Geology

According to the BGS website (accessed 22th December 2016), Glaciofluvial deposits comprising sands and gravel, underlay the site, excluding the north western corner. This is further underlain by Glacial Till (Thrussington Member), comprising gravel, sands, silts and clay. The Glacial Till is formed of reddish brown, poorly sorted stones and matrix derived primarily from the underlying Triassic rocks.

The bedrock geology underlying the site is the Edwalton member of the wider Mercia Mudstone Group. The Edwalton member was deposited in the Triassic Period within a monsoonal, hot, dry desert environment. This resulted in dune and evaporite deposits, dominated by sand and muds deposited in

(1) GRM, New Lubbesthorpe Employment Zone; Project Ref: P7187; Dated: October 2015

sabkha mudflat environments, interbedded with very fine-grained sandstone formed during flash floods. Because of the variety and complexity of the environment, deposits can vary laterally very rapidly.

The Edwalton member is described as red-brown and greenish grey dolomitic mudstone and siltstone, containing significant amounts of mixed-layer swelling clays, interbedded with very fine-grained sandstone (termed locally as 'skerries') which are stronger, and more resistant to erosion and excavation, than the mudstones and may contain perched water tables. Its thickness ranges between 35 and 45 m.

Published information, describes the bedrock geology underlying the site varying from north to south. The northern third of the site is depicted as Edwalton sandstone, whilst the southern two thirds are depicted as Edwalton mudstone. It should be recognised that these are not mutually exclusive and were formed as part of the same environmental system, where the percentage of mud/silt and sand will vary between beds within the group as well as laterally within the same bed.

To the west of the site, deposits of South Leicestershire Diorite Complex were once present, prior to being quarried. The Diorite is an igneous intrusion of silica poor magma. The magma intrusion rose through the underlying Cambrian to Ordovician Shale Groups, and was subsequently unconformable overlain by the younger Triassic strata or Quaternary superficial deposits.

3.5.2 Hydrogeology

Regional Hydrogeology

According to the Environment Agency website (accessed 22th December 2016) the superficial deposits are classed as a Secondary A aquifer. Secondary A aquifers are described by the Environment Agency as *'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers'.*

The Edwalton Member (Mercia Mudstone Group) has been classified as a Secondary B aquifer. Secondary B aquifers are described by the Environment Agency as '*predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers'.*

The Environment Agency website indicates that the site is not located within a groundwater source protection zone and is not located within a groundwater nitrate vulnerable zone.

3.5.3 Hydrology

According to the local Ordnance Survey Maps, the nearest surface water feature to the site, is a small unnamed pond, located within woodland approximately 160 m northeast of the site. This pond feeds a minor unnamed water course which flows towards the north.

According to the Environment Agency website the site is not located in a flood risk area.

3.6 FIELD OBSERVATIONS

3.6.1 Observed Geology

The ERM intrusive investigation encountered competent, soft to firm, gravelly, clay at all locations across the site. The thickness of this uppermost layer varies between 1.0 m (BH03) and 6.0 m (BH05 and BH13).

Mudstone / weathered mudstone was encountered at each location, at depths between 1.8 m bgl (BH01) and 7.5 m bgl (BH04). Sandstone was identified, interbedded with the mudstone at BH01, BH02, BH03, BH04, BH06, BH12, BH13 and BH14 and the shallowest sandstone bed was encountered at 2 m bgl at BH16. Sandstone was not present in BH05, BH11, BH15 and BH16.

3.6.2 Observed Hydrogeology

During the initial phase of works, groundwater was encountered at five of the six locations, excluding BH06. Perched groundwater was observed seeping into the hand dug pit within BH02 and BH03 at 1.3 and 1.5 m bgl respectively.

Deeper perched groundwater strikes were recorded between 6.5 m bgl and 8.8 m bgl across each of the five boreholes, corresponding with sandstone horizons (BH01 and BH02), just below the sandstone within mudstone (BH03) and weathered mudstone (BH04 and BH05).

During the second phase of works perched groundwater strikes were encountered at 6 m bgl and 7 m bgl at BH12 and BH13 respectively, both strikes were encountered within sandstone strata.

The groundwater strikes correspond with the sandstone or weathered mudstone horizons with the resting groundwater level rising between 1.3 and 5.5 m above the groundwater strike, other than at BH05.

The large variation in groundwater depths indicates that there is no continuous groundwater body underlying the site, and that the encountered groundwater is perched and predominantly located within the more permeable sandstone lenses.

4 REVISED CONCEPTUAL SITE MODEL

4.1 INTRODUCTION

The following *Section* highlights the potential sources of ground gas impact on site, from the adjacent off-site landfill and identifies potential receptors and plausible pollutant linkages in the context of the site setting and commercial land use. The Conceptual Site Model (CSM) pre development of the site is presented in *Figure 3a*.

4.2 SOURCES

4.2.1 Potential Primary Sources

Primary sources are man-made activities that have the potential to introduce contamination into the ground.

Based on the information gathered with respect to the current on and off site activities and the history of the site and the surrounding area, the following are considered to be potential primary sources of potential impacts ground gas impacts:

On-Site

It is not considered that current or historical site activities have affected land quality at the site.

Off-Site

As described previously to the west of the site is the former Enderby Warren Landfill site which is owned by Suez (formerly Sita). The landfilling occurred in an exhausted Diorite quarry. Information provided by Environment Agency describes the landfill to extend to a depth of up to approximately 60 m bgl, which does not include an engineering basal or sidewall containment system. It is understood that the landfill received waste between 1981 and 2001, with the majority of waste comprising of municipal waste collections from Leicester City & Blaby District Councils, and as such will contain a large volume of biodegradable waste, which can give rise to the production of landfill gas for a number of years.

The landfill has since been capped with an engineered capping layer and an active gas system is in place to collect gas generated within the landfill, with energy generation, taking place as required by the Environmental Permit that exists for the landfill.

4.3 POTENTIAL RECEPTORS

Potential receptors of ground gas impact at the site are discussed below.

4.3.1 Human Health

On-Site Human Health

Given the proposed commercial land use, the primary human receptors are likely to be on-site working adults.

4.3.2 Property

The proposed redevelopment of the site will introduce two large commercial units, which are considered to be significant sensitive receptors.

4.4 POTENTIAL PATHWAYS

Potential pathways of exposure to on-site personnel include from the migration of soil gasses into buildings or outdoors, through preferential flow pathways such as:

- lateral migration of gasses through sufficiently permeable strata;
- lateral migration of gasses through bedding;
- vertical and lateral migration of gasses through cracks and fissures within low permeable strata (if a pathway then considered to be at low flow rates and volumes); and
- lateral migrations through service corridors and service penetrations.

The foundations for the buildings proposed at the site are raft/pad rather than piled. Therefore pathways through piled foundations penetrating clay / mudstone do not exist.

5 THE DEVELOPMENT AND IMPLICATIONS IN RELATION TO GAS MANAGEMENT

As part of the development works at the site, a significant cut and fill exercise will take place. Material from the elevated southern area of the site will be 'cut' and reused to 'fill' the northern area of the site. *Figure 2* includes the cut and fill contours for the site.

The conceptual site model discussed in *Section 4*, has identified that potential gas migrations will be through potential pathways such as, high permeable strata, bedding plans and potential cracks and fissures within the underlying geology, and therefore there is a potential for underlying ground gas to migrate to the proposed building development.

The geological field assessment completed as part of these works has identified that a significant amount of low permeable strata underlying the majority of the site. *Table 5.1* below summaries the geological condition underlying the site (with column showing the thickness of clay / mudstone present, from the formation level down, after the cut has occurred).

Table 5.1 Encountered Geology assessed against the 'Cut' Operation

Location	Elevation (m AOD)	Initial Clay/ Mudstone Zone (m bgl)	Sand / Sandstone (Skerrie) Band (m bgl)	Deeper Mud-stone (m bgl)	Standing Water Level (m bgl)	Standing Water Level (m AOD)	Thick-ness of Cut (m)	Thickness of Clay / Mudstone after cut / fill (m bgl)
BH01	77.62	0 - 8.0	8.0 - 9.0	9.0 - 10*	2.59	75.03	Fill	8.0
BH02	75.21	0 - 6.8	6.8 - 8.5	8.5 - 10*	6.2	69.01	Fill	6.8
BH03	76.47	0 - 7.5	7.5 - 8.0	8.0 - 10*	7.96	68.51	Fill	7.5
BH04	75.85	0 - 9.5	9.5 - 9.7	9.7 - 10*	1.09	74.76	Fill	9.5
BH05	81.68	0 – 10*	n/a	n/a	8.76	72.92	2.9	4.6
BH06	80.76	0 - 5.0	5.0 - 8.2	8.20 - 10*	n/a	n/a	2.3	2.7
BH11	79.809	0 - 7.0	n/a	n/a	n/a	n/a	0.8	6.2
BH12	80.042	0 - 4.2	4.2 - 4.5 & 6-6.3	4.5 - 6 & 6.3 - 7.5	6	74.042	1.5	2.7
BH13	80.517	0 - 6	6 - 7.5	n/a	7	73.517	1.5	4.5
BH14	80.840	0 - 4.8	4.8 - 8	n/a	n/a	n/a	2	2.8
BH15	80.445	0 - 8.5	n/a	n/a	n/a	n/a	2.5	6.0
BH16	82.155	0 - 2	2 - 4.5	4.5 - 9.5	n/a	n/a	3.3	-1.3

Notes
* Borehole terminated at 10 m bgl
m bgl metres below ground level

The northern "small" unit (Unit 2 - where BH01 and BH02 are located) and the northern area of the southern "large" unit (Unit 1 - BH04 location) benefit from considerable underlying low permeability strata (6.8 to 9.5 m) and are also in areas of fill (i.e. none of this cover will be removed).

The southern area of Unit 1 (BH05 to BH06, BH11 to BH16), which is in an area of cut, has between 4.2 and 10.0 m of low permeable clay/mudstone

before permeable Skerrie sandstone bands are encountered at 7 of the 8 locations. The exception is BH16 where there is only 2 m of low permeable strata. This is located within the highest area of the site and the cut is greatest at 3.3 m. Therefore in this localised area, after excavation to formation level, there will be no low permeability cover present. Every other location has of minimum of 2.7 m of low permeable cover after cut.

Figure 4 shows the investigation locations, the cut / fill contours and a conservative assessment of the area that may not benefit from the natural low permeability deposits (based on adjacent boreholes and the contours) post cut.

Based on the findings of the further assessment work it is concluded that, for the majority of the site, no plausible pathway exists between the permeable strata at depth, which could potentially contain gas in worst case condition of a failed gas collection system on the landfill/substantial drop in atmospheric pressure, and the buildings and services on-site as a consequence of the substantial thicknesses of low permeability clay / mudstone strata that exist from the surface downwards.

However in the area of the southwest corner of the large building, following the cut operation, no low permeability strata will remain i.e. the building would be directly founded on permeable strata. *Figure 3a* shows the CSM for the developed site in this scenario.

To address this potential pathway it is proposed to overdig the area shown on *Figure 4* by one metre depth and then replace it with engineered clay layer placed in accordance with the Highways Specification (Series 600). *Figure 3b* shows a revised CSM following placement of this clay liner. This measure has been discussed with the EA and agreed.

In addition, as a further precautionary measure to reflect the worst case gas scenario, the following gas protection measures (in accordance with BS 8485:2015) should be incorporated in all buildings on site:

- Structural Barrier Floor and substructure design: Cast in situ monolithic reinforced ground bearing rate or reinforced cast in situ suspended floor slab with minimal penetrations; and

- Gas Resistant Membrane Protection element/system: multi-layer reinforced LDPE membrane with aluminium core, taped and jointed that is verified in accordance with CIRIA C735.

Services that could convey gas into a building e.g. foul or storm drainage systems or ducting should be vented externally to the buildings (e.g. with venting manhole covers). All services that enter a building should ideally break ground outside the concrete raft and enter the building through the side of the building. Where this is not possible services should be appropriately sealed where they enter a building. As a further precautionary measure appropriate safe working systems should also be adopted before workers enter any drains, sewers or other confined spaces at the site for maintenance, inspection or other purposes.

To ensure compliance with the Gas Management Strategy a Gas Protection Measures Implementation Plan should be prepared and approved by the Planning Authority prior to building construction works commencing. This should include quality assurance and validation measures to be completed to ensure the measures are appropriately specified and implemented. An appropriate validation report should also be prepared and approved by the planning authority prior to occupation of a building.

Figures

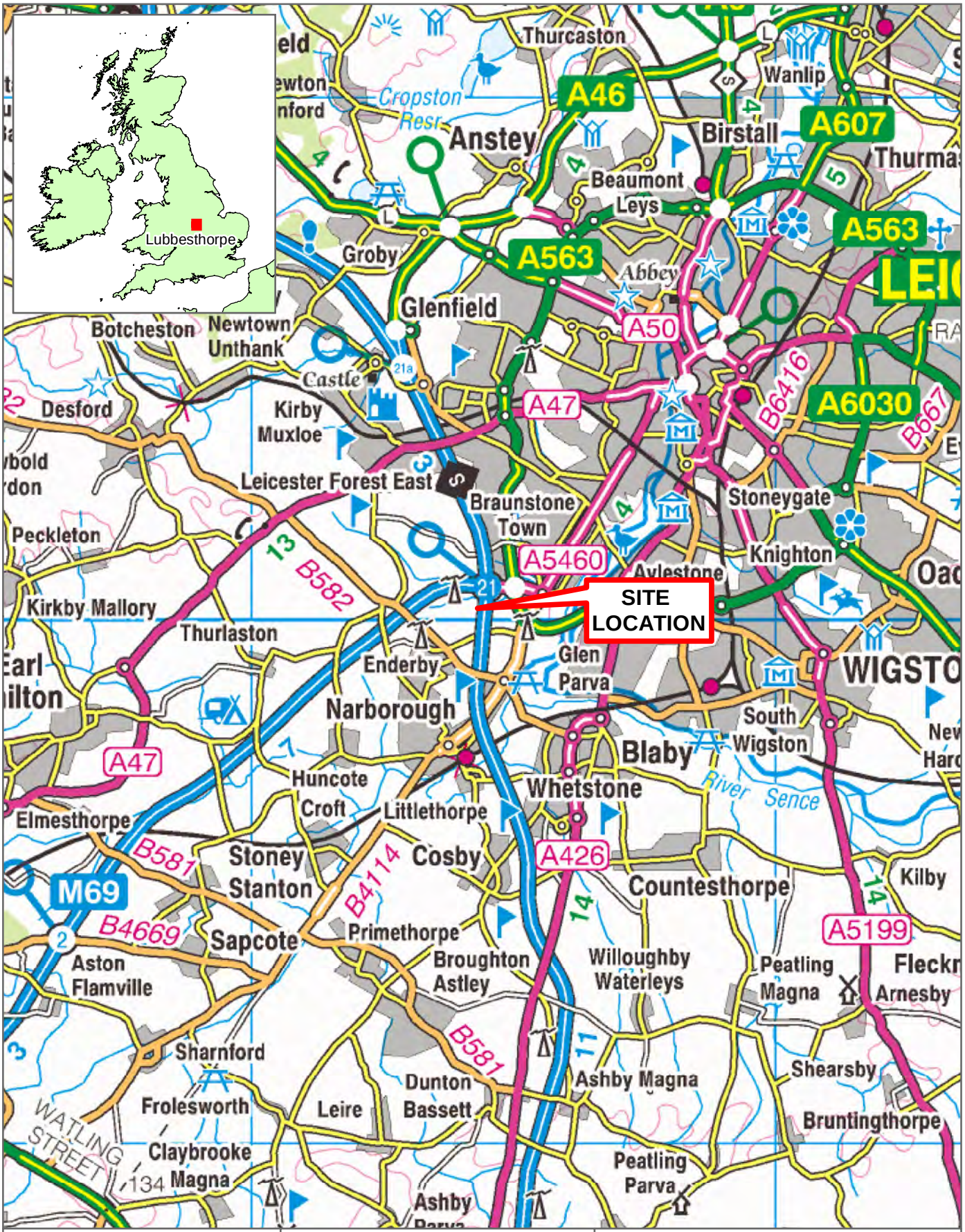


Figure 1
Site Location Plan
Lubbesthorpe, LE19 4AS

SIZE: A4	VERSION: A
SCALE: 1:100,000	DRAWN: MTC
PROJECT: 0383453	CHECKED: PB
DATE: 10/02/2017	APPROVED: ADS

ERM

Goodman

PROJECTION: British National Grid

Path: P:\Projects\0383453 Goodman Lubbesthorpe.CIY\GIS\MAPS\00383453_SiteLocation_A01.mxd

Phase 1 Borehole

Phase 2 Borehole

Site Boundary

0 20 40 60 80 100

Metres

N

Figure 2
Borehole Location Plan
Lubbesthorpe, LE19 4AS

SCALE: See Scale Bar	VERSION: A
SIZE: A4	DRAWN: MTC
PROJECT: 0383453	CHECKED: PB
DATE: 15/02/2017	APPROVED: ADS

ERM

Goodman

PROJECTION: British National Grid

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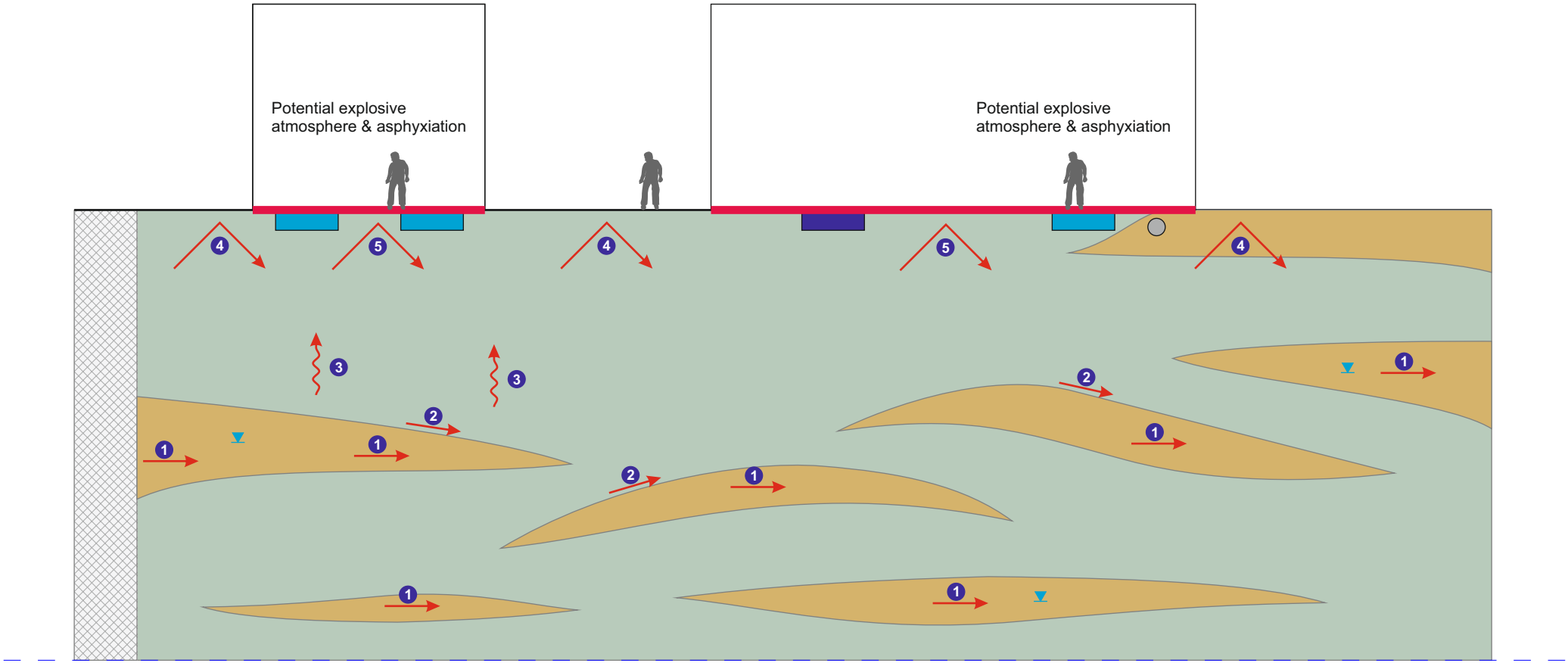

- Sealed service entries
- Service corridors
- Concrete slab incorporating vapour resistant membrane
- Landfill
- High permeable strata (Skerries bands)
- Low permeable strata (Clay / Edwalton mudstone)
- Foul sewer drainage channel
- Discontinuous perched groundwater, associated with weathered and high permeable strata

1. Lateral migration through high permeable intervening strata
2. Lateral migration along bedding
3. Potential vertical migration through cracks & fissures
4. Low permeable strata restricting gas migration
5. Vapour membrane with building restricting gas migration

Figure 3a
Revised Conceptual Site Model, Pre-development
Lubbesthorpe, Leicester Lane, LE19 4AS

SCALE: Not to Scale	VERSION: A
SIZE: A4	DRAWN: MTC
PROJECT: 0383453	CHECKED: CIY
DATE: 13/02/2017	APPROVED: ADS

ERM

Goodman

0383453_CSM_PreDev_A01.cdr