

Enderby Relief Road (ERR) Leicestershire

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

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IN

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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 (<u>www.mapapps.bgs.ac.uk/geologyofbritain</u>) (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

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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.

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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.

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, or 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.

Table 2.1Proposed ERR Sections – Footprint and Surrounding AreaDescription

3. ENVIRONMENTAL SETTING

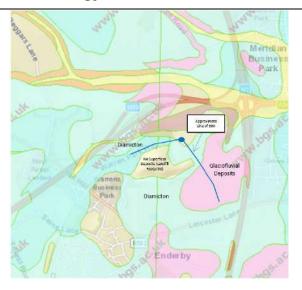
3.1 Geology

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.

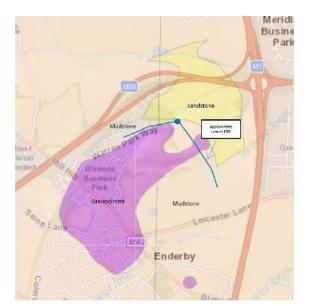


Bedrock (Solid) Deposits -

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:

- 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

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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.

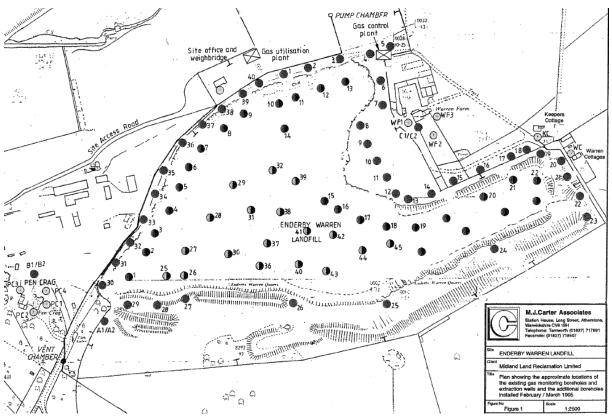


Figure 3 – EWL Boreholes Reviewed by ERM

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
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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

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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:

- 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.

Receptor Number (as on Figure 2)	Receptor Name	Receptor Characteristics
Potentially Sens	itive Receptors to La	andfill 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 lo	lentified as Sensitive	e (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

Table 5.1 – Identified Receptors – Current Situation

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

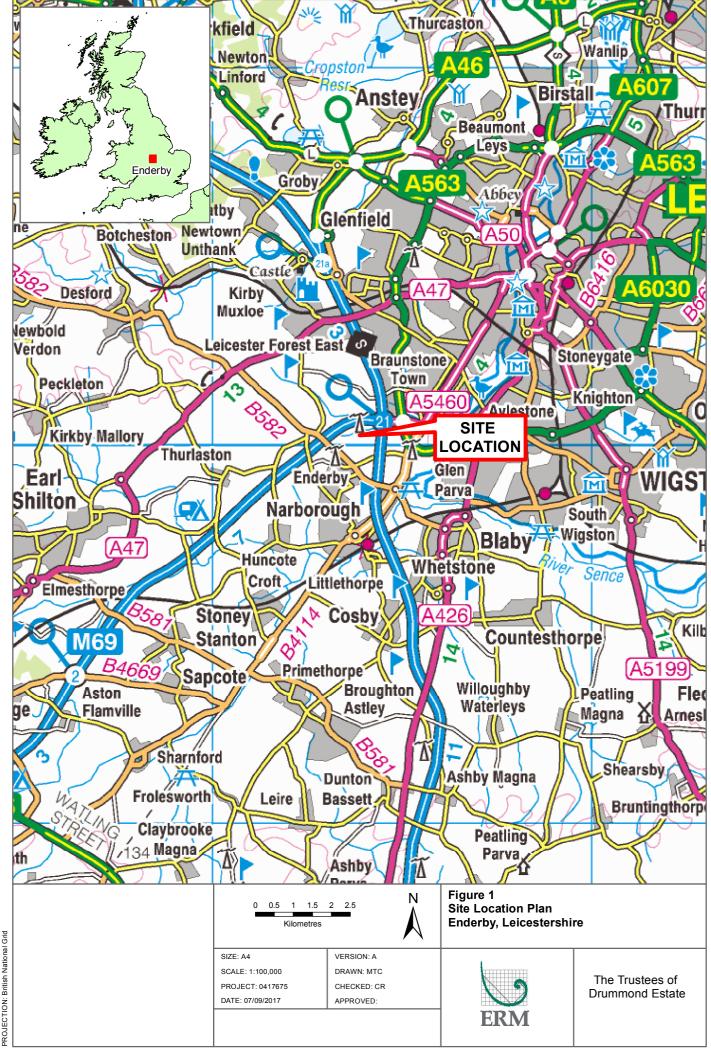
In overall summary, the review of available information leads to the assessment that the risk of impact to identified sensitive receptors, from landfill gas, both currently and after construction of the ERR, remains as Low. This assessment relies on the continuous operation of the SUEZ/Infinis gas extraction 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.

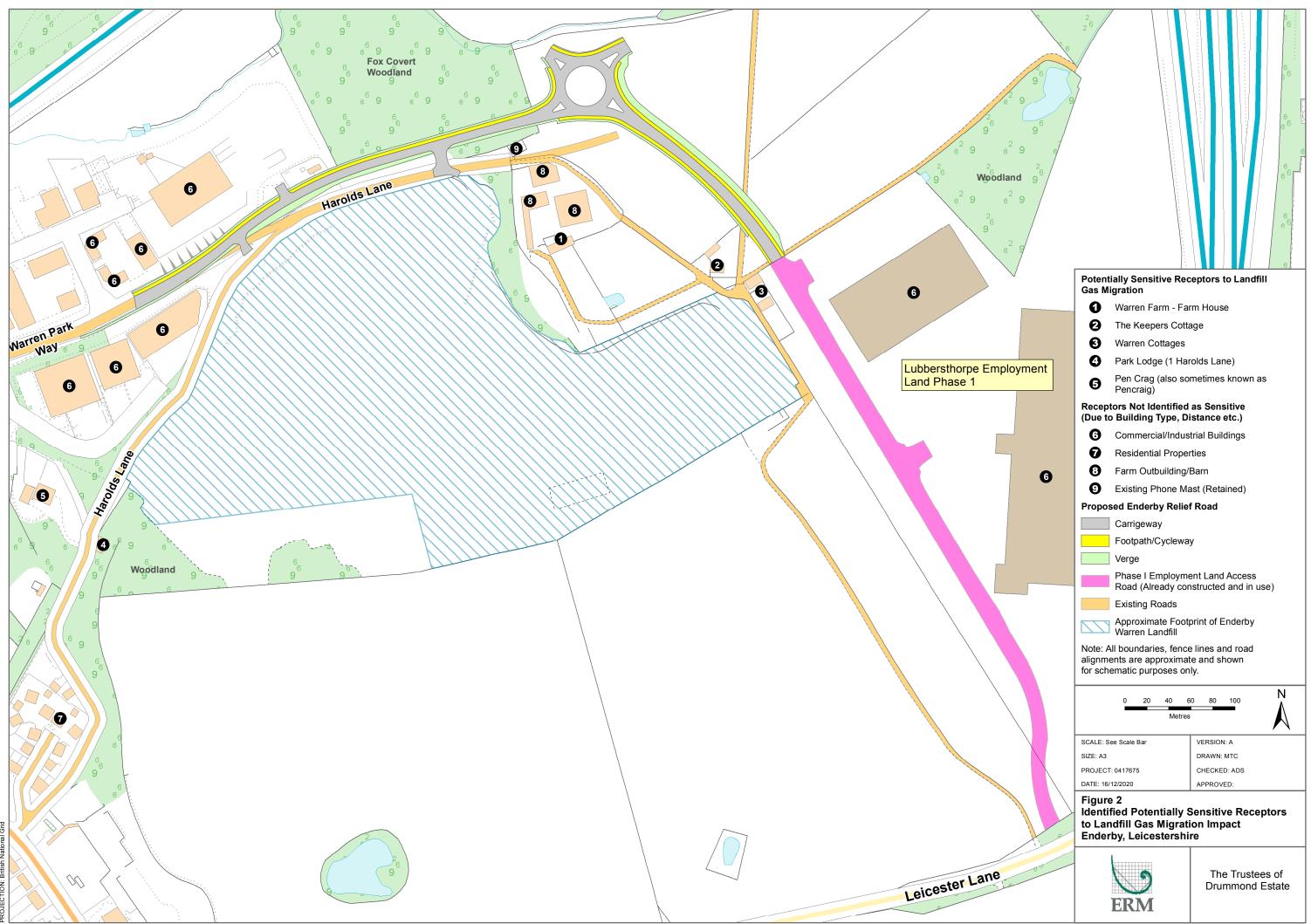
Following completion of the ERR, relocation and reconfiguration of the treatment compound to adjacent to the EWL, and removal of the identified sensitive receptors, it is considered likely that the risk from EWL will have reduced, in comparison to the current situation.

APPENDIX A FIGURES

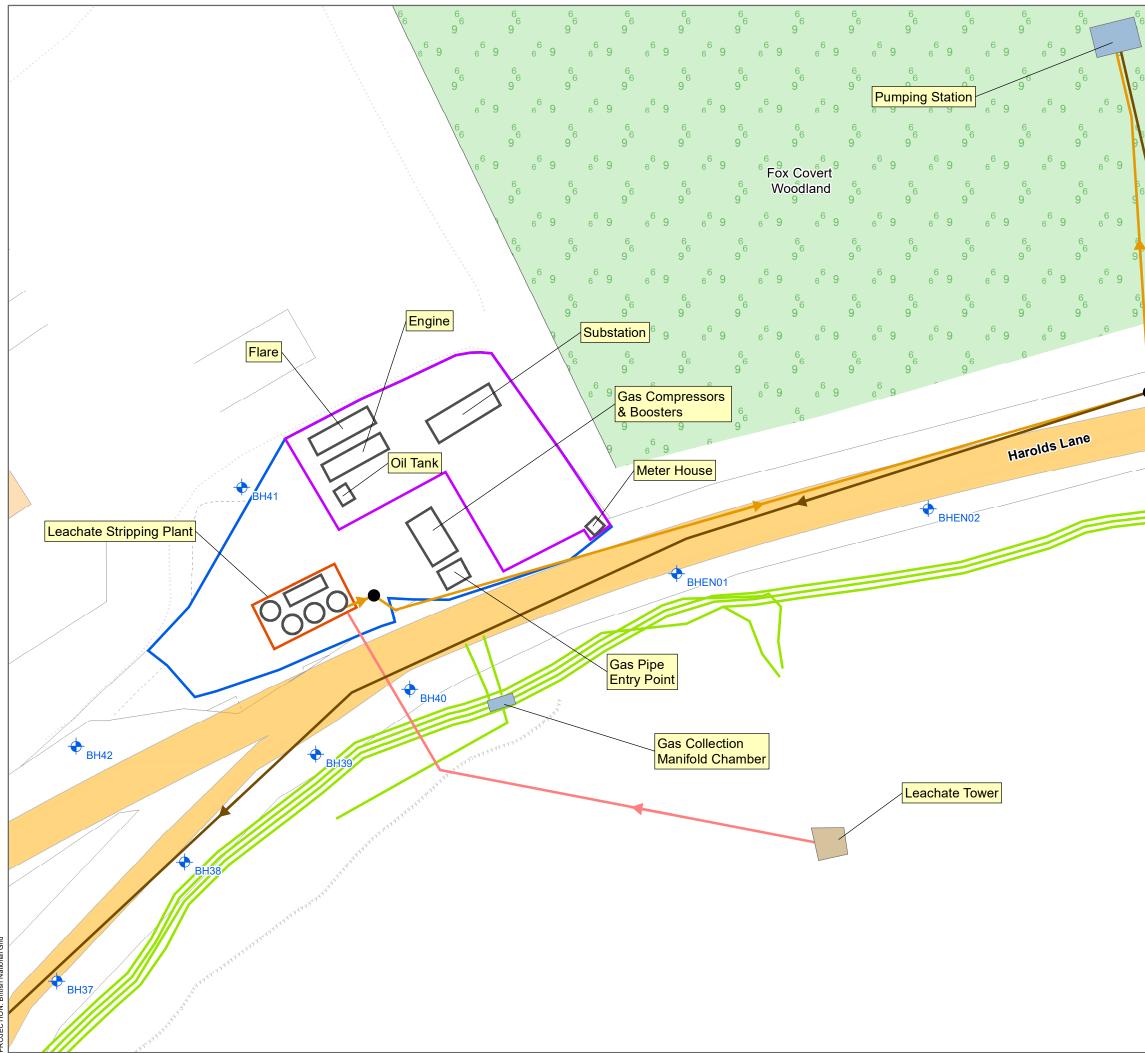


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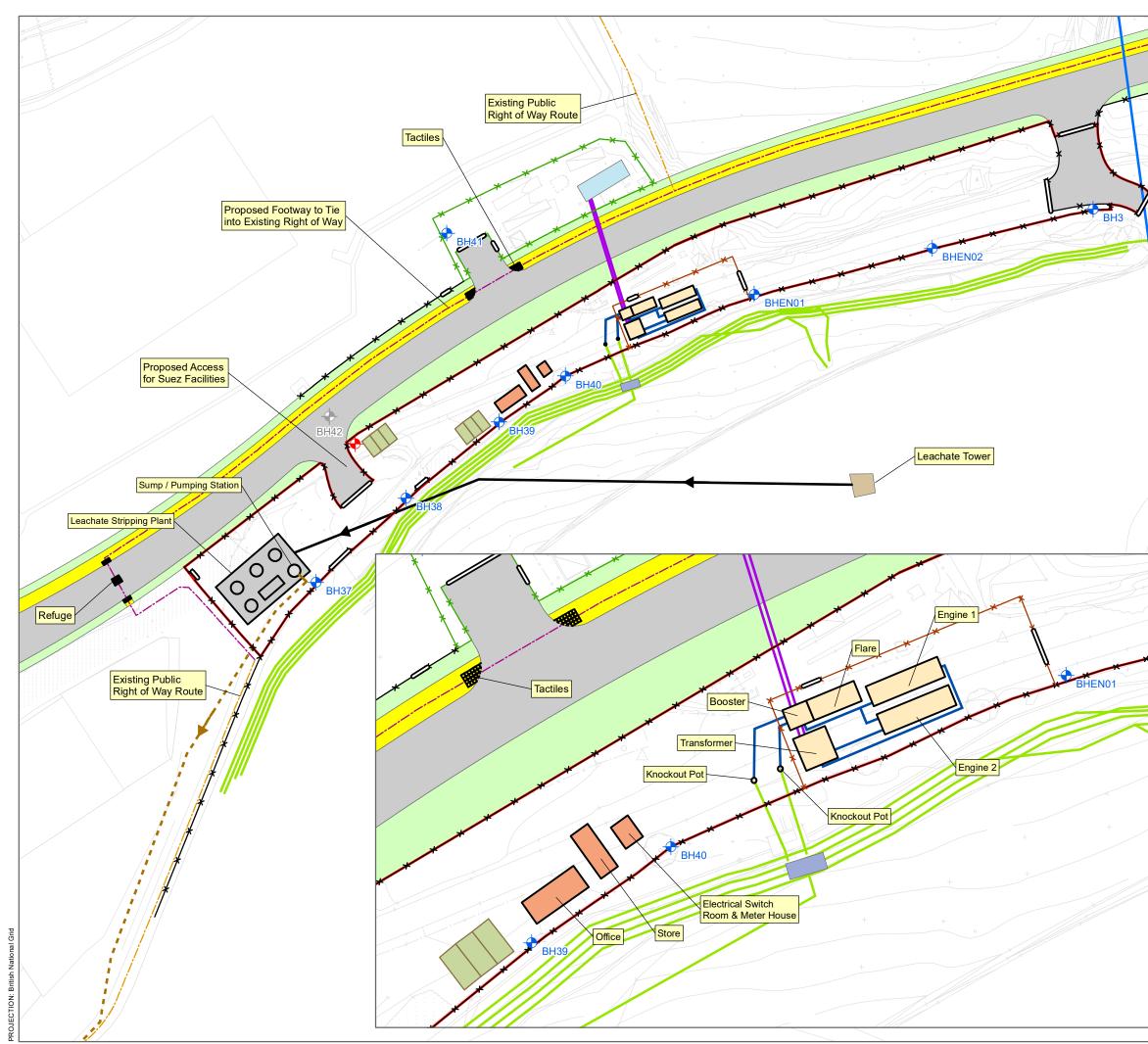
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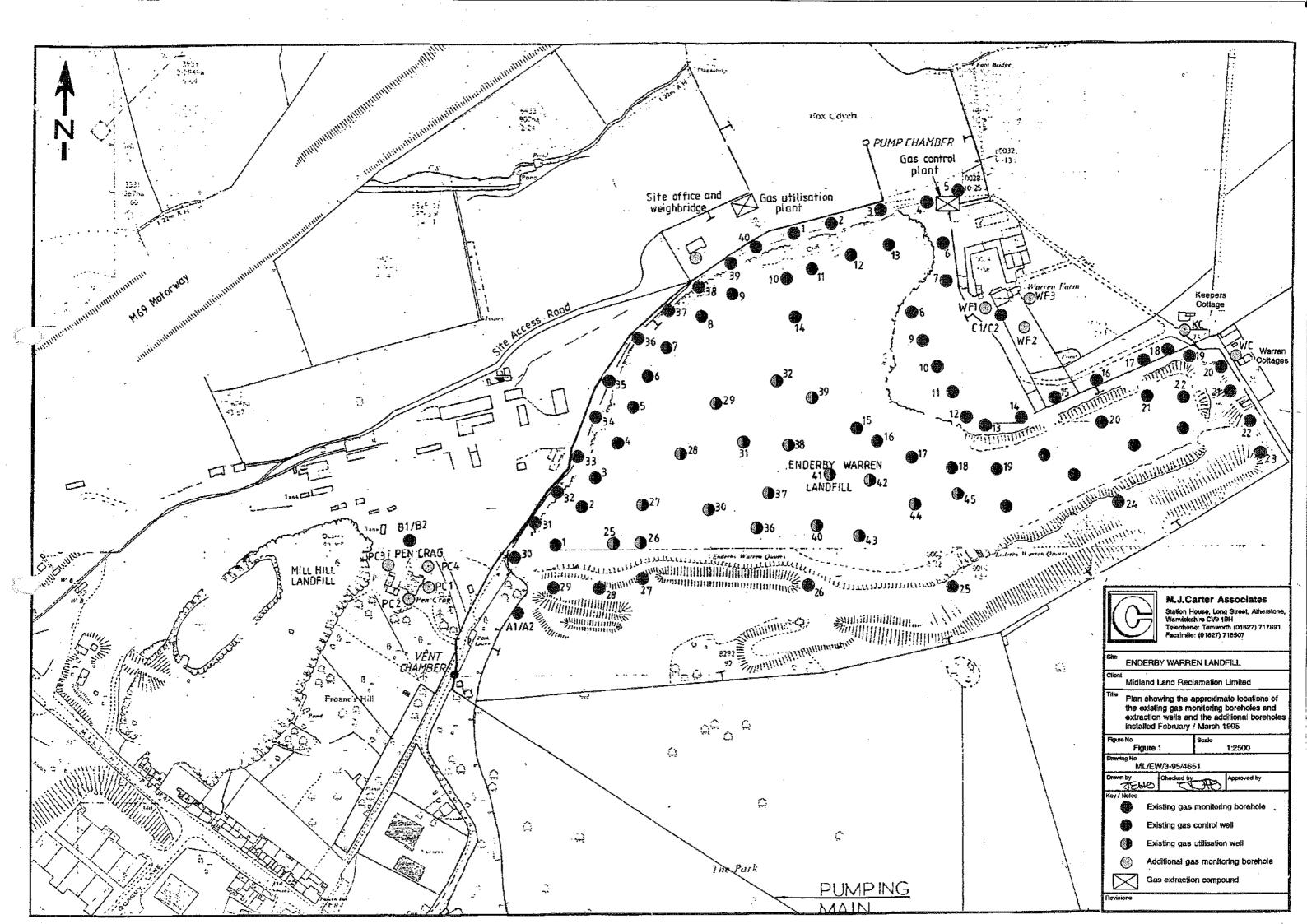
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APPENDIX B EWL BOREHOLE LOG EXTRACTS



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Daily Site Report

Borehole No. 1



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Daily Site Report

Piezometers/Standpipes (Details in "remarks")

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Daily Site Report

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Borehole No. A 50 M

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At end of days boring	12.0	,	ls boreho	le comple	ted	,	I	I	l		Yes,	/Not		

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	B	oring/Casir	ng
Water struck at							Depth to m	Boring mm dia.	Casing mm. dia.
Rose to									
Sealed off at									
Water added from									
Water added to							Were Piezo Installed	meters Yes/No	

Details of tin	ne spent	From	То	Time Hours	REMARKS:- (Delays, weather, details of
	C E 40	m	ពា		Standpipes etc.)
(Details in "r		m	m		
		m	n.		
Awaiting Ins	tructions	am pm	am pm		
Moving Posit	tion	вн.	BH.		~ 1
Piezometers/	Standpipes (Details	in "remarks")			£11
Rain/Breakde	owns (Delays) "	14 - A			Signed
Boring (Inclu	iding Casing and Sar	mpling)			SITE INVESTIGATION SERVICES
Vehicle No		TOTAL TIME			4, HIGH STREET,
0.05.00	1.	······································			FILLINGHAM, NR. GAINSBOROUGH
CREW NAMES	2.				LINCOLNSHIRE DN21 5BW
· · · · · · ·	3.				TELEPHONE: 0427 668458 FAX: 0427 668077

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Daily Site Report

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Borehole No. /

TAMROLY PRIV SPON MOUS

Ske ivanie	ARM YARO		K_12					Dayl.	13	.S.G.	243	1,	r [Date			<u>-</u>	
Description o	f Strata			Dep	th D	epth of Casing	1 (S	Depth amples/ SPT's)	s	ampl	es		Star	ndan	d Per Tes		tion	I
At st	art of days boring						From		ģ	8	٩đ	ŝ	Ę	Ę	Ę	Ę	Ë	1
RLO	CLAY 8 81-71	SAW	<u> </u>	.0,1	<u></u>		m	m	Ref.	TYI	S 8 9 8 8	ъ С	75 0	75 1	75 mm	75 n	75 1	75.
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****	******			• • • • • •														
At en	d of days boring			2-	N		is bore	hole compl	eted						Yes.	/M46	'	
	Water	Dep	nth T	ime	Dep	oth	Time	Depth	T I	me	1				10			
Mator struck				n/pm	<u> </u>	<u>1 a</u> l	m/pm	m	am,	/pm	De	pth			/Cas		Casi	ina
Water struck	at	<u>Ner</u>	15									m			n dia		m. c	
Rose to																		
Sealed off at	<u></u>																	
Water added	from		_				1						i					
Water added t	0					İ						re Pi talle	iezor d	nete Y	rs es/N	0		
Details of time		From	То	T	ime													
				-	ours	REN	ARKS	: (Delay Stand	/s, wa pipes	eath etc.	er, c)	leta	ils O	Ŧ				
CHISELLING	Etc	m		m 														
(Details in "re	marks")	m		m														
		n am		m														
Awaiting Inst		pm	pi pi	m														
Moving Positi	on Standpipes (Details in "	BH.	BH.			ļ		~	0									
Rain/Breakdo			1	+		Signe	ad	hars.	Кρ	uτ	LL							
	ting Casing and Sampli				· ·	-								•				
Vehicle No		ral Timi		-				STIGAT	ON S	SER	VIC	ES						
	1.	////						TREET, AM, NR.	GAI	VSB	OR	ou	GH	ŧ				
CREW NAMES	2.					LINC	COLNS	SHIRE DI	V21	5BV	V				_			
	2	•				e teli	EPHO	NE: 0427	668	458	F/	AX:	042	27.6	680	377		

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Daily Site Report

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Borehole No. A Convertier

ite Name		Depth	Depth of Casing	(Sai	epth mples/	Sam	ples		Star	ndaro	d Pen Test		tion	
At start of days boring	n		Caarrig	Fram	PT'si To	° 2	No. of Blows	Ś	E	E	Ē	Ē	Ê	E
OPEN MOLE 125 MM				m		Ref. No.		ပီ	75	75	75.	Я	75	5
		0.0												
Soft Brann SANOY	Su.TY	030												
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MARL			· [· · · · · · · · ·	·			1							
STIFF BROWN SILTY M	جر بر آنا	XXX (& & .	, 1	╠╍──────				┨╶┥						
10174 A LITILS REALS				┨────	1	╂┼┼		┨╌╴┤		-				
STIFF REDDISH BROWN.	SILTY					╏╌┿	- [1				
Marc				╢		╉━╀		$\left - \right $		<u> </u>				
				ļ		┨┈┼╴		-		<u> </u>	$\left \right $			
CORING +12F AIR	FULPH			ļ		┞				-			├	-
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											<u> </u>		}	
At end of days boring		400		Is bore	hole comp	leted		·			¥.	5/No		
Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Tin am/	- 1		E		ng/Ca			
Water struck at								Depth M	to		Boring Im di		Ça: mm.	sing dia
Rose to										-				
Sealed off at														
Water added from						ļ	_							
Water added to								Vere F nstall		ome	ters Yes/(Vo		
		- 	me				- 41			~				
Details of time spent	From		ours RE	MARKS	S: (Dela Stanc	ys, we Ipipes	etc.)	, ueu	0112	01				
	m	m	P	<u>M.001</u>			60	t.o.	u.t	€1-7		5	Mo	<u>ک</u> ر
CHISELLING Etc (Details in "remarks")	m	m		NSMAN	R C	15° K 1	≍ •~× ~	700- 1700-		~		ନ ହ		-
	m	m	10	, re		11		اى	مدا		ີຄ	-		
Awaiting Instructions	am pm	am pm		ڪ⊇ن_ ا	CAM.	י ויכע	suit				_			
		3H.	G	یلامر کے	CAM.	5.R.A 7		0	30		15.	30)	> 40
Piezometers/Standpipes (Details in "	remarks")				EL									
Rain/Breakdowns (Delays) " "			Sig	ned		<u></u>	<u>7 —</u>							•
Boring (Including Casing and Samplin	ng)		sr	TE INVE	STIGAT	ION S	SERV	ICES	s					
Vehicle No	AL TIME		4,	HIGH S	STREET,									
1.					IAM, NR				UG	iΗ				
			1 1 1	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	CALIE 11. 2									
CREW 2.				NCOLN	SHIRE D NE: 042)N21 7 669	00VV 1458	FAX	e o	427	7 66	807	7	

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Daily Site Report

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CREW

NAMES

Rocard Borehole No. 1 A Count 4121 Tues and

Site Name FACMHOUSE G	ENDERG	<u> </u>	المحب	ean			Day	٥	+-1	Date 7	3 - 95
Description of Strata	<u> </u>			Depth	Depth o Casing	"I (Sa	epth nples/ PT's)	Sample	s St	andard Pen Test	etration
At start of days boring				<u> </u>		From	То	Ref. No. Type	C or S 75 mm	EEE	E E E
olar out 11925	6-1 R2	ans	aix]	'n	m	Het H	홈페이 #	75	55 75 75
To 6" DIAM 0-						C		COR	يل ل	24	112 rpa
VERY WEAK REDS GAS				450				240	Cons '	45-6	od (¤'
MML.								BROK	Cons (0.0-7	50 (NI
······································								4 14	on -	7.50-9	od (IVI
STRONG LT GAST MU	1057PN	5		900				5-1-16	9 61	-	oits ()
WEAK REABIOUN W				10.10				671			2.00 6
WITH SOFT SIGH BAN						'		7-04	one 12	.0 - 13	50 ()
STEAR R30/BROWN H		vъ		1500				846		2 - 15	
(FISSUND & BROKEN)					1			9#1	3/1 1	500 16	20 K
DAW BROWN SILVER S	ANDY (J		1700	•		1			84	CICATS
SCHONG BROWN & GISEN	Mus	5001	1 1		A1920	×	1	1074	Gri	16.25 -	1750 (1
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At end of days boring				20.0	>	Is bore	iole comp	pieted		Yes/	'No
		Depti		ime	Depth	Time	Depth	Time	1	Boring/Cas	
Water		_m		/pm	m	am/pm	m	am/pm	Depth to		Casing
Water struck at	N	10'	_							mm d <u>ia</u>	. <u>mm. dia.</u>
Rose to											
Sealed off at											
Water added from	i .=								Were Pier	ometers	
Water added to							. <u> </u>	- i	Installed	Yes/N	0
Details of time spent	Fro	m	To	Tim		MARKS		ys, weath		of	
		m		<u>ກ</u>		A		dpipes etc.			
CHISELLING Etc		m		n		Carry	<u></u>	CL3			(L)/1] 1/
(Details in "remarks")		m		າ ກ		r Muri Zi	mup :	- 佐水		h	
Awaiting Instructions		am	ar	n	K	CAMIN	out	0-4	20 2	240	×4/1 ·
Moving Position	ВН.	<u>pm </u> 	pr BH.					\sim			
Piezometers/Standpipes (Details							£1				
Rain/Breakdowns (Delays) "				1	Sig	gne d	Ľ.	ony	·····		
Boring (Including Casing and Sar	mpling)					TE INVE	STIGAT	ION SER	VICES		
Vehicle Na	TOTAL T	IME		1		HIGH S					

FILLINGHAM, NR. GAINSBOROUGH

TELEPHONE: 0427 668458 FAX: 0427 668077

LINCOLNSHIRE DN21 5BW

Garden - orchard? Site Investigation Services

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TANROCH PRILL OPON KOUS

Daily Site Report

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Borehole No. 2

Site Name FARM YALD ENOSIBY WARREN DayLOGONESOM Date 1-3-95

Description of Strata			Dept	th Depti Cas	h of sing	(Sar	pth nples/ PT'sl	s	smpl	es	Standard Penetration Test						
At start of days boring						From	То	°. Z	ə	No. of Blows	C or S	75 mm	75 mm	75 mm	Ę	75 mm	Ē
SET RED SPET SILTY MARL				<u>,</u>		តា	m	Ref.	Тv	20 NG	ပိ	75	75	75	75	75	75
STIGH REO/CASH SUZH MALL. WEAK LT BIDWN 8 CASH			2.5	<u>.</u>													
WEAK LT BIDLIN & GREA			45	5													
MUDSTONS								L			_			_			
HARD GRANITE			<u></u>	<u>.</u>		<u></u>	 			ļ						<u> </u>	<u> </u>
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At end of days boring			16.	0		Is oore	nole comp	etea							57040		
11/			Time am/pm	Depth m		Time m/pm	Depth	Time am/pm			Boring/Casing						
Water struck at No					1		Ţ			Jepti m			lorin m di		Ca mm.	sing dia	
Rose to		<u> </u>						1		┦							
Sealed off at										1			1				
Water added from			<u> </u>	1			-	╞		┥							
Water added to			ļ	. <u></u>	+		·	1—			lere i Istal	Piezo ad	Intel	ers Yes/l	No		
Water added to			 					··			-						
Details of time spent	Fro	m		Fime Hours	REA	MARKS	:– (Dela Stand	ys, v Inine	veat	her, cl	det	ails	of				
		m	m				D raina	, p. p.									
CHISELLING Etc (Details in "remarks")		m	m														
		m	m														
Awaiting Instructions		am pm	am pm														
Moving Position	BH.	BH	ł.				0	0									
Piezometers/Standpipes (Details in					C .	. (D. Ach	6	1	7.	م,						
Rain/Breakdowns (Delays) "		•			Sign	ed	.74655				. يويان						
Boring (Including Casing and Sampling)							STIGAT		SE	RVI	CE	S					
Vehicle No TOTAL TIME							TREET, AM. NR		(NP	SBO	RC	UG	н				
CREW 2.					LIN	FILLINGHAM, NR. GAINSBOROUGH LINCOLNSHIRE DN21 5BW											
NAMES 2.		TËI	EPHO	NE: 042	7 66	584	58	FA	K: 0	427	66	807	77				

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Daily Site Report

Borehole No. 2 A 4125

Site Name FARM HOUSS ENOSUBY LOARS Day WEDNESDAY Date & -3-95

Description of Strata			De	pth D	epth of Casing	(Sa	Depth (Samples/ Samples SPT's)					Standard Penetration Test								
At start of days boring						From	To	ź ż	şq	ŝ	ę	Ē	Ē	E	Ę					
						m	m	Ref. No. Type	No. of Blows	ο υ	75 n	75.	אַן אַ		12					
	6P 50						C-0	~ 4	12		Δ	12 6								
FIRM 15	NOLUN SIGT	(1A.7			• • • • •	·				[]	Ĩ			1						
STIFF.K	REPERSES	<u> </u>	17. 20	. . <u></u>		L5	Tr Con	E FOD	-	2.	10	- k	.30	5	.					
CLANC 8	INTE (POSSIEL	Barren	1) 4			·]	No Cor			1 1			- L	V.	30)					
11-au	enk Reo/sns	- Sur-	<u> </u>	. 1	•••••	•	20 Gru		r—		L 1				74					
Mark	41.5			T 	•••••	- 4-			1		- 1		170	6	. (0)					
	VINI VILLY SANDY	MAL.	7	~~	••••		2	Carrie					1:20	6	20					
					•••••	1	A		T	8	20	<u>- k</u>		6	44					
	WEAK SOFT BE DRILLINS																			
PossiBi	Possible Sann SPAUL (LEATURE			SegN	rτ.)]									\square					
	REANITS.]								_						
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		•••••													1					
At end	of days boring					Is bore	note compl	eted					Yes/⊉	ю *						
	Water	Depth			pth	Time	Depth	Time	T		B	oring	Casir							
<u> </u>		m	am/pr	<u>n </u>	<u>n</u>	am/pm	m	am/pr	_)epth		Bo	ring	Ca						
Water struck a		Nons	-						+	m		mm	dia	mm.	, dia.					
Rose to																				
Sealed off at			<u>_</u>					} 	┥					<u> </u>						
Water added fi	rom		ļ						-	ere P	viezo			<u> </u>						
Water added to)			<u> </u>					<u>lir</u>	nstall	ed	Ye	<u>s/No</u>							
Details of time	spent	From	To	Time Hours	RE	MARKS	:- (Delay	ys, weat	her,	deta	ails d	of								
	· <u> </u>	m	m	(Todita		C Sta	Stand Stand	pipes et Ata	:c.) 1.~K	ΞÉ	61	FA	ms	ห						
CHISELLING		m	m			i Ma	K Ris		NE	×7	Test Test 2 E E E E E E E E E									
(Details in "re	marks'')	Biown Mulps Tends 740 Biown Mulps Tends 900 Biown Mulps Tends 900 Biown Mulps Tends 900 Biown Mulps Tends 920 Biown Mulps T																		
Awaiting Instr	uctions		am pm		-			•												
Moving Positio	······						p)												
Piezometers/S	tandpipes (Details in "						E V													
Rain/Breakdor	with (Delays)				Sig	ned	-Jo	~	-	•••••		<u>.</u> .			_*					
Boring (Including Casing and Sampling)																				
VCIIIIIIIIIIIIII																				
CREW	1.										υq									
NAMES	3									FAX	(; 04	127 6	680	77						

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Daily Site Report

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Borehole No.3 CORANG

Site Name	FACHHOUSE	ENDSABY	LOAKESN	Day L	JEONESON-1	Date 8 - 3 - 9>

At end of days boring	700		Is boreho	ole comple	eted						254	/No		
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STRONG REO/SA31 MUDSTONS	530			BLD!	<u>1.61</u>	31	Ś		<u>بر،</u>	<u>s</u> _	1	~0	20	- 3
					h			_			1			
VERY SOFT SANDY CLAY (STICKY)	4.00			2~0	δ1	5	10	، د	<u>t o</u>	01	5.	29	4	<u>vi</u>
SANOY MALL		[<u>ا</u>						_			
STUH REO/BROND VERY	100			15-0	61.	٤I	na	4	2.	50	- L	-04	۶Ü	.3
		.	ļ	CORIN								r 1	- Z1	\square
SOFT 4, BROWN SILTY MARL. WATTH SMALL GRANITE COBELES	035]												
Top Soin	0.00]												
HAND DUC TRIAL HOLS TO 1.5	am .		m	m	Ref.	ŕ	S _N	ő	75	75	75	£	75	75
At start of days boring			From	То	Š	ā	No. of Blows	r S	E	Ē	Ε	75 mm	Ê	Ē
Description of Strata	Depth	Depth of Casing			s	amp	les		Star	Idaro	Test	netra t	tio n	

	Water		Dept m	h ∏ìn am/g	··- II	Depti	n Time am/pm	Depth	Time am/pm	В	oring/Casir	ng .
Water struck	at		دتمطلا						• ··· · • •	Depth to m	Boring mm dia.	Casing mm. dia.
Rose to												
Sealed off at												
Water added 1	from		:					:				
Water added t	t o									Were Piezo Installed	meters Yes/No	
Details of tim	e spent	F	rom	То		me ours	REMARKS	i:- (Delay	ys, weath	er, details o	of	
			m	ពា			DAriog		pipes etc.			L.V.a d
CHISELLING			m	m					ITANO U	s teinc	HOU6 -	1 MOLA
			m	m								
Awaiting Inst	ructions	`	am pm	am pm								
Moving Positi	on	BH	·	вн.				$\partial \Lambda$				
Piezometers/S	Standpipes (Details	s in ″rem	ark s'')					{V.	~			
Rain/Breakdo	wns (Delays) "	**	ø				Signed	-Y-	<u> </u>			
Boring (Inclue	ting Casing and Sa	mpling)					SITE INVE	STIGATI		VICES	•	
Vehicle No,		TOTAL	TIME				4, HIGH S			VIOLO		
00.511	1.						FILLINGH	AM, NŔ.			ł	
CREW NAMES	2.						LINCOLN				07 000	77
					TELEPHO	INE: 0427	058455	FAX: 04	27 0080	[]		

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Daily Site Report

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Borehole No. 3 Cours

Name FARM HOUSE	E	NDCR	67 LD	مرارت	D	ay			nderr	i Pene	tratio		٦
scription of Strata			Depth	Depth o Casing	fl (Same	th ples/ T's)	Samples	503	1.0800	Test			_
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At start of days boring		<u> </u>	700	+	From	C _m A	JES	NSP.	50	5	FF*	<u>ج</u>] ۲	ξ
CORING 412F AVR	FOAM	1				1. W 12						1	
474 CORE 7-85 574 CORE 7-85 674 CORE 10:0-11. 774 Core 11:50-13	•• (50 ••	·50) (1·0) (1·0) (1·3) (1·3)	5)	· · · · · · · · · · · · · · · · · · ·	ACT CIR			N			╱╌╀╴ ╶╌┼╴ ┨╶┼		_
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HAND GRANITS.	•••••	•••••			· · · · · · · · · · · · · · · · · · ·								
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At end of days boring			20.	0	is bore	hole com	pleted			¥ (_
At end of care of a			Time	Depth	1 Time	Depth	Time	1	 Bo	ring/C	asing		
Water		Depth m	am/pm	m	am/pm		am/pm	Depth		Bori mm c	ng	Ca: mm.	-
Water struck at		 		╢				<u> m</u>	-+	11012 0			_
Rose to				1		╢						_	
Sealed off at				[]]]		<u> </u>		.					_
Water added from		<u>+</u>						Were P	10700	neters	<u> </u>		_
		-				l		Installe		Yes	/ <u>No</u>		
Water added to Details of time spent		From	10	Time Hours	REMARK	S:- (De Sta	lays, weat ndpipes et	her, deta c.}	aits o	of Ru			
CHISELLING Etc (Details in "remarks")		m m m	m m		WAITI Ris 1	nt ite ourt (napipeset A Tege DF Fill	-0 F	Ĩ	يعصا	Ă,		
Awaiting Instructions		am pm	am pra				Λ						
Moving Position			вн.			P							
Piezometers/Standpipes (Detai	ls in "re	marks")			Cianad	لح	lor	1					
Rain/Breakdowns (Delays)					Signed .			1					
Bering (Including Casing and S	ampling	Boring (Including Casing and Sampling)						RVICE	s				
Bound function a company													
Vehicle No	TOTA	AL TIME				HAM, NSHIBI	IR, GAIN E DN21 5 427 6684	BW					

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Daily Site Report

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1.

2.

3

CREW

NAMES

Borehole No.1

OPEN HOLS

6" Rock Hannish

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From	1.7.1		REMARKS	:- (Dela	ys, v	veat	her,	det	ails	of					
Details of time spent From m						es et ,	e, e,	51-1	6-	<u>ر</u>	~	1µ	QL I	1	
HISELLING Etc m Details in "remarks")															
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liezometers/Standpipes (Details in "remarks")					m	1.	•••				** **	-			
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LINCOLNSHIRE DN21 5BW

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Daily Site Report

All drillers accredited. Borehole No. 2 Some Rock Hand. 74-2-94

Description of Strata	Depth	Depth of Casing	De (Sar S	epth mples/ PT's)		amp	les		Stan	idare	Test			
At start of days boring			From	То	Ref. No.	ype	No. of Blows	C or S	75 mm	8				
GRAVEL TO SAND & GRANFT. QHIPS	.	• • • • • • • • • •		m	Ref	Ĥ	žā	ũ	75	75	75	75	75	75
HALD GRANIT	070													
				· · · · ·										
VERT MAND ROCK	750	 												
		Rec	ucé '	To 10	2~~	м	Dı	ন	4					
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		J												
At end of days boring	10-0	1-0	'le harab	ole comple							Yes/			

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	Water				ie im	Depti	n Time am/pm	Depth	Time sm/pm	в	ng				
Water struck	at		 3&							Depth to m	Boring mm dia.	Casing mm. dia,			
Rose to															
Sealed off at															
Water added	from														
Water added	to					l				Were Piezo Installed	meters Yes/No				
Details of tim	ne spent	F	rom	To	-	ime ours	REMARKS				of				
			m	m			UNABLE	Stand Tes S	pipes etc. TAI-T	, રાં ડ & Ge	1405550	3.4			
CHISELLING			m	m			THE O				•				
	ennaria 1		m	m			TENN	ANT	= 1	i kour	5	-			
Awaiting Inst	tructions		am pm	am pm			REAMS					. Here all			
Moving Posit	ion	B₽	I. B	н.											
Piezometers/	Standpipes (Details	in "ren	narks")				Supra	11		L CASING		ом			
Rain/Breakdo	owns (Delays) "	н	**				Signed	$\mathcal{I}_{\mathcal{O}}$	<u> </u>	••••••		:			
Boring (Inclu	ding Casing and San	n pling)					SITE INVE			-		-			
Vehicle No		ΤΟΤΑΙ	. TIME				4, HIGH S			VIOLO					
	1.						FILLINGH	IAM, NR.			4				
CREW NAMES	2.						LINCOLN								
	1						TELEPHONE: 0427 668458 FAX: 0427 668077								

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Rain/Breakdowns (Delays)

1.

2.

3.

Vehicle No.....

CREW

NAMES

Boring (Including Casing and Sampling)

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TOTAL TIME

Borehole No. 2

TANROCH OPAN HOW ISOM

Description of Strata	Depth	Depth of Casing	} (San	pth nples/ 'T's)	s	amp	les		Star	ndaro	d Per Test	netra t	tion
At start of days boring			From	То	ź	ä	¥ of	r S	Ē	e u	Ę	Ē	Ê
CHIPINKS 8 Sol	0.0		m	m	Ref.	4	20 20	ů	75 1	75 r	751	75 mm	751
HARD GRANITE	0.55												
,	••••••				.								

At end of days boring	10.0	ls b	prehole completed		Yes/No
· · · · · · · · · · · · · · · · · · ·					
	•••••••••	••••••••••••••••••••••••••••••••••••••		┈┼┈╋╍╎╶┟╸	╉┥┨┨╼
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Water	Dep			epth Time m am/pm	Depth m	Time am/pm	E	loring/Casi	 ng
Water struck at	35	õ					Depth to	Boring	Casing
Rose to	······				1		<u>m</u>	mm dia.	<u>mm. dia.</u>
Sealed off at		<u>_</u>				·			
Water added from				<u>_</u>		 -	_		
Water added to					1		Were Piezo Installed	meters Yes/No	
Details of time spent	From	То	Time Hours	REMARK	S:- (Dela	ys, weath	er, details c	of	
CHISELLING Etc	m			- DA-200	Stand	nines etc.	1		NI.
(Details in "remarks")	m			KK + (Comin -S	rioa p	15-10	ues	
Awaiting Instructions	am pm			-					
Moving Position	· · · · · · · · · · · · · · · · · · ·	BH.		1	\sim				
Piezometers/Standpipes (Deta	ails in "remarks"		_	1	A				

Signed

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 4 OP= N HOL

Site Name PENN CLASS ENOLOGY LOPERSN Day MONORY Date 27-2-95

TAMROCK

Description of Strata	Depth	Depth of Casing	l (San	pth nples/ PT's)		amp		Standard Penetration Test						
At start of days boring			From	То	. No.	ype	No. of Blows	or S	Βu	E	75 mm	E	75 mm	Ē
GRASS TO CLAY STONE				m	Ref	Ŧ	žö	U	75	75	75	75	75	35
METAL FILL										:				Ĺ
VZAY WEAK REO/BROWNS	<u>?.o</u> e.													
SANOY MAAL. HARD GRANITE.	3.30													
	•••••	••••••												
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At end of days boring	10.0		ls boreho	ie complet	ted	1					Yes/	Kabo		
164 a tar	oth Time D	epth T	îme	Deoth	Tin	18	1	•						

Water	Depth m	Time am/pm	Depth m	Time am/pm	Depth m	Time am/pm	в	oring/Casir	ıg.
Water struck at	Non3						Depth to m	Boring mm dia.	Casing mm. dia.
Rose to			Į						
Sealed off at									
Water added from							· · · · · ·		
Water added to							Were Piezo Lostalled	meters Yes/No	£

Details of tim	Details of time spent		То	Time Hours	REMARKS:- (Delays, weather, details of					
	? Eta	m	m		Standpipes etc.)					
CHISELLING Etc (Details in "remarks")		m	m m							
	m	m								
Awaiting Inst	tructions	am pm	am pm							
Moving Posit	BH.	BH.								
Piezometers/	Standpipes (Details i	n "remarks")		PI					
Rain/Breakdo	wns (Delays) "	14 <i>11</i>			Signed					
Boring (Inclu	ding Casing and Sam	pling)			SITE INVESTIGATION SERVICES					
Vehicle No		OTAL TIME			4, HIGH STREET.					
	1.				FILLINGHAM, NR. GAINSBOROUGH					
CREW NAMES	2.				LINCOLNSHIRE DN21 5BW					
	3.			-	TELEPHONE: 0427 668458 FAX: 0427 668077					

LOCATION ENDERBY	RIG No. らての 1.	BH No.
CONTRACT No.	VEHICLE No. 6757 SFU	DIAMETER
TYPE OF DRILLING AUGERING	CREW S.MCCRINDLE	ANGLE
DATE 11- 17 94 FRI	T. DEAN	

0	PERATION	SIZE	FROM	то	LENGTH	REC.	DESCRIPTION
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							INSTALLATION DETAILS
		WATER L	EVEL RECOP	US			INSTALLATION DETAILS
TIME							
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						INSTALLAT	FION
						DRILLING	
						OBSTRUC	· · · · · · · · · · · · · · · · · · ·
		· · · · · · · · · · · · · · · · · · ·	a an	21.)	MOVE & S	ET UP
SIGI	NED - CLIENTS	REPRESEN	TATIVE			STANDING	<u>i</u>
	SIGNED-DRILLER S. Machille						
SIG	NED DRILLER	$\underline{ }$	- All	- C- C	si-C	BENTONI	

 \sim SOUTH TYNE DRILLING DAILY DRILL LOG No. 2607

LOCATION ENDER BY	RIGNO. STOL	BH No. /
CONTRACT No.	VEHICLE No. 1757 JFU	DIAMETER 12"
TYPE OF DRILLING AUGERING	CREW J.MCCRINDLE	ANGLE
DATE 19-12 912 MON	T. DEAN	CASING DIAMETER

1	OPERATION	SIZE	FROM	то	LENGTH	REC.		DESCRIPTIC	N
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LOCATION ENDER BY	RIG No. STO 1.	BH No. 11.
CONTRACT No.	VEHICLE No. 1 257 JEU	DIAMETER 12"
TYPE OF DRILLING AUGERING	CREW - MCCRINDLE	ANGLE
DATE 14-12-96 MON	T. DEAN	CASING DIAMETER

(OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION
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			00 00	-01	with all a second		
·			22-00	26-00	Ale:00		WASTE (DAMP)
			26.00	3000	4:00		WASTE (WET).
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<u>)</u>			B/H	Q Or	IPLET	£	
				* 29XP			
		<u> </u>	ISTALL Å (<u>e p</u>		rs of	6" PIPE
					GRAL BENTO	EL.	·····
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	······		VEL RECOR				
TIME				03			INSTALLATION DETAILS
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Der ^t TH	OF CASP:G						·····
<u>م</u>	OF WATER						· · · · · · · · · · · · · · · · · · ·
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						DRILLING	30 117
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0101				C.	Ş	MOVE & SET	TUP
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No. 2609

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LOCATION EMPERBY	RIG No. STO 1.	BH No. 2
CONTRACT No.	VEHICLE No. 1757 JFU	DIAMETER 12
TYPE OF DRILLING AUGERING	CREW J. MCCRINDLE	ANGLE V
DATE 20-12-94 THES	T. OEAN	CASING DIAMETER

	OPERATION	SIZE	FROM	то	LENGTH	REC.	DESCRIPTION
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Au	GERING "	12"	000	9.50	8.50		WASTE (DRY)
			<i>(</i>)				
			8.50	24.50	16.00		WASTE (WET)
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-			21:50		anna a sui		OBSTRUCTION.
i l			B/H	COM	PLETE		
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		10	STALL	ED	22 H	175	OF 6" PIPE.
					GRAU	EL.	
			<u> </u>		IMT	BEA	TONITE.
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 					<i>4</i> 7		
		WATER LE	VEL RECOR	DS			INSTALLATION DETAILS
TIM	Ξ						
т	OF HOLE						· ····································
	OF CASP:G			·			
	OF WATER			<u> </u>		· ·	
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						INSTALLATI	ON 22 MTS
						DRILLING	24.50 post
	· · · · · · · · · · · · · · · · · · ·					OBSTRUCT	1.000
				<u> </u>		MOVE & SE	TUP IMOVE
SIG	IED – CLIENTS R	EPRESENT	TATIVE			STANDING	1070x60/5000
			mit .	and the second sec		CASING R/	
SIG	ied – Driller –	\geq \sim	Mad	server and	d. ^y	BENTONITE	E I Brags.

No. 2611

	WERB	/ RI	G No. 🧧	STO	l –	BH No. 4		
CONTRACT No.		VE	VEHICLE No. 1. 757 JFU			DIAMETER 12		
TYPE OF DRILLING	AUGE	RING CF	CREW J. MCCRINDLE			ANGLE 'V		
DATE 21-12-94 WED				NFAN	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	CASING DIAMETER		
OPERATION	SIZE	FROM	то	LENGTH	REC.	DESCRIPTION		
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Êut	GERING	12	0.00	20.00	20.00		WASTE (DRY)
rµ4	1 ((, 13) (V L)			<u>/~0~00</u>	<u>*0*00</u>		VVII 2 (6 (1015/)
			20.00	27.00	7-00		WASTE (WET)
						*	· · · ·
			27-00				OBSTRUCTION,
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			B/H	<u>CDPIP</u> ,	ETE.		
			STALL	= 1	27,	175 C	F 6" PIPF
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		-	11		1147		BENTOMITE
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	· · · · · · · · · · · · · · · · · · ·	WATER LE	VEL RECOR	DS			INSTALLATION DETAILS
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ᡓ┠	OF HOLE						
ЯĿ	OF CASP;G						
	OF WATER					•.	
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				···· · · ·		DRILLING OBSTRUCT	27 MTS
x	•					MOVE & SE	TIP
SIGNE	D - CLIENTS R	EPRESENT	TATIVE	- Ole	al	STANDING	
and a second state of the						CASING	
NONE	D – DRILLER	and the second sec	Mar	pla -	Alle -	BENTONITI	E 2. BAGS

No. 2612

LOCATION ENDERBY	RIGNO, STD1.	BH No. 5
CONTRACT No.	VEHICLE No. L 757 JFU	DIAMETER 12"
TYPE OF DRILLING AUGERING	CREW J. MCCRINDLE	ANGLE
DATE 21-12-94 WED	T. DEAN	CASING DIAMETER

	OPERATION	SIZE	FROM	то	LENGTH	REC.		DESCRIPTION	
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	ja .					ļ			
P	44ERING	12"	10-00	19.50	19.50	<u> </u>	W	ASTE (DRY)	
			16. 5. 3	01 00		· · · · · · · · · · · · · · · · · · ·	_		
· · ·			19-50	24.50	5.00		W	ASTE (WET)	
			24-50	30.00	5.50	<u> </u>	0.	110.01	
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(C			R/H	COM	PLETA	,			
			-7					··· ·· ·· ·· ·· ·· ·· ·· ·· ·· ·· ·· ··	
		INS	MUED	30	MTS	ØF	6"	PICE	
			ŀ I	GR	AVEL				
<u> </u>			1. 7.	/ ŀ	15 01	<u> </u>	NTU	INITE	
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		WATER LE	VEL RECORI	os		INSTALLATION DETAILS			
TIM									
E	OF HOLE					·····			
E	OF CASP:G						·		
	OF WATER					• 4			
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						OBSTRUCT	ION	**************************************	
a <i>i</i> = ·				110		MOVE & SE STANDING	T UP	IMOVIE	
SIGN	SIGNED - CLIENTS REPRESENTATIVE							Non-201-201-201-201-201-201-201-201-201-201	
00								- Sa,	
SIGN	SIGNED - DRILLER SMALL							2 Brings	

No. 2616

LOCATION ENDERBY	RIGNO. STO.1.	BH No.
CONTRACT No.	VEHICLE No. L757 JFU	DIAMETER 12"
TYPE OF DRILLING AUG ERING	CREW J. MCCRINDLE	ANGLE 1
DATE 10-1-95 /TUES	TOFAN	

OPERATION	SIZE	FROM	TO	LENGTH	REC.	DESCRIPTION		
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AUGERING	12"	0-00	20.50	20.50		WASTE (DRY)		
		20.00	00.00	700				
		2030	28.00	1.50		WASTE (WET.)		
		28.00			-c	BSTRUCTIONS		
		1						
<u> </u>		B/11	0	MPLE	TE.			
		/				·····		
	<u> </u>	TALL	FD 2			6" PIPE		
		11		<u>lan</u>	AUFL	· · · · · · · · · · · · · · · · · · ·		
	•	11		2 B2	<u>92 13-</u>	ELTONITE		
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	WATER LE	EVEL RECOR	DS		INSTALLATION DETAILS			
TIME								
OF HOLE OF CASP:G					: 			
OF WATER -						· · · · · · · · · · · · · · · · · · ·		
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			- 		DRILLING OBSTRUCT	28 1975		
					MOVE & SE			
SIGNED - CLIENTS I	REPRESEN	TATIVE	- Jah	Estimation	STANDING	TUP I MONE		
			CASING					
SIGNED - DRILLER		Male	yu al	A.	BENTONIT	= 2. Brig .		

No. 2618

LOCATION ENDERBY	RIG No. STO).	вн №. 3
CONTRACT No.	VEHICLE No. L 757 JF4	DIAMETER 12
TYPE OF DRILLING AUGE PING	CREW J. MCCRINDLE	ANGLE V
DATE 11-1-95 /WED	TOFAN	CASING DIAMETER

	OPERATION	SIZE	FROM	то	LENGTH	REC.	DESCRIPTION		
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<u> </u>			1100	22-00	2.00		WASTE (DAMP)		
			22.00	26.00	4-00		WASTE WET)		
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<u>}</u>			26.00	an an ann an			OBSTRUCTION.		
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—					B	AGC.	BENTONITE		
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		WATER LE	VEL RECORI	DS		INSTALLATION DETAILS			
TIME		· · · · · · · · · · · · · · · · · · ·							
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	OF WATER			··· ·					
	144.A						<u></u>		
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	···								
						INSTALLATI	ON 27MTS		
						DRILLING	26 1975		
			·····			OBSTRUCT			
SIGN	ED - CLIENTS RE	PRESENT	ATIVE	C	Summer .	MOVE & SE STANDING			
	SIGNED - CLIENTS REPRESENTATIVE								
					F	CASING			

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1990

DAILY DRILL LOG

94)

OUTH TYNE DRILLING	DAILY DRILL LUG	63
LOCATION ENDERBY WARREN CONTRACT NO. TYPE OF DRILLING ROTARY	RIG NO. GRY PHON VEHICLE NO. CREW J.MCCRINDLE	BH No. 10 DIAMETER 44
DATE 23-2-90 FRL	T. DEAN.	CASING DIAMETER 5"
OPERATION SIZE FRO	M TO LENGTH	DESCRIPTION
Duit-	MT Trial PIT	for Gerricio
O/H Lite G/L	- 1.50 1.50 (000) - 1.50 1.50	nus husdrove
1.5	0 90.00 88.50 G	RANITE.
B/i	+ COMPLETE.	· · · · · · · · · · · · · · · · · · ·
INSTALLE	3 MTS DE	GLOTTED PIPE PLAIN PIPE TONITE SEAL
C Rei	EMENT B/H	COVER in AFCHY: INSTALLATION DETAILS
WATER LEVEL F TIME UF HOLE OF CASING Water A OF WATER	T 3.3.00 MTS.	
CASED TO	150 MTS	
	DRILLI	10 100 14 TS
		UCTION
SIGNED - DRILLER	A Casing	*1NSTAL 90 MTS.

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DAILY DRILL LOG

58

LOCATION ENDER	BY/WA	RREN RI	G No. G	RYPHON	<u>ر</u>	BH No. 11		
CONTRACT No.			EHICLE No.	-		DIAMETER 44		
TYPE OF DRILLIN	GROTA	RY CF	REW J.C	W J. MCCRINDLE ANGLE				
DATE 22-2-9		1	T.	DEAN		CASING DIAMETER 510		
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION		
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		WATER I	EVEL RECO)RD				<u> </u>	
	ME								
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	137240	w Al	MIS	<u>`</u>		 			
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┣─					·	DRILLING	3	100+00 1	
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SIGNED CLIENTS REPRESENTATIVE

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Mic SIGNED - DRILLER

Sheef-

OBSTRUCTION MOVE + ROAD SIGN MOVE & SET UP STANDING TOUL 1.50 MTS. CASING DELARS INSTALL 9900MTS

DAILY DRILL LOG

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0U'	TH TYNE DRI	LLING		•	DAILY DRI	LL LUG		57	~
CON TYF	LOCATION ENDER BY (NARREN CONTRACT NO. TYPE OF DRILLING A OTARY DATE 22-2-90 / THURS			CREW J. MCCRINDLE				12. ER 44	-10
	OPERATION	SIZE	FROM	то	LENGTH		DE	SCRIPTION	
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			В/н	COR	1 PLETE	AĨ	88.0	DO MTS	<u> </u>
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				ENT		COVI	ER	TE SE IN. NAY.	
			MON	1ED	10	В/н	11	* 	
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DEPTH	OF HOLE	<u></u>						-*	· · · · · · · · · · · · · · · · · · ·
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						DRILLIN	G		
+	Sheet	101	2:			OBSTRU	CTION		
				$\subset \prime$	2	MOVE &		MOVE +	ROAD SIG
SI	GNED CLIENTS	REPRESE	NTATIVE	11	idele	STANDIN	4G		
	GNED - DRILLE	, <i>K</i>	M	1 n.	rde	CASING	INSTAL	791	ITS.
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DAILY DRILL LOG

97

OUTH TYNE DRI	LLING		DA	AILY DRIL	L LOG		55		
LOCATION ENDERBY / WARREN CONTRACT NO. TYPE OF DRILLING ROTARY DATE 21-2-90 / WED.			RIG NO. GRYPHON VEHICLE NO. CREW J.MCCRINDLE T.DEAN.			BH No. DIAMETE ANGLE CASING	1.2. R 44	· i /	
OPERATION	SIZE	FROM	то	LENGTH		DE	SCRIPTION		
	1	1				Pit for SERVICES			
0/H	4 5	G/L 1-80	1-30	1-80 86-20	BOUL	:, Nar DERS	lure, G	RAUTE	
· · · · · · · · · · · · · · · · · · ·		B/⊦	iN	COMI	DLET	~F.			
						INSTALL	ATION DETA	ILS	
TIME	H WE EAVY Y	WATER	T 38.0	2 MTS					
B/H, VE AN E Rods Fa	<u>ال</u>	ABOUT	70-00 2.br	MTS.					
G ettiny		out 1	y B/	Ή	DRILLING OBSTRUC	TION	FROM 88-00 M I MOVE +	TO TS. ROAVD STGO	
SIGNED CLIENTS			<u>A</u> Mi	2		STRIAL P		}	

DAILY DRILL LOG

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SOUTH TYNE DR	ILLING		DA	AILY DRIL	L LOG		64	\$
LOCATION ENDER CONTRACT NO. TYPE OF DRILLIN DATE Z1 -2-91	GROTARY	VEI CRI	HICLE NO. W J.M.	HNDO CAINDL J. BRD	E GAN	BH No. DIAMETER ANGLE CASING D	13. R 45	
OPERATION		ROM	то	LENGTH		DES	CRIPTION	
0/н	44 33	.00	100.00	77-00	G I	LANIT	Ē	
	· B,)+	COMI	LETE	-			
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) 		CEI	MENT		H CO			
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4								,
	WATER LEVEL	RECO	DRD	l		INSTALLA	TION DETA	ILS
TIME TOF HOLE OF CASING V OF WATER	NATER	AT	65-	00 MTS				
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	K1			·····	DRILLING OBSTRUC MOVE & SI	TION	77.00 1	175
SIGNED CLIENTS			indle	· · · · · · · · · · · · · · · · · · ·	STANDING		۱. 	

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DAILY DRILL LOG

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OUTH TYNE DRI	LLING		DA	ILY DRIL	L LOG		62	
LOCATION ENDER CONTRACT NO. TYPE OF DRILLING DATE 23-2-90	i Protar	VE	NO. DAN HICLE NO. EW J.MC DEAN		SF SGAN	13 R 42 DIAMETER 5	~	
OPERATION	SIZE	FROM	то	LENGTH		DES	SCRIPTION	
0/14	44	G/L	1.50	1.50	MADE	up_	GROUNI)
<i>v</i>		1-50	33.00	31-50	GRA	ANI TÉ		
		B/H	INC	OMPI	ETE			
			- -					
······							ATION DETAI	LS
Ŵ	ATER L	EVEL REC	ÓRD					
TIME TOF HOLE OF CASING OF WATER								
CASE	D 7	0 1	-50 F	175				
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<u> </u>	$f \in \mathcal{C}$	7 . 1	1-7		DRILLING		FROM 33-00	TO MES
SIGNED CLIENTS		NTATIVE	19	Ter	OBSTRUC			
SIGNED - DRILLER		. Me	Current	di a	CASING DELAYS		1-50 M	73

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DAILY DRILL LOG

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LOCATION ENDER	<u>BY (WA</u>	RREN RIC	$\frac{1}{2}$ No. $\frac{1}{2}$	<u>rábho</u>	N	BH NO. 14A	
CONTRACT No.		VE	HICLE No.	<u>F331</u>	KIN.	DIAMETER 44	
TYPE OF DRILLING				ACCRI		ANGLE	
DATE 23- 3-91	<u>o F</u>	RI	1	OFAL	<u>/</u>	CASING DIAMETER 5-11	
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	
O/H	44	35-00	100-00	65.00	GR	ANITE.	
		Bli		MPLI	FTF.		_
			·				
INS	TAL	LEO.	97	175 0	F SL	OTTED PIPE	
••		1	2	MTS 1	F 1	PLAIN PIPE	
			1	MT	BENT	H COVER.	
		CEP	ENT	ÉD IN	Б В/	H COVER.	
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	66	5 5	tandi	y T	ine		
		<u> </u>		∇			
			1	f			
	J	J	1	<u> </u>		INSTALLATION DETAILS	
W	ATER.LE		ÖRD	<u>,</u>			
TIME	 ^	V.					
		<u></u>					
A OF CASING B	122 10	JET	ATEZ	-00 M	15		
OF WATER	<u> </u>			<u>- 00 pr</u>			
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							-0
			_		DRILLING	65-00 MTS	
		,			OBSTRUCT	TION	
			1192	1	MOVE & SI		
SIGNED CLIENTS	REPRESE	NTATIVE	MIA	the	STANDING	6hrs-	
	••••			- ,1	CASING		
	,	< N	M. C.	, ll	LIELARS,	NETOIN IND MES-	

DAILY DRILL LOG

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		t		NAU at	BH No.	11. 0	······
LOCATION ENDERG	y Iwa	APEN RIC	A NO. GA	VHHOM		<u>iet (</u>	
CONTRACT No.	-				KTN. DIAME		
TYPE OF DRILLING	ROTA	RY CH			IN PLE ANGLE		-112
DATE 22-3-9	0 11	HURS		<u>- DEA</u>		DIAMETER 5	_
OPERATION	SIZE	FROM	ТО	LENGTH	D	ESCRIPTION	ľ
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ИС	NEO	FRO	MB	1+ 3.4	E to B	H 14 A	
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OH	41	4/2	1-20	1.20	Hardwore	and Parts	leter
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		1-20	35.00	33.80	GRA	NITÉ.	
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		B/H	IN	KOMF	LETE.		
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		· - · · · · · · · · · · · · · · · · · ·			INSTAL	LATION DETAIL	
W	ATER LE	EVEL REC	ORD		<b>a</b>	<u></u>	
ТІМЕ			<u> </u>	·		<u> </u>	<u> </u>
T OF HOLE					Timn	$\Lambda < 1$	raged _
				<u> </u>	beyond	<u>L'répair</u>	1 MAR
	· · · ·		]			Any chance	
					recom	panso I	<u> 7200,266</u>
CASE	1 - 1	0	-50	MEST	· · · · · · · · · · · · · · · · · · ·		
		<u>_</u>					
Brohen ly	panite	from	31 m TS	10			
		V		MTS.			
			1 1				
Replacin	<u>q</u> a	condon	ed Hale		<del>_</del>		TO
,	<i>v</i>					FROM	TO
- n	<u> </u>	······	~~~		DRILLING	35-00 01	5
Sheet		- 11	<u></u>		OBSTRUCTION		
			A	5	MOVE & SET UP	IMOVES	
SIGNED CLIENTS	REPRESE	NTATIVE	11-		STANDING		<u></u>
	$\sim$	Ma	· -	Ilt	CASING	1-50	<u> </u>
SIGNED - DRILLER	<u>າ່ ປະ</u>	NUL	Lot	ia _	DELAYS		<u> </u>

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# DAILY DRILL LOG

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LOCATION	ENDER	BYLWA	RREN	RIG	à No₊	<u>N</u>	AN00.		8H No.	15-	
CONTRACT				VE	ністе				DIAMETE	15 U	
TYPE OF D		ROTA	RY	CR	EW:J-	MC	CRINDL	Ξ.	ANGLE		
		1		1.	DED	Ψ.	CRINDL J.BR	OGAN	CASING I		-7 (
DATE 22-	2-91	<u> </u>	MN7	L	·····	<u> </u>	GUOK.		ononing 1		<u></u>
OPERAT	ON	SIZE	FRO	M	тс	>	LENGTH	· · . · ·	DES	CRIPTION	• • • • • • • • • • • •
					] 		<u></u>	<u> </u>	<u></u>		
		44	20		<u> </u>			( )			
0/14		44	72.0	00	100	- 00	28.00	G R	ANI	ι Ε .	
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		[			ļ		1 MI	BEI	UTON	ITE 9	EAL
·		ł 	CE	М	ENT	EC	B	44	COVI	ER	
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TIME								· · ·			
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		1								28.00	MTS
She	etlo	<u> </u>					- ·- ·	DRILLING			102.12
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					$\leq$	N	<u> </u>	MOVE & SI		LMOVE	<u>k</u>
SIGNED CL	IENTS F	REPRESE	NTATIV	Έ		$\sim$		STANDING	1		<b> </b>
			1 _ / ;	1. <i>1</i>	_		-11	CASING			[
1	RILLER	5	. /	NL	Ň	pn	Mp	OF AYS	INSTAL	100 MC	ጜ

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### DAILY DRILL LOG

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LOCATION ENDERBY/WARREN RIG NO. DANDO       BH NO. 15         CONTRACT NO.       VEHICLE NO.       DIAMETER 42         TYPE OF DRILLING ROTARY       CREW J. MCCRINDLE.       ANGLE         DATE 21-2-90       WED       TOFAN: 5-BROGAN       CASING DIAMETER 5"         OPERATION       SIZE       FROM       TO       LENGTH       DESCRIPTION         0/H       44       G/L       3-00       3-00       Bouldur cluy e Murl         3-00       75-00       72-00       GRANITE.
OPERATION SIZE FROM TO LENGTH DESCRIPTION O/H 4/2 G/L 3-00 3-00 Boulder day & Murl
OPERATION SIZE FROM TO LENGTH DESCRIPTION O/H 4/2 G/L 3-00 3-00 Boulder day & Murl
OPERATION SIZE FROM TO LENGTH DESCRIPTION O/H 4/2 G/L 3-00 3-00 Boulder day & Murl
0/H 4/2 G/L 3-00 3-00 Boulder clay e Marl
0/H 4/2 G/L 3-00 3-00 Boulder duy e Murl 3-00 75-00 72-00 GRANITE.
0/H 4-7 G/L 3-00 3-00 Boulder duy & Murl 3-00 75-00 72-00 GRANITE.
3-00 75-00 72-00 GRANITE.
3-00 75-00 72-00 GRANITE.
B/H INCOMPLETE
INSTALLATION DETAILS
WATER LEVEL RECORD
TIME
T OF HOLE
OF WATER
CASED TO 3.00 MT.
FROM TO
DRILLING 75-00 HTS
OBSTRUCTION
MOVE & SET UP
SIGNED CLIENTS REPRESENTATIVE STANDING
SIGNED - DRILLER S Mitmell DELAYS

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#### DAILY DRILL LOG

OUTH TYNE DRI	LLING		DA	AILY DRIL	L LOG		54	(04
LOCATION ENDER CONTRACT NO. TYPE OF DRILLING DATE 20-2-9	3ROTA		HICLE No.	INDO CRIND J.BRO GIBB	LÉ GAN	BH No. DIAMETI ANGLE CASING	11	
OPERATION	SIZE	FROM	то	LENGTH		DE	SCRIPTION	
0/4	42	72-00 B/H	100-00 COM	28-00 PLET	•	ANIT	٠.	
		CEME VED	VTED	3 MIS MI B/H	OF SL OF BENG COV	PLAIN TONM	, PIPI	E
	VATER L	EVEL REC				INSTAL	LATION DETAI	LS
TIME CF HOLE OF CASING OF WATER							÷	
		· · · · · · · · · · · · · · · · · · ·				GTION	500 N	- <del>70</del>
SIGNED CLIENTS		ENTATIVE MU	- Al Cindo	$\sum_{k}$	MOVE & STANDIN CASING DELAYS	IG	I MOVÉ	

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#### DAILY DRILL LOG

LLING		DA	ILY DRIL	L LOG	52	(105)
ROTA		HICLE No.	RINDL	DI E AN	AMETER 44	
SIZE	FROM	то	LENGTH		DESCRIPTION	
42	G/L	9-00	9-00			4
	9-00	72-00	63-00	GRA	IN ITE.	
	В/н	IN	COMP	LETE.		
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		· · · · · · · · · · · · · · · · · · ·				
		· · · ·			· · · · · · · · · · · · · · · · · · ·	
				1	ISTALLATION DETA	ILS
VATER L						
	0 9	-00 p	ITS.			
						·
				DRILLING		то 1/Тз
					ON	
REPRES	ENTATIVE	4	2)	STANDING		
R J	M	1-0-0-	dh	CASING DELAYS	9-00 M	<u>rs</u>
	REPRESE	ROTARY CRE ROTARY CRE MUN SIZE FROM 444 G/L 9-00 B/H 9-00 B/H 9-00 CRE CRE CRE CRE CRE CRE CRE CRE CRE CRE	REPRESENTATIVE	BY / WARPEN       RIG NO. DANDO         ROTARY       CREW J. MCC RINDL.         ROTARY       CREW J. MCC RINDL.         Iman       T. DEAN, J. BR.         Iman       T. GLBB         SIZE       FROM       TO         Iman       Iman       Iman         SIZE       FROM       TO       LENGTH         Iman       G/L       9-00       9-00         Iman       G/L       9-00       9-00         Iman       G/L       Iman       G/L         Iman       G/L       G/L       G/L         Iman       G/L       G/L	BAY / WARREEL       RIG NO.       DANDO       BI-         VEHICLE NO.       DI         AROTARY       CREW S. MCLRINDLE       AN         INDU       TO EAN, J. BRO LAN       C/         SIZE       FROM       TO       LENGTH         LAA       G/L       9-00       9-00       BOULDER         YATER       LEVEL RECORD       IN       IN         TO       9-00       72-00       63-00       GRF         DI       IN       COMPLETE.       IN         VATER       LEVEL RECORD       IN       IN         TO       9-00       MTS.       IN         DRILLING       DRILLING       IN       DRILLING	52         BH ING NO. OPNOO         BH NO. 1/6         VEHICLE NO.         DIAMETER 1/2 //         ANGLE //         INSTALLATION DETA         ANGLE //         ANGLE //         ANGLE //

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### DAILY DRILL LOG

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LOCATIONENDER	M /WAI	RREN RIC	NO. DAN	JDO		BH No.	7		
CONTRACT No. VEHICLE No.						DIAMETER	- <u></u>		
TYPE OF DRILLING ROTARY CREW J. MCCRINDLE DATE 26-2-90 / FRI. T. DEAN. J. BRO I. DEAN. J. BRO						ANGLE			
DATE 26-2-90 / FRI. T. DEAN. J. T. GIB					G HN	CASING DIAMETE	FR 5"	Ì.	
<i>₹. v</i>							·····		
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTI	ON		
				-					
······································		INSTA		97 r	175 0	E SINTTE	D PIPE	, ;	
	<u> </u>				115 0	<u>F SLOTTE</u> DF <u>PLAIN</u>	PIPF	` <b>`</b>	
	<u> </u>		[ \	1 1-	L RE	NTONITE	SEAL	h	
<b>.</b>	<u> </u>	15	MENT		BIH	COVER		†	
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<u></u>		<u> </u>	<u> </u>			INSTALLATION	DETAILS	İ	
Y	ATER L	EVEL REC	0RD	· · · · · · · · · · · · · · · · · · ·	1		KCOV	Ee	
TIME							- FCCC		
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					DRILLING	3			
					OBSTRUC	TION			
	<u> </u>	· · · · · · · · · · · · · · · · · · ·	~	2	MOVE & S		VE.		
SIGNED CLIENTS	REPRESE	NTATIVE	77	$\overline{\mathcal{O}}$	STANDING	1			
Signed Vernitio		· · · · · · · · · · · · · · · · · · ·	A		CASING				
SIGNED . DRILLER	, < .	Mil	, i s Il		DELAYS	NEW 100	MIS		
SIGNED . DHILLED	<u> </u>	<u>now</u>	Montell'	·			• • • • •		

#### DAILY DRILL LOG

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LOCATION EN CONTRACT NO. TYPE OF DRIL DATE 25-2	LING ROTA	VE	A NO. DA HICLE NO. EW J.M ^{CC} DEAN.	NDD CRINDLE J. BROGH J-GI	BH No DIAME NO 3.B CASING	TER H	511
OPERATION	\$IZE	FROM	то	LENGTH	[	DESCRIPTION	
Ø/H	41	40-00	100-00	60100	GRAN	NTE.	
		B/H	COP	PLE	TE-		
	•						
·							
					INSTA	LLATION DETA	NLS
THE	WATER L	EVEL REC	ÓRD	·····			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
TIME OF HOLE OF CASING OF WATER							
Rig	Втоке	n/D1	<u>7WM-</u>				
		•	·····			FROM	то
		AN /			DRILLING OBSTRUCTION	60-00	MTS
SIGNED CLIEN					MOVE & SET UP STANDING CASING		
SIGNED - DRII		·Mil	Anin	Ma	DELAYS		

### DAILY DRILL LOG

(108)
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SOUTH TYNE DR	ILLING		DA	ILY DRIL	L LOG	45 (08)
LOCATION ENDER CONTRACT NO. TYPE OF DRILLIN DATE 14-2-91	IG ROTA	RY CF	HICLE NO. NEW J.M.C T. DEAN	NDO RINDLE J.BR GIBB	069N	BH No. 17 DIAMETER 42 ANGLE CASING DIAMETER 5"
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION
0/14	44	G/L 11-00	11-00	11-00 24-00	Top B GR	oil, Boulder Clay & Ma ANITE
		в/н	<u> Ini</u> (	омр	FTE	
) 						
						INSTALLATION DETAILS
TIME T OF HOLE OF CASING OF WATER						-* -*
CASED						
Bhe	t,	2.0f	2	2,	DRILLING OBSTRUC MOVE & S	TION
SIGNED CLIENTS			In	ill.	STANDING CASING DELAYS	3 11.00 MTS

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#### AUV BOUL LOC

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OUTH TYNE DRI	LLING			DAILY DRIL	L LUG	44 (10)			
LOCATION ENDE	RBY/n	( INKIGETY	·	DANAO		BH No. 18			
CONTRACT No.			VEHICLE N	0.	<u> </u>	DIAMETER	44	ť	
TYPE OF DRILLIN	G ROTP	HRY (	CREW J-N	ACCIZIN N J	05E 3R0 GA1	ANGLE	-		
DATE 14-2-90	) [w	ED	1.0004	ACCRIN NJ. J. ( GIBB	·	CASING DIA	METER 5		
OPERATION	SIZE	FROM	то то	LENGTH		DESCR	IPTION		
······									
		12357	TALER	102	MTS	OF SE	οΤΤΕΛ	PIPE	
····	<u> </u>			3	MTS	DE PI	AIN	PIPE	
<u> </u>	· · · · · · · · · · · · · · · · · · ·	1		}		BENTON			
			1346	VT B	1	OVER.			
			CEMEI		FT_C		<u> </u>		
		110.	. 50	TO	211	17	<u> </u>		
		mer	JED		D/M				
	<u> </u>	20				<u> </u>			
<u> </u>		th h	m B	tandin	M	ACHINE	MAKL	NG	
<u> </u>		0	CESS	101	B/L	17.		· ·	
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			<u></u>		_	INSTALLATI	ON DETAIL	s	
	WATER L	EVEL R	ECORD	······					
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Sh a	<i>I</i> -	art	-7		OBSTRU				
		1	- free -		MOVE &		MOVE		
SIGNED CLIENTS				tD-	STANDIN		h.m.		
		··· ···			CASING	<u>^</u> -	4147-1.		
SIGNED - DRILLE	$\sim$	·m·	1.1.	10.	1	INSTALL 1	05 MT	-ς	
SIGNED - DRILLE	н ~~,	114	unn	rue_	100000	1117114 1	<u> </u>		

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### DAILY DRILL LOG

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OUTH TYNE DR	ILLING			JAILY DRIL	L LUG	41	(P	10	
CONTRACT No.	PE OF DRILLING ROTARY CREW J. MCCR			ANDO CCRINDL	BH NO. DIAMET -E ROGAN CASING		-11		
DATE 13-2-90	1.10	165		E-GIBB	CASING	CASING DIAMETER 5"			
OPERATION	SIZE	FROM	то	LENGTH	D	ESCRIPTION			
0/14	44	33-00	105.00	72-00	GRAN	NTE.			
		B/	H C	OMPLE	TE.				
····	WATER L				INSTAL	LATION DETA	123		
TIME I OF HOLE OF CASING OF WATER				ЧТ5.					
		······				FROM			
	<u> </u>				DRILLING	72.00 M			
	. <u> </u>	·			OBSTRUCTION		<u> </u>		
<u></u>		· · ·		7	MOVE & SET UP				
SIGNED CLIENTS		INTATIVE	4	t	STANDING				
			1.1.1.	. 1	CASING	<u> </u>			
NONER - REHIE	-n <u>`</u>	N	1.1	10	DELAYS	1	-		

DRILLING

# DAILY DRILL LOG

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A HAR AND A	ILLING		DA	ILY DRIL	L LOG	38		
CONTRACT No.	CONTRACT No. VE			NDO LA INACE J. BR IBB	BH NO. LS DIAMETER 45 DIAMETER 45 ANGLE CASING DIAMETER 5''			
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION		
0/H	44 0	ī[L	19-50	14-50	Top boil,	Boulder Elang e	red Musl	
	10	1-50	33-00	13-50	GRAN	1778		
· · · · · · · · · · · · · · · · · · ·		B/H	IN (	OMPL	ETE.			
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······						· · · · · · · · · · · · · · · · · · ·		
	WATER LEVE		08D		INS	TALLATION DETAIL	LS	
ТІМЕ								
DF HOLE CF CASING OF WATER								
CASED	-10	19-5	0 MT	<u>ح</u>	-			
			<u>v 111</u>	<u> </u>		· · · · · · · · · · · · · · · · · · ·		
			<u></u>		<u>,</u>	······································		
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	<u>,, ,, ,, , , , , , , , , , , , , , , ,</u>				DRILLING	53.00 MT	то	
					OBSTRUCTIO	N	<b></b>	
SIGNED CLIENTS	REPRESENTA	TIVE	Mh	)	MOVE & SET STANDING	UP		
		<del>л/</del>	crid		CASING	19-50 M	' <del>'</del> '	
SIGNED - DRILLE	R 7 - 7 - 1	Inc	~ nun		DELAYS			

# DAILY DRILL LOG

							40	to order.
LOCATION ENDE	RBYING	POEN RIG	NO. DA	NOO	B	H No. /	9	]
CONTRACT No.	1	VE	HICLE No.			AMETER	44	
TYPE OF DRILLING	E. A	NGLE						
TYPE OF DRILLING ROTARY CREW J. MCCRINDLE DATE 7-2-90 WED T. DEAN. J.BROCH T. GIBB.					<i>1</i> <del>7</del> 0	ASING DIA	METER 5	- 71
		·		<u></u>				
OPERATION	SIZE	FROM	то	LENGTH		DESCR	IPTION	
			·····		······			
DH	12	G/L	14. ADA	14.00	Bould	V Thur	M	url.
		197-				- Car		
		19-00	25.00	6.00	GRAI	NITE		
	1							
		B/H_	IN	COMPL	ÉTE .			
	1							
<u></u>		1						
							-	
······	+	1						
<u> </u>	1		†					
·			<u> </u>		1			
		· · · · · · · · · · · · · · · ·						
		<u></u>		_ <b>L</b>		NSTALLATI	ON DETAI	LS
	VATER L	EVEL REC	ORD					
TIME				· · · · ·				
	· · · · · · · · · · · · · · · · · · ·						-*	
OF WATER								
CASED	10	19-1	20 M-	٢٢.				
								<u>.</u>
<u> </u>	<u></u>	<u> </u>						
								·
			· · · ·					
<u> </u>	<u> </u>	<u> </u>					EROM	70
					DRILLING	7	5-00 K	155
- Chan	F7	A.	7.		OBSTRUCT	1 ·	<b>1</b> -	
	<u>~ /</u>	TA			MOVE & SE			
SIGNED CLIENTS	DEDOES				STANDING			· · · · · · · · · · · · · · · · · · ·
SIGNED CEIENTS	•				CASING	<u> </u>	9-00 M	T c
		- Mie	/ `	110	DELAYS	<u> </u>	1 1- 1	
SIGNED - DRILLE	M / ~	- me	man	- UX				

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### DAILY DRILL LOG

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CONTRACT No.	ATION ÉNDÉRBY/WARREN RIG NO. DANDO TRACT NO. VEHICLE NO. E OF DRILLING ROTARY CREW J. MCCRIND E 8-2-90/TH449 T. DEAN. J. BR T. GIBB.				BH NO. 19 DIAMETER 47 ANGLE CASING DIAMETER		
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	
0/11	44	25-00	105-00	\$0-00	GR	ANITÊ .	
		B/1+	COM	1 PLETI	E . 1		
		INST	ALATIO	N .	INCOM	1 PLETE	
						INSTALLATION DET	AILS
TIME TIME OF HOLE OF CASING OF WATER				· · · · · · · · · · · · · · · · · · ·	-		
						· · · · · · · · · · · · · · · · · · ·	
					DRILLING	FROM 80-00	TO MTS.
SIGNED CLIENTS	REPRESE	NTATIVE	A	$\rightarrow$	OBSTRUCT MOVE & SE STANDING	TUP	
SIGNED - DRILLER	,	Mi	Cra	Cle.	CASING DELAYS		

### DAILY DRILL LOG

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LOCATION END	EEBY hu	ARRENRIC	a No. DAI	NOO	······	BH No.	19.	
CONTRACT NO.			VEHICLE No.			DIAMETER 4-2		
TYPE OF DRILLING ROTARY			EWJ.MC	LE. ANGLE				
DATE 9-2-9	O FRI	1	EWJ.MC DEAN	GIBB	OGAN	CASING	DIAMETER 5	-/ <
OPERATION	SIZE	FROM	то	LENGTH		DE	SCRIPTION	
	IN	STALL	ED	902 ·3	175 ( 175 (		lotted lein f.	Pipi
			1111	Ben	Tonit		eal.	
)		- U	ment	- 13/		Core	<u> </u>	
	P	DVE		10	3/н	18	}	
						INSTAL	ATION DETAI	LS
	WATER LE	VEL REC	ORD				· · · · · · · · · · · · · · · · · · ·	
TIME			1					
						· · · · · · · · · · · ·		
I OF HOLE OF CASING OF WATER	Wate	in a	E 8.	5 MTS.				
			· · · ·				· · · · · · · · · · · · · · · · · · ·	
		····						
			· ··· -					
			<u> </u>	<u> </u>				
			•••	· <u>-</u>			FROM	то
		<u> </u>				~	- <b></b>	
		· ·			DRILLIN			
			-i/A-		MOVE &		IMOVE	<b> </b>
SIGNED CLIENTS	REPRESE	TATIVE	MR In	$\sim$	STANDIN			
	<u>_</u>			11.	CASING			
		mi	1 .	II R	· · ·	1.11 - 11 -	105	1 1

# DAILY DRILL LOG

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					<i>[</i> 41
LOCATION ENDE	EBY/W	ARRE RIG	NO. DA	NDO	BH No. 20
CONTRACT No.	11	VE	HICLE No.		DIAMETER 44
TYPE OF DRILLING	ROTK	IKY CR	EW J.MC	CRINDUE TO DE	
DATE 7-2-90		ED J.	BLOGAN	T-DE T-DE T-BB	CASING DIAMETER 5
			r		
OPERATION	SIZE	FROM	то	LENGTH	DESCRIPTION
0/1+	44	90-00	105.00	15.00	GRANITE
[					
		B/H	COM	PLETE	-
	INS.	TAUER			15 OF SLOTTED PIPE
		•		3 M	S OF PLAIN PIPE
	l		ļ	<u> </u>	
· 				IMT.	Bentonite Geal.
				-	
		L 7	ement	m.	B/H TOP
		<b>_</b>			·
	MO	VED	10	<u> - B/H</u>	19
				·	
		]			INSTALLATION DETAILS
16/	ATED 1	EVEL REC		· · · · · · · · · · · · · · · · · · ·	
ТІМЕ					COVER
	. <u></u>				The All Them
			······		CEMENT ->
OF WATER					LEINS SIN
					Ecolivy 0
·····		, <u></u>			
·······					DV "A \$
	- <u></u>				00 100 00
		<u> </u>			
		<u> </u>			<del>5.80M</del> · 70
101		Λ	7	······································	DRILLING 15 MTS
Chaleet	. 1	Of .	- 5		OBSTRUCTION
	The second	All	ill n		MOVE & SET UP   MOVE
SIGNED CLIENTS	REPRESE	NTAL			STANDING
				1/	CASING
SIGNED - DRILLEF	· 5. ·	Mil	rid	U	DELAYS INSTAU 105 MTES

#### DAILY DRILL LOG

SOUTH IYNE DRI	LLINU		UA			26	
LOCATION ENDER	BY/WAR	KEN -		INDO	BH N		7
CONTRACT NO.	, 		EHICLE No.	· A 4 1		ETER 44	
TYPE OF DRILLING		y c	REWJ.M.		LE. ANGI		
DATE 6-2-90	TUE	5	1. 01/1	BROGA	N CASI		
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	
0/H	44	GfL	10.00	10-00	RED	MARL	. <u> </u>
-7		-7 0-00	40.00	80-00	GRA	UITE	
	<b>1</b> 	0-00				· · · · · · · · · · · · · · · · · · ·	
		B/H	INCO	PMPLE	ETE.		
		1.		·			
	-						
						· · · · · · · · · · · · · · · · · · ·	
					INST	ALLATION DETAI	LS
W	ATER LEV	/EL RE	CORD				<b>.</b>
TIME	<u> </u>	ļ					
E OF HOLE							
T OF HOLE							
10.00 M	<u>T5</u>	_C.F	ASING			· · · · · · · · · · · · · · · · · · ·	
	<u> </u>	. ,	······································				
						· · · · · · · · · · · · · · · ·	
· · · · · · · · · · · · · · · · · · ·							
					····	FROM	T
					DRILLING	90.00 M1	·S .
					OBSTRUCTION		
	Alle	ack	EK -		MOVE & SET U	P	
SIGNED CLIENTS	REPRESEN	TATIVE	$\sim$		STANDING		
			clound	11	CASING	10-00 MT	5.
SIGNED - DRILLER	5.	M	church	N.	DELAYS		

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#### DAILY DRILL LOG

OUTH TYNE DR	RILLING			DA	ILY DRIL	L LOG		21	
OCATION CHIAC			BIG	No. OF	LNIDO		3H No.		
OCATION ENDE	<u>RBY WA</u>			IICLE No.	F10120	<u> </u>			
	10 0 0501		CRE	W J.MC	CRINDLE		NGLE	<u> </u>	• • •
TYPE OF DRILLIN		-	τØ	EAN. J	CRINDLE 1. BROGAN BB (	U. F			<u>sir.</u>
DATE 4 - 2-	90 5	<u>4N</u>		<u> </u>	<u>BB (</u>	C	Aoing		<u> </u>
OPERATION	SIZE	FRO	м	TO	LENGTH	· · · · · · · · · · · ·	DE	SCRIPTION	
0/1+	42	1-11		8-00	8-00	REO	) M	ARL.	
		4/4	5				• •		
		8-0	0	100-00	92-00	- Gf	RAN		<u> </u>
,,,,_,_,_,_,_,									
				<u></u>					
				<u>.                                    </u>			<u> </u>	<u></u>	
				···			<u></u>		
h/=					· · · · · · · · ·				
									<u> </u>
	-								
<u></u>					<u> </u>		NSTALL	ATION DETAI	LS
	WATER L	EVEL F	RECC	RD				· · · · · · · · · · · · · · · · · · ·	
TIME									
T OF HOLE									
									<u>_</u>
OF WATER									
						· · · · · · · · · · · · · · · · · · ·			
CASE	<u>p 7</u>	0 9	<u>5 -</u>	00 r	1TS				<u> </u>
. <u>,</u> ,			<u> </u>						·
	·			<b></b>	<u> </u>				
		<u> </u>							
<u></u>				<u>,</u>					
					·····			FROM	то
						DRILLING		100 MTS	þ
		•			····	OBSTRUCT	ION		
				A		MOVE & SE	Т UP		 
SIGNED CLIENTS				TT		STANDING			· · · · · · · · · · · · · · · · · · ·
SIGNED - DRILLS	~	~	A .		16	CASING		\$-00 MT	<u> </u>
SIGNED - DBILLS	_{टन} २२	. M	1,	land	NU	DELAYS			1

## DAILY DRILL LOG

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LOCATION STAR	a arely cannot	RIG No.	ANDO	BH No. 21
LOCATION ENDE	internet with the party of the	VEHICLE No.	4000	DIAMETER 444
TYPE OF DRILLING		CREW J. MC	CRINDLI	
		T. DEA J. BROKAN	JN.	AR CASING DIAMETER 5"
DATE 5-2-90	) MON.	J. BROHAN	<u> </u>	AB TOASING DIAMETER 9
OPERATION	SIZE FROM	і то	LENGTH	DESCRIPTION
	B/+	1 10	100 p	1TS.
	1.16	TALLED	- G-	MTS SLOTTED PIPE
		INFEC U	3	MTS PLAIN PIPE.
	GR	AVELLE	ED (	IP B/H
	B	ENTONI	TE	SEAL
		· · · · · · · · · · · · · · · · · · ·		
	<u> </u>	EMENT	<u> </u>	P COVER.
	MOVES	FROI	n 131	H 21 TO B/H 20.
			<u> </u>	
	ACCESS	VERY		08 NEEDED
	10	KLEAR	ROI	
١٨	ATER LEVEL R	ECORD		INSTALLATION DETAILS
TIME			······	4 Cour
				TAX VII : 11 CIL - SENCES
	<u></u>			K K S K
			<u>.</u>	GULL GU D LOW CENER
	<u></u>		<u> </u>	00-0
· · · ·	<u> </u>			00 01
· ··· ··· ··· ···			<u></u> .	00 15 00
······				OOF GRAVE
	·			1020
	•			
		<u> </u>		FROM TO
			<u> </u>	DRILLING
·			<u> </u>	OBSTRUCTION
		INC	$\frown$	MOVE & SET UP   MOVE .
SIGNED CLIENTS	REPRESENTATIV	: 1110	//	STANDING 4 by

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#### DAILY DRILL LOG

UUIH ITNE DR	ILLING				L L00		16	
CONTRACT No.	DEATION ENDERBY WARREN DNTRACT NO. (PE OF DRILLING ROTARY			NDO	TDEAN	BH No. 22 DIAMETER 44		
	TE 1-2-90 / THUR J-BROGAN/I-G					<b>}</b>	DIAMETER L	5
OPERATION	SIZE	FROM	и то	LENGTH		DE	SCRIPTION	
Ma	VE .	10	B/I-I	22				
/н	0/H 4 + G/L		3-00 Tops			<u>pilþM</u>	ARL WITH	+ BOWDERS
		3-0	0 28.00	9	GRA			
· · · · · · · · · · · · · · · · · · ·							·····	
	·		10000			INSTAL	LATION DETA	LS
TIME	WATER L							
H OF HOLE								
CASED	To 3	.00	MTS		· · · · · · · · · · · · · · · · · · ·			
						· · · · ·		
	<b></b>						VEROM	- <del></del>
		· · · · · · · · · · · · · · · · · · ·			DRILLING	3	28.00	
SHF	ET B	100	<u>F2</u>	······	OBSTRUC		ONE M	OVE
SIGNED CLIENTS	REPRESE	NTATIV	/E		STANDIN			
	ч	$\hat{\mathcal{A}}$	• .		CASING		3-001	<u>4TS</u>

DELAYS

#### DAILY DRILL LOG

SOUTH TYNE DR	ILLING		DA	ALY DRIL	L LOG		19/	16. 120
LOCATION ENDE	ex In	RI	G NO. 01	ANDO		BH No.	22	
CONTRACT No.	cor j vog	HAREN VE	HICLE No.	110		DIAMETE	R 44	
TYPE OF DRILLIN	GROTA	RY CF	NEW J.MC	CRINDLE	T-DEAN	ANGLE		
DATE 2-2-9			J. BROG			CASING [	DIAMETER 3	-11
OPERATION	\$†ZE	FROM	то	LENGTH		DES	CRIPTION	
0/1+	44	28-00	100-00		(	FRAN	ITE	
	•							
		B/I	F C	OMPI	ETE	<u> </u>		
		/						
	1	NGTH	ALLA	Tink		OLA DI	ETE	
	<b> </b>					9777		
	- <b>-</b>						······································	
		_1		<u> </u>		INSTALL	ATION DETAI	LS
	WATER L	EVEL REC	ORD	····	· · · · · · · · · · · · · · · · · · ·			
TIME								
T OF HOLE	<u> </u>							<u> </u>
H OF HOLE								
		!						
			· · · · · · · · · · · · · · · · · · ·	- <u></u>			· · · · · · · · · · · · · · · · · · ·	
						<b>.</b> .		
								-10
- 0 0	P C	7	L		DRILLING	<u>a</u>	72 M1	<u> </u>
phel		- 01		=: 	OBSTRUC			<b> </b>
		1	~0	2	MOVE & S			
SIGNED CLIENTS	REPRESE	NTATIVE	Aln	<u>~</u>	STANDING	G		
	~	(M	1.1-	_ll		. :	<u> </u>	
SIGNED - DRILLE	R 🔨	r = r	in		DELAYS			1

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#### DAILY DRILL LOG

a 20/19/16.

LOCATION ENDE	20.041	Le and Big	No. 131	4.(0)	BH No. ZZ
CONTRACT No.	(	IVE	HICLE No.		DIAMETER In-
TYPE OF DRILLING	anth		W-J.MC	LRINDI	-É . ANGLE
TYPE OF DRILLING	10 3	DATI	, DEAN	· J.BR	B CASING DIAMETER 5"
OPERATION	ŞIZE	FROM	то	LENGTH	DESCRIPTION
	1105	CALLEI 15 Lyr	s avell pention	97 r 3 r ile	to vj Bolotted Pipe 175 hoj Plain Pipe h seal.
			temo	t 1	of writer
		MOU	ED	10	13/17 21.
					INSTALLATION DETAILS
γ	VATER L	EVEL REC	ORD		Top 2014
TIME OF HOLE OF CASING OF WATER					00 00 00 00 00 00 00 00 00 00 00 00 00
	<b></b>				FROM TO
AA		1	4	· · · · · · · · · · · · · · · · · · ·	
5000	t	-0-7-	- <i>f</i>	-P-	MOVE & SET UP
SIGNED CLIENTS	REPRESE	NTATIVE	A	$\rightarrow$	STANDING
			<u> </u>		CASING
SIGNED - DRILLE	. 5	Min	Criqu	171	DENTSINSTAL LOOINTSI

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#### DAILY DRILL LOG

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DUTH TYNE DRILLING	DA	ILY DRIL	L LOG	95	
OCATION ENDERBY WARREN ONTRACT NO. YPE OF DRILLING ROTARY DATE 26-3-90 MON	RIG NO. GR VEHICLE NO. CREW J.M T. D	F331	KTN. DIAMETER 42		
OPERATION SIZE FRO	ом то	LENGTH		DESCRIPTION	
MOVED F	ROM B/1	25	TO B	H 23.	
0/H 47 4/	L 2.85	2.85	Top	Boil, Boulde	+ Tlay
2.8	5 100.00	97.15	GR	ANITE	
B/H	СОМИ	LETE		· · · · · · · · · · · · · · · · · · ·	· · · · ·
INSTALLED	97M7 3M	TS O	= <u>p</u>	TTED PIP LAIN PIPE VITE SEAL	
	CEMENT	1 *		1	
				INSTALLATION DETAILS	S
WATER LEVEL	· · · · · · · · · · · · · · · · · · ·		``````````````````````````````````````		
CASED TO ?	3.00 MT	<u>5</u>			
		·····		FROM	τo
SIGNED CLIENTS REPRESENTATI	······································	2	MOVE & SE STANDING CASING		
SIGNED · DRILLER JM	i Cand	16.		NETAL 100 MTS	

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#### DAILY DRILL LOG

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OUTH TYNE DRILLING	DAILY DRILL	96 🦸 🧖
LOCATION ENDERBY WARREN CONTRACT NO. TYPE OF DRILLING ROTARY DATE 27-3-90 TUES	RIG NO. GRY PHON VEHICLE NO. F331 K CREW J. MCRIN T. OFAN	DLE ANGLE
OPERATION SIZE FRO	M TO LENGTH	DESCRIPTION
MOVED FR	on B/H 23	TO B/H 24
0/14 47 4/	L 330 330 -	Top Soil & Boulder They
3-30	100.00 96.70	GRANITE.
B/	H COMPLET	TE
INSTALLED C	3 MTS OF P	•
		U B/H COUER
	· · · · ·	INSTALLATION DETAILS
WATER LEVEL	HECORD	5
CASED TO	3.50MTS	
		FROM TO
	AD.	OBSTRUCTION MOVE & SET UP 1 MOVE
SIGNED CLIENTS REPRESENTATI		CASING 3.50 MTS
SIGNED · DRILLER 5. M		DELAYS INSTALL 100 MTS

#### DAILY DRILL LOG

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OUTH TYNE DRI	LLING		DA	ILY DRIL	L LOG		94	
LOCATION ENDER CONTRACT NO. TYPE OF DRILLING DATE 25-3-4	3 ROTA	VEI HRY CRI	NO. GAR HICLE NO. EW J. M T. M	F331	KTN DIAMETER 44"			
OPERATION	SIZE	FROM	то	LENGTH		DE	SCRIPTION	
0/14			м В/ 3-80				5. Brulder te	lang
		3.80 B/H	100.00 CC	96.20 MPLE	F.	RANI	TE.	
1N5	TALLI	CEMI	3 I ENTED	175 MT IN	OF BENTO B/H	PLA DNITI CC	TTED IN P E SEA IVER	IPE.
		EVEL REC AT AT	····				LATION DETAIL	
CASED	-70	4	<u>МТ5.</u>					
SIGNED CLIENTS	REPRESE	NTATIVE	Ą	2	DRILLING OBSTRUC MOVE & S STANDIN	TION SET UP	FROM 100 MTS 1 MOVE 12 AND	то
	5	MA	·	115		100	4 MTS	· <u>·</u>

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### DAILY DRILL LOG

							93	
LOCATION ENDE	ERBY h	ARREA RIG	NO. GR	YPHON	J	BH No.	26	······
CONTRACT No.				F331_		DIAMETE	R 44	
TYPE OF DRILLIN	IG ROTA	ARY CRE		MCCR	1	ANGLE		
DATE 24-3-			1	. DEP	N.	CASING	diameter $5'$	<u></u> }
OPERATION	SIZE	FROM	то	LENGTH		DE	SCRIPTION	
						0		'
	MOVE	DERO	PM B	/H 14	<u> 10</u>	<u> </u>	<u>H_26.</u>	t
			<u> </u>				1 8.	100.0
_ 0/H·	ht-	G/L	5-90	5.90	Bould	<u>u u</u>	any and her	L'Illerce
				() () (D)	C-0	A 1117	΄	
		5.90	100.00	96-10	GR.	HNL	<u>_h</u>	
			C.	OMPLE	TF.		· · · · · · · · · · · · ·	
<u> </u>		<u>                                     </u>	<u> </u>					
	INST	ALLED	97	MITS 0	F Sh	OTTE	D PIPE	
,							PIPE	
<u></u>			1	MTI	BENTOI	VITE	SEAL	
			CEM	ENTED	IN E	<u>3/н</u>	COVER	
			<u> </u>					
					<u> </u>			
· · · · · · · · · · · · · · · · · · ·	· · · ·				<u> </u>	INSTAL	LATION DETAILS	S
······································	WATER L	EVEL REC						
TIME								
T OF HOLE	DAMP	1	<u>52</u> r					
L OF CASING	Web	AT	<u> </u>	475-	-			
OF WATER	·····							
0000		1 - 0						
CASEI	<u>) (</u> )	6=0	0 MI	5.				
e		. <u> </u>		······				
	<u> </u>			······································				
	-	<u> </u>						
							FROM	то
					DRILLING	3	100 MTS	
			1	4	OBSTRUC		······	
			110		MOVE & S	SET UP	LMOVE	
SIGNED CLIENT	S REPRES	ENTATIVE	111	n	STANDIN	G		<u> </u>
SIGNED - DRILL			/ -	.1	CASING		6 MTS	······································
SIGNED - DRILL	ER -5	. Mic	land	lle	DELAYS	1 PSTAL	LOO MTS	

(125)

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#### DAILY DRILL LOG

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OUTH TYNE D	RILLING		DA	AILY DRIL	L LOG	<i></i>	53	) S T
LOCATION END	EDON I.	LOAAC BIG	No. C-K	2VPITO	N	BH NO. 2	7	
CONTRACT No.	<u>cicio 1 / u</u>	VE	HCLE No.			DIAMETER	44	k
TYPE OF DRILLI	NG DIATA			ACCRI	NDL-E	ANGLE	14 Le	
				DEAN	• . 1	CASING DIAMET	<u>51</u>	
DATE 20-2-	<u> 90   -</u>	TUES	<u> </u>	DEFI	<u> </u>	CASING DIAMET	<u>er 9</u>	
OPERATION	OPERATION SIZE FROM					DESCRIPT	ION	
OH	44	50-00	100-00	50.00	G	RANITE	<u> </u>	
		B/r	СО	MPLI	ETE.			
······································	NST	ALLEN	C	17 MT	5 51	OTTED	PIPE	
		1		3 M-	<u>ts</u>	PLAIN	PIPI	E.
				1 M-	ß	ENTONIT	<u>E 58</u>	FAL
		CF	MENT	B/	1 60	NUER_		
			1					
· · · · · · · · · · · · · · · · · · ·								
			<u> </u>					
		The for	5	stan	lin	Farmer	· · · · · · · · · · · · ·	
	- T	M.V.			t.t.	of no		
	quart	Lunn	- av	mit_	June	and die		
	1							
						INSTALLATION		
	WATER L	EVEL REC			<b>-</b>			
TIME	<u> </u>							
E OF HOLE				<b>_</b>				
L OF CASING				····	ļ			
				<b>.</b>	ļ		<u> </u>	
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				· · · <del></del>		· · · · · · · · · · · · · · · · · · ·		·····
			·					
		. <u> </u>				FRi		TO
					DRILLING	3 50	00 MT	<u> </u>
		-	······		OBSTRUC	TION		
			$\sim$	$\overline{\mathcal{D}}$	MOVE & S	SET UP	_	
SIGNED CLIENT	S REPRESE	NTATIVE	$\square$	$\Sigma$	STANDIN	G H	hon.	
				<u></u>	CASING			
SIGNED - DRILL		Min	1	Ch-	DELINKS	INSTALL TOO	MIS	
ROBARCO - OTTEL		· · · · ·	contract c	~ L.T	f			

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### DAILY DRILL LOG

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LOCATION ENDER CONTRACT NO. TYPE OF DRILLING DATE 17-2-90 OPERATION	3 ROTA	VE Ry CR	INO. GR HICLE NO. EW J.M T. (		DLE	BH NO. 2 DIAMETER ANGLE CASING DIAMET	rer 5	
	MOU	ED	FROM	B/H	28 7	28 TO B/H 27		
0/H	44	GL	6.30	6.30	TOP SE MA	RL BOULDE	<u>e Ci</u>	Αγ
\ \		6-30				RANITE		
	- B	/H	INCO	MPL	ETE			
						INSTALLATION	DETAI	LS
TIME I OF HOLE	IATER LE	R AT	ORD 30	MT5.				
CASED	· 10	> 6.	50 M					
· · · · · · · · · · · · · · · · · · ·								
		•	· · · · · · · · · · · · · · · · · · ·				00 }	
SIGNED CLIENTS		NTATIVE Mc		D- Mi	MOVE & SE STANDING CASING DELAYS		ieti	20AD 5140 TS

DAILY DRILL LOG

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						50	(28)
LOCATION ENDE	e BY ha	ARRENRIC	3 No. G	eypho.	N BI	н No. 28. Аметея 44	
CONTRACT No.	<u> ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~</u>		HICLE No.			AMETER 44	
TYPE OF DRILLING	BOTAR	Y CR	EW J.M	CCRINC	LE AN	NGLE	
DATE 16-2-90	1		T.C	EAN	C/	ASING DIAMETER 6	-11
			·······				
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	· · ·
OH	44	25.00	100.00	75-00	(TR	ANITE.	
1			ļ				
		B/H	CO	HPLE	TE.		
		i 		<u> </u>			A:
,	IN	PTALL	ED	97M	<u>15 520.</u>	TTED PI	
·		<u> </u>				LAIN PI	
l /						NTONITE	SEAL
-	<b> </b>	L C.Ei	TENTE	p IN	13/14	COVER	
	· · · ·						
			· · · · · · · · · · · · · · · · · · ·				
	· · · · · · · · · · · · · · · · · · ·		· [	<u> </u>			
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······································	<u> </u>	I			IN	STALLATION DETA	ILS
	ATER L	EVEL REC	ORD				
TIME							- COVER
T OF HOLE					Ţ.		
	IATI	ER	AT L	62 M 15	1		
OF WATER				•	7	1/03/14	IS F NTOLICE
						00 - 00,	- <del></del>
					CEMENT		
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						0, 12/21	
					<u> </u>		·
					<u> </u>	- BO V (2)	
						10 1001	
				<b>_</b>		- <del>FROM</del>	TO
					DRILLING	75-004	10
· · · · · · · · · · · · · · · · · · ·	<u> </u>	!		~		····	+
			CH	$\rightarrow$	MOVE & SET		
SIGNED CLIENTS				· · · · · · · · · · · · · · · · · · ·	CASING		
SIGNED - DBILLEE	$\sim$	m	C.	1.		5001 100 M	15

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SOUTH TYNE DRILLING DAILY DRILL LOG

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n.	' Æ	
-1	8	

1		2.01- L.	BI ALL A	G NO. Gr	Dy Det Ar	BH No.	28	· · · · · · · · · · · · · · · · · · ·
	LOCATION ENDE	RBY JU		EHICLE No.	CY PRIOR	DIAMET		
	TYPE OF DRILLING	ANTA		REW J.M	ACCAN			
	DATE \$5-2-90		+ RURS		OFAN	CASING	DIAMETER 5	1
4		· · · · · ·				······································		
	OPERATION	SIZE	FROM	то	LENGTH	D	ESCRIPTION	<u> </u>
	0/H	44	G/L	4.50	4-50	HARDCORE e MARL	, BOULDÉR	CLAY_
			4-50	2500	20.50	GRAN	ITE	
			B/H	INC	OMPI	ETE		*
(								
						INCTAL	LATION DETAI	1 0
			EVEL RE			INSTAL	LATION DETAI	
					· · · · · · · · · · · · · · · · · · ·			
(								
	CASED		h-50		<u>)</u>			
					<b></b>			
	·····							
		<u> </u>	, ,				FROM	то
		. <u></u>				DRILLING	25-00 M	TS.
	Sheet	7,	of.	2.		OBSTRUCTION		
		NN1:	li -	<u> </u>	<u></u>	MOVE & SET UP		
	SIGNED CLIENTS	REPRESE	NTATIVE			STANDING		
			A. A.	Cride	1	CASING	4-50 M-	ts
	SIGNED - DRILLER	· 5.	. Nic	Conde	r	DELAYS		

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#### DAILY DRILL LOG

SOUTH TYNE DR	ILLING		D/	AILY DRIL	L LOG		46	(30)
LOCATION ENDER	LAY M	AFRENR	IG NO. GA	RYPHON	)	BH No.	29	
CONTRACT No.			EHICLE No.		DIAMETER 44			
TYPE OF DRILLIN	GROTA	RYC	REW J. I	1 CC RIN	OLE	04E ANGLE		
DATE 15-2-90	1		<u> </u>	DEAN	CASING DIAMETER 5"			
OPERATION	SIZE	FROM	то	LENGTH		DE	ESCRIPTION	
0/4	44	50-00	100000	50-00	6	RAN	VITE .	
		B I	f co	MPLET	<u> </u>			
		INST	ALLED	94			= BLOTT PLAIN P	
	1	1			-		TE SEA	1
		C	EMEN			OVE		
	M	DVE	p. 10	B/J	1 2	<u> 8.</u>		
	<u> </u>	<u> </u>					LATION DETAIL	LS
\	WATER L	EVEL RE	CORD				<u> </u>	COLER
ТІМЕ								
I OF HOLE					1			
		· ·		. <u></u>			2//	
	<u>.</u>			·····				-
				. <u> </u>		/		- SEMENT
B/H COL	ASPE	<u>N</u> 67, <i>F</i>	T ABO	UT_	BEN	TOULTE		. <u></u>
- 70 K	ITS:	<del></del>				···· <del>-</del>	200	·
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							-21- 3º	
							500	
							10 2 20	• • • • • • • • • • • • • • • • • • •
							12. 45	
							FROM	тo
					DRILLING	3	50-00 M	73
Shack		of	4.		OBSTRUC			
	(h)	n.			MOVE & S	BET UP	IMOVE +	ROAD SULL
SIGNED CLIENTS	REPRESE	NTATIVE			STANDIN	G		
	/	<u></u>	]	0	CA\$ING	<u>., </u>		·
SIGNED - DRILLE	<u>⊢`)</u> _	<u>_M.</u>	crived	<u>(</u>	BECAYS.	INSTALL	97-000	465

## DAILY DRILL LOG

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				-			4	3	2
LOCATION ENDE	RBY WI	Arren	RIC	3 NO. GR	LYPHON	J	BH No. 24	·····	-
CONTRACT No.	<u> </u>		VE	HICLE No.			DIAMETER 4	Ţ	
TYPE OF DRILLIN		} <b>&amp;</b> Y	CR	EW J.P	1CCRIN	DLE	ANGLE	-ff	·
DATE 14-2-9	<u>o [v</u>	ノデカ		1.	DEAN	J	CASING DIAMETER	5"	
OPERATION	SIZE	FRO	м	то	LENGTH		DESCRIPTION		
0/14	4-4	Gefe		4.50	4-50	Tof &	vil, Boulder Nurl.	they -	
		4-50	2	50-00	45.50	- Ked J	RANITE.		
		BTI	 _}	INC	OMPL	ETE			
	1	<u></u>			<u> </u>				
		<u>,</u> .		·	·				
<u>}</u>									
						,,,			<u></u>
		····							
						. <u></u>			
								<b>-</b>	
WA	TER LEV	/F1 8E	<u></u>	<u> </u>			NSTALLATION DET	AILS	
TIME									
OF HOLE OF CASING BA	+ W	ET	ľ	77 35	-00M	r <u>s</u>			
			= ^	<u></u>				<u> </u>	
CASED "	[0_	4.5	0	MT	5.				
							· · · · · · · · · · · · · · · · · · ·	. <del></del>	-
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	·			·					
	·						·····	··· <b>····</b> ·······	
								-10	ي بعندا
Sheet	2 1	N-	2	_ `		RILLING	50-00 M	<u>[\$</u>	
						BSTRUCTIO		· · ·······	
NED CLIENTS REF	RESENTA			HQ-		OVE & SET		·	
			<u>'</u>	. 11.		ANDING			
NED - DRILLER	3.1	Nel	- 	indl:			- 4"50 M	<u>&gt;</u>	
	<u> 37 /</u>	jur	7	mari	DE	LAYS			

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OUTH TYNE DRIL	LING		DA	ILY DRIL	L LOG		4	$\ddot{2}$	(132
LOCATION ENDER CONTRACT NO. TYPE OF DRILLING DATE 14-2-90	ROTA		HICLE NO. EW J. 1	YPHO MCCRI EAN	DIAMETER 42				
OPERATION	SIZE	FROM	то	LENGTH			SCRIPTION	······	
0/11	4:4		100-00	40-00 PLETI		ANIT	÷£.		
		DTALLI		97 M 3 M 1 M - B/H	TS C TS O C- B F C-C	FP	LOTTE LAIN NITE 2.		PIPE
	ATER LE	EVEL REC	QRD			INSTAL	LATION D	ETAI	LS COVER
					BENTO		00 00 00 00 00 00 00 00 00 00 00 00 00	con GRAVELCO CACO	CEMEN
							FROM		то
Sheet SIGNED CLIENTS	REPRESE	10/-	2- 	<u>&gt;</u> 11	DRILLIN OBSTRUC MOVE & STANDIN CASING	SET UP	40.00 1 MOVE		3 ROAD SI

SIGNED - DRILLER

5. Milmoth MINSTAL 100 MTS

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#### DAILY DRILL LOG

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OUTH TYNE DR	ILLING		D	AILY DRIL	L LOG	40	(33)		
OCATION ENDER	l 	V	EHICLE NO.	YPHON ICCRIND	DIAME	BH NO. 30 DIAMETER 42			
TYPE OF DRILLIN	- 1	i		DEAN					
OPERATION	SIZE	FROM	то	LENGTH	[	DESCRIPTION	· · · · · · · · · · · · · · · · · · ·		
0/н	4 4	G-/2	7-50	7.50	Top boil, red. 7 GRA.	boulder Clu	y-and		
		7.50	60.00	52.50	- GRA	NITE			
		B/+	H INC	OMP	ETĘ		· · · · · · · · · · · · · · · · · · ·		
				· · · · · · · · · · · · · · · · · · ·			<u></u>		
	WATER L	EVEL RE	CORD		INSTA	LLATION DETAI	LS		
TIME C OF HOLE OF CASING	2 1	1 RY	r						
UF WATCH	3/н		1	<u>، ، ، ، ، ، ، ، ، ، ، ، ، ، ، ، ، ، ، </u>			· · · · · · · · · · · · · · · · · · ·		
CASED	10	/·_	50 MI	<u>S </u>					
Bjohen Do	un f	br 2-	kr						
						-FROM	TO		
					DRILLING OBSTRUCTION	60-00 1	115		
SIGNED CLIENTS	BEPRES		A	<u>}</u>	MOVE & SET UP STANDING				
SIGNED - DRILLE	· · ·		11	1	CASING DELAYS	7-50 M	5		
SIGNED - DRILLE	:H ಎ+	<u>"ucr</u>	man						

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SOUTH TYNE DRI	LLING		DA	ILY URIL	L LUG		36	(34	
CONTRACT No.	YPE OF DRILLING ROTAR Y		WJ.M	YPHON CIRIN DEP	NLE	BH No. DIAMETER ANGLE CASING D	ETER 4 3"		
OPERATION	SIZE	FROM	то	LENGTH	DESCRIPTION				
		в/н	COLI	-APS)	JG-		····		
	A DU Cl	ANCE	EN C IED	ASING OUT	FROI B/H	м 16-4	TO TO	14.50	
	I IV	STAL	-hEŊ L	9-			SLOTTED PLAIN		
		•		NT B	ENTO B/I	NITE H CO	SEAU		
8	HOVE	E0	FRO	nB/	-1 31	10	B/# 3	2	
TIME TOF HOLE OF CASING OF WATER	ATER LEV	VEL RECO	DRD				TION DETAIL	.S 	
CASINO	F	3.MT	<u>۲</u> ۲۲	l G'R	ANIT			,	
							PROM	<del>. न र</del>	
SIGNED CLIENTS		TATIVE	3		DRILLING OBSTRUG MOVE & S STANDIN	STION SET UP	IMOVE	· · · · · · · · · · · · · · · · · · · ·	
			ridi	4	CASING		3 MTS_	-5_	

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#### DAILY DRILL LOG

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OUTH TYNE DRILLING			Ľ	DAILY DRIL	L LOG	35		
OCATION END	FRBY / 1.	ARREN F	RIG NO.	RYPHON		BH No. 31		
CONTRACT No.			VEHICLE No			DIAMET	ER 44	
	NG ROTA	RYC		MCCRIN	JALE	ANGLE		
ATE 10-2-90 / SAT				DEAN		CASING	DIAMETER 5'	r e
	·····							
OPERATION	SIZE	FROM	то	LENGTH		DI	ESCRIPTION	******
0/H	44	30.00	) 100-00	70-00	6	, RA	NITE.	
	·····	B/	H LO	MPLE	TF		· · · · · · · · · · · · · · · · · · ·	
<b></b>								··· ·· · · · · · · · · · · · · ·
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						·····		
								·····
								·····
·····						INSTAL	LATION DETAIL	S
	WATER L	EVEL RE	ECORD					
TIME								
DF HOLE	3/H W	VET	A7 3	0.00 MT	\$			
			·				······································	
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	· ·			· · · · · · · · · · · · · · · · · · ·				
<u></u>							FROM	то
					DRILLING	1	70.00 MT	<u>s</u>
	· · · ·	· · · · · · · · · · · · · · · · · · ·			OBSTRUC			
			1/A	<u> </u>	MOVE & S			
SIGNED CLIENTS			/14h	$\frown$	STANDING			
			<u> </u>	, /	CASING			
SIGNED - DRILLE		MI	and	t.	DELAYS	· · · · · · · ·		
งเจเนตย - ยกแนนต			<b>*</b> ·					

### DAILY DRILL LOG

SOUTH TYNE DR	LLING		DA	VILY DRIL	L LOG	× - •	34	(36)
CONTRACT No.	TYPE OF DRILLING ROTARY			ICCRIN DEAN		BH NO. 31 DIAMETER 44 ANGLE		
DATE 9-2-90	FI	21	T.1	EAN	,	CASING DIAME	TER 5	۶ 
OPERATION	SIZE	FROM	то	LENGTH		DESCRIP	TION	
	P	10VED	10	B/H	31			
0/17	5"	Gfh.	16.50	16-50	Top so	rit sand	and	Reel
	4-4-	16.50	30-00	13:50	G	RANIT	Ē	
	· · · · ·	alu	1.5.1	comp	IET	E		-
· · · · · · · · · · · · · · · · · · ·						<b></b>		
			, ,					
	-		· · · · · · · · · · · · · · · · · · ·				<u> </u>	
V	VATER LE	VEL RECO	ORD					
TIME TOFHOLE OFCASING						······································		
OF WATER					-			
CASED	TO	_/b ·	50 r	15.				
			-					
	·							
	· · · · · · · · · · · · · · · · · · ·					· · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · ·
			- <u></u>				NOM	то
					DRILLING		-70 M	<u>7</u> 5.
			TAIA		OBSTRUC MOVE & S		1011	
SIGNED CLIENTS	REPRESE	NTATIVE	1/KA	V.	STANDIN			
			-#	11	CASING	16	- 50.	
		Mic	f	N	DELAYS			

#### DAILY DRILL LOG

39 32. BH No. RIG NO. GRYPHON. LOCATION ENDERBY /WARREN 44 VEHICLE No. DIAMETER CONTRACT No. CREW S. MCCRINDLE ANGLE TYPE OF DRILLING ROTARY CASING DIAMETER 5''T. DEAN DATE 13-2-90 THES.

ſ	(	PERATION	SIZE	FROM	то	LENGTH	DESCRIPTION
				10 V	EMEL	3 -	TS OF SOLOTTED PIPE TS OF PLAIN PIPE T. BENTIONITE SEAL 14 COVER. 14 30.
4			11		· · · · · ·		
							INSTALLATION DETAILS
	рертн <u>н</u>	ME OF HOLE OF CASING	WATER L	EVEL REC		· · · · · · · · · · · · · · · · · · ·	CEMENT
(`)		OF WATER					BENTOMITE VILLE
							2000 2000 2000 2000 2000 2000 2000 200
							FROM TO DRILLING
	SI	GNED CLIEN	ITS REPRES	ENTATIVE	a	æ.	OBSTRUCTION MOVE & SET UP 1 MOVE. STANDING 1 4-
			~	Mil	/	0	CASING HOO HTS

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(137)

#### DAILY DRILL LOG

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SOUTH TYNE DR	ILLING		DA	ILY DRIL	L LOG	37	(138)
LOCATION ENDERBY WARREN CONTRACT NO. TYPE OF DRILLING ROTARY DATE 12-2-90 / MON			IG NO. GR EHICLE NO. REW J.M. T. D		DIAMETER 4 10		
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	
0/14	44	G/1-	9-00	9.00	Topsvil	, RED/MARL 2	Boulder
······		9.00	100.00	91.00	GRA	, RED/MARL 2 VITE.	
		B/	H CC	MPL	ETE.		
· · · · · · · · · · · · · · · · · · ·							
	WATER L	EVEL RE	CORD			STALLATION DETA	
TIME OF HOLE OF CASING W OF WATER	ATER	2 AT	25~	00 MT	s		
CASED	10		1.00 M	TS			
							······································
					DRILLING	100 M2	∓0 `\$
SIGNED CLIENTS				IN2	OBSTRUCTIO	UP	
SIGNED - DRILLE			Amil	ll	CASING DELAYS	9.00 M	τs、 

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OUTH TYNE DR			D#	ALY DRIL	L LOG	32	(139)
LOCATION END	ERBY /	Vi	G NO. Ehicle No.		Di	1 No. 33 AMETER 444	
TYPE OF DRILLING ROTARY CREW J. MCCRIN DATE 9-2-90 / FRI J. BIBARDELEN D. HARPER				CRINDL	ANGLE ANGLE CASING DIAMETER 5"		
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	
	44	78-00		22-00 11PLE		RANITE	
		0/1 INST/				Slotted Plain	Pipe.
				Bento		Beal	
		Cer	ment	-B/F		rer	
						· · · ·	
		EVEL RE	COBD		41	ISTALLATION DET	AILS
TIME DF HOLE OF CASING OF WATER				· · · · · · · · · · · · · · · · · · ·			
					DRILLING	FROM	то 0
SIGNED CLIENT	S REPRES	ENTATIVE	MDr	$\mathcal{N}$	OBSTRUCTI MOVE & SET STANDING		
		h	M.	16	CASING	USTAKI 100	MES

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### DAILY DRILL LOG

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OUTH TYNE DRILLING			DI	AILY DRILI	_ LOG	31 (40)			
OCATION <u>ENDER</u> CONTRACT NO. TYPE OF DRILLING DATE 8-2-90	ROTAP	<u> </u>	NG NO. /EHICLE NO. CREW J.MC T. D FAN O.	CRINDL T. BEAN HARPER	Е. 551 БУ	BH NO. 33 DIAMETER 44 ANGLE CASING DIAMETER 5"			
OPERATION	SIZE	FROM	то	LENGTH		DES	CRIPTION		
-0/17 47 62-1		62-00	) 73-00	16-01)	(fi	RANI	TE.		
	<u></u>	· · · · · · · · · · · · · · · · · · ·	<u>_</u>			INSTALL	TION DETAIL	LS	
OF HOLE OF CASING OF WATER	Sturk			ζ.					
							FROM 16-001	то Т <u>с</u>	
SIGNED CLIENTS		M	- A	lle	STANDIN CASING DELAYS				

#### DAILY DRILL LOG

141

OUTH TYNE DR				ILY DRIL	L LUU		29	(14-1
LOCATION ENDER CONTRACT NO. TYPE OF DRILLIN DATE 7-2 -9	IG ROTAI	L VEHICLE NO. DIAMET ROTARY CREW J. MCCRINULE. ANGLE			DIAMETER ANGLE	33 44 AMETER 5	11	
			1 · · · · · · · · · · · · · · · · · · ·	LENGTH	<u> </u>			
OPERATION	\$IZE	FROM	то				DESCRIPTION	
0/14	44	35.0	62.00	27-00	GI	RANT	TE_	
		B/1	- IN	COMP	RETE	•		
			· ·					·····
		· · · · · · · · · · · · · · · · · · ·						
••••••••••••••••••••••••••••••••••••••	· · · · · · · · · · · · · · · · · · ·							
					· · · · · · · · · · · · · · · · · · ·		TION DETAIL	_8
	WATER LE	VEL REC	ORD					
TIME								
H OF HOLE OF CASING OF WATER	-							
								·
						-		
				·			FEOM-	-70
					DRILLING		27-00	
	<b>u</b> / <i>u</i>	-	) ~•		OBSTRUCT			<u> </u>
	Maco	U_			MOVE & SE			<u></u>
SIGNED CLIENT		MATIVE			STANDING CASING	1 		

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OUTH TYNE I	DRILLING		DAILY DRILL LOG			25	(14-2)
LOCATION ENT CONTRACT NO. TYPE OF DRILL DATE 6-2-4	ING ROTA	N CR	RIG NO. VEHICLE NO. CREW J. MC RINDLE T. DEAN D. HARPER T. BEAROSLEY			o. 33 ETER ケケ E IG DIAMETER (	
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	
0/14	42	G/L.	12-60	12:60	RED	MARL 2	Boulden
······································		12.60	35.00	22.40	GRAN	ITE.	
·		B/H	INCO	OMPLE	TE.		
			•				
					· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·
	1				INSTA	ALLATION DET	AILS
TIME	WATER LI	EVEL REC					
						<u></u>	
CASER	<u>, 70</u>	12 .5	10 MT	<u>(</u> \$.			
						·	<u></u>
							,
						P <del>ROM</del>	-40
AA-	L n			· · · · · ·	DRILLING	35.00m	142
Shee	C L	- Of	1.	·····	OBSTRUCTION		
SIGNED CLIEN	TS REPRESE				STANDING		
		· · · · · · · · · · · · · · · · · · ·	•	10	CASING	12.500	TS
SIGNED - DRIL		Ma	Ani	NQ'	PERMS	Ţ	

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#### DAILY DRILL LOG

25

12

SOUTH TYNE DR	ILLING		D <b>A</b>	AILY DRIL	L LOG	8 * * 1	24 (43)		
LOCATION ENDER	RBY /WI	AREN RIC	G No.			BH No.	34.		
CONTRACT No.			HICLE No.			DIAMETER LE			
TYPE OF DRILLIN	IG ROTA	RY CR	EW J.M	C RINDI	E	ANGLE			
DATE 6-2-90		E5 T.	DEAN G. BEARD	0.H. 5657	ARPER	CASING DIAMETE	в <i>5</i> ″		
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTIC	DN		
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·		<u>_</u>		3 M	5 OF	PLAIN	PIPE		
						- 1			
		G	RAVEL	LED	up	<u>В/н</u>			
		L A	RAVE	LITE	SEAL	1			
			1		1				
			CEMEN	17 -	TOP.				
				<u> </u>					
<u>,                                     </u>					— , —				
	h	IDVE	- ^-	TO	R/11	33、			
· · · · · · · · · · · · · · · · · · ·	<u> </u>	TUV G	-D		<u>+//////</u>				
		<b> </b>		<u> </u>	<u> </u>				
		<u> </u>				÷			
			+			. <u>.</u>			
		<b> </b>				· · · · ·			
		<u> </u>	1	<u> </u>					
					<u></u>	INSTALLATION	DETAILS		
	WATER L	EVEL REC	ORD						
TIME		_			<b>.</b>				
T OF HOLE						<u>-</u>			
L OF CASING				<u> </u>					
OF WATER									
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						FROM			
		ļ	<u> </u>	·	DRILLIN	G			
Shee	t	104	<u> </u>	<u></u> ,	OBSTRU				
······································	11/0/	dat e	<		MOVE &	SET UP 1 MOV	1 <u>E</u>		
SIGNED CLIENES	REPRESE	NTATIVE		<b>-</b>	STANDIN	IG			
				<i>A</i>	CASING				
SIGNED - DBU LE		Min	· A.	1.	DEtatys	INSTALL 100	INTS		

#### DAILY DRILL LOG

22/18 (44)

LOCATION ENDER	BY THING	DEN RI	G No. 200	 	BH No	34	
CONTRACT No.	<u>+                                     </u>	<u></u>	EHICLE No.		DIAME	· 34	
TYPE OF DRILLIN	G ROTAR	Y CF	REW J. MCO T. DEAN.	CRINDLE	ANGLE		
DATE 5-2-41		ON		Л·ВЕАРОЗ Э <u>рреп</u>	CASIN	G DIAMETER 5	с 
				<b>-</b>			
OPERATION	SIZE	FROM	TO	LENGTH		DESCRIPTION	
0/14	44	50-00	100-00	50-00	GRAN	ITE.	
		010	10.4	0105		· · · · · · · · · · · · · · · · · · ·	
		в/н	LOM	PLETI			
		INST	ALLA-	TION	INCOMPL	ETE.	
· · · · · · · · · · · · · · · · · · ·	-						
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					···	·····	
					A		······································
<u></u>	WATER !	EVEL REG	COBD		INSTA	LLATION DETAILS	) 
TIME							
E OF HOLE						J.	<u> </u>
			l		· · · · · · · · · · · · · · · · · · ·	······································	
CORE	Bit	<u>.                                    </u>	1/5.				<u></u>
(B	rt W	EAR.	)'			<u> </u>	
				· · · · · · · · · · · · · · · · · · ·			
					· · · · · · · · · · · · · · · · · · ·		
						CERON-	то
					DRILLING	50 MTS.	
		· · · · · · · · · · · · · · · · · · ·		<u></u>	OBSTRUCTION		
			ICA	$\cap$	MOVE & SET UP		
SIGNED CLIENTS	REPRESE	NTATIVE	M. hr	/	STANDING		
· · ·	$\checkmark$	<u> </u>	, [–] 19	, ~			
SIGNED - DRILLE	R J-	Min	mon	~	DELAYS	1	

### DAILY DRILL LOG

18	
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LOCATION MUSIC	N N 1/ 1 / 1 A A A A	, 80	3 No.		B	+ No. 344	****.**********************************
	LOCATION ENDER BY WARREN BIG NO. CONTRACT NO. VEHICLE NO.					AMETER $42$	· · · · · ·
	TYPE OF DRILLING ROTARY CREW J. MERINDLE HT.						
	DATE 2-2-90 /FRI T. BEARDSLEY /D'L					ASING DIAMETER 5	
DATE 2-2-70	<u> / FRI</u>		<u> BEARDSL</u>	<u>k7 / 1) - H</u>	TAKPER -		
OPERATION	SIZE F	ROM	то	LENGTH		DESCRIPTION	
Mov	ED TO	<u>5</u> ]	<u>B/14_3</u>	4 FR.	m B/H	55	
OPEN HOLE	42 6	IL	6-00	6-00	Turpo	Red-Brown Mart	. Fill.
	11 6	-00	7-00	1-00	Saft To	- Firm Grey Bar	ley chang
	107-	00	18-15	11-15	RED	MARL	
	4-2 14	-15	5000	31-85	GRI	ANITE.	<b>_</b>
		T _{rx}					
		/ <u>H</u>		V COM	PHETE	1	
	<u> </u>				IN	STALLATION DETAILS	
	WATER LEVE	REC	ORD				<del>_</del>
TIME						·	
I OF HOLE							
				···.			<del>_</del>
		<u> </u>	<u> </u>		<b></b>		
CASED	TO	16	-00 MT	<u>(5.</u>			
· · · · · · · · · · · · · · · · · · ·						<u> </u>	·
			<u> </u>				
; • • • • • • • • • • • • • • • • • • •					·		
			<del></del>		- <b> </b>		
	<u> </u>		•···			PROM	770
		,			DRILLING	50 mts	
theat	- 19	1	1-		OBSTRUCTIO		
		7			MOVE & SET		
SIGNED CLIENTS	REPRESENTA	TIVE	P	2	STANDING		
					CASING	16 MTS	
		M.	1	1	DELAYS		

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SOUTH TYNE DRILLING	DAILY DRIL	L LOG 90 (46)
LOCATION ENPERBY WARREN CONTRACT NO. TYPE OF DRILLING ROTARY DATE 22- 3-90 / THUAS	RIG NO. GRYPHON VEHICLE NO. F331 OREW J. MCCRI. T- DEAN	KTN. DIAMETER 44
OPERATION SIZE FRO	TO LENGTH	DESCRIPTION
INSTALLE	00 100.00 40.00 1 COMPLE 0 97MTS 3 MTS 1 MT EMENTED 11	
WATER LEVEL 1 TIME	RV	INSTALLATION DETAILS
T OF HOLE OF CASING B/H		
Sheet 1 M SIGNED CLIENTS REPRESENTATIV		FROM     TO       DRILLING     40 MT5 -       OBSTRUCTION
SIGNED - DRILLER S. MA	critte	CASING DEFERTS INSTALL 100 14 TS

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SOUTH TYNE DR	ILLING		DA	ILY DRIL	L LOG	89	(14-7)
LOCATION EVY CONTRACT NO. TYPE OF DRILLIN DATE 21-3	IG ROTARY		HICLE NO. EW -5-M	YPHON F331_K 1°CRIN DEAN	CTN. D DLE A	H NO. 35 IAMETER 42 NGLE ASING DIAMETER 5	
OPERATION		ROM	то	LENGTH	· · · · · · · · · · · · · · · · · · ·	DESCRIPTION	·····
iv	10VED	FRO	MB/	HL	ío B/	H 35	
0/14	hik 4	L	1 20.00		Boulde	+ May, Red	Mar
L	20	-0.Q	60-00	40.00	GRA	NITE	
	B	4	INC	OMPLE	TE.	· · · · · · · · · · · · · · · · · · ·	
		I					
	·····			·	11	NSTALLATION DETAIL	S
	WATER LEVEL	. REC					
		<u> </u>					
(.DSEY	) 10	7	0-50	MTS			
				£ -			
				<u> </u>			
			,			FROM	TO
·			x	<u> </u>	DRILLING	60-00 MT	
Bho	,t 2:	ol.	2.		OBSTRUCTI		
	<u> </u>	1	1	$\rightarrow$	MOVE & SE	TUP   MOVE.	
SIGNED CLIENTS	REPRESENTA	τiγe	The	-	STANDING		
SIGNED - DRILLE	····			1	CASING	20.50 MT	•~

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#### DAILY DRILL LOG

OUTH TYNE DRI	LLING		DA	ILY DRIL	L LOG		88	(148)	
ONTRACT No.			G NO. GRU HICLE NO. EW J.M T.K	F331	KTN	BH NO. KTN DIAMETER 41." LE. ANGLE CASING DIAMETER 5"			
OPERATION	SIZE	FROM	то	LENGTH		DES	CRIPTION		
0/н	44	70-00 3 /it	100-00 Cor	30.00 1PLE		RANIT	Ë.		
	5 TALL- 1.		<u>3</u> M		PLP ENTOR	MN	PIPE PIPE SEAL VER.	1	
TIME	WATER L	EVEL REC	CORD			INSTALL	ATION DETAIL	-8	
T OF HOLE OF CASING P OF WATER	,/I+ 	ØR)					· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	
Bhee		1 0/			DRILLIN OBSTRUC MOVE &		FROM 30-00 M	то 75	
SIGNED CLIENTS			And	Je :	STANDIN CASING	IG	100 M	TK	

of white

#### DAILY DRILL LOG

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OUTH TYNE DRILL	ING	D	AILY DRIL	L LOG	87	(149)		
LOCATION ENDEREN CONTRACT No.	RIG NO. GR	F 331 J	CTIN. DIAME					
TYPE OF DRILLING R DATE 20-3-90		CREW J.1 T.C	IEAN	CASING DIAMETER 5"				
OPERATION S	IZE FRO	M TO	LENGTH	D	ESCRIPTION			
MOVI	ED FG	com B/H	2.1	3- B/H I				
0/1+ 1	the Gh	9.40	9.40	Boulder e	lary Red	MARL		
	9.4	0 70-00	60+60					
	- R/H		GMPLE					
	D/r					<u> </u>		
		PEROPO	·····	INSTAL	LATION DETAI	LS		
	ER LEVEL I		· · · · · · · · · · · · · · · · · · ·					
CF HOLE OF CASING OF WATER								
CASED	10	9-50 r	115					
						·		
					FROM	то		
<u> </u>	$\overline{l-\gamma}$			DRILLING	70 MTS			
Sheel	1	of 1		OBSTRUCTION	1 MOVE.			
SIGNED CLIENTS REF	PRESENTATI	VE 4	$\underline{\mathcal{D}}_{-}$	STANDING	J MOVE.			
SIGNED - DRILLER	J. M	ner	M-	CASING DELAYS	9.50 M	TS.		

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SOUTH TYNE DRI	LLING		DA	ILY DRIL	L LOG	86	16) (50)
LOCATION ENDER CONTRACT NO. TYPE OF DRILLING DATE 20-3-90	ROTA		HICLE No. F	Y PHON 331 K MCCRIM DEAN	TN UDLE	BH NO. 2. DIAMETER 444 ANGLE CASING DIAMETER 5	{
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	
OH	44	60.00	100-00	40.00	G	RANITE	
		BH	COM	1PLET	Ę.		
INSTR	hh Er (	q	7 MTS 8 MTS MT	OF BENT	ONITE	IN PIPE SEAL	
(`)		C	EMEN	TED	1N (	3/H COVER	
			· · · · · · · · · · · · · · · · · · ·				
			· · · · · · · · · · · · · · · · · · ·				
W	ATER LE	EVEL REC	ORD			INSTALLATION DETAIL	S
TIME TOF HOLE OF CASING OF WATER	· · · · · · · · · · · · · · · · · · ·				· · · · · · · · · · · · · · · · · · ·		
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			· · · · · · · · · · · · · · · · · · ·				
Shee	ŀ	of	2		DRILLING OBSTRUC MOVE & S	TION	то \$
SIGNED CLIENTS	~	NTATIVE Min	and	£.	STANDIN CASING DELAYS		

	SOUTH TYNE DRI	LLING		DA	ILY DRIL	L LOG		85	SI
	LOCATION ENDER CONTRACT NO. TYPE OF DRILLING DATE 19-3-90	ROTA	VEI RY CRE	NO. GRN HICLE NO. EW J. M T. J	<u>F331</u> 1 C C R I A	KTN	BH No. DIAMETI ANGLE CASING	2.	1.
	OPERATION	SIZE	FROM	то	LENGTH			SCRIPTION	en ante ante a constante de
	M01	VED	FROM	1 B/I	+ 3	TO B	JH 2	, i i	
	al		<u>cl</u>	10 00	10.00	0.	11	11	
	$-O_{1}$	ha	G/L	10-80	10-80	Ride	Murl	Mary a	ww
	/	· · · · · · · · · · · · · · · · · · ·							
			10.30	60.00	49.20	Gr	ZAN	ITE	
		<u> </u>		]	-	· ·		· ·	
			B/H_	INC	OM	PLET	E.		
(							<u> </u>		
			<u></u>			<u> </u>			
		<u> </u>							
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			<u> </u>						
				: 					
			<u> </u>				INISTAL	LATION DETAI	1.8
			EVEL RECO		<u> </u>				
	TIME					<b>-</b>	~		
	I OF HOLE	AMP	AT	44.5	TO MTS				
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	CASER			-00 M	115				
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			···					FROM 60.00 M	TO TC
			<u> </u>			OBSTRUC		BUUN	<u>,                                     </u>
		<u></u>		<u></u>	4	MOVE & S		1 MOVE	· · · · · · · · · · · · · · · · · · ·
	SIGNED CLIENTS	REPRESE	NTATIVE	T		STANDING			
					11	CASING		11 MTS	
	SIGNED . DRILLER	4 J.	Mil	mil	И :_	DELAYS			<u> </u>

SOUTH TYNE DRUITING

#### DAILY DRILL LOG

29

SUUTH TYNE DRI			UI.		2 200		84	(152)
LOCATION ENVERY	1 WARREN.			PHON		BH No.	3	
CONTRACT No.				33(1)		DIAMETI	ER /	
TYPE OF DRILLING	-			1CCRIK		ANGLE		
DATE 15-3-40	) THUKS			DEPI	<u>v</u>	CASING		
OPERATION	SIZE FR	ом	то	LENGTH			SCRIPTION	
	MOVED	E	ROM B	flit by	to- Bj	<u> H 3</u>	<u></u>	<u> </u>
Ø/H	Kt G	<u>1.</u>	4-00	6-00	Bond	der 7	Lump lut	M.
<u> </u>			A		B_1	milder-	lag for	
	4-1	00	100.00	96-00	G	RAN	ITE.	
				l	*	·····		
		<u>7/17</u>	(.0	MPLE	LE_		· · · · · · · · · · · · · · · · · · ·	
INST	ALED						O PIPE	
				TS 0			PIPE.	
			CEME,	VTEN_	IN BJ	H CI	OVER	
			11-				· · · · · · · · · · · · · · · · · · ·	
	k	<u>۲</u>	Blur	follong				
			L			INSTAL	LATION DETAIL	S
	ATER LEVEL	RECO	ORD					
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	17777	[						
		71	196					<u></u>
DAMP	AT E	<u>)                                    </u>	~112				· · · · · · · · · · · · · · · · · · ·	
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	<u> </u>						FROM	тО
					DRILLIN	G	100 MTS	
			/		OBSTRU	CTION		·
	114	1,			MOVE &	SET UP	1 MOUE	. <u></u>
SIGNED CLIENTS	REFRESENTAT	IVE	$\frown$		STANDIN	IG	Ihr.	
			/	11	CASING		4.1-	
1	a 5 - M	1.1	- · _ /	18	DC	INSTAL	100 MI	

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1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 1997 - 1997 - 1997 1997 - 1997 - 1997 1997 - 1997 - 1997 1997 - 1997 - 1997 1997 - 1997 - 1997 - 1997 - 1997 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1977 - 1

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SOUTH TYNE DRILLING	DAILY DRILL	. LOG 83 (53)		
LOCATION FINDERBY /WARREN CONTRACT NO. TYPE OF DRILLING ROTARY DATE 14-3-90 WED	RIG NO. GRNPHON VEHICLE NO. F331 K CREW J.MCCRIN T. DIFAI	TN DIAMETER 42		
OPERATION SIZE FRO	M TO LENGTH	DESCRIPTION		
NOVED FRE Dug Int Trial 0/17 4th G/L 6.91 B/I NSTALLED 11 Represe	Pit for Suprice 690 6-90 100.00 93.10 1 COMPLETE 97MTS DE S. 3 MTS DE S. MT BENT CEMENTED IN	/		
WATER LEVEL I	P AT 97.00 MT	INSTALLATION DETAILS		
	2.00 MTS			
SIGNED CLIENTS REPRESENTAT	VE Ma	FROM TO DRILLING 100.00 MTS OBSTRUCTION MOVE & SET UP L MOU'E & ROAD SIGN STANDING TRIAL		
SIGNED . DRILLER J. M	unde	CASING 7 MT DELANS INSTAUL 100 MTS		

#### DAILY DRILL LOG

SOUTH TYNE DRILLING 154 82 BH No. RIG NO. GRIPPHON LOCATION ENDERBY WARREN VEHICLE NO. F331 KIN CREW J. MCCR. IMDLE DIAMETER CONTRACT No. ANGLE TYPE OF DRILLINGROTARY CASING DIAMETER 5 TOFAN DATE 3-3-40 TUES DESCRIPTION LENGTH FROM то **OPERATION** SIZE FROM 10 l, MOVED Kert Outer 12m sulega 6-90 6-40 42 Murleore w 6.90 100.00 93.10 G VRAN COMPLETE DE INSTALLED CĄ ØĒ ٠t COVER IN 21 Rein 1 A ITA INSTALLATION DETAILS WATER LEVEL RECORD TIME 75115 ₿/Д DAMP AT OF HOLE DEPTH OF CASING Ste MIS AŦ OF WATER 7-00 MTS D Jusid FROM то 100.00 MT DRILLING OBSTRUCTION 1 MOVE - thoul begin MOVE & SET UP SIGNED CLIENTS REPRESENTATIVE STANDING THE IMTS CASING

NED DOWLED AN CALL

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DELAYS UNCTON

SOUTH TYNE DRILLING	1	DAILY DRIL	L LOG	81	(155)
LOCATION ENDERBY/W. CONTRACT NO. TYPE OF DRILLING ROTAL DATE 12-3-90 MI	RY CREW J. N	D.F. 331 1	NTN DIAMETER 42 IDLE ANGLE		
OPERATION SIZE	FROM TO	LENGTH	DI	ESCRIPTION	· · · · · · · · · · · · · · · · · · ·
MOVED Dug Im	FROM B/H T Trial Pruenutic	7 TO Pit fu Driell	B/H 6. r Berrie	es with	· · · · · · · · · · · · · · · · · · ·
0/H 4-4	G/L 7-00 7-00 100.	7-00	Idurdeore, and lyran GRAN	Boulder t Le Boulde	lan
	3/н СОМР 97 мт 3 мт 1 мт	LETE 5 OF 6 5 OF 6 DF BENT NTED 11	DLOTTED	PIPE PIPE AL VER.	
	· · · · · · · · · · · · · · · · · · ·		INSTAL	LATION DETAI	LS
WATER LE TIME OF HOLE OF CASING OF WATER COm.	Small an	nonal			
CASED TO	) 7-00_	MTS			
· · · · · · · · · · · · · · · · · · ·					
		25	DRILLING OBSTRUCTION MOVE & SET UP	FROM 100-00 M IMOVET	TO 1 TS Reral Signs
SIGNED - DRILLER		Mi	CASING DELAYS INSTALL	7 MTS	TS

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# DAILY DRILL LOG

OUTH TYNE DRILLING			DAILY DRILL LUG				80 🚱			
LOCATION ENNELL CONTRACT NO. TYPE OF DRILLING DATE 11 - 3 -90	3 ROTA	R.Y CF	G NO. GA EHICLE NO. REW J.	F331 1	KTN NDLE	TW DIAMETER 1				
OPERATION	SIZE	FROM	то	LENGTH		DE	SCRIPTION			
0/н	44	15-00	100-00	85-00	<u> G</u> RA	NITE	<u> </u>			
μ51	ALLE I.	CE	7 MT 3 MT	T BE	PLAII VTONITE H CO	∪∕ ≦ \$1	PIPE			
	NATER L	EVEL REG	CORD			INSTAL	LATION DETAIL	_8		
TIME TOF HOLE OF CASING OF WATER	Inter	at	53-00	» MTS.						
				~	DRILLING OBSTRUC MOVE & S	TION	FROM 95-00 MT	то 5-		
SIGNED CLIENTS			Ah.	<u>~</u>		G	100 M.TS			

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### DAILY DRILL LOG

SOUTH TYNE	DRI	LLING		DA	ALLY DRIL	L LOG		79	(57)
LOCATION EN	UDE	RBY/W	MERENRIC	3 No. GR	VPHO	N	BH No.	7. ER 442	
CONTRACT NO	».		VE	HICLE No.	F3311	KIN .		ER 44	
TYPE OF DRI							ANGLE	·	.tr
DATE 10 -3	- 41	) / 51	AT.	1.	DEAN	1	CASING	DIAMETER 5	
OPERATION		SIZE	FROM	то	LENGTH		1	SCRIPTION	
······································		MOVE	O FA	OM B	H3B	TOE	3/ <u>H</u>	7	
	- 10		1. 1-		D.F	Por s	50000		i lh
	<u>.</u>	ny	Pont	nutic	Dre	U.	<u>~~~</u> v	ile, w	
		- K							
O/H		44	GL	7-00	7.00	Marde	pre l	oulder C	lan <u>y e</u>
<u> </u>	,	 				Green	uto D	ouldur	<u>S</u>
			7.00	15-00	8-00	GR	ANI	TEN	
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							<u> </u>		<u>-</u>
		<u> </u>	<u> </u>				INSTAL	ATION DETAI	LS
	W	ATER L	EVEL REC	ORD	<u> </u>			·····	
TIME						ļ		,,,,	
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CAS	Ep	TO	7-	00 M	<u>15.</u>				
	<u> </u>		<u></u>			-			
						· · · · · · · · · · · · · · · · · · ·			
							Ţ	FROM	то
						DRILLING	3	15-00 MT	· · · · · · · · · · · · · · · · · · ·
Sh	et	- 2	of I	) <u> </u>		OBSTRUC			
	<u> </u>		1	/7	5	MOVE & S		I MOVIE-T	Road Bizo,
SIGNED CLIE	ENTS					STANDUN			
SIGNED - DR		. J.	M.I	fill	[	CAGO		7-00M-	<del>ک</del>
ISIGNED - DR	ILLEP	ייייי די <u>ה</u>	11 412	<u>r / `</u>	-	1		L	

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(158)

		-					<b>.</b>		)	(58)	
LOCATION ENDER	BY WA	REAN			RYPHON		BH No.				
CONTRACT No.					- F331						
TYPE OF DRILLING	g Lota	RY	CRE	W .J.	.MCCR T.DEA	INDLE	ANGLE		<u></u>		
DATE 10 - 3- 4	0 51	97.			TOPA	<u>N.</u>	CASING	DIAMETER	5′′	i	
OPERATION	SIZE	FRO	м	то	LENGTH		DE	ESCRIPTION			
0/14	linter	50-0	0	(00-01	50.00	<u>G</u> RF	ANIT	E			
		B/1-	+	COM	1PLETE						
111	TAL	ED		97	MIS	OF S	0.07	TED P	PIPE		
			Í	3	MITS	OF	PLA	NV P	IPF		
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		C	EM	ENT	ED IN	1. B/H	CE	VER.			
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							INSTAL	LATION DET			
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	7			1 ~			G	50.001	175		
Sha	, t	1.0	1	4.	, ,	OBSTRUC					
- inf V		/	f -			MOVE & S			_		
SIGNED CLIENTS	REPRESE	NTATIV	νE	Æ	$\rightarrow$	STANDIN					
					11.	CASING					
SIGNED - DRILLE	_R Э.	M	Ń	jud	ÚŁ_	DELAYS	INSTAL	100	MT.	5	

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						8 -				
SOUTH	TYNE	DRIL	LING		D,	AILY DRIL	L LOG	:	77	(159)
LOCAT	ION EN	IDER	BYTW	ARREN RI	G NO. GI	R-Y PHO	N B	SH No.	36	
	ACT No		<u> </u>	VE	HICLE No.	F331	KTN. P	AMETER	26 44	· · · · ·
TYPE	OF DRIL		ROTA	PRY CF	iew J.M	10CRIN	DAE A	NGLE		·
DATE	9-3	-91	<u>) F</u>	RI.	1	DEAN	<i>J</i> . c	ASING DIA	METER 5	×
OPE	RATION	1	SIZE	FROM	то	LENGTH		DESC		
			MOVI	ED EI	20M 1	B/H 3-	7 10	<u> В/н з</u>	6	
							1. 0		<b>*</b>	
ļ	<u></u>		Duy		T 1+		t for	Ber	mes	<b>_</b> _
				With	l'm-	remation	- Degel	u		
0	- H		1-4	GL	6.00	6-00	CONCRET Eluny GRA	EHARD	CORE Bun	ulder
<b> </b>	<u> </u>		↓ <del> </del>	1	50.00	1100	Clury.	· · · · · · · · · · · · · · · · · · ·	·····	<u> </u>
			<u> </u>	6.00	50-00	44.00	- (FKP			
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Ì				BH	IN	COM	PLETE	5		
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		W	ATER LE	EVEL REC	ORD					
TIME	- ·	T								
	HOLE									
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	WATER	1								
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	<u> </u>							 	FROM	TO Te
	Zho	e.t	-2	A	2		OBSTRUCT		50-00 K-L	. 1.5
	J 1000	~~`			TI		MOVE & SE		MOVE -+	rad Juin
SIGNE	ED CLIE	NTS 8	REPRESE	V NTATIVE	119:20		STANDING	RIAL		1
				ΛΛ	Knu	11.	CASING	, , , , , , , , , , , , , , , , , , , ,	MITS	
SIGNE	D - DRI	LLEF	<u>.</u> 5.	. 'NU	in	<i></i>	DELAYS			: •

# DAILY DRILL LOG

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SOUTH TYNE DRI	LLING		DAILY DRILL	LOG	76	(160)
LOCATION EN DEN CONTRACT NO. TYPE OF DRILLING DATE 9-3-91	ADTARY	CREW J.	R <u>YPHON</u> • F331 M ^C CRINI CDEAN	)LE ANGLE	37 ER 42 DIAMETER 5	<u>د</u>
OPERATION	SIZE FRO	ом то	LENGTH	DE	SCRIPTION	
	<u>'</u>	k	Times.	CLEANED		
	NSTPLLE 15 C	D 7 2 EMENT tated	MTS C MT P	E PLAIL ENTONITE B/H CON	) <u>PIPI</u> SEAL	<u> </u>
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	her	Bit	andin	ý -		
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				INSTALI	ATION DETAIL	.S
TIME TIME OF HOLE OF CASING OF WATER	VATER LEVEL	RECORD				· · · · · · · · · · · · · · · · · · ·
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					FROM	то
She	et t	of 2	- r	DRILLING OBSTRUCTION MOVE & SET UP		
SIGNED CLIENTS	REPRESENTATI	IVE AT	NP-	STANDING CASING	4.65.	
NICHED - DRUIE	□ < <u>&gt;</u> - 11/	Unn	WV.	SELATSINSTON	95 Mt	- ۲ <u>-</u>

SOUTH TYNE DE	ILLING		DAILY DRI	L LOG		74	(162)
LOCATION	RBY WARREN	RIG No. G	RYPHON		BH No.	37	
CONTRACT No.		VEHICLE	NO. F331	KTN.	DIAMETE	R 44	<u>_</u> ,
TYPE OF DRILLI	NG ROTARY	CREW 5	MCCRI		ANGLE		
DATE 6-3-			DEAN	J.	CASING	DIAMETER 5"	
DAIL 6-5		\				······	
OPERATION	SIZE FR	ом то	) LENGTH		DE:	SCRIPTION	
	MOUED	FROM	B/H 38	to 1	<u>3/H 3</u>	7	·
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	with	Porues	natic.	Prill	•		
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OTH	KE G	L 5-8	0 5.80	Hara	lure	yrand	<u>ı</u> .
				Bould	in, un	al Bouls	<u>br lla</u>
	5.4	50 60-	00 54-20	GRI	ANIT	<u>F.</u>	
	ß	H L	NCOMP	LETE			
		<b></b>					
		<u>_</u>	·ł	_	INSTALL	ATION DETAIL	LS
	WATER LEVEL	RECORD					
TIME		11200110					
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<i>n</i>	+	-1-6	,	DRILLIN		60-00 MT	
1 <i>11 V</i>	ノント	or 1	· · · · · · · · · · · · · · · · · · ·	OBSTRU		IMOUE the	10.
5he		-		LUOVE &	SET UP	MADE + KO	W. Ors
Bhe		10			1 - 1	11-0000 011	1
SIGNED CLIENT	S REPRESENTAT		Roj.		1 - 1	1	<u> </u>
	S REPRESENTAT		- 11.		totaid	1 6-00 MTS	<u> </u>

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# DAILY DRILL LOG

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LOCATION ENDERBY WARREN	RIG NO. GRYPHON.	BH No. 37
CONTRACT No.	VEHICLE NO. F331 KTN	DIAMETER 44
TYPE OF DRILLING ROTARY	CREW J.MCCRINDLE	ANGLE
DATE 9-3-40 THUKS	T. DEAN	CASING DIAMETER 5

OPERATION	SIZE	FROM	то	LENGTH	DE	ESCRIPTION	
OH	42	60.00	95.00	35.00	GRANIS	TE.	
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		2/1					<u>.                                    </u>
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IME						·····	ii <del></del> _
OF HOLE	<u></u>						
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OF WATER					······································		
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						FROM	то
				<u> </u>	DRILLING	35-00 M	TS
•••••••••••••••••	•				OBSTRUCTION		
	<u> </u>	$-\epsilon$			MOVE & SET UP		
IGNED CLIENTS	REPRESE				STANDING		
GNED - DRILLE			*	0 1.5	CASING		
IGNED - DRILLE		Mu	bril	Ħ	DELAYS		

JTH TYNE DRILLING

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### DAILY DRILL LOG

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			-	,			73	(63)
LOCATION ENDER	BY NO	PRENT	RIG No. GRI	PHON		BH No.	38	
CONTRACT No.	<u>v v v </u>	<u>, R.C.</u> , 1	VEHICLE No.	F331	KEN	DIAMETE	R 44	
TYPE OF DRILLING	A ROTA	ARY.	DREW J.M	1CLRIN	JOLE	ANGLE		· · · · · · · · · · · · · · · · · · ·
DATE 6-3-90			1.			CASING	DIAMETER 5	
	t *1		 				······	
OPERATION	SIZE	FROM	і то	LENGTH		DE	SCRIPTION	
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			MT.	BE	STONI	TE	SEAL	
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						INSTAL	ATION DETAILS	S
Υ	ATER L	EVEL R	ECORD					
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T OF HOLE							······································	
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<i>DD</i> I	<u>t</u>	D	<u> </u>		DRILLING		25-00 MTS	
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		Į.	$\langle $	$\sim$	MOVE & S			
SIGNED CLIENTS					STANDIN	G		
	$\checkmark$	MI	icned		CASING	· · · · · · · · · · · · · · · · · · ·	OF UTC	
SIGNED - DRILLE	G A	, 'W	und	7A	RELATS	NSTALL	95 MTS	

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# DAILY DRILL LOG

OUTH TYNE DRILLING		DA	AILY DRIL!			72	
OCATION ENDERBY WAR		H No. 3	38				
CONTRACT No.	DI		h 4 -				
YPE OF DRILLING	CRE	W.J.M	CCRINI	) L F AI			
DATE 5-3-90 MON	)	1.0	EAN	C	ASING DIAM	IETER 5	¢
OPERATION SIZE	FROM	то	LENGTH		DESCRI	PTION	
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	eunoti	· D	Ell.			-	
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4	4.30	70.00	65-70	G_R	ANCT	<u> </u>	- <u></u>
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· ·	_ <b>B/</b> }	10	COMP	LETE	·······	·	
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WATER LEV	/EL HEU		<u></u>		<u></u>		
OF HOLE BAN 1	PAMP	AT	38-0041	S			
OF CASING							
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						TOM	<b>'</b> †o
				DRILLING		0.00 M	
				OBSTRUCTIO			1105
	<u>م</u>	An	$\rightarrow$	MOVE & SET	UP MC	NE+R	Al Sega
SIGNED CLIENTS REPRESEN		10	7	CASING	971 4	50m	5
	Mil	in M	t -	DELAYS			

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# DAILY DRILL LOG

SOUTH TYNE DR	LLING			DA	AILY DRIL	L LOG		71		(165)
LOCATION ENDER	BY W	ARRENT	RIG No.	GR	VPHON		BH No.	39	• • •	ا کیک
CONTRACT No.			/EHICLE	•			DIAMET			
TYPE OF DRILLIN	G ROTA	ARY C		. M	CRINDI	LE.	ANGLE			
DATE   - 3 - 90	1-14	yn s	1.	DE	EAN.		CASING	DIAMETER	511	
OPERATION	SIZE	FROM	т	) )	LENGTH			ESCRIPTION	, 	
M	OVED	FRO	M	в/1	1 40	<i>10</i> 3	9.			
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	l Pr	uno	tie_		Popull.					
0/H	44	lt /L	3.0	0	3.00	HARDO	ORE	SAWA 1	Boul	Ler
		3.00	95.	00	92-00	CLA) G	RAN	ITE.	· · · · · · · · · · · · · · · · · · ·	
) .		B/	H Ce	9M	PLET					
<b>I</b>	NSTA.	LED	.0	12				<u>€0 PIP</u>		
				3	1			<u> </u>		
		CE	MENT	-	NN P	VH (	COVE	ER.		
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			·			0	INSTAL	LATION DETA	LS	
М	ATER LE	EVEL RE	CORD							<u></u>
TIME	±			<u> </u>						
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LASED	10	3	MTS	) <u> </u>						
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			<u> </u>				T	EDOU		<u> </u>
				<b>.</b>	·	DRILLING		FROM 95 MTS	1	то
						OBSTRUCT		_13_MIS		
						MOVE & SE	ET UP	I MOVE +	Roan	5161/9
SIGNED CLIENTS		TATIVE	M			STANDING	TRIAL			
		-	74-	11		CASING		3 MTS		
SIGNED - DRILLER	5	Mi	brud	U	1	DELAYS )	NSTAU	95 MT	<u>k</u>	

4 m K	à
(66)	

SOUTH TANE DR	ILLING		DA		L L00	70	(GC)
LOCATIONENDER	BY WARR	έν ^{Rig}	NO. GR	YPHO	N. E	H No. 40	
CONTRACT No.	· · · · · · · · · · · · · · · · · · ·	VEF	HICLE No.			NAMETER 47	
TYPE OF DRILLIN	G RUTAR		WJ.M	CCRIN	DLE A	NGLE	
DATE 28-2-9	O /WED		1.	DEA	N	ASING DIAMETER 5	1
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	
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	WATER LEVE	EL RECO	DRD	·····.			· ····
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				.	DRILLING	FROM 25-00 M	<u>το</u> τς
					OBSTRUCT		<u>+</u> >
			······	<u></u>	MOVE & SE		+
SIGNED CLIENTS	REPRESENT	ATIVE	4		STANDING		
SIGNED - DRILLE				· _ · · · · · · · · · · · · · · · · · ·	CASING		
SIGNED - DRILLE	$_{\rm B} \lesssim M$	lip	vill.		DELAYS	R MTS 95	>

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LOCATION END	érby Mae		NO. CAN	~/1=/fl		DIAMETER 1 4	
CONTRACT No.		<u> </u>		ANGLE			
F				EAN		CASING DIAMETER 5	11
DATE 27-2-	90 TU	ËST	1- <i>I</i> ,	1 IZAN		CASING DIAMETERS	<u></u>
OPERATION	SIZE	FROM	то	LENGTH		DESCRIPTION	<u></u>
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	<u>-</u>	• 			yran	te Boulders.	
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				<u> </u>	DRILLING	70.00 M	ts.
					OBSTRUC		
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SIGNED CLIENT	S REPRESEN	IALIVE				10.7 L	
SIGNED CLIENT	S REPRESEN		Iniv	10.	CASING	PIT 3MTS	+

SO YNE DRILLING

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UUTH TYNE DRILLING		DA		L LUG		67	(168)
OCATION ENDERBY WAR CONTRACT NO.					BH No. DIAMETER ANGLE	8 44."		
DATE 25-2-40 SI	UN	1.0	EAN		CASING DIA	METER 5	-4	<u> </u>
OPERATION SIZE	FROM	то	LENGTH	``````````````````````````````````````	DESCF	RIPTION		
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	· · · · · · · · · · · · · · · · · · ·	lated		glura		/		
	MOU	FD	10	B/H	1 4-0	2.		
					INSTALLAT	ION DETAI	LS	<u></u>
WATER LE	VEL RECO	ORD	······································					
TIME TOF HOLE DAMP OF CASING WET	AT AT	37 MT 45 M	5 1T.5					
			· · · · · · · · · · · · · · · · · · ·					<u> </u>
						-FROM	*	3
·····	*		· · · · · · · · · · · · · · · · · · ·		C^	0.00 M	Ţ	
SIGNED CLIENTS REPRESEN			2	MOVE & SI STANDING		IOVE + R	DAD S	IGN
SIGNED - DRILLER J.	Nic	milli-		CASING DELAY S	INCTA)	91 MT	5	

SUCTINE DRILLING . .

DATE 24-2-90

OPERATION

CONTRACT No.

LOCATION ENDERDY WARREN

SAT

FROM

SIZE

TYPE OF DRILLING ROTARY

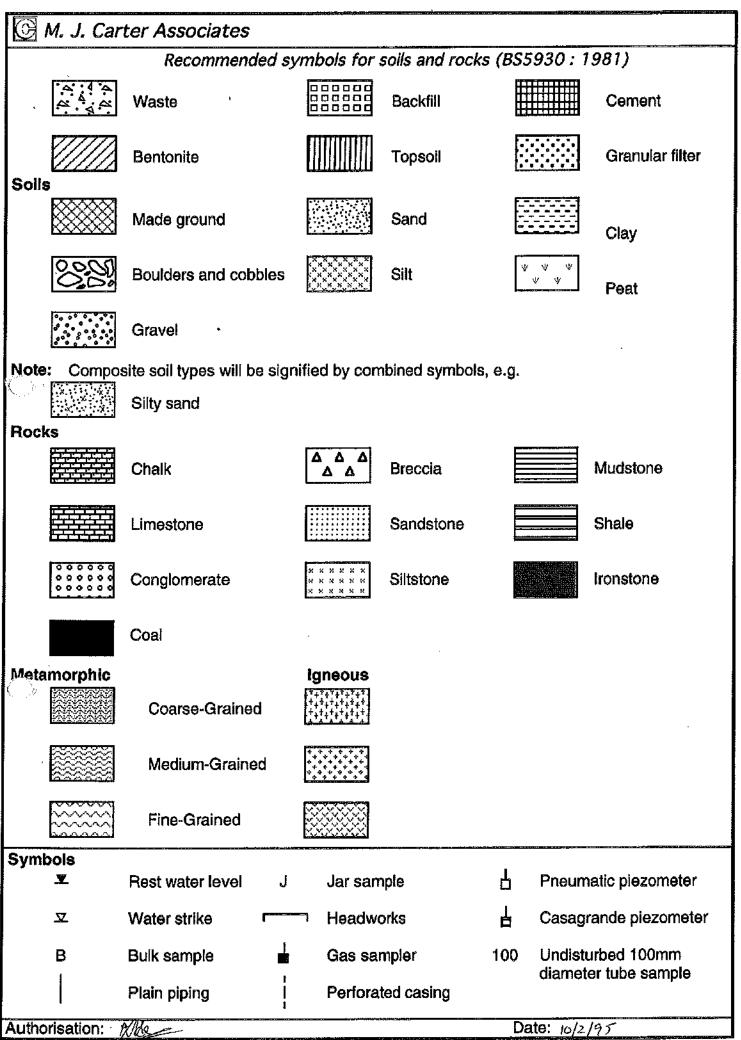
DAILY DRILL

DAILY DRIL	L LOG	66 (169)				
RIG NO. GRYPHON		BH No. 8.				
VEHICLE No.		DIAMETER HE				
CREW J. MCCRIND	ILE.	ANGLE				
TOFAN		CASING DIAMETER 5"				
M TO LENGTH		DESCRIPTION				
FROM B/H9	10	В/Н 8.				
Init. Torial	Pit	for berries				
1 Pneumuti	L D	roll-				

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						- Berri	<u>د</u>
	Duc	· / r	11	Torial	Pit for	- berri	ies
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olu	1,1	r le	1 00	7.00	1 ano 11 -	l	1 Prover
0/1+	1th	-lt/le-	1.00	1.00	Kommuc Bouldes	muran	- Apana
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					<i>A</i>		
	<u> </u>	2.00	10-00	8.00	GRANIT	<u>E.</u>	
		B/H	INC	LOMP	LETE		
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	<u> </u>	<u> </u>					1.0
				·····	INSTAL	LATION DETAI	11.0
W	ATER LE	EVEL RECO					
TIME							
T OF HOLE						<u></u>	
T OF HOLE							·
OF WATER							
					-		
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^					DRILLING	10.00 F	रत्त
Ishee		- A	-7-		OBSTRUCTION	vv	
- ince	7Å	<u> </u>			MOVE & SET UP	1.1005 5	DODD GILL
111	da.					I MOVE T	ROAD SIGN
SIGNED CLIENTS	REPRESE	NTATIVE	<u></u>		STANDING Trul		
		5. M	/-	II.	CASING	2-00 N	175
SIGNED - DRILLER	7	2- (1)	um	w	DELAYS	<u> </u>	

SOUTH TYNE DR			ILY DRIL		65	(170)
LOCATION FLOER CONTRACT NO. TYPE OF DRILLIN	V	AIG NO. G VEHICLE NO. REW J.N		DIAM		!-
DATE 24-2-	90 SAT	1.	DEA	∨ CASII		5 1
OPERATION	SIZE FROM	то	LENGTH		DESCRIPTION	·····
	MOVED F	ROM B/	<u>н ю</u>	<u>~10 B/H</u>	<u>q</u>	.
	DUG IMT WITH	Torial Poreus		for be DRILL	prich.	······
0/H	4- 14- 14- 14-			Tarmac 1	lordave,	GRAWIT
	2-00	90.00	88.00	Bould GRAN		
	<u> </u>	H CON	1P/E	TE.		
	USTALLED		MTS (F SCOTT	U PIPE	
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			- gr	_/	ALLATION DETA	110
	WATER LEVEL RE	CORD		10017	ALLATION DETA	
	IATER A	т 35	MTS,		,	
Cased	Ato 2.0	20 MT:	5			
					······································	
Cha	t_ of	2		DRILLING	FROM- 90.00	то И.T.S
SIGNED CLIENTS	DE DESENTA BAVE		<u></u>	OBSTRUCTION MOVE & SET UP	MOVE +	food su
SIGNED - DRILLE	K-M	Crude	l	CASING DELAYS IN STA	2.00 M	3



🕑 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Location: Leicester

Client: Midland Land Reclamation Limited

Contractor: Site Investigation Services

Borehole Nº: PC1 Sheet 1 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

			<u>, .</u>							tefe	erence: N	IL/EW/JT/	080/01
							ROCK		SS DESCRIPTION				
Drilling Run	TCR %	RQ %		FI Di:	scon.	Depth	Sam	ples	Description		Sorehole stallation	Reduced Level	Legend
			1969, 1969 , 1969, 1969, 1969, 1969, 1969, 1969, 1969, 1969, 1969, 1969, 1969, 1969, 1969, 1969, 1969, 1969, 19						MADE GROUND: Gravel, sand and stone fill (driller's description)	11111			
						1 .00			Brown mari (driller's description)				
						1.40 			Highly weathered and fissured GRANODIORITE				
						2.10			Moderately weathered GRANODIORITE with tight or closed fissures, many orientations.				
m diameter						- - - - - - - - - - - - - -			At 3.58m, subhorizontal fissure with approximately 5mm aperture At 3.88m to 3.92m, subhorizontal tight fissure				$\begin{array}{c} + & + & + & + & + & + & + & + & + & + $
Open hole 150mm diameter		-				4.20			Slightly weathered to fresh GRANODIORITE. Occasional tight or closed fissures.	V.A.A.			
r in the second second second second second second second second second second second second second second seco									At 6.67m to 7.14m, diagonal and subvertical fissures with aperture of a few mm. At 7.97m, tight fissure				
GROU	NDWA	TER						REM	ARKS	- b -i	INSTALI	ATIONS	
Date	am pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	Depth struck (m)	Flow rate (m/a)	sealed (on the	ools and abbreviations are explained e accompanying key. All linear hsions are in metres		Crew: E	otary Drill . Goring, A	
23/02/ 02/03/				7.84	9.50			Logg	ed by CCTV survey from 1.31m to n depth		Type and Rotary hole 15	open	Depth 10.0m
06/03 09/03				4.86 4.97			-					e: 23/02/9	
03/03/	190			4.97				rogg	ed by : M. Cliff		FHIISTI CA	te : 23/02/	3 0
									A2				

🕞 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Location: Leicester

Client: Midland Land Reclamation Limited

Contractor: Site Investigation Services

Borehole Nº: PC1 Sheet 2 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

			- , .					RO	СК МА	SS DESCRIPTION	 l ere alte d'alles a	en an	
Drilling Run	J TCF %	RC א		Ft	Disco	on.	Depth	Sa	amples	Description	Borehole stallation	Reduced Level	Legend
Open hole 150mm	quameter									Slightly weathered to fresh GRANODIORITE. Occasional tight or closed fissures.			
										BASE OF BOREHOLE			
GROU			Dent		nih D	ion#h	Flow	Dooth		IARKS pols and abbreviations are explained	 INSTALL Plant : Ro		
Date	am pm	Depth of hole (m)	Deption of casin (m)	g w	pth D to si ater (m)	lepth Iruck (m)	rate (m/s)	Depth sealed (m)	on th	e accompanying key. All linear nsions are in metres	Crew: E.	Goring, A.	
23/02	2/95	<u></u>).50			Logg	ed by CCTV survey from 1.31m to	Type and	Dia.	Depth
02/03 06/03	3/95				84 86				9.73	m depth	Rotary o hole 150		10.0m
09/0					97				1000	ed by ; M. Cliff		e : 23/02/9	
03/0	<i></i>				"				T	······		0.20/02/3	~~~~~
										A3			

🚱 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: PC2 Sheet 1 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Location: Leicester

an the grant and a grant and a grant and a grant and a grant and a grant and a grant and a grant and a grant a							ROCK	C MA	SS DESCRIPTION				
Drilling Run	TCR %	RG %		FI [Discon.	Depth	Sam	ples	Description		rehole allation	Reduced Level	Legend
						7.80			MADE GROUND: Gravel, sand and granite chips (driller's description) 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				
GROU		TER			r				ARKS			ATIONS	··
Date	am pm	Depth of hole (गः)	Depth of casin((m)	10	er (m)	Flow rate (m/s)	sealed (on the	ols and abbreviations are explained a accompanying key. All linear sions are in metres	Ľ	Crew : E	otary Drill . Goring, A	
24/02 02/03 06/03	/95			3.4	0	Rapid Inflow		Logg	ed by CCTV survey from 0.71m to n depth		Type and Rotary (hole 150	pen	Depth 10.0m 5
09/03	/95			1.3	3		L. L.	Logge	ad by : M. Cliff			te : 24/02/	
									A4				

🕞 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: PC2 Sheet 2 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Location: Leicester

Drilling Run TCR % RQD % FI Discon. Depth Samples Description Borehole Installation Reduced Level U % % FI Discon. Depth Samples Description Borehole Installation Reduced Level U % % FI Discon. Depth Samples Description Borehole Installation Reduced Level U % % % % % % % % U % % % % % % % U % % % % % % U % % % % % U % % % % % U % % % % % U % % % % % U % % % % % U % % % % % U % % % % U % % % % U % % % % U % % </th <th></th> <th></th> <th>•,•• • • •, •• •,•• • • • • • •</th> <th>, , , , , , , , , , , , , , , , , , ,</th> <th>SS DESCRIPTION</th> <th>СК МА</th> <th>ROO</th> <th>- <u> </u></th> <th></th> <th></th> <th></th> <th></th> <th> ,</th> <th></th> <th></th>			•,•• • • •, •• •,•• • • • • • •	, , , , , , , , , , , , , , , , , , ,	SS DESCRIPTION	СК МА	ROO	- <u> </u>					,		
GRANODIORITE. GRANODIORITE. Gradient At 8.34m, 8.56m, 9.23m and 9.30m, 1 Gradient tight subhorizontal fissures. Gradient At 8.34m, tight subhorizontal fissure. Gradient At 9.30m, subhorizontal fissure with aperture approximately 2mm	Legend			ac	Description	amples	h Sa	Depth	scon.	Dis	FI				
Image: Section of the section of t				Im and 9.30m, sures. rizontal fissure. tal fissure with ly 2mm	GRANODIORITE. At 8.34m, 8.56m, 9.23r tight subhorizontal fiss At 8.34m, tight subhori At 9.30m, subhorizonta aperture approximately		0	10.0							Open hole 150mm
GROUNDWATER REMARKS INSTALLATIONS							1	1			·····	3	ATER	NDW.	GROU
arm pm Depth of hole (m) Depth of (m) Depth to casing (m) Depth to (m) Depth to (m) Depth to (m) Depth to (m) Depth to (m) Symbols and abbreviations are explained on the accompanying key. All linear Plant : Rotary Drill Crew : E. Goring, A. J	Jones	Goring, A.	Crew : E.		e accompanying key. Al	on the	Depth sealed (m)	Flow rate (m/s)	Depth struck (m)	water)epth of asing	Di Ca	Depth of hole (m)		Date
23/02/95 3.50 Rapid inflow Logged by CCTV survey from 0.71m to Type and Dia. 02/03/95 3.40 Inflow 9.52m depth Rotary open hole 150mm	Depth 10.0m	pen ,	Rotary o	Logged by CCTV survey from 0.71m to 9.52m depth Rota				3.50	3.40		- `		/95	0 2/0 3	
06/03/95 1.20				<u> </u>	ed by: M. Cliff	Loga									
A5											<u></u> [L		

🕞 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: PC3 Sheet 1 of 2 Logged By: E. Goring Reference: ML/EW/JT/080/01

Location: Leicester

	*******					1	R	OCK N	ASS DESCRIPTION	a gitte anna a state agus	<u></u>	
Drilling Run	TCF %	i RC %		FI	Discon	De	oth	Sampl		Borehole nstallation	Reduced Level	Legend
			, 1fe			- - - -	50		MADE GROUND: Chippings and soil (driller's description)			
- - - - -									Hard granite (driller's description)			
)												
meter												
Open hole 150mm diameter												
Open hol												
· · · ·												
, , , , , , , , , , , , , , , , , , ,												
· 			5			r I. tra I. t						
GROU						F		 BI	- I - EMARKS	INSTALL	ATIONS	**********
Date	am pm	Depth of hole (m)	Depth of casing (m)	i Dep to wat	olh Dep struk ter (m)	h Fiov k rate (m/s	y D \$4 \$1	epth Sy	mbols and abbreviations are explained the accompanying key. All linear nensions are in metres	Plant : Re Crew : E.	otary Drill Goring, A.	Jones
28/02	/95				3.5	0		u		Type and	·····	Depth
0 2/03				1.5						Rotary o hole 150		10.0m
09/03	/95			2.3	90			Lo	gged by : E. Goring		e : 28/02/9	
									A6			

🕑 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: PC3 Sheet 2 of 2 Logged By: E. Goring Reference: ML/EW/JT/080/01

Location: Leicester

	*** ********					·····	ROCK	(MA	SS DESCRIPTION				<u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>
Drilling Run	I TCF %	२ RC १		Fi	Discon.	Depth	Sam	ples	Description		orehole stallation	Reduced Level	Legend
Open hole 150mm	ulameter								Hard granite (driller's description)				
									BASE OF BOREHOLE	· · ·	· · · · · · · · · · · · · · · · · · ·		
GROU Date	am	Depth of hole (m)	Dept of casin (m)	h Dep to g wa (л	oth Deptz sinuci ter (m)	Flow rate (m/s)	Depth	Symt	IARKS pols and abbreviations are explained e accompanying key. All linear		INSTALL Plant : Ro Crew : E.		Jones
	pm	(10)	(m)	у wa (л	(m) n) 3.50	_	601	dime	nsions are in metres		Type and		Depth
28/02 02/03 09/03	3/95			1.5 2.3	50						Rotary o hole 150)mm	10.0m
								Logg	ed by : E. Goring			e: 28/02/9 te: 28/02/	
									A7				

() M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: PC4 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Legend

Depth

10.0m

Finish date : 27/02/95

Sheet 1 of 2 Location: Leicester Contractor: Site Investigation Services ROCK MASS DESCRIPTION Drilling TCR RQD Discon. Depth Samples FL Description Borehole Reduced Run Installation % % Level MADE GROUND: Grass on clay, stone and metal fill (driller's description) 2.00 Very weak reddish brown sandy mar (driller's description) Open hole 150mm diameter 3.30 Highly weathered fissured GRANODIORITE 4.25 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 REMARKS INSTALLATIONS Symbols and abbreviations are explained Plant : Rotary Drill Depth sealed (m) Depth of hole Depth of Depih to Depth struck (m) am Flow rate (m/s) Date on the accompanying key. All linear Crew : E. Goring, A. Jones pm casing (m) (m) water (m) dimensions are in metres Type and Dia. Logged by CCTV survey from 3.58m to No water ingress during drilling 7.29m depth. Open hole Cloudy water obscured picture below 7.29m. 02/03/95 2.40, odour of sewage 150mm 06/03/95 1.32, odour of sewage Start Date : 27/02/95

Logged by : M. Cliff

🕞 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Location: Leicester

Contractor: Site Investigation Services

Borehole Nº: PC4 Sheet 2 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

ROCK MASS DESCRIPTION

Drilling Run	TCR %	RQD %	FI	Di	scon.	Depti	n Samp	oles	Description		Borehole nstallation	Reduced Level	Legend
	%	%							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. BASE OF BOREHOLE				
- GROUN	IDWAT	ER	<u> </u>	<u> </u>	F	-		IEM.	ARKS	I	INSTALL	ATIONS	
Bate 8	im t)epth D fhole (m) ca	lepth of esing	Depth to water	Depth struck (m)	Flow rate (m/s)	Depth sealed (m)	ymb n the	ois and abbreviations are explained accompanying key. All linear		Piant : Ro Crew : E.	tary Drill	Jones
No wate	ar Ingre		(m) na dri	(m) Ilina					sions are in metres ad by CCTV survey from 3.58m to		Type and	Dia.	Depth
02/03/9	95			2.40,		of sewa	ige C	.29n	depth. ly water obscured picture below 7.29	m.	Open h 150mr		10.0m
		6/03/95 1.32, odour of sewage		ogge	d by:M. Cliff		Start Date Finish dat	: 27/02/9					

M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Location: Leicester

Contractor: Site Investigation Services

Borehole Nº: KC1 Sheet 1 of 1 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Run % % % MADE GROUND: (driller's description) Boy Boy Boy Boy Boy Boy Boy Boy Boy Boy	1999 - An Anna 1998 - 1999 - 1999	ga. 4-0.7972 - 4-1-1				n an suite ann fhe a	ROCK M/	ASS DESCRIPTION	i stan to standy		
87 1.50 87 2.30 9 3.30 9 3.30 9 3.30 9 3.30 9 3.30 9 3.30 10 1.30	Drilling Run			FI	Discon	. Depth	Samples	Description			Legend
arn prin Depth of hole (m) Depth of casing (m) Depth of water (m) Depth truck (m) Depth seled (m) Depth seled (m) Depth seled (m) Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres Plant : Botary Drill Crew : E. Goring, A. Jones No water ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during d		0						(driller's description) Soft brown silty marl and clay (driller's description) Stiff reddish brown silty sandy CLAY with fine to coarse gravel sized fragments of sandstone, quartzite and coal. Sandstone and granodlorite cobbles at 2.10m (glacial deposits) Very stiff reddish brown with grey mottling silty CLAY with very weak mudstone lithorelicts. Some layers firm (Mercia Mudstone Group)			
Date of hole (m) of hole (m) of hole (m) of hole (m) strick (m) rate (m) strick (m) rate (m) strick (m) on the accompanying key. All linear dimensions are in metres Crew : E. Goring, A. Jones No water ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during drilling Image: Crew ingress during dri	GROUN	DWAT	ER	T					INSTALL	ATIONS	
No water ingress during drilling No water ingress during drilling Rotary open 1.50m hole 150mm Rotary coring 4.50m Start Date : 27/02/95	LIAIA	m De M (m) cas	of sing w	water ((m)	Flow rate (m/s)	sealed on th	e accompanying key. All linear	Crew: E	. Goring, A.	
Rotary open 1.50m hole 150mm 4.50m Rotary coring 4.50m Start Date : 27/02/95	No wate	r ingres	s durin	g drilli	ng	†			Type and	Diâ.	Depth
									hole 150) mm	
							1.000	ed by (M. Cliff			
A10		I			L	L				5. 21/UZ/9	

🕑 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: KC1A Sheet 1 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Location: Leicester

							ROCK	MASS DESCRIPTION		· · . · ·	
Drilling Run	TCR %	RQ %		-1 Di	iscon.	Depth	Sampl	s Description	Borehole Installation	Reduced Level	Legend
						0.80		MADE GROUND: Soil and granite boulders (driller's description) Soft brown silty mari and clay (driller's description) Soft reddish brown sandy silty mari (driller's description) (probably Mercia Mudstone Group) Stiff red very silty shaly mari			
Den hole 150mm diameter						3.70		(driller's description) (probably Mercia Mudstone Group) Reddish brown silty MUDSTONE with grey lenses (Mercia Mudstone Group)			
						4.90		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			
-						8.45		occasional tight or closed fissures			\$********** **************************
Date p	im c im °	Depth Depth Depth Depth Flow D		Depth sealed (m) dir	MARKS nbols and abbreviations are explained the accompanying key. All linear tensions are in metres gged by CCTV survey from 1.46m to 50m depth.	Plant : F	open	Jones Depth 12.0m			
							Lo	ged by : M. Cliff A11		e : 28/02/9 te : 28/02/9	

M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

4

Borehole Nº: KC1A Sheet 2 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Location: Leicester

Drilling Bun	TCR	RQD	FI	Dis	icon.	Depth	n Sam	ples	Description		Borehole	Reduced	Legend
Open hole 150mm diameter	%	%				12.00		ox	esh GRANODIORITE with coasional tight or closed fissures 10.22m to 10.40m, weathered BASE OF BOREHOLE			Level	
						-						ATIONS	
1 IGTA	am D	epth De hole	ofi	Depth to	Depth struck	Flow rate	Depth		and abbreviations are explained ccompanying key. All linear	· • •	Plant : Ro	otary Drill	lonan
F	om "	(m) (m)				rate (m/s)		dimensi	ons are in metres		Type and	Goring, A. I Dia.	Depth
No wate	er ingres	s durin	g dril	ling				Logged I 1.50m	by CCTV survey from 1.46m to depth.		Rotary of hole 150		12.0m

🕑 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: WC Sheet 1 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Location: Leicester

ROCK MASS DESCRIPTION														
Drilling Run	I TCF %		QD 6	FI	Disc	on.	Depth	San	nples	Description		lorehole stallation	Reduced Level	Legend
							1.80			Clay and sand (driller's description) Granite boulder fill (driller's description)				
Open hole 150mm diameter						(probably glacial deposits) Reddish brown with grey lenses highly weathered MUDSTONE with some infilled fissures (Mercia Mudstone Group)								
							5.90			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				
										grained GRANODIORITE Occasional tight joints				
GROU	am		Den			Denth	Flow	Depth	-	ARKS ols and abbreviations are explained		INSTALL Plant : Re		
Date	pm	Depth of hole (m)	Dep of casi (m	ng y	epth [lo s vater (m)	Depth struck (m)	rate (m/a)	sealed (m)	on the	e accompanying key. Ali linear isions are in metres		Crew: G	Bartle	
No w	1	ingress during drilling Seepage at 3.55, 5.85 and 6.48 9.32				Logg	ed by CCTV survey from ground leve f0m depth]	Type and Rotary o hole 150	pen Imm	Depth 10.0m			
								F	Logg	ed by : M. Cliff			e: 01/03/9 e: 01/03/9	
A13														

🕞 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: WC Sheet 2 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Location: Leicester

								MASS DESCRIPTION			1
Drilling Run	TCF %	i RC %		FI I	Discon.	Depth	Samp	les Description	Borehole Installation	Reduced Level	Legend
Open hole 150mm diameter								Fresh darker fine to medium grained GRANODIORITE Occasional tight joints			
-						⊑ 10.00 F		BASE OF BOREHOLE	<u>*:, !=_=,=,=,=</u> ,		<u> #;+;+;+;</u> +
- GROU							-⊥	IEMARKS	INSTAL		
Date	arm Depth Depth Depth Depth Flow Dep							ymbols and abbreviations are explained n the accompanying key. All linear imensions are in metres	Plant : Ro Crew : G	otary Drill . Bartle	
No water ingress during drilling Logged by CCTV survey								ogged by CCTV survey from ground level	Type and	i Dia.	Depth
06/03/95 Seepage at 3.55, 5.85 and 6.48								9.40m depth	Rotary o hole 150	Rotary open hole 150mm	
								ogged by : M. Cliff		e: 01/03/9 te: 01/03/9	
	I		L	L	···· k · · · ·	<u></u>	_	A14			

M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehote Nº: WF1 Sheet 1 of 3 Logged By: G. Bartle Reference: ML/EW/JT/080/01

Location: Leicester

Run % % Mailation Level Red S % Novelotion Installation Level Red Re	ROCK MASS DESCRIPTION													
and a section of the				FI	Dis	con.	Depth	Sam	ples	Description				Legend
Date am pm Depth of hole (m) Depth of casing (m) Depth to water (m) Depth struck (m) Depth rate (m) Depth struck (m) Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres Plant : Rotary Drill Crew : G. Bartle No water ingress during drilling Image: Companying key in the accompanying key. All linear dimensions are in metres Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres Plant : Rotary Drill Crew : G. Bartle No water ingress during drilling Image: Companying key in the accompanying key. All linear dimensions are in metres Rotary open hole 150mm Depth Start Date : 28/02/95 Finish date : 28/02/95 Logged by : G. Bartle Start Date : 28/02/95 Start Date : 28/02/95	n An Anna an Inn an Anna Anna Anna an Anna an Anna an Anna an Anna an Anna an Anna an Anna an Anna an Anna an An									(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)				
Date of fiele (m) of fiel	GROUN	IDWA1	rer						REM	IARKS				
No water ingress during drilling Rotary open hole 150mm 20.0m Logged by : G. Bartle Start Date : 28/02/95	l Jate	im ç im	Septh De (hole (m) ca (of t	to I	Depth struck (m)	rate I	sealed (m)	on the	e accompanying key. All linear		Crew: G	. Bartle	Donth
	No water ingress during drilling Rotary open hole 150mm 20.0m												20.0m 5	
A15	•													

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ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midiand Land Reclamation Limited

Borehole Nº: WF1 Sheet 2 of 3 Logged By: G. Bartle Reference: ML/EW/JT/080/01

э

Location: Leicester

ROCK MASS DESCRIPTION													
Drilling Run	TCR %	RQD %	FI	Di	scon.	Depth	Sa	mples	Description	Borehole Installation	Reduced Level	Legend	
Open hole 150mm diameter	n De n (ppth D hole m) ca	(m)	Depth water (m)	Depth struck (m)	8.50	Depth sealed (m)	Symbor on the	Weak reddish brown and grey silty marl with softer bands (driller's description) (Mercia Mudstone Group)	INSTALL Plant : Ro Crew : G. Type and	ATIONS Dtary Drill Bartle		
No water ingress during drilling										Rotary o hole 150	Rotary open hole 150mm		
Logged by : G. Bartle Finish date : 28/02/95													
		E	I			_ _			A16				

M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: WF1 Sheet 3 of 3 Logged By: G. Bartle Reference: ML/EW/JT/080/01

Location: Leicester

Contractor: Site Investigation Services

							ROCK M	ASS DESCRIPTION			
Drilling Run) TCF %	i RQ %	D I	FI D)iscon.	Depth	Sample	s Description	Borehole stallation	Reduced Level	Legend
Coen hole 150mm diameter						20.00		Weak reddish brown and grey silty marl with softer bands (driller's description) (Mercia Mudstone Group) BASE OF BOREHOLE			
GROU	NDWA			- I		T T		MARKS	 	ATIONS	<u></u>
f 1010	am pm	Depth of hole (m)	Depth of casing (m)	Depth to water (m)	n Depth struck r (m)	Flow rate (m/s)	(m) on i	bols and abbreviations are explained he accompanying key. All linear ensions are in metres	Plant : Re Crew : G	. Bartle	
No wat	er ingre	ess dur							Type and Rotary c hole 150	pen	Depth 20.0m
							Log	ged by : G. Bartle		e: 28/02/9 e: 28/02/9	
								A17			

🕑 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: WF1A Sheet 1 of 3 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Location: Leicester

Contractor: Site Investigation Services

								ROC	K MA	SS DESCRIPTION	 		
Drilling Run	TCI		QD %	FI	Dis	con.	Depth	Sar	mples	Description	Borehole stallation	Reduce Level	d Legend
	23									No record Reddish brown with grey patches, In places laminated, highly weathered MUDSTONE with small lenses of grey fine grained sandstone (Mercia Mudstone Group)			
GROU			1		T	·· · · · ·				ARKS	 INSTALL		
Date	am pm	Depth of hole (m)	Dep of casir (m)	ng w	epth to rater (m)	Depth struck (៣)	Flow ratə (m/a)	Depth sealed (m)	on the	ols and abbreviations are explained accompanying key. All linear isions are in metres	Plant : Re Crew : E	Goring,	A. Jones
No wa	iter ing	ress d	i during	drilli	ng						Type and		Depth
											Rotary o hole 150 Corin	mm	4.50m .50-20.0m
									Logge	əd by: M. Cliff	Start Date Finish dat		
										A18	 <u></u>		

M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Location: Leicester

Client: Midland Land Reclamation Limited

Contractor: Site Investigation Services

Borehole Nº: WF1A Sheet 2 of 3 Logged By: M. Cliff Reference: ML/EW/JT/080/01

									F	lefe	rence: N	iL/EW/	JT/(80/01
							ROCH	K MA	SS DESCRIPTION					
Drilling Run	I TCR %	RQ %		=l D	iscon.	Depth	San	nples	Description		Borehole stallation	Reduc Leve		Legend
	0 73					9.00 9.15 1 1 10.00	0		Reddish brown with grey patches, in places laminated, highly weathered MUDSTONE with small lenses of grey fine grained sandstone (Mercia Mudstone Group)/ Reddish brown and grey mottled very porcus calcareous fine grained SANDSTONE with solution cavities maximum 18mm x 18mm x 8mm lined with caloite. (Mercia Mudstone Group) Grey weakly cemented line grained SANDSTONE with occastonal thick					
	33								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 Reddish brown with grey motiling MUDSTONE. At 10.00m to 12.40m many subvertical and diagonal planar closed fissures with black motiling on fissure surfaces. At 12.40m to 12.50m and 12.60m,					
	90								vertical planar light 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 motiling on surfaces. At 12.50m cavities maximum size 5mm with yellow discolouration,					
	80						5		no infili (Mercia Mudstone Group)					
	100		:						Grey weakly cemented thinly bedded line 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)	Z Z Z A • • •				
	77					16.20			Grey and plnk 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)					
GROU	NDWA	TER				·			IARKS		INSTAL	ATION	١S	
Date	am pm	Depth of hole (m)	Depth of casing (m)	ťo	slruck	Flow rate (m/s)	Depth sealed (m)	on th	ools and abbreviations are explained e accompanying key. All linear nsions are in metres		Plant : R Crew : E Type and	. Goring		
No wa	ater ingr	ress du	uring c	irilling							Rotary o hole 150 Corin	open)mm Ig	4.5	Depth I.50m 0-20.0m
								Logg	ed by : M. Cliff		Start Date Finish da			
									A19					

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ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Location: Leicester

Contractor: Site Investigation Services

Borehole Nº: WF1A Sheet 3 of 3 Logged By: M. Cliff Reference: ML/EW/JT/080/01

							ROCK	(MA	SS DESCRIPTION			
Drilling Run	TCR %	RQD %	Fl	Dise	con.	Depth	San	nples	Description	torehole stallation	Reduced Level	Legend
	77 100					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)			
	1 0 0					20.00						
GROUN									BASE OF BOREHOLE	INSTALL		
	1		oth I	Depth	Depth	Flow			ols and abbreviations are explained	 Plant : Ro		
l)ata	m	(m) [ca	opth I of sing m)	Depth to water (m)	Depth struck (m)	rate (m/s)	sealeci	on the	e accompanying key. All linear isions are in metres	Crew: E.	Goring, /	
No wat	er ingre	ss durin	g drill	ing						Type and Rotary of hole 150 Corir	open Omm Ig 4	Depth 4.50m .50-20.0m
							•	Logg	ed by:M. Cliff	 Start Date Finish dat		
									A20			

🕞 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Borehole Nº: WF2A Sheet 1 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Location: Leicester

Contractor: Site Investigation Services

					100 Se 100 s			ROCK	MAS	SS DESCRIPTION	A769			
Drillin Run	TCF		QD %	Fl	Dis	con.	Depth	Samp	oles	Description	orehole stallation	Reduc Leve		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		- - - - - - - - - - - - - - - - - - -	Grey medium grained SANDSTONE, strong, filssured (Mercia Mudstone Group) Reddish brown MUDSTONE, with				
	73								1	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)				
	80						-							
GROL	INDW/	ATER	 				1 1			ARKS	 INSTALL			
Date	am pm	Depth of hole (m)	Dej o casi (n	ing \	epth to water (m)	Dəpth struck (m)	Flow rate (m/s)	sealed 0	in the	ols and abbreviations are explained e accompanying key. All linear hsions are in metres	Plant : R Crew : E	Goring	, A.	
No w	ater ing	ress (luring	g drilli	ng				Gran	odiorite continued to 16.00m in hole WF2 adjacent to this borehole	Type and Rotary hole 15 Rotary o Start Date	open Omm oring	2 2.50	Depth 50m -10.20m
						·		L	ogge	ed by : M. Cliff	Finish dai			
	········		-		·				2.462-74	A21	 			ر د د دور بر این اور د د د در این

C M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Contractor: Site Investigation Services

Borehole Nº: WF2A Sheet 2 of 2 Logged By: M. Cliff Reference: ML/EW/JT/080/01

Location: Leicester

					<u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>		ROCH	< MA	SS DESCRIPTION			n in the second second second	· · · · · · · · · · · · · · · · · · ·
Drilling Run	TCR %	RQD %	FI	Dis	scon.	Depth	San	nples	Description		ehole Illation	Reduced Level	Legend
	80					9.20			Reddish brown MUDSTONE with grey motiling Highly weathered GRANODIORITE, weak Dark pink fresh GRANODIORITE BASE OF BOREHOLE				
GROUN	IDWAT	ER							ARKS			ATIONS	·····
1 1916	im p	(m) 🛛 🔾	epth of asing (m)	Depth to water (m)	Depth slruck (m)	Flow nate (m/e)	sealed (m)	on the	ols and abbreviations are explained accompanying key. All linear hsions are in metres	C	rew:E.	otary Drill Goring, A.	Jones
No wate	er ingre							Gran	odiorite continued to 16.00m in	T	ype and	Dia.	Depth
no wati								borel	hole WF2 adjacent to this borehole	H R	Rotary o nole 150 Rotary co	mm [2.50m)+10.50m
								Logg	ed by : M. Cliff			e: 08/03/95	
									A22				

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🕑 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Client: Midland Land Reclamation Limited

Location: Leicester

Contractor: Site Investigation Services

Borehole Nº: WF3 Sheet 1 of 3 Logged By: M. Cliff Reference: ML/EW/JT/080/01

an ga 65 a, mat a, a			t i en stag und					ROCK	(MA	SS DESCRIPTION	 an May () in a strain factor	an a su suit anna anna a	
Drillin Run			QD %	FI	Dis	icon.	Dəpth	Sam	iples	Description	rehole allation	Reduced Level	Legend
Copen hole 150mm diameter		-					1.00			TOPSOIL (driller's description) Soft light brown silty marl with smail granite cobbles (driller's description) Stiff reddish brown silty CLAY with fine to coarse gravel sized fragments of sandstone, marl and quartz. Below 3.00m, very stiff (glacial deposits)			
······································	87 0		и и и и и и и и и и и и и и и и и и и				3.70 4.00 5.30			Reddish brown with a little grey mottling laminated highly weathered MUDSTONE (Mercia Mudstone Group) Very soft sandy CLAY (driller's description) Reddish brown MUDSTONE with many fissures At 5.50m to 5.60m grey porous calcareous fine grained sandstone			
	10									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			
GROL	JNDW		1							ARKS pols and abbreviations are explained	 	ATIONS	
Date No w	am pm ater ing	Depih of hole (m)	ol Casi (m	ing 1)	Xepth to water (m)	Depth struck (m)	Flow rate (m/s)	eealed	on the	accompanying key. All linear sions are in metres	Crew : E ype and Rotary op hole 150r Rotary con Rotary op hole 100r	. Goring, A. Dia. D nen 2 nm 2.50n	epth 50m n-16.00m m-20.00m
	****								Logg	ed by : M. Cliff		te: 08/03/8	
										A23			

🕞 M.J. Carter Associates

ROTARY CORE DRILLING RECORD

Project: Enderby Warren

Location: Leicester

Client: Midland Land Reclamation Limited

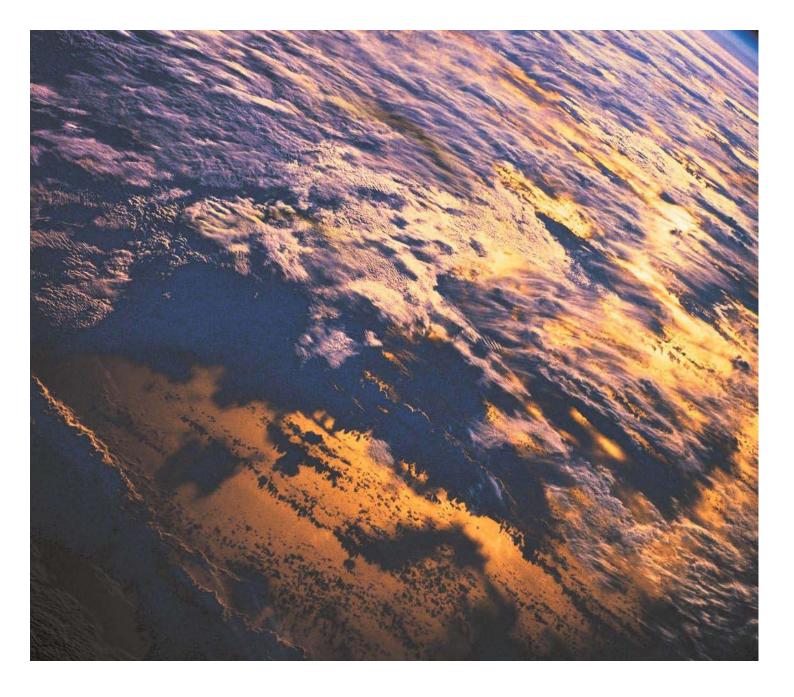
Contractor: Site Investigation Services

Borehole Nº: WF3 Sheet 2 of 3 Logged By: M. Cliff Reference: ML/EW/JT/080/01

. The Albert Press	<u></u>				******					leter	ence: M	L/EW/JT/(080/01
							ROC	ж м <i>і</i>	ASS DESCRIPTION			A 	
Drilling Run	TCR %	RQD %	FI	Die	scon.	Depth	a San	nples	Description		orehole tallation	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				
	67						_		sandstone. At 10.70m calcareous mudstone (Mercia Mudstone Group)				
	90					□11.8 □ □12.5(□ □			Grey and dark pink thinly bedded medium to coarse grained SANDSTONE. Bedding plane fissures at approximately 100mm spacing (Mercia Mudstone Group)				
	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.				
	80			·	-)		At 15.00m to 15.10m diagonal planar tight fissure with black mottling on surfaces. (Mercia Mudstone Group) Reddish brown MUDSTONE with				
Open hole 100mm diameter									granodiorite boulders (Mercia Mudstone Group)				
GROUN	IDWAT	ER						REM	ARKS	I	NSTALL	ATIONS	
Llate	of	hole (m) ce	of	Depth to water (m)	Depth struck (m)	Flow rate (m/s)	sealed (m)	on the	ols and abbreviations are explained accompanying key. All linear asions are in metres	(Plant: Ro Crew: E. Type and I	Goring, A.	Jones epth
No wat	er ingre	ss durir	ıg dril	ling							Rotary ope hole 150m		.50m
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								Logge	ed by : M. Cliff		Start Date	: 08/03/95 e: 08/03/9	
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🕞 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 TCR RQD Fl Discon. Depth Samples Description Borehole Reduced Legend Run % % Installation Level Reddish brown MUDSTONE with granodiorite boulders Open hole at 100mm diamater (Mercia Mudstone Group) 18.50 Fresh GRANODIORITE 20.00 BASE OF BOREHOLE) GROUNDWATER REMARKS INSTALLATIONS Symbols and abbreviations are explained Plant : Rotary Drill am Depth of hole (m) Depth of casing (m) Depth struck (m) Flow rate (m/s) Depth sealed (m) Depth Io Date on the accompanying key. All linear Crew: E. Goring, A. Jones pm vrater (m) dimensions are in metres Type and Dia. Depth Rotary open hole 150mm 2.50m No water ingress during drilling Rotary coring 2.50m-16.00m Rotary open hole 100mm 16.00m-20.00m Start Date : 08/03/95 Logged by : M. Cliff 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

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For and on beh Environmental	nalf of Resources Management
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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 Appraisal¹ including site investigation in 2015 and a Gas Assessment Report² 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

SUMMARY OF SITE INVESTIGATION AND GAS MONITORING WORKS

2.1 INTRODUCTION

2

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 23^{rd} December 2016. All gas monitoring wells were monitored using a GFM436 infra-red gas analyser for flow rate (l/hr), methane (CH₄), carbon dioxide (CO₂), 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 <u>www.wunderground.com</u>.

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 2.3Gas Results and Screening Risk Assessment

Borehole	Flow	Max CH₄	SS CO ₂	O ₂	СО	H_2S		ning Value /hr)	Gas Hazard Potential*
Dorenoie	(L/hr)	(%)	(%)	(%)	(ppm)	(ppm)	CH ₄	CO ₂	(CIRIA C665)
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 <u>http://mapapps.bgs.ac.uk/geologyofbritain/home.html?location=S21%2</u> 01TZ
- Environment Agency webpage 'What's in Your Backyard?' <u>http://maps.environment-</u> 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.

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 5.1Encountered 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.

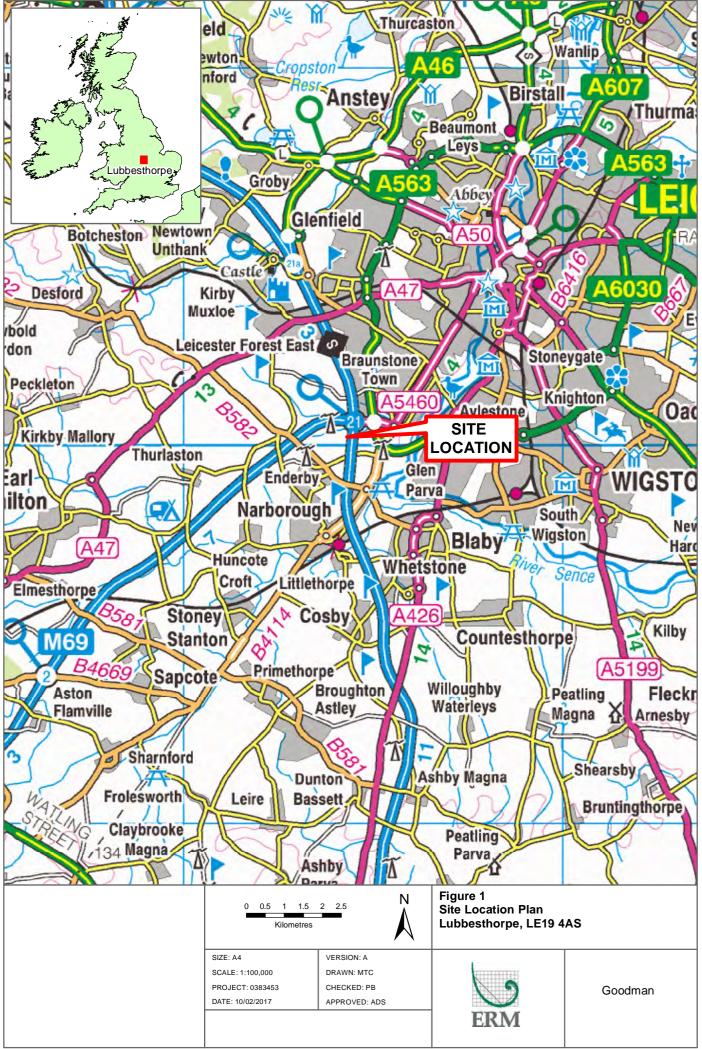
In addition, as a further precautionary measure to reflect the worst case gas scenario, the following gas protection measures (in accordance with BS 8485:2015) should be incorporated in all buildings on site:

- 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



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