REPORT

Sandsfield Gravel Company Ltd

Environmental Setting and Installation Design - Milegate Eastern Extension

Submitted to:

Sandsfield Gravel Company Ltd
Sandsfield
Brandesburton
Driffield
East Yorkshire
YO25 8SA

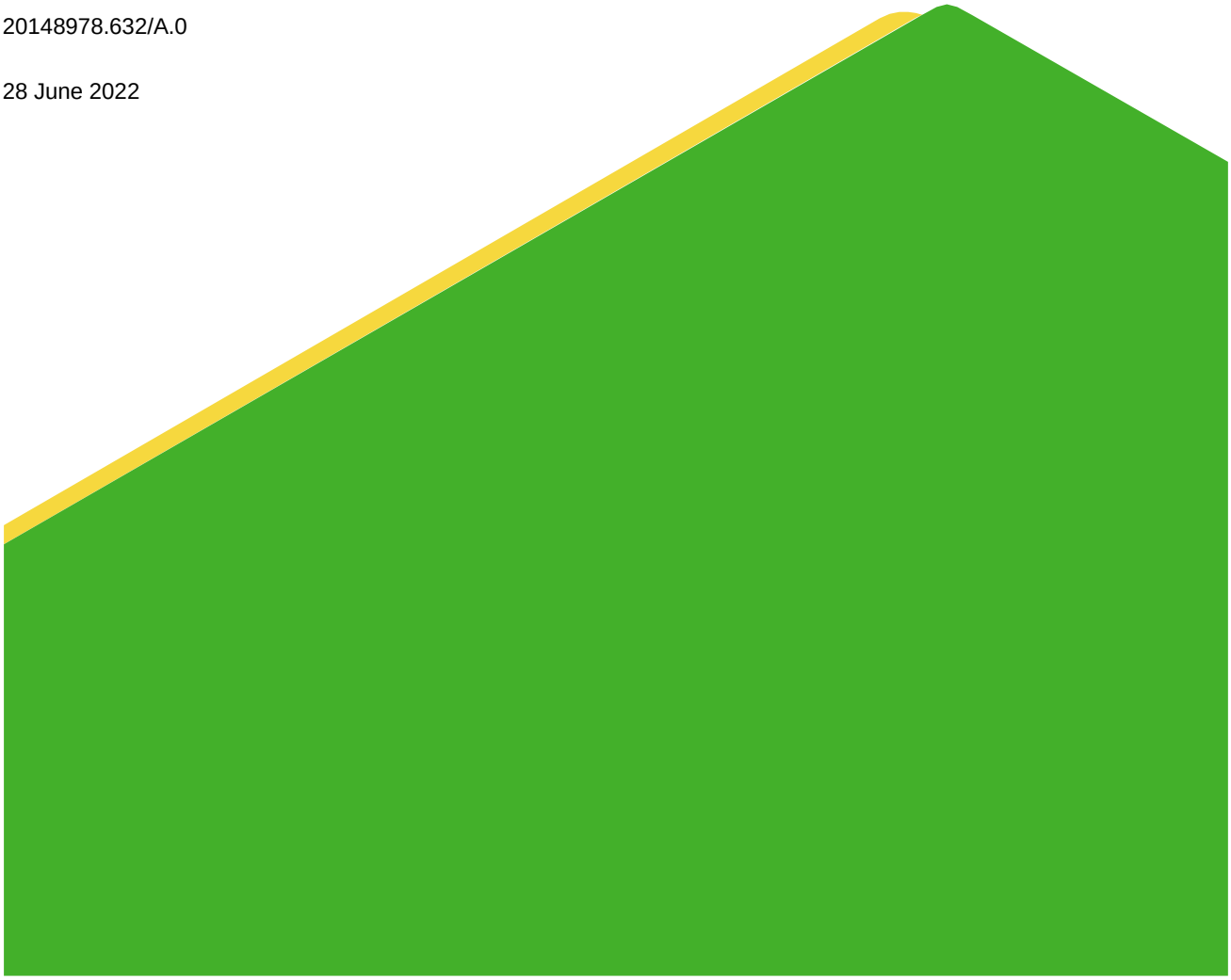
Submitted by:

Golder WSP UK Ltd
Attenborough House, Browns Lane Business Park, Stanton-on-the-Wolds,
Nottingham, NG12 5BL, UK

+44 [0] 115 937 1111

20148978.632/A.0

28 June 2022



Distribution List

Sandsfield Gravel Company Ltd - 1 copy (pdf)

Environment Agency - 1 copy (pdf)

Golder WSP UK Ltd - 1 copy (pdf)

Table of Contents

TABLES

APPENDICES

DRAWINGS

1.0 INTRODUCTION

1.1 General

Sandsfield Gravel Company Ltd ('Sandsfield') has requested that Golder Associates (UK) Ltd ('Golder') prepares an Environmental Permit Variation Application (hereafter referred to as the 'variation application') for its Milegate Extension landfill at Catwick Lane, Brandesburton, Driffield, East Yorkshire, YO25 8SA (the 'Site').

The landfill is currently authorised by Environmental Permit (EP) EPR/BX1942IX which was issued by the Environment Agency (EA) in 2006 and last varied and consolidated by the EA in February 2020 (Variation Notice V003). The EP allows Sandsfield to dispose of non-hazardous waste under the listed activity of Section 5.2 Part A(1)(a) of the Environmental Permitting (England and Wales) Regulations and the Site can accept up to 75,000 tonnes of waste per year for landfilling. The following directly associated activities (DAAs) are also permitted:

- Storage of leachate in two above ground storage tanks and associated pipework;
- Leachate pumping, extraction and removal off Site;
- Flaring of landfill gas for disposal in an appliance;
- Discharge of Site drainage from the landfill (surface water management); and
- Storage of fuel for operation of plant and equipment.

Sandsfield proposes to extend the existing Site into the neighbouring field to the east (the 'Eastern Extension') which is currently in agricultural use. A variation to the EP would allow continued and uninterrupted landfilling operations to extend into the Eastern Extension following mineral extraction. This Environmental Setting and Installation Design (ESID) report is prepared in support of the variation application.

The existing landfill is divided into ten cells, Cells 1 to 8 (Cells 2 and 4 are split into A and B). Landfilling at the Site has taken place continuously since waste acceptance commenced in 2007. Filling began in Cell 1 and proceeded in a westerly direction through Cells 3, 5 and 7. Cell 8 was constructed to the north of Cell 7 in 2016, and subsequently landfilling has continued in an easterly direction into Cell 6, Cell 4A and Cell 4B, with Cell 2A and 2B to follow. Cells 1, 3, 5, 7 and 8 are filled and restored. Cell 6 and Cell 4A have been filled and await restoration; Cell 4B is the currently operational cell.

Landfill gas is collected from the waste and is currently flared at the Site. The amount of the produced gas has risen over past years as the amount of the deposited waste has increased and Sandsfield would now like to seek approval for installation of two gas engines at the Site. Leachate is collected and directed to two above-ground holding tanks and discharged to sewer via a 750 m long buried pipe; infrastructure that was installed in late 2016.

In May 2022, Sandsfield submitted three planning applications (two S.73 applications and a full application for Planning Permission) to East Riding of Yorkshire Council (ERYC) in parallel (one Environmental Statement) to develop the existing operations as follows:

- Mineral extraction (Eastern Extension Quarry) including stripping and re-use of topsoil, excavation and re-use of overburden and interburden, excavation and removal of sand and gravel, and groundwater and surface water management.
- Disposal of non-hazardous and inert wastes (Eastern Extension Landfill) in the Quarry void including landfill engineering and environmental monitoring infrastructure, and landfill capping, restoration and aftercare. The Eastern Extension is proposed to be completed within the timeframe already permitted for the existing operations i.e. before February 2038.

- Relocation of the existing landfill flare from the southeast corner to the northwest corner of the existing site (January 2019) and upgrade of that flare (September 2021) (retrospective application).
- Installation of a new landfill gas utilisation compound at the northwest corner of the existing site, in which there will be the phased installation of two new landfill gas-to-energy engines ('micro-generators') and associated equipment. The landfill gas flare will be moved into this compound. A new cable connection will be installed from the compound, extending northwest to a new step-down transformer, enabling the gas engines to generate electricity and supply a neighbouring business by private wire and the National Grid.

A decision regarding the planning application submitted to ERYC is pending.

1.2 ESID Scope

An ESID report was produced in November 2004 as part of the application for the existing Site under the Pollution Prevention and Control (PPC) Regulations (Golder, 2004), and updated in June 2018 within the Environmental Permit variation application for the Northern Extension (Golder, 2018).

For this variation application, and as required by the EA application form (Part C3, Appendix 4, Question 1), the ESID has been updated to take into account current operations and the proposed development of the Site. This variation application is primarily for an extension to the East to align it with the new ownership boundary; this will be engineered and managed in accordance with the principles already established at the existing Site.

This ESID report details Site-specific source-pathway-receptor linkages and updates the conceptual model used in each of the quantitative and qualitative risk assessments. As part of the original application, quantitative risk assessments were carried out for hydrogeology, stability and landfill gas, and qualitative risk assessments were carried out for nuisance and health. These have been updated for the purposes of this variation application and this is detailed in the Supporting Statement (ref. 20148978.631).

Consequently, this ESID report (ref. 20148978.632) fully supersedes the previous ESID report (Golder, 2018) but is updated only so far as to reflect the current *operational status* of the Site or where there is considered to be a *material change* to the conceptual model. It is not intended to fully update non-material changes or summarise aspects of engineering, construction quality assurance, environmental monitoring or annual review that are fully considered by the EA elsewhere in accordance with the EP.

The following drawings are provided in this ESID report (ref. 20148978.632):

- Drawing ESID1 – Site Location Plan;
- Drawing ESID2 – Environmental Site Setting;
- Drawing ESID3 – Cultural and Natural Heritage;
- Drawing ESID4 – Site Layout and Waste Deposition;
- Drawing ESID5 – Restoration;
- Drawing ESID6A – Installation Infrastructure;
- Drawing ESID6B – Installation Details;
- Drawing ESID7A – Leachate Management Infrastructure;
- Drawing ESID7B – Leachate Management Details;
- Drawing ESID7C – Leachate Holding Tanks and Discharge Pipeline;
- Drawing ESID8 – Landfill Gas Management Infrastructure;
- Drawing ESID9A – Superficial and Bedrock Geology;

- Drawing ESID9B – Eastern Extension Site Investigation Infrastructure;
- Drawing ESID10 – Groundwater Vulnerability and Source Protection Zones;
- Drawing ESID11 – Local Hydrogeology and Hydrology; and
- Drawing ESID12 – Hydrogeological Cross Section.

1.3 Installation Details

1.3.1 Location and Access

The Site is located approximately 1 km southeast of the village of Brandesburton, East Yorkshire and is centred on National Grid Reference (NGR) TA 131 472 (**Drawing ESID1 – Site Location Plan**). The Site is bound to the north by open fields and the Moor Main Drain, to the south and east by the Milldam Beck, and to the west by another landfill, Milegate landfill (closed).

Access to the site is obtained from Catwick Lane via the waste transfer station also operated by Sandsfield. The access road leading to the waste transfer station is constructed from tarmac and concrete. The entrance to the waste transfer station has secure steel and mesh gates to prevent non-operational vehicle access, which will also prevent access to the site. The roads connecting the transfer station to the site are constructed from crushed hardcore.

On Site vehicle speeds are monitored and appropriate controlling action is taken if necessary. A crawling speed limit is imposed, and maintained at all times, and is aided by traffic calming measures. Signs giving safety information, traffic directions, and speed limits are erected where appropriate and moved or modified as required.

The site reception includes a manager's office, weighbridge, meeting room, welfare and storage areas. There is a connection to mains electricity and telephone and to a septic tank for foul water. There is parking for staff and visitors.

An identification board is situated at the entrance to the facility from the highway that displays the following information:

- Operator's name and address;
- Site name and address;
- Opening hours;
- EA contact details;
- EA emergency out-of-hours contact details; and
- EP number.

The notice will be maintained in good order throughout the operational life of the Site.

1.3.2 Landfill Classification

The Site is classified as a non-hazardous landfill. It accepts non-hazardous and inert solid wastes; stable non-reactive hazardous waste is not accepted.

1.3.3 Variation Application Permit Boundary and Site Setting

The installation boundary, including the Eastern Extension is shown on **Drawing ESID2 – Environmental Site Setting**.

The Site lies in an area of relatively flat-lying predominantly rural land. Much of the surrounding area has been worked for the extraction of sand and gravel, and this has resulted in a number of pits that have been restored to ponds or have been utilised as landfill sites. The rural and disturbed location of the Site means that the main areas of population lie some distance away, but there are a few residential areas in closer proximity to the site. The main areas of population and an approximate distance as measured from the closest point of the site boundary can be summarised as follows:

- Brandesburton village 0.85 km to the west on the far side of the A165 dual carriageway road;
- Leven 2.2 km to the southwest;
- Catwick village 1.5 km to the south;
- Sigglesthorne village 2.2 km to the southeast;
- Seaton village 2.5 km to the east; and
- Bewholme village 3.3 km to the northeast.

A summary of the surrounding land uses is given in Table ESID1. The setting of the Site is shown on **Drawing ESID2 – Environmental Site Setting**.

Table ESID1: Land uses within 500 m of the Site

Direction	Use
Northern boundary	To the immediate north of the existing Site lie open fields. The northern boundary of the Eastern Extension is bounded by the Moor Main Drain, which joins with the Milldam Beck in the northeastern corner of the Eastern Extension. The Above Towns Trading Estate is approximately 200 m northwest of the Site and extends to approximately 700 m north of the Site. Catfoss Airfield, a former RAF base, lies approximately 400 m north of the Site and extends beyond 1 km from the Site. The airfield is now used as an industrial estate.
Eastern boundary	The eastern boundary of the proposed Eastern Extension is adjacent to the Milldam Beck. Beyond the Beck are open fields and a minor road passing north to south on which Manor Farm and Catfoss Cottages are located approximately 600 m east of the Site. Beyond the road and these residential dwellings, there are further open fields.
Southern boundary	The site is bound on its southern edge by the Milldam Beck, which flows south and westwards and discharges to the New Drain at a distance of approximately 600 m southwest of the site. Beyond the Milldam Beck, there are a number of surface water ponds (flooded remains of sand and gravel workings) which are used for coarse fishing (Fossehill Fishery) and a clay pigeon shooting range (Humberside Shooting Ground) for which the clubhouse is located approximately 200 m south of the Site. Within this area is also a recently developed static caravan park and a log cabin park; these are located adjacent to Catwick Lane and approximately 250 m south of the Site. Catwick Lane is a minor road orientated northwest to southeast. Beyond Catwick Lane and extending beyond 1 km from the site, is an area comprising landfill sites (Fosse Hill Quarry, New Feeding Pasture, Pit Field and Catwick Grange), flooded gravel pits, and open fields. To the southeast are Sandsfield's operations including active workings and historical landfills, which are consented under separate Planning Permissions. Beyond these workings to the southeast are the closed

Direction	Use
	historical landfills, comprising Westlands Hill East, Catfoss, Catwick Crossroads, Hill Top House and Westfield Farm Landfills. The closest residential receptors include the occupied residential properties of the house at Watersedge Caravan Park approximately 270 m south of the Site, and Sandsfield Farm approximately 750 m south.
Western boundary	Adjacent to the western boundary of the Site lies Milegate Landfill, a closed and restored landfill excavated and subsequently filled by Sandsfield. A trading estate (off Catwick Lane) is located approximately 200 m west of the Site and extends to approximately 800 m northwest of the Site. The A165 passes north to south about 750 m west of the Site beyond which are further fields and then the village of Brandesburton.

1.3.4 Local Topography

The Site lies in an area of relatively flat land, with ground elevations varying from 5 to 15 m AOD. Ground levels across the Site typically fall gently to the south and west towards the Milldam Beck, which lies at an approximate elevation of 5 m AOD.

1.3.5 Identified Potential Receptors

The locations of identified potential receptors, including residential areas, scheduled monuments, sensitive land uses, and water bodies, are indicated on **Drawings ESID2 – Environmental Site Setting** and **Drawing ESID3 – Cultural and Natural Heritage**. The Site is not located within any landscape designations.

There are no immediately adjacent nature conservation designations although there are a number of Sites of Special Scientific Interest (SSSIs) within 5 km of the Site: these include the Hornsea Mere SSSI, located 3.5 km east of the site; the Leven Canal SSSI, located 3.0 km southwest of the site; and Tophill Low SSSI, located 4.6 km west of the end of the leachate discharge pipeline in Brandesburton.

There are no Special Areas of Conservation (SACs) or Ramsar wetland sites affected or within 5 km of the Site. Hornsea Mere, located 3.5 km east of the site is Special Protection Area (SPA). There are no adjacent or nearby National Nature Reserves (NNRs), Local Nature Reserves (LNRs) within 5 km of the site. The nearest are the Sigglesthorne LNR which is 5.8 km southeast and the Southorpe LNR which is 5.9 km east of the Site.

The Catwick and Brandesburton Pits, to the south of the Site, have been designated as a Candidate Local Wildlife Site (LWS). There are Conservation Areas in Brandesburton, 850 m northwest of the Site; and Catwick, 2.3 km south of the Site.

The Site is located in an area classified as Grade 2 and Grade 3 agricultural land on the Agricultural Land Classification map for Yorkshire and the Humber. The Brandesburton Gravel Pits to the south of the Site are designated as a Regionally Important Geological or Geomorphological (RIG) Site.

There are no public rights-of-way (PROW) within the Site. The closest PROWs to the Site are:

- A bridleway running parallel to the northern boundary of the Site, connecting Catfoss Bridge to Brandesburton. At its closest point the bridleway is approximately 340 m from the site boundary. There is no connection between the bridleway and the site; and
- A public footpath through Watersedge Park starting and finishing at Catwick Lane (a winding minor road, unsuitable for safe pedestrian use).

According to the EA Flood Maps, the site is largely within an area of low probability of flooding (less than 1 in 1,000 years). However, there is an area of land to the north of Milldam Beck in the central part of the landfill immediately west of the Eastern Extension boundary that is identified as being in Flood Zone 3, which has a high probability of flooding (1 in 100 years).

The Site is located in a Nitrate Vulnerable Zone for Surface Water.

1.3.6 Compliance with Groundwater Protection Guidelines

Current guidance entitled '*The Environment Agency's approach to groundwater protection*', version 1.2 dated February 2018 sets out the EA's landfill location position statement (E1) which states that:

The Environment Agency will normally object to any proposed landfill site in groundwater SPZ1.

For all other proposed landfill site locations, a risk assessment must be conducted based on the nature and quantity of the wastes and the natural setting and properties of the location.

Where this risk assessment demonstrates that active long-term site management is essential to prevent long-term groundwater pollution, the Environment Agency will object to sites:

- *Below the water table* in any strata where the groundwater provides an important contribution to river flow, or other sensitive receptors*
- *Within SPZ2 or 3*
- *On or in a principal aquifer.*

Position Statement E1 uses the terms "important contribution" and "sensitive surface waters", which must be defined by site specific professional hydrogeological judgement. The relevant factors to be considered in "important contribution" and "sensitive" include:

- *proximity of surface water;*
- *directness of the hydraulic connection;*
- *quality and quantity of both the groundwater and the receiving surface water;*
- *the consequences of the potential impact on the surface water quality of any landfill development;*
- *the consequences of the potential impact on the ecology of the surface water due to changes in quality or level from any landfill development.*

For simplicity the general term "water table" has been used in Position Statement E1. When considering a landfill development, this term also applies to a piezometric head within a confining layer, where there is sufficient connectivity to the underlying aquifer to allow water to flow into the landfill void

Compliance with the guidance (previously RGN3) was fully assessed in the original Hydrogeological Risk Assessment (HRA) and the PPC Permit was issued. This variation application seeks to extend the landfill operations eastwards in line with Sandfield's new ownership boundary and therefore beyond what has previously been assessed. Discussion regarding each of the aspects within position statement E1 is presented in the following sub-sections. A HRA for the Eastern Extension has been carried out and is ref. 20148978.633.

1.3.6.1 Location Below the Water Table in the Glaciofluvial Deposits

The landfill will lie within the Glaciofluvial Deposits with Boulder Clay beneath. The water table in the glaciofluvial deposits has been found to lie within the LSG[1], with some localised perched levels in the USG as a result of leakage from perched surface water features. For the purposes of compliance with the position statement, consideration of whether the groundwater within the sand and gravels provides an important contribution to river flow, or other sensitive receptors is required.

The Eastern Extension lies within the catchment of the Milldam Beck which marks the site boundary to the east and south, while its tributary, the Moor Main Drain, runs along its northern boundary. The Milldam Beck discharges into the New Drain. There are also a number of ponds in the area which largely result from sand and gravel extraction.

As part of the planning application process for the existing landfill, a water features survey was conducted to assess whether groundwater in the sand and gravel provides an important contribution to river flow or other sensitive surface waters by considering groups of the numerous surface water features in the vicinity of the site. From the survey and assessment, it was concluded that groundwater in the sand and gravels does not provide an important contribution to these surface water features and that they are instead influenced to differing degrees by surface water run-off and direct rainfall.

1.3.6.2 Location in relation to Source Protection Zones

Reference to the EA's website finds that the proposed Eastern Extension does not lie within a source protection zone (SPZ1, 2 or 3) (MAGIC, 2021).

1.3.6.3 Location in relation to Aquifer Status

Both the glaciofluvial deposits and the Chalk are likely to allow the lateral flow of groundwater. The Till (Boulder Clay) is unlikely to transmit water at a significant rate and water flow can be expected to be predominantly in a vertical direction.

The glaciofluvial sand and gravel is designated as a Secondary A aquifer (MAGIC, 2021) with overlying soils of low leaching potential. The northeastern area of the site is underlain by Till (Boulder Clay) classified as a Secondary (undifferentiated) aquifer. Chalk, classified as a Principal aquifer, is present at depth beneath the Till.

Two boreholes drilled as a part of the Eastern Extension investigation proved the base of the Boulder Clay and found its full thickness to reach about 14 m. As is the case for the existing site, the elevation of the piezometric level of groundwater in the Chalk is likely to lie above the base of the landfill. The elevation of the base of each landfill cell will require designing to ensure that the pressure of water in the Chalk cannot heave the clay rich materials that will lie between the landfill liner and the Chalk which could potentially allow free flowing water to enter the landfill void. The potential for basal heave will need to be assessed by the stability risk assessment. Providing adequate thickness of Boulder Clay is present and maintained, the Eastern Extension does not lie in or on a principal aquifer.

1.3.6.4 Summary

Noting experience with the existing site, providing that adequate thickness of Boulder Clay is present and maintained by the landfill design, the Agency should not object to the landfill because of its location.

[1] The geology and hydrogeology of the Site is described in Section 3.0.

2.0 SOURCE TERM CHARACTERISATION

2.1 The Development of the Installation

2.1.1 Historical Development

Before the extraction of sand and gravel commenced at the existing Site, the Site comprised open fields. The Eastern Extension is currently open fields.

The Site is operated as a sand and gravel quarry and landfill for the disposal of non-hazardous waste. Extraction of sand and gravel has taken place in a generally east to west direction across the existing Site and is essentially complete except for small areas in the base of the extraction area and along the northern boundary.

It is proposed that the northernmost section of the Eastern Extension area will be explored for sand and gravel extraction first with entry via Cell 2 of the existing Site, with the intention of creating a flat working face to continue exploration in a north-south direction. Recovered clay will be used as an engineering material in the lining system.

2.1.2 Site Development

2.1.2.1 Landfilling

Landfilling at the Site has taken place continuously since waste acceptance commenced in 2007. Filling began in Cell 1 and proceeded in a westerly direction through Cells 3, 5 and 7. Cell 8 was constructed to the north of Cell 7 in 2016, and subsequently landfilling has continued in an easterly direction into Cell 6, 4A and 4B with Cells 2A and 2B to follow. Cells 1, 3, 5, 7 and 8 are filled and restored. Cells 6 and 4A has been recently filled and await restoration; Cell 4B is the currently operational cell. The Eastern Extension will comprise a further six landfill cells (Cells 9 to 14).

Landfill gas is collected from the waste and is currently flared. There is now sufficient gas to power a landfill gas engine, and this application seeks approval for installation and operation of two landfill gas engines.

In summer 2016, Sandsfield installed two leachate holding tanks and a 750 m long discharge pipeline to sewer for the disposal of leachate.

2.1.2.2 Waste Types and Quantities

The waste types accepted at the Site for both disposal and restoration purposes are presented in Schedule 2 (Tables S2.1 and S2.2) of the current EP and remain unchanged for the Eastern Extension development sought by the variation application. The Site can accept up to 75,000 tonnes of waste per year for landfilling.

2.1.2.3 Phasing

The layout of the Site and the phasing of waste deposition is presented on **Drawing ESID4 – Site Layout and Waste Deposition**.

Cells 1, 3, 4A, 4B, 5, 6, 7 and 8 have already been developed and their footprint will remain unchanged.

The site will be extended (i.e. made larger) by about 200 m towards the east in line with Sandsfield's ownership boundary. Cells previously designated as Cell 2A and 2B have been redesigned and will now be split north-south instead of east-west like Cells 4A and 4B. Appropriate buffer space (approximately 10 m wide) will be preserved east of Cell 1 between the already filled and restored part of the landfill and the planned excavations to avoid disturbance of the already restored part of the existing landfill. Cell 2B will extend from Cell 2A eastwards followed by Cells 9 and 10.

The remaining part of the Eastern Extension will be split east-west into Cells 11, 12, 13, and 14 from north to south. The size of each operational cell will be designed to minimise the area open to rainfall whilst maintaining overall operational efficiency. During filling of each cell, effective infiltration into the site should not form free leachate in the base of the cell. A water balance for the Eastern Extension similarly formatted to that presented with the original PPC permit application is provided in **Appendix ESID1**.

Excavation in the Eastern Extension will remove sand and gravel, recover clay to be used as an engineering material in the lining system, and release top soils and subsoils to be used in the restoration. A sidewall drainage system will be installed, and engineered fill will be placed to provide a stable subgrade for the landfill lining system.

Progressive capping, restoration, and installation of landfill gas and leachate management systems will be carried out as each cell is completed.

2.1.2.4 Leachate Quality

The site has been, and will continue to be, developed under a non-hazardous landfill classification. For the purposes of the original HRA, leachate quality data was derived from the closed Plant Pit 3 landfill, which accepted similar waste streams to that which was proposed to be accepted at the Site.

The HRA has been reviewed thrice since that time, in accordance with the EP requirements, in 2009, 2015, and 2021. The leachate quality data has been systematically collected from the site throughout the operational life of the site also in accordance with the permit. A copy of the 2021 review is provided in Appendix C of the Supporting Statement (ref. 20148979.631) submitted for the variation application.

2.1.2.5 Hydrogeological Risk Screening

Groundwater is present within the Lower Sand, within the Chalk, and as perched water within the Upper Sand. There is no evidence that this groundwater is permanently unsuitable for use.

The waste deposited at the site contains leachable substances. Water being exposed to the waste has the potential to become contaminated and to form landfill leachate. Groundwater receptors are present within and close to the site, and therefore it is considered necessary to minimise the generation of, and control and collect, landfill leachate.

The HRA that supported the original PPC permit application was carried out in accordance with the requirements of the EA guidance documents titled '*Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control and Trigger Levels*' (EA, 2003) and '*Guidance on the Monitoring of Landfill Leachate, Groundwater, and Surface Water*' (EA, 2002). The most recent HRA review in 2021 sought to establish compliance with Schedule 10 and Schedule 22 of the Environmental Permitting Regulations (2016) and followed current guidance.

2.2 Installation Engineering

2.2.1 Groundwater Management System

Groundwater present in the Lower Sand discharges into the excavation. As such, groundwater in the Lower Sand has been managed during the construction of the Site by the use of a back-drain behind each cell.

The groundwater drainage system already installed behind the sidewalls of existing cells will be extended behind Cells 2A and 2B, and Cells 9, 10, 11, 12, 13, and 14 in the Eastern Extension. Groundwater management is required whilst each cell is under development. As the site moves towards completion, it may be possible to 'turn off' the drain behind some completed cells to minimise the groundwater discharging to the Milldam Beck. In development of Cell 14 (the final cell), the back drain may be accessed by a temporary manhole with submersible pump until such a time that waste levels in the cell are high enough that the pump can be withdrawn.

Once landfilling is completed in all cells, no drainage of groundwater will be required, and water levels will re-bound to their natural level to provide hydraulic containment of the site.

Details regarding the drains placed behind the lined side slopes were presented in the Stability Risk Assessment (SRA) as part of the original PPC Permit application and an updated version including the Eastern Extension is presented in 20148978.634. Detailed cell design and CQA procedures for engineering the lining system have been described within the CQA Plans submitted to the EA for each cell. A CQA Validation Report, which presents the final as built construction and engineered details of each cell, is also submitted to the EA after construction of each cell.

2.2.2 Basal and Sidewall Lining System

The design and construction details for the installation are shown in **Drawing ESID6A – Installation Infrastructure** and **Drawing ESID6B – Installation Details**.

The design principles of the lining system have been established through the development of Cells 1, 3, 4, 5, 6, 7, and 8 and have been installed in accordance with the EP.

This variation application is primarily for an eastward extension of the landfill to align it with the ownership boundary. This will be engineered and managed in accordance with the design principles already established at the Site.

2.2.2.1 Geological Barrier

The geological barrier for the basal and lower sidewall lining system comprises *in situ* Till.

The full thickness of the Till has been proven in several boreholes at the existing site, and ranges from 13.1 m in the northwest of the site to 17.2 m in the southeast of the existing Site. Two boreholes drilled as a part of the Eastern Extension investigation have proven the Chalk boundary and found the total Till thickness to reach about 14 m. Following excavation of the landfill, a minimum of 9 m of Till will remain between the base of the liner and the top of the Chalk.

The geological barrier for the upper sidewall lining system will comprise a minimum 1.0 m thick engineered clay with a maximum permeability of 1 x 10^{-9} m/s.

The engineered clay will conform to the specification contained within a CQA plan submitted to the EA prior to construction. Installation and CQA procedures for engineering the clay will be defined within the CQA plan.

2.2.2.2 Artificial Sealing Liner

The artificial sealing liner for the basal and lower sidewall lining system will comprise 1.0 m of engineered clay with a maximum permeability of 1 x 10^{-9} m/s placed on the natural geological barrier. If necessary, use of on-Site clay may be substituted by fully welded geomembrane or geosynthetic clay liner (GCL) with approval of the EA in accordance with the EP.

The engineered clay will conform to the specification contained within a CQA plan submitted to the EA prior to construction. Installation and CQA procedures for engineering the clay will be defined within the CQA plan.

The requirement for an artificial sealing layer for the upper sidewall lining system is established by the HRA such that the minimum 1.0 m thick engineered clay placed in the upper sideslopes meets requirements for both geological barrier and artificial sealing layer.

The results of permeability testing of the clay are provided as a part of the CQA Validation Reports submitted to the EA after construction of each cell.

2.2.2.3 Intercell Bunds

Each cell will be hydraulically separated from adjacent cells by an intercell bund constructed using engineered clay with a maximum permeability of 1.0 x 10^{-9} m/s. Bunds will be a minimum of 2.0 m high and 2.0 m wide at their crest.

2.2.2.4 Site Investigation Boreholes

Where site investigation boreholes are identified within the footprint of a cell, they will be decommissioned at the time of construction of each cell by filling the borehole installation with a bentonite/cement grout. The grout will be placed over the full remaining height of the borehole and, if necessary, will be tremmied to the base of the hole (this may be required in the deeper boreholes installed in the Chalk). The work will be undertaken in the presence of a CQA Engineer who will provide records of the amount of grout filled into each hole and the grout level (depth) within the hole as decommissioning proceeds.

2.2.2.5 Leachate Management

Leachate in Cells 1, 3, 4A, 4B, 5, 6, 7, and 8 is managed at the Site in accordance with the EP. Leachate in Cells 2A and 2B and in Cells 9 to 14 will be managed by continuation of the existing design.

For protection of the groundwater environment and in accordance with the EP, the site will be hydraulically contained such that the level of leachate in the base of each cell is maintained at a level lower than the surrounding groundwater level. Therefore, each cell has infrastructure installed to manage leachate.

2.2.2.6 Leachate Collection and Removal System

A leachate collection system is provided in each cell, as follows:

- Cell 1 – Blanket of recycled brick aggregate and 20 mm virgin gravel with drainage pipes leading to a sump;
- Cells 3, 5, 7, 8 – Blanket of recycled tyres with drainage pipes leading to a sump in each cell;
- Cell 6 – Blanket of shredded tyres with drainage pipes leading to a sump in each cell; and
- Cells 4A and 4B – Blanket of aggregate composed of recycled aggregate and granite with drainage pipes leading to a sump in each cell.

Leachate will be collected in Cells 2A, 2B, 9, 10, 11, 12, 13, and 14 by continuation of the existing design or as approved in accordance with the EP.

Leachate will be extracted from leachate sumps in each cell by means of a vertical leachate extraction well extending to the surface of the landfill. The wells accommodate automatic pumping equipment (eductor or submersible pumps) to extract leachate.

The base of each cell will be profiled to provide a fall of approximately 1:100 towards a leachate collection point located as shown on **Drawing ESID7A – Leachate Management Infrastructure**. The collection point at the Eastern Extension will be located at the lowest point along the northern boundary of Cells 2A and 2B, 9, and 10 and the western boundary of Cells 11, 12, 13, and 14. A pipe system will be placed on the surface of the basal clay that comprises a central HDPE slotted pipe with secondary drains comprising HDPE slotted pipe connected at regular intervals in a herringbone pattern. The central pipe will be connected to the leachate collection point, which will be constructed from the base of the cell to the surface of the site to enable the extraction of the collected leachate.

The leachate drainage system will conform to the specification contained within a CQA Plan submitted to the EA prior to construction. Installation and construction quality assurance procedures for the leachate drainage system will be defined within the CQA Plan.

2.2.3 Capping System

2.2.3.1 General

To reduce the amount of precipitation that can infiltrate the waste, a low permeability cap will be constructed as waste deposition in each cell is completed to final pre-settlement levels. The specification of the cap is outlined in the following sections.

2.2.3.2 Blinding Layer

Prior to the placement of the sealing layer, the waste will be thoroughly compacted and smoothed so that sharp objects do not protrude excessively. A blinding layer typically comprising up to 300 mm subsoil will be placed if deemed necessary.

2.2.3.3 Sealing Layer

The upper sealing layer for each cell will comprise 1 mm fully welded geomembrane liner or as approved in accordance with the specification contained within a CQA Plan submitted to the EA prior to construction.

2.2.3.4 Drainage Layer

A geocomposite drainage layer (if free draining restoration soils are not used) will be placed above the geomembrane to provide both protection and drainage. The drainage layer will typically comprise a non-woven geotextile bonded to a cuspated HDPE geomembrane on the top side.

2.2.3.5 Restoration Soils

Restoration cover soils will be placed above the capping system to promote the regeneration of the landform for agricultural use. Following placement of the cap, subsoil and topsoil will be spread evenly to achieve the final pre-settlement, post-restoration profile.

The final cap will be placed within 12 months of cell completion of filling to pre-settlement restoration levels.

2.2.4 Restoration and Aftercare

2.2.4.1 Surrounding Topography and Restoration Contours

The topography of the surrounding area and the proposed post-settlement post-restoration contours are shown on **Drawing ESID5 – Restoration**.

The post-settlement post-restoration contours established by the 1999 planning permission and updated in 2018 when the Northern Extension was added, were designed in keeping with the surrounding topographic contours and to maintain a generally southerly flow of surface water towards Milldam Beck. To accommodate the Eastern Extension, the existing approved restoration has been extended across to the east to tie in with the surrounding topographic contours. The resultant topography will be slightly higher at the eastern end than initially planned, although it will enable a more sinuous ‘natural looking’ transition between the two parts of the site.

The amount of settlement used (1999) to calculate the pre-settlement pre-restoration contours was an average of 12.5%. This amount of settlement was selected (1999) on the basis of the assumed lower quantities of biodegradable wastes to be accepted at the landfill. This settlement figure is a fair approximation of the wastes received up to date and appropriate to the long-term low amount of biodegradable waste going to landfill in the future.

Consequently, the pre-settlement, pre-restoration contours have been re-modelled using the cell base levels the post-settlement post-restoration landform, and the settlement rate (12.5%). The pre-settlement, pre-restoration contours which include the Eastern Extension are shown in **Drawing ESID4 – Site Layout and Waste Deposition**.

2.2.4.2 After-Use

The progressive capping and restoration of the landfill cells will produce a gently undulating landform that will be returned to agricultural use. During the restoration programme, the opportunity will be taken to enhance the appearance and nature conservation value of the site by the introduction of species rich grassland, and small blocks of peripheral woodland.

2.2.5 Fuel and Oil Storage

Should fuel or oil require storage at the site, the following procedures will apply:

- All above-ground container(s) for bulk liquids e.g. gas oil, will be of sound construction and sited within a bund or secondary container. The floor and bund wall, or the secondary containment, will be constructed of a material that is impervious and chemically resistant to the material(s) stored. A bund or secondary container will be capable of containing at least 110% of the volume of the container(s);
- All pipes, gauges and valves will be enclosed within the bund wall or secondary containment so that, should a spillage occur, it is contained. Where applicable, all pipes and valves will be securely locked at the end of each working day;
- Any liquid accumulating within the bund or secondary containment will be removed and disposed of at a suitably licensed facility when the depth of the liquid reaches 0.1 m. A record of any removal is to be made in the site diary;
- Any chemicals that are used on site will be stored in secure compounds or buildings. These compounds or buildings will be locked at the end of each working day;
- Any spillage of materials will be cleaned by means of sand/saw dust spreading procedures; and
- All accidental spillages and leaks will be recorded, and steps taken to identify the cause and prevent further occurrence.

An oil ‘soak-up’ kit will be kept at the Site comprising absorbent matting and granules and an absorbent boom for the protection of water courses. After use, all contaminated material will be placed in a skip or container prior to disposal at an appropriately licensed facility.

All above ground tanks, storage containers and pipework will be inspected at once per week to identify any evidence of damage or leakages and check the level of liquid accumulating within the bunds. Any leaks identified will be repaired at least temporarily such that pollution is prevented as soon as possible on the same day that the issue is identified. If a short-term repair is not possible the vessel will be drained. A permanent repair will be completed within two weeks.

2.3 Leachate Management and Monitoring Infrastructure

2.3.1 Leachate Generation

The decomposition of waste within a landfill is a complex process with microbiological, physical and chemical processes acting simultaneously to break down the waste. Leachate is formed by the decay and release of moisture and contaminants from the waste coupled with the percolation of infiltrating water through the waste mass.

The volume of leachate produced within a landfill is based upon the rate of infiltration to the Site and the approximate surface area of the individual landfill cells. When the site is active, it can be conservatively assumed that all effective rainfall infiltrates through the waste to produce leachate, i.e. 236 mm per year. When the site has been restored, the effective rainfall is assumed to be 50 mm per year. These values are applicable to the site in its entirety, the existing Site and the planned Eastern Extension.

2.3.2 Leachate Management

2.3.2.1 Leachate Extraction

Leachate extraction at the Eastern Extension will follow the procedures applied at the current Site. As such it will take place from the leachate sumps, one of which is to be located within each cell, as shown on **Drawing ESID7A – Leachate Management Infrastructure**. Leachate will be removed from the leachate collection points by means of vertical leachate extraction wells extending to the surface of the landfill. The wells will be able to accommodate automatic pumping equipment (eductors or submersible pumps) to extract leachate (**Drawing ESID7B – Leachate Management Details**).

Leachate will be extracted from the cells to maintain the level of leachate within each cell in accordance with the EP.

2.3.2.2 Leachate Recirculation

Leachate recirculation has not been used at the site to date, however procedures are described below should it be required.

During the early stages of waste infilling each cell, and when required, leachate may be re-circulated after abstraction from the leachate extraction wells. It may be re-circulated onto the waste in the active cell by pumping below the working face using temporary pipework or a vacuum tanker. Alternatively, leachate may be recirculated via pipework installed into shallow trenches filled with selected hardcore, excavated into recently placed wastes or installed below the cap.

To minimise odour, leachate will not be spray irrigated onto areas of the site and shallow trenches (once installed with an inlet pipe and backfilled with hardcore) will be covered with suitable material to suppress odour. Leachate re-circulation will be monitored to ensure that it does not give rise to unacceptable odour.

Where trenches become a source of odour, these will be abandoned and the entry covered over to prevent further odour. The use of trenches will be rotated to obtain a uniform distribution of wetting and prevent saturation at individual locations. Re-circulation points will be retained after capping and in the aftercare period such that the absorptive capacity of the waste is fully utilised. Once waste reaches final levels, a sub cap irrigation system will be installed if required, and will comprise pipework to a similar specification as the basal drainage system, placed in 0.5 m wide by 0.5 m deep trenches excavated into the waste at the surface of the landfill. Trenches will be backfilled with selected hardcore and aggregate which is free draining.

Leachate will be re-circulated within unsaturated wastes to promote the accelerated stabilisation of the wastes in addition to providing a means of leachate level control in the site. Leachate re-circulation will promote accelerated stabilisation by maintaining moisture levels within the waste body as a whole and assist in the flushing out of contaminants such as ammonia. This process will also aid landfill gas production, and the use of active landfill gas extraction and flaring will also aid biodegradation. Enhanced gas production rates as a consequence of leachate re-circulation and gas extraction will further promote accelerated stabilisation and will also increase the potential for landfill gas utilisation, rather than simple flaring.

It is not anticipated that pH adjustment of leachate being re-circulated will be required, prior to re-introduction back into the site, as inert materials will also be accepted at the site and this is expected to maintain buffering capacity within the site, such that acid souring will not prevent the establishment or maintenance of

methanogenic conditions. Heat pre-treatment of leachate is not anticipated as being necessary prior to re-circulation. The placement of the engineered cap and thickness of restoration materials will reduce heat losses through the surface and aid heat retention. This additional insulation will assist the onset of thermophilic conditions within the wastes and accordingly assist in accelerated anaerobic decomposition and acceleration of waste stabilisation.

To prevent loss of anaerobic decomposition due to air ingress, capping will be installed as soon as practicable following completion of waste deposits in any cell and gas and leachate monitoring and extraction wells will be sealed at the surface when not in use or connected to extraction systems.

It is not considered that the use of leachate re-circulation, in conjunction with gas extraction and the above supplementary methods, to achieve accelerated stabilisation will impact on the designed capping and control systems.

2.3.2.3 Leachate Disposal

Long term leachate management is required at the Site to ensure leachate heads are maintained in accordance with the EP. In 2016, Sandsfield secured a Trade Effluent Discharge Consent from Yorkshire Water (see Appendix B of Supporting Statement, ref. 20148978.631) to dispose of excess leachate generated at the Site to sewer for treatment at their Brandesburton Sewage Treatment Works. To facilitate this, Sandsfield installed two above-ground leachate holding tanks on the western side of the Site and a discharge pipeline to the sewer discharge point, as described below and shown **Drawing ESID7C – Leachate Holding Tanks and Discharge Pipeline**.

- The western tank is 2.75 m diameter, and the eastern tank is 3.1 m diameter. Both tanks are approx. 5.2 m high, and are about 3.5 m apart;
- Each tank is black, double-skinned and constructed from HDPE, founded on a compacted clay base;
- The pipeline is 750 m long, fully fusion welded, 90 mm OD, 10 bar rated, solid wall, polyethylene pipe;
- The pipeline is buried, installed at less than 1 m depth in an approx. 150 mm wide trench;
- There are flow meter valve chambers at each end of the pipeline. Each chamber comprises approx. 1.0 m diameter, 1.0 m deep, HDPE chamber, with 0.6 m x 0.6 m hinged lockable cover. Each chamber provides access to a gate valve and flow meter on the pipeline; and
- The pipeline is connected to the leachate storage tanks at the eastern end and the sewer main at the western end.

A CQA Report was provided by the installer, Earth Direct Ltd, and has been submitted to the EA.

Yorkshire Water has provided the following details of the treatment process that takes place at the Brandesburton Sewage Treatment Works. It is a filter-type works and receives pumped flow to the inlet, which is screened. Flow then passes to two settlement tanks and then to two siphon driven percolating filters. Filtered effluent passes to two humus tanks, after which a portion of the flow is diverted for polishing to tertiary wetlands and is then recombined with effluent from the humus tanks prior to leaving site. The works has consent to nitrify. The excellent performance of the works is considered to be a result of the reed beds that polish the effluent.

There is no requirement on Yorkshire Water by the EA to remove either phosphates or nitrates from the effluent that is treated at Brandesburton Sewage Treatment Works; however, some will be taken up through the reed bed system. Given the predicted low concentrations of phosphates and nitrates in the leachate from the Site, this is not considered to be an issue. BOD and ammonia are treated via the biological processing in the humus tanks, and are reduced to levels acceptable for discharge in line with EA consents.

2.3.3 Leachate Monitoring

2.3.3.1 Monitoring Infrastructure

Two leachate monitoring points per cell have been, and will be, installed to allow monitoring of leachate levels remote to the leachate abstraction point. The locations of existing and proposed leachate monitoring wells are shown on **Drawing ESID7A – Leachate Management Infrastructure**.

2.3.3.2 Leachate Levels

In accordance with the findings of the original HRA, and confirmed in the subsequent HRA reviews, the leachate level within each cell have been, and will be, maintained at or below 1.0 m above the base of the cell (control level). Leachate is monitored from one leachate collection point and two remote monitoring points located within each cell in accordance with the Site's Leachate Management and Monitoring Plan (ref. 20148978.638).

As the site operates under hydraulic containment, compliance limits for leachate head have been set and an action plan to be implemented following a breach of the compliance limits has been implemented, as described in the Site's Leachate Management and Monitoring Plan (ref. 20148978.638).

2.3.3.3 Leachate Quality

In the original ESID, a summary of the leachate quality observed in the Plant Pit 3 landfill site (which accepted similar waste to that proposed at the Site) was presented, as the Site was not yet operational, so data was not available.

The current EP (Table S3.9) requires Sandsfield to collect leachate samples and carry out quality monitoring on a quarterly (or annually for some parameters) basis. A report, reviewing the results of the monitoring completed over the previous 12 month period, is produced and submitted to the EA by 31 January each year.

2.4 Landfill Gas Management and Monitoring Infrastructure

2.4.1 Landfill Gas Production

Details relating to the expected production of landfill gas from the site were presented in the Landfill Gas Generation and Risk Assessment (GRA) provided as part of the original PPC permit application. At that time, given the low quantities of readily biodegradable waste that were to be disposed at the Site, it was not expected that sufficient quantities of gas would be generated at the Site to allow the gas to be used to generate power. However, it was expected that landfill gas would be generated from the waste in sufficient quantity for flaring after approximately two years of landfilling. This turned out to be the case and up until now landfill gas has been a subject to flaring. The current GRA (ref. 20148978.635) finds the quantities of gas generated at the Site to be sufficient for energy generation via two micro generator gas engines. These will be located in the northwest corner of the Site within a new gas compound, along with the relocated flare.

2.4.2 Landfill Gas Management

The landfill gas management infrastructure is shown on **Drawing ESID8 – Landfill Gas Management Infrastructure**. Details relating to the management of landfill gas from the site are presented in the Landfill Gas Risk Assessment which has been updated for the purposes of this 2021 variation application (ref. 20148978.635). In summary, gas generated at the site will be collected at the site by retrospectively installed gas extraction wells and sent to the two micro engines. Any surplus landfill gas will be utilised by the single high-temperature Biogas flare installed at the site.

2.4.3 Landfill Gas Monitoring

Landfill gas monitoring will be undertaken according to the schedule and procedures laid out in the EP and existing Landfill Gas Management and Monitoring Plan. Perimeter landfill gas monitoring is undertaken in boreholes installed outside the waste mass to identify any migration of landfill gases from the site.

2.5 Surface Water Management and Monitoring infrastructure

2.5.1 Surface Water Management

The landform slopes in the final restoration have been designed to shed surface water to the perimeter of the Site and towards the Milldam Beck and the Moor Main Drain. Surface water drainage details are shown on **Drawing ESID11 – Local Hydrogeology and Hydrology**. Perimeter surface water drainage ditches will be installed progressively at the site and will be unlined where constructed into virgin ground. Surface water contained in the ditches will infiltrate directly into the underlying sand and gravel and to the south.

2.5.2 Surface Water Monitoring

The existing surface water monitoring locations are shown on **Drawing ESID11 – Local Hydrogeology and Hydrology**. Surface water monitoring is undertaken in accordance with the EP and will be extended on to the Eastern Extension accordingly.

2.6 Construction Quality Assurance of Engineered Management Systems

A suitably experienced CQA engineer, managed by a suitably qualified and experienced Chartered Engineer or Engineering Geologist, will be present during all construction works to ensure compliance with the CQA requirements. The works themselves will be undertaken under the control of suitably qualified and experienced personnel.

The detailed design of the engineered liner, leachate drainage, capping, and surface water management systems will be submitted to the EA for approval prior to their construction in the form of a CQA plan. The CQA plan will include detailed CQA procedures that will be undertaken during construction to ensure compliance with the specification and design. These procedures will include on-Site inspection, field testing, and laboratory testing.

The CQA Engineer will produce a report summarising the construction activities carried out during the works, detailing the Engineer's daily logs and the results of inspections carried out as part of the CQA programme. This report will include the as-built drawings.

2.7 Post Closure Controls

On completion of the last phase of restoration, the site will enter a post closure aftercare period until the Permit is surrendered. During this period, environmental monitoring will continue at a frequency specified by the EP and to be agreed with the EA.

The site infrastructure may be dismantled soon after completion of active landfilling operations if not required for adjacent Waste Transfer Operations. The landfill gas flare and engine and associated active gas extraction systems will be decommissioned after they can no longer be sustained, or when a risk assessment has identified that these do not need to continue. Leachate management systems will be decommissioned and dismantled after issue of a Certificate of Permit Completion, or when a risk assessment has identified that these do not need to continue. All headworks, pipework, and manifold chambers above the capping system will be removed as part of the decommissioning.

A method statement for the decommissioning of the landfill gas extraction system, leachate extraction systems, and any repair of penetrations through the landfill cap will be submitted to the EA for approval prior to the works being carried out.

Wells within the waste are subject to damage due to waste settlement and all infrastructure will have a finite operational life due to material decay or attack by external processes. Irrespective of this, all infrastructure that is required during the post closure period to prevent a significant adverse impact upon the environment will be maintained and replaced as necessary.

The Stability Risk Assessment report generated for the original PPC permit application demonstrated that there is no long-term likelihood of mining related subsidence, differential settlement, or structural failure that would otherwise represent a significant risk to the environment. An updated SRA is provided as a part of this variation application (ref. 20148978.634) including the Eastern Extension.

A Permit may be surrendered when risk assessments have shown that the Site conditions have reached long-term equilibrium, that no further Site management is required, and that there is no significant risk of an adverse impact on the environment in the future.

3.0 PATHWAY AND RECEPTOR TERM CHARACTERISATION

The following information updates that presented in the original PPC permit application (Golder, 2004) for material issues applicable to this variation application.

3.1 Climate

3.1.1 Rainfall

Total long-term rainfall and potential evapotranspiration for the region are reported in the Ministry of Agriculture, Fisheries and Food Technical Bulletin 35 for the period 1941 to 1970 (MAFF, 1976). The site lies within Area 13, for which rainfall is reported as being 655 mm per year and potential evapotranspiration is reported as being 484 mm per year. The difference in the two values of 171 mm per year is a first order estimate of the effective rainfall to grassland in the region.

A better estimate of the average annual effective rainfall to open waste has been calculated using the ERAIN software. ERAIN uses the soil water budgeting method developed by Grindley to estimate infiltration. The calculation incorporates an initial soil moisture deficit of zero and a root constant of 0 mm to represent waste. The root constant is a specified amount of soil moisture that vegetation may extract from soil. The calculation predicts that the average annual effective rainfall to the waste will be approximately 236 mm per year, although note that calculations using monthly values could be in error by as much as 20%.

3.1.2 Prevailing Wind Direction and Speed

Wind rose data has been obtained from Finningley monitoring station located approximately 100 km to the southwest of the site. The wind rose data indicates that the prevailing wind direction is towards the northeast.

3.2 Geology

3.2.1 Site Investigations

Several intrusive investigations have been historically completed at the site, and these are summarised below.

- Site Investigation Services completed an investigation in 1988. Six borings were advanced to a maximum depth of 15 m. All borings were in the western area of the site. The locations were originally referred to as borings ‘1’ to ‘6’, but these have since been re-named as SI 1 to SI 6.
- Site Investigation Services completed a second investigation in 1998. Seven borings were advanced to a maximum depth of 15 m. The borings were located to north of the site (borings ‘1a’ and ‘2a’) and in the eastern area of the existing site (borings ‘3a’ to ‘7a’). The investigation locations have since been re-named as SI 7 to SI 13.

- A soils resource survey was completed in 1999 by an unknown contractor. Thirteen borings were advanced to a maximum depth of 1 m in order to characterise the soil covering the site and assess its suitability for use as construction materials for the proposed landfill development. The borings were located in a grid with 100 m spacing.
- Site Investigation Services completed an investigation in 1999. Six borings were advanced to a maximum depth of 30 m (MB1 to MB6). All borings were installed with HDPE pipework such that groundwater could be monitored. Boreholes MB1 and MB6 were screened in the Chalk, MB2 was screened into waste in the adjacent Milegate Landfill, and the remaining boreholes were screened in the Upper and Lower Sand deposits.
- Golder Associates (UK) Ltd installed four boreholes at the site during 2004 for the purpose of monitoring groundwater levels in the Upper and Lower Sand units. The borings were located in pairs at two locations along the southern boundary of the site (i.e. adjacent to the Milldam Beck). One borehole in each pair was screened in the Upper Sand and the other was screened in the Lower Sand.
- Sandsfield-commissioned investigation took place in autumn 2019 which involved installation of six investigation boreholes. Four of these were within the bounds of the planned Eastern Extension (BH01 to BH04) and two were drilled on the eastern bank of Milldam Beck (initially named UBH01 and UBH02 and subsequently renamed to BH05 and BH06). The maximum drilled depth reached -22.49 m AOD and two boreholes located across the Milldam Beck proved the entire thickness of the Till.

Borehole logs relevant to the Eastern Extension site investigation are provided in **Appendix ESID2** and their locations are illustrated on **Drawing ESID9B – Eastern Extension Site Investigation Infrastructure**.

3.2.2 Regional Geology

An indication of the regional geology has been obtained from the following published sources:

- 1:50,000 scale British Geological Survey geological map Sheet 72 for Beverley; and
- 1:50,000 scale British Geological Survey geological map Sheet 73 for Hornsea.

The regional geology is shown on **Drawing ESID9A – Regional Geology**. The maps indicate that the drift deposits in the region are dominated by post-glacial and glacial deposits consisting of estuarine clay and silt, alluvial clay and silt, peat, dry valley gravel, windblown sand, glacial lake deposits, glaciofluvial sand and gravel, and glacial Till. The drift deposits overlie the Cretaceous Chalk Group, which comprises the Flamborough Chalk Formation (white flintless chalk with thin marl beds) and the Welton and Burnham Chalk Formations (white flinty chalk with thin marl beds).

A summary of the regional stratigraphic sequence presented on the geological maps is given in Table ESID2.

Table ESID2: Regional Stratigraphic Sequence

Age	Formation	Description
Quaternary	Post-glacial deposits	Estuarine clay and silt, alluvial clay and silt, and peat.
	Glacial and post-glacial deposits	Dry valley gravels and blown sand.
	Glacial deposits	Vale of York glacial lake deposits including the 25-Foot and 100-Foot Drift, comprising clay and silt, sand and gravel, underlain by glacio-fluvial sand and gravel.
	Glacial deposits	Undifferentiated sand and gravel overlying stony clay Till.

Age	Formation	Description
Cretaceous	Flamborough Chalk Formation	White flintless chalk with thin marl beds. Thickness indicated on the geological map as approximately 200 m.
	Welton and Burnham Chalk Formations	White flinty chalk with thin marl bands. Thickness indicated on the geological map as approximately 180 m.
	Ferriby Chalk Formation	Grey to red marly chalk. Thickness indicated on the geological map as approximately 25 m.
	Hunstanton Chalk Formation	Brick red chalk. Thickness indicated on the geological map as approximately 5 m.

3.2.3 Local Geology

The published geological maps indicate that the southern part of the site is underlain by drift deposits comprising undifferentiated glaciofluvial sand and gravel. The maps indicate that the sand and gravel are replaced by Till along the northern edge of the current Site and within the northwest and northeast corner of the Eastern Extension.

A review of the borehole logs from intrusive investigations at the Site has been undertaken to confirm and refine the geology indicated on the published geological maps. The borehole logs indicate that the geology beneath the current site corresponds well with that indicated on the geological maps. The southern part of the Site is immediately underlain by sand and gravel, then Till, and Chalk is present at depth. Borings located to the northeast of the current site did not intercept any sand and gravel, with topsoil being immediately underlain by Till. These findings had been further confirmed by inspection of the geological exposures resulting from the quarrying works and operational experience. Borehole logs from the Eastern Extension indicate geological continuity between the currently operating site and the planned extension. It is underlain by an identical sedimentary sequence with the Chalk present at depth and the mineral absent in the northern peripheries.

Within the footprint of currently operating site, the sand and gravel deposits have been mostly removed as part of the quarrying works that have taken place and the landfill therefore lies directly on the Till. An analogous approach will be applied to the Eastern Extension.

3.2.4 Description of Strata

3.2.4.1 Sand and Gravel

The sand and gravel unit that immediately underlies the site comprises three distinct layers: an upper sand unit (locally referred to as the ‘Upper Sand’) and a lower sand unit (locally referred to as the ‘Lower Sand’) that are separated by a thin discontinuous clay layer (locally referred to as the ‘Middle Clay’).

The Upper Sand unit is generally described in the borehole logs as being fine brown clayey or silty sand, with some traces of fine gravel reported nearer the upper part of the unit. Within the footprint of the currently operating site, the base of the unit lies at elevations ranging from 3.1 to 7.5 m AOD, with an average elevation of 5.5 m AOD. Adjacent to the Milldam Beck, the unit has been shown to be less than 1.5 m thick. Similar base depths were observed in boreholes proven in the Eastern Extension with elevations ranging from 1.79 m AOD to 7.08 m AOD.

The Middle Clay is described in the borehole logs as being a soft or firm orange-brown and dark brown silty clay. Some of the logs describe the clay as being laminated. Borehole logs from the currently operating site indicate that the base of the clay lies at elevations ranging from 0.2 to 5.8 m AOD, with an average elevation across the site of 4.0 m AOD. Where present, the clay ranges in thickness from 0.5 to 4.5 m, with an average thickness of 1.5 m. The clay is thickest in the eastern part of the site and thins towards the west. In some investigation locations outside the Eastern Extension, it was found to be absent.

The Lower Sand unit is described as being a fine to coarse sand with fine to medium gravel. In some locations it is reported as being silty or containing cobbles. At the currently operating site, the base of the unit lies at elevations ranging from -4.56 to 3.9 m AOD, with an average elevation of -0.11 m AOD. The thickness ranges from 2.9 to 6.8 m, with an average thickness of 4.8 m. Where reached, by the recently drilled investigation boreholes in the Eastern Extension, the base of the Lower Sand was found at depths ranging from -3.08 m AOD to -0.42 m AOD.

3.2.4.2 Till

The Till unit underlies the Lower Sand unit beneath the site, and outcrops to the north of the site. It is described as being soft to stiff grey silty slightly sandy clay mixed with some assorted gravel. In some locations, the logs indicate that the clay becomes sandier, however these sandy units are not continuous across the site. The full thickness of the Till has been proven in several boreholes at the current site, and ranges from 13.1 m in the northwest of the site to 17.2 m in the southeast of the site. The two boreholes drilled across the Milldam Beck as a part of the Eastern Extension site investigation indicate Till thicknesses of 13.9 m and 14 m.

Determination of fraction of organic carbon, total carbon, and cation exchange capacity has been undertaken on samples of Till from the site. The results are summarised below:

- Fraction of Organic Carbon (FoC): Minimum 0.61%, maximum 0.80%, mean 0.72%;
- Total Carbon: Minimum 1.72%, maximum 2.88%, mean 2.05%; and
- Cation Exchange Capacity (CEC): Minimum 6.7 meq/100 g, maximum 8.7 meq/100 g, mean 7.3 meq/100 g.

3.2.4.3 Chalk

The Chalk beneath the existing landfill has been proven in six boreholes, at approximate elevations between -15 m AOD and -17 m AOD (depths of between 22 and 28 metres below ground level). As part of the Eastern Extension site investigation, the Chalk was proven in BH05 and BH06 at elevations of -16.39 m AOD and -14.42 m AOD, respectively, consistent with the existing conceptual model.

The Chalk is described as being a soft to firm greyish-white or white putty chalk with occasional flints. The Chalk penetrated by the investigation boreholes is not fractured.

The geological description of the Chalk at the Site is in accordance with the description provided in the Aquifer Properties Manual (British Geological Survey, 1997), which describes the Flamborough Chalk as being soft white chalk with thin marl beds and negligible flint.

3.3 Man-Made Subsurface Pathways

With the exception of boreholes that are currently located within and around the current site and the planned Eastern Extension, there are no known man-made subsurface pathways present within the footprint or immediate vicinity of the site.

3.4 Hydrology

3.4.1 Local Hydrological Setting

The local hydrological setting is illustrated in **Drawing ESID11- Local Hydrogeology and Hydrology**. The site lies within the catchment of the Milldam Beck and is separated from surrounding fields by the stream and its tributary. The Milldam Beck forms the eastern and southern boundary of the site and flows towards the south and west. The Moor Main Drain, forms the northern boundary of the Eastern Extension and joins the Milldam Beck in the northeast corner of the site. The bed of the Milldam Beck at the southeastern corner of the currently operating site lies at an elevation of approximately 5.0 m AOD and falls to approximately 4.5 m AOD at the southwestern corner of the site.

Observations made of the Beck indicate it flows during the winter months and tends to run dry during the summer months. Flow in the summer months occurs only after significant rainfall events. These observations indicate that the Beck is supported by surface water run-off rather than by being supported by groundwater base flow. Flow in the Milldam Beck was measured on one occasion in 2001 as approximately 24 l/s.

The Milldam Beck is fed to the north of the site by the Moor Main Drain, which itself is likely to be supported by surface water run-off from East Field airfield located approximately 500 m north of the site. The Moor Main Drain discharges to the Milldam Beck at the north-eastern tip of the planned Eastern Extension. The Milldam Beck discharges approximately 600 m southwest of the Site to the New Drain (also called the Catfoss Drain and Carr Dike in its upper reaches).

A number of surface water ponds are present to the south of the Milldam Beck. Surveying works were completed at the Site during December 2003 and, at this time, eight surface water ponds were identified within 300 m of the Site. With the exception of one pond, the ponds are reported to be excavated into the Upper Sand unit, with their bases lying on top of the Middle Clay. The most north westerly pond is reported by Sandsfield to be slightly deeper than the other ponds with its base lying in the upper part of the Lower Sand unit.

Beyond 300 m from the site, there are many water-filled sand and gravel sites. Regionally these ponds follow a path from Hornsea Mere, located to the east of the Site, past the southeast of the Site towards Brandesburton, and then north towards North Frodingham. The geological map indicates that a buried sub-glacial valley coincides with these features.

3.4.2 Flood Risk and Indicative Flood Plains

The southern and eastern part of the site lies within the Flood Zone 3 largely along the bank of the Milldam Beck (as indicated on the gov.uk ‘Flood map for planning’ website). Lying within the Flood Zone 3 indicates that the area has a one percent chance of flooding each year. Flood risk at the currently operating landfill site has been addressed in the Flood Management Plan (FMP) which was submitted to the EA in 2014 as a requirement of the EP and is updated as ref. 20148978.642.

The pre-development site was agricultural fields, and surface water run-off from the greenfield site would have discharged directly to the Milldam Beck with no attenuation on site. During gravel extraction works prior to landfill operation, surface water was captured within the excavated void space where it infiltrated to ground or was pumped to a settlement pond in the southwest corner of the Site prior to discharge to the Milldam Beck.

During landfill development, flood risk from surface water and groundwater sources are managed on site in a phased manner as landfill cells are progressively constructed and waste disposal occurs. The southern flanks of Cells 1, 3, 5, and 7 have been capped and protect against fluvial flooding by providing a freeboard above the normal water level within the Milldam Beck. An analogous strategy is planned to be implemented at the Eastern Extension to protect against flooding from water courses to the north, east, and south.

During development of the proposed extension eastwards, surface water run-off from the site will continue to be captured within the available void space. Run-off captured within the void which does not infiltrate to groundwater will be pumped to the surface water manhole, prior to discharge to the Milldam Beck in accordance with EP requirements. Prior to construction of the final cell surface water attenuation ponds will be provided to accommodate the 1% Annual Exceedance Probability (AEP) 18-hour rainfall event for the Site.

Groundwater flood risk is limited to the void space within the Site and can be adequately managed using an on-site dewatering system during operations.

Post-development, permanent surface water attenuation ponds to the south of the site will be required to accommodate the 1% AEP, 24-hour rainfall including Climate Change event. The existing low bund and surface water channel will be retained along the southern boundary of the Site to capture all run-off within the Site and divert this to the attenuation ponds. To reduce run-off into the site, a surface water channel was constructed along the northern boundary to capture upslope run-off and allow this to infiltrate to ground.

The flood mitigation measures submitted under the FMP and discussed/updated above will adequately mitigate the impact of the development during both operational and post-development phases.

3.4.3 Surface Water Quality

At the time of the original PPC permit application, no monitoring of surface water quality had been undertaken, for any of the surface water features in the vicinity of the site.

Today surface water is monitored in accordance with the EP and will continue to be monitored accordingly around the Eastern Extension.

3.4.4 Surface Water Abstractions

For the purposes of this variation application, the EA was contacted in order to determine any licensed or unlicensed surface water abstractions within 5 km of the site. Table ESID3 presents the summary of the licensed and unlicensed surface water abstractions identified.

Table ESID3: Surface Water Abstractions within 5 km of the Site

Licence Holder	National Grid Reference	Distance from Site* (km)	Use	Maximum Annual Quantity (m^3)	Maximum Daily Quantity (m^3)
W Lee & Co	TA0840047690 TA0830046970	3.1	General Agriculture: Spray Irrigation - Direct	30310	822
W Lee & Co	TA0862049320 TA0872048880	3.1	General Agriculture: Spray Irrigation - Direct		
W Lee & Co	TA0979347730 TA0992446000	1.9	General Agriculture: Spray Irrigation - Direct	20000	822

**The site's extent includes the leachate discharge pipeline.*

3.5 Hydrogeology

The regional hydrogeological setting of the Site is shown on **Drawing ESID10 – Regional Hydrogeology and Hydrology**.

3.5.1 Aquifer Characteristics

3.5.1.1 Source Protection Zones

Source Protection Zones (SPZs) have been defined by the EA for groundwater sources (wells, boreholes and springs) used for public drinking water supply. The SPZs provide an indication of the risk to groundwater supplies that may result from potentially polluting activities and accidental releases of pollutants. Generally, the closer the activity or release is to a groundwater source the greater the risk. Four SPZs have been defined; Zone I or Inner Protection Zone, Zone II or Outer Protection Zone, Zone 3 or the total catchment of the borehole, and a Zone of Special Interest. The site does not fall within any defined SPZ.

3.5.1.2 Groundwater Vulnerability

The EA outlines a classification scheme to determine the vulnerability of groundwater to contamination. The classification is based upon a number of variables including the nature of the overlying soil cover, the presence and nature of drift deposits, the nature of the strata, and the thickness of the unsaturated zone. Groundwater vulnerability maps may be accessed online (MAGIC, 2021), and the groundwater vulnerability of the area surrounding the site is illustrated on **Drawing ESID10 - Regional Hydrogeology and Hydrology.**

The glaciofluvial sand and gravel is designated as a Secondary A aquifer with overlying soils of low leaching potential. Secondary A aquifers are 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.

The underlying Till is classified as a Secondary (undifferentiated) aquifer, typically meaning that the aquifer has variable characteristics in different locations and has not been defined as either Secondary A (defined above) or Secondary B (predominantly low permeability layers which may store and yield limited amounts of groundwater).

Underlying the site at depth, the Chalk has been classified as a Principal Aquifer. These are highly permeable formations usually providing a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

3.5.1.3 Relevant Hydrogeological Parameters

At the time of the original PPC permit application, no laboratory or field testing of the sand and gravel had been completed at the Site. However, it is reported in a review completed for the original planning application in 1999, titled ‘Geological and Hydrogeological Report for Milegate Extension Site’ (Ludlow, 1999), that a number of tests conducted to the south of the Site indicate a range for hydraulic conductivity of 1×10^{-7} to 1×10^{-5} m/s. This range is considered to be typical of poorly sorted silty sands and gravels.

The Till beneath the site is an aquitard, limiting the downward migration of contaminants from the landfill into the underlying Chalk aquifer. Results of permeability testing undertaken on re-compacted samples of Till are reported by the applicant to range from 1.6×10^{-10} to 2.1×10^{-9} m/s with an average of 6.3×10^{-10} m/s. The Till therefore represents a natural geological barrier.

No laboratory or field testing of the Chalk has been completed at the Site. However, the Aquifer Properties Manual (BGS, 1997) has been consulted to provide an indication of the properties of the Chalk at the site. It reports that transmissivity values range from less than 1 to over 10,000 m^2/d. Solutional features on Chalk outcrops are reported to have a density of less than 5 per 100 km^2. Matrix porosity is reported to range from 3.3% to 45.3%, with an average from 191 samples of 35.4%.

The EA has provided details of one pumping test completed on a borehole located approximately 500 m northwest of the site. The pumping test, completed in February 1993, estimated a transmissivity of 81.59 m^2/d.

3.5.1.4 Groundwater Abstractions

For the purposes of this variation application, the EA has been contacted in order to determine any licensed or unlicensed groundwater abstractions within 5 km of the site. Table ESID4 presents a summary of the licensed and unlicensed groundwater abstractions identified.

Table ESID4: Groundwater Abstractions within 5 km of the Site

Licence Holder	National Grid Reference	Approx. Distance from Site* (km)	Use	Maximum Annual Quantity (m^3)	Maximum Daily Quantity (m^3)
Sandsfield Gravel Co Ltd	TA13204651	0.55	Industrial, Commercial And Public Services: Mineral Products	763744	2545.813
Sandsfield Gravel Co Ltd	TA131466	0.5	Industrial, Commercial And Public Services: Mineral Products	36368.761	1272.907
F D Bird & Sons Ltd	TA12114650	0.8	General Agriculture: Spray Irrigation - Direct	45460	1227
Cranberry Foods Ltd	TA13194830	0.75	General Agriculture: General Farming & Domestic	17885	49
Cranberry Foods Ltd	TA13484829	0.7	General Agriculture: General Farming & Domestic	17885	49
Agricultural Contract & Marketing Co Ltd	TA14434924	1.5	General Agriculture: General Farming & Domestic	24820	68
H Thompson & Son	TA0901650826	2.5	General Agriculture: Spray Irrigation - Direct	20550	771
H Thompson & Son	TA0930750000	3.75	General Agriculture: Spray Irrigation - Direct		
W Lee & Co	TA0969048350	2.1	General Agriculture: Make-Up or Top Up Water	30310	822
W Lee & Co	TA0979048560	2.1	General Agriculture: Make-Up or Top Up Water		

Licence Holder	National Grid Reference	Approx. Distance from Site* (km)	Use	Maximum Annual Quantity (m^3)	Maximum Daily Quantity (m^3)
W Lee & Co	TA0956048020	2.1	General Agriculture: Make-Up or Top Up Water		
W Lee & Co	TA0969048350	2.1	General Agriculture: Spray Irrigation - Direct		
W Lee & Co	TA0979048560	2.1	General Agriculture: Spray Irrigation - Direct		
W Lee & Co	TA0956048020	2.1	General Agriculture: Spray Irrigation - Direct		

**The site's extent includes the leachate discharge pipeline.*

3.5.1.5 Long-Term Change

The site is located in an area of extensive sand and gravel extractions, and these may have resulted in lowering of the water level in the drift deposits overlying the Till (i.e. the sand and gravel). Water levels are likely to rebound, especially in the immediate vicinity of the Site; however, increased water levels in the Lower Sand aquifer will increase the extent to which the Site is hydraulically contained, and therefore this is considered to reduce the risks posed by the landfill in the long-term.

3.5.2 Groundwater Levels and Flow

3.5.2.1 Water Levels

Prior to the original PPC permit application, water levels had been monitored infrequently since 2001 in boreholes installed at the site. Since then groundwater elevations have been monitored regularly in the shallow and deep aquifer in accordance with the conditions of the EP in monthly or quarterly intervals. Boreholes GWC01 to GWC06 have been installed in the Chalk, GWS01 to GWS10 and MB3, MB04/01, and MB4/3 are screened across the shallow sedimentary aquifer.

The water levels measured at the site are provided with this variation application as a part of the HRA (ref. 20148978.633).

Water levels measured in the boreholes installed in the Middle Clay and Upper Sand are at a higher elevation than the water levels measured in boreholes installed in the Lower Sand. Boreholes screened in both the Upper and Lower Sand exhibit water levels equivalent to those measured in the boreholes installed in the Lower Sand. This suggests that water collects temporarily in the Upper Sand before moving down into the Lower Sand.

A cross-section illustrating the movement of groundwater beneath the site based on the measurements undertaken at the site is presented in **Drawing ESID12 – Hydrogeological Cross Section**.

Today, water levels are monitored in accordance with the EP.

3.5.2.2 Flow in the Sand and Gravel

The sand and gravel unit at the site comprises an Upper Sand layer, a Middle Clay layer, and a Lower Sand layer. During drilling into the Upper Sand in 2004, perched groundwater was present immediately above the Middle Clay layer in the southeast corner of the site. The Lower Sand unit was found to be dry immediately beneath the Middle Clay, confirming that the water in the Upper Sand is perched above the Middle Clay. Perched water in the Upper Sand is unlikely to be extensive in its vertical or lateral extent. Rainfall that infiltrates into the Upper Sand will move vertically downwards forming the perched water seen in some boreholes during drilling. This perched water will then move through the Middle Clay to recharge the underlying Lower Sand aquifer.

As expected, and because of the ongoing dewatering as landfill progresses, groundwater levels in the sand and gravel are variable. In general, water levels in the Middle Clay and Upper Sand unit lie at between 6.7 and 7.8 m AOD, while the water levels in the Lower Sand unit are generally much lower.

3.5.2.3 Flow in the Till

The Till unit, present between the sand and gravel unit and the Chalk, comprises low permeability clay and silty clay. The full thickness of the Till has been proven, and ranges from 13.1 m in the northwest of the site to 17.2 m in the southeast of the site. The Till serves as an aquitard, preventing the downwards migration of contaminants into the Chalk, and confines groundwater in the Chalk.

3.5.2.4 Flow in the Chalk

Chalk has been encountered in four boreholes adjacent to the Eastern Extension; two previously drilled for the purposes of groundwater monitoring at the currently operating site and two more drilled as a part of the site investigation for the Eastern Extension along its eastern edge across Milldam Beck. The groundwater in the Chalk was identified as being confined beneath the Till as at the current site.

Groundwater levels in the Chalk have been systematically measured at the current site over the past two decades in monthly or quarterly intervals. The data collected from six monitoring wells shows that the groundwater elevation does not change significantly over time with only minor deviations typically not exceeding 0.25 m in each well. Monitoring well GWC06 is directly adjacent to the Eastern Extension and GWC01 is on the southern end of the boundary between the current site and the Eastern Extension. The maximum and minimum groundwater levels observed for GWC01 over last six years are equal to 2.68 m AOD and 2.03 m AOD, accordingly.

The direction of groundwater flow in the Chalk appears to be in a general south-westerly direction, however regional groundwater flow directions in the Chalk reported on the hydrogeological map for the area (1:100,000 scale IGS Hydrogeological Map Sheet 10 for East Yorkshire) are towards the east and southeast. Groundwater contours for the Chalk presented on **Drawing ESID11 - Local Hydrogeology and Hydrology**, which now includes boreholes across the whole site following installation of borehole GWC06, are consistent with the original ESID, indicating a south westerly direction of flow.

In locations where the potentiometric elevation of the groundwater in the Chalk is greater than the elevation of the water table in the Lower Sand, the vertical hydraulic gradient is upwards, and groundwater will tend to flow in an upwards direction. Conversely, where the potentiometric elevation of the groundwater in the Chalk is lower than the elevation of the water table in the Lower Sand, the vertical hydraulic gradient is downwards, and groundwater will tend to flow in a downwards direction.

The base of the landfill (i.e. top of basal liner) is planned to lie at around -4 m AOD. In order to ensure the site remains hydraulically contained, the elevation of the leachate should be maintained below 1 m AOD.

3.5.3 Groundwater Quality

Since the time of original PPC permit application, groundwater samples have been collected and analysed in accordance with the EP. A comprehensive framework of eighteen groundwater monitoring boreholes is currently in operation at the site; six of them tap into the Chalk, deep primary aquifer, and twelve into the Lower Sand, shallow secondary aquifer. Groundwater quality analysis is undertaken on a quarterly basis and this strategy will be continued as per conditions of the Permit.

3.6 Off-Site Landfill Gas Monitoring

Today, off-site landfill gas monitoring continues to be undertaken in accordance with the EP.

3.7 Receptors and Compliance Points

The sources, pathways, and receptors that have been identified within this report are shown on **Drawing ESID2 – Environmental Site Setting**.

3.7.1 Groundwater

The specific groundwater receptors that are considered in the original HRA (and subsequent reviews) are:

- Groundwater in the Lower Sand; and
- Groundwater in the Chalk.

In order to ensure that hazardous substances are prevented from entering groundwater and the environmental standards are met at both identified receptors, compliance points were chosen and characterised by appropriate Environmental Assessment Levels (EALs). The hazardous substances compliance point has been established directly downgradient of the discharge just below the water table immediately outside the sidewall liner within the expected mixing zone.

Similarly, to limit the entry of non-hazardous pollutants to groundwater, compliance points have been identified in groundwater at the site boundary adjacent to the waste and appropriate EALs have been selected.

3.7.2 Surface Water

In accordance with the findings of the original HRA (and subsequent reviews) and assuming the measures described in Section 2.5 are successfully implemented, there are no pathways that could connect the Site to any nearby surface water features.

3.7.3 Landfill Gas

The specific receptors that are considered in the Landfill Gas Risk Assessment are:

- Global atmosphere;
- Vegetation;
- Dacre Caravan Park;
- Brandesburton;
- Above Towns Trading Estate;
- Fosse Hill Pond and associated buildings; and
- Residential properties near to the site.

3.7.4 Amenity (nuisance and health)

The specific receptors that are considered in the Nuisance and Health Management Plan are:

- Fosse Hill Pond and associated buildings;
- Above Towns Trading Estate;
- Course fishings ponds located south of the site;
- Bridleways, footpaths and roads located near to the site;
- Farmland located near to the site; and
- Milldam Beck and other surface water courses located south of the site.

3.7.5 Habitats

Information regarding relevant European sites within a 2 km and a 5 km radius of the site has been obtained and has identified that the Hornsea Mere, located 3.5 km east of the site, is designated as a Site of Special Scientific Interest (SSSI) and a Special Protection Area (SPA). The Leven Canal, located 3.0 km south west of the site, and Tophill Low SSSI, located 4.6 km west of the end of the leachate discharge pipeline in Brandesburton, are also designated as SSSIs.

4.0 SITE REPORT

4.1 Site Details

Name of Applicant:

- Sandsfield Gravel Company Ltd.

Activity Address:

- Milegate Extension Landfill, Catwick Lane, Brandesburton, Driffield, East Yorkshire, YO25 8SA

National Grid Reference:

- TA 130472.

Document Reference and dates for Site Condition Report at permit application and surrender:

- The Site Condition Report for the landfill was submitted as part of the Environmental Setting and Installation Design (ESID) Report (ref.03523539.501) dated November 2004;
- The Site Condition Report for the northern strip and area of leachate holding tanks is provided in the last variation application (ref.1671322.628); and
- The Site Condition Report for the Eastern Extension and area of the gas compound is provided in this variation application (ref. 20148978.644).

Document references for site plans (including location and boundaries):

- Environmental Setting and Installation Design Report including drawings (ref. 20148978.632).

4.2 Condition of the Land at Permit Issue

Environmental Setting including:

- Geology – see Section 3.2, above;
- Surface Waters – see Section 3.4, above; and
- Hydrogeology – see Section 3.5, above.

Pollution history including:

- Pollution incidents that may have affected land – see Section 2.1, above;
- Historical land-uses and associated contaminants – see Section 1.3, above;
- Any visual/olfactory evidence of existing contamination – see Section 1.3.1 above which notes the presence of Milegate landfill to the west; and
- Evidence of damage to pollution prevention measures – not applicable.

Evidence of historical contamination, for example historical site investigation assessment, remediation and verification reports:

- None.

Baseline soil and groundwater reference data:

- Sections 3.2, 3.4 and 3.5 above, plus environmental monitoring and reporting undertaken in accordance with the Permit.
- The Eastern Extension is only partially bounded by the existing boreholes and monitoring infrastructure along its western edge, therefore additional ground investigation has been carried out.

4.3 Permitted Activities

4.3.1 Permitted Activities

An application to operate the existing Milegate Extension Landfill under the Pollution Prevention and Control (PPC) Regulations was submitted to the EA in November 2004, and subsequently Permit BX1942IX was issued by the EA on 3 March 2006.

Environmental Permit (EP) EPR/BX1942IX was issued by the EA in 2006 and last varied (Variation Notice V003) in February 2020 which allowed the site to expand landfilling activities northwards in accordance with ownership boundary. The EP allows Sandsfield to dispose of non-hazardous waste under the listed activity of Section 5.2 Part A(1)(a) of the Environmental Permitting (England and Wales) Regulations and the Site can accept up to 75,000 tonnes of waste per year for landfilling. The following directly associated activities (DAAs) are also permitted:

- Storage of leachate in two above ground storage tanks and associated pipework;
- Leachate pumping, extraction and removal off Site;
- Flaring of landfill gas for disposal in an appliance;
- Discharge of site drainage from the landfill (surface water management); and
- Storage of fuel for operation of plant and equipment.

The currently operating landfill is divided into ten cells, Cells 1 to 8 with cells 2 and 4 split into A and B, and the Eastern Extension will consist of six cells, Cells 9 to 14. Landfilling commenced in 2007 in Cell 1 and subsequently proceeded in a westerly direction to Cells 3, 5, and 7. Subsequently, filling of the northern part of the site commenced starting with Cell 8 and progressing eastwards to Cells 6, 4A and 4B. Cell 4B is currently (June 2022) being filled with waste. Cells 6 and 4A will shortly be restored alike the cells that have already been filled. The future landfilling will progress in an easterly direction through Cells 2A, 2B, 9, and 10, and then from north to south through Cells 11, 12, 13, and 14.

In the past landfill gas was collected from the waste but was not sufficient to power a landfill gas engine; as such, gas was flared at the Site. The quantity of extracted landfill gas is deemed adequate for gas engine operation which is planned to be installed at the site in the near future. Leachate is collected and directed to two above-ground holding tanks and discharged to sewer via a 750 m long buried pipe, infrastructure that was installed in late 2016.

4.3.2 Non-Permitted Activities

None.

4.3.3 Documents

The activity layout of Milegate Extension Landfill is described in Environmental Setting and Installation Design (ESID) Report (ref. 20148978.632), and **Drawing ESID 4 – Site Layout and Waste Deposition**

As part of the current variation application, quantitative risk assessments are presented for hydrogeology, stability and landfill gas, and qualitative risk assessments have been carried out for nuisance and health.

4.4 Changes to the Activity

This variation application is to allow the landfilling activity to:

- Extend landfill operations by about 200 m eastwards in line with Sandfield's ownership boundary and thus increase the capacity of the landfill;
- Obtain retrospective permission for moving the location of the gas flare from the southeast corner to the northwest corner of the existing site; and
- Enable installation of gas engines in accordance with the described operating techniques.

This variation application is to change the Permit boundary. Quantitative risk assessments for hydrogeology, stability and landfill gas, and qualitative risk assessments for nuisance and health have been reviewed for the purposes of this variation application and this is detailed in the Supporting Statement (ref. 20148978.631).

This variation application seeks approval for utilisation of the landfill gas for energy production via gas engines.

No 'dangerous substances' not identified in the Application Site Condition Report have been used or produced as a result of the permitted activities.

4.5 Conclusions

Background quality of surface water, gas, and groundwater at the installation is provided in the conceptual model and risk assessments or is collected in accordance with the EP.

Parts of the installation where waste will not be permanently deposited are small. The approach covering these parts will also rely on information in the risk assessments and conceptual model and the known history of the site. Such areas include the gas flare compound, leachate holding tanks/pipeline, and the northern corners of the Eastern Extension. No specific site investigation has been carried out for these areas.

5.0 REFERENCES

British Geological Survey, 1997. *The Physical Properties of Major Aquifers in England and Wales,* s.l.: s.n.

Environment Agency, 2002. *Guidance on the Monitoring of Landfill Leachate, Groundwater, and Surface Water,* s.l.: s.n.

Environment Agency, 2003. *Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control and Trigger Levels,* s.l.: s.n.

Golder Associates (UK) Ltd, 2004. *Environmental Setting and Installation Design Report (November 2004) Milegate Extension Landfill Site,* s.l.: s.n.

Golder Associates (UK) Ltd, 2018. *Environmental Setting and Installation Design Report (June 2018) Milegate Extension Landfill Site,* s.l.: s.n.

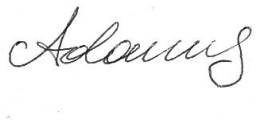
Ludlow, 1999. *Geological and Hydrogeological Report for Milegate Extension Site,* s.l.: s.n.

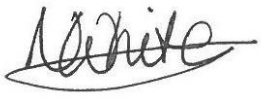
MAFF, 1976. *Technical Bulletin 35,* s.l.: Ministry of Agriculture, Fisheries and Food.

MAGIC, 2021. *Magic Map Application.* [Online]
Available at: magic.defra.gov.uk
[Accessed October 2021].

Signature Page

Golder WSP UK Ltd





Aneila Adamus
Hydrogeologist

Nicola White
Project Manager

Date: 28 June 2022

AA/NW/DD/ab

Company Registered in England No. 01383511
At WSP House, 70 Chancery Lane, London, WC2A 1AF
VAT No. 905054942

DRAWINGS

Drawing ESID1 – Site Location Plan

Drawing ESID2 – Environmental Site Setting

Drawing ESID3 – Cultural and Natural Heritage

Drawing ESID4 – Site Layout and Waste Deposition

Drawing ESID5 – Restoration

Drawing ESID6A – Installation Infrastructure

Drawing ESID6B – Installation Details

Drawing ESID7A – Leachate Management Infrastructure

Drawing ESID7B – Leachate Management Details

Drawing ESID7C – Leachate Holding Tanks and Discharge Pipeline

Drawing ESID8 – Landfill Gas Management Infrastructure

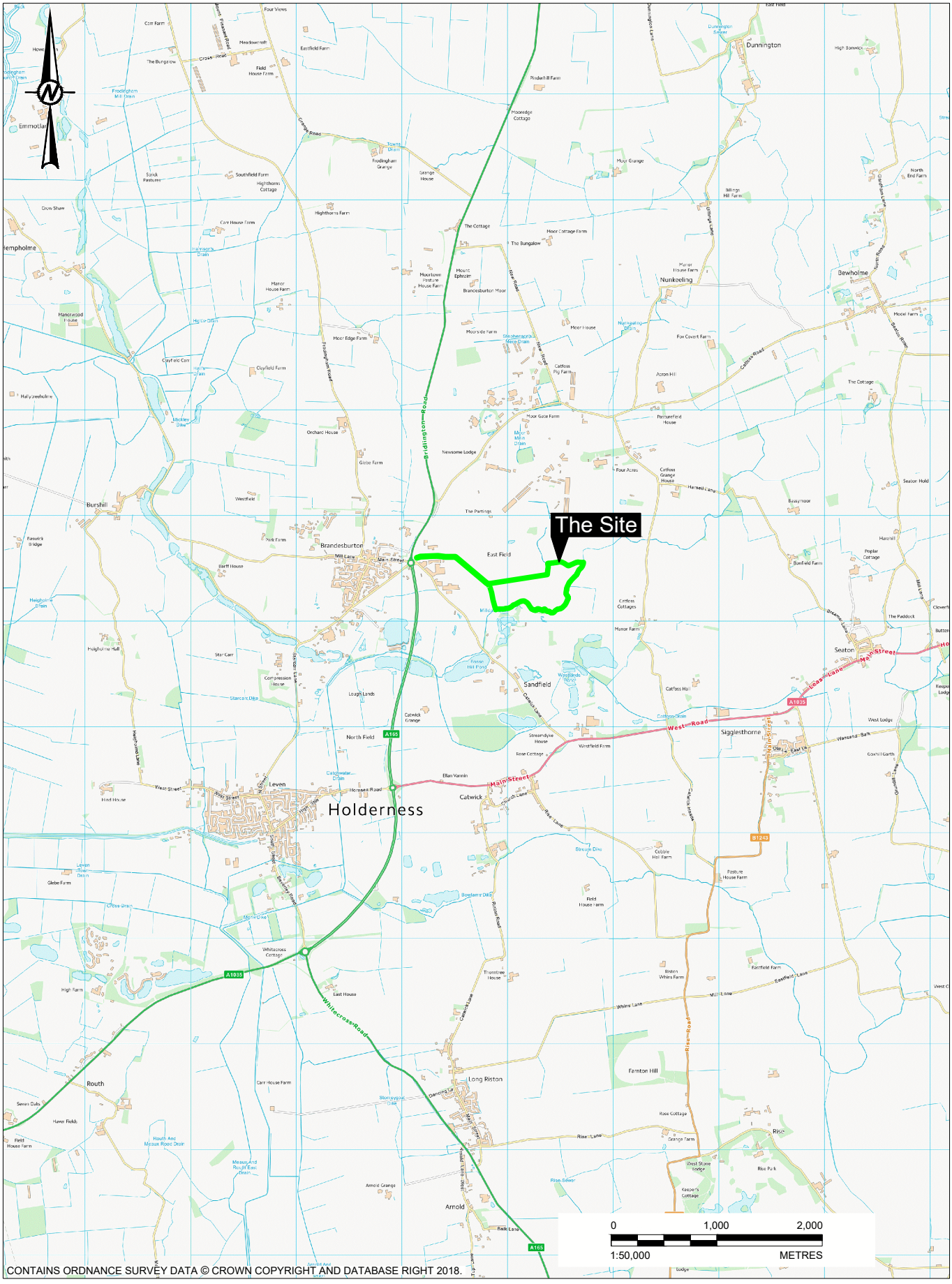
Drawing ESID9A – Superficial and Bedrock Geology

Drawing ESID9B – Eastern Extension Site Investigation Infrastructure

Drawing ESID10 – Groundwater Vulnerability and Source Protection Zones

Drawing ESID11 – Local Hydrogeology and Hydrology

Drawing ESID12 – Hydrogeological Cross Section



CLIENT
SANDSFIELD GRAVEL COMPANY LTD

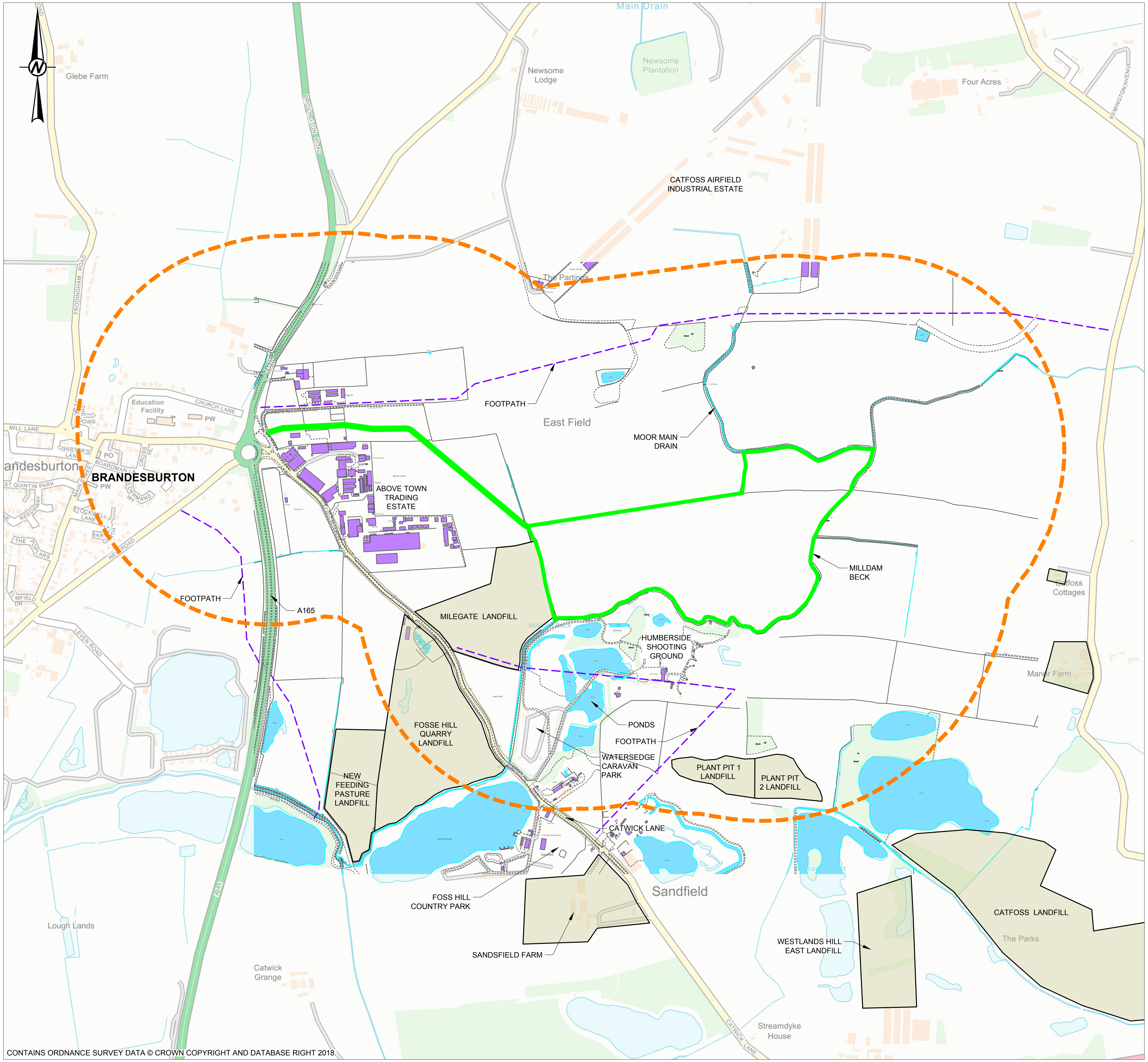
PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

CONSULTANT
GOLDER
MEMBER OF WSP

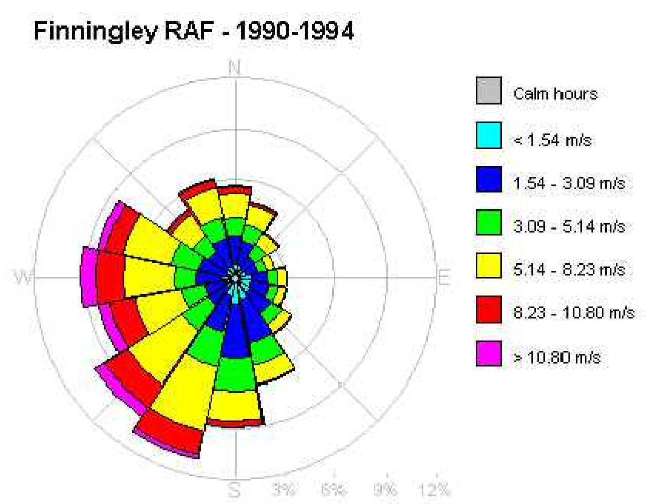
YYYY-MM-DD	2021-10-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

TITLE
SITE LOCATION PLAN

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0001	A	ESID1


N
Glebe Farm
Newsome Lodge
Main Drain
Newsome Plantation
Four Acres
CATFOSS AIRFIELD INDUSTRIAL ESTATE
The Partings
FOOTPATH
East Field
MOOR MAIN DRAIN
Education Facility
CHURCH LANE
MILL LANE
BRANDESBURTON
ABOVE TOWN TRADING ESTATE
MILLDAM BECK
Catfoss Cottages
FOOTPATH
A165
MILEGATE LANDFILL
HUMBERSIDE SHOOTING GROUND
Manor Farm
FOSSE HILL QUARRY LANDFILL
PONDS
FOOTPATH
WATERSEDGE CARAVAN PARK
PLANT PIT 1 LANDFILL
PLANT PIT 2 LANDFILL
NEW FEEDING PASTURE LANDFILL
CATWICK LANE
FOSS HILL COUNTRY PARK
Sandfield
CATFOSS LANDFILL
The Parks
WESTLANDS HILL EAST LANDFILL
SANDSFIELD FARM
Lough Lands
Catwick Grange
Streamdyke House
LEVEN ROAD
FRODINGHAM ROAD
A165
CONTAINS ORDNANCE SURVEY DATA © CROWN COPYRIGHT AND DATABASE RIGHT 2018.

WIND ROSE



REFERENCES

CONTAINS ORDNANCE SURVEY DATA © CROWN COPYRIGHT AND DATABASE RIGHT 2017

NOTE

THERE ARE NO RAMSAR (OR PROPOSED RAMSAR) SITES, NO SPECIAL AREAS OF CONSERVATION (OR POSSIBLE SPECIAL AREAS OF CONSERVATION), NO SPECIAL PROTECTION AREAS (OR POSSIBLE SPECIAL PROTECTION AREAS), AND NO SITES OF SPECIAL SCIENTIFIC INTEREST (SSSI) WITH 1 km OF THE LANDFILL.

LEGEND

- PERMIT BOUNDARY
- 500 m RADIUS FROM SITE BOUNDARY
- FOOTPATH

0 250 500

1:10,000 METRES

CLIENT

SANDSFIELD GRAVEL COMPANY LTD

PROJECT

EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE

ENVIRONMENTAL SITE SETTING

CONSULTANT

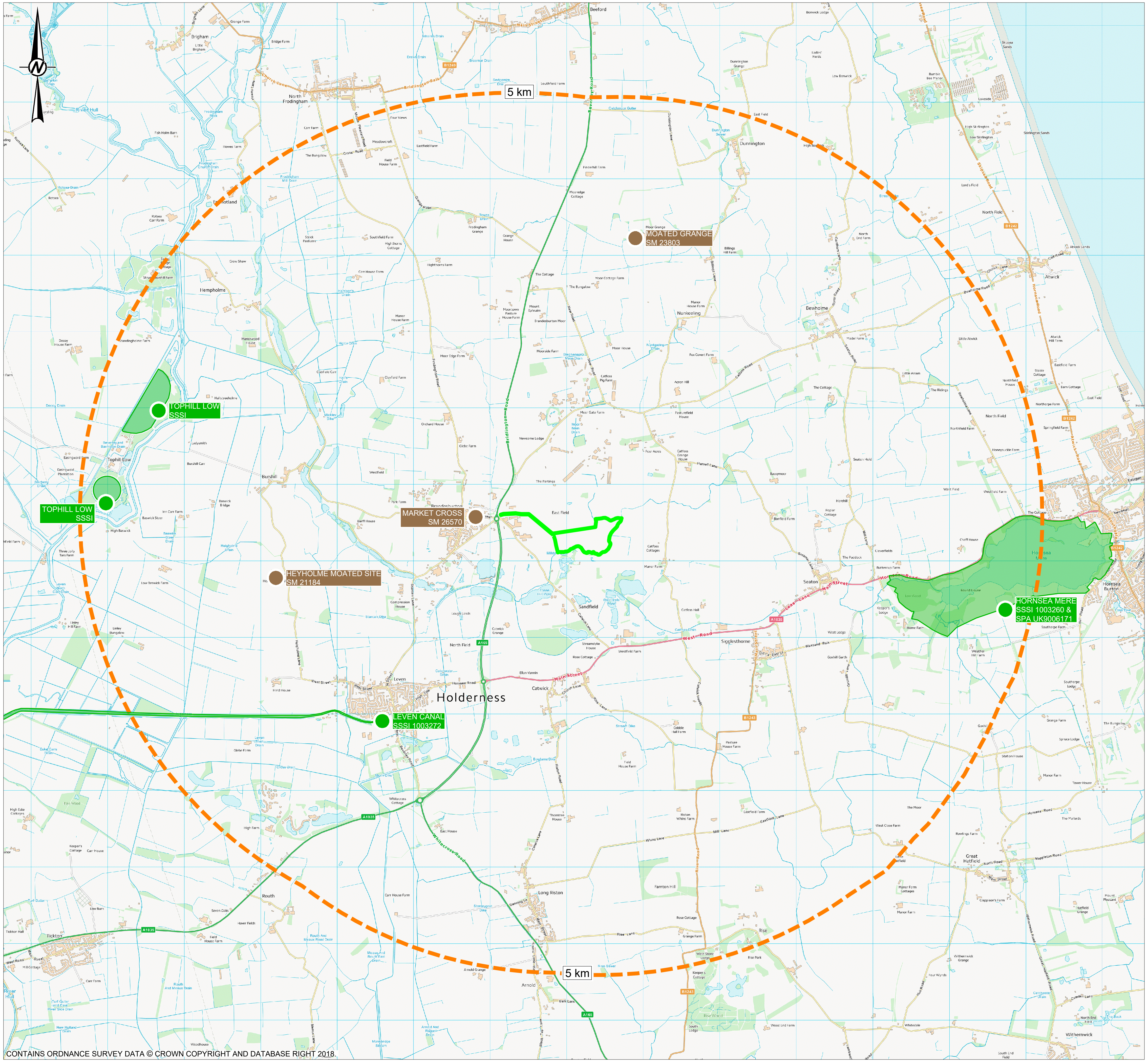
GOLDER MEMBER OF WSP

YYYY-MM-DD	2021-10-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0002	A	ESID2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

25 mm



LEGEND

- INSTALLATION BOUNDARY
- 5 km OFFSET FROM INSTALLATION BOUNDARY
- NATURAL HERITAGE: SSSI AND SPA
- CULTURAL HERITAGE: SCHEDULED ANCIENT MONUMENTS

0 1,000 2,000
1:50,000 METRES

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

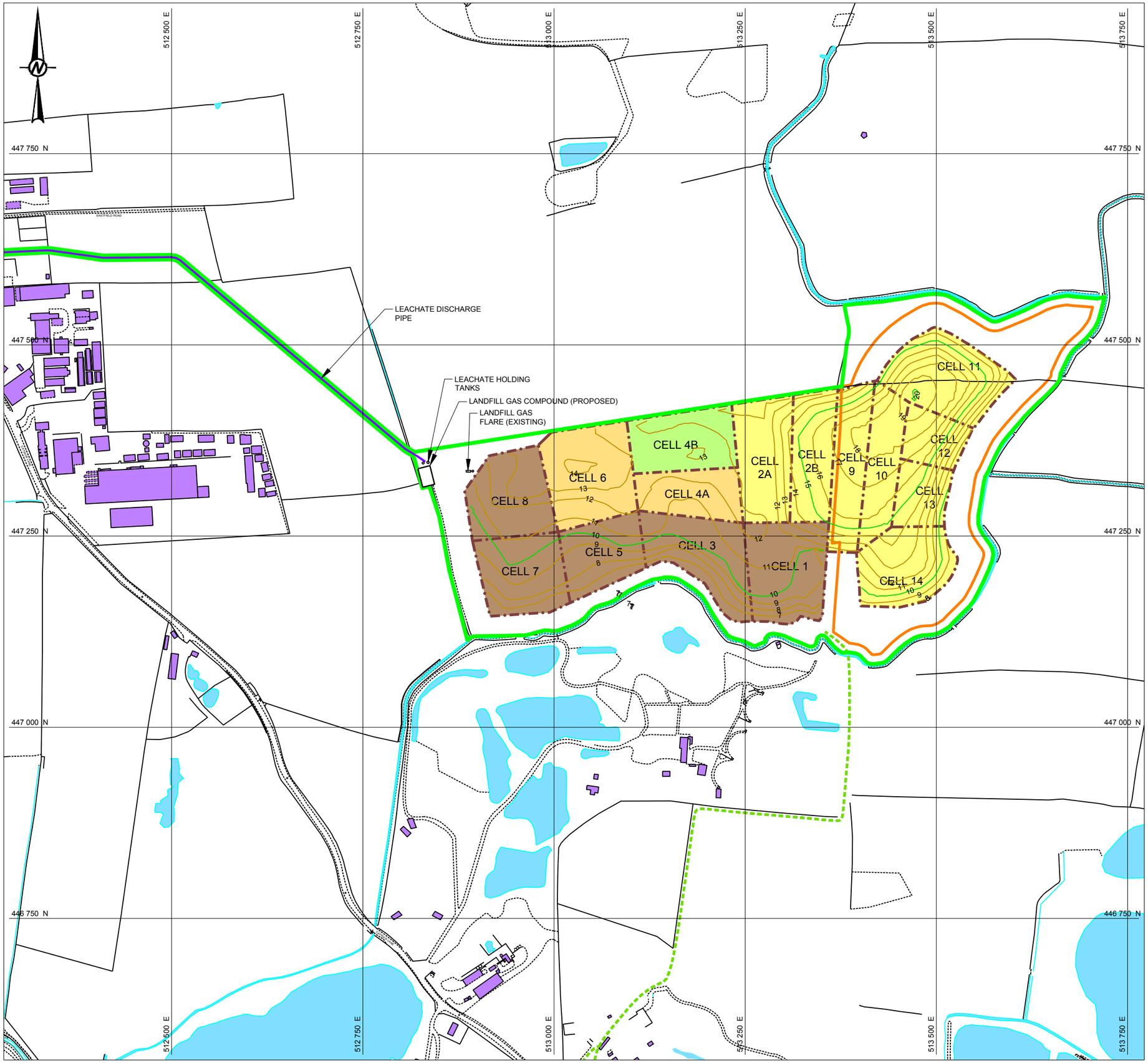
TITLE
CULTURAL AND NATURAL HERITAGE

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0003	A	ESID3

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3



LEGEND

- PERMIT BOUNDARY
- CELL BOUNDARY
- MINERAL EXTRACTION BOUNDARY
- FILLED AND RESTORED LANDFILL
- FILLED AND UNRESTORED LANDFILL
- ACTIVE LANDFILL
- FUTURE LANDFILL
- ACCESS ROUTE FROM SITE RECEPTION TO LANDFILL
- PRE-SETTLEMENT, PRE-RESTORATION CONTOURS

REFERENCE(S)

SURROUNDING TOPOGRAPHY REPRODUCED FROM ORDNANCE SURVEY® DIGITAL MAP DATA © CROWN COPYRIGHT 2003. ALL RIGHTS RESERVED.

CONTOUR DATA FROM PRE SETTLEMENT PRE RESTORATION CONTOURS.DWG AND E_EXT RESTORATION PRE SETTLE PRE RESTORE.DWG.

0 100 200
1:5,000 METRES

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE
SITE LAYOUT AND WASTE DEPOSITION

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-06-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

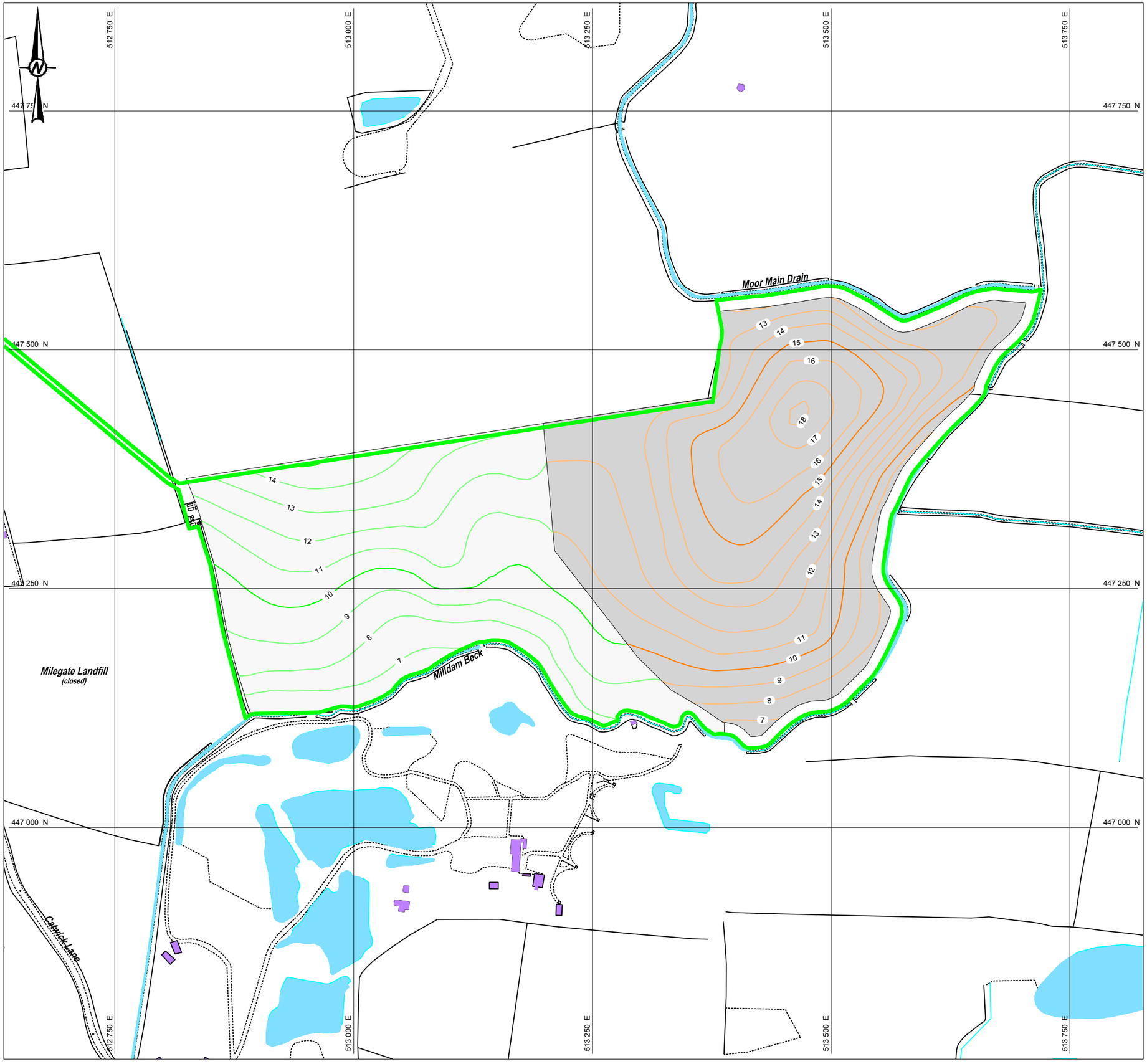
PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0004	B	ESID4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

25 mm

0

Path: \\golder.gds\corp\ie\data\dfiles\Bound\Edi\CADDS\Sandsfield Gravel Company Ltd\Maps\ie99_PROJECTS\20148978\1004_Environmental Permit Variation\02_PRODUCTION\DWG\ | File Name: 20148978-1004-EP-0004.dwg



LEGEND

- PERMIT BOUNDARY
- BUILDING
- EXISTING PERMITTED RESTORATION PROFILE (POST SETTLEMENT, POST RESTORATION)
- PROPOSED RESTORATION PROFILE (POST SETTLEMENT, POST RESTORATION)

NOTE(S)

1. ALL LEVELS RELATIVE TO NEWLYN ORDNANCE DATUM.

REFERENCE(S)

SURROUNDING TOPOGRAPHY REPRODUCED FROM ORDNANCE SURVEY® DIGITAL MAP DATA © CROWN COPYRIGHT 2003. ALL RIGHTS RESERVED.

EXISTING FINAL RESTORATION SCHEME PROVIDED BY DJM WASTE MANAGEMENT CONSULTANCY, DRAWING REF: 02/01/005, DATED 08.05.02. EXTENSION BY GOLDER ASSOCIATES.

0 100 200
1:4,000 METRES

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE
RESTORATION

CONSULTANT
WSP GOLDER

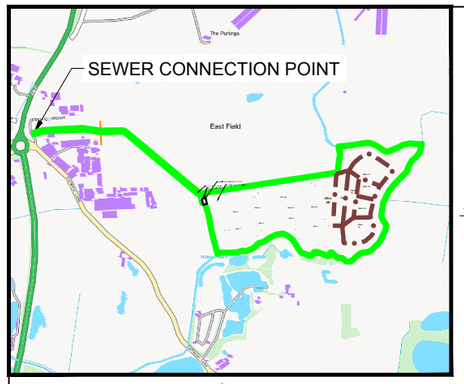
YYYY-MM-DD	2022-06-15
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0005	B	ESID5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

0 25 mm

Path: \\golder.gds\complete\data\ukoffice\Bourne\Esd\CAD\DS\Sandsfield Gravel Company Ltd\Milegate\99_PROJECTS\20148978\1004_Environmental Permit Variation\02_PRODUCTION\DWG\ | File Name: 20148978-1004-EP-0005.dwg | Last Edited By: tsmith Date: 2022-06-15 Time:2:26:33 PM. | Printed By: tsmith Date: 2022-06-15 Time:2:27:19 PM



513 000 E
513 250 E
513 500 E
513 750 E
512 750 E
447 750 N
447 500 N
447 250 N
447 000 N

LEACHATE DISCHARGE PIPELINE
LEACHATE HOLDING TANKS
LANDFILL GAS COMPOUND (PROPOSED)
LANDFILL GAS FLARE (EXISTING)

CELL 1
CELL 2A
CELL 2B
CELL 3
CELL 4A
CELL 4B
CELL 5
CELL 6
CELL 7
CELL 8
CELL 9
CELL 10
CELL 11
CELL 12
CELL 13
CELL 14

Moor Main Drain
Foot Bridge
Pond
Millsam Beck
Sandfield
Club House
House
East Field
BM 11.59m
9.4m

CONTAINS ORDNANCE SURVEY DATA © CROWN COPYRIGHT AND DATABASE RIGHT 2018.

LEGEND

- PERMIT BOUNDARY
- CELL BOUNDARY
- CLAY LINER CONTOUR

NOTE(S)

1. ALL LEVELS RELATIVE TO NEWLYN ORDNANCE DATUM.

REFERENCE(S)

SURROUNDING TOPOGRAPHY REPRODUCED FROM ORDNANCE SURVEY® DIGITAL MAP DATA © CROWN COPYRIGHT 2003. ALL RIGHTS RESERVED.

0 100 200
1:4,000 METRES

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE
INSTALLATION INFRASTRUCTURE

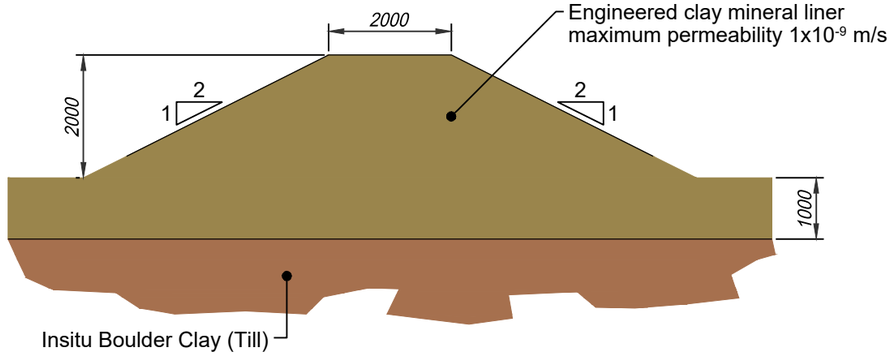
CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-06-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0006	B	ESID6A

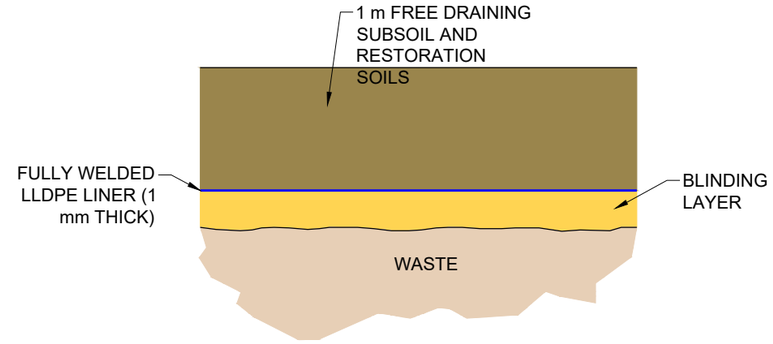
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3
25 mm
0

Path: \\golder.gds\complexdata\office\Bourne\Exd\CADD\S\Sandsfield Gravel Company Ltd\Allegation\99_PROJECTS\20148978\1004_Environmental Permit Variation\02_PRODUCTION\DWG\ | File Name: 20148978-1004-EP-0006.dwg | Last Edited By: tsmith Date: 2022-06-14 Time:11:21:46 AM | Printed By: tsmith Date: 2022-06-15 Time:2:28:24 PM



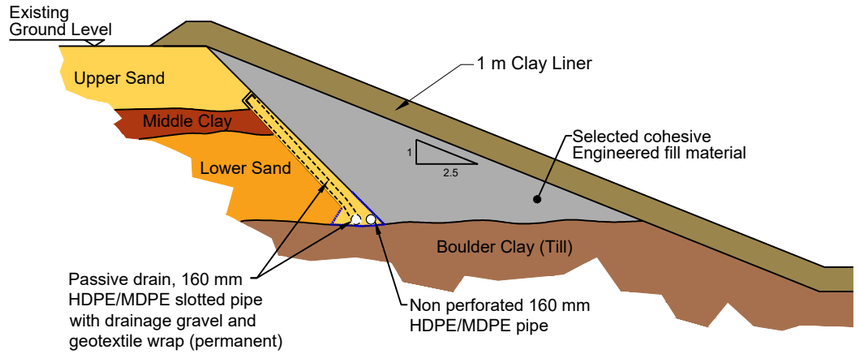
Typical Intercell Bund Detail

1:100



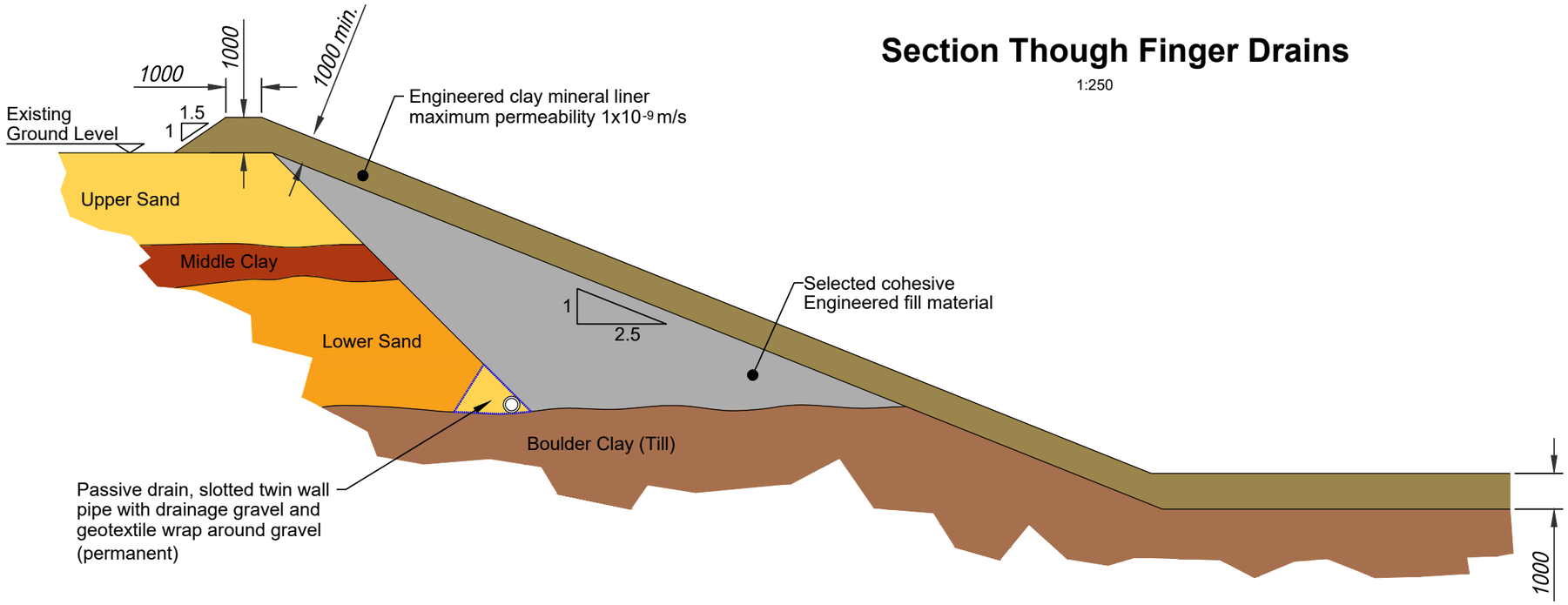
Typical Restoration Detail

1:50



Section Though Finger Drains

1:250



Typical Section Through Sidewall And Basal Liner

1:150

NOTE(S)

1. ALL DIMENSIONS IN METRES UNLESS STATED OTHERWISE.

0 5 10
1:250 METRES

0 2.5 5
1:150 METRES

0 2.5 5
1:100 METRES

0 1 2
1:50 METRES

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE
INSTALLATION DETAILS

CONSULTANT
GOLDER
MEMBER OF WSP

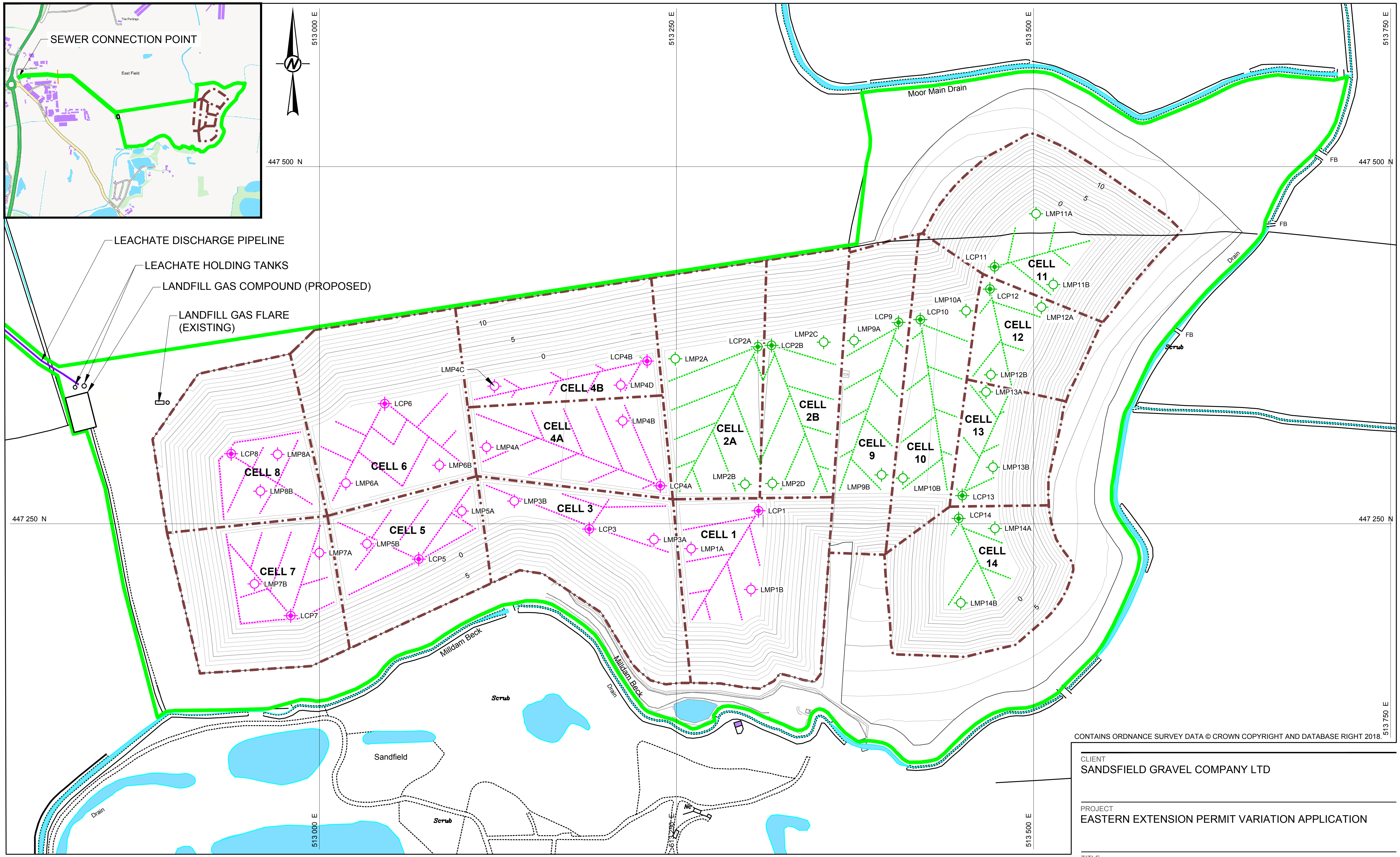
YYYY-MM-DD	2021-10-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0007	A	ESID6B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

25 mm

0



LEGEND

- PERMIT BOUNDARY
- CELL BOUNDARY
- CLAY LINER CONTOUR
- LEACHATE EXTRACTION WELL - EXISTING
- LEACHATE MONITORING WELL - EXISTING
- LEACHATE DRAINAGE PIPE - EXISTING
- LEACHATE EXTRACTION WELL - PROPOSED
- LEACHATE MONITORING WELL - PROPOSED
- LEACHATE DRAINAGE PIPE - PROPOSED

NOTES

1. ALL LEVELS RELATIVE TO NEWLYN ORDNANCE DATUM.
2. GENERALISED LAYOUT OF EXISTING INFRASTRUCTURE SHOWN.

REFERENCE(S)

TOPOGRAPHY REPRODUCED FROM ORDNANCE SURVEY® DIGITAL MAP DATA © CROWN COPYRIGHT 2003. ALL RIGHTS RESERVED.

0 50 100
1:2,500 METRES

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE
LEACHATE MANAGEMENT INFRASTRUCTURE

CONSULTANT
WSP GOLDER

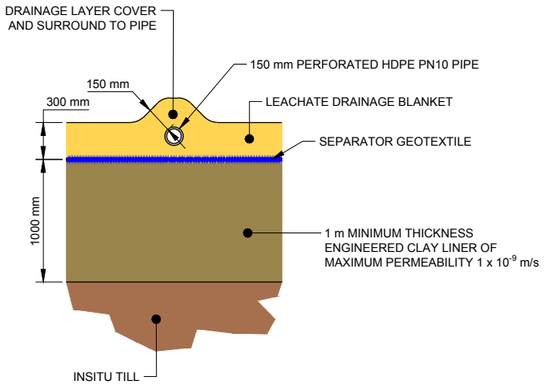
YYYY-MM-DD	2022-06-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0008	B	ESID7A

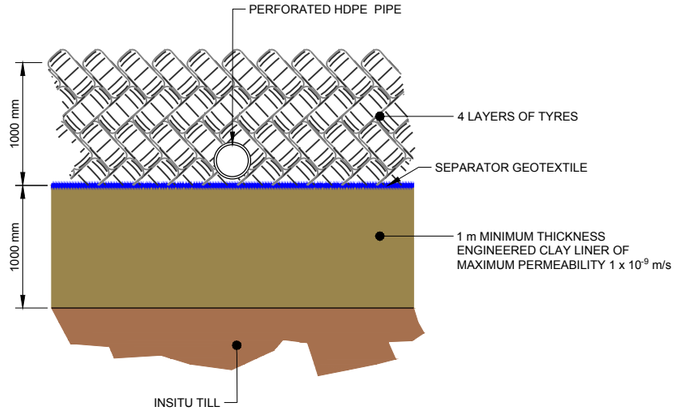
25 mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

NOTE(S)

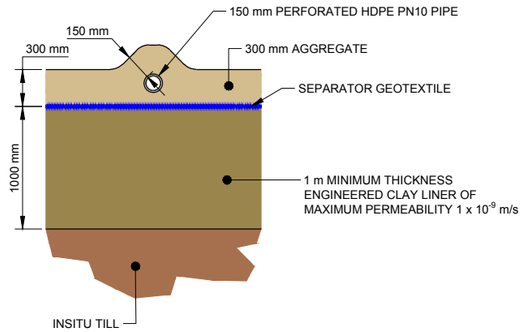
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.



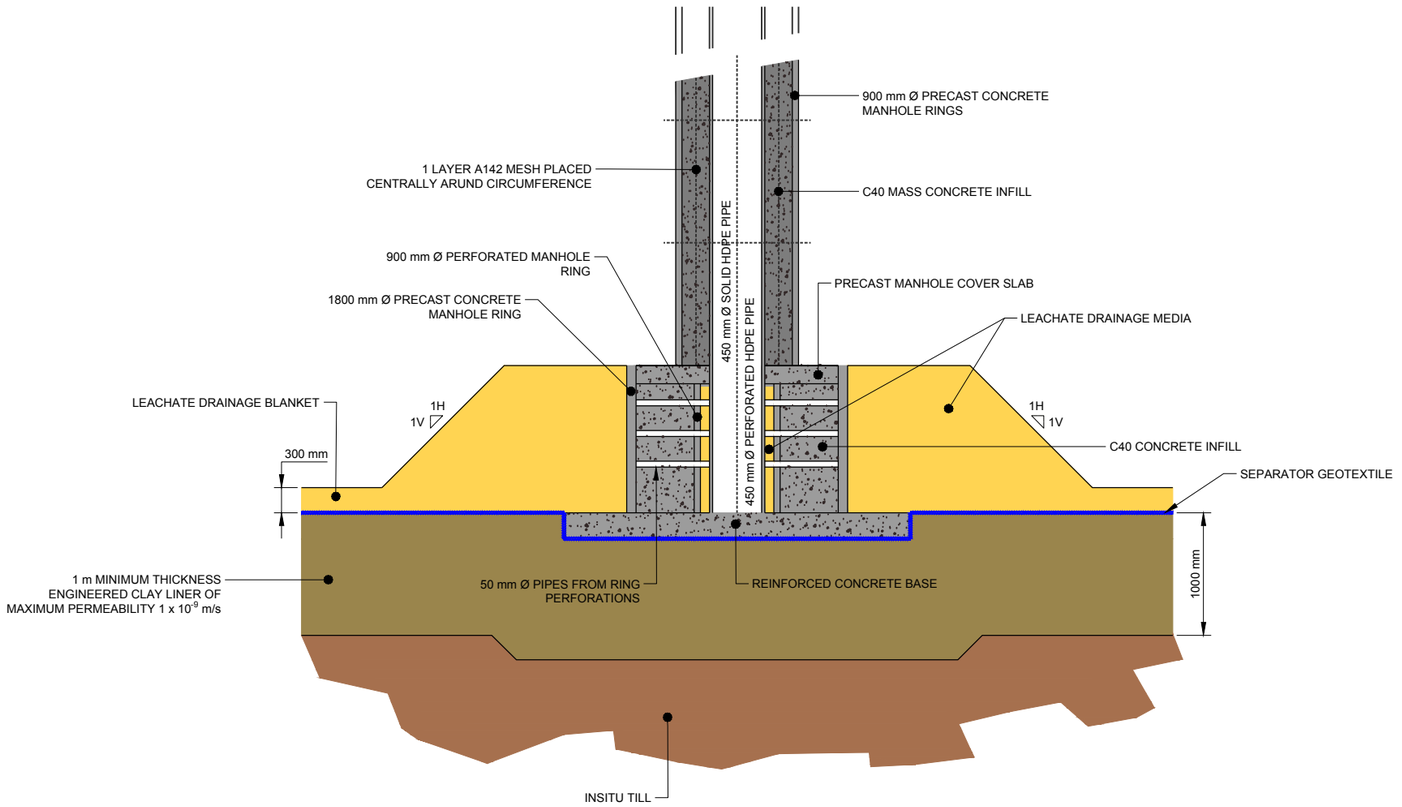
LEACHATE CARRIER PIPE (GRAVEL)
SCALE 1:50



LEACHATE CARRIER PIPE (TYRES)
SCALE 1:50



LEACHATE CARRIER PIPE (AGGREGATE)
SCALE 1:50



TYPICAL LEACHATE COLLECTION AND MONITORING POINT CONSTRUCTION
SCALE 1:50

0 1 2
1:50 METRES

SANDSFIELD GRAVEL COMPANY LTD

EASTERN EXTENSION PERMIT VARIATION APPLICATION

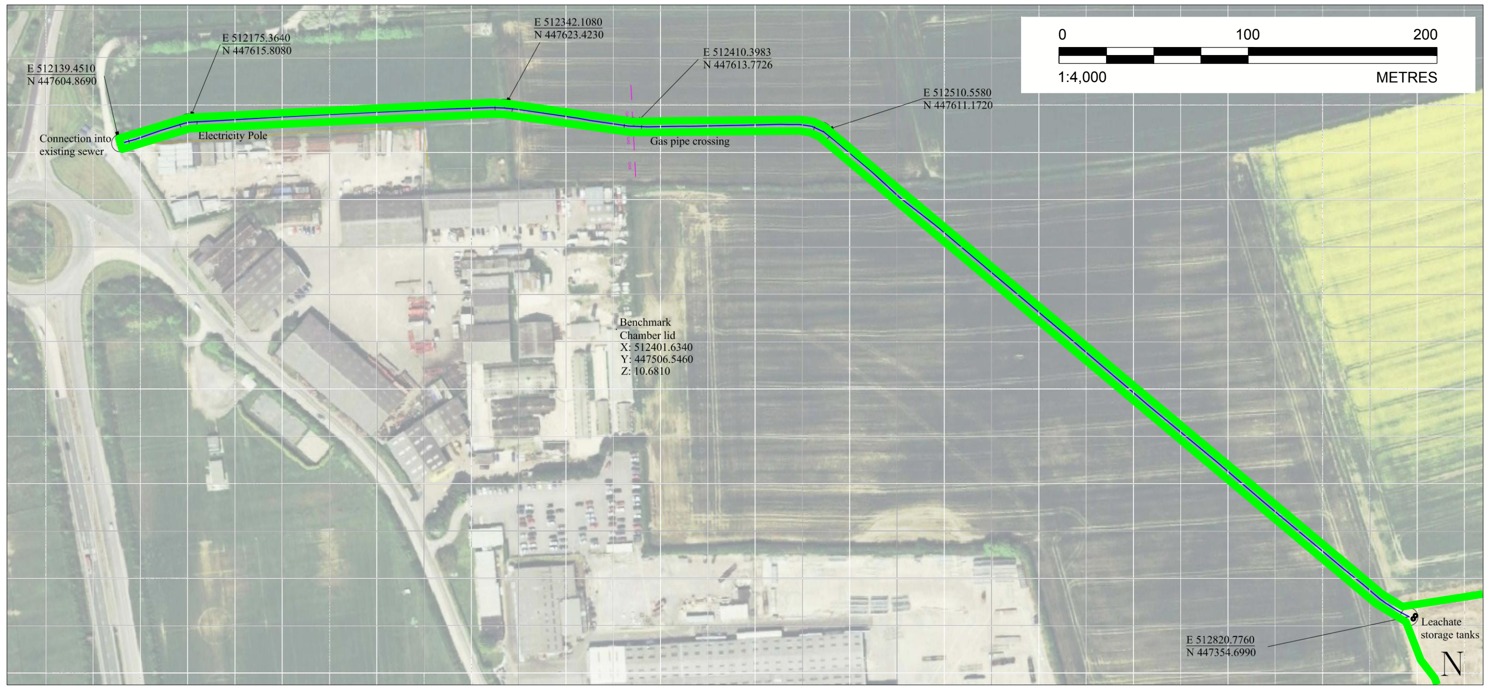
LEACHATE MANAGEMENT DETAILS

2021-10-14	
AA	
ECS	
DD	
DD	

GOLDER
MEMBER OF WSP

CONTROL			DRAWING
20148978	1002-PA-0009	A	ESID7B

25 mm
0



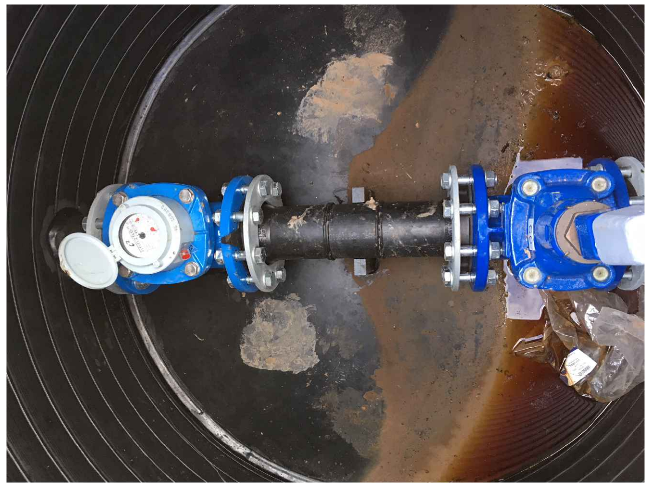
LOCATION OF DISCHARGE PIPELINE (FROM LAND DRAINAGE CONSULTANCY LTD), USING GPS, 31ST OCTOBER 2016

LEGEND

PERMIT BOUNDARY

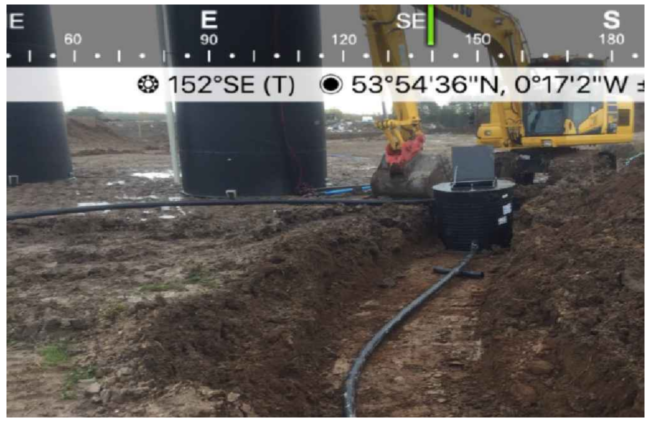

LEACHATE HOLDING TANKS (FRONT ELEVATION)


FIRST LEACHATE CHAMBER (EAST), ADJACENT TO LEACHATE HOLDING TANKS


FLOW METER AND VALVE IN FIRST LEACHATE CHAMBER

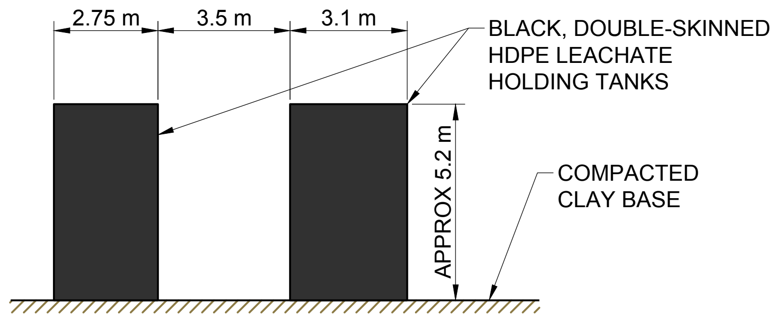

FINAL (WEST) LEACHATE CHAMBER AND ENTRY TO EXISTING SEWER

CONNECTION FROM TANKS TO FIRST CHAMBER



PIPELINE DURING INSTALLATION

EXCAVATION OF TRENCH DURING INSTALLATION



CROSS SECTION OF LEACHATE TANKS
SCALE 1:200

INSTALLATION OF PIPELINE

TRENCH PRIOR TO BACKFILL

DISCHARGE POINT TO SEWER (DURING INSTALLATION)

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

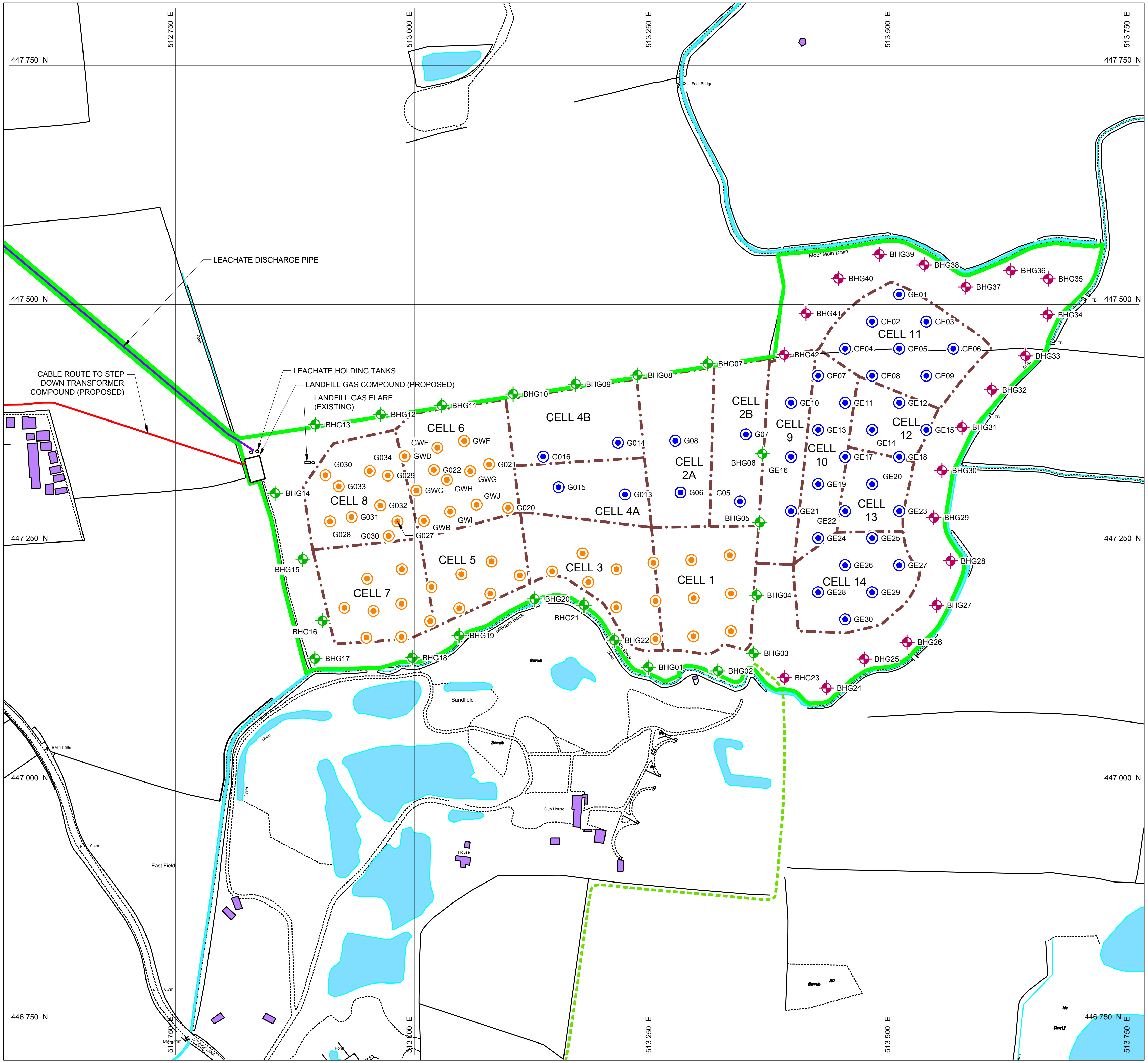
TITLE
LEACHATE HOLDING TANKS AND DISCHARGE PIPELINE

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0010	A	ESID7C



512 750 E
513 000 E
513 250 E
513 500 E
513 750 E
447 750 N
447 500 N
447 250 N
447 000 N
446 750 N
Foot Bridge
Moor Main Drain
LEACHATE DISCHARGE PIPE
CABLE ROUTE TO STEP DOWN TRANSFORMER COMPOUND (PROPOSED)
LEACHATE HOLDING TANKS
LANDFILL GAS COMPOUND (PROPOSED)
LANDFILL GAS FLARE (EXISTING)
CELL 1
CELL 2A
CELL 2B
CELL 3
CELL 4A
CELL 4B
CELL 5
CELL 6
CELL 7
CELL 8
CELL 9
CELL 10
CELL 11
CELL 12
CELL 13
CELL 14
BHG01
BHG02
BHG03
BHG04
BHG05
BHG06
BHG07
BHG08
BHG09
BHG10
BHG11
BHG12
BHG13
BHG14
BHG15
BHG16
BHG17
BHG18
BHG19
BHG20
BHG21
BHG22
BHG23
BHG24
BHG25
BHG26
BHG27
BHG28
BHG29
BHG30
BHG31
BHG32
BHG33
BHG34
BHG35
BHG36
BHG37
BHG38
BHG39
BHG40
BHG41
BHG42
GE01
GE02
GE03
GE04
GE05
GE06
GE07
GE08
GE09
GE10
GE11
GE12
GE13
GE14
GE15
GE16
GE17
GE18
GE19
GE20
GE21
GE22
GE23
GE24
GE25
GE26
GE27
GE28
GE29
GE30
G05
G06
G07
G08
G013
G014
G015
G016
G020
G021
G022
G027
G028
G029
G030
G031
G032
G033
G034
GWB
GWC
GWD
GWE
GWF
GWG
GWH
GWI
GWJ
Sandfield
Club House
House
East Field
Millbeck Beck
Drain

LEGEND

PERMIT BOUNDARY

CELL BOUNDARY

EXISTING GAS EXTRACTION WELL

PROPOSED GAS EXTRACTION WELL

EXISTING PERIMETER GAS MONITORING WELL

PROPOSED PERIMETER GAS MONITORING WELL

NOTE(S)

1. ALL LEVELS RELATIVE TO NEWLYN ORDNANCE DATUM.
2. ALL WELL LOCATIONS ARE INDICATIVE ONLY.

REFERENCE(S)

FINAL RESTORATION SCHEME PROVIDED BY DJM WASTE MANAGEMENT CONSULTANCY, DRAWING REF: 02/01/005, DATED 08.05.02.

0 100 200

1:4,000 METRES

CLIENT

SANDSFIELD GRAVEL COMPANY LTD

PROJECT

EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE

LANDFILL GAS MANAGEMENT INFRASTRUCTURE

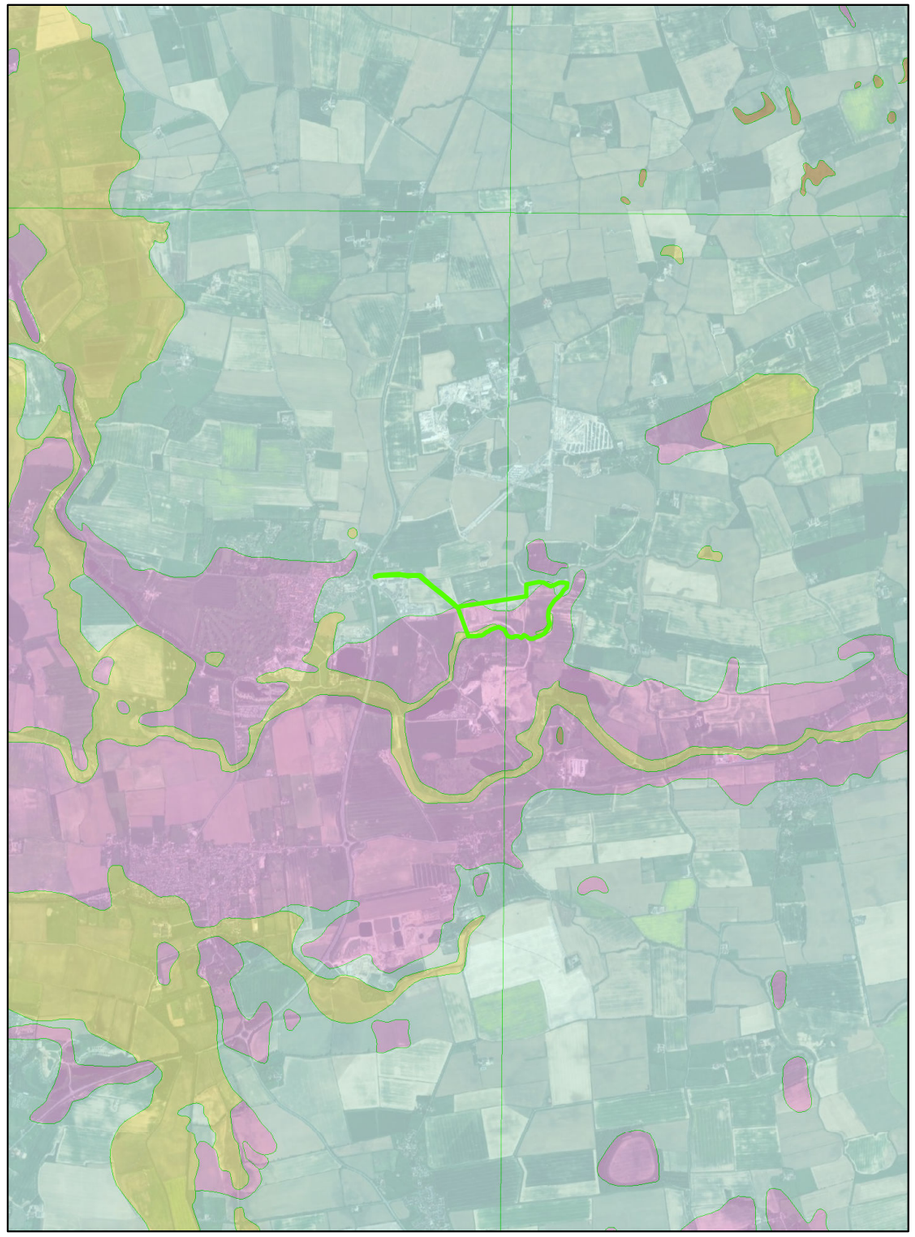
CONSULTANT

WSP GOLDER

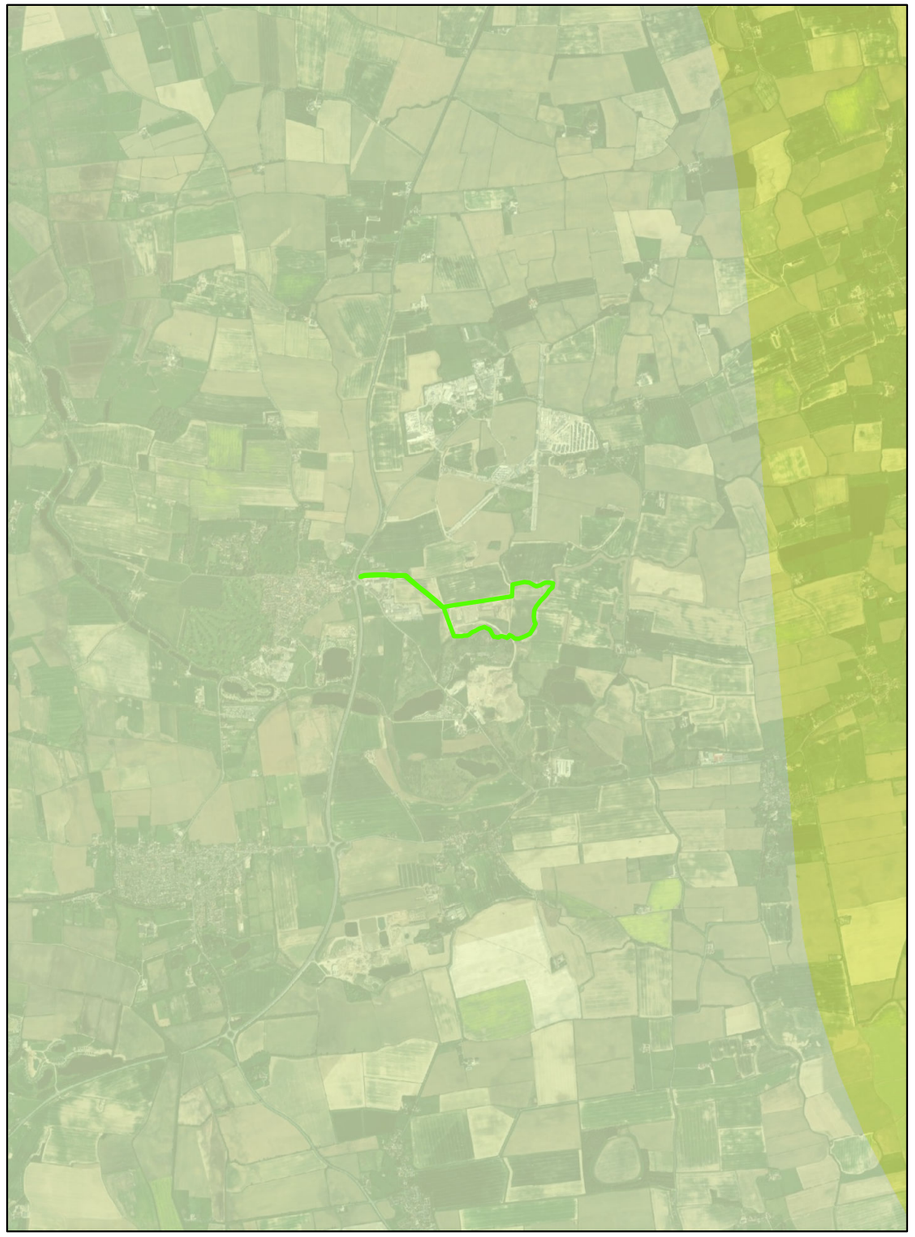
YYYY-MM-DD	2022-06-22
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0011	B	ESID8

Superficial Geology



Bedrock Geology



LEGEND

Permit Boundary

Geology - Superficial

- Alluvium - Clay, Silt, Sand and Gravel
- Marine Deposits - Sand and Gravel
- Glaciofluvial Deposits, Devensian - Sand and Gravel
- Lacustrine Deposits - Sand, Silt and Gravel
- Till, Devensian - Diamicton

Geology - Bedrock

- Flamborough Chalk Formation - Chalk
- Marine Deposits - Sand and Gravel

0 1,000 2,000

1:50,000 METRES

NOTE(S)

REFERENCE(S)

1. COORDINATE SYSTEM: BRITISH NATIONAL GRID
2. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
3. CONTAINS PUBLIC SECTOR INFORMATION LICENSED UNDER THE GOVERNMENT LICENCE V3.0.
4. C04/06-CSL BRITISH GEOLOGICAL SURVEY.© NERC. ALL RIGHTS RESERVED.

CLIENT

SANDSFIELD GRAVEL COMPANY LTD.

PROJECT

EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE

SUPERFICIAL AND BEDROCK GEOLOGY

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021 NOV 05
DESIGNED	AA
PREPARED	CB
REVIEWED	NW
APPROVED	DD

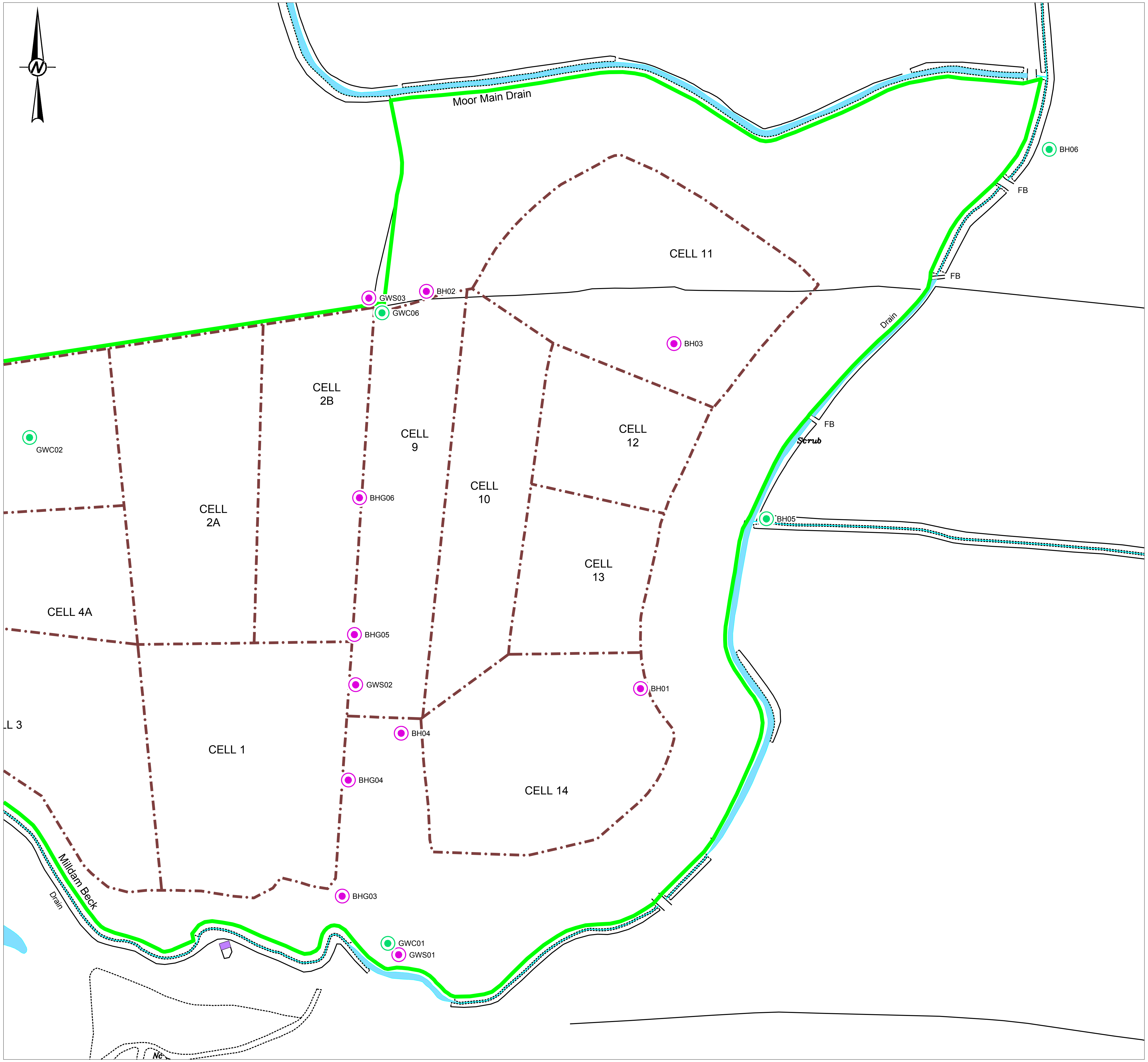
PROJECT NO.	CONTROL	REV.	DRAWING
20148978	GEO_0006	B.0	ESID9A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3

25mm

0

PATH: E:\Sandsfield\Mxd\gis\99_PROJECTS\20148978\900_ESID\02_PRODUCTION\MXD\20148978_ESID_GEO_0006_Geology.mxd PRINTED ON: 2021-11-05 AT: 11:04:14 AM



LEGEND

- PERMIT BOUNDARY
- CELL BOUNDARY
- INVESTIGATION LOCATIONS IN THE LOWER SAND (SHALLOW)
- INVESTIGATION LOCATIONS IN THE CHALK (DEEP)

REFERENCE(S)

SURROUNDING TOPOGRAPHY REPRODUCED FROM ORDNANCE SURVEY® DIGITAL MAP DATA © CROWN COPYRIGHT 2003. ALL RIGHTS RESERVED.

EXISTING FINAL RESTORATION SCHEME PROVIDED BY DJM WASTE MANAGEMENT CONSULTANCY, DRAWING REF: 02/01/005, DATED 08.05.02. EXTENSION BY GOLDER ASSOCIATES.

0 50 100
1:2,000 METRES

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE
EASTERN EXTENSION SITE INVESTIGATION INFRASTRUCTURE

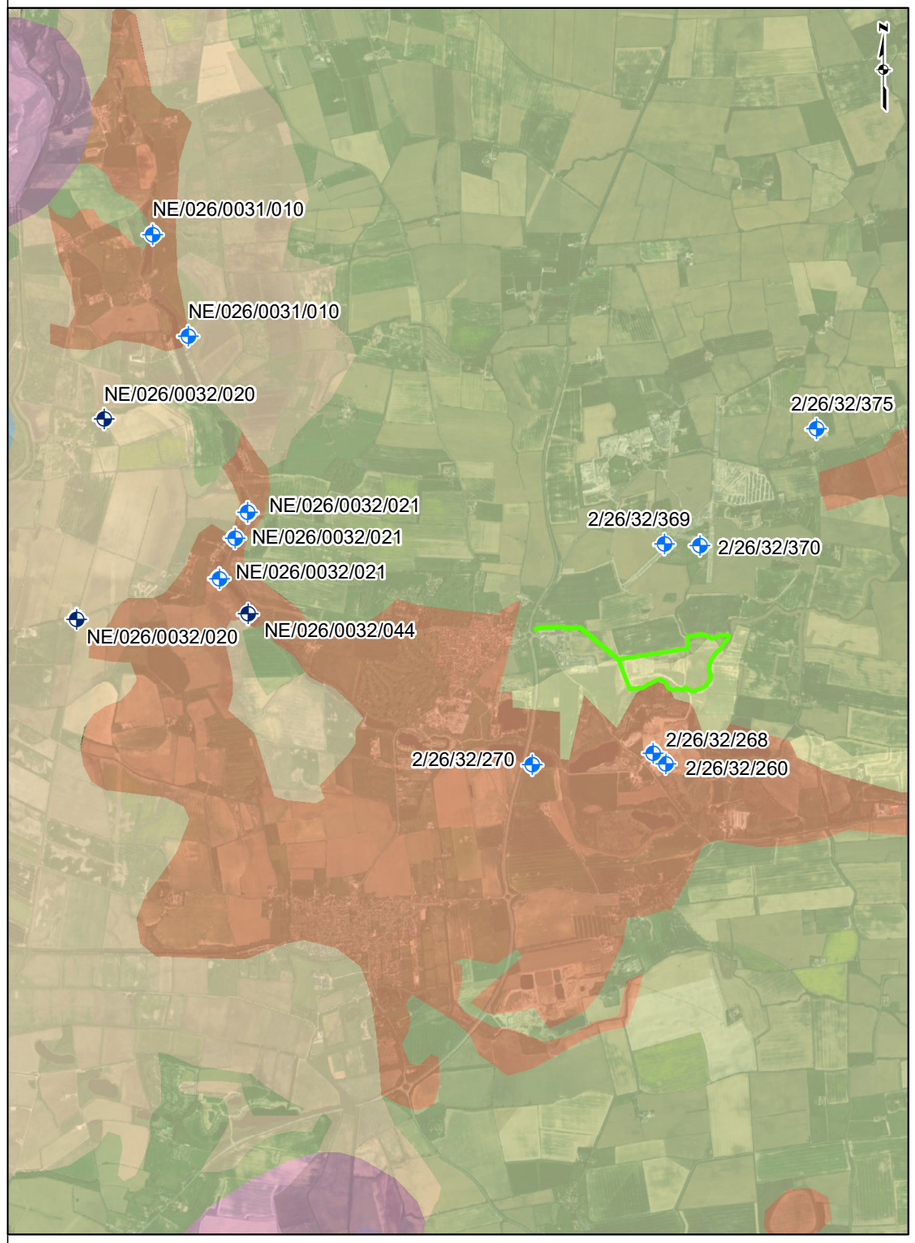
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0013	A	ESID9B

25 mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

Groundwater Vulnerability



Source Protection Zones

LEGEND

Permit Boundary

Groundwater Vulnerability

- Principal Aquifer - High
- Principal Aquifer - Intermediate
- Principal Aquifer - Low
- Secondary Aquifer - High
- Secondary Aquifer - Intermediate
- Secondary Aquifer - Low
- Non-Aquifer
- Surface Water

Source Protection Zones

- Zone I - Inner Protection Zone (Not Present)
- Zone II - Outer Protection Zone (Not Present)
- Zone III - Total Catchment
- Zone of Special Interest (Not present)

Licensed Abstraction Sites

- Groundwater
- Surface Water

0 1,000 2,000

1:50,000 METRES

NOTE(S)

REFERENCE(S)

1. COORDINATE SYSTEM: BRITISH NATIONAL GRID
2. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
3. CONTAINS PUBLIC SECTOR INFORMATION LICENSED UNDER THE GOVERNMENT LICENCE V3.0.
4. C04/06-CSL BRITISH GEOLOGICAL SURVEY.© NERC. ALL RIGHTS RESERVED.

CLIENT
SANDSFIELD GRAVEL COMPANY LTD.

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

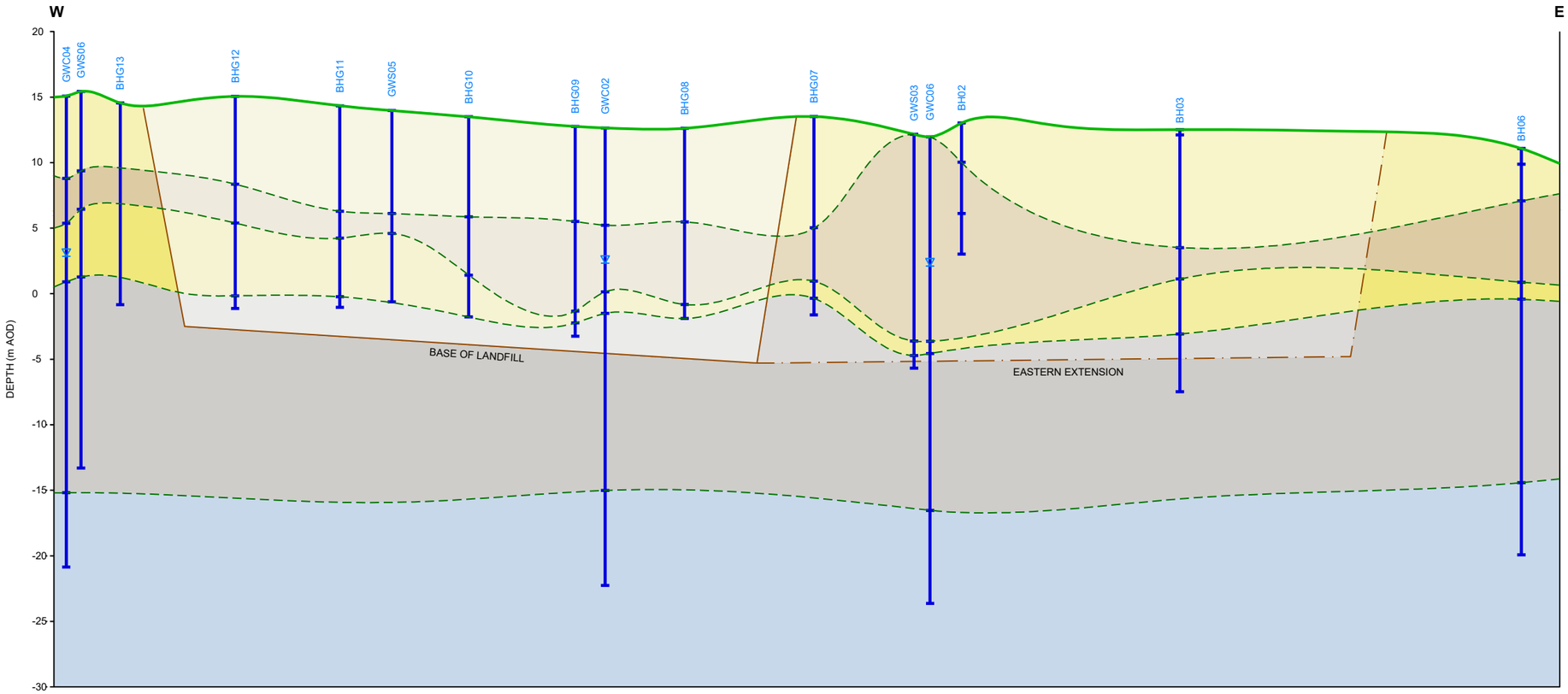
TITLE
GROUNDWATER VULNERABILITY AND SOURCE PROTECTION ZONES

CONSULTANT
GOLDER
MEMBER OF WSP

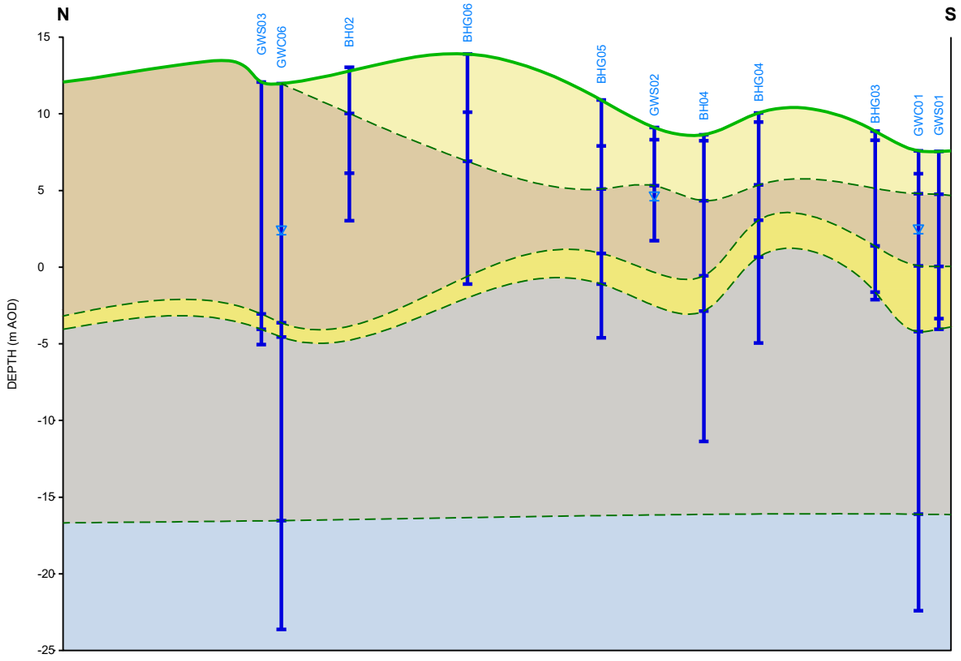
YYYY-MM-DD	2021 NOV 11
DESIGNED	AA
PREPARED	CB
REVIEWED	NW
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	GW_0005	B.0	ESID10

25mm
0

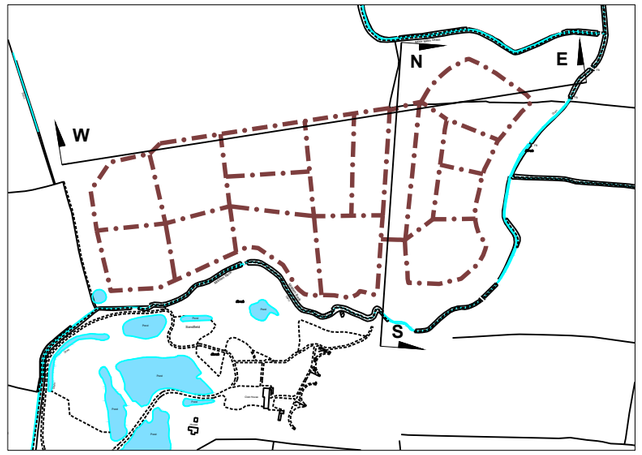


CROSS SECTION - WEST TO EAST
SCALE 1:400 V, NTS H



CROSS SECTION - NORTH TO SOUTH
SCALE 1:400 V, NTS H

SECTION LOCATIONS - 1:10,000



0 10 20
1:400 METRES

LEGEND

- GROUND LEVEL
- INFERRED BOUNDARY
- BOREHOLE
- UPPER SAND
- CLAY
- LOWER SAND
- TILL
- CHALK

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

TITLE
HYDROGEOLOGICAL CROSS SECTION

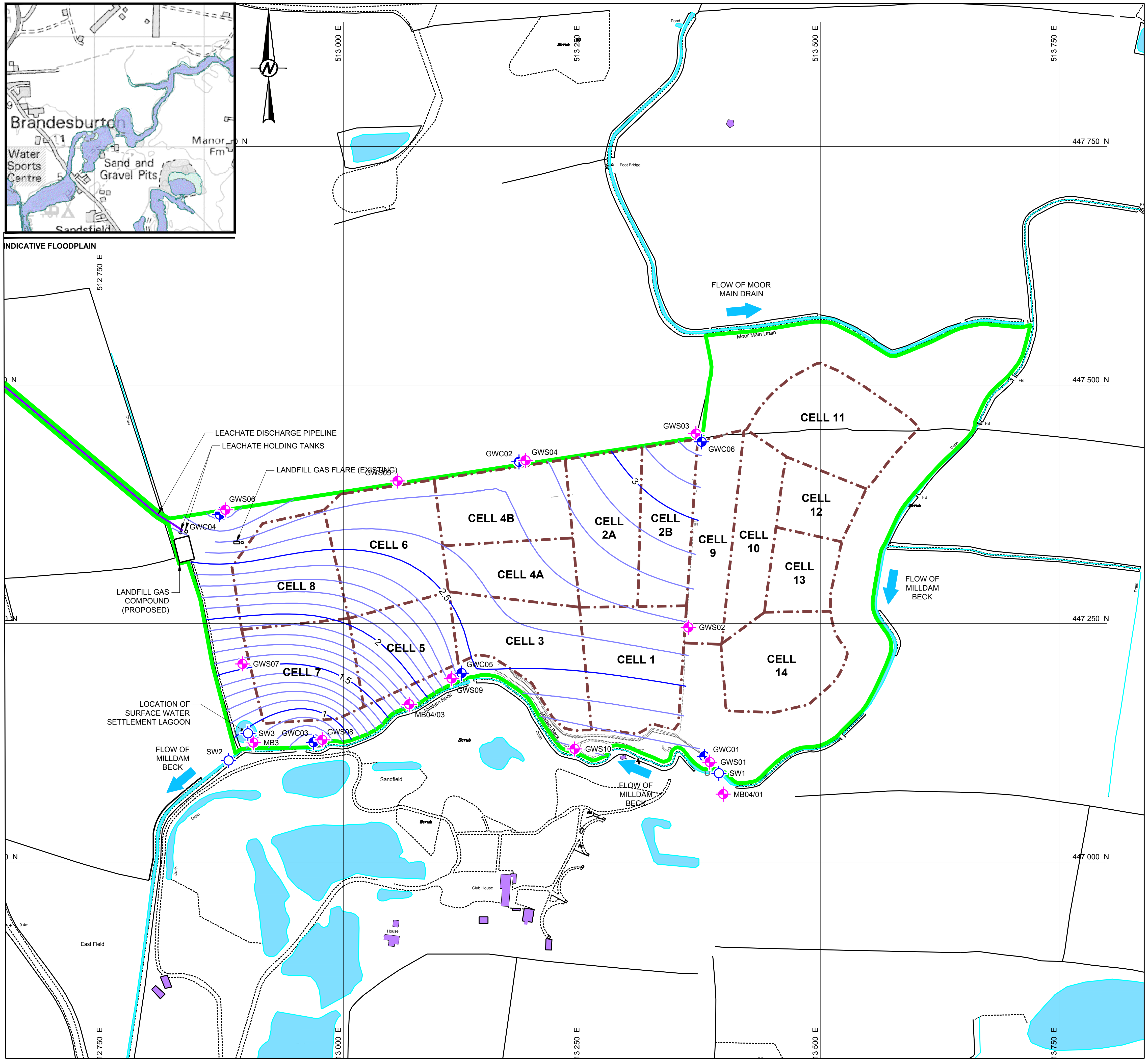
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0015	A	ESID12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3
25 mm
0

Path: \\golder.gds\comp\edinburgh\office\Bourne\End\CADDS\sandsfield gravel company ltd\Mileyate\99_PROJECTS\20148978\1004_Environmental Permit Variation\02_PRODUCTION\DWG\ | File Name: 20148978-1004-EP-0015.dwg | Last Edited By: lskinner Date: 2021-11-11 Time:12:25:53 PM | Printed By: lskinner Date: 2021-11-11 Time:12:27:07 PM



LEGEND

- PERMIT BOUNDARY
- CELL BOUNDARY
- GROUNDWATER MONITORING BOREHOLE IN THE LOWER SAND (SHALLOW)
- GROUNDWATER MONITORING BOREHOLE IN THE CHALK (DEEP)
- SURFACE WATER MONITORING POINT
- CHALK GROUNDWATER ELEVATION CONTOURS, DECEMBER 2020 (m AOD)

LEGEND - INDICATIVE FLOODPLAIN

- FLOODING FROM RIVERS OR SEA WITHOUT DEFENCES
- EXTENT OF EXTREME FLOOD

NOTE(S)

1. ALL LEVELS RELATIVE TO NEWLYN ORDNANCE DATUM.

REFERENCE(S)

CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PLANNING APPLICATION

TITLE
LOCAL HYDROGEOLOGY AND HYDROLOGY

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-06-14
DESIGNED	AA
PREPARED	ECS
REVIEWED	DD
APPROVED	DD

PROJECT NO.	CONTROL	REV.	DRAWING
20148978	1002-PA-0016	B	ESID11

APPENDIX ESID1

Water Balance

1.0 INTRODUCTION

Water balance calculations for the Eastern Extension of the Milegate Extension landfill site, have been used to determine the cell size and compare the quantities of water entering and leaving the waste mass during landfilling of each cell. Any imbalance between water input and water output will lead to a change in the quantity of liquid held in the waste mass as leachate.

Water is present in the current landfill as either free leachate or absorbed onto or into solid waste materials. The same leachate forms are expected to be encountered in the planned Eastern Extension. The amount held in each form depends on the storage characteristics of the waste. This varies depending on the type, source, and age of the waste.

The water balance calculations are based on the standard water balance equation for any hydrologic system, where the rate of inflow of water minus the rate of outflow of water is equal to the rate of change of the quantity of water stored within the system. In its application to a landfill system, this equation is rearranged and combined with assumptions about the volume and storage characteristics of the waste. The volume of free leachate can be calculated using the following equation:

$$V_L = V_{(in)} - AW$$

Where $V_{(in)}$ equals the volume of water entering the landfill system (m³), V_L equals the volume of free leachate in the landfill system (m³), A equals the absorptive capacity of the waste (m³/tonne), and W equals the waste input during the specified period (tonne).

The size of each cell will ensure that no free leachate is generated during the filling of each cell, i.e. the results of the above equation are negative and some absorptive capacity remains in the waste.

Water may enter the landfill as a result of effective rainfall, surface run-on, groundwater discharge, and, where permitted by the Environment Agency, leachate recirculation. Water can leave the landfill by evaporation, transpiration, surface run-off, surface seepage or springs, groundwater recharge, and leachate removal.

2.0 COMPONENTS OF THE WATER BALANCE FOR EASTERN EXTENSION

2.1 Effective rainfall

Effective rainfall is commonly the major input to the water balance. It is defined as the amount of rainfall available for infiltration after run-off and evapotranspiration losses have been taken into account and any soil moisture deficit has been satisfied. A soil moisture deficit evolves because of an excess of evapotranspiration over rainfall.

The effective rainfall to open waste at the Eastern Extension is conservatively estimated to be 236 mm per year (calculated in Section 3.1.1 of the ESID report), the same as for the currently operating site. For water balance calculation purposes, all the effective rainfall in active landfill phases is assumed to infiltrate into the waste.

2.2 Surface water run-on and run-off

Surface water that enters the Eastern Extension and the current site by run-on and leaves the site by run-off will be prevented as much as possible from entering the waste mass or leaving the site by a series of interception ditches and sumps within the landfilled areas of the site. The effect of surface water management has been ignored for the purposes of the water balance calculations, and surface water run-on and run-off are therefore not included in the inputs and outputs of the water balance calculations.

2.3 Groundwater inflow

The Eastern Extension, similarly to the current landfill site, will be situated in a shallow void that remains after sands and gravels are extracted. The upper sideslopes of the site will comprise sands and gravels while the lower sideslopes and base will comprise Glacial Till.

Low permeability base and sidewall linings will be constructed in all the cells and will comprise recompacted Till sourced from the site. The basal and sidewall lining of each cell will be a minimum of 1.0 m thick and will have a maximum permeability of 1.0 x 10^{-9}m/s.

As the Eastern Extension will be operated on the principal of hydraulic containment, similarly to the currently operating site, groundwater ingress into the landfill is anticipated to be occurring in areas where the elevation of the groundwater external to the site is greater than the elevation of the leachate within in the site. However, during construction and filling of the site, a back drain will be installed adjacent to the outer edge of the sidewall lining, therefore preventing the ingress of groundwater into the waste. As such, groundwater ingress has been ignored for the purposes of the water balance calculation.

2.4 Leachate recirculation

Leachate recirculation may take place at the site, as permitted by the Environment Agency, during filling in order to utilise the available absorptive capacity of the waste efficiently. As the cells have been designed to ensure free leachate does not generate while a cell is active.

2.5 Storage characteristics

As water percolates down through the Eastern Extension, it may be absorbed by the porous components of the waste. Waste at field capacity is defined as the maximum amount of moisture that can be held by the waste against the pull of gravity. The absorptive capacity is defined as the maximum amount of water that can be taken up by the waste to take it from its initial moisture content to field capacity.

A review of literature was carried out for the purposes of the original PPC application to determine an appropriate value for the absorptive capacity of refuse (References 1 to 12). Based on the findings of this review, a value of 0.05 m³/tonne was considered a reasonably cautious estimate for the absorptive capacity of the waste that is to be deposited, and this value is judged applicable to the Eastern Extension water balance calculations.

2.6 Waste input and phasing

Landfilling at the Eastern Extension will be undertaken in a phased manner in order to optimise the use of minerals and available void space. The size of each cell will be determined based on the findings of the water balance calculation to ensure that no free leachate generates within each cell during filling of that cell, i.e. the result of the equation presented previously is negative.

3.0 WATER BALANCE METHODOLOGY AND SUMMARY OF RESULTS

The water balance calculations have been undertaken using an Excel spreadsheet and a summary of the results is presented in Table 1. They indicate that free leachate will not be produced during landfilling of each cell, assuming:

- Groundwater ingress into the site during filling of each cell is zero;
- Effective rainfall is 236 mm per year;
- The absorptive capacity of the waste is 0.05 m³/tonne;
- The waste input rate to the site is 65,000 tonnes per year; and
- The waste has a density of 1.0 m³/tonne.

Table 1: Summary of Water Balance

Cell	Plan Area	Total Void Space	Time to Fill Cell	Total Water Input During Filling	Total Water Output (Absorptive Capacity) During Filling	Free Leachate Volume
	(m^2)	(m^3)	(years)	(m^3)	(m^3)	(m^3)
Cell 9	9499	136347	2.1	4703	6817	-2115
Cell 10	8535	130503	2.0	4044	6525	-2481
Cell 11	13528	114787	1.8	5638	5739	-102
Cell 12	5418	139474	2.1	2744	6974	-4230
Cell 13	5598	128596	2.0	2614	6430	-3816
Cell 14	11194	141106	2.2	5735	7055	-1320

4.0 REFERENCES FOR APPENDIX ESID1

1) Oweis, I.S. and Khera, R.P., 1990. Geotechnology of waste management. Butterworths.

2) North West Waste Disposal Officers, November 1991. Leachate Management Report.

3) Cambell, D.J.V., 1982. Absorptive capacity of refuse – Harwell research. Proceedings Harwell Landfill Symposium on Landfill Leachate, pp10.

4) Stegmann, R. 1982. Absorptive capacity of refuse – West German research. Proceedings 2nd Harwell Waste Management Symposium on Landfill Leachate, May 12pp.

5) Blakey, N.C. and Craft, D.G., 1986. Infiltration and absorption of waster by domestic wastes in landfills – leachate volume changes with time. Proceedings 6th Harwell Waste Management Symposium on Landfill Water Management, June 5-18.

6) Department of the Environment, 1986. Landfilling of wastes. Waste Management Paper No.26, HMSO, London. 206pp.

7) Department of the Environment, 1995. Landfill Design, Construction and Operational Practice. Waste Management Paper No.26B, HMSO, London.

8) Beaven, RP and Powrie, 1995. W “Hydrogeological and geotechnical properties of refuse using a large scale compression cell”. Proceedings Sardinia ’95. Fifth International Landfill Symposium.

9) Maier, T.B., 1998, Analysis procedures for design of leachate recirculation systems. Proc. 3rd Annual SWANA Landfill Symposium, Palm Beach Gardens, Florida.

10) GeoSyntec and Todd, D.K. 1995. Geotechnical Waste Characterisation. Report for a landfill in southern California.

11) McBean, E.A., Rovers, F.A. and Farquhar, G.J., 1995. Solid waste landfill engineering and design. Prentice Hall PTR, Englewood Cliffs, New Jersey.

12) Canziani, R and Cossu, R., 1989. Landfill hydrology and leachate production. Sanitary landfilling: process, technology and environmental impact. Harcourt Brace Jovanovich, New York, pp185-212.

APPENDIX ESID2

Borehole Logs

GOLDER

Client : Sandsfield Gravel Company

Hole No. BH01

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 20/09/2019 **Completed :** 20/09/2019

Logged by : A Moore (Driller)

Ground Level (mAOD) : 9.68

Co-ordinates : E 513510.3 N 447244.1

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
						9.48		0.20	Brown silty TOPSOIL.
								(1.80)	Dense orange/brown clayey SAND/GRAVEL.
						7.68		2.00	
								(2.20)	Fine brown SAND.
						5.48		4.20	
								(7.30)	Soft to firm grey silty CLAY.

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. BH01

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 20/09/2019 **Completed :** 20/09/2019

Logged by : A Moore (Driller)

Ground Level (mAOD) : 9.68

Co-ordinates : E 513510.3 N 447244.1

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES				STRATA RECORD			
		Depth (m)	No.	Type	SPT 'N'	Level (mAOD)	Legend	Depth (Thickness) m	Description
									Soft to firm grey silty CLAY.
						-1.82		11.50	
									Fine grey wet SILT.
								(3.50)	
						-5.32		15.00	
									End of Hole at 15.00m

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. **BH02**

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 20/09/2019 **Completed :** 20/09/2019

Logged by : A Moore (Driller)

Ground Level (mAOD) : 13.03

Co-ordinates : E 513398.4 N 447451.8

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
								(3.00)	Brown silty TOPSOIL.
						10.03		3.00	
								(3.90)	Dense orange/brown clayey SAND/GRAVEL.
						6.13		6.90	
								(3.10)	Soft to firm grey silty CLAY.
						3.03		10.00	

End of Hole at 10.00m

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. BH03

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 25/09/2019 **Completed :** 25/09/2019

Logged by : A Moore (Driller)

Ground Level (mAOD) : 12.52

Co-ordinates : E 513527.8 N 447424.5

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
						12.12		(0.40) 0.40	TOPSOIL.
									Brown clayey silty fine SAND becoming wet at 4.6 m.
▼1								(8.60)	
						3.52		9.00	Firm to stiff greyish brown very silty laminated CLAY.

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. BH03

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 25/09/2019 **Completed :** 25/09/2019

Logged by : A Moore (Driller)

Ground Level (mAOD) : 12.52

Co-ordinates : E 513527.8 N 447424.5

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
								(2.40)	Firm to stiff greyish brown very silty laminated CLAY.
2						1.12		11.40	
								(2.10)	Dense grey silty gritty SAND with small to large sized rounded mixed gravels.
						-0.98		13.50	
								(1.30)	Firm to stiff greyish brown very silty sandy CLAY with rounded and subangular chalk and flint gravels. Wet.
3						-2.28		14.80	
								(0.80)	Grey clayey gritty silty SAND with small to medium sized gravels.
						-3.08		15.60	
								(1.30)	Very stiff/compact grey very sandy CLAY with subangular and rounded flint and chalk gravels.
						-4.38		16.90	
						-4.68		17.20	Large flint gravels/cobbles with grey sandy matrix.
								(2.80)	Soft to firm greyish brown sandy silty CLAY with angular and rounded gravels.
						-7.48		20.00	

End of Hole at 20.00m

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. BH04

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 26/09/2019 **Completed :** 26/09/2020

Logged by : A Moore

Ground Level (mAOD) : 8.64

Co-ordinates : E 513385.2 N 447220.7

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	Level (mAOD)	Legend	Depth (Thickness) m	Description
						8.24		(0.40) 0.40	TOPSOIL.
						7.24		(1.00) 1.40	Brown clayey silty fine SAND with chalk.
						4.34		(2.90) 4.30	Orange coarse silty SAND.
						3.14		(1.20) 5.50	Firm grey CLAY with pebbles.
▼1						-0.56		(3.70) 9.20	Firm grey brown laminated silty CLAY.
									Dense grey silty gritty SAND with small to large sized rounded mixed gravels

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. BH04

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 26/09/2019 **Completed :** 26/09/2020

Logged by : A Moore

Ground Level (mAOD) : 8.64

Co-ordinates : E 513385.2 N 447220.7

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
								(2.30)	Dense grey silty gritty SAND with small to large sized rounded mixed gravels
						-2.86		11.50	
								(0.90)	Stiff/very compact greyish brown sandy CLAY with rounded and subangular gravels.
						-3.76		12.40	
								(0.50)	Grey gritty SAND with small gravels.
2						-4.26		12.90	
								(2.00)	Grey clayey gritty silty SAND with small to medium sized gravels.
						-6.26		14.90	
								(0.60)	Very stiff/compact grey very sandy CLAY with subangular and rounded flint and chalk gravels. Wet.
3						-6.86		15.50	
								(1.50)	Large flint GRAVELS/COBBLES with grey sandy matrix. Wet.
						-8.36		17.00	
								(3.00)	Firm to very stiff greyish brown sandy silty CLAY with angular and rounded gravels with occasional lenses of wet gritty sand.
						-11.36		20.00	

End of Hole at 20.00m

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. BH05

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 24/10/2019 **Completed :** 28/10/2019

Logged by : Structural Soils

Ground Level (mAOD) : 8.49

Co-ordinates : E 513576.2 N 447332.8

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
						6.49		(2.00) 2.00	Soft to firm brown/orange silty sandy CLAY.
						4.99		(1.50) 3.50	Orange coarse sandy GRAVEL.
						1.79		(3.20) 6.70	Fine orange SILT/SAND with clay bands. At 5 m occasional gravel bands.
						-0.31		(2.10) 8.80	Soft to firm brown silty CLAY with occasional chalk gravel.
								(2.20)	Grey brown silty fine to medium SAND. Coarse gravel at base.

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. **BH05**

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 24/10/2019 **Completed :** 28/10/2019

Logged by : Structural Soils

Ground Level (mAOD) : 8.49

Co-ordinates : E 513576.2 N 447332.8

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES				STRATA RECORD			
		Depth (m)	No.	Type	SPT 'N'	Level (mAOD)	Legend	Depth (Thickness) m	Description
									Grey brown silty fine to medium SAND. Coarse gravel at base.
3						-2.51		11.00	
									Stiff to very stiff slightly sandy CLAY with occasional fine subangular gravel.
								(3.00)	
						-5.51		14.00	
									Firm greyish brown SILT.
3								(2.00)	
						-7.51		16.00	
									Stiff to very stiff slightly sandy CLAY with occasional sand lenses of fine to coarse sand + water.
								(5.00)	

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. BH05

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 24/10/2019 **Completed :** 28/10/2019

Logged by : Structural Soils

Ground Level (mAOD) : 8.49

Co-ordinates : E 513576.2 N 447332.8

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES				STRATA RECORD			
		Depth (m)	No.	Type	SPT 'N'	Level (mAOD)	Legend	Depth (Thickness) m	Description
									Stiff to very stiff slightly sandy CLAY with occasional sand lenses of fine to coarse sand + water.
						-12.51		21.00	
									Firm to stiff slightly sandy SILT with regular fine sand lenses.
								(3.00)	
						-15.51		24.00	
									Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse.
								(0.60)	
						-16.11		24.60	
									Soft to firm light grey to black sandy slightly gravelly SILT. Gravel is subrounded fine to medium chalk. Becoming very gravelly at base.
						-16.41		24.90	
									Completely weathered chalk with occasional cobbles, gravel and cobble content increasing with depth. Cobbles max 90 mm.
								(6.10)	

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. **BH05**

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 24/10/2019 **Completed :** 28/10/2019

Logged by : Structural Soils

Ground Level (mAOD) : 8.49

Co-ordinates : E 513576.2 N 447332.8

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES				STRATA RECORD			
		Depth (m)	No.	Type	SPT 'N'	Level (mAOD)	Legend	Depth (Thickness) m	Description
						-22.51		31.00	Completely weathered chalk with occasional cobbles, gravel and cobble content increasing with depth. Cobbles max 90 mm.
									End of Hole at 31.00m

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. **BH06**

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 29/10/2019 **Completed :** 31/10/2019

Logged by : Structural Soils

Ground Level (mAOD) : 11.08

Co-ordinates : E 513724.0 N 447526.1

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	Level (mAOD)	Legend	Depth (Thickness) m	Description
						9.88		(1.20) 1.20	Dark brown slightly organic slighly sandy slighty gravelly silt. (TOPSOIL)
						8.68		(1.20) 2.40	Soft to firm brown sandy SILT.
						8.28		(0.40) 2.80	Light grey slightly silty medium SAND with occasional reddish brown mottle.
						7.08		(1.20) 4.00	Brown slightly silty SAND with occasional fine-coarse sub-rounded sandstone gravel.
						5.58		(1.50) 5.50	Stiff dark brown slightly sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine to coarse chalk and sandstone. Sand is medium to coarse.
						4.28		(1.30) 6.80	Medium dense sandy GRAVEL with occasional cobble. Gravel is subangular to subrounded fine to coarse quartzite and chert. Sand is medium to coarse.
								(3.40)	Stiff brown very sandy very gravelly CLAY with occasional cobble. Fine is fine to coarse. Gravel is subrounded to rounded fine to coarse quartzite and chert. At 7.4 m becoming firm with chalk gravel.

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. BH06

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 29/10/2019 **Completed :** 31/10/2019

Logged by : Structural Soils

Ground Level (mAOD) : 11.08

Co-ordinates : E 513724.0 N 447526.1

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES				STRATA RECORD			
		Depth (m)	No.	Type	SPT 'N'	Level (mAOD)	Legend	Depth (Thickness) m	Description
2						0.88		10.20	
								(1.30)	Slightly silty sandy GRAVEL. Gravel is fine to coarse of chalk, chert and sandstone. Small pockets of boulder CLAY.
						-0.42		11.50	
								(10.50)	Firm to stiff dark grey slighly gravelly CLAY with occasional slighly sandy lenses. Gravel is subangular fine to coarse.
3									

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. **BH06**

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 29/10/2019 **Completed :** 31/10/2019

Logged by : Structural Soils

Ground Level (mAOD) : 11.08

Co-ordinates : E 513724.0 N 447526.1

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
									Firm to stiff dark grey slighly gravelly CLAY with occasional slighly sandy lenses. Gravel is subangular fine to coarse.
3						-10.92		22.00	
								(1.20)	Grey SAND with occasional gravel. Sand is fine to coarse.
						-12.12		23.20	
								(2.30)	Soft to firm brown dark grey slightly sandy SILT. Large limestone cobble at 23.9 m.
						-14.42		25.50	
								(5.50)	Soft white clayey chalk.

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. **BH06**

Site : Milegate Extension Landfill - Eastern Extension

Project : Milegate Extension Landfill

Project No : 07514290324

Equipment & Methods : Dando 3000

Contractor : Site Investigation Services

Date Started : 29/10/2019 **Completed :** 31/10/2019

Logged by : Structural Soils

Ground Level (mAOD) : 11.08

Co-ordinates : E 513724.0 N 447526.1

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES				STRATA RECORD			
		Depth (m)	No.	Type	SPT 'N'	Level (mAOD)	Legend	Depth (Thickness) m	Description
						-19.92		31.00	Soft white clayey chalk.
									End of Hole at 31.00m

Remarks :
This borehole log has been generated using client supplied material. Golder was not present during the borehole construction.

Checked By: AA

Scale 1:50

GAUK - CP April 2008

Golder Associates	**Client :** Sandsfield Sand and Gravel Company Ltd.	**Hole No.** **BHG03**
Site : Milegate Extension Landfill, YO25 8SA, UK	**Project :** Cell 1 LFG Extraction	**Project No :** 07514290324
Equipment & Methods : Hymac 590 with Rotary Auger	**Contractor :** Earth Direct Ltd / South Tyne Drilling **Date Started :** 31/03/2009 **Completed :** 31/03/2009 **Logged by :** GJF	**Ground Level (mAOD) :** 9.75 **Co-ordinates :** E 513293.5 N 447150.6

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (m0)	Legend	Depth (Thickness) m	Description
								(1.20)	Dry contaminated soils
						8.55		1.20	
								(1.20)	Dry domestic MSW
						7.35		2.40	
						6.95		(0.40) 2.80	Moist commercial and building waste with mixed black contaminated soils
								(1.70)	Moist partially decomosed wood with high gas emmisions
						5.25		4.50	
								(1.50)	Moist domestic MSW
						3.75		6.00	
								(1.90)	Very moist patially degraded mixed putrescible wastes with occasional contaminated soils and textiles
						1.85		7.90	
								(0.50)	Very moist domestic MSW
						1.35		8.40	
									End of Hole at 8.40m

Remarks :
Top of plain pipe 1.3 above ground following installation

Checked By: BW

Scale 1:50

GAUK - RC April 2008

Golder Associates	Client : Sandsfield Sand and Gravel Company Ltd.	Hole No. **BHG04**
Site : Milegate Extension Landfill, YO25 8SA, UK	**Project :** Cell 1 LFG Extraction	**Project No :** 07514290324
Equipment & Methods : Hymac 590 with Rotary Auger	**Contractor :** Earth Direct Ltd / South Tyne Drilling **Date Started :** 31/03/2009 **Completed :** 31/03/2009 **Logged by :** GJF	**Ground Level (mAOD) :** 9.46 **Co-ordinates :** E 513329.8 N 447158.5

WATER/ PROGRESS	INSTALLATION /BACKFILL	CORING				STRATA RECORD			
		Top of Core Run	TCR (%)	SCR (%)	RQD (%)	Level (m0)	Legend	Depth (Thickness) m	Description
								(1.60)	Dry contaminated soils
						7.86		1.60	
								(1.90)	Dry domestic MSW
						5.96		3.50	
								(0.70)	Moist industrial and building waste
						5.26		4.20	
						4.96		4.50	Moist partially degraded lignified wood and other putrescibles
								(1.20)	Moist domestic MSW
						3.76		5.70	
								(0.60)	Dry contaminated soils with occasioal plastic bags
						3.16		6.30	
						2.76		(0.40) 6.70	Moist wood rich building and commerical waste
								(1.10)	Very moist domestic MSW
						1.66		7.80	
						1.06		(0.60) 8.40	Very moist domestic MSW
								(1.40)	Wet mixed black soils and degraded MSW, significant free lechate
						-0.34		9.80	
									End of Hole at 9.80m

Remarks :
Top of plain pipe 1.2 above ground following installation

Checked By: BW

Scale 1:50

GAUK - RC April 2008

Golder Associates

Project: **Milegate Extension**

Borehole ID: **BHG05**

Sheet 1 of 2

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 29/04/2006 Completed: 29/04/2006

Logged by: JL

Ground Level: 10.90

Co-ordinates: 513360.74 447272.31

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
						10.40		0.50	Firm, damp, dark brown, SILT / CLAY. (RECENT DEPOSITS)
		1							Very stiff, moist, orange and brown CLAY and some medium sand. (RECENT DEPOSITS)
		2							
		3				7.90		3.00	Soft, wet, light brown SILT with some sand. Sand is fine to coarse. (GLACIAL DEPOSITS)
▼		4				6.90		4.00	Soft, damp, SILT and SAND with occassional gravel. Gravel is fine to medium, angular to rounded. (GLACIAL DEPOSITS)
		5							
▼		6				5.10		5.80	Stiff, damp grey CLAY. Patches of fine to coarse orange sand between 7.1 and 7.4 m b. g. l. (GLACIAL DEPOSITS)
		7							
		8							

Continued on next sheet

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

Golder Associates

Project: **Milegate Extension**

Borehole ID: **BHG05**

Sheet 2 of 2

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 29/04/2006 Completed: 29/04/2006

Logged by: JL

Ground Level: 10.90

Co-ordinates: 513360.74 447272.31

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
		10				0.90		10.00	Stiff, damp grey CLAY. Patches of fine to coarse orange sand between 7.1 and 7.4 m b.
						0.70		10.20	g.
						0.30		10.60	l. (GLACIAL DEPOSITS)
		11							Dense, moist, light grey sandy silty GRAVEL. Gravel is fine to coarse, angular to sub-rounded of chalk, yellow sandstone, chert, flint and shale. (GLACIAL DEPOSITS)
		12				-1.10		12.00	Stiff, damp, light grey CLAY with gravel. Gravel is fine to coarse, angular to sub angular. (GLACIAL DEPOSITS)
									Stiff, damp, light grey silty GRAVEL. Gravel is fine to coarse angular to sub-rounded. (GLACIAL DEPOSITS)
		13							Stiff, damp, dark grey CLAY with some gravel. Gravel is fine to coarse, sub angular to sub rounded of mudstone and limestone. (GLACIAL DEPOSITS)
		14							
		15				-4.60		15.50	*End of Borehole at 15.50 m*
		16							
		17							

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

Golder Associates

Project: **Milegate Extension**

Borehole ID: **BHG06**

Sheet 1 of 2

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 21/04/2006 Completed: 21/04/2006

Logged by: JL

Ground Level: 13.90

Co-ordinates: 513363.40 447343.84

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
						13.85		0.05	Soft, moist, brown SILT/ CLAY. (TOPSOIL)
		1							Firm, damp, light brown and red CLAY with occassional gravel. Gravel is fine, sub angular to sub rounded of limestone and sandstone AND medium sand of coal. (MADE GROUND)
						12.80		1.10	
		2							Firm, damp, light brown and red CLAY with occassional gravel. Gravel is fine, sub angular to sub rounded, limestone and sandstone) and medium sand of coal. (MADE GROUND)
		3							
						10.10		3.80	
		4							Firm, damp, light brown clay with sand and GRAVEL. Gravel is fine to medium, angular to rounded. (RECENT DEPOSITS)
						9.30		4.60	
		5							Dense, light brown, yellow GRAVEL. Gravel is fine to coarse, angular to sub rounded. (GLACIAL DEPOSITS)
		6							
		7				6.90		7.00	
									Stiff, damp, grey SILT / CLAY with occassional gravel. Gravel is fine, sub-angular to sub-rounded. (GLACIAL DEPOSITS)
		8							

Continued on next sheet

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

Golder Associates

Project: **Milegate Extension**

Borehole ID: **BHG06**

Sheet 2 of 2

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 21/04/2006 Completed: 21/04/2006

Logged by: JL

Ground Level: 13.90

Co-ordinates: 513363.40 447343.84

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
		10							Stiff, damp, grey SILT / CLAY with occassional gravel. Gravel is fine, sub-angular to sub-rounded. (GLACIAL DEPOSITS)
		11							
		12							
						1.20		12.70	
		13							Firm, damp, light grey CLAY with some sand and gravel. Gravel is fine to medium, angular to sub rounded. (GLACIAL DEPOSITS)
		14							
		15				-1.10		15.00	*End of Borehole at 15.30 m*
		16							
		17							

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

Golder Associates

Project: **Milegate Extension**

Borehole ID: **GWC01**

Sheet 1 of 4

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 08/05/2006 Completed: 10/05/2006

Logged by: JL

Ground Level: 7.59

Co-ordinates: 513383.87 447110.59

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
						6.89		0.70	Soft, moist, dark brown, black SILT / CLAY with high organic content. (RECENT DEPOSITS)
		1	1.00	SPT BULK	1.00 7	6.09		1.50	Soft, damp, silty peaty CLAY. (RECENT DEPOSITS)
		2				4.79		2.80	Moist, orange, black, grey and white clayey GRAVEL. Gravel is fine to medium, angular to rounded. (GLACIAL DEPOSITS)
		3	3.00	SPT BULK	3.00 8	2.89		4.70	Soft to firm, dark grey CLAY. (GLACIAL DEPOSITS)
		4	4.00	U100		2.59		5.00	Soft, damp dark grey sandy CLAY. (GLACIAL DEPOSITS)
			4.45 4.50	D BULK					Firm, damp dark brown CLAY. (POSSIBLE GLACIAL DEPOSITS)
		5							
		6	6.00	SPT BULK	6.00 11				
		7				0.09		7.50	
			7.50	SPT BULK	7.50 8				Loose, moist, orange, black, grey and white clayey GRAVEL. Gravel is fine, angular to rounded. Becoming dense from 9.5 m bgl. (GLACIAL DEPOSITS)
		8							
			9.50	SPT BULK	9.50 27				

Continued on next sheet

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

Golder Associates

Project: **Milegate Extension**

Borehole ID: **GWC01**

Sheet 2 of 4

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 08/05/2006 Completed: 10/05/2006

Logged by: JL

Ground Level: 7.59

Co-ordinates: 513383.87 447110.59

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
		10				-2.41		10.00	Loose, moist, orange, black, grey and white clayey GRAVEL. Gravel is fine, angular to rounded. Becoming dense from 9.5 m bgl. (GLACIAL DEPOSITS)
		11	11.00	SPT BULK	11.00 60				Very dense, damp, orange, black and grey GRAVEL. Gravel is fine, sub angular to sub-rounded. (GLACIAL DEPOSITS)
						-4.21		11.80	
		12	12.00	U100					Stiff, damp, light brown grey CLAY. (GLACIAL DEPOSITS)
						-4.61		12.20	
						-4.91		12.50	Damp, white, black dark grey and orange GRAVEL. Gravel is medium to coarse, angular to sub rounded of limestone. (GLACIAL DEPOSITS)
		13	13.00	U100					Firm, moist, dark grey CLAY. (GLACIAL DEPOSITS)
			13.45	D					
		14							
			14.50	SPT	14.50 11	-6.91		14.50	Firm, wet, dark grey SAND and CLAY with gravel. Gravel is fine to medium, angular to rounded. (GLACIAL DEPOSITS)
		15							
		16	16.00	U100					
		17							
						-10.41		18.00	
			18.20	U100					Firm, wet, dark grey CLAY. (GLACIAL DEPOSITS)

Continued on next sheet

Remarks:

Scale: 1:50

GAUK CP (SPT) October 2005

Golder Associates

Project: **Milegate Extension**

Borehole ID: **GWC01**

Sheet 3 of 4

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 08/05/2006 Completed: 10/05/2006

Logged by: JL

Ground Level: 7.59

Co-ordinates: 513383.87 447110.59

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
		20				-12.41		20.00	Firm, wet, dark grey CLAY. (GLACIAL DEPOSITS)
		21	21.00	SPT	21.00 20				Stiff brown SILT / CLAY with gravel. Gravel is fine, angular to rounded. (GLACIAL DEPOSITS)
		22							
		23				-15.41		23.00	Stiff damp, dark brown silty sandy CLAY. (GLACIAL DEPOSITS)
▼		24				-16.11		23.70	Stiff, white chalk. (FLAMBOROUGH CHALK FORMATION)
		25							
		26							
		27							

Continued on next sheet

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

Golder Associates

Project: **Milegate Extension**

Borehole ID: **GWC01**

Sheet 4 of 4

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 08/05/2006 Completed: 10/05/2006

Logged by: JL

Ground Level: 7.59

Co-ordinates: 513383.87 447110.59

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
		30				-22.41		30.00	Stiff, white chalk. (FLAMBOROUGH CHALK FORMATION)
									End of Borehole at 30.00 m
		31							
		32							
		33							
		34							
		35							
		36							
		37							

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

GOLDER

Client : Sandsfield Gravel Company

Hole No. GWC06

Site : Brandesburton, East Yorkshire

Project : Milegate Quarry

Project No : 07514290324

Equipment & Methods : Dando 3500

Contractor : SIS Drilling

Date Started : 26/10/2020 **Completed :** 29/10/2020

Logged by : DL

Ground Level (mAOD) : 11.97

Co-ordinates : E 513372.4 N 447448.7

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
						11.77		0.20	Damp, dark brown sandy gravelly SILT. Gravel is fine to medium, sub-angular to sub rounded of mixed lithologies.
								(2.80)	Soft to firm, Yellowy brown to dark brown, slightly gravelly sandy SILT/CLAY
						8.97		3.00	Firm to stiff, brown to grey gravelly sandy SILT/CLAY. Gravel is subrounded fine to medium of mixed lithologies.
								(8.50)	

Remarks :

Checked By: BZ

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. GWC06

Site : Brandesburton, East Yorkshire

Project : Milegate Quarry

Project No : 07514290324

Equipment & Methods : Dando 3500

Contractor : SIS Drilling

Date Started : 26/10/2020 **Completed :** 29/10/2020

Logged by : DL

Ground Level (mAOD) : 11.97

Co-ordinates : E 513372.4 N 447448.7

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES				STRATA RECORD			
		Depth (m)	No.	Type	SPT 'N'	Level (mAOD)	Legend	Depth (Thickness) m	Description
						0.47		11.50	Firm to stiff, brown to grey gravelly sandy SILT/CLAY. Gravel is subrounded fine to medium of mixed lithologies.
						-3.63		(4.10) 15.60	Stiff grey-brown CLAY.
						-4.53		(0.90) 16.50	Dark brown, occassionally white and red gravelly CLAY/SILT. Gravel is fine to medium and sub-rounded and of mixed lithologies
						-8.03		(3.50) 20.00	Sandy silty GRAVEL. Gravel is Coarse to fine and subangular to subrounded of mixed lithologies. Occasionally becomes gravelly SAND.

Remarks :

Checked By: BZ

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. GWC06

Site : Brandesburton, East Yorkshire

Project : Milegate Quarry

Project No : 07514290324

Equipment & Methods : Dando 3500

Contractor : SIS Drilling

Date Started : 26/10/2020 **Completed :** 29/10/2020

Logged by : DL

Ground Level (mAOD) : 11.97

Co-ordinates : E 513372.4 N 447448.7

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
								(1.50)	Firm to Stiff, dark brown gravelly CLAY/SILT. Gravel fine to coarse and sub-angular to subrounded.
						-9.53		21.50	
								(4.20)	Yellow brown to grey, gravelly SAND. Gravel is fine to coarse, generally subrounded to subangular but occassionally angular. Occasionally becomes sandy GRAVEL.
						-13.73		25.70	
								(2.80)	Stiff, grey brown to dark brown gravelly CLAY. Gravel is fine to coarse and subangular to subrounded. Gravel is of mixed lithologies.
						-16.53		28.50	
									Very weak, pale grey to white CHALK.

Remarks :

Checked By: BZ

Scale 1:50

GAUK - CP April 2008

GOLDER

Client : Sandsfield Gravel Company

Hole No. **GWC06**

Site : Brandesburton, East Yorkshire

Project : Milegate Quarry

Project No : 07514290324

Equipment & Methods : Dando 3500

Contractor : SIS Drilling

Date Started : 26/10/2020 **Completed :** 29/10/2020

Logged by : DL

Ground Level (mAOD) : 11.97

Co-ordinates : E 513372.4 N 447448.7

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES Depth (m)	No.	Type	SPT 'N'	STRATA RECORD Level (mAOD)	Legend	Depth (Thickness) m	Description
								(4.00)	Very weak, pale grey to white CHALK.
						-20.53		32.50	
								(3.10)	Weak to medium strong, white CHALK
						-23.63		35.60	
									End of Hole at 35.60m

Remarks :

Checked By: BZ

Scale 1:50

GAUK - CP April 2008

Golder Associates

Project: **Milegate Extension**

Borehole ID: **GWS01**

Sheet 1 of 2

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 08/05/2006 Completed: 08/05/2006

Logged by: JL

Ground Level: 7.55

Co-ordinates: 513385.64 447106.27

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
						6.75		0.80	Damp black and dark grey SILT. (GLACIAL DEPOSITS)
		1				5.75		1.80	Soft, wet, light brown and grey SILT / CLAY with occassional gravel. Gravel is fine to coarse, angular to rounded. (GLACIAL DEPOSITS)
		2				4.75		2.80	Damp, white, grey, yellow and black GRAVEL. Gravel is fine to medium, sub angular to sub rounded. (GLACIAL DEPOSITS)
		3							Firm, damp, light brown and orange sandy CLAY. (GLACIAL DEPOSITS)
		4							
		5							
		6							
▼		7				0.05		7.50	Damp, white, dark grey and yellow clayey GRAVEL. Gravel is fine to coarse, angular to rounded. (GLACIAL DEPOSITS)
		8							

Continued on next sheet

Remarks:

Scale: 1:50

Golder Associates

Project: **Milegate Extension**

Borehole ID: **GWS01**

Sheet 2 of 2

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 08/05/2006 Completed: 08/05/2006

Logged by: JL

Ground Level: 7.55

Co-ordinates: 513385.64 447106.27

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
		10							Damp, white, dark grey and yellow clayey GRAVEL. Gravel is fine to coarse, angular to rounded. (GLACIAL DEPOSITS)
		11				-3.35		10.90	Stiff, damp, light brown CLAY. (GLACIAL DEPOSITS)
		12				-4.05		11.60	*End of Borehole at 11.60 m*
		13							
		14							
		15							
		16							
		17							

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

Golder Associates

Project: **Milegate Extension**

Borehole ID: **GWS02**

Sheet 1 of 1

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 19/04/2006 Completed: 19/04/2006

Logged by: JL

Ground Level: 9.11

Co-ordinates: 513359.87 447246.31

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
									Soft, damp, dark brown CLAY/ SILT. (RECENT DEPOSITS)
						8.31		0.80	
		1							Firm, brown, mottled SILT / CLAY (GLACIAL DEPOSITS)
						7.81		1.30	
									Soft, damp, light brown gravelly SILT / CLAY. Gravel is fine, sub angular to sub rounded. (GLACIAL DEPOSITS)
		2				7.11		2.00	
▼									Soft, damp greyish brown silty sandy CLAY. (GLACIAL DEPOSITS)
						6.71		2.40	
		3							Dense, damp, SAND and GRAVEL. (GLACIAL DEPOSITS)
						5.31		3.80	
		4							Very loose, wet, light brown, sandy SILT / CLAY. (GLACIAL DEPOSITS)
		5							
		6				3.11		6.00	
									Very Stiff, dark brown CLAY. (GLACIAL DEPOSITS)
		7				2.11		7.00	
									End of Borehole at 7.00 m
		8							

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

Golder Associates

Project:
Milegate Extension

Borehole ID:
GWS03
Sheet 1 of 2

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods:
Dando 175

Drilled by: Site Investigation Services
Date started: 28/04/2006 Completed: 02/05/2006
Logged by: JL

Ground Level: 12.05
Co-ordinates:
513369.30 447448.93

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
						11.85		0.20	Damp, dark brown sandy gravelly SILT. Gravel is fine to medium, sub angular to sub rounded. (TOPSOIL)
									Damp, dark brown sandy SILT / CLAY with occassional gravel. Gravel is fine to medium, sub angular to sub rounded. (GLCACIAL DEPOSITS)

Continued on next sheet

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

Golder Associates

Project: **Milegate Extension**

Borehole ID: **GWS03**

Sheet 2 of 2

Site: Brandesburton

Client: Sandsfield Ltd.

Project No. 06529180

Equipment & Methods: Dando 175

Drilled by: Site Investigation Services

Date started: 28/04/2006 Completed: 02/05/2006

Logged by: JL

Ground Level: 12.05

Co-ordinates: 513369.30 447448.93

WATER	INSTALLATION/ BACKFILL	HOLE DEPTH (m)	SAMPLES Depth (m)	Type	SPT Result	STRATA RECORD Level (m aOD)	Legend	Depth *Thickness* (m)	Description
		10							Damp, dark brown sandy SILT / CLAY with occassional gravel. Gravel is fine to medium, sub angular to sub rounded. (GLCACIAL DEPOSITS)
		11							
		12				0.05		12.00	Soft, damp, dark brown SILT / CLAY. (GLACIAL DEPOSITS)
		13							
		14							
▼		15				-3.05		15.10	Damp, white, light grey and yellow silty GRAVEL. Gravel is fine to medium, angular to rounded. (GLACIAL DEPOSITS)
		16				-4.05		16.10	Firm, damp, dark brown sandy CLAY. (GLACIAL DEPOSITS)
		17				-5.05		17.10	*End of Borehole at 17.50 m*

Remarks:

Scale: 1:50

GAUK CP (SPT)
October 2005

golder.com