**REPORT**

# Sandsfield Gravel Company Ltd

*Groundwater Management and Monitoring Plan - Milegate Eastern Extension*

Submitted to:

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# Distribution List

Sandsfield Gravel Company Ltd - 1 copy (pdf)

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# 1.0 REPORT CONTEXT

Sandsfield Gravel Company Ltd ('Sandsfield') has requested Golder Associates (UK) Ltd ('Golder') develops a Groundwater Management and Monitoring Plan at Milegate Extension Landfill Site ('Milegate Extension Landfill') including the proposed extension towards the east ('Eastern Extension') which are collectively referred to as the 'Site'. A location plan for the Site is provided in **Drawing ESID1 - Site Location Plan**. The Milegate Extension Landfill is operated by the Sandsfield Gravel Company Ltd. under Environmental Permit BX1942IX issued on 3 March 2006 which was subsequently varied several times with the most recent variation notice EPR/BX1942IX/V003 dated 17 February 2020 (the 'Permit').

This Plan should be read in conjunction with the Permit variation application, in particular Environmental Setting and Installation Design (ESID; ref. 20148978.632), and Hydrogeological Risk Assessment (HRA; ref. 20148978.633). This plan has been revised to incorporate the Eastern Extension deeming the previous Groundwater Management and Monitoring Plan (ref. 06529180.503), listed as an operating technique in the Table S1.2 of the Permit, inapt. This document is to be treated as new operating techniques guidance and added to the Table S1.2 of the Permit.

The assistance of Sandsfield in the provision of data for this work is gratefully acknowledged. Golder has not attempted to independently verify any of the information supplied.

# 2.0 GROUNDWATER MANAGEMENT

Observations made at the Site during the extraction of sand and gravel show that groundwater present in the Lower Sand flows into the excavation. As such, groundwater in the Lower Sand has been managed during the construction of the Site using a back-drain behind each cell.

Groundwater drains have been constructed for all cells that received waste. One drain prevents ingress of groundwater from south and west running along the eastern edge of Cell 1, southern edges of Cells 1, 3, 5, and 7, and western edges of Cells 7 and 8. A back drain sump located in the north-west corner of the landfill collects the water and from where it is transported via a network of pipes and ditches to settlement ponds from which it gets discharged to the Milldam Beck in the south-west corner of the Site. Leading to the same sump is a drain collecting water from the northern side of the Site and which currently runs along the northern edges of Cells 8, 6 and 4B and is planned to be extended on to Cells 2A and 2B.

A groundwater drainage system will be constructed around the Eastern Extension with the same general design as at the existing parts of Milegate Extension Landfill. Groundwater will flow under gravity from the back drain into a back drain sump from which it will be pumped and transported via a surface water network to be discharged to the Milldam Beck. A detailed design will be provided upon approval of this permit variation application.

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 sufficiently high 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 SRA as part of the original PPC Permit application and an updated version including the Eastern Extension is presented in the SRA supporting this variation application (20148978.634). Detailed cell design and CQA procedures for engineering the lining system have been described within the CQA Plans submitted to the Environment Agency (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.

No active control of groundwater is required following cessation of landfill construction and filling operations at the site.

# 3.0 GROUNDWATER MONITORING INFRASTRUCTURE

## 3.1 Location and Installation of Boreholes

The EA's Landfill Technical Guidance Note 2 (LFTGN02) states that "*the requirements of the Landfill Regulations are as follows:*

- *For all sites at which groundwater monitoring is specified, there should be at least one measuring point in the groundwater inflow region (i.e. up-gradient of the landfill), and two in the outflow region (i.e. down-gradient); and*
- *For engineered containment sites where any leakage of leachate is likely to be diffuse (e.g. by use of mineral liners), at least one borehole should be provided per 100 m width of the Site on the down-gradient landfill margin".*

The site operates based on engineered and hydraulic containment and all surrounding groundwater is therefore upgradient. Only if hydraulic containment is lost will groundwater become downgradient of the Site. Nevertheless, monitoring boreholes are, and will continue to be, placed around the perimeter of the existing site and the Eastern Extension at a minimum spacing of approximately 100 m.

A comprehensive network of eighteen groundwater monitoring boreholes is currently in operation at the existing site; six of them monitor the Chalk, deep primary aquifer, and twelve monitor the Lower Sand, shallow secondary aquifer. Installation of a further six wells is proposed in order to extend the existing network into the Eastern Extension. They are located in pairs, a deep and a shallow well adjacent to each other, spread evenly around the eastern side of the extension.

The existing and proposed groundwater monitoring boreholes' locations are shown on **Drawing HRA1 - Monitoring and Extraction Point Plan**.

## 3.2 Design of Boreholes

The EA's Landfill Technical Guidance Note 2 (LFTGN02) states that the "*design objectives relating to groundwater monitoring points are:*

- *To permit an accurate water level or pressure ('piezometric') level to be measured and recorded to an elevation expressed as metres above ordnance datum; and*
- *To enable an appropriate sample to be obtained from the surrounding strata."*

It also states that "*In strata in which groundwater varies seasonally, the screened section of the borehole should extend below the lowest likely water level by sufficient depth to enable sampling*."

The Chalk aquifer is confined and known to exhibit a piezometric head that exceeds the elevation of the top of the Boulder Clay. Up to date only minimal variations of water level have been observed at the site and the same trend is anticipated within the Eastern Extension boreholes. Therefore, the boreholes are screened over a 6 m interval within the Chalk, permitting groundwater levels to be measured and representative samples to be collected.

As expected, and because of the ongoing dewatering as landfill progresses, groundwater levels in the sand and gravel are variable. The boreholes are typically screened for 6 m through the thickness of the Lower Sand such that the water level variation within the unsaturated zone can be measured. 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. 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.

The design specification for the Lower Sand (shallow) and the Chalk (deep) monitoring boreholes are shown in **Drawings GwMP1** and **GwMP2**, respectively.

The boreholes will be drilled at a diameter of 200 mm. Slotted HDPE piping will be installed throughout the entire groundwater horizon in the Lower Sand for boreholes installed in the Lower Sand and 6 m into the Chalk for boreholes installed in the Chalk with the remainder comprising solid pipework. The slotted piping will be surrounded with a filter wrap to prevent the ingress of fines. The annulus between the slotted pipe and the edge of the boring will be filled with a 2 mm to 6 mm gravel pack. Bentonite seals will be placed above the filter pack and below the surface concrete. The remainder of the annulus will be filled with clean granular material. An end cap will be fitted to the base of the piping, while the top of the piping will be fitted with a removable cap. Secure lockable headworks will be fitted over the top of the borehole and secured into position using concrete.

Prior to installing the HDPE piping in the Chalk wells, the boring will be developed by removing water until such time as the site engineer deems the water to be clean and free from drilling (chalky) debris.

## 3.3 Construction Quality Assurance of New and Replacement Monitoring Points

Installation of new or replacement groundwater monitoring boreholes has been and will continue to be undertaken in accordance with the following construction quality assurance (CQA) plan which covers the elements of the design and installation.

The CQA Plans include and will continue to include, but not be limited, to the following:

CQA supervision will be carried out full time during the Site works. The engineer will conduct the following:

- Record the drilling locations;
- Make observations regarding the lithology encountered during drilling and record details regarding water strikes;
- Record the depth of drilling;
- Describe the materials in relation to the specification;
- Record the way installation materials are delivered, handled and stored with reference to the manufacturer’s recommendations; and
- Record the installations with reference to the design.

Groundwater monitoring boreholes will be drilled and recorded in accordance with BS 5930 Code of Practice for Ground Investigations. Borehole logs and *as-built* installation details will be forwarded to the EA and will provide the following information:

- Labelling of the borehole;
- Date of drilling and installation;
- Geological strata descriptions;
- Groundwater level (and any perched water levels);
- Design of the borehole if more than one type is being used on the Site;
- Depth of borehole (metres) and level of the bottom of the borehole in metres above ordnance datum (m AOD);
- The surveyed height of the top of the borehole in metres above ordnance datum, and the surveyed ground level at the point if it differs; and
- The National Grid Reference of the boreholes (10 figure).

A CQA validation report will be provided that includes the above details and borehole construction detail drawings. The CQA validation report will be submitted to the EA within three months of completion of installation.

Following installation, all groundwater monitoring boreholes will be levelled to Ordnance Datum, and an elevation reference mark permanently placed on the point. Where any monitoring well is extended or repaired, the well will be resurveyed within one month and, where necessary, any monitoring results obtained in the intervening period will be corrected according to the revised level.

# 4.0 MAINTENANCE OF GROUNDWATER MONITORING POINTS

## 4.1 Borehole Maintenance

Groundwater monitoring boreholes are and will be maintained in a condition that allows them to fulfil their required purpose. Boreholes will be inspected for damage each time that they are monitored or sampled. Any damage noted will be repaired within seven days of detection. Where a borehole is damaged such that it requires replacement, a replacement borehole will be drilled within one month subject to availability of drilling contractor, weather conditions, and access to the location, and in any event, no later than within three months.

Details of inspections of monitoring boreholes, remedial actions undertaken, or replacement boreholes installed will be recorded in the site diary, to include relevant dates of inspections and remedial works and details of who carried out the inspection or works.

## 4.2 Borehole Redundancy and Decommissioning

The following details for decommissioning of redundant boreholes have been based on guidelines from the EA.

Decommissioning will commence with the following objectives:

- Remove the hazard of any open hole (safety issues);
- Prevent the borehole acting as a conduit for contamination to enter groundwater;
- Prevent the mixing of contaminated and uncontaminated groundwater from different aquifers;

- Prevent the flow of groundwater from one geological horizon to another; and
- Prevent the wastage of groundwater from overflow from artesian boreholes.

The borehole shall be made free from all obstructions. In particular, pipe work and the condition of the casing shall be checked to ensure retention of the grout. The hole should be backfilled with uncontaminated material of a similar permeability to that of the geological strata against which they are placed.

When sealing the top of the borehole, the final two meters from ground level should be filled with cement concrete or bentonite grout. A concrete or cement cap should then be installed over the top of the borehole and surrounding ground.

Where necessary, the decommissioning process should mimic the existing permeability of the geological stratigraphy and prevent a contamination pathway occurring. In the Chalk boreholes, the decommissioning process should aim to confine the groundwater to the aquifer from which it came in order to prevent loss of confining pressure, and the loss of water resources to the overlying strata.

The following shall be recorded when decommissioning:

- Reasons for abandonment;
- Measurement of groundwater level prior to backfilling;
- The depth and position of each layer of backfilling and sealing material;
- Any changes made to the borehole during abandonment; and
- Any problems encountered during the abandonment procedure.

# 5.0 GROUNDWATER MONITORING PLAN

Groundwater monitoring is cognisant of EA guidance (EA, 2021).

## 5.1 Monitoring Programme

The proposed groundwater monitoring programme to be undertaken at the Site is presented in Table GwMP1 in accordance with Tables S3.4 and S3.7 of the EP and variations proposed due to addition of the Eastern Extension and reassessment of the priority contaminants. Boreholes with the prefix GWC are installed within the Chalk, while those with the prefix GWS are installed within the Lower Sand. Boreholes prefixed MB are installed within the Lower Sand and are pre-existing at the Site.

**Table GwMP1: Proposed Groundwater Monitoring Programme**

| Location | Measurement or Analysis Required | Frequency |
|---|---|---|
| GWC01, GWC02, GWC03, GWC05, GWC06; | ammoniacal nitrogen, lead, chloride, nickel, benzene, fluoranthene, mecoprop;<br>water level, electrical conductivity, pH; | Quarterly |
| GWS01, GWS02, GWS03, GWS04, GWS05, GWS06, GWS07, GWS08, GWS09, GWS10;<br><br>MB3, MB04/03<br><br>Eastern Extension monitoring wells | total alkalinity, magnesium, potassium, total sulphates, calcium, sodium, chromium, copper, iron, cadmium, nickel, zinc, manganese; hazardous substances*;<br>Base of monitoring point (m OD) | Annually |
| *up-gradient for the first six years of operation and down-gradient for hazardous substances detected in leachate for the first six years of operation then every two years | | |

During the operational phase of the landfill, the annual suite has been and will continue to be reviewed and altered where necessary following the findings of the annual hazardous and non-hazardous substances leachate screen.

### 5.1.1 Groundwater Level Monitoring

Groundwater levels are currently measured at quarterly intervals in the boreholes specified in Table GwMP1. Groundwater levels will be measured to an accuracy of 0.01 m as metres below ground level and will be calculated as a groundwater level in metres above Ordnance Datum, and reported together with the date of measurement.

### 5.1.2 Groundwater Quality Monitoring

The Landfill Directive requires that groundwater control and trigger levels be set for potentially polluting substances. Control levels are *specific assessment criteria that are used to determine whether a landfill is performing as designed*. They are intended to be used as an early warning system to enable appropriate investigative or corrective measures to be implemented so that the relevant trigger level will not be breached. Trigger levels have been defined in EA (2003) as '*…specific compliance levels…at which significant adverse environmental effects and/or breaches of legislation have occurred'*. When a trigger level is breached, the EA will consider that groundwater has been polluted.

The proposed groundwater quality control and trigger levels are presented in Table GwMP2 and Table GwMP3. The trigger levels are those in Table S3.4 of the Permit as amended by the HRA supporting this Permit variation application (20148978.633).

**Table GwMP2: Proposed Control and Trigger Levels for Groundwater in Chalk**

| Monitoring Location | Parameter | Control Level | Trigger Level |
|---|---|---|---|
| GWC01, GWC02, GWC03, GWC05 and GWC06. | Ammoniacal nitrogen | 1.8 mg/l | 5.4 mg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 13 µg/l | 20 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.02 µg/l | 18 µg/l |
| GWC01 | Lead | - | 0.63 µg/l |
| GWC02 | | - | 0.76 µg/l |
| GWC03 | | - | 0.2 µg/l |
| GWC05 | | - | 0.44 µg/l |
| GWC06 and Eastern Extension wells | | - | To be set following collection of 12 months of data. |

**Table GwMP3: Proposed Control and Trigger Levels for Groundwater in Lower Sand**

| Monitoring Location | Parameter | Control Level | Trigger Level |
|---|---|---|---|
| GWS01 | Ammoniacal nitrogen | 5.5 mg/l | 6.9 mg/l |
| | Lead | - | 0.36 µg/l |
| | Chloride | 330 mg/l | 415 mg/l |
| | Nickel | 13 µg/l | 20 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.13 µg/l | 18 µg/l |
| GWS02 | Ammoniacal nitrogen | 3.7 mg/l | 4.6 mg/l |
| | Lead | - | 0.25 µg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 13 µg/l | 20 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.02 µg/l | 18 µg/l |
| GWS03 | Ammoniacal nitrogen | 4.3 mg/l | 5.4 mg/l |

| Monitoring Location | Parameter | Control Level | Trigger Level |
|---|---|---|---|
| | Lead | - | 0.25 µg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 13 µg/l | 20 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.03 µg/l | 18 µg/l |
| GWS04 | Ammoniacal nitrogen | 4.4 mg/l | 5.5 mg/l |
| | Lead | - | 0.4 µg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 13 µg/l | 20 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.02 µg/l | 18 µg/l |
| GWS07 | Ammoniacal nitrogen | 8.6 mg/l | 10.75 mg/l |
| | Lead | - | 0.25 µg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 40 µg/l | 50 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 1 µg/l | 18 µg/l |
| GWS08 | Ammoniacal nitrogen | 1.4 mg/l | 1.8 mg/l |
| | Lead | - | 3.75 µg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 13 µg/l | 20 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.06 µg/l | 18 µg/l |
| GWS09 | Ammoniacal nitrogen | 1.6 mg/l | 2.0 mg/l |
| | Lead | - | 0.43 µg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 13 µg/l | 20 µg/l |

| Monitoring Location | Parameter | Control Level | Trigger Level |
|---|---|---|---|
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.02 µg/l | 18 µg/l |
| GWS10 | Ammoniacal nitrogen | 4.3 mg/l | 5.4 mg/l |
| | Lead | - | 0.25 µg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 13 µg/l | 20 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.02 µg/l | 18 µg/l |
| MB3 | Ammoniacal nitrogen | 3.4 mg/l | 4.3 mg/l |
| | Lead | - | 0.25 µg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 29 µg/l | 37 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.02 µg/l | 18 µg/l |
| MB04/03 | Ammoniacal nitrogen | 4.4 mg/l | 5.5 mg/l |
| | Lead | - | 0.25 µg/l |
| | Chloride | 200 mg/l | 250 mg/l |
| | Nickel | 13 µg/l | 20 µg/l |
| | Benzene | - | 1 µg/l |
| | Fluoranthene | - | 0.06 µg/l |
| | Mecoprop | 0.02 µg/l | 18 µg/l |
| GWS05 and Eastern Extension boreholes | To be set following 12 months of data collection | | |
| GWS06 | To be set following collection and analysis of 12 samples | | |

## 5.2 Action Plan Following Breach of a Control or Trigger Level

In the event that the control or trigger levels are breached, the following steps shall be taken to determine both the cause of the breached concentration and the impact it may have upon the identified receptors. A proposed action plan for the site is summarised in Table GwMP4.

**Table GwMP4: Action Plan Following Breach of a Control or Trigger Level**

| Contingency Action | Control Level | Trigger Level |
|---|---|---|
| Advise site management and environmental manager of landfill operating company. | ✔ | ✔ |
| Notify EA. | | ✔ |
| The borehole will be resampled within two weeks of the breach to confirm the measurement. If repeat analysis confirms breach, then review existing groundwater level, leachate level, groundwater quality and leachate quality monitoring information. Data will be reviewed by use of statistics and graphical presentation to establish the presence of any trends or patterns.<br>If review of existing monitoring data indicates an increasing trend, review site management and operations, and implement actions such as leachate pumping to reduce level to prevent a future breach. Continue monitoring monthly until level reduces to the control level. | ✔ | |
| All groundwater boreholes should be resampled within two weeks of the breach to confirm the measurement. If repeat analysis confirms breach, then review existing groundwater level, leachate level, groundwater quality and leachate quality monitoring information.<br>Data will be reviewed by use of statistics and graphical presentation to establish the presence of any trends or patterns.<br>If review of existing monitoring data indicates an increasing trend, review site management and operations, and implement actions such as leachate pumping to reduce level to prevent a future breach. Continue monitoring monthly until concentration reduces to the control level. | | ✔ |
| The assumptions incorporated into the conceptual site model will be reviewed, along with the existing hydrogeological risk assessment, control, and trigger levels. If the laboratory results from the monthly monitoring show no indications of decline over the four month period, and the evidence indicates that the site is the most likely cause of the increase in levels, then the proposals for the implementation of mitigation measures shall be submitted to the EA , and trigger and control levels for surface water quality should be set. | | ✔ |

## 5.3 Quality Assurance of Monitoring and Sampling

### 5.3.1 Monitoring Personnel

Sampling is undertaken by staff appropriately trained in environmental monitoring procedures, and who are familiar with the equipment and its limitations. The company will ensure that the personnel engaged in monitoring activities are trained to undertake the task. These will comprise the company's own technical personnel, the Landfill Manager or nominated deputy, or a suitably experienced sub-contractor, following appropriate training by technical personnel. All Sandsfield monitoring staff undergo a period of on-the-job training and in addition external courses are used to supplement internal training. Results will be validated by the sampling personnel detailed above.

### 5.3.2 Monitoring Procedures

#### *5.3.2.1 Water Level Monitoring*

Before bailing or pumping the sample, the water level is measured using an electronic dip tape which is lowered down the borehole until the electronic bleeper sounds. The graduation on the tape is read to give the depth at which the bleeper starts to sound. Measurement is taken from the top level of the borehole headworks and recorded to the nearest 0.01 m. These readings are then converted to a level in metres above Ordnance Datum (m OD).

#### *5.3.2.2 Sampling*

It is proposed that groundwater is sampled using either a Waterra pump or a bailer. Sampling is normally undertaken by pumped means, but where difficulties arise or pumps are unavailable, bailed samples are taken from individual wells.

Where bailed samples are taken, the following procedure will be adhered to:

- Prior to use, the Teflon bailer will be rinsed with deionised/distilled water;
- Bailers used for groundwater monitoring will not be used for leachate sampling to eliminate the risk of cross contamination from leachate;
- The bottom filling bailer will then be lowered into the borehole and allowed to fill;
- The first sample retrieved will be discarded, having been used to rinse the bailer; and
- Where bailed samples are taken, boreholes will not be purged prior to sampling. Bailing will generally be used where pumping equipment has failed.

Where water samples are pumped using the Waterra system the following procedure will be adhered to:

- Wells have been equipped with the Waterra sampling system. Boreholes will be pumped until three times the cased well volume of water has been drawn out;
- The required volume to be pumped will be calculated having first measured the water level inside the well and having dipped the bottom of the well, or taking the corresponding value obtained from the borehole drilling and construction logs. (Periodically, the bottom level of the wells obtained from dipping will be compared with the corresponding value obtained from the borehole drilling and construction logs. This will be used to determine whether the wells have silted up and to decide on the need for any borehole maintenance);
- Boreholes will then be pumped until three times the cased well volume of water has been drawn out and a pumped sample taken for analysis. However, in low permeability strata, where recharge rates to the borehole are low, purging three well volumes may be impractical; and
- If the borehole is dewatered, a sample will be collected once water levels have recovered sufficiently to provide an adequate sample volume.

All samples taken by the above methods are unfiltered, but get filtered at the laboratory, prior to analysis.

If there is insufficient water in the base of a well for a pumped sample to be taken, the well is bailed instead. Such deviations from pumped sampling are recorded and forwarded to the EA with the results. In-situ monitoring is carried out as above.

Samples are collected in bottles, containing preservatives where required, supplied by the laboratory, and appropriate to the analysis to be undertaken. Bottles are normally one litre PET, filled to exclude all air, and fitted with an airtight PTFE cap.

All samples taken are labelled with the time and date of sampling, sampling locations and any other relevant information. Alternatively bar-coded sample bottles may be used which detail in bar coded form the above information and additionally details of analysis required.

All samples are delivered to the analytical laboratory within 24 hours of sampling, using refrigerated courier vehicles supplied by the laboratory. Analyses are undertaken by a laboratory under UKAS accreditation (equivalent to EN45001). Because of the large batches of samples that are processed by laboratories, the QA/QC checks implemented are efficient in identifying any quality control analytical failures. The use of purged sampling techniques at the Site, using Waterra pumps, ensures consistency of sampling and reduces sampling errors. Accordingly, it is not proposed to submit additional QC samples (sampling duplicates, field standards, or field blanks) from the Site.

The range of determinands detailed above includes an ionic balance for all samples taken for the full range of determinands at quarterly intervals. Groundwater samples which attain an ionic balance within ±15% will be deemed satisfactory. Where the ionic balance falls outside this range, the laboratory is requested to repeat the analysis or to investigate the results provided for errors.

## 5.4 Making and Submission of Records

Records are kept on Site of determinands and sampling points analysed, date of sampling, sampler, results, units and any repeat analysis or laboratory comment, or internal assessment, on the validity of the results.

A copy of the results of sampling and analysis of emissions to groundwater (Tables S3.4 and S3.7 of the Permit) is forwarded to the EA every 3 months in compliance with Table S4.1 of the EP.

Results of laboratory analyses of groundwater are compared with the trigger levels set out in Table GwMP2 and Table GwMP3 within one week of receipt. Any exceedance of the trigger levels set out in Table GwMP2 and Table GwMP3 will be notified to the EA in accordance with Schedule 5 of the EP.

An annual report is provided to the EA by 31 January (or other date agreed in writing by the EA) of every year in accordance with Section 4.2 of the Permit, detailing a review of the environmental monitoring results obtained from the Site during the previous year, ending three months before the due date of the report. This review will include an interpretation of the accuracy and validity of results of groundwater monitoring along with other information as per the Permit.

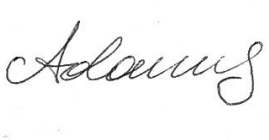
# 6.0 REFERENCES

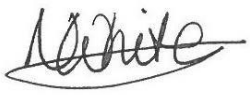
1) EA, 2003. Guidance on monitoring of landfill leachate, groundwater and surface water. LFTGN02. February 2003.

2) EA, 2021. Landfill operators: environmental permits. Monitor and report your performance - Landfill operators: environmental permits - Guidance - GOV.UK (www.gov.uk). Accessed 20 January 2022.

# Signature Page

**Golder WSP**





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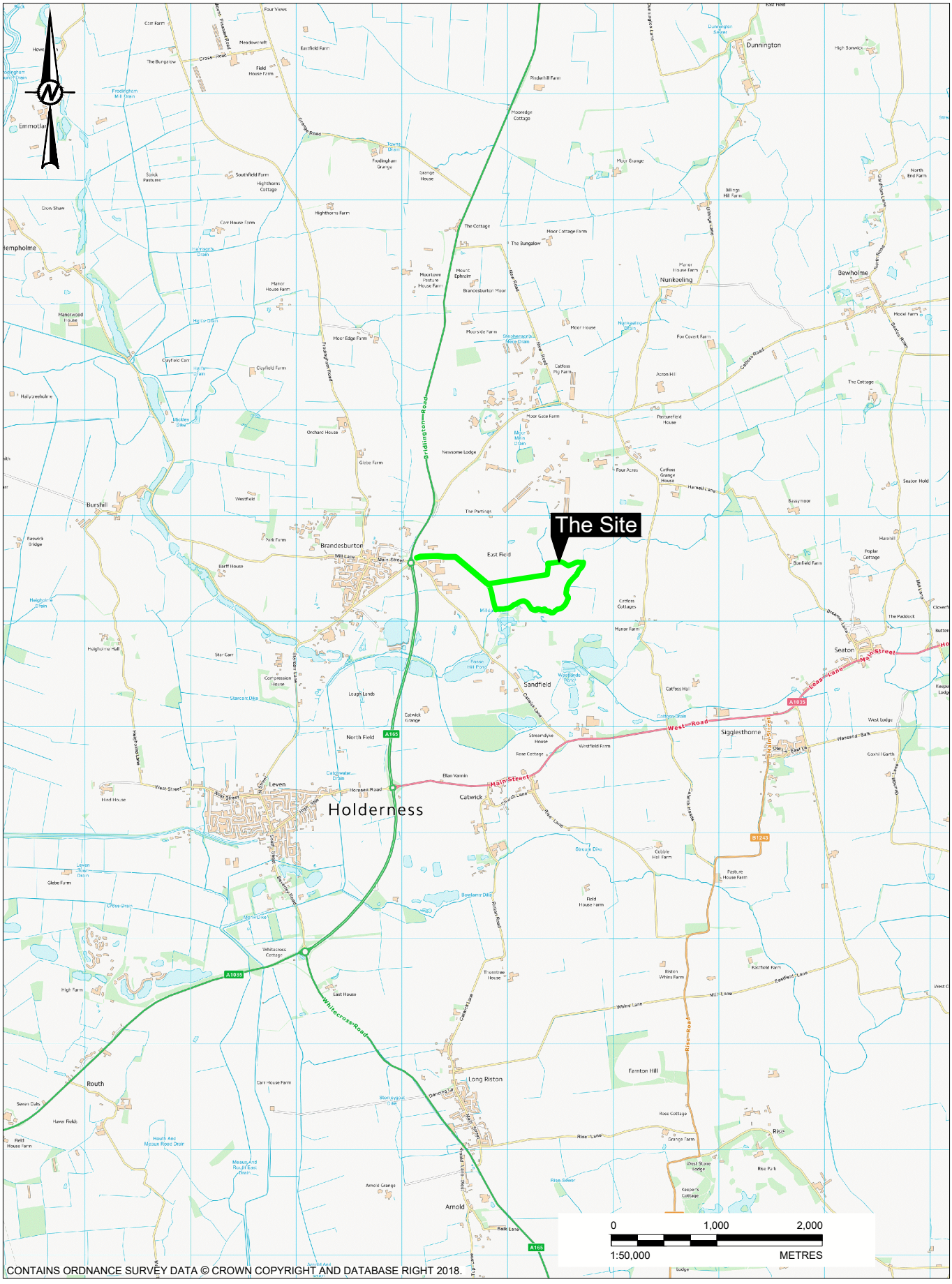
**DRAWINGS**

Drawing ESID1 - Site Location Plan

Drawing HRA1 - Monitoring and Extraction Point Plan

Drawing GwMP1 - Specification of Chalk Groundwater Monitoring Boreholes

Drawing GwMP2 - Specification of Lower Sand Groundwater Monitoring Boreholes






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 |

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

512 800 E
513 000 E
513 200 E
513 400 E
513 600 E
447 600 N
447 400 N
447 200 N

SW4
SW5
Moor Main Drain
BHG39
BHG38
BHG40
BHG37
BHG36
BHG35
BHG41
BHG34
FB
BHG33
Drain
BHG32
BHG31
Scrub
BHG30
BHG29
BHG28
BHG27
BHG26
BHG25
BHG24
BHG23
GWS01
SW1
MB04/01
BHG42
GWS03
GWC06
BHG07
GWC02
GWS04
BHG08
BHG09
GWS05
BHG10
BHG11
BHG12
BHG13
GWS06
GWC04
BHG14
BHG15
GWS07
BHG16
BHG17
SW3
MB3
GWS08
GWC03
BHG18
SW2
MB04/03
BHG19
Mildam Beck
GWC05
BHG20
BHG21
GWS09
BHG22
Mildam Beck Drain
BHG01
GWS10
BHG02
GWC01
BHG03
BHG04
BHG05
GWS02
BHG06
LMP11A
LCP11
CELL 11
LMP11B
LCP12
LMP12A
LMP10A
LCP10
LCP9
LMP9A
CELL 12
LMP12B
LMP13A
CELL 13
LMP13B
LCP13
LCP14
LMP14A
CELL 14
LMP14B
LCP2A
LCP2B
LMP2C
LCP4B
LMP2A
LMP4C
CELL 4B
LMP4D
LMP4B
CELL 4A
LMP4A
CELL 2A
CELL 2B
LMP9B
LMP10B
CELL 9
CELL 10
LCP4A
LMP2B
LMP2D
LCP1
LMP1A
CELL 1
LMP1B
LCP3
LMP3A
LMP3B
CELL 3
LMP5A
LCP5
LMP5B
CELL 5
LMP7A
LMP7B
CELL 7
LCP7
LMP8B
LCP8
LMP8A
CELL 8
LMP6B
CELL 6
LMP6A
MB5
LCP6
MB4
LMP1
LCP1
10
5
0
Sandfield
Scrub
Nc

## LEGEND

- PERMIT BOUNDARY
- CELL BOUNDARY
- CLAY LINER CONTOUR
- EXISTING SURFACE WATER MONITORING BOREHOLE - DEEP
- EXISTING SURFACE WATER MONITORING BOREHOLE - SHALLOW
- EXISTING GROUNDWATER MONITORING BOREHOLE
- EXISTING SURFACE WATER MONITORING POINT
- PROPOSED SURFACE WATER MONITORING POINT
- PROPOSED SAND AND GRAVEL MONITORING BOREHOLE
- PROPOSED CHALK MONITORING BOREHOLE
- EXISTING PERIMETER GAS MONITORING WELL
- PROPOSED PERIMETER GAS MONITORING WELL
- EXISTING LEACHATE EXTRACTION WELL
- EXISTING LEACHATE MONITORING WELL
- PROPOSED LEACHATE EXTRACTION WELL
- PROPOSED LEACHATE MONITORING WELL

## NOTES

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

## REFERENCE(S)

SURROUNDING 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

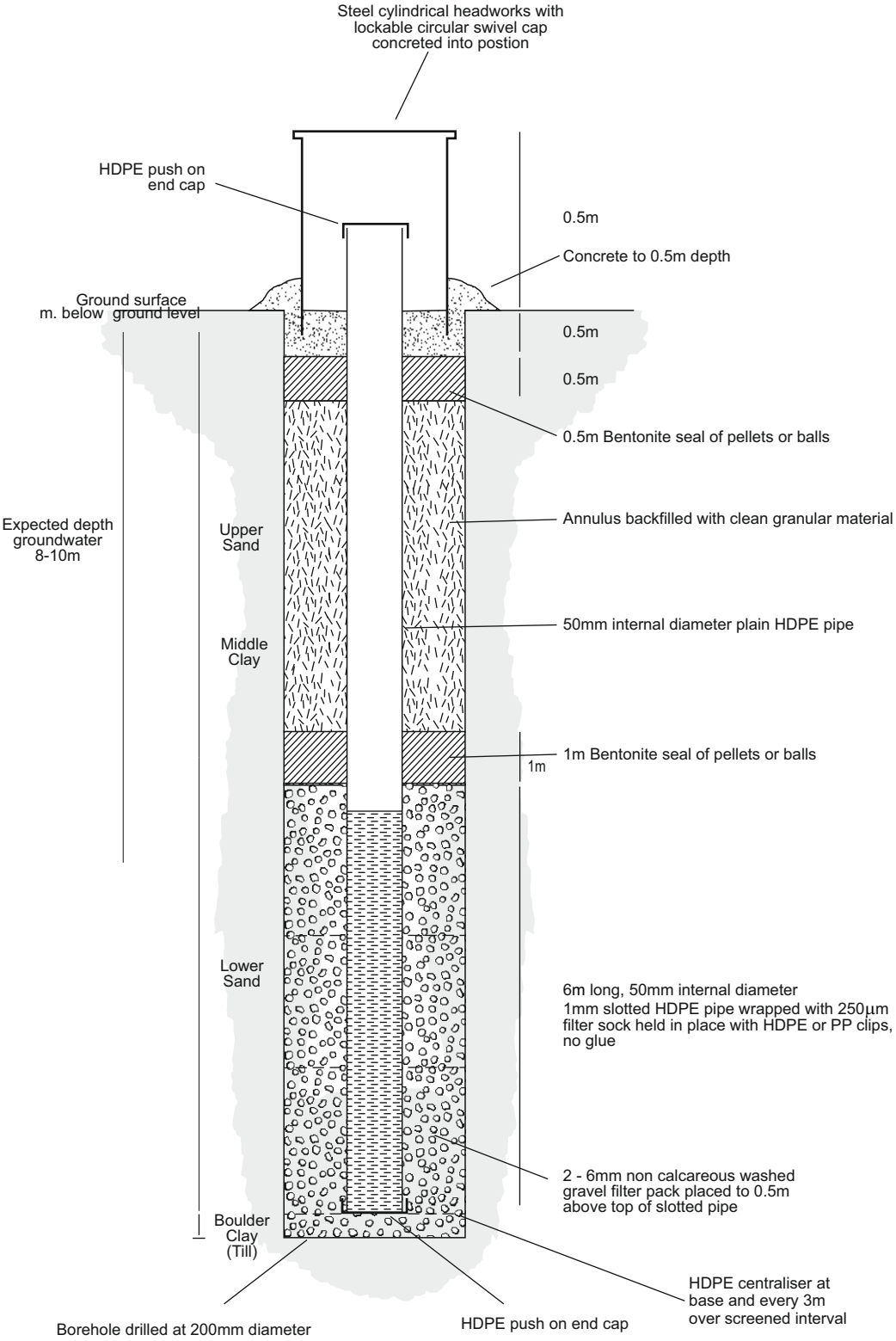
TITLE
**MONITORING AND EXTRACTION POINT PLAN**

CONSULTANT
WSP GOLDER

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

| PROJECT NO. | CONTROL | REV. | DRAWING |
|---|---|---|---|
| 20148978 | 1005-HR-0001 | B | HRA1 |

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

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SANDSFIELD GRAVEL COMPANY LTD

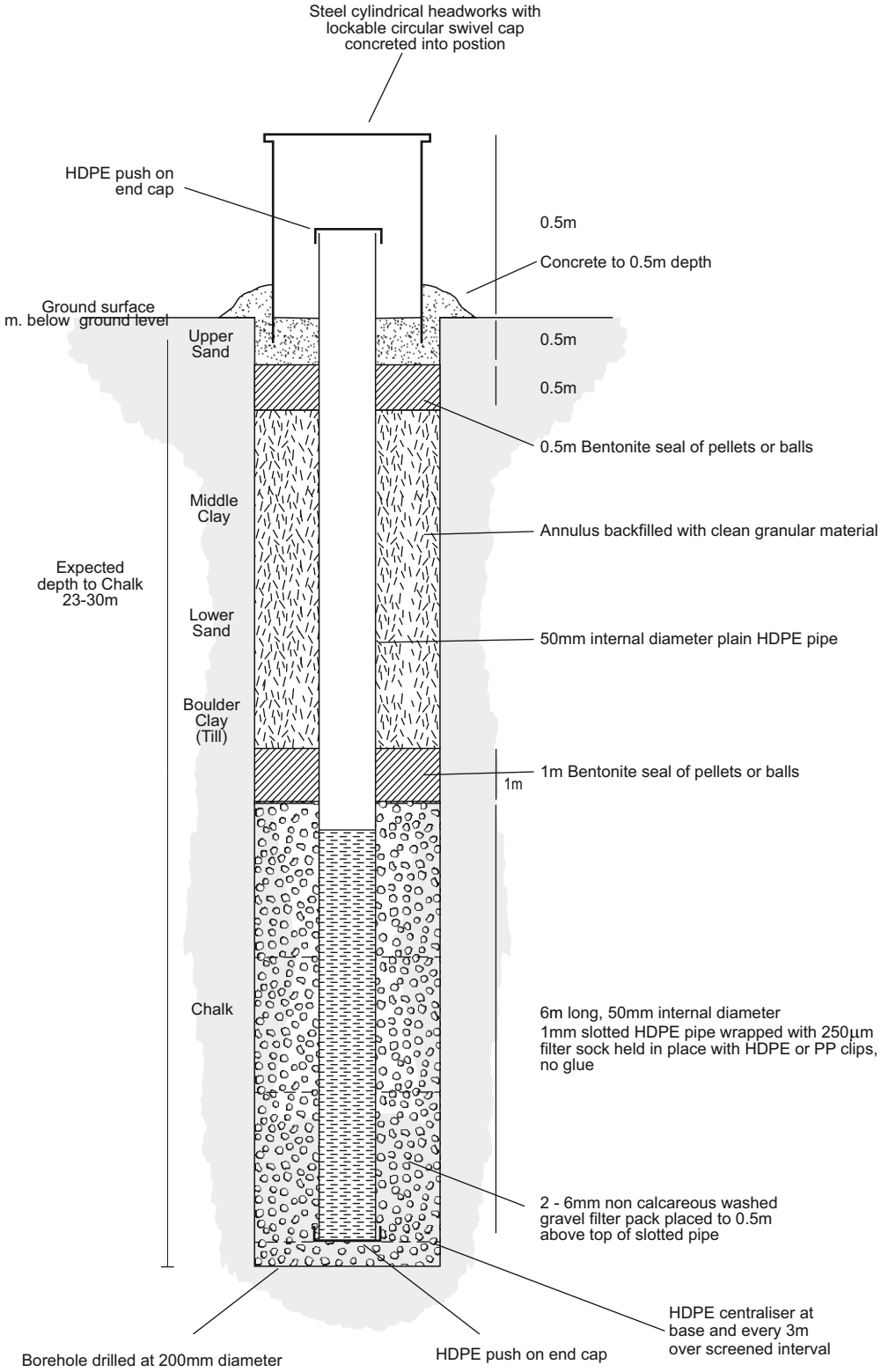
PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2021-12-01 |
| PREPARED | ECS |
| DESIGN | AA |
| REVIEW | DD |
| APPROVED | DD |

SHEET TITLE
**SPECIFICATION OF LOWER SAND GROUNDWATER MONITORING BOREHOLES**

| PROJECT NO | CONTROL | REV | DRAWING |
|---|---|---|---|
| 20148978 | 1004-EP-0018 | A | GwMP1 |




CLIENT
SANDSFIELD GRAVEL COMPANY LTD

PROJECT
EASTERN EXTENSION PERMIT VARIATION APPLICATION

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2021-12-01 |
| PREPARED | ECS |
| DESIGN | AA |
| REVIEW | DD |
| APPROVED | DD |

SHEET TITLE
**SPECIFICATION OF CHALK GROUNDWATER MONITORING BOREHOLES**

| PROJECT NO | CONTROL | REV | DRAWING |
|---|---|---|---|
| 20148978 | 1004-EP-0019 | A | GwMP2 |


**golder.com**