MOTT MACDONALD

Site Condition Report

Hull Waste Water Treatment Works

20 August 2019

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Site Condition Report

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	09/07/19	E. Royan N. Sridhar	N. Wilson S. George	C. Glover	For client comment
B	20/08/19	J. Seaward	S. George	A. Manns	Revised following client comment

Document reference: VS03-MMB-00-ZZ-RP-Z-0372

Information class: Standard

Contents

1 Introduction

This report forms the update to the site condition report for Hull Waste Water Treatment Works (WwTW) in support of a permit variation including an extension to the permit boundary. The site condition report[1] issued in 2008 in support of the original permit application. This report should be read in conjunction with this report.

1.1 Background

This site condition report is to support the application to vary the existing bespoke Environmental Permit (EPR/WP3030GC) for the Facility on behalf of Yorkshire Water Services Limited (YWS) ('the Operator'). In order to satisfy the requirements of the Environmental Permitting Regulations (EPR) 2016, the Operator must apply to the Environment Agency (EA) for a change (variation) to an existing Environmental Permit.

The permit variation is required to take account of the proposed changes at the Hull Sewage Treatment Facility, which include the refurbishment of a number of facilities on site to improve the Anaerobic Digestion process which produces biogas used for the generation of heat and power.

1.2 Site Details

1.2.1 Name of applicant

Yorkshire Water Services (YWS) is the applicant for the variation of an Environmental Permit for the operation of the Hull Waste Water Treatment Works (WwTW) Combined Heat and Power (CHP) Facility.

1.2.2 Activity address

The address for the WwTW is:

Hull Wastewater Treatment Works
Hull Road, Preston
Kingston upon Hull
Yorkshire and the Humber
HU12 8EY

1.2.3 National Grid Reference

The treatment works is centred on grid reference TA 16435, 29155, approximately 8km east of Kingston Upon Hull centre and 1km to the north of the Humber Estuary. The location of the site is shown in Appendix A1.

1.2.4 Document reference

The environmental permit that this application relates to is: WP3030GC.

[1] Arup (2008) *Site Condition Report* for Hull CHP Plant Application, HwTW– Report No. 207500-00.

1.2.5 Document references for site plans

- A.1 Site location plan;
- A.2 Installation boundary, including proposed changes;
- A.3 Location of key receptors, sources of emissions/releases, and monitoring points.
- A.4 Site drainage
- A.5 Site surfacing.

2 Condition of the land at permit issue

2.1 Environmental Setting

2.1.1 Geology

The published geological map of the area, BGS Sheet 81 (Patrington) and BGS Geology of Britain Viewer (2019) show the site as located on superficial deposits of Tidal Flat Deposits (Clay and Silt) and bedrock deposits of Flamborough Chalk Formation across the whole site area.

A ground investigation (GI) was undertaken between the 29th October and 16th November 2018 by Dunelm Geotechnical and Environmental Ltd (hereafter referred to as Dunelm). The GI identified generally consistent ground conditions across the site and exploratory positions confirmed the geological sequence as being Made Ground overlying Tidal Flat Deposits.

The Made Ground was identified in all exploratory positions and was observed to a maximum depth of 1.80m below ground level (bgl). Not all positions could be completed due to obstructions, so made ground depths may extend beyond 1.8m bgl. The Made Ground is likely to be attributed to construction / demolition of previous and existing structures on the site. No evidence of contamination was recorded during the GI works.

Superficial deposits of Tidal Flat Deposits were recorded to termination within all boreholes (observed to a maximum depth of 25.45m bgl).

The Flamborough Chalk Formation was not encountered during the 2018 GI, however a previous Arup desk study (2017) indicated that historic boreholes on site encountered Chalk bedrock at depths between 33.4 and 37.0m bgl.

2.1.2 Hydrogeology

The Environment Agency has classified the Tidal Flat Deposits as unproductive strata and the Flamborough Chalk Formation as a Principal aquifer. The Tidal Flat Deposits are likely to be unproductive due to the significant depths of relatively impermeable soils overlying the Chalk and given the sites location adjacent to the Humber Estuary, the intrusion of saline waters into the Chalk.

During the 2018 GI, eight 50mm standpipes were installed in eight boreholes (BH02, BH03C, BH04, BH05, BH07, WS10, WS3 and WS6). Piezometers (19mm standpipes) were installed into six of the boreholes (BH01, BH02, BH03C, BH04, BH06, BH07). The 50mm installation standpipes are presented below.

- BH02 (installed into Tidal Flat Deposits) – 2.0m to 7.0m bgl;
- BH03C (installed into Tidal Flat Deposits) – 3.20 to 7.30m bgl;
- BH04 (installed into Tidal Flat Deposits) – 9.40 to 11.40m bgl;
- BH05 (installed into Tidal Flat Deposits) – 2.0 to 5.0m bgl;
- BH07 (installed into Tidal Flat Deposits) – 7.60 to 9.50m bgl;
- WS3 (installed 20mm into Made Ground and 4.80m into Tidal Flat Deposits) – 1 to 3.70m bgl
- WS6 (installed into Tidal Flat Deposits) – 1.0 to 3.0m bgl;
- WS10 (installed into Tidal Flat Deposits) – 1.0 to 5m bgl.

2.1.3 Surface Water

The closest feature is a river referred to as 'Old Fleet Drain' which is located approximately 450m west (at its closest point) of the proposed site boundary. The Humber Estuary is located approximately 1.2km south of the site. The entire site is located within the Environment Agency Tidal Indicative Floodplains for the Humber Estuary and flooding is therefore a potential risk at the site.

2.2 Pollution History

2.2.1 Historical land uses and associated contaminants

From review of the historical development of the site, the WwTW should be considered as a potential source of contamination at the site, although this is not thought likely due to the relatively recent construction of the facility in 2008. There are no known records of leaking or overflowing tanks and therefore these have not considered further as a source of contamination at the site. Although the land surrounding the proposed permitted boundary has previously been used as timber yards and depots which could present a contaminative risk.

The ground investigation has indicated that made ground will be present in the shallow subsurface of the site and could also present a potential source of contamination.

Potential contamination associated with the above land uses includes:

- **Sewage Treatment Works** – sewage sludge typically contains elevated levels of nitrogen (predominantly in the form of ammonium and organic-N), metals and metalloids (including Hg, Cu, Ni, Pb, Zn, As, Cd, Se, Mo, Co, Cr and Ag), phosphate, pathogens and organic compounds (including polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), organochlorine pesticides, phthalate esters, surfactants, furans, chlorobenzenes, solvents, phenols and dioxins). Additionally, a wide variety of materials may be screened from raw sewage, including; textiles, plastics, metals, wood or other plant fragments.
- **Burial** – Waste material, such as sludge or screenings, or waste associated with nearby commercial uses may have historically been buried near to the site. burial of material is likely to have taken place in discrete 'hotspots'. It is unlikely that any burial areas were lined or capped. The nature of the material buried will determine whether it would biodegrade readily, the volumes and concentrations of leachate generated and potential for ground gas generation.
- **Chemical Storage and Use** – Historically, any chemicals or fuels stored or used in the sewage treatment works may potentially have leaked or been spilled. Such chemicals may include aluminium sulphate, ferric chloride or sulphate, lime, polymeric substances (generally biodegradable), fuel oils or lubricating oils, insecticides and herbicides.
- **Made Ground** – contaminants may be varied depending on the source of the made ground, but may include; metals, semi-metals, inorganic chemicals, PAH, TPH and asbestos, as well as ground gases (carbon dioxide (CO_2) and methane (CH_4)).
- **Adjacent Railway Land** – metals, semi=metals, inorganic chemicals, herbicides, PAH, TPH, volatile and semi-volatile organic compounds (VOC and SVOC) and asbestos.

2.2.2 Any visual/olfactory evidence of existing contamination

During the 2018 ground investigation, with the exception of ash and clinker identified in one exploratory location (TP2), no other visual or olfactory evidence of contamination was recorded during the GI works on the proposed site.

2.2.3 Evidence of damage to pollution prevention measures

No damage to pollution prevention measures is known to exist on site.

2.3 Evidence of historical contamination

Based on the previous site condition report (Version 1, Arup 2008) no known contamination of the existing or proposed site has been identified and no contamination events have occurred since the issue of Version 1 of this report.

2.4 Baseline soils and groundwater reference data

An intrusive ground investigation was undertaken between October and November 2018 in the location of the proposed site. The investigation and an assessment of the contamination results are described in a report in Appendix B, but are summarised here for reference.

The scope of the investigation was designed, scoped and procured by Mott MacDonald Bentley to determine the ground conditions and to obtain soils and groundwater samples for laboratory testing. The investigation comprised seven cable percussive boreholes (BH01 – BH10) to a maximum depth of 24.45m bgl, nine window sampling boreholes (WS1- WS10, excluding WS8) to a maximum depth of 5.45m bgl, and seven machine excavated trial pits (TP1 – TP9, excluding TP4 and TP6) to a maximum depth of 3.20m bgl.

The exploratory positions were located within the footprint and/or proximity of the proposed structures:

- **Inlet Works**: BH01 to BH03, WS1 to WS4 and TP1 to TP3;
- **Digestion Plant**: BH4, WS5 to WS6, TP5; and
- **Sludge Cake Import**: BH05 to BH07, WS7, WS9 to WS10, TP7 to TP9

Six samples of made ground and five samples of natural superficial Tidal Flat Deposits were submitted for laboratory analysis for metals, speciated polycyclic aromatic hydrocarbons (PAH), BTEX compounds (benzene, toluene, ethylbenzene and xylene), total petroleum hydrocarbons (TPH) (CWG aliphatic / aromatic split), phenols and asbestos. The concentrations were compared to generic screening values protective of human health for a commercial end use[2]. No concentrations of contaminants were reported in excess of their assessment criteria.

The selected soils were also screened for asbestos. No suspected asbestos containing materials were identified in the exploratory logs. Asbestos was however identified in one sample (TP2 at 0.50m bgl) located at the western extent of the proposed inlet (works) and was identified as both Amosite and Chrysotile fibres / clumps. Quantification of the sample indicated the total asbestos concentration to be 0.15%. No asbestos was indicated in any of the remaining samples tested.

Leachate analysis was undertaken on seven soil samples, four from made ground and three from natural Tidal Flat Deposits. The results were compared against Environmental Quality Standards[3] (EQS) and Drinking Water Standards (DWS)[4].

Marginal leachable concentrations of contaminants were identified across the site. Copper, Zinc and Fluoride were noted above the EQS in several samples tested. Concentrations of cyanide

[2] Land Quality Management (LQM)/ Chartered Institute of Environmental Health (CIEH) (2015) The LQM/CIEH S4ULs [Suitable for use levels] for Human Health Risk Assessment

[3] Water Framework Directive 000/60/EC (2000)

[4] Water Supply (Water Quality) Regulations (SI2016/614) (2016)

were recorded above the DWS in one sample of Made Ground, and leachable concentrations of Iron and Sulphate were noted above both the DWS and EQS within selected samples tested.

Groundwater monitoring and sampling was undertaken from seven samples from the superficial deposits. The samples were analysed for a general suite of contaminants. Groundwater exceedances of DWS were observed for Arsenic, Barium, Calcium, Iron, Magnesium and Selenium, exceedances of EQS were observed for Chromium III, Copper, Nickel and Zinc, and exceedances of both DWS and EQS was observed for Manganese, Sodium, Chloride and Sulphate. These were similar to those determinands identified as exceeding water quality standards in the leachate, indicating that that elevated concentrations may be natural in origin based on the underlying geology, although this cannot be fully concluded from the information available.

Dissolved methane concentrations >0.14mg/l were recorded in the groundwater at the location of the proposed sludge cake import facility. Groundwater discharged to sewer must not contain a dissolved methane concentration greater than 0.14ppm (0.14mg/l). This was likely associated with the gas leak in late 2018, detailed below. After repair of the leak, further groundwater monitoring recorded acceptable dissolved methane concentrations of <0.025 mg/l.

A ground gas risk assessment for a commercial land end use has been carried out as part of the ground investigation in accordance with CIRIA 665 and BS8485:2015. The initial classification (based on two visits from 8 no. monitoring locations prior to the fix of the gas leak) was calculated as Characteristic Situation 4 (moderate to high hazard potential) due to two elevated methane concentrations in two boreholes ranging from 89.4 %v/v and 50.1 %v/v. A maximum flow rate of 8.5 l/hr was recorded. The highest elevation of carbon dioxide was 6.5 %v/v.

Following the completion of the ground investigation, additional monitoring rounds presented higher flow rate readings of 98.4l/hr. It was identified that a gas main present on the site had two leaks and it was considered the high gas flow readings and high concentrations of methane are as a direct result of this. Gas monitoring was undertaken fortnightly to monitor the situation until the leaks were repaired.

Following the repair of the gas leaks, additional monitoring of the ground gas showed lowering of methane levels to <0.1 %v/v and a maximum flow rate of <0.1 l/hr was recorded.

The ground gas risk assessment was updated based on the monitoring visits following the repair of the pipe. This assessment indicated that the site is a Characteristic Situation 1 (very low risk), and therefore no special precautions are needed.

3 Existing permitted activities

3.1 Permitted activities

YWS originally applied for a PPC S1.1A(1)(b)(iii) activity for burning fuel from a waste >3MW <50MW, the permit was issued on 1st June 2009.

On 8th April 2013 an Industrial Emissions Directive (IED) initiated variation confirmed that schedule 1 to the EPR Regulations was updated to reflect the implementation of the IED. This changed the S1 activity to a waste operations activity R1.

YWS imports sludge into the sludge treatment facility (STF) under a T21 exemption ref WEX185480.

This permit variation is required because the upgrade and refurbishment work is replacing the existing boilers with new boilers and because imports of sludge will exceed the T21 exemption limit. The permit variation is required to reflect these changes and increase the permit boundary for the area taken up by the new assets. The Environment Agency requested YWS apply for an IED installation permit because the anaerobic digestion plant treats >100t wet tonnes sludge per day. This was confirmed by the Environment Agency in writing on the 9th July 2019.

Therefore, this permit variation is to vary YWS's waste operation permit for combustion to add activity 5.4 for biological treatment with the import of sludge and combustion as Directly Associated Activities.

The new boilers will be classified as new under the Medium Combustion Plant Directive. This introduces new emission limit values under the Environmental Permitting Regulations 2016 Medium Combustion Plant Schedule 25 A.

Table 1: Permitted activities

Description of activities for waste operations	Limits of activities
R1: Use principally as a fuel or other means to generate energy	Burning of waste as a fuel, from receipt of biogas fuel in the gas holders to export of heat and electricity and discharge of combustion gases from the stack.
	Burning of waste as a fuel, from receipt of biogas at the hot water boilers to release of the combustion products from the stacks.
	Burning of waste as a fuel, from receipt of biogas at the dryer steam boilers to the release of the combustion products from the stacks.
	Combustion of excess biogas in a biogas flare stack from receipt of the biogas at the flare to the release of the combustion products from the flare stack.
	Storage and handling of wastes including waste oils, from the generation of the wastes through to the removal from the installation.
	Storage of raw materials including lubrication oils, from receipt of raw material to the dispatch for use.
	Collection (via collection and drainage system) of the surface water arisings in the area of this installation and its disposal into the water treatment plant.

Source: Table S1.1 of Environmental Permit EPR/WP3030GC

3.1.1 Existing permitted plant

The Facility, as currently permitted, allows for the combustion of biogas produced at the Hull Waste Water Treatment Works' anaerobic digester plant. At the site there is a series of Combined Heat and Power (CHP) engines which generate electricity which is used elsewhere at the waste water treatment works. The heat is used for the anaerobic digestion to aid the generation of biogas in the digesters and feeds the boilers.

Table 2: Existing plant items within Environmental Permit EPR/WP3030GC

Existing items in permitted boundary	Current status
Three CHP engines, 1.362 MWth input capacity each	Operational
Low temperature hot water circuit	Operational
Double flare stack	Operational
Two standby hot water boilers, 3.5 MWth each	Operational
Two dryer steam boilers, 5.01 MWth each	Non-operational

Source: Environmental Permit EPR/WP3030GC

4 Changes to the activity

4.1 Changes to the activity boundary

A figure showing existing and new permit boundaries is presented in Appendix B.

4.2 Changes to the permitted activities

The proposed refurbed STF plant will involve the following main changes:

- New liquid sludge imports facility and blending with indigenous primary sludge in new sludge imports tank including liquid sludge screening facility and transfer to existing primary sludge and secondary sludge storage tanks.
- New sludge cake imports facility.
- Four of six digestors to be re-seeded and the remaining two to be decommissioned.
- New digester sludge feed pumps, digester mixing pumps, heat exchangers, recirculation pumps.
- Replacement of digester isolation valves and pipework.
- Full M&E Refurbishment of digesters including complete replacement of instrumentation.
- The digestor compound will have renovation to its surfaces to ensure it is impermeable and the contaminated drainage is returned to the process.
- New biogas holders, flare and boilers.
- New ferric chloride dosing system connected into the existing WwTW ferric dosing system.
- New sludge dewatering plant, including two centrifuges, polymer and lime dosing systems. Replacement macerators and dewatering feed pumps.
- Cake barn modifications to ventilation and layout.

4.3 Dangerous substances

A list of substances used and stored, and waste by-products were described in the former SCR (ARUP, 2008). Table 3 describes the substances and by-products used on the site.

Table 3: Substances used and stored and waste by-products

Substances used, stored and by products	Environmental Properties		
	Toxicity	Behaviour	Transport
Biogas	Explosive	May escape in soil in air if pipework is broken.	Spillage to soil. Air pathway.
Engine Lubricants	Harmful	Will remain in soil. Lighter than water.	Spillage to soil and groundwater.

Source: Hull WwTW Site Condition Report (Arup, 2008)

Substances used during the CHP process include:

- No chemicals are used on a regular basis by the CHP engines although CHP engine oil will be changed periodically by contracted engineers. The CHP engines internal water circuit will require the addition of small volumes of antiscalant and coolant which will generally be done during service intervals. These chemicals will not be stored on site.

- Softened potable water will be used to top up the CHP internal water circuit and overall hot water circuit.

Substances produced during the CHP process include:

- Condensate is produced as part of the CHP process. Condensate is passed back into the site drainage system.
- In the event that the biogas holder is full and the gas feed rate exceeds the gas withdrawal rate, then a biogas flare will be used to burn biogas until the level in the gasholder drops to a preset value. Carbon dioxide and water are produced during the process of methane flaring with the potential inclusion of carbon monoxide, nitrogen oxide and sulphur dioxide within waste gases.

5 Measures taken to protect land

The design for the refurbishment of Hull WwTW Sludge Treatment Facility has been carried out with appropriate measures for pollution prevention. All new plant has been designed in line with Yorkshire Water Asset Standards and Engineering Specifications that details materials of construction and life time of materials.

5.1 Point source emissions to surface water and sewer

There are no point sources to surface water from the Hull CHP plant.

5.2 Point source emissions to groundwater

There is no direct or indirect discharge of List I or List II substances from the Hull CHP plant.

6 Pollution incidents

6.1.1 Pollution incidents that may have affected land

In early 2018, failure of a mechanical mixer valve seal at the base of a digester vessel lead to loss of containment and release of sludge into the digester compound and drainage. Repair works were conducted and leaked digestate was pumped into tanks for safe containment before being returned to the system.

Later in 2018, two leaks of a gas main originating from a digester vessel were identified, leading to elevated dissolved methane in groundwater that was higher than the acceptable value for groundwater discharged to sewers, elevated methane in ground gas measurements, and an increased maximum gas flow rate. Following repairs, ground gas concentrations and gas flow rates have decreased to negligible levels. Dissolved methane concentrations in groundwater fell to below the laboratory limit of detection.

7 Soil, gas and water quality monitoring

7.1.1 Soils

Soil samples collected as part of the 2018 ground investigation from Tidal Flat deposits and made ground. The concentrations were compared to generic screening values protective of human health for a commercial end use and o concentrations of contaminants were reported in excess of their assessment criteria.

Asbestos was identified in one sample located at the western extent of the proposed inlet (works) and was identified as both Amosite and Chrysotile fibres / clumps. Quantification of the sample indicated the total asbestos concentration to be 0.15%. No asbestos was indicated in any of the remaining samples tested.

7.1.2 Groundwater

Based on groundwater elevations collected during the 2018 ground investigation, results indicate that the groundwater was encountered between 1.0mbgl (1.79m AOD) in TP1 and 19.3m bgl (-16.75m AOD) in BH6 within Tidal Flat Deposits. It should be noted that in five positions (BH02, BH04, BH06, BH07 and BH3C) groundwater was strikes were recorded at both shallow and deep depths suggesting two water bearing layers.

The monitoring collected samples for groundwater encountered in the Tidal Flat Deposits. These were analysed at the Chemtest Newmarket Laboratory for inorganic parameters, metals, speciated PAH, TPH, phenols and VOC.

The results identified slightly elevated concentrations of contaminants when compared to water quality standards (EQS and DWS). Groundwater exceedances of DWS were observed for Arsenic, Barium, Calcium, Iron, Magnesium and Selenium, exceedances of EQS were observed for Chromium III, Copper, Nickel and Zinc, and exceedances of both DWS and EQS was observed for Manganese, Sodium, Chloride and Sulphate.

These were similar to those determinands identified as exceeding water quality standards in the leachate of soil samples. Copper, Zinc and Fluoride were noted above the EQS in several samples tested. Concentrations of cyanide were recorded above the DWS in one sample of Made Ground, and leachable concentrations of Iron and Sulphate were noted above both the DWS and EQS within selected samples tested.

Water quality criteria applied are also very conservative for the location due to the presence of Principal Aquifer which is unlikely to be abstracted for drinking water, and the closest significant surface water feature is a river over 200m from the proposed boundary. It is therefore likely that natural dilution and attenuation would reduce the concentrations of the contaminants prior to them reaching the river.

Dissolved methane concentrations >0.14mg/l were recorded in the groundwater at the location of the proposed sludge cake import facility. Groundwater discharged to sewer must not contain a dissolved methane concentration greater than 0.14ppm (0.14mg/l). This was likely associated with the gas leak in late 2018. After repair of the leak, further groundwater monitoring on 17/06/19 recorded acceptable dissolved methane concentrations of <0.025 mg/l.

7.1.3 Ground gas

A ground gas risk assessment for a commercial land end use has been carried out as part of the ground investigation in accordance with CIRIA 665 and BS8485:2015. The initial classification (based on two visits from 8 no. monitoring locations prior to the pipe being fixed) was calculated as Characteristic Situation 4 (moderate to high hazard potential) due to two elevated methane concentrations in two boreholes ranging from 89.4 %v/v and 50.1 %v/v. A maximum flow rate of 8.5 l/hr was recorded. The highest elevation of carbon dioxide was 6.5 %v/v.

Following the completion of the ground investigation, additional monitoring rounds presented higher flow rate readings of 98.4l/hr. It has been identified that a gas main present on the site had two leaks and it is considered the high gas flow readings and high concentrations of methane were a direct result of this. Gas monitoring was undertaken fortnightly to monitor the situation until the leaks were repaired.

Following the repair of the gas leaks, additional monitoring of the ground gas showed lowering of methane levels from 19.1 %v/v on 06/06/19 to <0.1 %v/von 20/06/19.

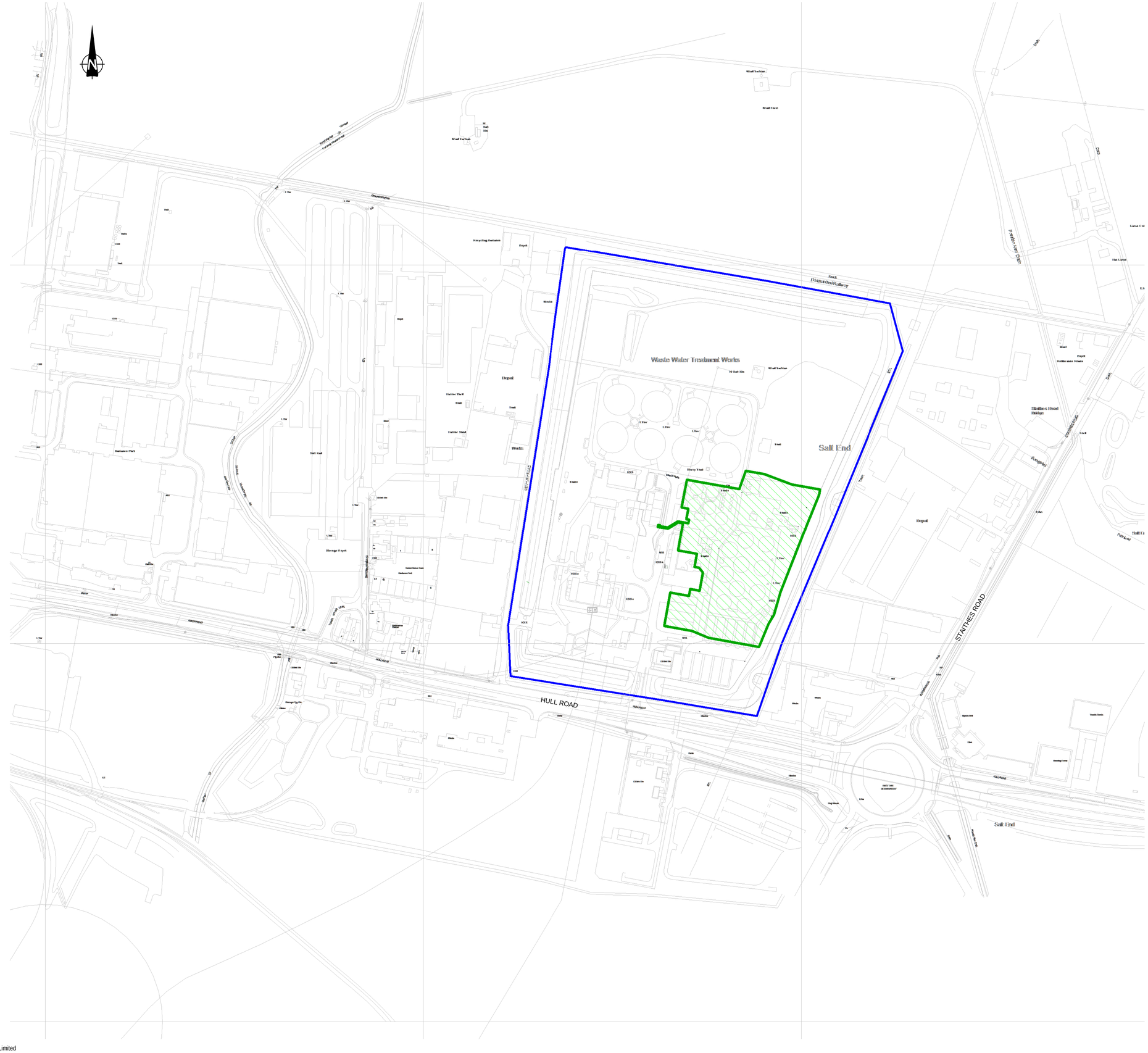
Flow rates were below the detection limit of the equipment following the fix of the pipe.

The updated ground gas risk assessment classification (based on the five most recent visits after the pipe had been fixed) is calculated as Characteristic Situation 1 (very low risk), and therefore no special precautions are needed.

Appendices

A. Site Information

A.1 Site Location Plan



NOTES

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LANDOWNERSHIP BOUNDARY

PERMITTED BOUNDARY

Rev:	Change Log:	Date:
P01	ISSUED FOR APPROVAL	05/07/19

Status:	Revision:	Drawn:	Checked:	Reviewed:	Approved:	Output Date:
S4	P01	DD	CB	TB	CDG	18/01/19

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LIFE SAVING RULES

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Framework:	Work Stream:
N/A	N/A
YW Batch ID / ProjectCode:	YW Solution ID:
R1434	

Site:
HULL WwTW
INLET WORKS AND STF REFURBISHMENT

OS Grid Reference:	DAZ or DMA References:
E516290, N428943	

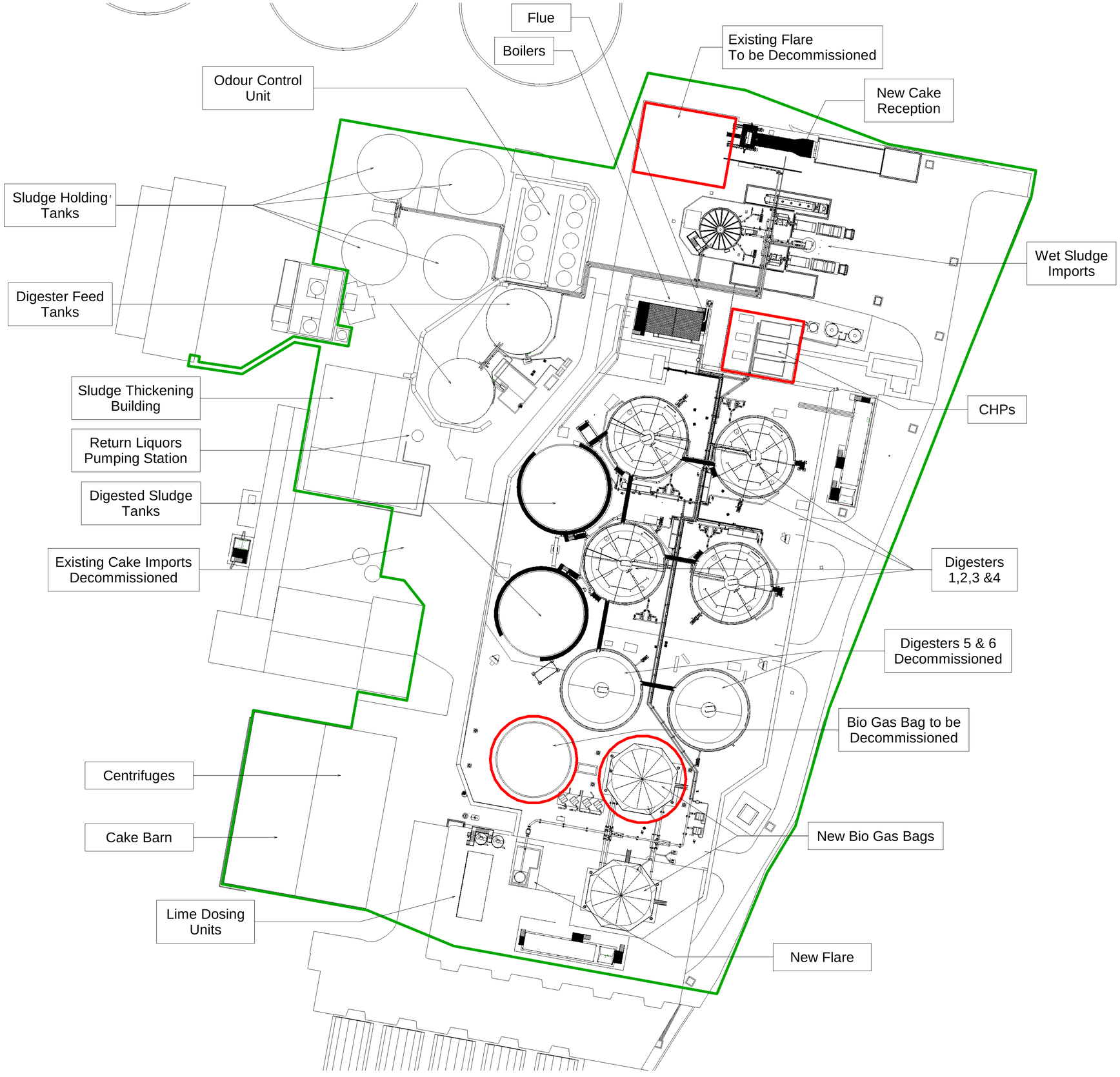
Drawing Title:
SLUDGE TREATMENT FACILITY
SITE LOCATION PLAN

Original Design / OEM Reference:	Size:	Scale:
VS03-MMB-00-ZZ-DR-C-2050	A1	1:2500

Status Description:	Status:	Revision:
WORK IN PROGRESS	S4	P01

Drawing Number:
VS03 - MMB - ### - ### - DR - C - ####

A.2 Installation Boundary/ Proposed Changes



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PERMIT BOUNDARY

PREVIOUS PERMIT BOUNDARY

Rev:	Change Log:	Date:
P02	ISSUED FOR APPROVAL	13/08/19

Status:	Revision:	Drawn:	Checked:	Reviewed:	Approved:	Output Date:
S4	P02	DD	CB	TB	CDG	13/08/19

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YORKSHIRE WATER
ALWAYS CONSIDERS

LIFE SAVING RULES

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Framework:	Work Stream:
N/A	N/A

YW Batch ID / ProjectCode:	YW Solution ID:
R1434	

Site:
HULL WwTW
INLET WORKS AND STF REFURBISHMENT

OS Grid Reference:	DAZ or DMA References:
E516290, N428943	

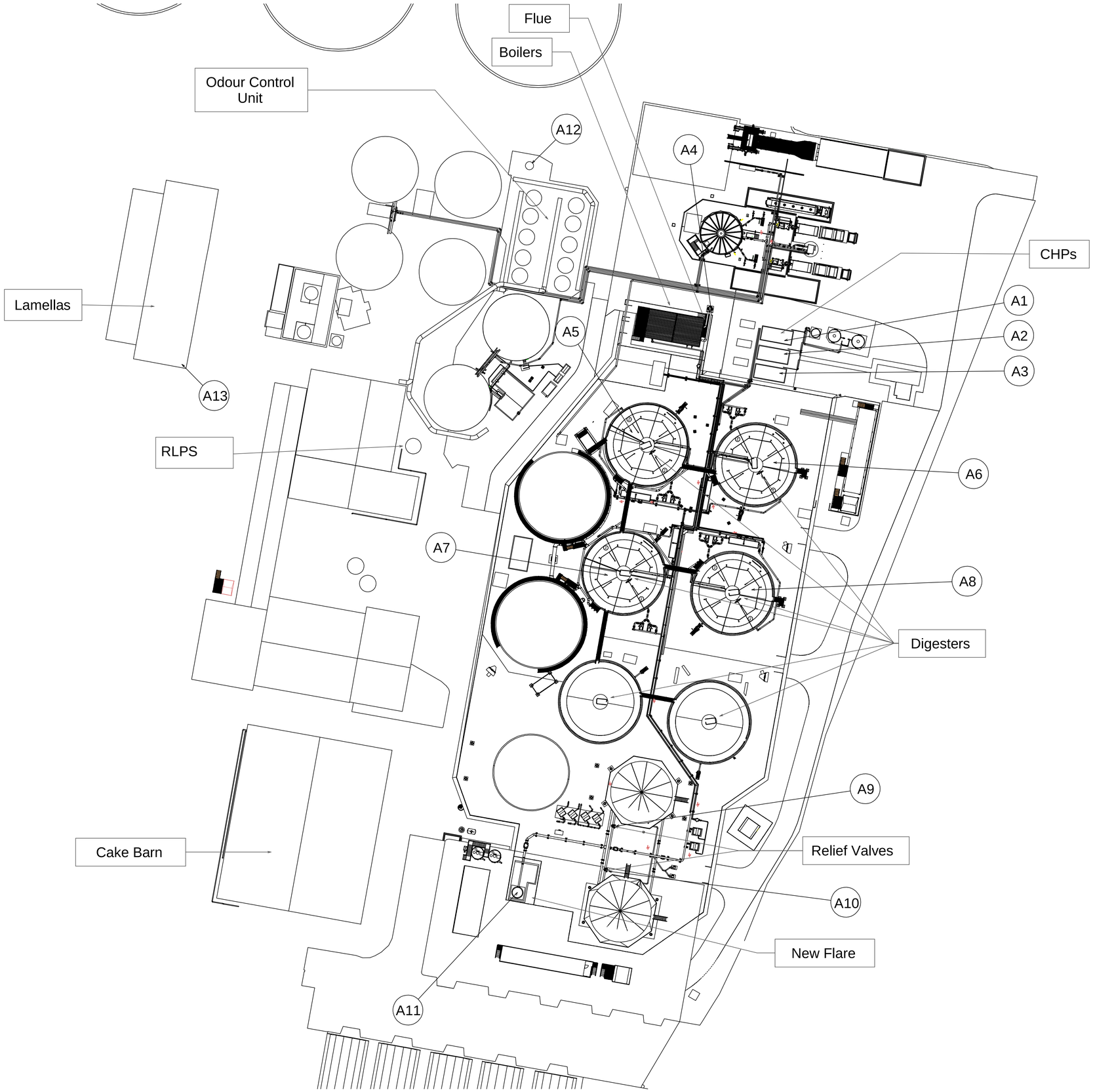
Drawing Title:
SLUDGE TREATMENT FACILITY
BLOCK PLAN

Original Design / OEM Reference:	Size:	Scale:
VS03-MMB-00-ZZ-DR-C-2051	A1	1 : 500

Status Description:	Status:	Revision:
WORK IN PROGRESS	S4	P02

Drawing Number:
VS03 - MMB - ### - ### - DR - C - ####

A.3 Location of Receptors, sources of emissions/ Releases, and Monitoring Points



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Emission Points

Point	Coordinates	What is this?
A1	E 51646 N 42916	CHP Exhaust
A2	E 51646 N 42916	CHP Exhaust
A3	E 51646 N 42916	CHP Exhaust
A4	E 51644 N 42916	Boiler Stack
A5	E 51643 N 42914	Digester PRV
A6	E 51645 N 42913	Digester PRV
A7	E 51642 N 42910	Digester PRV
A8	E 51645 N 42910	Digester PRV
A9	E 51642 N 42904	Gas Bag PRV
A10	E 51642 N 42903	Gas Bag PRV
A11	E 51639 N 42902	Flare Stack
A12	E 51640 N 42921	Odour Control Stack
A13	E 51631 N 42916	RLPS Emission Point to WwTW

Rev:	Change Log:	Date:
P02	ISSUED FOR APPROVAL	13/08/19

Status:	Revision:	Drawn:	Checked:	Reviewed:	Approved:	Output Date:
S4	P02	LF	CB	TB	CDG	13/08/19

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Framework:	Work Stream:
N/A	N/A
YW Batch ID / ProjectCode:	YW Solution ID:
R1434	TBC

Site:
HULL WwTW
INLET WORKS AND STF REFURBISHMENT

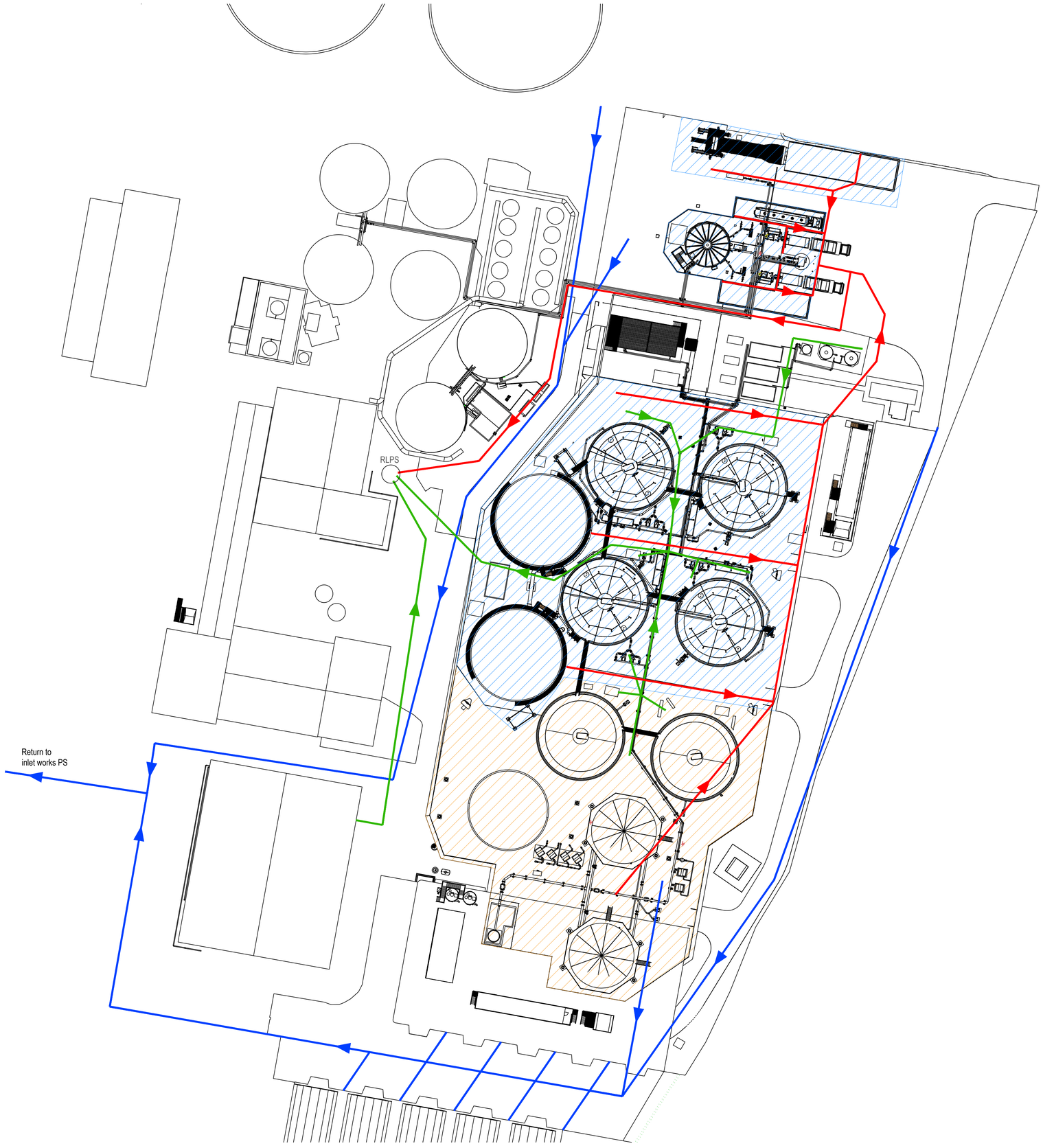
OS Grid Reference: E516290, N428943
DAZ or DMA References:

Drawing Title:
SLUDGE TREATMENT FACILITY
EMISSIONS PLAN

Original Design / OEM Reference:	Size:	Scale:
VS03-MMB-00-ZZ-DR-C-2052	A1	NOT TO SCALE
Status Description:	Status:	Revision:
WORK IN PROGRESS	S4	P02

Drawing Number:
VS03-MMB-00-ZZ-DR-C-0252

A.4 Site Drainage



NOTES

1. THIS DRAWING TO BE READ IN CONJUCTION WITH ALL RELEVANT DRAWINGS AND TOGETHER WITH THE SPECIFICATIONS.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES (MM), UNLESS NOTED OTHERWISE.
3. ALL LEVELS ARE SHOWN IN METRES (M) AOD, UNLESS NOTED OTHERWISE.
4. NO DIMENSIONS ARE TO BE SCALED FROM THIS DRAWING.
5. ALL WORKS TO YWS SPEC. 17TH VERSION.

Key

- Exisiting drainage
- New process drainage
- Surface water drainage
- Contaminated drainage
- Uncontaminated drainage

Rev:	Change Log:	Date:
P01	ISSUED FOR APPROVAL	11/07/2019

Status:	Revision:	Drawn:	Checked:	Reviewed:	Approved:	Output Date:
S4	P01	LF	CB	TB	CDG	11/07/2019

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Framework:	Work Stream:
N/A	N/A
YW Batch ID / ProjectCode:	YW Solution ID:
R1434	

Site:
HULL WwTW
INLET WORKS AND STF REFURBISHMENT

OS Grid Reference:	DAZ or DMA References:
E516290, N428943	

Drawing Title:
STF DRAINAGE

Original Design / OEM Reference:	Size:	Scale:
VS03-MMB-00-ZZ-DR-C-2054	A1	NOT TO SCALE

Status Description:	Status:	Revision:
WORK IN PROGRESS	S4	P01

Drawing Number:
VS03-MMB-00-ZZ-DR-C-2054

A.5 Site Surfacing

KEY

- CONCRETE
- TARMAC
- GRASS
- STONE
- PERMIT BOUNDARY
- LAND OWNERSHIP BOUNDARY

Rev:	Change Log:	Date:
P01	ISSUED FOR APPROVAL	05/07/19

Status:	Revision:	Drawn:	Checked:	Reviewed:	Approved:	Output Date:
S4	P01	DD	CB	TB	CDG	04/04/19

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Framework:	Work Stream:
	LARGE
YW Batch ID / ProjectCode:	YW Solution ID:
R1434	

Site:
HULL WwTW
INLET WORKS AND STF REFURBISHMENT

OS Grid Reference:	DAZ or DMA References:
E516290, N428943	

Drawing Title:
DIGESTER AND STF AREA
SITE SURFACING AND CHEMICAL STORAGE PLAN

Original Design / OEM Reference:	Size:	Scale:
VS03-MMB-00-ZZ-DR-T-2073	A1	1:500

Status Description:	Status:	Revision:
WORK IN PROGRESS	S4	P01

Drawing Number:
- MMB - DR - T -

B. Contamination Assessment

MMB
MOTT MACDONALD
BENTLEY

Technical Note

Project:	VS03 Hull WwTW		
Our reference:	381144IS35		
Prepared by:	K Munro	**Date:**	20th December 2018
Approved by:	C. Glover	**Checked by:**	C Stanford
Subject:	Hull WwTW – Contamination Assessment		

1 Executive Summary

Yorkshire Water Services (YWS) are proposing to undertake asset improvement works at Hull Wastewater Treatment Works (WwTW). Based on the proposed end use of the site and on the soil testing undertaken at locations of the proposed works, there were no reported contaminants in excess of their assessment criteria. However, asbestos was positively identified in one sample, therefore it is recommended that a specialist asbestos contractor is consulted to address the issue and to provide advice on risk or remedial measures.

Soil leachate testing indicated a number of exceedances of the water quality standards within the Made Ground and superficial deposits. Given the volume and magnitude of such exceedances, the absence of a plausible surface water receptor and considering the presence of a substantial depth of low permeability soils underlying the site, the proposed works, including the reuse of excavated material on site, presents a low risk to controlled waters.

Groundwater testing indicated a number of exceedances of the water quality standards. Where dewatering is required, an environmental permit may be required where it is proposed to discharge dewatering effluent into surface waters or onto the ground. Discharge to sewer requires permission from the YWS Networks Controller, and discharging to surface waters or ground will require liaison with the Environmental Agency (EA). Concerning the latter, de-watering is usually considered a temporary activity, and a permit may not be required. Groundwater may require treatment to remove suspended solids and to reduce concentrations of potential contaminants prior to disposal, the requirement for such will be dictated via communication with YWS or EA. Dissolved methane concentrations >0.14mg/l were recorded in the groundwater at the location of the proposed sludge cake import facility. Groundwater discharged to sewer must not contain a dissolved methane concentration greater than 0.14ppm (0.14mg/l).

A gas risk assessment for a commercial land use has been carried out in accordance with CIRIA 665 and BS8485:2015. The initial classification was calculated as Characteristic Situation CS4 (moderate to high hazard potential), therefore ground gas protection measures are likely required. Concentrations of Methane were observed up to 89.5%v/v. The ground gas risk assessment is to be completed upon receipt of the full monitoring data set.

Regarding waste disposal of excavated soils, the HazWasteOnline™ assessment has indicated that Made Ground deposits from the location of BH04 and BH07 will likely be classified as potentially-hazardous waste. The assessment has also indicated that the superficial deposits and Made Ground from the location of BH01 will likely be classified as non-hazardous waste. Waste Acceptance Criteria (WAC) testing has indicated that

the Made Ground deposits from the location of BH01 and TP03 may potentially be suitable for management as Stable, Non-reactive hazardous waste in a non-hazardous landfill. The assessment has also indicated that the superficial deposits and Made Ground from the location of BH01 may potentially be suitable for management as Inert Waste. It is recommended that the soil laboratory test certificates should be discussed with a waste operator, should excavation and off-site disposal of soils be required as part of the development.

It is assumed that some excavated material will be reused on site, although specific details of such reuse have not been provided at the time of writing. Reuse of uncontaminated natural soil and Made Ground on the site of origin presents a low risk to site end users and controlled waters. The excavated material, if proposed to be reused on site, must be shown to fulfil the requirements of a non-waste and subject to the necessary planning approval. Early engagement with both the EA and the Local Planning Authority (environmental health officer or contaminated land officer) is recommended to discuss the reuse proposals and gain their approvals.

2 Scheme Background

Mott MacDonald Bentley (MMB) have been contracted by Yorkshire Water Services (YWS) to investigate the proposed construction of a number of structures within the existing Hull WwTW site, located off A1033 Hull Road, Hull, HU12 8EY (Grid ref. 516310, 429077).

The proposed construction works comprise the following:

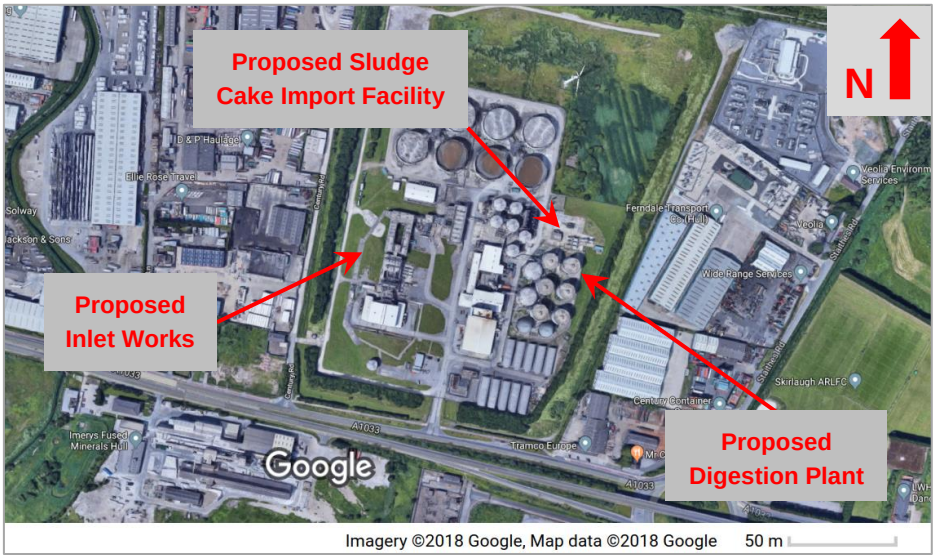
- New Inlet works
- Sludge cake import facility
- Digested sludge dewatering and lime sanitisation plant (digestion plant)

The site is an existing WwTW, which is bounded to the east and west by industrial units, to the south by a road beyond which is an electrical substation and heavy industry, and to the north by agricultural fields. Hull city centre is located approximately 6km west of the site.

Reference is made to a geotechnical and geoenvironmental desk study pertaining to the site, undertaken by Arup (August 2017).

A site overview plan indicating the approximate locations of the proposed structures within the existing WwTW is shown in Figure 1 below.

Figure 1. Site Overview Plan



3 Human Health

Ground investigation (GI) works were designed, scoped and procured by MMB to determine the ground conditions and to obtain soil/groundwater samples for laboratory testing. The GI works were undertaken by Dunelm Geotechnical and Environmental Ltd (hereafter referred to as Dunelm) between 29th October and 16th November 2018 and comprised 7No. Cable Percussive Boreholes (BH01 – BH07) to a maximum depth of 25.45m below ground level (bgl), 9No. Window Sampling Boreholes (WS1 – WS10, excluding WS8) to a maximum depth of 5.45m bgl, and 7No. machine excavated Trial Pits (TP1 – TP9, excluding TP4 and TP6) to a maximum depth of 3.20m bgl.

The following exploratory hole positions were located within the footprint and/or proximity of the proposed structures:

<u>Inlet Works</u>

- BH01 – BH03
- WS01 – WS04
- TP01 – TP03

<u>Digestion Plant</u>

- BH4
- WS5 – WS6
- TP5

<u>Sludge Cake Import</u>

- BH05 – BH07
- WS7, WS9, WS10
- TP7 – TP9

The GI identified generally consistent ground conditions across the site. Made Ground was encountered in all exploratory hole positions, observed to a maximum depth of 1.80m bgl (BH03C). It should be noted that 4 exploratory boreholes (BH03-BH03B and WS4) at the location of the proposed inlet works were terminated due to encountering obstructions, therefore the depth of Made Ground within this location may extend beyond 1.80m bgl. Based on the exploratory hole log descriptions, the Made Ground is detailed to predominantly comprise Topsoil over gravelly clay with inclusions of brick, concrete, glass, pottery and occasional plastic. The Made Ground material is likely to be associated with the construction/demolition of previous and existing structures on the site. With the exception of ash and clinker noted in TP2, no other visual or olfactory evidence of contamination was recorded during the GI works. The exploratory hole logs and an exploratory hole location plan are appended to this report.,

Made Ground was observed to overlie superficial deposits, which were recorded to termination within all boreholes (observed to a maximum depth of 25.45m bgl). The superficial deposits generally comprised a depth

of soft clay and/or silt, overlying layers of sand and clay to depth. Localised horizons of fibrous peat were noted in BH03C, BH04, BH05, and TP3, within the shallow clay/silt deposits.

Bedrock was not encountered during the 2018 GI, however the Arup 2017 desk study indicated that historic boreholes on site encountered chalk bedrock at depths between 33.4m – 37.0m bgl.

Laboratory testing has been undertaken on 11No. soil samples, these being 6No. collected from Made Ground (BH01 at 0.50m bgl, BH03B at 0.50m bgl, BH04 at 0.20m bgl, BH07 at 0.20m bgl, TP2 at 0.50m bgl and TP7 at 0.20m bgl), and 5No. from natural superficial deposits (BH02 at 2.10m bgl, BH05 at 2.00m bgl, WS6 at 0.50m bgl, TP3 at 1.0m bgl and TP8 at 0.50m bgl). Samples were analysed for a general suite of contaminants included within the Mott MacDonald Comprehensive Soil Suite. These results can be seen in the Chemtest Ltd laboratory test reports (report numbers: 18-34229-2, 18-34667-1 and 18-35064-1, 18-35859-1, 18-36197-1, all dated November 2018, and 18-35064-2 dated December 2018), appended to this report.

The results of the laboratory testing have been compared against current human health generic assessment criteria (GAC). The most appropriate values for the scheme are considered to be LQM/CIEH Suitable for Use Levels (S4UL's) for Human Health Risk Assessment (Nathanail et al., 2015) relating to "commercial" land use given that the proposed works are located on an existing wastewater treatment works with no public access. Specifically, the values have been selected for a soil organic matter (SOM) concentration of 2.5%, calculated from the nearest average organic matter measurements from the soil laboratory data whilst taking a conservative approach. There is currently no S4UL value for Lead, therefore the Defra Category Four Screening Level (C4SL) (CL:AIRE, 2014) has been used to assess Lead.

In terms of human health, no concentrations of contaminants were reported in excess of their assessment criteria. It should be noted that the assessment criteria utilised are for long term risks and cannot quantify acute risks to construction and maintenance workers resulting from close short-term exposure to soils.

The selected soil samples were also screened for asbestos. No suspected asbestos containing materials were identified in the exploratory hole logs. However, asbestos was identified in one sample (TP2 at 0.50m bgl, located at the western extent of the proposed inlet works), with both Amosite and Chrysotile fibres/clumps being recorded during the initial asbestos screen. Additional asbestos gravimetric testing (quantification) of this sample indicated the total asbestos concentration to be 0.15%. Laboratory screening confirmed that asbestos was absent in the remainder of the soil samples tested. A summary of the asbestos analysis is presented in Table 1 below.

Table 1: Summary of Asbestos Analysis

Exploratory Location	Depth (m bgl)	Material Type	Detected	Identification Type	Total Asbestos (%) *
BH01	0.50	Made Ground	No	N/A	N/A
BH02	2.10	Tidal Flat Deposits	No	N/A	N/A
BH03B	0.50	Made Ground	No	N/A	N/A
BH04	0.20	Made Ground	No	N/A	N/A
BH05	2.00	Tidal Flat Deposits	No	N/A	N/A
BH07	0.20	Made Ground	No	N/A	N/A
WS6	0.50	Tidal Flat Deposits	No	N/A	N/A
TP2	0.50	Made Ground	Yes	Amosite & Chrysotile	0.15
TP3	1.00	Tidal Flat Deposits	No	N/A	N/A
TP7	0.20	Made Ground	No	N/A	N/A
TP8	0.50	Tidal Flat Deposits	No	N/A	N/A

Note: * Asbestos by gravimetry

Mott MacDonald Limited is not insured for, and therefore will not give advice relating to, risks associated with asbestos. . It is therefore recommended that a specialist asbestos consultant is contacted to address the issue and to provide advice on risk or remedial measures.

As a depth of Made Ground was identified across the site during the GI, and is anticipated to be encountered during construction of the proposed works, construction workers should use standard personal protective equipment (PPE) including gloves, protective glasses, boots, and adopt suitable working practices during construction works.

Should any previously unidentified contamination be encountered during site works, the materials should be segregated, stockpiled (in accordance with a Materials Management Plan (MMP)) and undergo chemical testing. Further assessment should then be undertaken to assess potential risks from the material and to determine appropriate mitigation.

4 Controlled Waters – Soil Leachate Samples

Soil leachate testing was undertaken on the 7No. soil samples, these being 4No. from Made Ground (BH01 at 0.50m bgl, BH07 at 0.50m bgl, TP2 at 0.50m bgl and TP7 at 0.20m bgl) and 3No. from natural Tidal Flat Deposits (BH02 at 2.10m bgl, BH04 at 0.50m bgl and WS6 at 0.50m bgl).

The soil leachate results can be seen in the Chemtest Ltd laboratory test reports (report numbers: 18-34229-2 and 18-35859-1 both dated 26th November 2018, 18-34667-1 dated 15th November 2018, 18-35064-1 dated 19th November 2018, and 18-36197-1 dated 28th November 2018) appended to this report. This testing is required to assess the suitability of excavated material, with respect to chemical quality and potential risks to controlled waters, for reuse within the scheme, or for disposal off-site.

According to British Geological Survey (BGS) mapping, superficial deposits are indicated to comprise Tidal Flat Deposits (silty clay with layers of sand, gravel and peat), overlying Glacial Deposits comprising both Glacial Till (clay) and Glaciofluvial Deposits (sand and gravel). The superficial deposits underlying the site are classified as an 'unproductive' aquifer by the Environment Agency (EA). According to the BGS aquifer bedrock map, the EA classifies the underlying bedrock, which comprises the Flamborough Chalk Formation (chalk), as a 'Principal' Aquifer. The nearest surface waterbody is Preston New Drain, which is located approximately 200m east of the site, flowing generally from north to south.

Assessment criteria have been derived from the following sources:

- EA Fresh Water Environmental Quality Standards (EQS), taken from the Water Framework Directive
- Drinking Water Standards (DWS), taken from the Water Supply (Water Quality) Regulations 2016 (SI 2016/614)

Table 2 shows the results of the soil leachate testing where exceedances of the water quality standards were identified.

Table 2: Summary of Soil Leachate Exceedances

Borehole	Depth (m bgl)	Material Type	Contaminant	Result (µg/l)	UK DWS (µg/l)	EQS (µg/l)
BH01	0.50	Made Ground	Copper	4.5	2000	1
BH02	2.10	Clay		2.8		
BH07	0.50	Made Ground		1.3		
WS6	0.50	Clay		3.3		
TP2	0.50	Made Ground		1.3		
TP7	0.20	Made Ground		4.0		

Borehole	Depth (m bgl)	Material Type	Contaminant	Result (µg/l)	UK DWS (µg/l)	EQS (µg/l)
BH01	0.50	Made Ground	Iron	1500	200	1000
BH01	0.50	Made Ground	Zinc	51	5000	8
TP2	0.50	Made Ground	Cyanide (complex)	170	50	-
WS6	0.50	Clay	Fluoride	0.0012	0.0015	0.0010
BH01	0.50	Made Ground	Sulphate as SO_4	1.4	0.25	0.40
BH02	2.10	Clay		0.56		

Leachable concentrations of Copper, Zinc and Fluoride were noted above the EQS within a number of the samples tested, concentrations of cyanide were recorded about the DWS within one sample of Made Ground tested, and leachable concentrations of Iron and Sulphate were noted above both the DWS and EQS within selected samples tested.

The pH levels obtained from the samples were considered marginally above neutral (pH 7.7 – 8.4), which with respect to the DWS and EQS ranges, does not provide an environment whereby metal contaminants are readily leachable.

It should be noted that the significant thickness of the underlying cohesive superficial deposits (predominantly clay) within the Tidal Flat and Glacial Deposits will retard any potential downward migration of leachable contamination to the underlying Principal Aquifer (Flamborough Chalk Formation). Furthermore, it is to be noted that leachate extraction is an aggressive form of test and is known to produce considerably higher test results than would be expected in the naturally occurring environment.

If piled foundations are proposed to extend down into the underlying chalk bedrock (Principle Aquifer), consideration should be given to avoid the creation of a contamination pathway between shallow Made Ground deposits and the underlying chalk. It is envisaged that the risks to groundwater will be updated following confirmation of the piling methodology, depth/design. However, based on the initial assessment above, it is considered that the proposed works, including the reuse of excavated material on site, present a low risk to controlled waters.

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5 Groundwater Samples

Groundwater monitoring and sampling was undertaken as part of the 2018 GI, and laboratory testing was undertaken on 7No. groundwater samples collected from the monitoring installations within selected boreholes, to provide representative groundwater quality data for dewatering and disposal purposes. The samples were analysed for a general suite of contaminants, and the complete set of results can be seen in the Chemtest Ltd laboratory test report (report number: 18-38255-1 dated 12th December 2018) presented within the appendix.

Table 3 presents the results of groundwater testing where exceedances of the water quality standards were identified.

Table 3: Summary of Groundwater Exceedances

Borehole	Standpipe Response Zone Depth (m bgl)	Material Type	Contaminant	Result (mg/l)	UK DWS (mg/l)	EQS (mg/l)
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)	Arsenic	0.027	0.010	0.050
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)		0.015		
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)	Barium	0.35	0.10	-

Borehole	Standpipe Response Zone Depth (m bgl)	Material Type	Contaminant	Result (mg/l)	UK DWS (mg/l)	EQS (mg/l)
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.16		
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)		0.80		
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)	Calcium	1100	250	-
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)		260		
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)		0.070		
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)	Chromium III	0.032	-	0.0047
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)		0.043		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.0076		
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)		0.044		
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.025		
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)	Copper	0.063	2	0.001
WS3	1.00 – 3.70	Made Ground, Tidal Flat Deposits (clay)		0.010		
WS6	1.00 – 2.00	Tidal Flat Deposits (clay)		0.0049		
WS10	1.00 – 4.00	Tidal Flat Deposits (clay)		0.0054		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.79		
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)		0.64		
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.50		
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)	Iron	0.96	0.20	1
WS3	1.00 – 3.70	Made Ground, Tidal Flat Deposits (clay)		1.00		
WS6	1.00 – 2.00	Tidal Flat Deposits (clay)		0.63		
WS10	1.00 – 4.00	Tidal Flat Deposits (clay)		0.21		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		71		
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)		240		
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		120		
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)	Magnesium	160	50	-
WS3	1.00 – 3.70	Made Ground, Tidal Flat Deposits (clay)		110		
WS6	1.00 – 2.00	Tidal Flat Deposits (clay)		73		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.94		
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)		1.30		
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		1.50		
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)	Manganese	1.00	0.050	0.030
WS3	1.00 – 3.70	Made Ground, Tidal Flat Deposits (clay)		1.90		
WS6	1.00 – 2.00	Tidal Flat Deposits (clay)		2.20		
WS10	1.00 – 4.00	Tidal Flat Deposits (clay)		0.15		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.0051		
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)	Nickel	0.0076	0.020	0.004
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.0052		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)	Selenium	0.017	0.010	-
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)		0.039		

Borehole	Standpipe Response Zone Depth (m bgl)	Material Type	Contaminant	Result (mg/l)	UK DWS (mg/l)	EQS (mg/l)
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.027		
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)		0.095		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)	Sodium	730	200	170
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)		1800		
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		1200		
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)		1600		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)	Zinc	0.023	5	0.008
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)		0.016		
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		0.010		
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)		0.014		
WS3	1.00 – 3.70	Made Ground, Tidal Flat Deposits (clay)		0.011		
WS10	1.00 – 4.00	Tidal Flat Deposits (clay)		0.016		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)	Chloride	980	250	250
BH04	9.40 – 11.40	Glacial Deposits (clay and sand)		4600		
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		2400		
BH07	7.60 – 9.50	Tidal Flat Deposits (silt)		3500		
BH02	2.00 – 7.00	Tidal Flat Deposits (silt and clay)	Sulphate	640	250	400
BH05	2.00 – 7.00	Tidal Flat Deposits (silt and clay)		310		
WS3	1.00 – 3.70	Made Ground, Tidal Flat Deposits (clay)		580		
WS6	1.00 – 2.00	Tidal Flat Deposits (clay)		310		

Groundwater exceedances of DWS were observed for Arsenic, Barium, Calcium, Iron, Magnesium and Selenium, exceedances of EQS were observed for Chromium III, Copper, Nickel and Zinc, and exceedances of both DWS and EQS was observed for Manganese, Sodium, Chloride and Sulphate. The pH levels of the samples recorded were pH 7.5 – 8.2 which is above neutral. The exceedances of the water quality standards recorded in the groundwater suggest exceedances are not indicative natural background concentrations but instead have been anthropogenically enhanced.

Groundwater samples from the locations of BH05 and BH07 identified a dissolved methane concentration of 0.73mg/l and 1.0mg/l respectively.

Where dewatering is required, an environmental permit may be required where it is proposed to discharge dewatering effluent into surface waters or onto the ground. Discharge to sewer requires permission from the YWS Networks Controller. If dewatering to surface waters or ground is proposed, the EA should be contacted and groundwater chemical results communicated. Dewatering is usually considered a temporary activity, and therefore a permit may not be required, however liaison with the regulator is recommended to confirm. Groundwater may require treatment to remove suspended solids and to reduce concentrations of potential contaminants prior to disposal, the requirement for such will be dictated by communication with YWS or the EA. In particular pre-treatment of methane contaminated groundwater, identified within BH05 and BH07, will be required prior to discharge to sewer. Groundwater discharged to sewer must not contain a dissolved methane concentration greater than 0.14ppm (0.14mg/l).

6 Ground Gas

The proposed works comprise the construction of a number of structures, some of which are above ground man entry structures.

Exploratory holes undertaken during the 2018 GI identified potential ground gas sources within the Tidal Flat Deposits, which contained silt and localised horizons of fibrous peat. Decomposition of the organic material may give rise to the generation and migration of ground gas.

Ground gas monitoring is currently being undertaken by Dunelm on a weekly basis within 8No. selected exploratory positions, across the footprint of the proposed works. 2No. monitoring visits have currently been undertaken between 28 November and 11 December 2018. One of such visits undertaken to date included monitoring during a period of falling atmospheric pressure.

Table 4 shows the maximum concentrations of ground gases recorded at each exploratory location.

Table 4. Maximum concentrations of ground gas recorded during monitoring

Borehole Number	Response Zone (m bgl)	Target Strata	Maximum Gas Flow Rate (L/hr)	Maximum concentration of gas recorded			
				CO_2 (%v/v)	CH_4 (%v/v)	CO (ppm)	H_2S (ppm)
BH02	2.0 – 7.0	Superficial deposits (clay and sand)	0.0	1.7	0.0	0.0	0.0
BH03C	3.2 – 7.3	Superficial deposits (silt and peat)	0.0	1.3	0.0	0.0	0.0
BH04	9.4 – 11.5	Superficial deposits (clay and sand)	5.3	2.9	1.8	0.0	0.0
BH05	2.0 – 7.0	Superficial deposits (clay and silt)	0.0	0.8	50.1	0.0	0.0
BH07	7.6 – 9.5	Superficial deposits (silt)	8.5	6.5	89.5	0.0	0.0
WS3	1.0 – 3.7	Made Ground & Superficial deposits (clay)	0.0	4.3	0.0	0.0	0.0
WS6	1.0 – 2.0	Superficial deposits (clay)	0.0	1.8	0.0	0.0	0.0
WS10	1.0 – 4.0	Superficial deposits (clay)	0.0	0.5	0.0	0.0	0.0

A gas risk assessment for a commercial land use has been carried out in accordance with CIRIA 665 and BS8485:2015. The initial classification (based on 8No. monitoring locations with 2No. monitoring visits to date) was calculated as Characteristic Situation CS4 (moderate to high hazard potential) (BS8485:2015) and therefore ground gas protection measures are likely to be required for above ground man-entry structures within the east of the site. The elevated concentrations of methane (CH_4) in BH05 and BH07 may be attributed to the organic material encountered within the Tidal Flat Deposits, detailed in a number of borehole logs. The ground gas risk assessment is to be reviewed upon receipt of the complete set of ground gas monitoring data.

The potential risks from ground gases to the excavations and permanent underground structures are to be dealt with by the Contractor and operations staff, in accordance with the current Confined Spaces Regulations.

7 Waste Categorisation for Soils

It is anticipated that during construction works there will be the requirement to excavate and permanently remove soils from site. The analytical results for the 11No. soil samples collected from both the Made Ground (6No.) and superficial deposits (5No.) have been assessed using the HazWasteOnline™ software to provide an indication of the likely waste classification of the excavated soils on site (in accordance with guidance given

in WM3 v1.1). It is the responsibility of the waste producer to ensure that all waste created on site undergoes basic characterisation prior to disposal to an appropriate permitted landfill, and an indication of the likely classification is provided here.

The assessment indicated that the samples obtained from the natural superficial deposits (BH02 at 2.10m bgl, BH05 at 2.00m bgl, WS6 at 0.50m bgl, TP3 at 1.0m bgl and TP8 at 0.50m bgl) are likely to be classified as non-hazardous waste. The assessment has also indicated that 2No. samples obtained from the Made Ground (BH04 at 0.20m bgl and BH07 at 0.20m bgl) are likely to be classified as potentially hazardous due to hazardous property HP3(i): Flammable, resulting from concentrations of TPH (C6 to C40). Environment Agency guidance WM3 [7] states that hazardous property HP3 can be discounted if the waste is solid without a free draining liquid phase. No free phase product or olfactory evidence of hydrocarbon contamination was recorded in the exploratory hole logs. The HazWasteOnline™ assessment is appended to this report. The assessment has indicated the remaining 4No. samples tested from the Made Ground (BH01 at 0.50m bgl, BH03B at 0.50m bgl, TP2 at 0.50m bgl and TP7 at 0.20m bgl) are likely to be classified as non-hazardous waste. The HazWasteOnline™ assessment is appended to this report.

Waste Acceptance Criteria (WAC) testing was undertaken on 4No. soil samples, 1No. collected from the natural clay (TP8 at 0.50m bgl) and 3 No. collected from Made Ground (BH01 at 1.00m bgl, BH02 at 0.50m bgl and TP3 at 0.50m bgl). The details of this assessment can be seen in the Chemtest Ltd laboratory test reports (report numbers: 18-34229-2, 18-35064-1, 18-36188-1, all dated November 2018).

The WAC test results have indicated that the sample tested from the natural superficial deposits is potentially suitable for management as Inert Waste. The results have also indicated that 2No. samples tested from the Made Ground are potentially suitable for management as stable non-reactive hazardous waste in non-hazardous landfill and 1No, sample from the Made Ground is potentially suitable for management as Inert Waste.

Based on the results of the HazWasteOnline™ assessment, it is recommended that the soil laboratory test certificates should be discussed with a waste operator, to determine the suitable disposal options, should excavation and off-site disposal of soils be required as part of the development.

8 Reuse of Materials

The final details of the proposed works have not yet been finalised at the time of writing, however it is anticipated that earthworks for the proposed scheme are likely to involve the excavation of Made Ground and natural superficial deposits. Due to the positive identification of asbestos, it is recommended that a specialist asbestos consultant is contacted regarding the reuse of asbestos impacted material. The 2018 GI indicates a notable deposit of Made Ground over a substantial depth of natural superficial deposits. It is anticipated that earthworks for the proposed scheme are likely to involve the excavation of Made Ground and minimal natural deposits comprising clay and silt.

Chemical test results indicate that excavated Made Ground and natural deposits from the location of the proposed works present a low risk to site end users and controlled waters, if reused on site. Should the reuse of excavated Made Ground (soil and stones (from construction and demolition sites) not containing hazardous substances) be proposed, then up to 1000Tonnes may be placed under a U1 Exemption. If the amount of Made Ground proposed for reuse exceeds the exemption limit a materials management plan (MMP) or environmental permit must be used and the material would need to fulfil the requirements of a non-waste and subject to the necessary planning approval.

If it is proposed to reuse excavated material other than as backfill, early engagement with both the Environment Agency and the Local Planning Authority (EHO or contaminated land officer) is recommended to discuss the reuse proposals and gain their approvals.

9 References

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