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FORD ENERGY RECOVERY FACILITY AND WASTE SORTING AND TRANSFER FACILITY, FORD CIRCULAR TECHNOLOGY PARK

HYDROGEOLOGICAL IMPACT ASSESSMENT

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FORD ENERGY RECOVERY FACILITY AND WASTE SORTING AND TRANSFER FACILITY, FORD CIRCULAR TECHNOLOGY PARK HYDROGEOLOGICAL IMPACT ASSESSMENT

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1. INTRODUCTION

1.1 Brief

Ford Energy from Waste (EfW) Limited, a joint venture between Grundon Waste Management Limited (Grundon) and Viridor Energy Limited (Viridor) (therein referred to as 'the applicants'), are proposing to build and operate a conventional energy recovery facility (ERF) ('proposed development') at a site located within Ford Circular Technology Park near Arundel. Grundon, the sole owner / operator of the existing waste transfer station (WTS), is proposing to continue this operation in a new, purpose-built waste sorting and transfer facility (WSTF) on site. Ramboll UK Limited (Ramboll) has been appointed by the applicants to undertake a Hydrogeological Impact Assessment (HIA) to support the full planning application at the site, including the ERF and WSTF and ancillary uses.

1.2 Design Evolution

In order to limit visual impacts on the surrounding landscape, it is necessary to minimise the overall height of the proposed development, which will be facilitated by extension of structures to a greater depth below ground. Initial proposals for design were considered at Stage 1 Design to provide for this reduced level, with design completed by GDSA that comprised incorporation of the following to meet the ideal requirements of the ERF facility:

- A reduced level dig across a large portion of the site to a finished floor level (FFL) of 5 metres below ground level (mbgl) (incinerator bottom ash (IBA), bunker); and
- Creation of two bunker areas, one to 10 m depth (FFL) (IBA bunker) and the other to 15 m depth (FFL) (bunker hall).

Details of the Stage 1 Design are shown in Figure 2. The proposed elevations of the reduced level dig and bunkers for Stage 1 Design are below the groundwater table, and therefore construction of the proposed development would require groundwater control by lowering of the water table to produce a dry working environment to allow construction operations to proceed. The environmental impact of dewatering to achieve this option has been assessed to be high; details are included herein.

Due to the potential environmental impacts relating to groundwater for Stage 1 Design (as discussed in this report), an iterative approach has been taken, with the design amended at Stage 2. Details of the Stage 2 Design are shown in Figure 3. Stage 2 Design has been completed by GDSA to reduce the volume of water required to be managed during construction, and thus to reduce environmental impacts relating to groundwater derogation and impacts on surface water as far as is reasonably practicable whilst still enabling delivery of the proposed development.

1.3 Setting

The site is located at the Ford Circular Technology Park (the former Tarmac blockworks site, approximate National Grid reference (NGR) 498968 103119) to the west of the village of Ford. It is located off Ford Road, to the north of the aerodrome in the village of Ford, approximately 2.1 km northeast of the edge of the town of Littlehampton and 2.5 km north of the coastline, being 2.2 km to the south of the South Downs National Park. Figure 1 shows the site location.

The 6.72 hectare (ha) site is partially used for existing WTS operations and is partially vacant. The existing WTS building is located towards the centre of the site and portacabins; parking and containers associated with this operation are situated to the west of the WTS. There are two vacant former hangar buildings towards the north of the site and a large area of hardstanding is situated towards the south and east of the site.

Based on groundwater monitoring undertaken at the site a worst-case expected groundwater elevation of 4 mAOD (2.5 mbgl) in the area of the site proposed for ground level lowering has been assumed for the purposes of this assessment.

1.4 Objectives and Scope of Works

This hydrogeological impact assessment has been prepared to identify hydrogeological constraints which may relate to the proposed construction works below the groundwater table. It is produced in general accordance with Environment Agency (EA) guidance contained within Science Report SC040020/SR1[1]. Due to the stage of the project, the assessment is based on currently available information, with a requirement for update once further details relating to the proposed construction methods are known.

On this basis, the scope of the study is as follows:

- Provide a description of the proposed excavation requirements for Design Concepts 1 and 2;
- Assess key risks relating to Stage 1 Design in terms of impact on the groundwater environment;
- Assess comparative level of risk to the groundwater environment in relation to Stage 2 Design;
- Set out what consultation has occurred with regulators;
- Describe the methodology for assessment;
- Determine the complexity of assessment required (tier level);
- Assess the site's hydrogeological setting and relevant features to define the baseline conditions and expected zone of influence of dewatering;
- Identify water features within the expected zone of influence of the works;
- Derive a conceptual hydrogeological model and assess risks to the water environment; and
- Determine what further assessment and/or mitigation, if any, is necessary.

The completed development is intended to be watertight and to resist hydrostatic pressures; it therefore will not require long term abstraction following completion of the below ground construction works; groundwater control will be required for temporary dewatering only.

This report does not include assessment of any geotechnical risks, such as ground stability or construction methods.

1.5 Proposed Development Details

Ford EfW Limited wishes to develop a new ERF and WSTF, including ground level lowering in the main process area of the site and construction of deep bunkers. The site has a current ground elevation which varies between approximately 7 metres above Ordnance Datum (mAOD) and 6.5 mAOD.

Stage 1 Design

The area which is proposed to be constructed below the groundwater table under Stage 1 Design covers an area of approximately 2.3 ha. At present the ground elevation in this area is approximately 6.75 mAOD (± 0.5 m), with a slight fall to the south. The area of proposed

[1] Environment Agency (2007) Hydrogeological impact appraisal for dewatering abstractions SC040020/SR1

excavation is located as shown in Figure 2. The works comprise the creation of finished floor levels which are 5 mbgl for the process area, 10 mbgl for the IBA and 15 mbgl for the Bunker Hall.

Groundwater abstraction would be required for the purpose of construction related dewatering, and as such, the focus of dewatering would be to maintain a groundwater level below the base of the excavation. The excavation would need to extend below the level of the proposed finished floor levels and bunker floor levels in order to facilitate construction of those features. The deep bunkers would require an adequate thickness of floor slab to withstand hydrostatic uplift, or could be supported by ground anchors, tension piles or similar in order to reduce the overall depth of excavation required for the foundation slab. As such, the maximum depth of excavation has been assumed to be 2 m below the deepest bunker (bunker hall) and 1 m below the IBA and process area. As such, excavation depths are required to be below the finished floor levels i.e. 17 mbgl (-10.5 mAOD) for the bunker hall, 11 mbgl (-4.5 mAOD) for the IBA and 6 mbgl (0.5 mAOD) for the process area. Summary details of the Stage 1 Design proposals are provided in Table 1.1.

Table 1.1: Groundwater Abstraction Summary – Stage 1 Design

Required Ground Elevation (mAOD)	Duration of Construction Works Requiring Groundwater Lowering	Groundwater Lowering Method	Water Consumption
Bunker Hall -10.5 (17 mbgl)	Approximately six months	Deep wells	No intervening use Non-consumptive Abstracted groundwater discharge point: Surface water drainage on site which in turn discharges to surface waterbody of the River Arun. Or Recharge of groundwater via recharge wells back into the same aquifer from which it is abstracted.
IBA Bunker -4.5 (11 mbgl)			
Reduced Level Dig -0.5 (6 mbgl)			

It is likely that the surface water pumping system reduced level excavation would also be required in addition to the bunkers and reduced level dig identified for Stage 1 Design, but that design has not been developed in detail to have identified such requirements.

Stage 2 Design

The area proposed to be constructed below the groundwater table under Stage 2 Design covers an area of approximately 0.12 ha. The area of proposed excavation is located as shown in Figure 3.

The reduction in elevation of the wider area of reduced ground levels by 2.5 m depth (1.5 m reduced level to finished floor and finished external level, plus approximately 0.7 to 1 m thick base slab) would result in a new ground elevation of approximately 4 mAOD and would therefore be expected to be above the groundwater table. The IBA bunker would also be constructed above the groundwater table.

However, the proposed bunker hall would require excavation to 4 m depth (which includes a 1 m base slab), and therefore could encounter groundwater, depending on the water table elevation at the time of construction. Groundwater abstraction could be required for the purpose of construction related dewatering, and as such, the focus of dewatering would be to maintain a groundwater level below the base of the bunker hall excavation. The bunker would need to be designed to resist hydrostatic uplift. Based on the current site topography, this would give a deepest elevation of

excavation of 2.5 mAOD. Summary details of the Stage 2 Design proposals are provided in Table 1.2.

Some additional excavation below the 1.5 m reduced level will be required to incorporate the surface water pumping system . The depth of excavation required below the reduced level is expected to be 2.5 m for the surface water pumping system. Allowing for a 1 m thickness of base slab for the surface water pumping system itself, the excavation would be 5 mbgl (1.5 mAOD).

Table 1.2: Groundwater Abstraction Summary – Stage 2 Design

Required Ground Elevation (mAOD)	Duration of Construction Works Requiring Groundwater Lowering	Groundwater Lowering Method	Water Consumption
Bunker Hall 2.5 (4 mbgl)	Approximately six months	Deep wells	Non-consumptive
Pumping Station 1.5 (5 mbgl)			Abstracted groundwater discharge point: Surface water drainage on site which in turn discharges to surface waterbody of the River Arun.
Reduced Level Dig 4.0 (2.5 mbgl)			

2. BACKGROUND

The Water Act 2003 removed the exemption of abstraction of groundwater for dewatering purposes from the requirement for licensing, and there are now three types of abstraction licence:

- Temporary licences: for water abstraction for any purpose for a period of less than 28 days;
- Transfer licences: for water abstraction to transfer water from one source to another without intervening use, or to transfer water within the same source for dewatering activities without intervening use; and
- Full licences: for water abstraction for any other licensable use.

Licences are not required for small abstractions (less than 20 m^3/day).

For the groundwater abstraction, which is considered herein, water will be transferred from groundwater to surface water drainage, or back into groundwater if discharge to surface water is not pragmatic. There will be no intervening use. As such the licence type which applies is a transfer licence. The discharge of the abstracted water is to be managed separately. (NB, if the water is discharged to a surface water sewer that is not in private ownership, a full licence may be required for discharge to public surface water sewer).

3. METHODOLOGY AND TIERED APPROACH

It is imperative that the HIA develops a conceptual model of the site and dewatering process and is based upon both qualitative and quantitative information to produce a simplification of the situation in reality. The factors that are crucial to the model must be focussed upon, and the model must be built on an evidence base (even though an approximation).

HIA methodology takes a tiered risk assessment approach, with the tier denoting the level of complexity required for the assessment. A risk-based approach is adopted, such that the level of complexity is dependent upon factors which contribute to the degree of uncertainty and risk. Tiered levels have been developed with the tier level selected such that the uncertainty in the assessment may be reduced at each stage; the tiered levels are as follows:

- Tier 1 (Basic): Tested using lumped long-term average water balances and simple analytical equations, to arrive at a 'best basic' conceptual model;
- Tier 2 (Intermediate): Tested using more detailed data, such as time-variant heads and flows, and more sophisticated tools, such as seasonal or sub-catchment water balances (semi-distributed), analytical solutions (to investigate the impact of abstraction on river flows, for example), or two-dimensional steady-state groundwater models; and
- Tier 3 (Detailed): Likely to be tested using a spatially distributed and time-variant numerical groundwater model, calibrated and validated against historical data.

The conceptual modelling approach is iterative and is refined within each tier, from initial understanding to best available model. Confidence improves by moving through the tiers, but assessment stops at the point at which sufficient confidence is provided.

Impacts are focussed at a local scale, i.e. that of the zone of influence of the abstraction. However, assessment needs to consider a wider area in some circumstances such as for large abstractions. Impacts are considered as per the following categories and scenarios:

- Categories:
  - Flow Impacts, e.g. interception of water that would otherwise have reached a surface water body or inducing leakage from rivers. Usually of relevance at both a regional and local (abstraction catchment) scale.
  - Drawdown Impacts, e.g. impact on groundwater levels in nearby abstractions or wetlands. Usually of relevance at a local (abstraction catchment) scale.
- Scenarios:
  - Impacts during operational phase of dewatering.
  - Long-term impacts after cessation of active dewatering.

The HIA considers impacts to the water environment without mitigation measures such as water being discharged back into the environment, and then adds in the beneficial effects of mitigation.

4. BASELINE

This section sets out baseline information on the geological and hydrogeological setting of the site at which dewatering is assessed, together with the dewatering requirements. The information is utilised to ascertain what the key focus points are for the HIA (the 'HIA requirements' as per Table 4.3), and to identify likely abstraction licence restrictions.

This site-specific information is also subsequently used for tier scoring, which is developed within Section 6.

4.1 Aquifer Characteristics

Previous studies at the site have identified the underlying geology to comprise between 0.4 m and 2 m of Made Ground which rests on superficial River Terrace Deposits, which in turn lie directly upon the White Chalk Subgroup bedrock. Local to the main area which is proposed for groundwater lowering, chalk was encountered at a depth of approximately 2.3 to 4.0 mbgl (comprising Lewes

Nodular, Seaford, Newhaven, Culver and Portsdown Chalk Members, undifferentiated)[2,3]. See Figure 4 for a geological map of the site, and Table 5.1 for a summary of the strata encountered from investigation by Enzygo[3].

Table 4.1: Summary of Strata

Strata	Depth to Base of Stratum Recorded Mbgl	Design Depth to Base of Stratum mbgl	Bases for Selection of Design Value
Made Ground	0.4 to 2.0	1.0 based on typical value	Typical value across site
Cohesive River Terrace Deposits	2.0 to 4.2	2.0	Log for TP5, which is in the area of the proposed excavation and represents worst-case condition in terms of minimal depth to the Chalk
Granular River Terrace Deposits	2.3 to 4.4	2.3	
Chalk	Base not encountered	200	

The River Arun meanders through the region and is located approximately 950 m east of the area of the site proposed for groundwater level lowering. A drain, likely to form a tributary of the Arun, is located approximately 350 m southeast of the site and flows towards the east (towards the Arun). It is anticipated that surface water drainage from the site discharges to this drain feature which subsequently discharges to the Arun. The site lies at the edge of the current Arun valley, and the River Terrace Deposits are present throughout the site suggesting that the site is within an area of former river valley.

The River Terrace Deposits are designated by the EA as a Secondary Aquifer. Previous investigations at the site have found these strata to broadly comprise cohesive units of sandy clay over a granular unit of medium grained sand.

Based upon the British Geological Survey (BGS) geological maps[4] and memoir[5] for the area of the site plus previous investigations[3], the bedrock at the site comprises the White Chalk Subgroup (formerly referred to as the Upper Chalk over the Middle Chalk), comprising predominantly white chalks with flints. The White Chalk extends to approximately 200 m depth, beneath which the Grey Chalk (a marly chalk which was formerly known as the Lower Chalk) and Upper Greensand are encountered, which in turn are underlain by the Gault Formation which forms the base to the aquifer. The Chalk is designated as a Principal Aquifer by the EA, whilst the Upper Greensand is a Secondary Aquifer, although the two stratum are in hydraulic continuity and therefore act as a single aquifer unit.

The Grey Chalk is marly, and typically has significantly lower permeability than the White Chalk. The bedrock geological strata are gently folded into a monocline structure, with the crest of Littlehampton Anticline lying approximately 700 m north of the site and striking approximately east-west, and the Chichester Syncline being approximately 1.5 km north beyond the anticline; bedrock strata at the site therefore dip gently towards the south. Hardgrounds are expected to be present within the Chalk, which may represent zones of higher permeability, for example the Top Rock and Chalk Rock

[2] Ramboll (June 2020) Ford Energy Recovery Facility and Waste Sorting and Transfer Facility, Ford Circular Technology Park Geoenvironmental Desk Study 1620007830-RAM-XX-XX-RP-YE-00002

[3] Enzygo (2015) Ford Arundel Geoenvironmental Report CRM.049.009.GE.R001A

[4] BGS Onshore Geoindex www.bgs.ac.uk [Accessed June 2020]

[5] BGS (1897) The geology of the country around Bognor. Explanation of sheet 332

within the Upper Chalk and Melbourn Rock at the base of the Middle Chalk; these may represent preferential groundwater flow pathways due to their jointing and hence higher permeability.

According to BGS and EA data[6] relating to the Chalk aquifer in the South Downs area and BGS digital hydrogeological map[7], the White Chalk Subgroup is a highly productive aquifer in which flow is virtually all through fractures and discontinuities, and in the area of the South Downs shows some evidence of karstic development, with a highly connected network of fractures and fissures. Higher transmissivity within the Chalk of the South Downs area typically tends to occur in areas of shallow groundwater table and within valley areas, often with the majority of flow occurring with relatively few fractures focussed in the upper 40 m below the water table. The expected transmissivity of the Chalk in this part of the South Downs is high, and given that the site lies within a valley area with shallow groundwater table the transmissivity is expected to towards the higher end of the range of transmissivities in the South Downs Chalk. Based on the 75th percentile of transmissivity data, is expected to be approximately 1,600 m²/d in the area of the site, although the upper end of the range is 9,500 m²/d and it would therefore not be unreasonable for transmissivities to be higher e.g. around 5,500 m²/d. Storage coefficient range between the 25th and 75th percentile of data for the South Downs Chalk is between 0.00061 and 0.004.

Groundwater elevations were monitored at the site during the period 2015 to 2020; since 2018 this has been at approximately monthly intervals. The highest recorded groundwater elevation event during this monitoring period occurred on 11 March 2020, when the elevation of the groundwater table was recorded to be approximately 3.5 mAOD[8] (3.0 mbgl) in the area of the site which is proposed to be subject to lowering of ground levels; to the west groundwater levels were recorded at up to 4.5 mAOD (2.0 mbgl), and to the east at up to 3.0 mAOD [9] (3.5 mbgl). Groundwater was broadly within the Chalk and granular River Terrace Deposits. Allowing for groundwater level to rise higher than that recorded on 11 March 2020, a worst-case expected groundwater elevation of 4 mAOD (2.5 mbgl) in the area of the site proposed for ground level lowering has been assumed for the purposes of this assessment. From review of the BGS hydrogeology map[10], the groundwater level in the Chalk is expected to be in the region of 0 mAOD to 5 mAOD (1.5 mbgl to 6.5 mbgl) at the site, with groundwater flow towards the southeast at a shallow hydraulic gradient of approximately 0.0014, towards the River Arun and the coast. The BGS data concurs with the groundwater monitoring data obtained from boreholes at the site.

The site does not lie within or near to a groundwater Source Protection Zone (SPZ), designated for the protection of potable public groundwater supply. The nearest SPZs lie to the north of the site, north of the Chichester Syncline which is infilled with lower permeability deposits and effectively forms a barrier to groundwater flow in the Chalk towards the south.

A plan showing the pertinent hydrological features is provided in Figure 5.

Key hydrogeological parameters which have been estimated (from the sources noted above) for the site are as follows:

- Aquifer type — Chalk, with predominant flow through fractures and fissures
- Transmissivity — 1,600 m²/d to 5,500 m²/d
- Saturated aquifer thickness — 200 m (aquifer assumed to comprise the Upper and Middle

[6] BGS and EA (1997) The Physical Properties of Major Aquifers in England and Wales WD/97/34, R&D 8

[7] BGS Digital Hydrogeology Map 1:625,000 Scale [accessed December 2020]

[8] Ground levels of boreholes were not surveyed by Enzygo, therefore groundwater elevation data recorded by monitoring these boreholes has been estimated based on assumed ground elevations of the boreholes derived from a survey drawing of the site dated June 2020

[9] BH105 and BH106 were installed with piezometers at approximately 20 m depth in the Chalk. Depths to the base of the monitoring points were measured in November 2020 by a Ramboll consultant at BH105 and found to be 13 mAOD suggesting that the bottom part of the well was blocked and this resulted in shallow depth to water in the well which was atypical of the wider groundwater regime. The same is likely to apply at BH106 which is similarly installed and was flooded hence no measurements were made from this monitoring point. Groundwater level monitoring data from BH105 and BH106 has therefore been discounted

[10] BGS (1984) Hydrogeological Map of the Area Between Cambridge and Maidenhead

	Chalk)
• Hydraulic conductivity	8 m/d to 27.5 m/d (9 x 10^{-5} m/s to 3 x 10^{-4} m/s)
• Hydraulic gradient	0.0014
• Sensitive water features	River Arun
• Storage coefficient	0.004

4.2 Current Consents

There are two recorded groundwater abstraction licences at the site, relating to operations by Tarmac for process water (Refs 27/196 and 27/198), which were granted during the period 2000 to 2001, but for which no information is available relating to abstraction rate; these abstraction licences are likely to have been revoked or to have expired. Four other groundwater abstractions for agricultural purposes have been granted between 500 m and 900 m north of the site, and one has been granted approximately 1.7 km west of the site for agricultural use. Surface water abstractions have also been granted within the area of the site, but all are at least 1 km from the site and to the north (up hydraulic gradient) and are therefore not considered to be sensitive to groundwater activities at the site.

A number of discharge consents for discharge of trade effluent were granted to Tarmac for discharge to surface water on site, and for discharge to the drain east of the site which is assumed to connect to the River Arun. The consents ran for short periods of around six months, and all have been revoked with the latest consent being revoked in 2001.

4.3 Surface Water and Water-dependent Ecosystems

Surface water features within 1 km of the area of the site at which ground level lowering is proposed include the following:

- A rectangular pond feature at HM Prison Ford approximately 370 m southeast of the proposed bunker hall. This is expected to be a manmade feature and to not be in hydraulic continuity with the underlying aquifers;
- Drain which issues on the north side of HM Prison Ford approximately 400 m southeast of the proposed bunker hall and flows east towards the River Arun; it is expected to form a tributary of the Arun; and
- Drain which issues immediately north of Ford Lane Business Park. The drain is approximately 400 m north of the proposed bunker hall.

Water features between 1 km m and 2 km of the site include the River Arun transitional waterbody which is 1 km east of the site, and various tributaries of this river.

The natural groundwater flow direction is expected to be southeast, towards the River Arun and the coast. The drains within 1 km to the southeast and north of the site are located over raised beach deposits of sand and gravel which directly overlie the Chalk bedrock, and therefore may be in hydraulic continuity with the underlying principal Chalk aquifer.

The River Arun is a heavily modified transitional water body and is classified by the EA[11] as being of moderate ecological quality and failing chemical quality due to presence of priority hazardous substances as defined under the Water Framework Directive. The waterbody is not currently achieving good status due to water supply, industrial and agricultural groundwater abstraction, and physical modification of the waterbody.

[11] Environment Agency Water Framework Directive Cycle 2. South East River Basin District

An area of ancient woodland is present at 'Decoy' to the north of the railway line, which is north of the village of Ford, being approximately 1.1 km north of the site.

There are no recorded wetlands or other designated statutory or non-statutory environmentally sensitive sites within the zone of influence or within a 2 km radius of the area which is proposed to be subject to lowering of ground levels. Although the River Arun is linked to a Special Protected Area (SPA) and a Special Area of Conservation (SAC), these are located up hydraulic gradient and more than 2 km from the site and are therefore unlikely to be affected by the proposed works at the site.

4.4 Water Resource Availability

The level of stress on local water resources is based upon the availability of water resources as described in the Catchment Abstraction Management Strategy (CAMS) classification for the groundwater management unit which is of relevance to the dewatering scheme.

The relevant CAMS is the Arun and Western Streams abstraction licensing strategy[12], for which a summary of the water resource availability for different scenarios is provided in Table 4.2. Groundwater has been assessed by the EA as having 'restricted water available for licensing'.

Based upon the resource availability, the expected licensing outcomes based upon the CAMS for the area considered are summarised in Table 4.3, with the relevant assessment outcome shown in bold in that table. Based upon this, it is expected that the EA would consider granting a temporary non-consumptive licence for construction dewatering purposes.

Table 4.2: CAMS Resource Availability Summary

	Groundwater Resource
Resource Availability	Restricted water available for licensing (over licensed)

[12] Environment Agency (2019) Arun and Western Streams abstraction licensing strategy A strategy to manage water resources sustainably 227_10_SD01 version 7

Table 4.3: CAMS Resource Availability Summary and Licensing Implications

	No CAMS or WFD* Status Defined	Water Available for Licensing	Restricted Water Available for Licensing	Water Not Available for Licensing
Sufficient water to meet needs?	Abstraction is likely located in unproductive strata	Yes	More water is licensed than the amount available but recent abstractions are lower than the amount available, OR There are known local impacts likely to occur	More groundwater has been abstracted recently than the amount available
New non-consumptive abstractions (transfer licenses)		Can be permissible	Can be permissible	Can be permissible
New consumptive abstractions		Can be permissible	Not expected to be granted in restricted groundwater units. Water may be available through purchase of entitlement from existing licence holder	Not expected to be granted
Time-limited licence renewals		May require changes, and considerations to reduce risks	May require changes, and considerations to reduce risks	May require changes, and considerations to reduce risks
HIA requirements	Focus on specific local scale impacts	Focus on specific local scale impacts	Demonstration that abstraction is not part of regional water resources problem	Demonstration that abstraction will not exacerbate existing regional problems.
Expected licensing restrictions	Not expected	Not expected	Seasonal restrictions possible	Seasonal restrictions expected

Note: Assessment outcome is shown in **bold**

5. BASIS OF ASSESSMENT

5.1 Dewatering Operation

Dewatering would be required for Stage 1 Design to permit construction of the reduced site levels and to construct both the proposed bunker hall and IBA bunker. For Stage 2 Design, only the proposed bunker hall might require dewatering to construct the required reduced site levels (depending on seasonality of groundwater elevation), in addition to smaller areas at which the ground levels would need to be lowered to install drainage features.

At this stage, it is assumed that the reduced level digs and basement excavations will be accomplished by provision of a cut off wall formed by secant piling around the perimeter, with dewatering followed by excavation within the cut-off structures. During dewatering, groundwater is expected to flow into the excavation from the bottom until the water table has been sufficiently depressed, with cut-off structures preventing lateral flow. The foundations and piled structures will be subject to detailed design but are expected to include, for example, tension piles and ground anchors for Stage 1 Design.

Stage 1 Design

Dewatering would be required for Stage 1 Design to permit construction of the reduced site levels in the operational area of the site to a depth of 5 m, and two bunkers which are required to have

finished depths of 10 m and 15 m but will require deeper excavation to allow for a suitable foundation to account for hydrostatic uplift. Initial estimates are for the water table to be required to be suppressed with drawdown of the initial water table at 4 mAOD (2.5 mbgl) to an elevation of -10.5 mAOD (17 mbgl) for the deepest bunker; a drawdown of 14.5 m.

The dimensions of the proposed areas of the site at which ground levels will be lowered are provided in Table 5.1. Values provided are approximate and assume provision of ground anchors/ tension piles or similar.

Table 5.1: Summary of Groundwater Lowering Requirements – Concept Design 1

	Width (m)	Length (m)	Finished Floor Level Depth Below Existing Ground Level (m)	Depth of Required Excavation Allowing for Foundation (mbgl)	Elevation of Base of Required Excavation Allowing for Foundation (mAOD)	Drawdown Required (m)
Process Area	125	155	5	6	0.5	3.5
Incinerator Bottom Ash (IBA) Bunker	10	30	10	11	-4.5	8.5
Bunker Hall	25	40	15	17	-10.5	14.5

** Assumes groundwater elevation at 4.0 mAOD (2.5 mbgl)*

Stage 2 Design

Dewatering could be required for Stage 2 Design to permit construction of the bunker hall. The expected elevation of the reduced dig for the bunker hall would be 2.5 mAOD (4 mbgl).

The dimensions of the proposed areas of the site at which ground levels will be lowered are provided in Table 5.2.

Table 5.2: Summary of Groundwater Lowering Requirements – Concept Design 2

	Width (m)	Length (m)	Finished Floor Level Depth Below Existing Ground Level (m)	Depth of Required Excavation Allowing for Foundation (mbgl)	Elevation of Base of Required Excavation Allowing for Foundation (mAOD)	Drawdown Required (m)
Bunker Hall	30	40	3.0	4.0	2.5	1.5
Pumping Station	1.5	1.5	4.0	5.0	1.5	2.5
Reduced level dig	50	13	1.5	2.5	4.0	0.0

* Assumes groundwater elevation at 4.0 mAOD (2.5 mbgl)

5.3 Radius of Influence

An estimate of the radius of influence (R_0) from dewatering, assuming groundwater is not recharged and in the absence of secant piles, may be given using the Sichardt formula[13] for which R_0 is given as follows:

$$R_0 = Cs\sqrt{K}$$

Where: s is the drawdown (m)
K is the hydraulic conductivity (m/s)
C is an empirical factor, usually taken as 3000 for radial flow

As a conservative approach, and to estimate a sufficiently large radius of influence such that significant water features will be captured in the assessment, a value for hydraulic conductivity has been selected from the high-end of likely values for the aquifer, it has been assumed that K is 27.5 m/d (3×10^{-4} m/s). The bunker hall has been considered, given that this aspect of development requires the greatest drawdown. The estimate is also highly conservative as it is proposed to construct secant piled walls and dewater from within the piled area, and as such lateral flow into the excavation will be mitigated resulting in a smaller cone of depression.

The estimated radius of influence would be as follows:

- Stage 1 Design 725 m
- Stage 2 Design 80 m

The estimated areas of influence are shown on Figure 4. The radius of influence calculated for Stage 2 Design is based upon the dewatering for the bunker hall only, as dewatering for other features which require additional lowering of the water table would be highly localised, and of short construction duration.

The radius of search regarding water features has been extended to a 2 km to align with expected EA requirements relating to water features surveys, however, features between the radius of influence extent and 2 km from the site are not expected to be adversely affected by dewatering at the site.

Estimates of the radius of influence identify that for Stage 1 Design, the dewatering operation could impact upon baseflow to nearby surface water drains and may reduce baseflow to the River Arun. Within the radius of influence of dewatering for Stage 1 Design are two groundwater abstraction licenses for agricultural use north of the site (and one for Tarmac process operations water at the Ford ERF site boundary, which is expected to have been revoked). The dewatering for Stage 1 Design could cause reduction in baseflow to water courses, and derogation of existing groundwater abstractions from an aquifer in which groundwater resources are already under pressure.

The estimated radius of influence for Stage 2 Design does not include any existing surface water features or existing groundwater abstractions (other than that which is expected to have been revoked).

5.4 Groundwater Abstraction Rate

The aquifer may be confined in part when groundwater elevation is high, depending upon the permeability of the River Terrace Deposits, which is currently unknown. Excavations are, however,

[13] Environment Agency (2007) Hydrogeological impact appraisal for dewatering abstractions. Guidance notes that this formula should be used with care. There are no significant boundary conditions expected within the zone of influence and therefore this is expected to be a reasonable worst-case scenario. Similar values for R_0would be obtained using the Theim method given maximum anticipated discharge and a 200 mm diameter well

expected to extend through the superficial deposits, and therefore dewatering would be required from the Chalk aquifer. On a precautionary basis, estimated abstraction rates are based on the assumption that the aquifer would be unconfined. The reduced level dig will encounter a variety of thicknesses of superficial deposits, and it is likely that in some areas, excavation will reach the Chalk, or will require excavation of sufficient overburden such that where the aquifer may be confined, the remaining overburden would be insufficient to withstand groundwater pressure and thus dewatering from the chalk would be necessary. Therefore, abstraction rates have been calculated with respect to dewatering from the chalk aquifer.

Based upon assessment using the Theim method of calculation, worst-case estimated discharge rates, ignoring the cut-off provided by secant piling, the expected rates of groundwater abstraction required to provide adequate drawdown over the area required to be dewatered are approximated as shown in Table 5.3.

Table 5.3: Approximate Abstraction Rates

Option	Component	Abstraction Rate Day One	Abstraction Rate After Five Days	Abstraction Rate After 40 Days
Stage 1 Design	Bunker Hall	8,500	6,000	4,600
	IBA Bunker	5,000	3,500	2,700
	Reduced Level	6,200	3,300	2,100
Stage 2 Design	Bunker Hall	1,500	900	660
	Pumping Station #	750	630	530*

Values are in m³/d and are provided as estimates only. Values are based on assumed conservative hydraulic properties of the Chalk, and do not account for construction methods such as the use of secant piles. Abstraction rates provided assume that each component is constructed in isolation.

\# Dewatering for the Bunker Hall would provide the majority of the abstraction required if construction of these components is carried out simultaneously.

* Duration of work would not be likely to reach 40 days

These values are, however, highly sensitive to the transmissivity value of the Chalk, which at present is not known specifically for the site, and therefore actual abstraction rates may be lower.

No long-term dewatering is expected to be required as the bunkers and ground level lowering will be designed with impermeable bases and walls to prevent groundwater ingress once constructed.

The most onerous case for Stage 1 Design relates to dewatering for the Bunker Hall, and therefore this forms the basis for the remainder of the assessment for Stage 1 Design. Furthermore, the dewatering for the Stage 2 Design Bunker Hall will likely result in sufficient drawdown for the laydown area reduced level excavation and would provide the bulk of dewatering requirements for the surface water attenuation and surface water pumping system. Groundwater abstraction rates will be far higher (by around an order of magnitude) for Stage 1 Design compared to Stage 2 Design.

If the abstraction is less than 100 m³/d, then this would fall within the 'small scale dewatering in the course of building or engineering works' definition of The Water Abstraction and Impounding (Exemptions) Regulations 2017[14] and an abstraction licence would not be required. Due to the expected possible total discharge rate being higher than 100 m³/d, a groundwater abstraction licence is expected to be required. Depending on groundwater elevation at the time of the construction works, hydraulic properties of the aquifer and construction methods, then potentially construction dewatering for Stage 2 Design may fall within these limits for 'small scale dewatering'.

[14] UK Statutory Instruments (2017) The Water Abstraction and Impounding (Exemptions) Regulations No. 1044. Part 2 Section 5

There are no other operations proposed for the site which may contribute significantly to the water balance at the site.

5.5 Proposed Discharge of Abstracted Groundwater

The proposed works will require discharge via surface water sewers into surface water drains which ultimately drain to the River Arun (see Figure 5). Alternatively, water could be recharged back into the Chalk aquifer, providing that suitable access to land to do that can be achieved. These options are discussed below. Requirement for a Water Framework Directive assessment may be triggered in both cases.

Stage 1 Design

A discharge of abstracted water could be to the River Arun via the existing surface water drainage network on site, with no consumptive use. However, given the high abstraction rates required, the existing surface water buried drainage network may be inadequately sized to sufficiently accommodate the flow. Furthermore, due to the high rate of abstraction, discharge into nearby ditches could result in erosion of banks, scour and increased sediment loading in the ditches and downstream surface watercourses. An assessment of surface water flooding resulting from the discharge would also need to be made.

Alternatively, discharge could be made back to the Chalk aquifer via recharge wells if surface water discharge is not feasible. However, this would require a series of recharge wells to be constructed, potentially outside of the site boundary, for which land access would be required as the Applicant does not have control on any land outside the application boundary

Recharge of groundwater into the Chalk will require modelling to identify suitable locations at which recharge could occur, and recharge rates at each of those locations. To inform modelling, a site-specific hydrogeological assessment will be required, and may include pump testing for which a separate licence would be required from the EA to investigate the groundwater resource. An abstraction and recharge system would be expected to require a large number of wells to be constructed, and significant infrastructure to supply the pumping and recharge system. Ongoing monitoring of water quality and groundwater levels would be required during and post operation of the recharge scheme.

Treatment of contaminants in groundwater would be required prior to discharge of the water.

Discharge would be subject to Environment Agency permitting. Consent may also be required from the water authority should they own the surface water sewer system which is to be utilised.

Stage 2 Design

A discharge of abstracted water could be to the River Arun via the existing surface water drainage network on site. It is likely that the existing drainage network would be suitable to accommodate the smaller volumes of water which would be abstracted.

An assessment of risks relating to flooding from the additional water proposed to be discharged to the tributaries to the River Arun will be required, together with consideration as to whether the proposed discharge of water into the River Arun could affect water quality and ecology within that transitional waterbody. Given the relatively low quantity of abstracted water and providing any contamination of groundwater is remediated in advance of abstraction and discharge, the risks relating to flooding and surface water quality are considered to be low.

Discharge could be subject to Environment Agency permitting. Consent may also be required from the water authority should they own the surface water sewer system which is to be utilised. Discharge via a recharge scheme into the Chalk would require design of a more complex solution and is not expected to be required given the small radius of influence and limited potential for groundwater abstraction relating to Stage 2 Design to significantly affect the environment.

Other Issues

A summary of geo-environmental findings from previous ground investigations at the site is provided in the contaminated land assessment for the site[2], including groundwater quality. Based upon this data review, groundwater at the site has been identified to be impacted by organic contaminants including polycyclic aromatic hydrocarbons (PAHs) and total petroleum hydrocarbons (TPH) at a number of locations across the site. Risks of contamination of the abstracted groundwater are therefore considered to be moderate and may require treatment prior to being discharged.

There is potential for sediment to be temporarily present within the abstracted water owing to construction operations, however, abstraction from the Chalk would not be expected to yield a high fines content, and provision of a filter pack around the wells will act to reduce fines being drawn through the abstracted water. Other measures may be incorporated into the system design, such as water passing through a v-notch tank that would act against the discharge of fines. A v-notch tank reduces the velocity of abstracted groundwater and as a result promotes the settling of fines prior to discharge. Flow rates from the discharge will require measuring, for example using a mechanical flowmeter in the discharge line, from which manual readings can be taken daily.

6. TIER SCORING

Based upon the EA guidance, a scoring system for identification of the expected tier level required for the HIA is set out below, this is intended to provide an indication of the level of assessment required. This scoring system is derived from those factors which are typically crucial factors and thus focus upon the pertinent hydrogeological issues. The scores ascribed to the study of groundwater abstraction are shown in Table 6.1, together with the calculated weighted score and expected level of assessment required. Based upon this, a Tier 2 assessment is likely to be required to provide adequate confidence in the risks and impacts from the abstraction. At this stage a Tier 1 assessment is provided but may subsequently require further detailed assessment in accordance with Tier 2 to support an abstraction licence.

Table 6.1: Tier Scoring

Criteria	Class	Score	Weight	Weighted Score Stage 1 Design	Weighted Score Stage 2 Design	Rationale
Aquifer characteristics	Karst	4	2	Score 4 Weighted Score 8	Score 4 Weighted Score 8	The site overlies the Chalk Principal Aquifer. Karstic features could be present.
	Principal aquifer	3				
	Secondary aquifer	2				
	Unproductive strata	1				
Water-dependent conservation sites	Habitats Directive (Natura 2000) sites	4	4	Score 1 Weighted Score 4	Score 1 Weighted Score 4	No sensitive sites within the zone of influence
	Sites of Special Scientific Interest	3				

Criteria	Class	Score	Weight	Weighted Score Stage 1 Design	Weighted Score Stage 2 Design	Rationale
	Other designations (including National Parks and AONB)	2				
	None	1				
Water resource availability status	Over-abstracted	4	1	Score 3 Weighted Score 3	Score 3 Weighted Score 3	The CAMS identifies there is restricted water available for licensing.
	Over-licensed	3				
	No water available	2				
	Water available	1				
Dewatering quantity	Very large (>5000 m³/d)	4	3	Score 4 Weighted score 12	Score 1 Weighted score 3	Discharge rates would be calculated at the dewatering design stage but are estimated to be very large based on aquifer properties and required drawdown for Stage 1 Design. For Stage 2 Design the flow rates are expected to be broadly <1,000 m³/d
	Large (2500 to 5000 m³/d)	3				
	Medium (1000 to 2500 m³/d)	2				
	Low (<1000 m³/d)	1				
Total weighted score				27	18	
Tier rating	Based on Weighted Score 31-40 Tier 3 21-30 Tier 2 12-20 Tier 1			Tier 2	Tier 1	

7. TIER 1 - FLOW IMPACTS

7.1 Apportioning of Flow

The proposed works will result in an overall temporary loss of groundwater from Chalk, with drawdown in an area that is within 725 m of the proposed area at which levels will be lowered, over a period of approximately six months. The abstracted water will pass through a settlement tank prior to discharge to surface water sewer that ultimately discharges to the River Arun at a distance of approximately 900 m downstream (east) of the excavation works.

7.1.1 The only surface water features within the radius of influence of dewatering are the drains southeast and north of the site. It is, however, likely that the proposed dewatering would also reduce base-flow to the River Arun as well as these drains as a result of temporary alteration in groundwater flow towards the abstraction. Based on assessment of hydraulic resistances with assumption of a 0.5 m thick low permeability (0.002 m/d) riverbed sediments for the drains, and 1.0 m thick sediment in the River Arun cases, flow can be apportioned between these three surface water receptors. Flow would be apportioned approximately as 40 % from each of the drains located 400 m from the site, and 20 % from the River Arun. As a worst case, reduction in flow to each of these watercourses arising from abstraction for the deepest excavation (the bunker hall) during the first day of dewatering could be as shown in Table 8.1.

Flow apportioning has been assessed with respect to construction dewatering for the deepest part of the works, but bunker hall. The flow apportioning shows a significant impact on surface water courses, including the River Arun in relation to Stage 1 Design. Impacts relating to Stage 2 Design, however, are minor.

Table 7.1: Approximate Apportioning of Flow Impacts

	Stage 1 Design	Stage 2 Design
Abstraction Rate on Day One		
	8,500	1,500
Apportioned Flow		
Drain N of HM Prison	3,400	600
Drain N of Ford Lane Business Park	3,400	600
River Arun	1,700	300

Values are in m^3/d and are provided as estimates only. Values are based on assumed conservative hydraulic properties. Over time, the proportional flow apportioning will remain the same, but the total volume of water affected would reduce in line with reduction in abstraction rate over time. Based on estimations for groundwater abstraction for the Bunker Hall only

7.2 Mitigation of Flow Impacts

The water from the dewatering activity will ultimately be discharged to the River Arun, with no consumptive use prior to discharge, if water is discharged to surface water. As such, reduction in baseflow to the Arun which may occur as a result of drawdown affecting the tributary drains would be compensated for downstream by the discharge of water back into the River Arun; the tributary drains may, however, remain affected upstream of the discharge point to the River Arun. Impact on surface watercourses could be exacerbated during periods when the natural groundwater table is lower. Impacts relating to water quantity could be significant for Stage 1 Design but are likely to be minor for Stage 2 Design.

If abstracted water is recharged back into the Chalk aquifer, then this would mitigate loss of baseflow to the River Arun replenishing water quantity in the Chalk, and thus mitigating overall changes in baseflow to local watercourses. It is noted that the Applicant does not have control on any land outside the application boundary, as such the proposed discharge route is to surface water.

Based upon historical investigations which did identify groundwater contamination, water quality issues could occur, which would need to be further assessed (e.g. through a H1 assessment) or mitigated against.

7.3 Flow Barriers

Although the proposed construction will create a barrier to groundwater flow, groundwater will flow around the secant piled structure, with no overall loss in water quantity.

Notwithstanding this, a barrier to groundwater flow will be created, which may result in groundwater mounding on the up hydraulic gradient side of the buried structure. Risks relating to groundwater mounding are more significant for Stage 1 Design given that this would require a greater extent of construction works below the groundwater table. Groundwater mounding is, however, unlikely to pose an issue in relation to Stage 2 Design given that this design includes minimal construction below the water table.

8. TIER 1 - DRAWDOWN IMPACTS

8.1 Stage 1 Design

There are four existing groundwater abstractions for agricultural use within the estimated radius of influence of the dewatering works for Stage 1 Design, and drainage water features within the expected radius of influence. There is a further groundwater abstraction licence within 2 km of the site, however, this is not within the zone of influence expected from the abstraction works.

Therefore, the significance of drawdown effects are as follows:

If discharge is to the surface water system:

- Derogation of existing abstractions – moderate-high; and
- Environmental impacts on waterbodies or groundwater dependent terrestrial ecosystems – moderate

Dewatering may affect existing abstractions if the water is not directly replenished to the aquifer. The degree of impact would depend on the depth from which groundwater is abstracted and abstraction rates of these existing licence abstractions, in addition to the time of year during which they are operational. Impacts would be mitigated by adoption of a groundwater recharge system.

If abstracted groundwater is recharged to the Chalk aquifer:

- Derogation of existing abstractions – low; and
- Environmental impacts on waterbodies or groundwater dependent terrestrial ecosystems - low

No significant impacts are expected on cessation of the dewatering activity once the groundwater table has reached equilibrium. This may take a number of weeks.

8.2 Stage 2 Design

There are no water features within the radius of influence of the expected dewatering scheme for Stage 2 Design.

9. COMPARISON OF DESIGN CONCEPTS

The table below sets out a summary of the environmental and project complexity implications for the two design concepts. The environmental impacts relating to Stage 1 Design are considered to be significant in comparison to those for Stage 2 Design.

Table 9.1: Comparison Summary

Key

Significant impact to environment
Medium impact to environment, would require additional assessment and significant mitigation
Medium impact to environment, would require additional assessment
Insignificant impact, unlikely to require significant mitigation
Negligible impact expected

	Stage 1 Design	**Stage 2 Design**
Abstraction rate	Required groundwater abstraction rates would be expected to be very large, being more than 5000 m^3/d.	Required groundwater abstraction rates would be low, broadly <1000 m^3/d.
Licensing requirement	Licensing of abstraction may be complicated owing to there being restricted water available for licensing in the Chalk aquifer at the site.	Licensing of abstraction would be simpler. Depending on seasonality of water table elevation, construction methods and aquifer properties, licensing may not be required at all.
Radius of influence	Large radius of influence from dewatering operations could occur. Potentially, this may incorporate surface water features and existing groundwater abstractions.	Small radius of influence, expected to be confined to the boundaries of the Ford ERF site.
Contaminated water	Groundwater would be drawn to the abstraction from a large area. Groundwater quality treatment likely required in advance of discharge.	Reduced potential to mobilise contamination as groundwater would be drawn from a smaller area. Groundwater quality treatment likely required in advance of discharge.
Impact on surface water bodies from abstraction	Potential reduction of baseflow to River Arun and its tributaries.	No impact to baseflow of surface water features expected.
Impact on existing groundwater abstractions	Potential reduction of groundwater elevation causing derogation of existing abstractions.	No impact to existing abstractions expected.
Impact to surface water from discharge	Existing surface water drainage system may be inadequately sized to accommodate flow. Possible flooding, erosion of banks of ditches, scour and increase in turbidity. Alternative such as groundwater recharge scheme could be required but may be restricted by land availability constraints.	Existing surface water drainage system may be capable of managing discharge, subject to survey. This impact has not been fully assessed at this stage.
Permitting requirement	Discharge of abstracted groundwater would be subject to environmental permitting.	Discharge of abstracted groundwater could be subject to environmental permitting if the discharge would not meet the Environment Agency's Regulatory Position Statement. The requirement will depend on surface water drainage survey and establishment of volume and quality of abstracted water.
Complexity of mitigation	Groundwater recharge scheme likely to be required. Could require access to land beyond the site boundary and separate planning approvals. Design of system may require modelling. Water quality requires treatment.	Simple or no mitigation measures expected to be required, other than treatment of water quality.

	Stage 1 Design	Stage 2 Design
Impact on groundwater flow regime post construction	Deeper excavations, requiring secant piling will impact on groundwater flow regime post development. Potential groundwater mounding.	Shallower excavations with limited construction below water table. Groundwater mounding unlikely to occur.

10. CONCLUSION

The abstraction of groundwater on a temporary basis (approximately six months) for the purposes of lowering the groundwater table, to allow construction of bunkers and lowered ground levels in the Chalk, at the proposed Ford ERF site, could result in impacts to groundwater quantity at nearby existing groundwater abstractions, base flow to the River Arun and water quality of waterbodies which would receive the abstracted water.

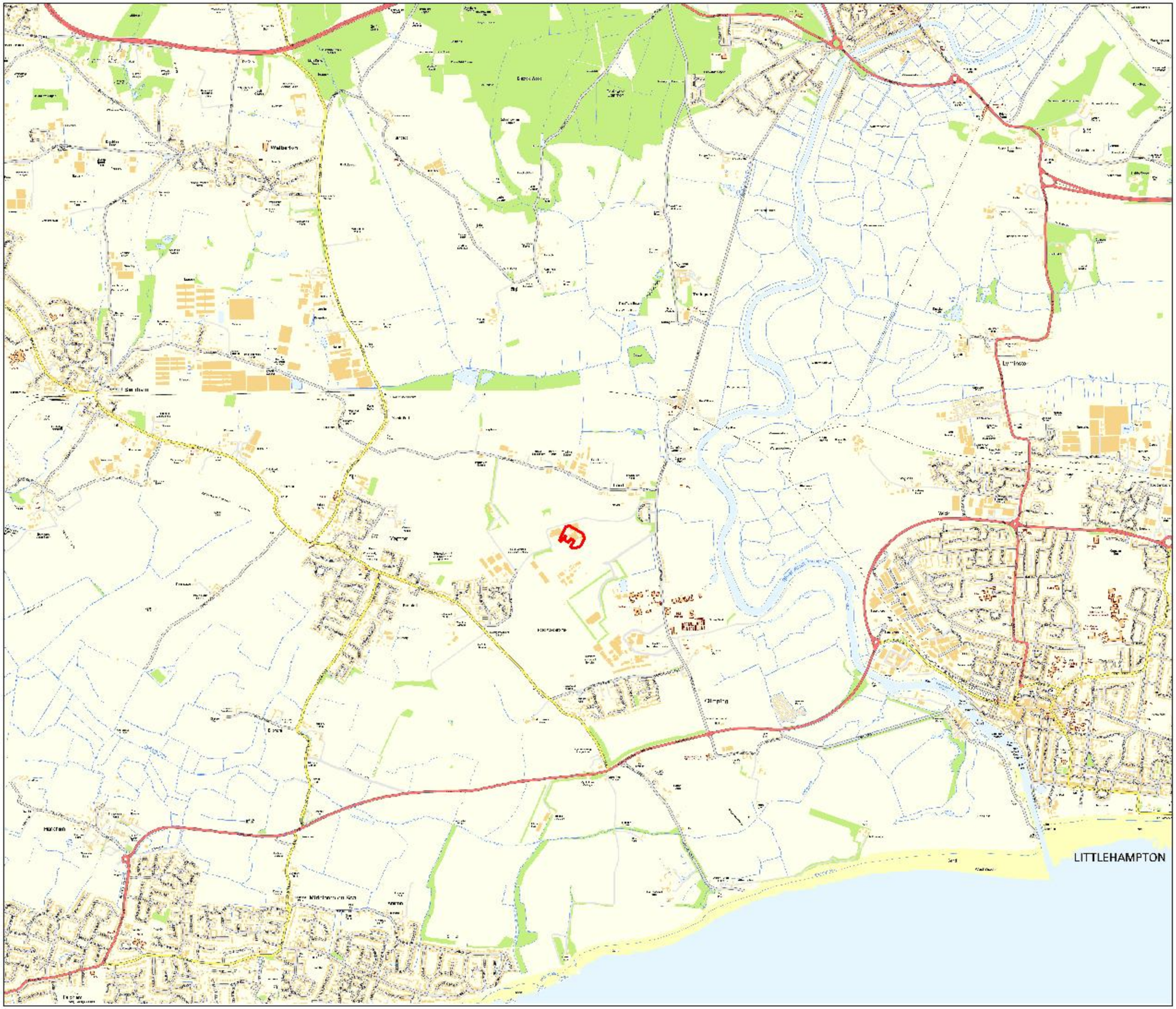
The environmental impacts arising from Stage 1 Design are significant in terms of impact on availability of water in the Chalk aquifer which is already limited in resource, impact to existing abstractions and base flow to surface water courses, as well as water quality of the receiving waterbody of abstracted water. Potentially, there may be risks caused relating to erosion of banks of surface water courses, scour and flooding. Furthermore, although not covered in the scope of this report, ground settlement could occur as a result of extensive dewatering.

Stage 1 Design may require groundwater to be recharged to the Chalk aquifer to mitigate risks of surface water flooding and erosion/scour of watercourses and to mitigate derogation of existing groundwater supplies. Such a recharge scheme would require careful design and management, and potentially access to land outside of the boundaries of the Ford ERF site. Due to the expected depth of secant piles that would be required, the proposed development may create a barrier to groundwater flow, which could cause groundwater mounding and increase in groundwater elevation on the up-hydraulic gradient side of the proposed development. This could potentially increase risk of groundwater flooding in the long term.

Stage 2 Design will substantially reduce the extent to which the groundwater table is required to be lowered. Potentially, depending on seasonal groundwater elevations, the works could be constructed with the need for minimal or possibly no dewatering (if they are carried out when groundwater levels in the Chalk aquifer are low). It is therefore recommended that Stage 2 Design is taken forward as the preferred approach.

For Stage 2 Design, once further detail is available for the construction design, assessments are expected to be required at detailed design stage in relation to: water quality of abstracted water, and suitable routes for discharge of abstracted water. Liaison with the EA and site-specific investigation will be required to refine the mitigation measures that may be required in terms of dewatering design and treatment of abstracted water prior to discharge.

FIGURES



Area of Ground Proposed to be Lowered

N

Drawn in A3

1:25,000

Client

Ford Energy from Waste Ltd

Project Title

Ford Energy Recovery Facility & Waste Sorting & Transfer Facility

Project Number

1620007830

Figure Title

Location of Area at Which Ground Levels Are Proposed to be Lowered

RAMBOLL

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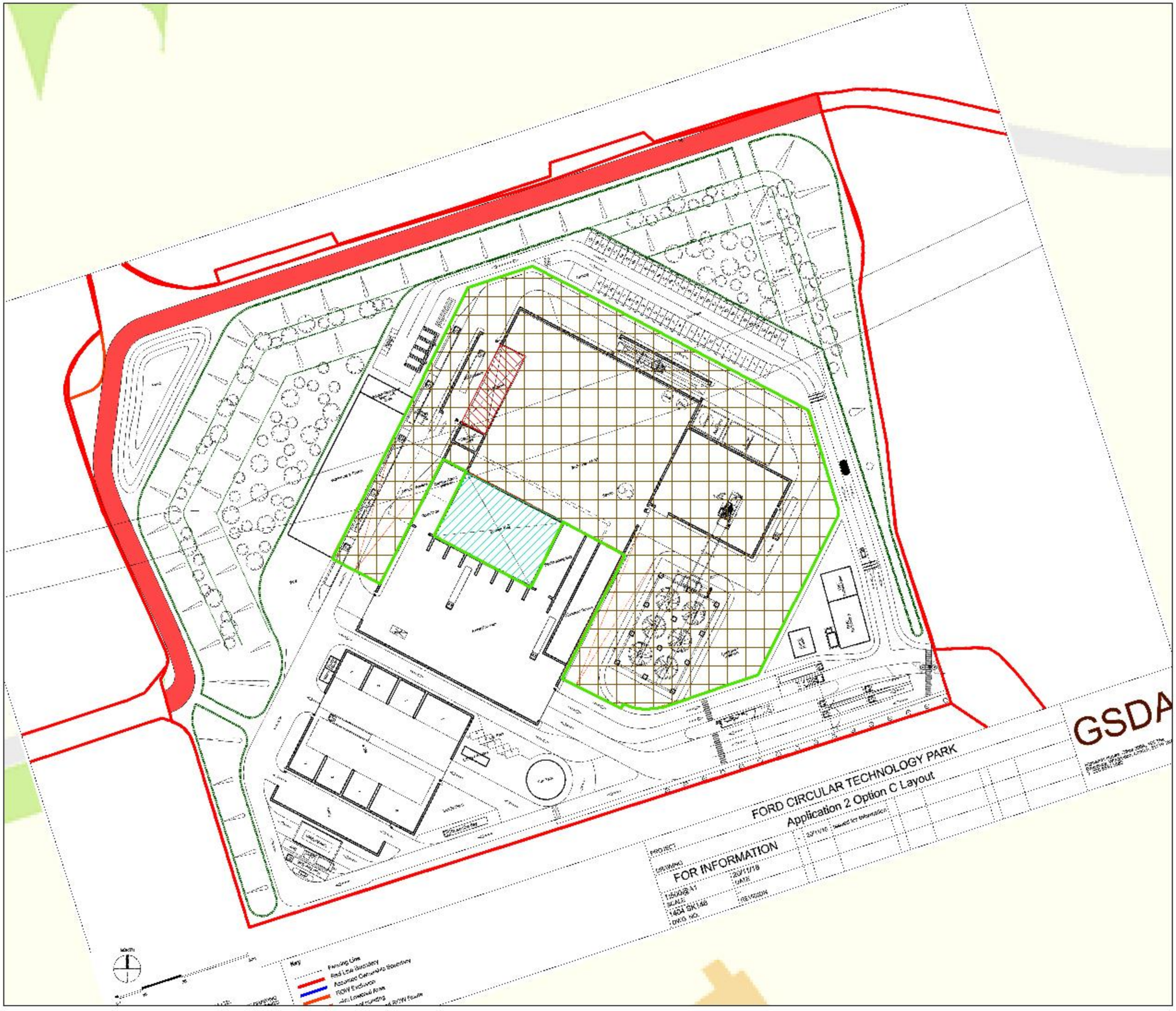
www.ramboll.co.uk

Date	Prepared By
Dec 2020	KA
Figure No.	Revision
Figure 1	-



Boundary of Area to be Dewatered
5m Reduced Level
15m Deep Bunker Hall
10m Deep IBA Bunker

N

Drawn in A3

1:1,250

Client

Ford Energy from Waste Ltd

Project Title

Ford Energy Recovery Facility & Waste Sorting & Transfer Facility

Project Number

1620007830

Figure Title

Proposed Development Stage 1 Design

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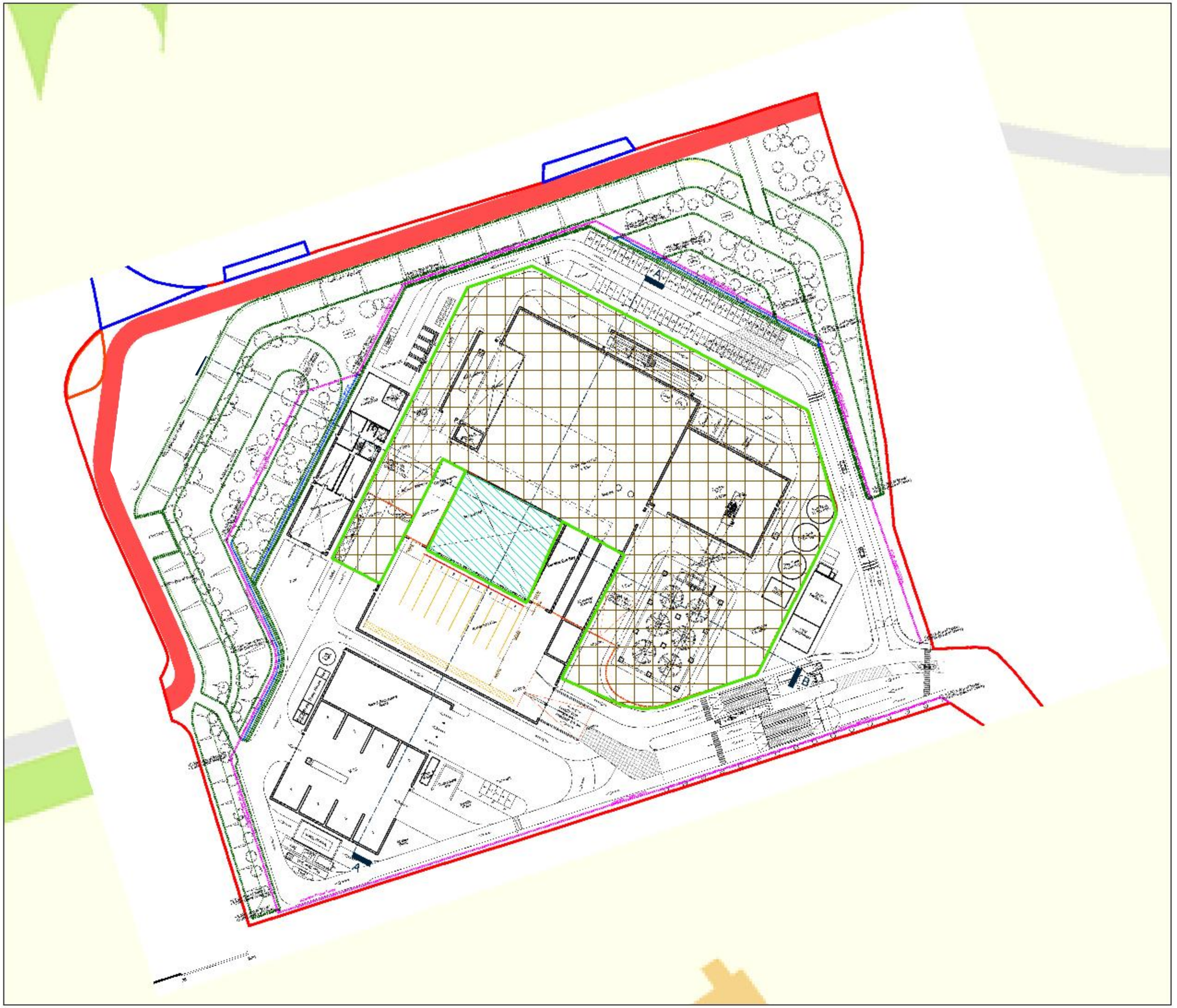
Date	Prepared By
Dec 2020	KA
Figure No.	**Revision**
Figure 2	-



Boundary of Area to be Lowered

Bunker Hall

1.5m Reduced Level

NOTES

The reduced level dig to finished floor level of 1.5 m below ground level (the 1.5m Reduced Level) is expected to be above the groundwater table, depending on seasonality of the water table.

N

Drawn in A3

1:1,250

Client

Ford Energy from Waste Ltd

Project Title

Ford Energy Recovery Facility & Waste Sorting & Transfer Facility

Project Number

1620007830

Figure Title

Proposed Development Stage 2 Design

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Date	Prepared By
Feb 2021	KA
Figure No.	**Revision**
Figure 3	-

SUPERFICIAL STRATA

HEAD

RAISED MARINE DEPOSITS

RIVER TERRACE DEPOSITS

Abstraction license revoked

RAISED BEACH DEPOSITS

BEDROCK STRATA

Chichester Syncline

LONDON CLAY

LAMBETH GROUP

NEW PIT CHALK

Littlehampton Anticline

Abstraction license revoked

CHALK (UNDIFFERENTIATED WHITE CHALK)

Discharge Consent
Groundwater Abstraction
Surface Water Abstraction
80m Radius of Influence
725m Radius of Influence
2000 m Buffer
Tidal Water
Surface Water
Surface Water

N

Drawn in A3

1:30,000

Client

Ford Energy from Waste Ltd

Project Title

Ford Energy Recovery Facility & Waste Sorting & Transfer Facility

Project Number

1620007830

Figure Title

Geology and Water Features

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Date	Prepared By
Figure 4	KA
Figure No. Feb 2021	Revision -

Location proposed for discharge to sewer (approx.)

Abstraction license revoked

Location at which sewer is expected to outfall (approx.)

Drain

Drain

River Arun

Ford

Yapton

Burndell

Ellisham

Climping

Torrington

Discharge Consent
Groundwater Abstraction
Surface Water Abstraction
80m Radius of Influence
725m Radius of Influence
2000 m Buffer
Tidal Water
Surface Water
Surface Water

N

Drawn in A3

1:15,000

Client

Ford Energy from Waste Ltd

Project Title

Ford Energy Recovery Facility & Waste Sorting & Transfer Facility

Project Number

1620007830

Figure Title

Hydrological Setting

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Date	Prepared By
Figure 5	KA
Figure No. Feb 2021	Revision -

APPENDICES

Appendix A
Borehole Records

enzygo
environmental consultants
STEP Business Centre, Wortley Rd, Sheffield, S6 2UH

CLIENT
Grunden Waste Management Ltd

SCALE
1:1,000@A3

PROJECT REF
CRM.049.009

DRAWN
MG

CHECKED
RH

DATE
Sept 2015

PROJECT
Ford Arundel

TITLE
Site Location Plan

FIGURE NO
CRM.049.009.GE.D.001

enzygo
environmental consultants

Trialpit No
TP 1
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Grundon Ford CTP project (West Sussex)	CRM.049.009	Level: -	13/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.60m	Scale 1:25
Client:		Depth 3.10m / 0.45m	Logged By dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						CONCRETE
			0.20			MADE GROUND lean mix concrete
			0.40			MADE GROUND black ashy sandy fine angular gravel
0.50	ES		0.60			Firm orange brown sandy CLAY
1.00	D					
2.00	D					
			2.30			Orange brown and yellow brown slightly clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
3.00	D					
			3.10			Trialpit Complete at 3.10 m

Remarks:

Groundwater: Not encountered

AGS

enzygo environmental consultants			Trialpit No **TP 2** Sheet 1 of 1
Project Name: Grundon Ford CTP project (West Sussex)	Project No.: CRM.049.009	Co-ords: - Level: -	Date: 13/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.90m Depth 3.20m 0.45m	Scale: 1:25
Client:			Logged By: dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.15			CONCRETE
						MADE GROUND lean mix concrete
0.40	ES		0.40			MADE GROUND black ashy sandy fine angular gravel
			0.55			Firm orange brown and dark brown with black speckling sandy CLAY
1.00	D					
2.00	D		2.10			Orange brown and yellow brown slightly clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
3.00	D					
			3.20			Trialpit Complete at 3.20 m

Remarks:

Groundwater: Not encountered

AGS

enzygo
environmental consultants

Trialpit No
TP 3
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Grundon Ford CTP project (West Sussex)	CRM.049.009	Level: -	13/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.90m	Scale 1:25
Client:		Depth 3.00m	Logged By dn

0.45m

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.15			CONCRETE
						MADE GROUND lean mix concrete
0.40	ES		0.35			MADE GROUND dark brown and grey sandy gravelly clay with carbonaceous deposits
			0.50			Firm orange brown sandy CLAY
1.00	D					
2.00	D					
			2.30			Orange brown and yellow brown slightly clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
3.00	D		3.00			Trialpit Complete at 3.00 m

Remarks:

Groundwater: Not encountered

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Trialpit No
TP 4
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Grundon Ford CTP project (West Sussex)	CRM.049.009	Level: -	13/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.80m Depth 0.80m 0.45m	Scale 1:25
Client:			Logged By dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						CONCRETE
			0.20			MADE GROUND lean mix concrete
			0.30			MADE GROUND dark grey lean mix concrete
			0.40			MADE GROUND dark brown and grey sandy gravelly clay with carbonaceous deposits
			0.50			Firm orange brown sandy CLAY
			0.80			Trialpit Complete at 0.80 m

Remarks: 64 mm diameter water pipe encountered at 0.30 m.Service damaged and pit abandoned

Groundwater: Not encountered

AGS

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Project Name: Grundon Ford CTP project (West Sussex)	Project No.: CRM.049.009	Co-ords: - Level: -	Date: 13/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.90m Depth 3.00m 0.45m	Scale: 1:25
Client:			Logged By: dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.12			Reinforced CONCRETE
0.20	ES					MADE GROUND dark brown sandy gravel
			0.30			
			0.40			MADE GROUND dark brown and grey sandy gravelly clay with carbonaceous deposits
0.50	D					Firm orange brown sandy CLAY
1.00	D					
2.00	D					
			2.10			Orange brown and yellow brown very clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
			2.30			Structureless CHALK composed of sub-angular to rounded medium to coarse gravel size light brown highly weathered weak fragments with sub-rounded cobble size weathered weak fragments. Some matrix of soft lightr brown clayey sand size fragments
3.00	D		3.00			Trialpit Complete at 3.00 m

1 2 3 4

Remarks:

Groundwater: Not encountered

AGS

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Project Name: Grundon Ford CTP project (West Sussex)	Project No.: CRM.049.009	Co-ords: - Level: -	Date: 13/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.70m Depth 3.10m 0.45m	Scale: 1:25
Client:			Logged By: dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.13			Reinforced CONCRETE
			0.25			MADE GROUND lean mix concrete
0.30	ES		0.40			MADE GROUND dark brown and grey sandy gravelly clay with carbonaceous deposits, brick and slate fragments
						Firm orange brown sandy CLAY
1.00	D					
2.00	D					
			2.50			Orange brown and yellow brown very clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
3.00	D					
			3.10			Trialpit Complete at 3.10 m

Remarks:

Groundwater: Not encountered

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Project Name: Grundon Ford CTP project (West Sussex)	Project No.: CRM.049.009	Co-ords: - Level: -	Date: 14/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.90m Depth 3.00m 0.45m	Scale: 1:25
Client:			Logged By: dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.12			Reinforced CONCRETE
0.20	ES		0.25			MADE GROUND dark brown sandy gravel
			0.40			MADE GROUND dark brown and grey sandy gravelly clay with carbonaceous deposits
						Firm orange brown sandy slightly gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded flint
1.00	D					1
2.00	D					2
			2.40			Orange brown and yellow brown very clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
			2.60			Structureless CHALK composed of sub-angular to rounded medium to coarse gravel size light brown highly weathered weak fragments with sub-rounded cobble size weathered weak fragments. Some matrix of soft lightr brown clayey sand size fragments
3.00	D		3.00			3
						Trialpit Complete at 3.00 m
						4

Remarks:

Groundwater: Not encountered

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Trialpit No
TP 8
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Grundon Ford CTP project (West Sussex)	CRM.049.009	Level: -	14/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.90m	Scale 1:25
Client:		Depth 3.30m	Logged By dn

0.45m

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.13			Reinforced CONCRETE
0.30	ES		0.40			MADE GROUND dark brown sandy gravel with fine brick fragments
1.00	D					Firm orange brown sandy slightly gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded flint
2.00	D					
			2.65			Orange brown and yellow brown very clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
			2.80			Structureless CHALK composed of sub-angular to rounded medium to coarse gravel size light brown highly weathered weak fragments with sub-rounded cobble size weathered weak fragments. Some matrix of soft lightr brown clayey sand size fragments
3.00	D					
			3.30			Trialpit Complete at 3.30 m

Remarks:

Groundwater: Not encountered

AGS

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Project Name: Grundon Ford CTP project (West Sussex)	Project No.: CRM.049.009	Co-ords: - Level: -	Date: 14/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.80m Depth 2.50m 0.45m	Scale: 1:25
Client:			Logged By: dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.50	ES					MADE GROUND large concrete blocks (300 mm + square), rebar, pieces of plastic, chicken wire, cable, tin in a sandy gravel matrix. Slight discernible hydrocarbon odour
1.00	D					
			1.40			
1.50	D					Firm orange brown sandy CLAY
2.00	D		2.00			Orange brown and yellow brown slightly clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
			2.50			Trialpit Complete at 2.50 m

Remarks:

Groundwater: Seepage at 1.40 m

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Trialpit No
TP 10
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Grundon Ford CTP project (West Sussex)	CRM.049.009	Level: -	14/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.80m Depth 2.50m 0.45m	Scale 1:25
Client:			Logged By dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						MADE GROUND large concrete blocks (300 mm + square), rebar, cable in a sandy gravel matrix.
			0.70			
0.80	ES					MADE GROUND firm brown sandy gravelly clay. 150 mm diameter clayware duct surrounded by 40 mm rounded gravel at 1.50 m on western elevation
1.50	D		1.50			Firm orange brown sandy CLAY
			2.10			Orange brown and yellow brown slightly clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
			2.50			Trialpit Complete at 2.50 m

Remarks:

Groundwater: Seepage at 1.40 m

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Trialpit No
TP 11
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Grundon Ford CTP project (West Sussex)	CRM.049.009	Level: -	14/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.80m Depth 3.00m 0.45m	Scale 1:25
Client:			Logged By dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						MADE GROUND large concrete blocks (300 mm + square), rebar, pieces of plastic, roots, wood and rag
0.50	ES					
			0.70			MADE GROUND firm brown, grey and black sandy gravelly clay
1.20	ES					
			1.30			CONCRETE lean mix
			1.40			Firm orange brown sandy CLAY with some grey and black staining
2.00	ES					
			2.30			Stiff orange brown very sandy CLAY
			3.00			Trialpit Complete at 3.00 m

1
2
3
4

Remarks:

Groundwater: Seepage at 1.40 m

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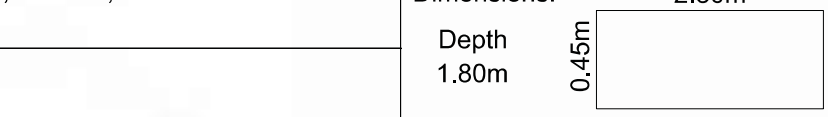
Trialpit No
TP 12
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Grundon Ford CTP project (West Sussex)	CRM.049.009	Level: -	14/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.80m	Scale 1:25
Client:		Depth 1.80m	Logged By dn



Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						MADE GROUND large concrete blocks (300 mm + square), rebar, cable in a sandy gravel matrix.
0.50	ES					
			0.70			MADE GROUND lean mix concrete
			0.90			Firm orange brown sandy CLAY
1.00	D					
			1.80			Trialpit Complete at 1.80 m

Remarks:

Groundwater: Seepage at 1.40 m

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Trialpit No
TP 13
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Grundon Ford CTP project (West Sussex)	CRM.049.009	Level: -	14/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 3.00m Depth 1.20m 0.45m	Scale 1:25
Client:			Logged By dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						MADE GROUND large concrete blocks (300 mm + square), rebar, cable in a sandy gravel matrix.
			0.70			MADE GROUND large concrete blocks with abundant 6 mm rebar in grey sandy gravelly size concrete matrix
			1.20			Trialpit Complete at 1.20 m

1
2
3
4

Remarks: Pit abandoned at 1.20 m due to tangled rebar

Groundwater: Not encountered

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Trialpit No
TP 14
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Grundon Ford CTP project (West Sussex)	CRM.049.009	Level: -	14/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 2.80m	Scale 1:25
		Depth 1.50m, 0.45m	
Client:			Logged By dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						MADE GROUND dark brown sandy gravelly topsoil with roots and large concrete blocks
			0.55			
0.65	ES		0.65			MADE GROUND black sandy gravelly clay with brick fragments
						Firm orange brown sandy CLAY
1.00	D					
			1.50			Trialpit Complete at 1.50 m

Remarks:

Groundwater: Seepage at 1.40 m

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Project Name: Grundon Ford CTP project (West Sussex)	Project No.: CRM.049.009	Co-ords: - Level: -	Date: 13/07/2015
Location: Ford Road, Ford, Arundel, BN18 0DB		Dimensions: 3.50m Depth 1.50m 0.45m	Scale: 1:25
Client:			Logged By: dn

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.10			MADE GROUND dark grey sandy gravelly topsoil with brick and concrete fragments
						MADE GROUND large concrete blocks with rebar, metal pipe, brick in a topsoil matrix
0.50	ES					
1.50	ES		1.50			Trialpit Complete at 1.50 m

Remarks: Pit very unstable and abandoned at 1.50 m due to collapse

Groundwater: Fast inflow at 0.95 m

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			Borehole No **BH 1** Sheet 1 of 1
Project Name: Grundon Ford CTP project (West Sussex)	Project No.: CRM.049.009	Co-ords: -	Hole Type: Cable
Location: Ford Road, Ford, Arundel, BN18 0DB		Level: -	Scale: 1:50
Client:		Dates: 13/07/2015	Logged By: dn

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.20			CONCRETE
					0.40			MADE GROUND lean mix concrete
		0.50	ES					
		0.60	D		0.60			MADE GROUND black ashy sandy fine angular gravel
								Firm orange brown sandy CLAY
		1.20	SPT	N=8				
		1.20	SPTLS	(1,1,1,2,2,3)				
		1.70	D					
		2.00	SPT	N=6	2.00			
		2.00	SPTLS	(2,2,2,2,1,1)				Loose orange brown and yellow brown slightly clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
		2.50	D					
		3.00	SPT	N=1				
		3.00	SPTLS	(0,0,1,0,0,0)				
		3.50	D		3.50			Medium dense yellow brown clayey medium SAND
		4.00	SPT	N=26				
		4.00	SPTLS	(3,5,6,6,6,8)				
		4.40	D		4.40			White weathered CHALK weak. Fractures very closely spaced infilled in excess of 10 mm with light brown comminuted chalk with occasional coarse flint gravel
		5.00	SPT	N=22				
		5.00	SPTLS	(3,7,6,5,5,6)				
		5.50	D					
	▽							
		6.50	SPT	N=16	6.50			White fresh CHALK moderately strong. Fractures medium spaced clean and tight
		6.50	D	(2,2,3,3,5,5)				
		6.50	SPTLS					
		7.50	D					
		8.00	SPT	N=47				
		8.00	SPTLS	(4,6,8,11,12,16)				
		8.50	D					
		9.50	SPT	N=44				
		9.50	D	(3,5,5,9,15,15)				
		9.50	SPTLS					
			Type	Results				End of Borehole at 10.00 m

Remarks: 50 mm diameter standpipe installed to 10.00 m

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Borehole No	
BH 2	
Sheet 1 of 1	

Project Name	Project No.		Hole Type
Grundon Ford CTP project (West Sussex)	CRM.049.009	Co-ords: -	Cable
Location: Ford Road, Ford, Arundel, BN18 0DB		Level: -	Scale 1:50
Client:		Dates: 13/07/2015	Logged By dn

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
								CONCRETE
					0.30			MADE GROUND brown sandy coarse rounded gravel
					0.60			Firm orange brown sandy CLAY
		1.00	D					
		1.20	SPT	N=7				
		1.20	SPTLS	(1,1,2,1,2,2)				
		2.00	SPT	N=17	2.00			Loose to medium dense orange brown clayey sandy fine to coarse sub-rounded to rounded flint GRAVEL
		2.00	D	(1,1,3,4,4,6)				
		2.00	SPTLS					
		3.00	SPT	N=6				
		3.00	D	(1,1,1,2,1,2)				
		3.00	SPTLS					
		4.00	SPT	N=12	4.00			White weathered CHALK weak. Fractures very closely spaced infilled in excess of 10 mm with light brown comminuted chalk with occasional coarse flint gravel
		4.00	D	(1,1,3,3,3,3)				
		4.00	SPTLS					
		5.00	SPT	N=15				
		5.00	D	(2,4,3,3,4,5)				
		5.00	SPTLS					
		6.00	SPT	N=19	6.00			White fresh CHALK moderately strong. Fractures medium spaced clean and tight
		6.00	D	(4,3,5,5,4,5)				
		6.00	SPTLS					
		7.00	D					
		7.50	SPT	N=10				
		7.50	SPTLS	(1,1,1,2,3,4)				
		8.00	D					
		9.00	SPT	N=11				
		9.00	D	(1,2,1,1,4,5)				
		9.00	SPTLS					
		Type		Results				End of Borehole at 10.00 m

Remarks: 50 mm diameter standpipe installed to 10.00 m

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Borehole No	Sheet
BH 3	1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Grundon Ford CTP project (West Sussex)	CRM.049.009		Cable
Location: Ford Road, Ford, Arundel, BN18 0DB		Level: -	Scale 1:50
Client:		Dates: 13/07/2015	Logged By dn

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			CONCRETE
								MADE GROUND brown sandy coarse rounded gravel
		0.60	D		0.60			MADE GROUND black ashy sandy gravel
		1.20	SPT	N=6	1.20			
		1.20	SPTLS	(1,1,1,2,1,2)				MADE GROUND soft brown and grey and black sandy gravelly clay
		2.00	SPT	N=8	2.00			
		2.00	D	(3,3,3,2,2,1)				Firm orange brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded flint
		2.00	SPTLS					
		3.00	SPT	N=20	3.00			
		3.00	D	(2,3,3,4,6,7)				White weathered CHALK weak. Fractures very closely spaced infilled in excess of 10 mm with light brown comminuted chalk with occasional coarse flint gravel
		3.00	SPTLS					
		4.00	SPT	N=42				
		4.00	D	(4,9,9,10,12,11)				
		4.00	SPTLS					
		5.00	SPT	N=21				
		5.00	D	(6,6,6,5,5,5)				
		5.00	SPTLS					
		6.00	SPT	N=18				
		6.00	D	(2,3,4,4,4,6)				
		6.00	SPTLS					
		7.00	D					
		7.50	SPT	N=9	7.50			
		7.50	SPTLS	(1,2,1,1,2,5)				White fresh CHALK moderately strong. Fractures medium spaced clean and tight
		8.00	D					
		9.00	SPT	N=17				
		9.00	D	(1,1,2,3,5,7)				
		9.00	SPTLS					
			Type	Results				End of Borehole at 10.00 m

Remarks:

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Borehole No	Sheet
BH 4	1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Grundon Ford CTP project (West Sussex)	CRM.049.009		Cable
Location: Ford Road, Ford, Arundel, BN18 0DB		Level: -	Scale 1:50
Client:		Dates: 13/07/2015	Logged By dn

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.20			CONCRETE
					0.40			MADE GROUND lean mix concrete
		0.50	ES					MADE GROUND black ashy clayey sandy fine angular gravel with lumps of brown clay
		0.50	D					
		1.20	SPT	N=4				
		1.20	SPTLS	(1,1,1,1,1,1)				
		1.70	D					
		2.00	SPT	N=7	2.00			Soft to firm orange brown sandy CLAY
		2.00	SPTLS	(1,1,1,2,2,2)				
		2.50	D		2.50			Firm to soft orange brown and yellow brown sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded flint
		3.00	SPT	N=18				
		3.00	SPTLS	(1,1,3,5,5,5)				
		3.50	D					
		4.00	SPT	N=5				
		4.00	SPTLS	(1,0,1,2,1,1)	4.20			White weathered CHALK weak. Fractures very closely spaced infilled in excess of 10 mm with light brown comminuted chalk with occasional coarse flint gravel
		4.40	D					
		5.00	SPT	N=28				
		5.00	SPTLS	(4,5,5,5,9,9)				
		5.50	D					
		6.50	SPT	N=24				
		6.50	D	(2,4,5,6,6,7)				
		6.50	SPTLS					
	▼				7.00			White fresh CHALK moderately strong. Fractures medium spaced clean and tight
		7.50	D					
	▽	8.00	SPT	N=29				
		8.00	SPTLS	(2,3,5,9,7,8)				
		8.50	D					
		9.50	SPT	N=18				
		9.50	D	(1,3,3,4,5,6)				
		9.50	SPTLS					
			Type	Results				End of Borehole at 10.00 m

Remarks:

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Borehole No
BH 5
Sheet 1 of 1

Project Name: Grundon Ford CTP project (West Sussex)	Project No.: CRM.049.009	Co-ords: -	Hole Type: Cable
Location: Ford Road, Ford, Arundel, BN18 0DB		Level: -	Scale: 1:50
Client:		Dates: 14/07/2015	Logged By: dn

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.20			CONCRETE
					0.30			MADE GROUND lean mix concrete
		0.50	ES					MADE GROUND black ashy sandy fine angular gravel
		0.80	D		0.80			Soft orange brown sandy CLAY
		1.20	SPT	N=5				
		1.20	SPTLS	(2,2,1,1,1,2)				
		1.70	D					
		2.00	SPT	N=4				
		2.00	SPTLS	(1,2,1,1,1,1)				
		2.50	D		2.50			Medium dense orange brown and yellow brown clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint and abundant fine chalk fragments
		3.00	SPT	N=13				
		3.00	SPTLS	(2,3,3,3,3,4)				
		3.50	D		3.50			White weathered CHALK weak. Fractures very closely spaced infilled in excess of 10 mm with light brown comminuted chalk with occasional coarse flint gravel
		4.00	SPT	N=27				
		4.00	SPTLS	(2,4,4,6,10,7)				
		4.50	D		4.50			White fresh CHALK moderately strong. Fractures medium spaced clean and tight
		5.00	SPT	N=39				
		5.00	SPTLS	(3,6,8,9,10,12)				
		5.50	D					
		6.50	SPT	N=16				
		6.50	D	(2,3,4,3,4,5)				
		6.50	SPTLS					
		7.50	D					
		8.00	SPT	N=22				
		8.00	SPTLS	(4,4,5,5,6,6)				
		8.50	D					
		9.50	SPT	N=23				
		9.50	D	(1,2,4,6,6,7)				
		9.50	SPTLS					
			Type	Results				End of Borehole at 10.00 m

Remarks:

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Borehole No
BH 6
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Grundon Ford CTP project (West Sussex)	CRM.049.009		Cable
Location: Ford Road, Ford, Arundel, BN18 0DB		Level: -	Scale 1:50
Client:		Dates: 14/07/2015	Logged By dn

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20			CONCRETE
					0.40			MADE GROUND lean mix concrete
		0.60	D					MADE GROUND black ashy sandy fine angular gravel
					1.00			CONCRETE
								End of Borehole at 1.00 m
			Type	Results				

Remarks: Concrete obstruction encountered at 1.00 m.Borehole abandoned

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Borehole No	Sheet
BH 6A	1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Grundon Ford CTP project (West Sussex)	CRM.049.009		Cable
Location: Ford Road, Ford, Arundel, BN18 0DB		Level: -	Scale 1:50
Client:		Dates: 14/07/2015	Logged By dn

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.20			CONCRETE
					0.25			MADE GROUND lean mix concrete
								MADE GROUND black ashy sandy fine angular gravel
		1.20	SPT	N=11	1.20			
		1.20	SPTLS	(1,1,2,3,3,3)				Firm orange brown sandy CLAY
		1.70	D					
		2.00	SPT	N=19	2.00			
		2.00	SPTLS	(1,3,3,4,5,7)				Orange brown and yellow brown slightly clayey slightly gravelly medium SAND. Gravel is medium to coarse rounded flint
		2.50	D		2.50			Loose yellow brown clayey medium SAND
		3.00	SPT	N=6				
		3.00	SPTLS	(1,1,1,2,2,1)				
		3.60	D		3.60			White weathered CHALK weak. Fractures very closely spaced infilled in excess of 10 mm with light brown comminuted chalk with occasional coarse flint gravel
		4.00	SPT	N=24				
		4.00	SPTLS	(3,5,5,6,6,7)				
		4.50	D					
		5.00	SPT	N=29				
		5.00	SPTLS	(4,4,8,6,8,7)				
		5.50	D					
		6.50	SPT	N=15				
		6.50	D	(2,3,4,3,4,4)				
		6.50	SPTLS					
		7.50	SPT	50/195mm	7.50			
		7.50	D	195mm (2,7,19,19,12)				White fresh CHALK moderately strong. Fractures medium spaced clean and tight
		8.00	SPTLS					
		8.50	D					
		9.50	SPT	N=19				
		9.50	D	(1,2,1,8,5,5)				
		9.50	SPTLS					
			Type	Results				End of Borehole at 10.00 m

Remarks: 50 mm diameter standpipe installed to 10.00 m

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Borehole No	Sheet
BH 7	Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Grundon Ford CTP project (West Sussex)	CRM.049.009		Cable
Location: Ford Road, Ford, Arundel, BN18 0DB		Level: -	Scale 1:50
Client:		Dates: 14/07/2015	Logged By dn

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.30			CONCRETE
								MADE GROUND brown sandy coarse rounded gravel
		0.60	D		0.60			Firm and locally soft orange brown sandy CLAY
		1.20	SPT	N=5				
		1.20	SPTLS	(1,0,1,1,1,2)				
		2.00	SPT	N=15				
		2.00	D	(2,3,3,4,4,4)				
		2.00	SPTLS					
		3.00	SPT	N=2	3.00			
		3.00	D	(1,0,1,0,1,0)				Soft to firm orange brown very sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded flint
		3.00	SPTLS					
		4.00	SPT	N=12	4.00			
		4.00	D	(2,3,3,3,2,4)				White weathered CHALK weak. Fractures very closely spaced infilled in excess of 10 mm with light brown comminuted chalk with occasional coarse flint gravel
		4.00	SPTLS					
		5.00	SPT	N=14				
		5.00	D	(3,3,3,4,3,4)				
		5.00	SPTLS					
		6.00	SPT	N=26				
		6.00	D	(3,3,4,7,7,8)				
	▼	6.00	SPTLS					
	▽	7.00	D					
		7.50	SPT	N=12				
		7.50	SPTLS	(2,2,2,3,3,4)				
		8.00	D					
		9.00	SPT	N=15				
		9.00	D	(2,2,2,3,4,6)				
		9.00	SPTLS					
			Type	Results				End of Borehole at 10.00 m

Remarks: 50 mm diameter standpipe installed to 10.00 m

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Borehole No	Sheet
BH 8	1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Grundon Ford CTP project (West Sussex)	CRM.049.009		Cable
Location: Ford Road, Ford, Arundel, BN18 0DB		Level: -	Scale 1:50
Client:		Dates: 14/07/2015	Logged By dn

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			CONCRETE
					0.50			MADE GROUND brown sandy coarse rounded gravel
		0.60	D					Soft orange brown sandy gravelly CLAY. Gravel is coarse sub-rounded flint
		1.20	SPT	N=2	1.20			
		1.20	SPTLS	(1,0,0,1,0,1)				Soft to firm orange brown sandy CLAY
		2.00	SPT	N=7				
		2.00	D	(1,2,2,2,2,1)				
		2.00	SPTLS					
		3.00	SPT	N=22	3.00			
		3.00	D	(4,4,5,5,6,6)				White weathered CHALK weak. Fractures very closely spaced infilled in excess of 10 mm with light brown comminuted chalk with occasional coarse flint gravel
		3.00	SPTLS					
		4.00	SPT	N=23				
		4.00	D	(3,3,4,5,6,8)				
		4.00	SPTLS					
		5.00	SPT	N=29				
		5.00	D	(4,4,6,6,8,9)				
		5.00	SPTLS					
		6.00	SPT	N=33				
		6.00	D	(4,6,6,8,9,10)				
		6.00	SPTLS					
		7.00	D					
		7.50	SPT	N=29				
		7.50	SPTLS	(2,1,2,5,9,13)				
		8.00	D		8.00			White fresh CHALK moderately strong. Fractures medium spaced clean and tight
		9.00	SPT	N=45				
		9.00	D	(3,4,7,9,13,16)				
		9.00	SPTLS					
			Type	Results				End of Borehole at 10.00 m

Remarks: 50 mm diameter standpipe installed to 10.00 m

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