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

FLOOD RISK ASSESSMENT AND OUTLINE SURFACE WATER DRAINAGE STRATEGY

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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) at the site. 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 Flood Risk Assessment (FRA) and develop an Outline Surface Water Drainage Strategy to support the full planning application at the site, including the ERF and waste sorting and transfer facility (WSTF) and ancillary uses.

1.2 Scope and Objectives

This document considers the risks of various sources of flooding to the site and the consequent risk of flooding to downstream receptors (such as people, property, habitats, infrastructure and statutory sites) from the proposed development as a result of surface water runoff. A comparison is made between the current situation and the proposed future development.

This FRA has been carried out in accordance with the National Planning Policy Framework (NPPF)[1]. It is to be used to assist the Waste Planning Authority (WPA), the associated Lead Local Flood Authority (LLFA) and Environment Agency (EA) when considering the flooding issues of the proposed development, as part of a planning application. An FRA is required as the developable area is greater than 1 hectare (ha).

This report provides the following information:

i. An assessment of the flood risk to the site based upon flood data and the flood maps provided by the EA and Arun District Council Level 1 and 2 Strategic Flood Risk Assessment (SFRA)[2];
ii. An assessment of the impact of the new development in terms of surface water runoff;
iii. Proposals for measures to mitigate the generation of surface water runoff by the proposed development; and
iv. Recommendations to mitigate any residual flood risks to the development as a result of climate change (CC).

The references for the key source of information used to prepare this document are included in the footnotes section of this report. Ramboll cannot accept liability for the accuracy or otherwise of any information derived from third party sources.

2. SITE CONTEXT

2.1 Site Description

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.

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[1] Department of Communities and Local Government (2019). National Planning Policy Framework (online) London: House of Commons. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf [accessed 25/02/2021]

[2] Arun District Council (2016). Level 1 and Level 2 Strategic Flood Risk Assessment Final Report (online) West Sussex. Available at: https://www.arun.gov.uk/flood-risk-planning-policy/ [accessed 25/02/2021]

The 6.72 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.

The site location plan and site boundary are provided in Figure 1 and 2 respectively, at the rear of this report.

The site is bound on all sides by agricultural land. Ford Lane Business Park and a number of farmhouses are located approximately 500 m north of the site[3]. A triangular area of sports pitches, with a sewage treatment works located beyond the sports pitches are present approximately 20 m from the southern site boundary. The residential village of Ford and Ford Airfield Industrial Estate are located approximately 300 m east and 500 m west of the site, respectively.

2.2 Site Walkover

A site walkover was undertaken by a Ramboll flood risk consultant on the 11 December 2019. The principal objectives of the walkover survey were to inspect the site and surrounding area, verify information collected as part of the desk-based flood risk and drainage assessment, collect additional information and examine local records concerning the site.

The site walkover features are further described in Section 2.7 and photographs taken are presented in Appendix A.

2.3 Site Topography

Based on the topographic survey undertaken by Mitcham Surveys (2013, Drawing No. 1275-1), the site is generally flat. Topography in the vicinity of the site gently slopes towards the north. Ground elevations within the site boundary range from 6.5 to 7 m Above Ordnance Datum (mAOD), with the lowest levels recorded towards the west and northeast sides of the site.

The topographic survey is provided in Figure 3.

2.4 Geological Setting

The British Geological Survey (BGS) map of the area (1:50,000 scale map series), accessed online via the Onshore Geoindex[4] indicates that the site is underlain by superficial deposits of River Terrace Deposits (sand, silt and clay) which is in turn underlain by bedrock of the Lewes Nodular Chalk Formation (chalk). Made Ground is present across the site.

A review of historical borehole logs in the vicinity of the site was undertaken using the BGS Geology of Britain Viewer. The following borehole logs were reviewed:

- SU90SE18 – 85 m south of the rectangular portion of the site boundary at 5.5 m mAOD;
- SU90SE37 – 375 m east of the rectangular portion of the site boundary at 3.4 mAOD; and
- SU90SE16 – 480 m north of the rectangular portion of the site boundary at 4.6 mAOD.

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[3] Distance references included in this report are taken from the centre of the site

[4] British Geological Survey (BGS) Onshore GeoIndex (online). Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html [accessed 25/02/2021]

A summary of ground conditions in the area of the site as described within the historical borehole logs is presented as Table 2.1 below.

Table 2.1: Summary of Ground Conditions Identified by BGS Borehole Logs

Stratum	Description	Depth (m below ground level (bgl))	Thickness (m)
Made Ground	'Made Ground' OR Soil OR Brown soil	0.2 to 0.6	0.2 to 0.6
River Terrace Deposits	Sandy clay and gravel OR Clay, silty, reddish brown, with angular to well-rounded flint pebbles and gastropod shell fragments	1.1 to 6.4	0.9 to 5.8
Lewes Nodular Chalk Formation	Clay/chalk marl OR Chalk, rubbly, with matrix of olive silt and fine sand and some rounded flint pebbles to 5.5 m, greyish white, with nodular flints	>30	>23.6

Historical boreholes recorded groundwater levels ranging from 2.0 mbgl (1.4 mAOD) at SU90SE37, 4.21 mbgl (0.39 mAOD) at SU90SE16 and 5.87 mbgl (-0.37 mAOD) at SU90SE18. Historical groundwater levels in SU90SE16 and SU90SE18 indicate that groundwater is shallower in the southeast than in the northwest. This is consistent with the location of the River Arun to the east of the site.

2.4.1 An intrusive ground investigation followed by a supplementary ground investigation were undertaken by Enzygo in 2015 and 2018, respectively. Ground conditions were generally in line with the anticipated ground conditions detailed in Table 2.1: Summary of Ground Conditions Identified by BGS Borehole Logs A summary of ground conditions is presented in Table 2.2.

Table 2.2: Summary of Ground conditions (Enzygo, 2015; 2018)

Strata	Summary Description	Depth to Top of Strata (mbgl)	Thickness (m)
General Made Ground	Made Ground (concrete 120 mm to 250 mm thick) over lean concrete (150 mm to 200 mm) over black ashy sandy fine angular gravel.	0.0	0.15 to 2.0
Made Ground Backfilled slurry pit (TP12, TP13 and TP14)	Large concrete blocks (300 mm + square), rebar, cable in a sandy gravel matrix over large concrete blocks with abundant 6 mm rebar in grey sandy gravelly size concrete matrix black sandy gravelly clay with brick fragments	0.0	0.65 to 1.2
Made Ground backfilled pit (TP15)	Dark grey sandy gravelly topsoil with brick and concrete fragments over large concrete blocks with rebar, metal pipe, brick in a topsoil matrix	0.0	In excess of 1.5
Made Ground (demolished autoclaves (TP9, TP10 and TP11))	Large concrete blocks (300 mm + square), rebar, pieces of plastic, wire metal roots, wood fragments in a sandy matrix. Slight discernible hydrocarbon odour over firm brown, grey and black sandy gravelly clay over concrete lean mix.	0.0	2.1 to 3.0
Superficial materials (River Terrace Deposits)	Firm locally soft orange brown sandy clay over medium dense orange brown and yellow brown slightly clayey slightly gravelly medium sand and gravel. Gravel is medium to coarse rounded flint.	0.15 to 2.0	0.9 to 4.35
Chalk	Structureless chalk composed of sub-angular to rounded medium to coarse gravel size light brown highly weathered weak fragments with subrounded	2.3 to 4.5	In excess of 18.2

Strata	Summary Description	Depth to Top of Strata (mbgl)	Thickness (m)
	cobble size weathered weak fragments . Some matrix of soft light brown clayey sand size fragments		
Groundwater	Seepages within Made Ground at 1.4 mbgl. Water strike at depths between 5.5 mbgl and 9.0 mbgl during ground investigations. Hydraulic gradient generally appears to be towards the east to southeast.	N/A	N/A

For further details on the geological features at the development site, please refer to the Geoenvironmental Desk Study for the site (Report No. 1620007830-001-RAM-XX-XX-RP-YE-10002).

2.5 Hydrological Setting

The proposed development site is located within the Arun Lower Operational Catchment and is located approximately 900 m west of the River Arun. The River Arun (Transitional Water) is a heavily modified watercourse and its current ecological and chemical state is classified as moderate and good respectively by the EA[5].

There are no watercourses or other hydrological features within the site boundary. Approximately 350 m east of the site and adjacent to the new access road and Ford Road, a narrow drainage ditch flows in an easterly direction prior to discharging into the River Arun.

2.6 Hydrogeological Setting

According to the BGS Onshore GeoIndex 1:625,000 scale Hydrogeology Mapping, the site is situated above the White Chalk Subgroup, characterised as a highly productive aquifer, and designated a principle aquifer.

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 (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 (2.0mbgl), and to the east at up to 3.0 mAOD (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, 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 ground water 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 EA has developed Groundwater Source Protection Zones (SPZ) to assist in the assessment of risk to groundwater supplies taken from an abstraction point. According to MAGiC[6] interactive mapping, the site does not lie within a Groundwater SPZ.

In addition, the site is not located within a Nitrate Vulnerable Zone (NVZ) or Drinking Water Protected Area (DWPA), however the River Arun is classified as a DWPA and is linked to a Special

[5] Environment Agency (2020). Catchment Data Explorer – Arun Lower Summary (online). Available at: https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3266/Summary [accessed 25/02/2021]

[6] Natural England (2020). MAGiC (online). Available at: https://magic.defra.gov.uk/home.htm [accessed 25/02/2021]

Protected Area (SPA) and a Special Area of Conservation (SAC). The SPA and SAC are 10 km upstream of the site and are not anticipated to be relevant to this study.

The EA website shows aquifers and provides designations which are in line with the Water Framework Directive and are based on maps produced by the BGS. According to the EA aquifer mapping, the underlying superficial deposits (River Terrace Deposits) and bedrock geology (Lewes Nodular Chalk Formation) are designated as Secondary A and Principal aquifers, respectively.

In terms of groundwater vulnerability, the site is located within a medium vulnerability zone for the River Terrace Deposits and a high vulnerability zone for the Principal aquifer indicating that the area is able to easily transmit pollution to groundwater.

For additional information of groundwater, see the Hydrogeological Impact Assessment (Report No. 1620007830-001-RAM-XX-XX-RP-YE-10010).

2.7 Existing Drainage Regime and Surface Water Runoff

For context, greenfield runoff rates were calculated for the site using the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS) method in MicroDrainage 2018. The results of the calculations are shown in Table 2.3 below. The outputs from MicroDrainage are provided in Appendix B.

Approximately 93% of the site is occupied by existing buildings and hard landscaping and is considered to be brownfield and 100% impermeable. The existing (pre-development) runoff rates from the site in its current configuration have been calculated using Tekla Tedds (Version 2.0.00, 2017) and are presented in Appendix C6F[7]. The critical storm duration is 15 minutes. The results of the calculations are shown in Table 2.3.

Table 2.3: Greenfield and Pre-development Runoff Rate Calculations

Return Period (years)	1-in-1	1-in-2	1-in-10	1-in-30	1-in-100
Greenfield runoff rates (l/s)	22.5	23	43	60	84
Pre-development runoff rates (l/s)	559	723	1,119	1,371	1,772

During the walkover survey, it was noted that surface water runoff from the existing buildings (Unit 1, Unit 2 and the WTS) is collected by a number of plastic rainwater downpipes, discharging at ground level and draining (gravitational flow) into the nearest gully which comprises part of the existing private surface water drainage network. A number of these rainwater pipes were noted to be cracked, broken and dislocated (Photo A.9, Appendix A). The majority of the gullies observed were completely blocked by soil and debris, causing ponding of surface water around them (Photo A.7, Appendix A).

Surface water runoff from the external yard area (concrete hard standing with vegetation noted to be growing in between the cracks) is also discharging into existing gullies. Based on the Drainage Assessment undertaken by Enzygo Ltd[8], the private surface water sewer carries stormwater in an

[7] The design rainfall intensity is calculated in accordance with the Wallingford Procedure and BRE Digest 365 by defining the appropriate storm length and return period and the ratio(r) of a 60 minute to two-day rainfalls of five-year return period appropriate for the geographic location. The entire catchment (site area), and the percentage of that area that is impermeable, are considered in order to calculate the surface water runoff rate from the site

[8] Drainage survey and associated report by Enzygo Ltd, titled "Ford CTP, Arundel – Drainage Assessment", dated 2015

easterly direction with an outfall to an unnamed land drain located approximately 350 m east of the site at NGR 500095 103414[9].

A detailed description of the proposed outline surface water drainage strategy is provided in Section 4.

Southern Water asset records are provided in Appendix D. These records indicate that there is an adopted foul rising main passing close to the southern site boundary, conveying foul water flows to the Ford Sewage Treatment Works (STW). No foul, surface or combined sewers are shown in close proximity to the site. Once the location and condition of the existing connections to the foul sewer network are proven, it may be possible to reuse or upgrade these connections for the proposed development.

2.8 Existing Flood Risk

Fluvial and Tidal Flood Risk

The EA floodplain maps identify areas in England and Wales at risk of flooding by allocating them into flood risk zones. The flood risk zones shown on the flood maps are defined in Table 1 (Flood Zones) of the National Planning Policy Guidance (NPPG)[10].

The flood zones' spatial variation within the site boundary, based on the EA indicative flood map, is provided in Figure 5.

The EA indicative flood risk mapping shows that the site is entirely located in Flood Zone 1, at low risk of fluvial flooding.

Considering the above, the site is presently at low risk of fluvial flooding. The effects of climate change (CC) are considered in Section 3.

Surface Water and Sewer Drainage Flood Risk

The Flood and Water Management Act 2010 defines surface water flooding as flooding that takes place when surface water runoff generated by rainwater falls on the surface of the ground and has not yet entered a watercourse, drainage system or public sewer.

The EA's flood risk map for surface water flooding is provided in Figure 6.

The EA surface water flood mapping indicates low risk of flooding from surface water in the external yard area surrounding by Unit 1 (Hangar 1), Unit 2 (Hangar 2) and the WTS with the predicted depth from EA data as up to 0.30 m. Furthermore, the area adjacent to the west of the site office and weighbridge is shown to be at medium to low risk of surface water flooding. Associated depth of flooding is predicted to be between 0.15 m and 0.30 m. The northwest part of the site is also shown to be at low risk of surface water flooding with the predicted depth as up to 0.30 m.

The above described surface water flooding is created primarily due to natural ground depressions in certain parts of the site covered with concrete. Surface water ponding in these areas was also confirmed from surface water maps provided by Arun District Council (Level 1 SFRA: Appendix E Surface Water Flood Risk, p 34) and during the site walkover (Photos A10 and A11, Appendix A). In addition, during the site walkover, surface water ponding was also observed in the area along the

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[9] Drawing No.100.A and 102.A, form Enzygo Ltd Drainage Survey Report "Ford CTP, Arundel – Drainage Assessment", 2015

[10] Department for Communities and Local Government (2014). National Planning Practice Guidance (NPPG) – Flood risk and coastal change. Part of Planning practice and Planning system (online) London: House of Commons. Available at: https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones [accessed 25/02/2021]

south of the WTS (Photos A12 and A13, Appendix A). It is understood that this is primarily due to blockages in the existing surface water drainage system which do not allow surface water to freely drain off the site.

Considering the above, the overall risk of flooding from surface water within the site boundary is considered to be low. Low risk of flooding from surface water means that each year, this area has a chance of flooding of between 1-in-1000 (0.1%) and 1-in-100 (1%).

According to Arun District Council SFRA, there are no incidents of sewer flooding within the site boundary or in the vicinity of the site (within 1 km radius).

Groundwater Flood Risk

Groundwater flooding is caused by the emergence of water originating from sub-surface permeable strata. A groundwater flood event results from a rise in groundwater level sufficient for the water table to intersect the ground surface and inundate low lying land. Groundwater floods may emerge from either point or diffuse locations. They tend to be long in duration developing over weeks or months and prevailing for days or weeks.

Arun District Council SFRA (Level 1 SFRA: Appendix F Areas Susceptible to Groundwater, p 34) indicates that the area in general is highly susceptible to groundwater flooding. In addition, it is mentioned that 'significant groundwater flood events have been recorded across the Arun District. This risk is supported by the Areas Susceptible to Groundwater Flooding mapping and suggests that susceptibility to groundwater flooding is generally high through the district' (Arun District Council, 2016).

From review of groundwater level monitoring data at the site, the shallowest depth of groundwater (recorded during a prolonged wet winter period) during 11 March 2020 is 2.50 mbgl (4.0 mAOD) recorded in the southwestern corner of the site.

Based on the available ground investigation data, the shallowest depth to Lewes Nodular Chalk (Principal Aquifer) has been recorded at 2.3 mbgl in the southern half of the site and is generally slightly deeper towards the centre of the site.

Considering the above and taking a precautionary approach, the overall risk of flooding from groundwater within and in the vicinity of the site is considered to be high. A depth of 2.3 mbgl to the top of Lewes Nodular Chalk and 2.50 mbgl to groundwater are representative of the worst-case recorded data available for the site to date (as of March 2020)[11].

Risk from Reservoirs, Canal and Other Artificial Sources

2.8.1 here are two reservoirs, namely Swanbourne Lake and Bisham Farm Reservoir within the Arun District and in close proximity to the site (within 5 km radius). Nevertheless, the UK Government indicative mapping database[12] shows that there is no risk of flooding from reservoirs within the site boundary and therefore, the associated risk is considered low.

Flood Risk Summary

Table 2.4: Flooding Sources at the Proposed Development Site

[11] This is based exclusively on the ground investigation and groundwater level monitoring data available to date which does not provide full coverage in the vicinity of the proposed bunkers.

[12] UK Government (2020). Learn more about flood risk (online) Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map [accessed 25/02/2021]

Sources of Flooding	High	Medium	Low	Comments
Tidal and fluvial			√	The entire site is located within Flood Zone 1, at low risk of fluvial and tidal flooding
Surface water			√	EA surface water flood map indicates low risk of flooding within the site boundary. No incidents of sewer flooding within or in the vicinity of the site have been reported.
Groundwater	√			The overall risk of groundwater flooding within and in the vicinity of the site is considered to be high.
Reservoirs, canals and other artificial sources			√	The site is not shown to be at risk of flooding from reservoirs, canals and other artificial sources

3. ASSESSMENT OF NEW DEVELOPMENT

3.1 Development Proposal

Ford EfW Ltd, Grundon and Viridor propose to redevelop the site as a waste management facility comprising an ERF and WSTF. The buildings and ancillary structures to be constructed as part of the waste management facility are anticipated to occupy 40% of the site. The remaining 60% of the site will be occupied by external areas, predominantly comprising hardstanding and soft landscaping. External hardstanding areas of the site will include access roads and operational transport routes within the site, car and heavy goods vehicle (HGV) parking spaces, HGV washing areas ramps and pedestrian routes. Additionally, two deep waterproofed bunkers are proposed.

The central area of the site where the main process buildings are to be situated is to be lowered by 1.5 m.

The proposed architectural layout drawings are presented in Appendix E.

3.2 Flood Risk Vulnerability

According to Table 2 (Flood Risk Vulnerability Classification) in the Planning Practice Guidance to NPPF, buildings used for services and industrial purposes are classified as ‘Less Vulnerable’.

3.3 Sequential Test

The Sequential Test aims to steer development to areas with the lowest probability of flooding. The proposed development is classified as ‘Less Vulnerable’ in Flood Zone 1 and therefore, the sequential test is deemed to have been passed and the Exception Test is not required for the proposed development.

3.4 Surface Water Runoff

The NPPF identifies that rainfall intensities will increase in the future as a result of CC, thereby increasing surface water runoff rates and volumes. The EA CC allowance guidance (2016)[13] shows the recommended national precautionary sensitivity ranges for various parameters including peak rainfall intensity. The design life of the new development is considered to be 60 years; the recommended allowance for CC has a range between 20% (central) and 40% (upper end). Due to the development site being located in a wider urban environment, a 40% CC allowance has been applied and should be accounted for when designing the new surface water drainage systems.

[13] National Planning Policy Framework (NPPF) dated February 2016, and updated March 2020

The existing site is 93% impermeable, as it is occupied by existing buildings and hard landscaping. The footprint of the proposed development will result in a 40% decrease of the impermeable site area (4.00 ha) due to the inclusion of landscaping around the eastern, northern and western edges of the site.

Table 3.1 summarises the predicted change in peak flows as a result of CC (considering 40% allowance). The critical storm duration for runoff is 15 minutes. Calculations are provided in Appendices C and F.

Table 3.1: Surface Water Runoff Rate Calculations

Return Period (years)	1-in-1	1-in-2	1-in-10	1-in-30	1-in-100
Pre-development runoff rates (l/s)	554	717	1,109	1,361	1,758
Post-development runoff rates (l/s) including 40% CC	468	604	935	1,148	1,483
Post-development increase (when allowing for CC)	-87	-112	-174	-213	-275

To ensure that flood risk to downstream receptors does not increase following development, attenuation of surface water runoff will need to be incorporated into the proposed drainage strategy for the site. The attenuation requirements for the proposed development were agreed with the West Sussex County Council LLFA (refer to Appendix H and sections 3.4.5 and 3.4.6) and calculated using the Wallingford procedure. The footprint of the proposed development in conjunction with a 40% allowance for CC were considered for the storage volume calculations. Table 3.2 presents the calculated storage volumes for different critical storm events. The detailed calculations are provided in Appendix G.

According to the West Sussex LLFA Policy for the Management of Surface Water[14], redevelopment on brownfield land has the potential to rectify or reduce flood risk. Proposed brownfield developments are required to manage their surface water runoff in order to achieve a 50% reduction in the rates of surface water drainage compared to the existing ones at peak times.

Following direct liaison with WSCC (refer to Consultation and Scoping response, Appendix H), it is required to restrict post-development runoff rates to 60 l/s (1-in-30 year rainfall event at greenfield runoff rates) and attenuate the 1-in-100 year critical storm event including 40% allowance for CC below ground, equating to approximately 2,400 m^3.

Table 3.2: Storage Volume Calculations

Storm Event	M1-120	M2-240	M10-240	M30-240	M100-240
Storage Volume (m^3)	483	668	1,215	1634	2,393

NB The "M" value refers to the return period (M1 is the 1-in-1 year rainfall event). The "120" or "240" value refers to the time period of the rainfall event in minutes. This duration is assessed as being the critical storm duration whereby the maximum amount of storage is required based upon the allowable discharge

3.5 Groundwater Flood Risk

Whilst the overall risk of groundwater flooding within and in the vicinity of the site is considered to be high there are limited areas of the development that have the potential to interact with groundwater. The main below ground excavation that is likely to interact with groundwater will be for the construction of the bunker. Based on existing groundwater level data at the site (shallowest depth recorded at 2.50 mbgl), the potential for the bunker excavation to interact with groundwater is

[14] West Sussex County Council (2018). West Sussex LLFA Policy for the Management of Surface Water (online) West Sussex. Available at: https://www.westsussex.gov.uk/media/12230/ws_llfa_policy_for_management_of_surface_water.pdf [accessed 18/03/2020]

anticipated to be high. A separate and specific Hydrogeological Impact Assessment report has been undertaken to assess the potential impact of all construction works below ground level that has the potential to impact groundwater. As is standard practice, potential impacts can be mitigated, for example, by the provision of granular conveyance routes and drainage blankets on and surrounding below ground structures where necessary to maintain groundwater flow rates to be approximately equivalent to that pre-development. In addition, and as discussed in Section 4 below local surface runoff attenuation/ponding will be allowed to occur in significant events in managed external hardstanding areas, but groundwater itself will be prevented from being able to interact with ponded surface water due to the substantial concrete structure forming what would in effect be a basement structure.

4. OUTLINE SURFACE WATER DRAINAGE STRATEGY

The indicative surface water drainage strategy layout for the proposed development is provided in Figure 7.

The surface water drainage strategy takes into consideration the proposed development layout and levels, topography, geological, hydrological and hydrogeological setting and investigates how surface water runoff from the development site can be managed to comply with the requirements of the NPPF, EA and WSCC.

A range of SuDS options were considered in order to identify the most suitable options for attenuating surface water runoff on the proposed development site. Table I.1 in Appendix I presents the different SuDS approaches that are available and were considered for this site and describes their advantages, disadvantages and appropriateness for use on the proposed site.

Although a wide range of SuDS techniques were considered, there are limited methods available that would be practically feasible and suitable due to the extensive built footprint within the site boundary and its geological and hydrogeological setting. Specifically, considering the high potential groundwater levels and contamination at the site in conjunction with its location within a high vulnerability zone on Principal aquifer (Sections 2.3 and 2.5), infiltration is not considered to be a viable option for the site.

The existing surface water drainage system on site will be abandoned. The off-site surface water drainage connection with the unnamed land drain will be surveyed and cleaned out to the outfall to ensure that the new surface water drainage system will function appropriately.

At ground level it is proposed that surface water runoff is attenuated in impermeable-lined below ground cellular storage tanks prior to discharging at a significantly reduced peak discharge rate of 60 l/s equating a 1-in-30 year greenfield runoff rate, into the unnamed land drain using the existing outfall connection point. The proposed attenuation storage systems will collect surface water from rainwater pipes and external hardstanding areas.

It has been calculated that the proposed attenuation system will require 2,400 m^3 of attenuation storage volume designed to contain the 1-in-100 year critical storm event including 40% allowance for CC without causing any flooding to the site. As advised by WSCC, exceedance flows beyond the 1-in-30 year critical storm event can be discharged uncontrolled to the drainage system.

However, it is considered appropriate to manage surface water volumes in excess of the 1-in-30 year event (including 40% CC allowance) on site by allowing shallow ponding (approixmately 150 mm average depth) of managed external hardstanding areas thereby not increasing flood risk downstream as a result of the proposed development. This controlled ponding is proposed to occur at the south-west corner of the Proposed Development around the WTS and will be contained by areas of slightly raised ground (which will also serve to prevent ponding water from flowing down ramps to the lower site level).

At the lower level of the Proposed Development it is proposed that water be attenuated in an open - 0.3 m surface water storage zone situated at the contractors laydown area and under the air condenser units and pumped up to the wider drainage system at ground level at a rate of 50 l/s. The volume of storage will accommodate up to 650 m^3 during 1-in-100 year events including the 40% CC allowance, assuming a 50 l/s pump rate. An additional channel drain collection system with surface water ponding to a volume of 190 m^3 is incorporated at this site level to accommodate additional storage in the event of pump failure. Additional assessment has been undertaken for the complete power and pump failure for a prolonged period and as the internal floor area is not sensitive to floodwaters entering the building, then standing water to a depth of 150mm inside the building structure as well as the surrounding external areas is considered acceptable in an a worst-case scenario.

Considering the high groundwater levels of the site and its location within a high vulnerability zone on Principal aquifer, infiltration is not considered to be a viable option for the site.

Rainwater harvesting is proposed for the development and is indicated within the Surface Water Drainage Strategy in Figure 7. This will be further detailed in future design stages. The impact of rainwater harvesting on the required attenuation volumes has been considered and the storage volume is at a lower level (i.e. an enlarged sump detail) than the outlet to the drainage system and as such will not be impacted by the overall storage volume design. Thereby during extreme events the rainwater harvesting system may already be at capacity but all rainfall event storage would be above the downstand/sump rainwater harvesting area. This sump storage will feed pumps and an irrigation network for the soft landscaping features.

Water quality monitoring stations are to be installed at two locations: at the surface water drainage pipe receiving water from the WTS and at the contractor’s laydown area receiving drainage at the lower site level.

5. SUMMARY

i. The site is located at the Ford Circular Technology Park (the former Tarmac blockworks site, approximate NGR 499586 103315) to the west of the village of Ford. The site covers an area of approximately 6.72 ha, part of which is used for existing WTS operations with the rest of it being vacant.

ii. It is proposed to redevelop the site as a waste management facility comprising an ERF and WSTF. The buildings and ancillary structures to be constructed as part of the waste management facility are anticipated to occupy 40% of the site. The remaining 60% of the site will be occupied by external areas, including landscaped areas, access roads and operational transport routes within the site, car and HGV parking spaces, HGV washing areas ramps and pedestrian routes.

iii. There are no watercourses or other hydrological features within the site boundary. Approximately 350 m east of the site and adjacent to the new access road and Ford Road, a narrow drainage ditch flows in an easterly direction prior to discharging into the River Arun, approximately 1 km east of the site.

iv. The EA indicative flood risk mapping shows that the site is entirely located in Flood Zone 1, at low risk of fluvial flooding.

v. The risk of flooding from surface water within the site boundary is considered to be low.

vi. Taking a precautionary approach, the risk of flooding from groundwater within and in the vicinity of the site is considered to be high. A depth of 2.3 mbgl to the top of Lewes Nodular Chalk and 2.5 mbgl to groundwater are representative of the worst-case data available for the site to date (as of February 2020). Whilst being considered as high, this risk is capable of being mitigated by standard design measures.

vii. There is no risk of flooding from reservoirs within the site boundary and therefore, the associated risk is considered low.

viii. The proposed development is classified as 'Less Vulnerable' in the Planning Practice Guidance to NPPF and therefore, the sequential test is deemed to have been passed and the Exception Test is not required for the proposed development.

ix. The existing surface water drainage system on site will be abandoned apart from the existing outfall and pipework leaving the site. The off-site surface water drainage connection with the unnamed land drain will be surveyed and cleaned out to outfall to ensure that the new surface water drainage system will function appropriately.

x. Due to the high groundwater levels of the site and its location within a high vulnerability zone on Principal aquifer, infiltration measures are not considered to be a viable option for the site.

xi. To maintain an allowable discharge rate of 60 l/s it has been calculated that the drainage strategy will require 2,400 m^3 of attenuation storage volume designed to contain the 1-in-100 year critical storm event including 40% allowance for CC without causing any flooding to the site.

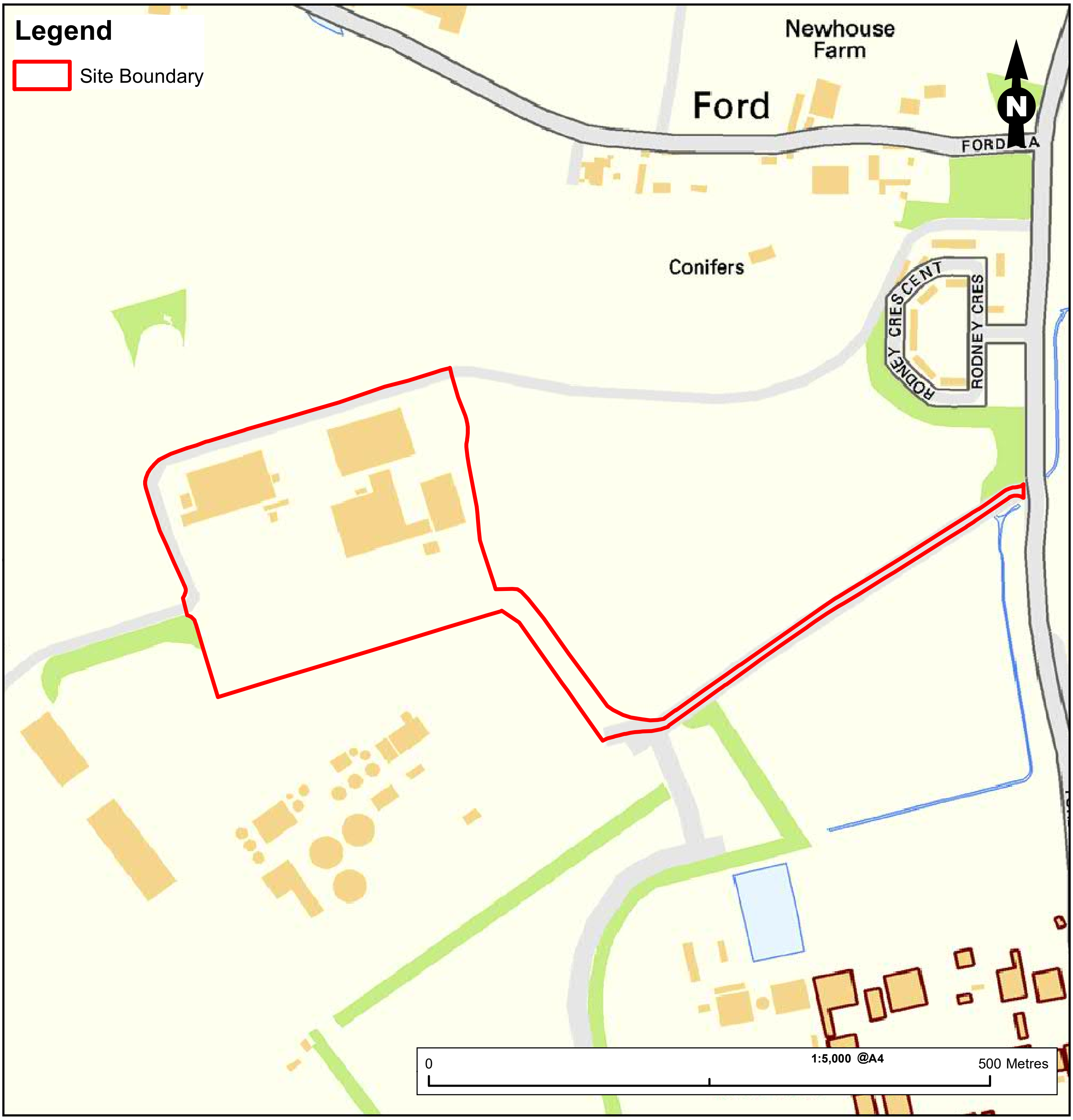
xii. At ground level it is proposed that surface water runoff is attenuated in impermeable-lined below ground cellular storage tanks prior to discharging at 1-in-30 year greenfield runoff rates into the land drain using the existing outfall. At the lower level of the Proposed Development it is proposed that surface water be attenuated in an open -0.3 m locally-lowered surface water storage zone situated at the contractors laydown area and air condenser units area and pumped up to the wider drainage system at ground level at a rate of 50 l/s. Both levels will include controlled surface water ponding in addition to the proposed below ground storage for controlling discharge to the drainage system during more extreme storm events (or in the event of complete pump or power failure at the lower level).

xiii. Rainwater harvesting is proposed for the development and will be further detailed in future design stages. The below-ground cellular storage tank beneath the car park is proposed to provide additional storage in the form of an enlarged sump that feeds pumps and an irrigation network for the soft landscaping features.

xiv. Water quality monitoring stations are to be installed as part of the proposal to monitor the chemical composition of runoff from the site.

xv. To aid in minimising the impact to the surrounding environment in terms of water quality as well as water quantity it is proposed to install "light liquid" separators as required as part of the proposed formal surface water drainage system.

FIGURES



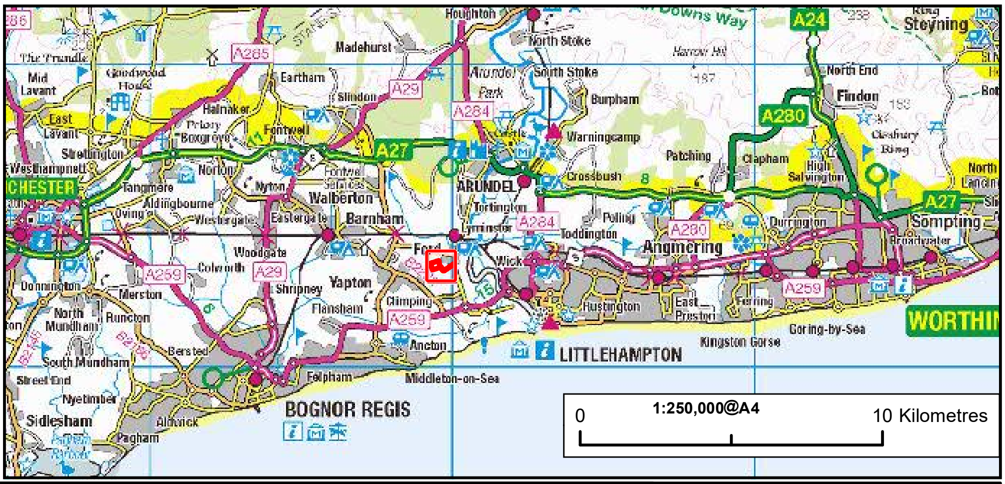
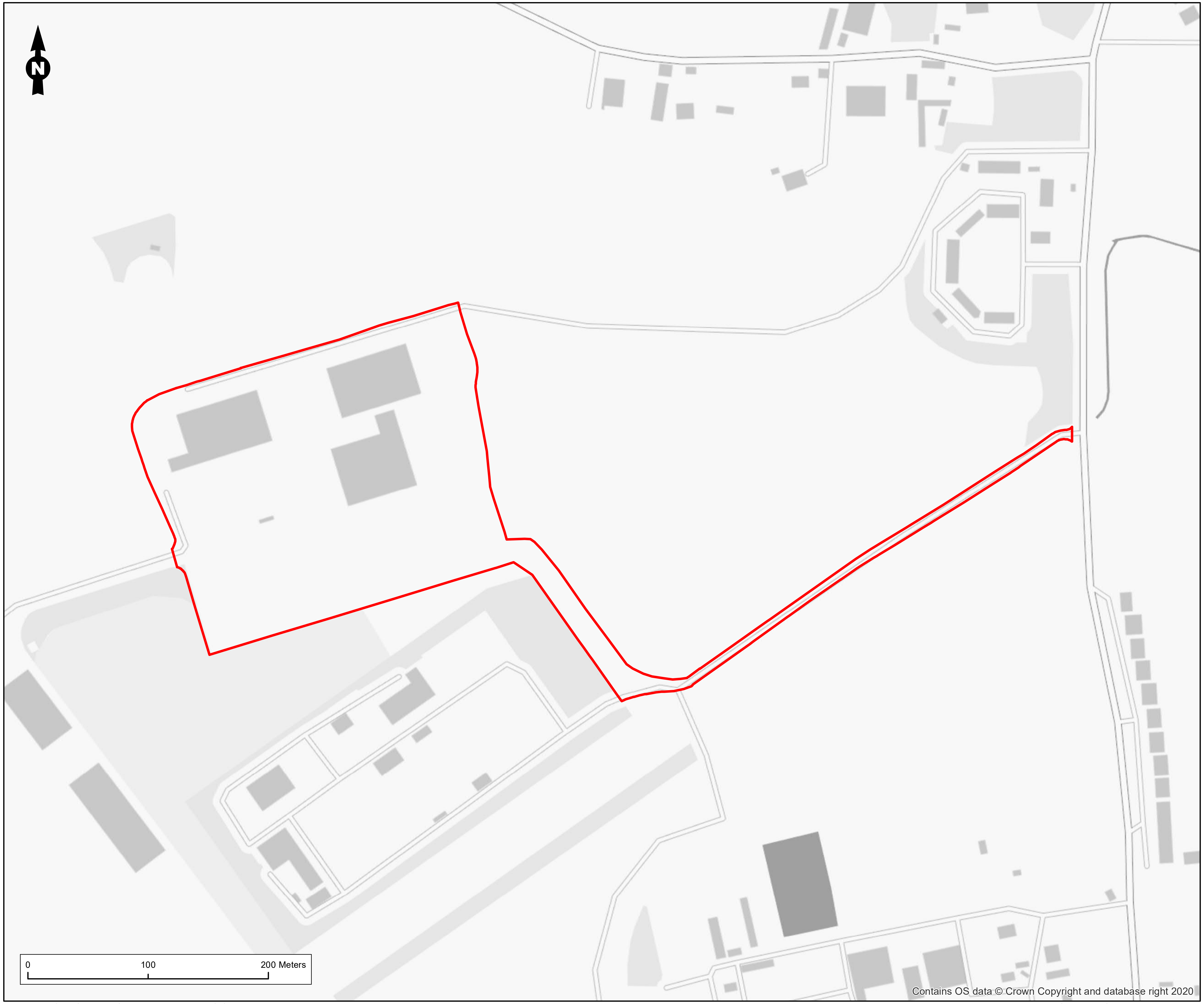


Figure Title	Project Name	Date	
Figure 1: Site Location	Ford Energy Recovery Facility and Waste Sorting and Transfer Facility, Ford Circular Technology	February 2021	RAMBOLL
		Scale: As shown	
Project Number: 1620007830	Client: Ford Energy from Waste Ltd	Issue: 01	Prepared By



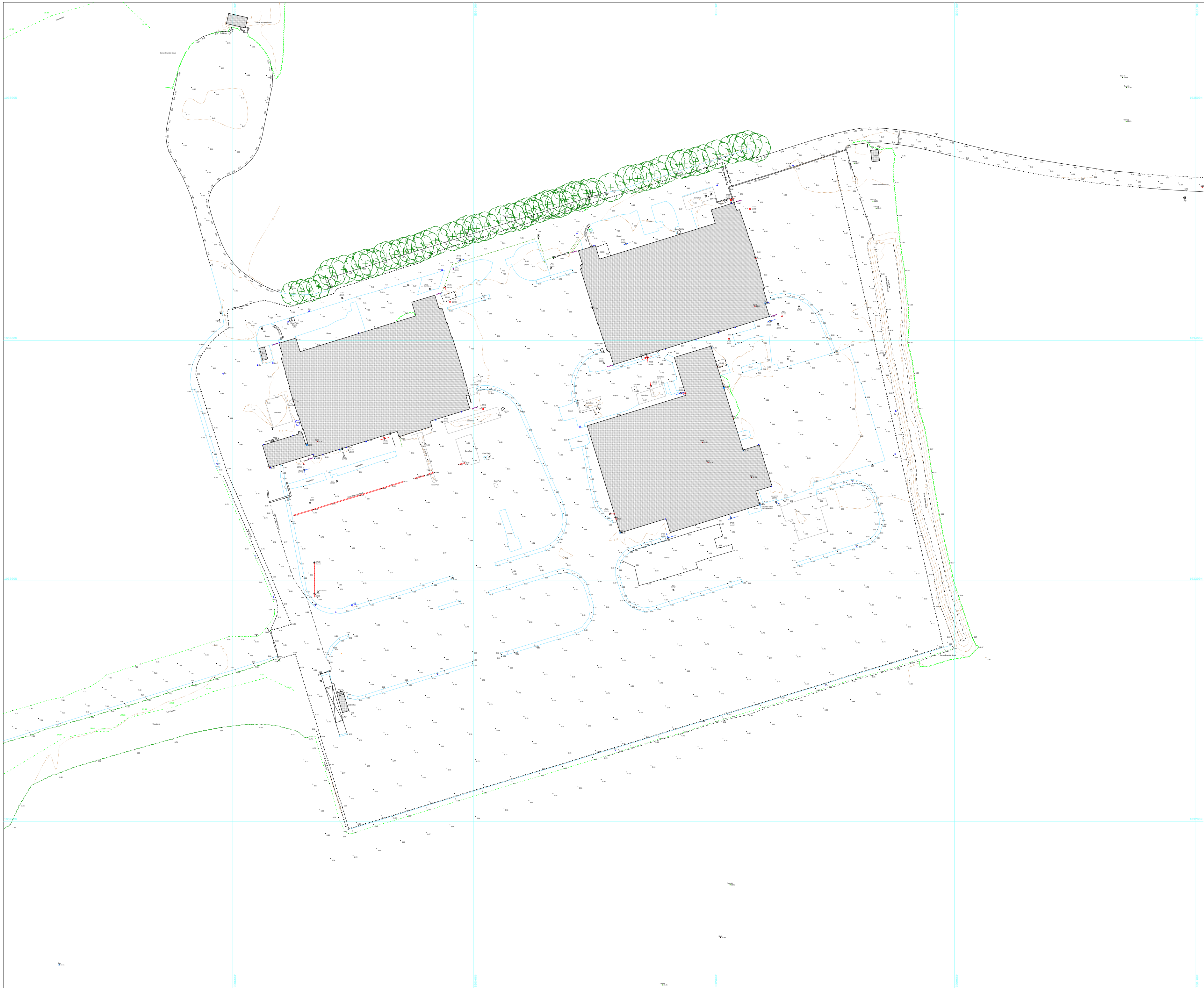
Legend

Site Boundary

Figure Title	
Site Boundary	
Project Name	
Ford Energy Recovery Facility and Waste Sorting and Transfer Facility, Ford Circular Technology Park	
Project Number	Figure No.
1620007830	2
Date	Prepared By
February 2021	DP
Scale	Issue
1:3,000 @A3	1
Client	
Ford EfW Ltd, Grundon & Viridor	

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



MITCHAM SURVEYS

Note;-

Contour Interval: 0.5m
This survey is orientated to OSGB36 using GPS methods and the OSTN02-OSGM02 transformation.

GRUNDON

Ford Works

Site Survey
August 2013

Drawn By. TJP	*Job No.* 1275
Date. 15-AUG-13	*Surveyed By.* TJP
Scale. 1 : 500	*Drg No.* 1

Legend

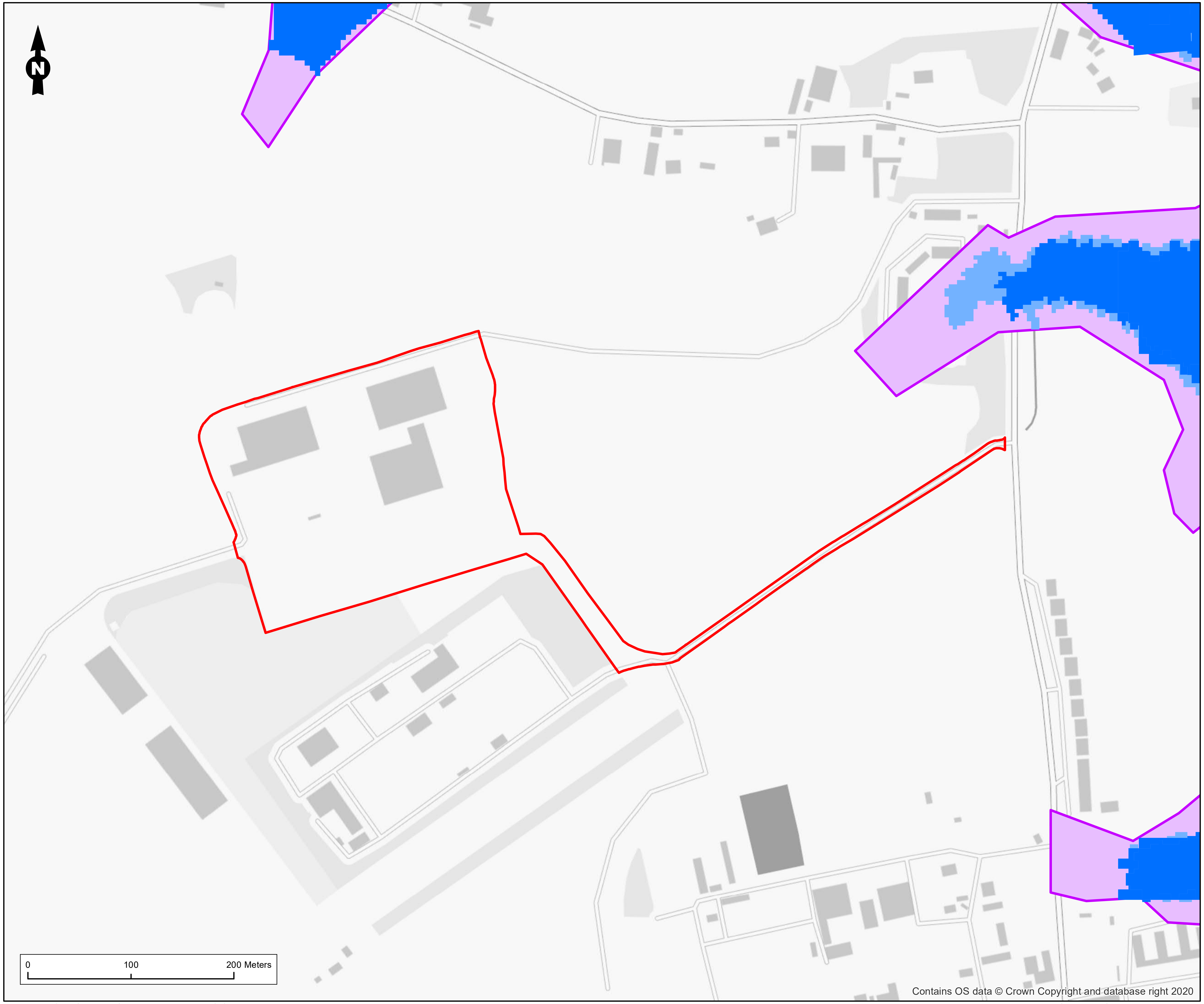
Site Boundary

Borehole

Figure Title	
Borehole Location Plan	
Project Name	
Ford Energy Recovery Facility and Waste Sorting and Transfer Facility, Ford Circular Technology Park	
Project Number	Figure No.
1620007830	4
Date	Prepared By
February 2021	DP
Scale	Issue
1:1,500 @A3	1
Client	
Ford EfW Ltd, Grundon & Viridor	

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Site Boundary
- Flood Zone 3
- Flood Zone 2
- Flood Alert Areas
- Flood Warning Areas

Figure Title
Environment Agency - Risk of Flooding from Rivers and Sea

Project Name
Ford Energy Recovery Facility and Waste Sorting and Transfer Facility, Ford Circular Technology Park

Project Number	Figure No.
1620007830	5
Date	**Prepared By**
February 2021	DP
Scale	**Issue**
1:3,500 @A3	1

Client
Ford EfW Ltd, Grundon & Viridor

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.

Legend

Site Boundary

Risk of Surface Water Flooding 1-in-1000

Metres

0.00 - 0.15
0.15 - 0.30
0.30 - 0.60
0.60 - 0.90
0.90 - 1.20
> 1.20

Figure Title
Environment Agency – Risk of Flooding from Surface Water (0.1% annual probability)

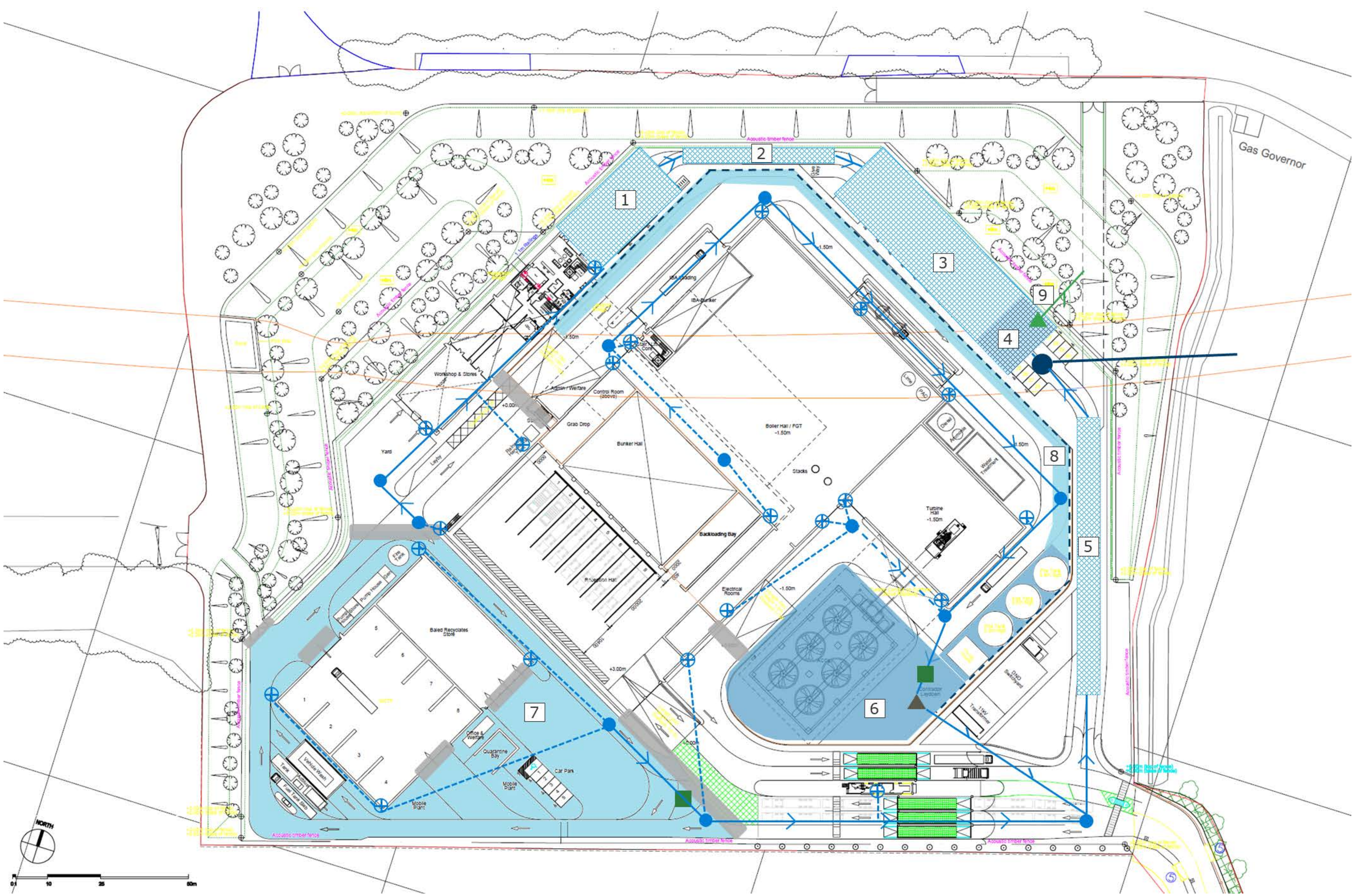
Project Name
Ford Energy Recovery Facility and Waste Sorting and Transfer Facility, Ford Circular Technology Park

Project Number	Figure No.
1620007830	6
Date	**Prepared By**
February 2021	DP
Scale	**Issue**
1:3,000 @A3	1

Client
Ford EfW Ltd, Grundon & Viridor

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Site boundary
- Below ground cellular storage tank
- Extreme event surface water ponding
- General surface water storage
- Raised Ground (0.15 m)
- Existing surface water manhole
- Existing surface water drainage
- Proposed surface water manhole
- Proposed surface water drainage
- Carrier drain
- Rainwater pipe
- Channel drain
- Water quality monitoring station
- Pump
- Pump (for irrigation system)

Note on storage requirements:

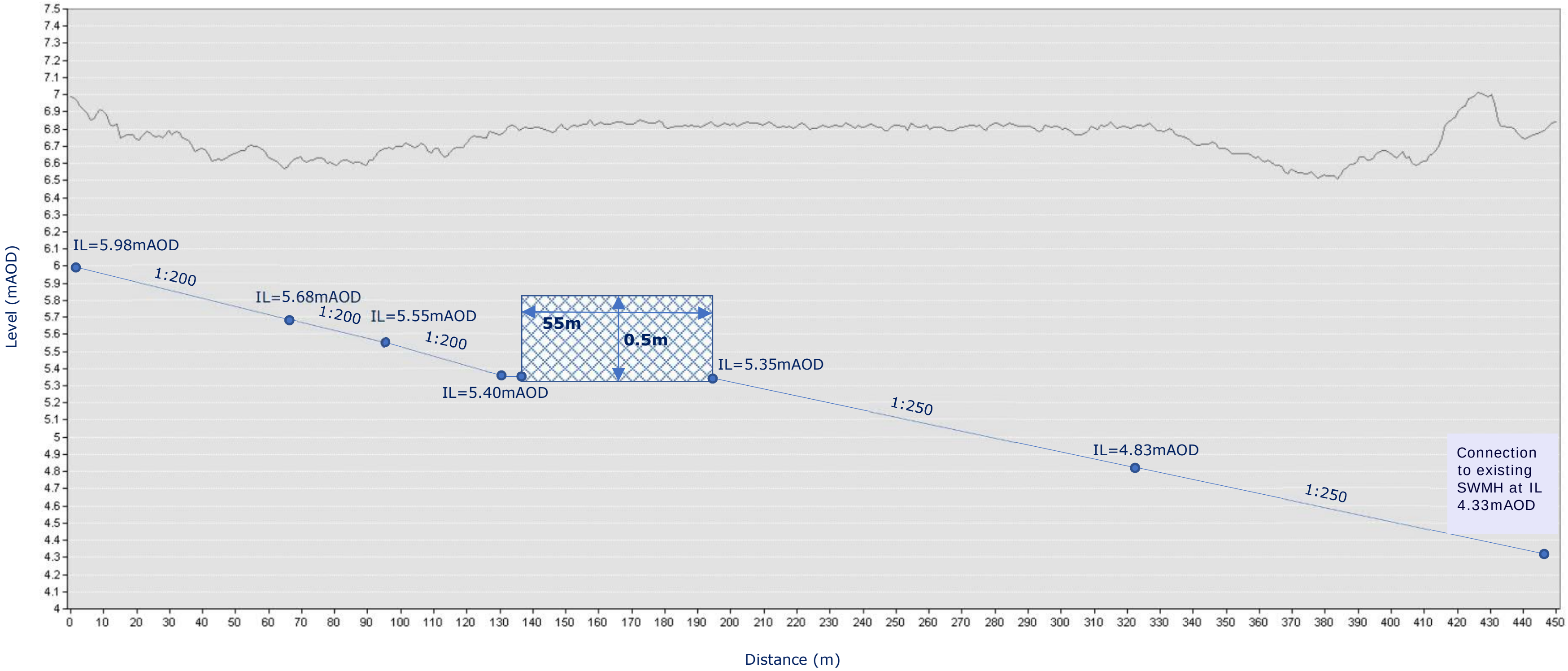
- Total storage required for 1-in-100 year storm event plus CC: 2,400 m3
- Proposed storage total: 2,400 m3
- Storage required for -1.5 m external area: 650 m3 based on 50 l/s pump rate for 1-in-100 year storm event plus CC
- Proposed storage total (-1.5 m level): 650 m3 + 190 m3

1. Below ground cellular storage: 250 m3 (250 m2 x 1 m)
2. Below ground cellular storage: 250 m3 (250 m2 x 1 m)
3. Below ground cellular storage:1,000 m3 (1,000 m2 x 1 m)
4: Cellular storage invert (lowered base level) for irrigation system
5. Below ground cellular storage: 300 m3 (300 m2 x 1 m)
6. Surface water storage at -0.3 m for low return period events, extending below fan units: 650 m3 (2000 m2 x 0.3 m)
7. Surface Water Ponding (for high return period events): average 0.15 m
8. Channel drain collection system with surface ponding for extreme events in case of pump failure : 190 m3 (1,250 m2 x 0.15 m)
9. Irrigation pump and pipe network

Figure Title	
Outline Surface Water Drainage Strategy	
Project Name	
Ford Energy Recovery Facility and Waste Sorting and Transfer Facility, Ford Circular Technology Park	
Project Number: 1620007830	Figure No.: 7
Date: March 2021	Prepared By: DP
Scale:	Issue: -
Client: **Ford EfW Ltd, Grundon, Viridor**	

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Existing Ground Level

Figure 08: Surface Water Drainage – Indicative Long Section (Long Section A-A)

Note

Please refer to Figure 07 'Outline Surface Water Drainage Strategy' for the long section's location.

Light-liquid separators to be installed as required as part of new SW drainage network

APPENDIX A
SITE WALKOVER PHOTOGRAPHS


Photo A.1: View from the Southeast Corner of the Site


Photo A.2: View of Unit 1 (Hangar 1)

Photos A.3–A.6: Rainwater Pipes in Existing Buildings

Photos A.7–A.9: Existing Drainage Features

Photos A.10 and A.11: Surface Water Flooding (between WTS and Units 1/2)

A.12 and A.13: Surface Water Flooding (along the south boundary of the site)

APPENDIX B
GREENFIELD RUNOFF RATES

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	SAAR (mm)	750	Urban	0.000
Area (ha)	7.140	Soil	0.400	Region Number	Region 7

Results	**l/s**
QBAR Rural	26.3
QBAR Urban	26.3
Q2 years	23.2
Q1 year	22.4
Q30 years	59.7
Q100 years	84.0

ICP SUDS Mean Annual Flood

Input

Return Period (years)	10	SAAR (mm)	750	Urban	0.000
Area (ha)	7.140	Soil	0.400	Region Number	Region 7

Results l/s

QBAR Rural	26.3
QBAR Urban	26.3
Q10 years	42.7
Q1 year	22.4
Q30 years	59.7
Q100 years	84.0

APPENDIX C
PRE-DEVELOPMENT RUNOFF RATES

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **1** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min$ = **12.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **0.61**
Rainfall for 15min storm with 1 year return period	$M1\_15min = Z2 \times M5\_15min_i$ = **7.6** mm
Design rainfall intensity	$I_{max} = M1\_15min / D$ = **30.3** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **93** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **559.3** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min$ = **12.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **0.79**
Rainfall for 15min storm with 2 year return period	$M2\_15min = Z2 \times M5\_15min_i$ = **9.8** mm
Design rainfall intensity	$I_{max} = M2\_15min / D$ = **39.2** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **93** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **723.1** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **5** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min$ = **12.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.03**
Rainfall for 15min storm with 5 year return period	$M5\_15min = Z2 \times M5\_15min_i$ = **12.7** mm
Design rainfall intensity	$I_{max} = M5\_15min / D$ = **50.8** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **93** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **937.3** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **10** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min$ = **12.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.23**
Rainfall for 15min storm with 10 year return period	$M10\_15min = Z2 \times M5\_15min_i$ = **15.2** mm
Design rainfall intensity	$I_{max} = M10\_15min / D$ = **60.6** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **93** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **1118.6** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **30** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i$ = Z1 × M5_60min = **12.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.51**
Rainfall for 15min storm with 30 year return period	M30_15min = Z2 × $M5\_15min_i$ = **18.6** mm
Design rainfall intensity	I_{max} = M30_15min / D = **74.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **93** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **1371.4** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min$ = **12.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.95**
Rainfall for 15min storm with 100 year return period	$M100\_15min = Z2 \times M5\_15min_i$ = **24.0** mm
Design rainfall intensity	$I_{max} = M100\_15min / D$ = **96.1** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **93** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **1772.0** l/s

APPENDIX D
SOUTHERN WATER ASSET RECORDS

Southern Water

ATKINS CHECKED

PA

Your Ref 38872/PS
Our Ref 197345
Date 24 June 2015
Contact searches@southernwater.co.uk
Fax 01634 844514
DX:400450 Chatham 5

Atkins
Atkins Telecoms - Stats Enquiries Team
The Hub - 500 Park Avenue
Aztec West
Almondsbury
Bristol
Attention: Sarah Generalski-Sparling

Dear Sirs

Provision of Sewer only Main Record Extracts – VAT Receipt

Ford Transfer, Ford BN18 0DB
Further to your recent enquiry regarding the provision of Southern Water apparatus record extracts for the above location.

Please be aware that there are areas within our region in which there are neither sewers nor water mains. Similarly, whilst the enclosed extract may indicate the approximate location of our apparatus in the area of interest, it should not be relied upon as showing that further infrastructure does not exist and may subsequently be found following site investigation. Therefore actual positions of the disclosed (and any undisclosed) infrastructure should be determined on site, because Southern Water does not accept any responsibility for inaccuracy or omission regarding the enclosed plan and accordingly it should not be considered to be a definitive document.

I confirm payment of the appropriate fee in the sum of £49.92

The breakdown of costs is as follows: -

- Provision of record extracts £41.60
- VAT @ 20.0% £8.32

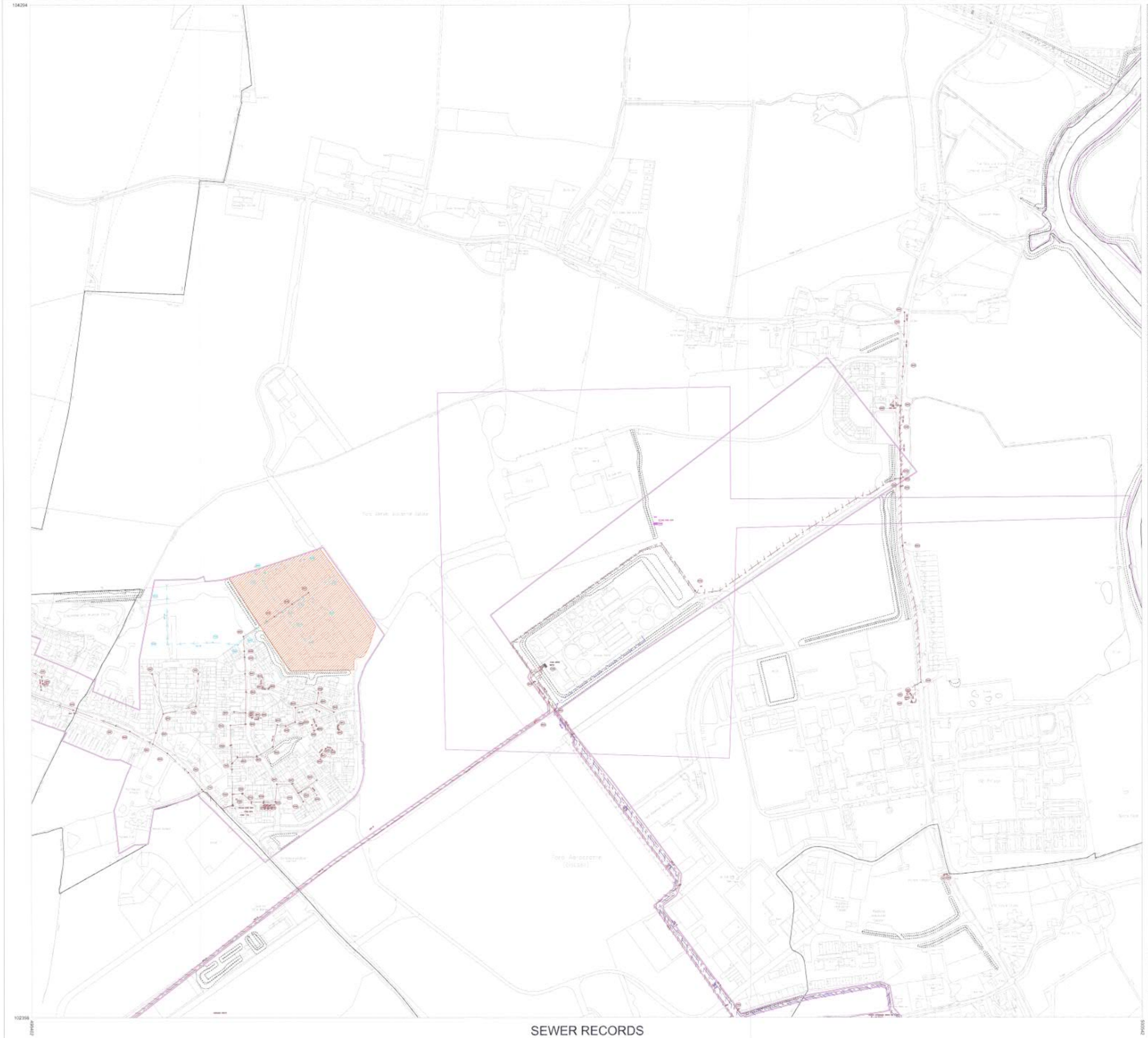
VAT Registration Number 813 0378 56

Should you require any additional information regarding this matter please contact this office at the address given at the foot of this letter.

Yours faithfully

Land Search Department

Letter B



Node	Cover	Invert	Size	Material	Shape
020AX	5.41	3.65	100	PE	CIRC
0301X			125	PE	CIRC
0302X	5.065	3.491	150	GRC	CIRC
030AX	5.17	3.65	100	PE	CIRC
031AX	5.1	3.3	100	PE	CIRC
0401X	2.8	1.563	150	GRC	CIRC
0501X	2.7	1.004	225	GRC	CIRC
050PX			100	PE	CIRC
0601X	5.1	3.93	150	GRC	CIRC
0602X	4.05	2.01	150	GRC	CIRC
0701X	4.9	3.325	150	GRC	CIRC
0901X			225	UNK	CIRC
0902X			225	UNK	CIRC
0903X			225	UNK	CIRC
090PX			100	PE	CIRC
1801X			UNK	UNK	CIRC
190WX	3.23	1.48	100	PE	CIRC
390AX			600	DI	CIRC
4001X	6.91	5.36	150	VC	CIRC
4002X			150	VC	CIRC
4005X		5.3	OTHER	PE	CIRC
4902X	6.4	4.86	175	VC	CIRC
4904X			150	VC	CIRC
490AX			OTHER	PE	CIRC
5901X	6.74	5.18	175	VC	CIRC
5902X	6.7	5.26	175	VC	CIRC
6001X	7.63	6.37	150	VC	CIRC
6050X	7.79	4.78	750	CP	CIRC
610AX	7.31	6.227	125	PE	CIRC
6801X	6.63	5.43	175	VC	CIRC
6802X	6.71	5.52	175	VC	CIRC
6901X	6.93	5.66	150	VC	CIRC
6902X	7.2	5.93	150	VC	CIRC
7001X	7.89	6.81	150	VC	CIRC
7050X	7.43		750	CP	CIRC
730AX			500	DI	CIRC
7701X	7.03	6.22	175	VC	CIRC
7702X	7.34	3.7	225	VC	CIRC
770PX	7.14	7.13	100	BAC	CIRC
7801X	7.25	3.93	225	VC	CIRC
7802X	7.32	4.09	225	VC	CIRC
7804X	6.83	5.68	175	VC	CIRC
7901X	7.19	5.1	150	VC	CIRC
7902X	7.16	4.26	225	VC	CIRC
7903X	7.62	6.35	150	VC	CIRC
8001X	7.1	4.79	225	VC	CIRC
8002X	7.44	5.14	150	VC	CIRC
8003X	7.4	4.98	150	VC	CIRC
8005X	7.53	5.01	150	VC	CIRC
8050X	7.58	4.65	750	CP	CIRC
8051X	7.61	4.65	525	CP	CIRC
8101X	7.24	5.55	150	VC	CIRC
8150X	7.37	5.44	300	CP	CIRC
8151X	7.36	5.09	525	CP	CIRC
8250X	7.27	5.52	300	CP	CIRC
8701X	7.29	3.8	150	VC	CIRC
8702X	7.34	3.98	150	VC	CIRC
8703X	7.05	4.13	150	VC	CIRC
8704X	6.67	4.29	150	VC	CIRC
8705X			100	VC	CIRC
8706X			100	VC	CIRC
8707X			100	VC	CIRC
8700X			100	VC	CIRC
8801X	6.9	4.5	150	VC	CIRC
8802X	7.04	4.31	150	VC	CIRC
8803X	6.66		150	VC	CIRC
8804X	7.22	4.16	150	VC	CIRC
8901X	7.06	4.43	225	VC	CIRC
8902X	7.09	4.43	225	VC	CIRC
8903X	7.27	4.67	225	VC	CIRC
8904X	6.7		150	VC	CIRC
8905X	6.57		150	VC	CIRC
8906X			UNK	VC	CIRC
8907X			UNK	UNK	CIRC
8908X			UNK	UNK	CIRC
8910X			UNK	UNK	CIRC
9050X	7.36	5.92	225	VC	CIRC
9101X	7.29	5.88	150	VC	CIRC
9102X	7.19	5.73	150	VC	CIRC
9150X	7.33	6.07	225	VC	CIRC
9151X	7.45	6.46	225	CP	CIRC
9152X	7.19	5.45	300	CP	CIRC
9153X	7.31	5.83	225	VC	CIRC
9250X	7.4	6.07	225	VC	CIRC
9701X	7.1	4.88	150	VC	CIRC
9702X	7.04	5.06	150	VC	CIRC
9703X			UNK	VC	CIRC
9700X			UNK	UNK	CIRC
9801X	6.78	4.71	150	VC	CIRC
9802X	7.21		150	VC	CIRC
9809X			UNK	UNK	CIRC
9800X			150	VC	CIRC
9810X			UNK	UNK	CIRC
9811X			UNK	UNK	CIRC
9902X	6.75		150	VC	CIRC
9903X	6.92		150	VC	CIRC
9904X	6.89		150	VC	CIRC
9905X	7.08		150	VC	CIRC
9906X	7.05		150	VC	CIRC
9907X			100	OTHER	CIRC
9908X			100	OTHER	CIRC
9910X			UNK	UNK	CIRC

O.S. Ref:	SU0903SW	Drawn by:	mondalb
Scale:	1:2500	Date:	24/06/2015

Title: 197345_Ford Transfer, Ford BN1

N

Southern Water

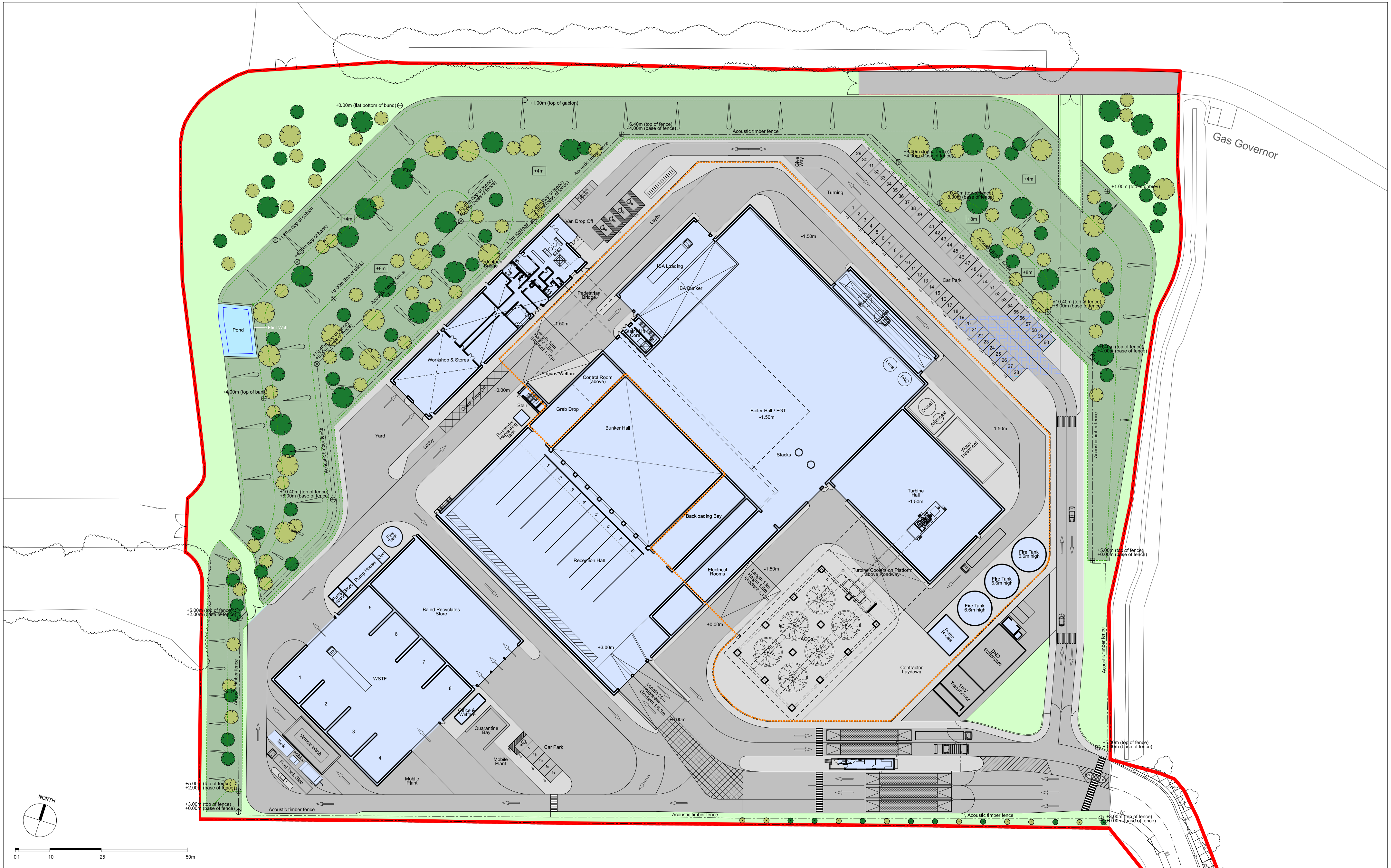
The information contained on this plan is provided as a guide to the approximate position of existing public sewers. The accuracy thereof cannot be guaranteed.

THIS INFORMATION MUST BE TREATED WITH CAUTION AND THE ACTUAL POSITION OF THE PUBLIC SEWERS MUST BE ESTABLISHED ON SITE, IN ALL CASES.

Southern Water must be informed before lifting manhole covers or excavating trial holes.

SEWER RECORDS

APPENDIX E
PROPOSED SITE LAYOUT



NOTE

1. THIS DRAWING IS COPYRIGHT GSDA LTD.
2. THE CONTRACTOR MUST NOT SCALE FROM THE DRAWING ALL DIMENSIONS TO BE TAKEN FROM DIMENSION STRINGS.
3. WHERE ANY DISCREPANCIES ARE FOUND BETWEEN DIMENSIONS THESE MUST BE BROUGHT TO THE ATTENTION OF THE ARCHITECTS FOR RESOLUTION.
4. WHERE DISCREPANCIES EXIST BETWEEN REFERENCE OR ASSEMBLY DRAWINGS & DETAIL DRAWINGS, THE LATTER TAKE PREFERENCE.

Key

- Planning Application Boundary
- -1.5m Lowered Area
- Extent of bunding
- Fencing Line
- Pastel Blue Block Paving Symbolising Path of Old Canal
- Indicative Landscaping

PROJECT	FORD CIRCULAR TECHNOLOGY PARK
DRAWING	Proposed Site Layout
FOR PLANNING	- 21/03/16 Issued for planning
1:500@A1 SCALE	21/03/16 DATE
1404 PL106 DWG. NO.	- REVISION

GSDA
GARRY STEWART DESIGN ASSOCIATES
Highlands House, Office 300A, 165 The Broadway, Wimbledon, London, SW19 1NE
T. 020 8544 8085

APPENDIX F
POST-DEVELOPMENT RUNOFF RATES

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **1** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **40** %
Factor Z1 (W allingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **17.3** mm
Factor Z2 (W allingford procedure)	Z2 = **0.63**
Rainfall for 15min storm with 1 year return period	$M1\_15min = Z2 \times M5\_15min_i$ = **10.9** mm
Design rainfall intensity	$I_{max} = M1\_15min / D$ = **43.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **84** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **723.8** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **40** %
Factor Z1 (W allingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **17.3** mm
Factor Z2 (W allingford procedure)	Z2 = **0.80**
Rainfall for 15min storm with 2 year return period	$M2\_15min = Z2 \times M5\_15min_i$ = **13.9** mm
Design rainfall intensity	$I_{max} = M2\_15min / D$ = **55.6** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **84** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **925.7** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **10** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **40** %
Factor Z1 (W allingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **17.3** mm
Factor Z2 (W allingford procedure)	Z2 = **1.24**
Rainfall for 15min storm with 10 year return period	$M10\_15min = Z2 \times M5\_15min_i$ = **21.4** mm
Design rainfall intensity	$I_{max} = M10\_15min / D$ = **85.6** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **84** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **1426.8** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **30** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **40** %
Factor Z1 (W allingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **17.3** mm
Factor Z2 (W allingford procedure)	Z2 = **1.53**
Rainfall for 15min storm with 30 year return period	$M30\_15min = Z2 \times M5\_15min_i$ = **26.5** mm
Design rainfall intensity	$I_{max} = M30\_15min / D$ = **106.0** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **84** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **1765.4** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = **15** min
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **40** %
Factor Z1 (W allingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5\_15min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **17.3** mm
Factor Z2 (W allingford procedure)	Z2 = **2.01**
Rainfall for 15min storm with 100 year return period	$M100\_15min = Z2 \times M5\_15min_i$ = **34.7** mm
Design rainfall intensity	$I_{max} = M100\_15min / D$ = **138.7** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **71400** m^2
Percentage of area that is impermeable	p = **84** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **2310.7** l/s

APPENDIX G
STORAGE VOLUME CALCULATIONS

RAMBOLL

Job No.	Wallingford Calculations	Prepared by	CS	Date	06/04/2020
		Checked by	AG	Date	07/04/2020

1 in 1 year storm event

Total Depth of rainfall - The Manual Method According to the Wallingford Procedure

Wallingford Modified Rational Method is a procedure for converting design storm into a rate of flow. Uses average rainfall corresponding to a 1 in 5 year event, 60 minutes in duration. Uniform intensity design requires an average rate of rainfall of a given return period for a series of durations.

i)

M5-60 =	20	mm
r =	0.35	

ii) **M5-D = Z1 (M5-60)**

Storm Duration	Total Rainfall	Z1	Z2
M5-15	12.53 mm	0.63	0.62
M5-30	15.80 mm	0.79	0.62
M5-60	20.00 mm	1.00	0.64
M5-120	24.33 mm	1.22	0.66
M5-240	30.33 mm	1.52	0.68
M5-360	32.67 mm	1.63	0.69
M5-600	39.33 mm	1.97	0.70
M5-1440	50.67 mm	2.53	0.72

Z2	
M5 Rainfall (mm)	M1
10.00	0.610
12.53	0.615
15.00	0.620
15.80	0.623
20.00	0.640
20.00	0.640
24.33	0.657
25.00	0.660
30.33	0.681
32.67	0.691
30.00	0.680
39.33	0.699
40.00	0.700
50.67	0.721
50.00	0.720
75.00	0.760

Forecast	
10	0.61
15	0.62
20	0.64
25	0.66
30	0.68
40	0.70
50	0.72
75	0.76

iii) **MT-D = Z2 (M5-D)**

Storm Duration	Total Rainfall	Total Rainfall + 40% CC	Intensity	Intensity + CC
M1-15	7.7 mm	10.8 mm	30.8 mm/hr	43.2 mm/hr
M1-30	9.8 mm	13.8 mm	19.7 mm/hr	27.6 mm/hr
M1-60	12.8 mm	17.9 mm	12.8 mm/hr	17.9 mm/hr
M1-120	16.0 mm	22.4 mm	8.0 mm/hr	11.2 mm/hr
M1-240	20.7 mm	28.9 mm	5.2 mm/hr	7.2 mm/hr
M1-360	22.6 mm	31.6 mm	3.8 mm/hr	5.3 mm/hr
M1-600	27.5 mm	38.5 mm	2.7 mm/hr	3.8 mm/hr
M1-1440	36.5 mm	51.2 mm	1.5 mm/hr	2.1 mm/hr

Impermeable Area	
6.64 ha	Existing
4.00 ha	Proposed

Peak run-off calculated using Modified Rational Method
Peak Run-off -- Qp = 3.61CviA (l/s)

Allowable Rate (l/s)	60

Storm Event	Existing Peak Runoff (l/s)	Post-Development Peak Runoff (inc CC) (l/s)	Increase over existing (l/s)	Storage Required (m³)
M1-15	554	468	-87	-78
M1-30	354	299	-55	-100
M1-60	230	194	-36	-130
M1-120	144	121	-23	-162
M1-240	93	78	-15	-210
M1-360	68	57	-11	-229
M1-600	49	42	-8	-279
M1-1440	27	23	-4	-370

Increase over allowable (l/s)	Storage Required (m³)	
408	367	
239	429	
134	483	
61	441	
18	264	
-3	-65	
-18	-660	
-37	-3,189	483

Storm Event	Total Volume Existing imp. Area (m³)	Proposed Development Total Volume (incl. CC) (m³)	Increase Over Existing (m³)
M2-15	512	432	-80
M2-30	654	551	-102
M2-60	850	717	-133
M2-120	1062	896	-166
M2-240	1372	1157	-215
M2-360	1498	1263	-235
M2-600	1825	1539	-286
M2-1440	2427	2047	-380

RAMBOLL

Job No.	Wallingford Calculations	Prepared by	CS	Date	06/04/2020
		Checked by	AG	Date	07/04/2020

1 in 2 year storm event

Total Depth of rainfall - The Manual Method According to the Wallingford Procedure

i)

M5-60 =	20	mm
r =	0.35	

ii) **M5-D = Z1 (M5-60)**

Storm Duration	Total Rainfall	Z1	Z2
M5-15	12.53 mm	0.63	0.80
M5-30	15.80 mm	0.79	0.80
M5-60	20.00 mm	1.00	0.81
M5-120	24.33 mm	1.22	0.82
M5-240	30.33 mm	1.52	0.83
M5-360	32.67 mm	1.63	0.84
M5-600	39.33 mm	1.97	0.84
M5-1440	50.67 mm	2.53	0.85

Z2	
M5 Rainfall (mm)	M1
10.00	0.790
12.53	0.795
15.00	0.800
15.80	0.802
20.00	0.810
20.00	0.810
24.33	0.819
25.00	0.820
30.33	0.831
32.67	0.835
30.00	0.830
39.33	0.839
40.00	0.840
50.67	0.851
50.00	0.850
75.00	0.870

Forecast	
10	0.79
15	0.80
20	0.81
25	0.82
30	0.83
40	0.84
50	0.85
75	0.87

iii) **MT-D = Z2 (M5-D)**

Storm Duration	Total Rainfall	Total Rainfall + 40% CC	Intensity	Intensity + CC
M2-15	10.0 mm	14.0 mm	39.9 mm/hr	55.8 mm/hr
M2-30	12.7 mm	17.7 mm	25.3 mm/hr	35.5 mm/hr
M2-60	16.2 mm	22.7 mm	16.2 mm/hr	22.7 mm/hr
M2-120	19.9 mm	27.9 mm	10.0 mm/hr	13.9 mm/hr
M2-240	25.2 mm	35.3 mm	6.3 mm/hr	8.8 mm/hr
M2-360	27.3 mm	38.2 mm	4.5 mm/hr	6.4 mm/hr
M2-600	33.0 mm	46.2 mm	3.3 mm/hr	4.6 mm/hr
M2-1440	43.1 mm	60.3 mm	1.8 mm/hr	2.5 mm/hr

Impermeable Area	
6.64 ha	Existing
4.00 ha	Proposed

Allowable Rate (l/s)	60

Peak run-off calculated using Modified Rational Method
Peak Run-off -- Qp = 3.61CviA (l/s)

Storm Event	Existing Peak Runoff (l/s)	Post-Development Peak Runoff (inc CC) (l/s)	Increase over existing (l/s)	Storage Required (m³)
M2-15	717	604	-112	-101
M2-30	455	384	-71	-128
M2-60	291	246	-46	-164
M2-120	179	151	-28	-202
M2-240	113	96	-18	-255
M2-360	82	69	-13	-277
M2-600	59	50	-9	-335
M2-1440	32	27	-5	-437

Increase over allowable (l/s)	Storage Required (m³)
544	490
324	583
186	668
91	655
36	511
9	193
-10	-358
-33	-2,831

668

Storm Event	Total Volume Existing imp. Area (m³)	Proposed Development Total Volume (incl. CC) (m³)	Increase Over Existing (m³)
M2-15	662	558	-104
M2-30	841	709	-132
M2-60	1076	907	-168
M2-120	1323	1116	-207
M2-240	1673	1411	-262
M2-360	1812	1528	-284
M2-600	2192	1849	-343
M2-1440	2862	2414	-448

RAMBOLL

Job No.	Wallingford	Prepared by	CS	Date	06/04/2020
	Calculations	Checked by	AG	Date	07/04/2020

1 in 10 year storm event

Total Depth of rainfall - The Manual Method According to the Wallingford Procedure

i)

M5-60 =	20	mm
r =	0.35	

ii) **M5-D = Z1 (M5-60)**

Storm Duration	Total Rainfall	Z1	Z2
M5-15	12.53 mm	0.63	1.23
M5-30	15.80 mm	0.79	1.24
M5-60	20.00 mm	1.00	1.24
M5-120	24.33 mm	1.22	1.24
M5-240	30.33 mm	1.52	1.22
M5-360	32.67 mm	1.63	1.21
M5-600	39.33 mm	1.97	1.19
M5-1440	50.67 mm	2.53	1.17

Z2	
M5 Rainfall (mm)	M1
10.00	1.220
12.53	1.230
15.00	1.240
15.80	1.240
20.00	1.240
20.00	1.240
24.33	1.240
25.00	1.240
30.33	1.219
32.67	1.209
30.00	1.220
39.33	1.191
40.00	1.190
50.67	1.169
50.00	1.170
75.00	1.140

Forecast	
10	*1.22*
15	*1.24*
20	*1.24*
25	*1.24*
30	*1.22*
40	*1.19*
50	*1.17*
75	*1.14*

iii) **MT-D = Z2 (M5-D)**

Storm Duration	Total Rainfall	Total Rainfall + 40% CC	Intensity	Intensity + CC
M10-15	15.4 mm	21.6 mm	61.7 mm/hr	86.3 mm/hr
M10-30	19.6 mm	27.4 mm	39.2 mm/hr	54.9 mm/hr
M10-60	24.8 mm	34.7 mm	24.8 mm/hr	34.7 mm/hr
M10-120	30.2 mm	42.2 mm	15.1 mm/hr	21.1 mm/hr
M10-240	37.0 mm	51.8 mm	9.2 mm/hr	12.9 mm/hr
M10-360	39.5 mm	55.3 mm	6.6 mm/hr	9.2 mm/hr
M10-600	46.9 mm	65.6 mm	4.7 mm/hr	6.6 mm/hr
M10-1440	59.2 mm	82.9 mm	2.5 mm/hr	3.5 mm/hr

Impermeable Area	
6.64 ha	Existing
4.00 ha	Proposed

Peak run-off calculated using Modified Rational Method
Peak Run-off -- Qp = 3.61CviA (l/s)

Allowable Rate (l/s)	60

Storm Event	Existing Peak Runoff (l/s)	Post-Development Peak Runoff (inc CC) (l/s)	Increase over existing (l/s)	Storage Required (m³)
M10-15	1109	935	-174	-156
M10-30	704	594	-110	-199
M10-60	446	376	-70	-251
M10-120	271	229	-42	-306
M10-240	166	140	-26	-375
M10-360	118	100	-19	-400
M10-600	84	71	-13	-475
M10-1440	44	37	-7	-600

Increase over allowable (l/s)	Storage Required (m³)	
875	788	
534	961	
316	1,138	
169	1,215	
80	1,154	
40	860	
11	398	
-23	-1,952	1,215

Storm Event	Total Volume Existing imp. Area (m³)	Proposed Development Total Volume (incl. CC) (m³)	Increase Over Existing (m³)
M10-15	1024	863	-160
M10-30	1301	1097	-204
M10-60	1647	1389	-258
M10-120	2004	1690	-314
M10-240	2455	2070	-384
M10-360	2623	2212	-411
M10-600	3111	2624	-487
M10-1440	3932	3316	-616

RAMBOLL

Job No.	Wallingford	Prepared by	CS	Date	06/04/2020
	Calculations	Checked by	AG	Date	07/04/2020

1 in 30 year storm event

Total Depth of rainfall - The Manual Method According to the Wallingford Procedure

i)

M5-60 =	20	mm
r =	0.35	

ii) **M5-D = Z1 (M5-60)**

Storm Duration	Total Rainfall	Z1	Z2
M5-15	12.53 mm	0.63	1.51
M5-30	15.80 mm	0.79	1.53
M5-60	20.00 mm	1.00	1.54
M5-120	24.33 mm	1.22	1.53
M5-240	30.33 mm	1.52	1.51
M5-360	32.67 mm	1.63	1.50
M5-600	39.33 mm	1.97	1.47
M5-1440	50.67 mm	2.53	1.42

iii) **MT-D = Z2 (M5-D)**

Storm Duration	Total Rainfall	Total Rainfall + 40% CC	Intensity	Intensity + CC
M30-15	18.9 mm	26.5 mm	75.7 mm/hr	106.0 mm/hr
M30-30	24.2 mm	33.9 mm	48.4 mm/hr	67.8 mm/hr
M30-60	30.8 mm	43.1 mm	30.8 mm/hr	43.1 mm/hr
M30-120	37.3 mm	52.2 mm	18.6 mm/hr	26.1 mm/hr
M30-240	45.8 mm	64.1 mm	11.4 mm/hr	16.0 mm/hr
M30-360	49.0 mm	68.6 mm	8.2 mm/hr	11.4 mm/hr
M30-600	58.0 mm	81.1 mm	5.8 mm/hr	8.1 mm/hr
M30-1440	71.8 mm	100.5 mm	3.0 mm/hr	4.2 mm/hr

Z2	
M5 Rainfall (mm)	**M1**
10.00	1.490
12.53	1.510
15.00	1.530
15.80	1.532
20.00	1.540
20.00	1.540
24.33	1.531
25.00	1.530
30.33	1.509
32.67	1.499
30.00	1.510
39.33	1.473
40.00	1.470
50.67	1.417
50.00	1.420
75.00	1.340

Forecast	
10	*1.49*
15	*1.53*
20	*1.54*
25	*1.53*
30	*1.51*
40	*1.47*
50	*1.42*
75	*1.34*

Impermeable Area	
6.64 ha	Existing
4.00 ha	Proposed

Peak run-off calculated using Modified Rational Method
Peak Run-off -- Qp = 3.61CviA (l/s)

Allowable Rate (l/s)	60

Storm Event	Existing Peak Runoff (l/s)	Post-Development Peak Runoff (inc CC) (l/s)	Increase over existing (l/s)	Storage Required (m³)
M30-15	1361	1148	-213	-192
M30-30	870	734	-136	-245
M30-60	554	467	-87	-312
M30-120	335	282	-52	-378
M30-240	206	173	-32	-464
M30-360	147	124	-23	-496
M30-600	104	88	-16	-587
M30-1440	54	45	-8	-728

Increase over allowable (l/s)	Storage Required (m³)	
1088	979	
674	1,213	
407	1,465	
222	1,602	
113	1,634	
64	1,377	
28	1,003	
-15	-1,266	1,634

Storm Event	Total Volume Existing imp. Area (m³)	Proposed Development Total Volume (incl. CC) (m³)	Increase Over Existing (m³)
M30-15	1257	1060	-197
M30-30	1607	1355	-252
M30-60	2045	1725	-320
M30-120	2474	2087	-388
M30-240	3039	2563	-476
M30-360	3252	2743	-509
M30-600	3848	3245	-603
M30-1440	4766	4020	-746

RAMBOLL

Job No.	Wallingford	Prepared by	CS	Date	06/04/2020
	Calculations	Checked by	AG	Date	07/04/2020

1 in 100 year storm event

Total Depth of rainfall - The Manual Method According to the Wallingford Procedure

i)

M5-60 =	20	mm
r =	0.35	

ii) **M5-D = Z1 (M5-60)**

Storm Duration	Total Rainfall	Z1	Z2
M5-15	12.53 mm	0.63	1.95
M5-30	15.80 mm	0.79	2.00
M5-60	20.00 mm	1.00	2.03
M5-120	24.33 mm	1.22	2.01
M5-240	30.33 mm	1.52	1.97
M5-360	32.67 mm	1.63	1.95
M5-600	39.33 mm	1.97	1.90
M5-1440	50.67 mm	2.53	1.80

Z2	
M5 Rainfall (mm)	M1
10.00	1.910
12.53	1.951
15.00	1.990
15.80	1.996
20.00	2.030
20.00	2.030
24.33	2.013
25.00	2.010
30.33	1.967
32.67	1.949
30.00	1.970
39.33	1.895
40.00	1.890
50.67	1.805
50.00	1.810
75.00	1.640

Forecast	
10	*1.91*
15	*1.99*
20	*2.03*
25	*2.01*
30	*1.97*
40	*1.89*
50	*1.81*
75	*1.64*

iii) **MT-D = Z2 (M5-D)**

Storm Duration	Total Rainfall	Total Rainfall + 40% CC	Intensity	Intensity + CC
M100-15	24.4 mm	34.2 mm	97.8 mm/hr	136.9 mm/hr
M100-30	31.5 mm	44.2 mm	63.1 mm/hr	88.3 mm/hr
M100-60	40.6 mm	56.8 mm	40.6 mm/hr	56.8 mm/hr
M100-120	49.0 mm	68.6 mm	24.5 mm/hr	34.3 mm/hr
M100-240	59.7 mm	83.5 mm	14.9 mm/hr	20.9 mm/hr
M100-360	63.7 mm	89.1 mm	10.6 mm/hr	14.9 mm/hr
M100-600	74.5 mm	104.4 mm	7.5 mm/hr	10.4 mm/hr
M100-1440	91.4 mm	128.0 mm	3.8 mm/hr	5.3 mm/hr

Impermeable Area	
6.64 ha	Existing
4.00 ha	Proposed

Peak run-off calculated using Modified Rational Method
Peak Run-off -- Qp = 3.61CviA (l/s)

Allowable Rate (l/s)	60

Storm Event	Existing Peak Runoff (l/s)	Post-Development Peak Runoff (inc CC) (l/s)	Increase over existing (l/s)	Storage Required (m³)
M100-15	1758	1483	-275	-248
M100-30	1134	957	-178	-320
M100-60	730	616	-114	-412
M100-120	440	371	-69	-496
M100-240	268	226	-42	-605
M100-360	191	161	-30	-645
M100-600	134	113	-21	-756
M100-1440	68	58	-11	-927

Increase over allowable (l/s)	Storage Required (m³)	
1423	1,280	
897	1,614	
556	2,000	
311	2,241	
166	2,393	
101	2,179	
53	1,909	
-2	-193	2,393

Storm Event	Total Volume Existing imp. Area (m³)	Proposed Development Total Volume (incl. CC) (m³)	Increase Over Existing (m³)
M100-15	1623	1369	-254
M100-30	2094	1766	-328
M100-60	2696	2274	-422
M100-120	3252	2743	-509
M100-240	3962	3342	-621
M100-360	4227	3565	-662
M100-600	4950	4175	-775
M100-1440	6071	5120	-951

APPENDIX H
EA, WSCC CONSULTATION & SCOPING RESPONSE

Our reference: SSD157384

SENT BY EMAIL ONLY: chara.sifaki@ramboll.co.uk

3 March 2020

Dear Chara,

Thank you for your request of 26 February 2020 to use Environment Agency Product 4 data, for the site at Ford Circular Technology Park, BN18 0XL.

Response to your request

The Environment Agency's records indicate that the above site is located in Flood Zone 1 (land assessed as having less than 0.1% (1 in 1,000) chance of flooding in any given year from **rivers or the sea**). Therefore, the likelihood of flooding from rivers and sea in this area is estimated as 'very low'.

Proximity to Flood Zones 2 or 3

The above main site is approximately 440 metres away from Flood Zone 3. We are therefore unable to provide data from our detailed fluvial or tidal models which is relevant to your site.

More information on Flood Zones can be found on the GOV.UK website:

http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-1-flood-zones/

Surface water flooding

Our mapping indicates that this site **is** at risk of surface water flooding.

For information on flooding from all other sources, such as surface water, please contact the Lead Local Flood Authority, which in this case is West Sussex County Council. A link to their information available online is shown below:

https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/dealing-with-flooding/flood-risk-management/local-flood-risk-management-strategy/

Please note that the above is a link to an external website which the Environment Agency does not control or maintain. Therefore, the link may not be the most up-to-date at the date of this letter. If the link does not work, and you are unable to find the information about surface water flooding on the relevant website, please contact the authority named above directly.

Where you can find further information

- Detailed long-term flood information and maps can be found on the GOV.UK website:

  https://flood-warning-information.service.gov.uk/long-term-flood-risk/

- Flood maps for planning can be found on the GOV.UK website:

  https://flood-map-for-planning.service.gov.uk/

- Please be aware that in February 2016 the Environment Agency updated its guidance on climate change allowances. The standard allowance of adding 20% to peak flows – as per previous guidance in the National Planning Policy Framework, may not be applicable for the purposes of informing development proposals. It is possible that our current modelling has under estimated flood risk when taking climate change into consideration. This does not however have an effect on Flood Zones 2 or 3. For further information please visit:

  https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

- Further details about the Environment Agency information supplied can be found on the GOV.UK website:

  https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather

- If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of Environment Agency information for Flood Risk Assessments:

  https://www.gov.uk/planning-applications-assessing-flood-risk

  https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

If you have any queries or would like to discuss the content of this letter further please call us on 03708 506 506, or reply to the email sent to you with this letter attached.

Please get in touch if you have any further queries or contact us within two (2) months if you would like us to review the information we have sent.

For information on what you can expect from us and our full service commitment to you, please click on this link:

https://www.gov.uk/government/publications/environment-agency-customer-service-commitment--2/environment-agency-customer-service-commitment

Yours sincerely,

Nick Allen

Customers and Engagement Officer

Environment Agency | Romsey District Office, Canal Walk, Romsey, SO51 7LP

Chara Sifaki

From: SSD Enquiries <SSDEnquiries@environment-agency.gov.uk>
Sent: 03 March 2020 11:40
To: Chara Sifaki
Subject: 200303 SSD157384 - Product 4 Data Request - Ford Circular Technology Park, Arundel
Attachments: 200303 FZ1 letter SSD157384.pdf; Risk of Flooding from Surface Water.pdf

Dear Chara,

Thank you for your below email providing clarification of the site location. Please be advised, as this site is within Flood Zone 1, please see the attached letter and surface water map for further details.

This information is supplied subject to the notice which can be viewed via the following link:
http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Please get in touch if you have any further queries or contact us within two months if you would like us to review the information we have sent.

Kind regards

Nick

Customers & Engagement Team| Environmental Planning and Engagement | Solent and South Downs Area |
Environment Agency | Romsey District Office, Canal Walk, Romsey, SO51 7LP

SSDEnquiries@environment-agency.gov.uk
National Customer Contact Centre 03708 506506

From: Chara Sifaki [mailto:chara.sifaki@ramboll.co.uk]
Sent: 26 February 2020 12:10
To: SSD Enquiries <SSDEnquiries@environment-agency.gov.uk>
Subject: RE: 200203 SSD157384 - Product 4 Data Request - Ford Circular Technology Park, Arundel

Hi Nick,

Excuse me for my late response, I was on annual leave. Please find attached a more precise boundary for the site (Figure_1_Site_Location_Plan.pdf) and the respective shapefile (Site_boundary.shp).

Please let me know if you need additional information.

Kind regards
Chara Sifaki
Graduate Consultant

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M +44 (797) 0509416
chara.sifaki@ramboll.co.uk

From: SSD Enquiries <SSDEnquiries@environment-agency.gov.uk>
Sent: 03 February 2020 13:04
To: Chara Sifaki <chara.sifaki@ramboll.co.uk>
Subject: 200203 SSD157384 - Product 4 Data Request - Ford Circular Technology Park, Arundel

Dear Chara,

Thank you for your email of 15 January 2020; I can confirm that we have received your request for Product 4 information and it has been sent on to the appropriate technical team.

During their investigation, the team have asked if you could please send a more precise and accurate site boundary of the location that you require information – the Shapefile and site map PDF is too broad to provide accurate information.

If you have any queries please contact our team directly on the email below and quote the reference number SSD157384, which is to be used in all future correspondence regarding this enquiry.

Kind regards

Nick

Customers & Engagement Team| Environmental Planning and Engagement | Solent and South Downs Area |
Environment Agency | Romsey District Office, Canal Walk, Romsey, SO51 7LP

SSDEnquiries@environment-agency.gov.uk
National Customer Contact Centre 03708 506506

From: Chara Sifaki [mailto:chara.sifaki@ramboll.co.uk]
Sent: 15 January 2020 11:47
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Subject: 200116/KG02 Product 4 Data Request - Ford Circular Technology Park, Arundel

Good morning,

I would like to request Product 4 data for Ford Circular Technology Park, Arundel – Address: Ford Circular Technology Park, Ford Road, Ford, Arundel, West Sussex, BN18 0XL.

Please find attached the following information of the site:

- Figure 1 – Site Location Plan;
- Figure 2 – Aerial Image (with NGR coordinates); and
- GIS polygon file of the boundary

Thank you in advance for your time and cooperation. I am looking forward to hearing from you soon.

Kind regards
Chara Sifaki

MSc MEng GMICE
Graduate Consultant
1622761 - Water - Southampton

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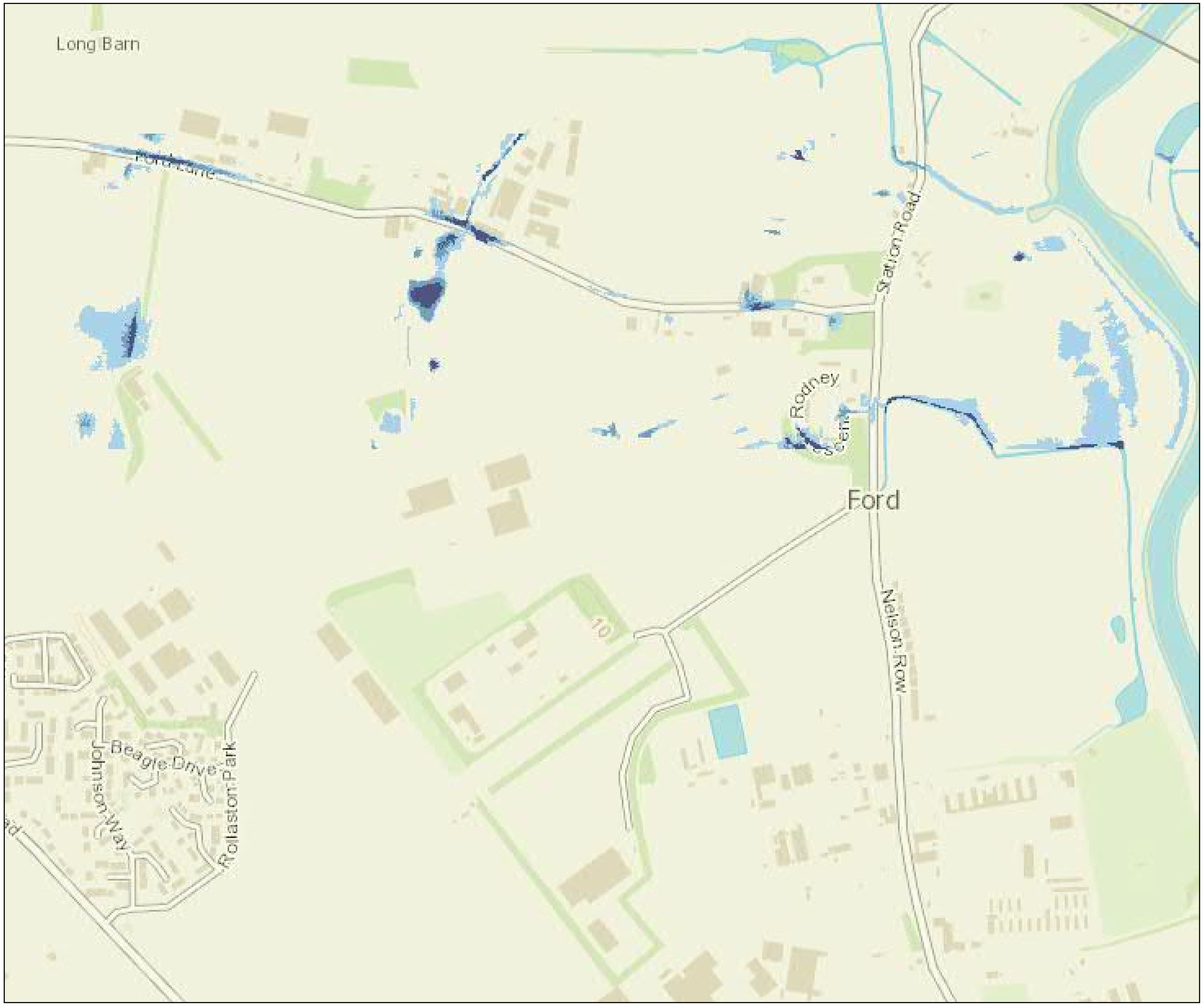
Risk of flooding from Surface Water - Ford Circular Technology Park



1: 10,000

0 Metres 250

N E S W

Likelihood of flooding from Surface Water

- High (>=3.3%)
- Medium (3.3% - 1%)
- Low (1% - 01%)
- Very Low

Likelihood of flooding from Surface Water

High:	Greater than or equal to 3.3% (1 in 30) chance in any given year
Medium:	Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year
Low:	Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year
Very Low:	Less than 0.1% (1 in 1,000) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on GOV.UK.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). E-mail: enquires@environment-agency.gov.uk

Chara Sifaki

From: Ray Drabble <Ray.Drabble@westsussex.gov.uk>
Sent: 26 March 2020 11:21
To: Chara Sifaki
Cc: Kevin Macknay; Paul Cann
Subject: RE: Drainage Requirements | Ford Circular Technology Park

Chara,

I hope that this finds you well.

Further to your email, I acknowledge that my initial scoping response could have been better worded and has sent mixed messages.

The LLFA Policy for the Management of Surface Water is what you are asked to work to (third of your 3 bullets); the second bullet is an interpretation of that policy that you were referred to in my original scoping response.

The LLFA recommends that the applicant restricts flows to the 1:30 Greenfield rate for all events up to a 1:30 storm event. Exceedance flows beyond the 1:30 storm event can be discharged uncontrolled to the drainage system.

I hope that this clarifies the position for you.

Kind regards

Ray Drabble
Flood Risk Engineer (Sustainable Drainage)
Economy, Infrastructure and Environment
Highways and Transport
West Sussex County Council

CALL IM EMAIL

Location: Western Area Office, Drayton Lane, Nr. Chichester, West Sussex. PO20 2AJ.
Contact: Internal: 24077 | **External:** +44 (0)330 2224077 | **Mobile:** +44 (0)7590183138 | **E-mail:** Ray.Drabble@westsussex.gov.uk

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From: Chara Sifaki [mailto:chara.sifaki@ramboll.co.uk]
Sent: 23 March 2020 14:23
To: Ray Drabble
Cc: Kevin Macknay
Subject: Drainage Requirements | Ford Circular Technology Park
Importance: High

Hi Ray,

Thank you for your quick response, much appreciated.

I'm sending this email as I would like to clarify the surface water drainage approach that the LLFA is content to accept with respect to Ford Circular Technology Park. We have received the following three approaches:

- In the Scoping response (17/02/2020, refer to attached document) produced explicitly for this site, it is stated that *'In accordance with LLFA Policy we would expect the applicant to demonstrate 50% betterment in terms of reduction in discharge rates for the proposed brownfield development'*.
- In your response to my email (12/03/2020, refer to email below), it is stated that '*The LLFA would like to see a much lower discharge rate from any proposed attenuation say to a value of 32 l/s (1:30 event) and exceedance flows for storm events in excess of 1:30 could bypass the flow restriction and discharge unrestricted to the drainage network'*.
- In addition, in the LLFA policy document, it is stated that '*In all cases, including on brownfield sites, runoff should where possible be restricted to the greenfield of 1 in 1 year runoff rate during all events up to and including the 1 in 100 year rainfall event with climate change*' and that '*…If it is deemed that this is not achievable, evidence must be provided and developers should still seek to achieve no increase in runoff from greenfield sites and a 50% betterment of existing run off rates on brownfield sites (provided this does not result in a runoff rate less than greenfield)'*.

Could you please advise on what the LLFA would like Ramboll to take forward?

Please note that greenfield runoff rates were calculated for the site (7.14 ha) using the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS) method* in MicroDrainage 2018. The existing (pre-development) runoff rates from the site in its current configuration were calculated using Tekla Tedds (Version 2.0.00, 2017). The critical storm duration is 15 minutes. The outputs from MicroDrainage and Tekla Tedds are shown in Table 1 below.

Table 1: Greenfield and Pre-development Runoff Rate Calculations

Return Period (years)	1-in-1	1-in-2	1-in-10	1-in-30	1-in-100
Greenfield runoff rates (l/s)	22.5	23	43	60	84
Pre-development runoff rates (l/s)	559	723	1,119	1,371	1,772

*The ICP SuDS method is considered to be the most appropriate method for calculating runoff rates for a site of this size. MicroDrainage (2018) advises that it is unusual to use the IH124 method with an area <50 ha. The Interim Code of Practice recommends that the IH124 method is applied with 50 ha (or more) and the resulting discharge is linearly interpolated for the required area.

Considering the proposed type of the development (Waste Transfer Station and conventional Energy Recovery Facility), the extensive built footprint within the development boundary and most importantly, the hydrogeological setting of the site (very high groundwater levels), there a limited number of SuDS techniques that would be practically feasible and suitable. Lined below ground storage is considered to be a suitable option for the site but again restricted due to limited available area, groundwater levels and cost.

Considering the above, Ramboll have suggested to restrict runoff from the whole development to 280 l/s, providing 50% betterment on the existing peak brownfield runoff rates for an 1-in-1 year event. Could you please advise on whether this is an acceptable approach that the LLFA would consider?

Thank you for your time and cooperation, much appreciated. I am looking forward to hearing back from you.

Kind regards
Chara Sifaki

MSc MEng GMICE
Graduate Consultant
1621784 - E&H - Southampton

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____

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Chara,

Further to your telephone call and email, the relevant section of our policy for the management of surface water:
https://www.westsussex.gov.uk/media/12230/ws_llfa_policy_for_management_of_surface_water.pdf
states:

5.4.4 Redevelopment on brownfield land has the potential to rectify or reduce flood risk. In all cases, including on brownfield sites, runoff should where possible be restricted to the greenfield 1 in 1 year runoff rate during all events up to and including the 1 in 100 year rainfall event with climate change. An alternative approach would be for discharge rates to be limited to a range of greenfield rates, based on the 1 in 1, 1 in 30 and 1 in 100 year storm events. However, the use of this method to restrict discharge rates requires the inclusion of on-line long-term storage, sized to take account of the increased post development volumes, discharging at no greater than 2l/s/ha. While discharging at no greater than 2 l/s/ha is acceptable, it is still the LLFA's preference that the former approach is used wherever possible. If it is deemed that this is not achievable, evidence must be provided and developers should still seek to achieve no increase in runoff from greenfield sites and a 50% betterment of existing run off rates on brownfield sites (provided this does not result in a runoff rate less than greenfield). For further guidance see Susdrain Fact sheet on Designing attenuation storage for redeveloped sites: http://www.susdrain.org/files/resources/fact_sheets/01_15_fact_sheet_attenuation_for_redeveloped.pdf

Having reviewed the above guidance, and assessed the greenfield run-off for the site (see attached) the LLFA does not consider restricting the discharge from the site to 228 l/s aligned with the above policy although I appreciate that the wording leaves some room for interpretation. The LLFA would like to see a much lower discharge rate from any proposed attenuation say to a value of 32 l/s (1:30 event) and exceedance flows for storm events in excess of 1:30 could bypass the flow restriction and discharge unrestricted to the drainage network (see method 2 in Susdrain Fact sheet). Clearly there is the scope for the development to incorporate SuDS and implement source control that could very significantly reduce the run-off from hardstanding areas into the drainage and the LLFA would be happy to discuss any options under consideration for this.

I hope this answers your query.

If not, please come back to me.

Kind regards

Ray Drabble
Flood Risk Engineer (Sustainable Drainage)
Economy, Infrastructure and Environment
Highways and Transport
West Sussex County Council

CALL IM EMAIL

Location: Western Area Office, Drayton Lane, Nr. Chichester, West Sussex. PO20 2AJ.
Contact: Internal: 24077 | **External:** +44 (0)330 2224077 | **Mobile:** +44 (0)7590183138 | **E-mail:** Ray.Drabble@westsussex.gov.uk

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From: Chara Sifaki [mailto:chara.sifaki@ramboll.co.uk]
Sent: 11 March 2020 16:19
To: Ray Drabble
Subject: RE: Drainage requirements | Ford Circular Technology Park

Hi Ray,

Following our phone conversation, please find below the calculated pre-development runoff rates (Table 1). In your scoping response (17/02/2020), it is mentioned that the WSCC 'would expect the applicant to demonstrate 50% betterment in terms of reduction in discharge rates for the proposed brownfield development'.

We are therefore proposing to restrict runoff from the whole development to 280 l/s providing 50% betterment on the existing peak runoff rates for a 1-in-1 year event.

Table 1: Pre-development Runoff Rate Calculations

Return Period (years)	1-in-1	1-in-2	1-in-10	1-in-30	1-in-100
Pre-development runoff rates (l/s)	559	723	1,119	1,371	1,772

Could you please confirm that you are happy with the above so that I can then proceed with developing the Surface Water Drainage Strategy for Ford Circular Technology Park?

Thank you in advance for your time and cooperation.

Kind regards
Chara Sifaki
Graduate Consultant

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M +44 (797) 0509416
chara.sifaki@ramboll.co.uk

From: Ray Drabble <Ray.Drabble@westsussex.gov.uk>
Sent: 26 February 2020 10:00
To: Chara Sifaki <chara.sifaki@ramboll.co.uk>
Subject: RE: Drainage requirements | Ford Circular Technology Park

Chara,

I attach a copy of our recent scoping response that should provide you with the information that you are seeking.

If you have any further queries, please come back to me.

Kind regards

Ray Drabble
Flood Risk Engineer (Sustainable Drainage)
Economy, Infrastructure and Environment
Highways and Transport
West Sussex County Council

CALL IM EMAIL

Location: Western Area Office, Drayton Lane, Nr. Chichester, West Sussex. PO20 2AJ.
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From: Chara Sifaki [mailto:chara.sifaki@ramboll.co.uk]
Sent: 25 February 2020 17:10
To: Ray Drabble
Subject: Drainage requirements | Ford Circular Technology Park

Good afternoon,

Ramboll have been commissioned to complete a flood risk assessment and an outline surface water drainage strategy of the proposed Ford Circular Technology Park (the former Tarmac blockworks site) to the west of the village of Ford. I would be grateful if you could advise on the WSCC drainage requirements and the level of detail you are expecting to see in the outline surface water drainage strategy. Information about the current site and proposed development is provided below.

Current site
The 7.14 ha site is partially used for existing waste transfer station (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.

Proposed development
Ford EfW Ltd, a joint venture between Grundon Waste Management Limited and Viridor, is now proposing to build and operate a conventional energy recovery facility (ERF) at the site. Grundon Waste Management, the sole owner/operator of the existing WTS, is proposing to continue this operation in a new, purpose built facility on site. A full planning application, including the ERF and WTS and ancillary uses, will be submitted later this year. As part of this application Ramboll will be providing the flood risk assessment and an outline surface water drainage strategy.

Please do not hesitate to contact me if you need more information.

Kind regards
Chara Sifaki

MSc MEng GMICE
Graduate Consultant
1621784 - E&H - Southampton

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APPENDIX I
SUDS OPTIONS

A Surface Water Drainage strategy for the proposed development is necessary to ensure that flood risk is not increased to downstream receptors. In addition, for sustainable management of surface water runoff from a new development, the use of SuDS is recommended. SuDS options for attenuating surface water runoff are presented in Table I.1 together with an indication of whether they are likely to be suitable for use at the site.

Table I.1: Options of SuDS

SuDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for Use at Site?
Retention	Balancing pond		Provides both storm water attenuation and treatment. Runoff from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation	Good removal of pollutants, can be used where groundwater is vulnerable, good community acceptability, high ecological, and amenity benefits	No reduction in runoff volume, land take may limit use in high density sites	✗ The space within the site boundary is considered to be limited for this option
	Sub-surface storage		Oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure	Modular and flexible, dual usage (infiltration/storage, high void ratios), can be installed beneath trafficked and soft landscaped areas	No water quality treatment	✓ Sub-surface storage is appropriate for use though consideration needs to be given to groundwater levels
Wetland	Shallow wetland Extended detention wetland Pond wetland Pocket wetland Submerged gravel wetland Wetland channel		Wetlands provide stormwater attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detain flows for an extended period to allow sediments to settle and to remove contaminants They can provide significant ecological benefits	Good pollutant removal and if lined can be used where groundwater is vulnerable. Good community acceptability, ecological and amenity benefits	Land take is high, requires baseflow, little reduction in runoff volume, not suitable for steep sites	✗ The space within the site boundary is considered to be limited for this option
Infiltration	Infiltration trench		Surface water runoff can be discharged directly to ground for infiltration by soakaways, basins,	Reduces the volume of runoff, effective at pollutant removal,	Requires appropriate pre-treatment, basins require	✗

SuDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for Use at Site?
	Infiltration basin Soakaway		or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to receive the quality and quantity of water generated	contributes to groundwater recharge, simple and cost-effective, easy performance observation	a large flat area, offset from foundations	Considering the hydrogeology of the site, infiltration is a not considered a suitable option
	Porous paving Permeable paving		Block or porous paving allows runoff to infiltrate through to sub base layer Water can then be infiltrated into ground or conveyed into storage or drainage systems	Reduces the volume of runoff and if designed for infiltration contributes towards groundwater recharge. Easy to install and retrofit. Simple to manage. If lined can be used where groundwater is sensitive	Not suitable for heavily trafficked areas or adoptable roads. Requires regular sweeping to prevent clogging with dirt	✓ Permeable paving can be utilised on the site for access routes, car parking and bike storage areas
Filtration	Surface sand filter Sub-surface sand filter Perimeter sand filter		Structures designed to treat surface water runoff through filtration using a sand bed filter medium. The filters can be designed with or without infiltration. Temporary storage of runoff is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required	Flexibility of design, efficient in removing pollutants, suitable for retrofits and in tightly constrained urban locations	Not for high sediment content, detention times can support algae growth, minimum hydraulic head of 1.2 m required, possible odour problems, high capital and maintenance cost	✗ There is no requirement for high pollution reduction at the site
	Bioretention /filter swale		Vegetated strips of land designed to accept runoff as overland sheet flow between a hard-surfaced area and a receiving system	Landscaping features, effective in removing pollutants, flexible layout to fit into landscape, suited for highly impervious areas, good retrofit capability, effective pre-treatment option	Requires landscaping and management, large land requirement, not suitable for steep sites; no significant attenuation or reduction of flows	✓ Filter swales may be a suitable option, but limited availability of space will need to be considered
	Filter trench /drain		Shallow excavations filled with rubble or stone that create temporary subsurface storage for filtration of storm water runoff Receive lateral inflow from an adjacent impermeable surface	Hydraulic benefits achieved with filter trenches, trenches can be incorporated into site landscaping and fit well beside roads and car parks	High clogging potential without effective pre-treatment, limited to small catchments, high cost of replacing filter material	✗ Not suitable due to the hydrogeology of the site

SuDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for Use at Site?
Detention	Detention basin		Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility.	Cater for a wide range of rainfall events, can be used where groundwater is vulnerable, potential for dual land use, easy to maintain	Land take, little reduction in runoff volume, detention depths constrained by levels	✗ Not suitable due to the limited availability of space within the site boundary
	Enhanced dry swale Enhanced wet swale		Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate.	Incorporate into landscaping, good removal of pollutants, reduces runoff rates and volumes, low cost	Not suitable for steep areas, significant land take, not suitable in areas with roadside parking	✗ Not suitable due to the limited availability of space within the site boundary
Conveyance	Conveyance swales Rills		Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate.	Negate the need for underground pipework. Can provide some attenuation Possible reduction in runoff volume via plant uptake and infiltration	Potential trip/wheel hazard, disabled access issues	✗ Conveyance swales/rills might cause disabled access issues and thus, these options are not considered suitable for the proposed development
	Rainwater harvesting		Uses rainwater coming from roofs to supply toilets, washing machines and irrigation systems. Harvested rainwater is stored underground and is substituted for potable water mains supply, reducing both site discharge and water consumption	Can provide source control of storm water runoff, reduces demand on mains water	Use is dependent on demand requirements, contributing surface water and seasonal rainfall characteristics, maintenance	✓ Rainwater harvesting comprises a suitable option for the proposed development. Harvested rainwater can be used for watering plants, car washing etc