Flood Risk Assessment and Drainage Strategy

Tees Valley Bottom Ash Facility
Grangetown Prairie, Dorman Point
Prepared on behalf of Viridor Waste Limited
March 2023

On behalf of
Viridor Waste Limited

Date
March 2023

Project Number
1620013801

TEES VALLEY BOTTOM ASH (BA) FACILITY GRANGETOWN PRAIRIE, DORMAN POINT

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

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Project name	**Tees Valley BA**
Project no	**1620013801**
Recipient	**Viridor Waste Limited**
Document type	**Report**
Version	**5**
Date	**20/03/2023**
Prepared by	**Daniel Porteous**
Checked by	**Anthony Guay**
Approved by	**Anthony Guay / Tom Smith**
Description	**Flood Risk Assessment and Drainage Strategy**
Document no	**1620013801-RAM-XX-XX-RP-FR-01**

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1. INTRODUCTION

1.1 Background

Ramboll UK Limited ('Ramboll') has been commissioned by Viridor Waste Limited (hereinafter referred to as the 'Applicant') to prepare flood risk assessment, outline drainage strategy and outline foul drainage strategy for the proposed development of a Bottom Ash (BA) Facility on site at Grangetown Prairie near Tees Valley (hereafter referred to as the 'site'). The site is located within the administrative authority of Redcar and Cleveland.

The development proposal comprises a BA Facility (hereinafter referred to as the 'proposed development') for which the Applicant intends to submit a planning application for outline planning permission (hereafter referred to as the 'application').

1.2 Objective and Scope of Works

This report 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 development.

This FRA has been carried out in accordance with the National Planning Policy Framework (NPPF)[1]. The report is to be used to assist the Local Planning Authority (LPA) and relevant statutory consultees when considering the flooding issues of the proposed development, as part of an outline planning application.

This report provides the following information:

i. A review of the flood risk to the site based upon flood data and the flood maps provided by the Environment Agency (EA) and the relevant Strategic Flood Risk Assessment (SFRA);
ii. An assessment of flood risk from all sources including tidal, fluvial, pluvial, groundwater and infrastructure failure to the proposed development;
iii. An assessment of the compatibility of the proposed development for its location based on flood risk and its proposed usage;
iv. An assessment of the impact of the proposed development in terms of surface water runoff;
v. Proposals for measures to mitigate the generation of surface water runoff and foul water generated as a result of the proposed development; and
vi. Proposals to mitigate any residual flood risks to the proposed development.

1.3 Limitations and Constraints

In preparation of the report and performance of any other services, Ramboll has relied upon publicly available information, information provided by the client and information provided by third parties. Accordingly, the conclusions in this report are valid only to the extent that the information provided to Ramboll was accurate, complete and available to Ramboll within the reporting schedule.

The key sources of information used to prepare this report are provided as footnotes within the document. Ramboll cannot accept liability for the accuracy or otherwise of any information derived from third party sources.

Ramboll's services are not intended as legal advice, nor an exhaustive review of site conditions and/or compliance. This report is intended solely for the use and benefit of the client for this

[1] GOV.UK, National Planning Policy Framework (published June 2019) https://www.gov.uk/government/publications/national-planning-policy-framework--2 (accessed 01/02/2023)

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2. BACKGROUND

2.1 Site Context

The proposed BA Facility site lies within the area known as Grangetown Prairie, owned by the South Tees Development Corporation (STDC). The site forms part of 1,800 ha of land previously occupied by heavy industry and infrastructure that is subject to STDC's Regeneration Master Plan.

The proposed BA Facility site was formerly used for the production of iron and steel. Following the closure of the steel works and cessation of industrial activities, the building complex was cleared in the 1980's and the site is now vacant.

The site lies within the southwest corner of the STDC regeneration area, within the Grangetown Prairie Zone. It is located approximately 1.5 km from the River Tees to the north, around 6.5 km to the northeast of Middlesbrough and approximately 5 km south west of Redcar town centre. It is also located immediately adjacent to the eastern boundary of the proposed Tees Valley ERF site.

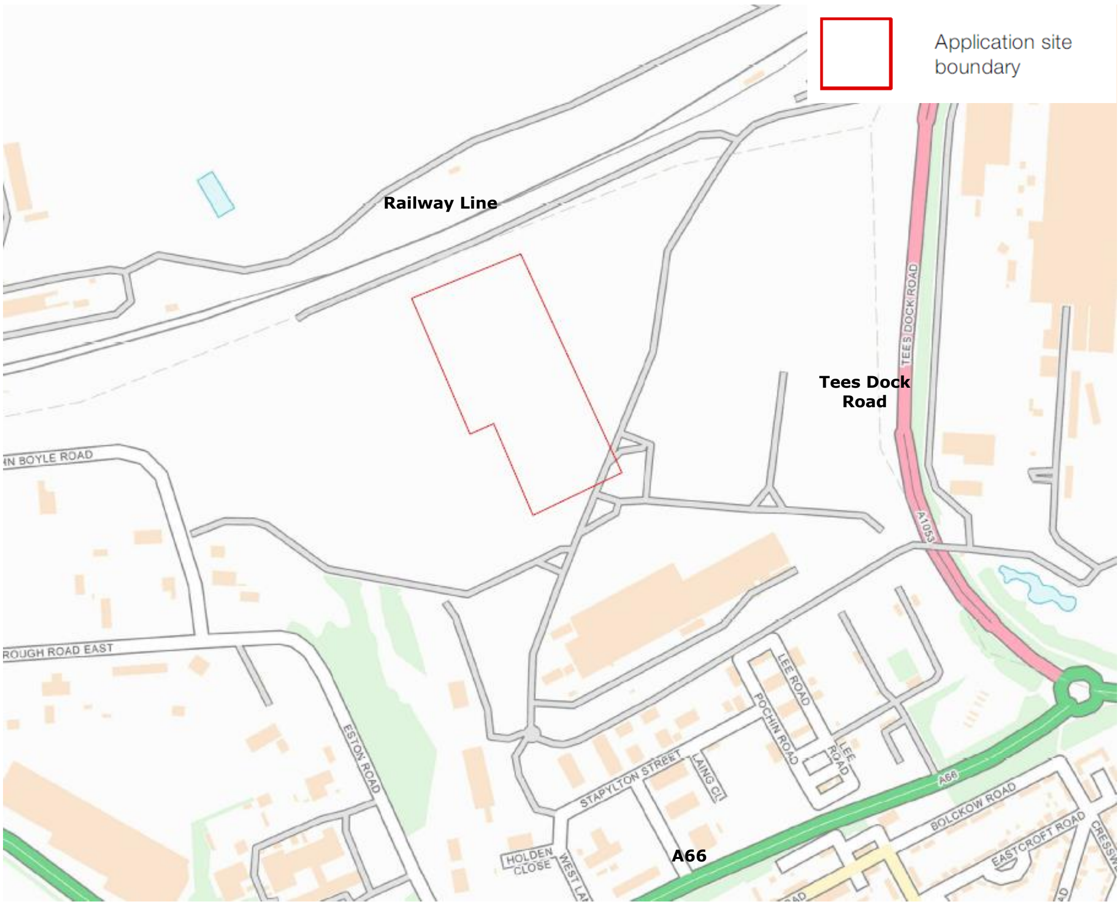


Figure 2.1: Site Location.

The proposed BA Facility site covers an area of around 4.74 ha, that is rectangular in shape and situated to the east of John Boyle Road (with the ERF site in between). To the east of the site lies Tees Dock Road, to the south runs the A66 and to the north is a railway line. Whilst the site does not currently have direct access to the public highway, it is expected that STDC will provide new road infrastructure to serve the site in the near future, as part of the Regeneration Master Plan.

The site is not covered by any landscape designations and is located within a predominantly industrial setting. However, there are some recognised sensitive rural landscape areas situated within the wider area, such as Eston Hills to the south.

2.2 The Proposed Development

The proposed development consists of an BA facility, including an BA hall, storage bays and ancillary buildings.

The proposed development is anticipated to transfer 100% of the BA (approximately 100,000 tonnes per annum (tpa)) produced from the Tees Valley Energy Recovery Facility (ERF), which is located directly adjacent (west) of the BA site. The process will involve the transfer, by covered conveyor, of the raw BA from the ERF to the raw BA hall at the proposed BA Facility site, or by covered vehicles via an internal link, or by road.

In addition to the 100,000 tpa from the Tees Valley ERF, the proposed new BA Facility would be designed to accommodate a further up to 80,000 tpa from third party sources. BA from third party sites would be delivered to the BA Facility by road. The BA will be placed into storage bays for maturation over a 14-56 day period.

3. REVIEW OF BASELINE DATA

3.1 Site Topography

The Environment Agency (EA) 1m resolution Digital Terrain Model (DTM) LiDAR data, accessed through DEFRA's online spatial data download service[2] indicates the site averages approximately 8 m to 9 m Above Ordnance Datum (mAOD) with isolated raised or pitted areas ranging between approximately 7.5 mAOD and 9.5 mAOD. Site elevations are generally lower at the north of the site.

The topographic LiDAR data is presented in Figure 2, in Appendix 1.

3.2 Surface Water Features

There are two culverted watercourses within 500 m of the site.

- The Holme Beck is situated approximately 300 m west the site. Within this distance the watercourse is culverted, however the watercourse becomes open approximately 400 m south.
- The Knitting Wife Beck is situated approximately 300 m east of the site where it is culverted. The watercourse becomes open approximately 450 m southeast.

Both watercourses flow north into the River Tees which is situated approximately 1.5 km northwest of the site. The River Tees flows in a north-easterly direction converging with the Tees Estuary approximately 5 km north of the site. Several small, unnamed ordinary watercourses and ditches are present between 500 m and 1 km to the north and west of the site.

3.3 Underlying Geology and Groundwater Levels

BGS mapping of the area (1:50,000 scale map series) was accessed via the online BGS Onshore GeoIndex digital mapping database[3]. The map series indicate the site is underlain by the Mercia Mudstone Group - mudstone. Superficial deposits consist of Glaciolacustrine Deposits, Devensian - clay and silt.

A site-specific ground investigation has not been undertaken for the site. However, two ground investigations have recently been conducted immediately adjacent to the western site boundary by Stantec[4] and Arcadis[5]. It is assumed the data from these investigation is representative for the BA site due to the topography, previous land use and BGS data profiles being similar across both sites.

A combined summary of the borehole records from these investigations is shown in Table 3.1. Trial pits and borehole records from a previous Phase II site investigation at the adjacent site identified extensive Made Ground of varying thickness through the site and surrounding area.

[2] DEFRA Data Services Platform, LiDAR Composite DTM 2019 – 1m, available at: https://environment.data.gov.uk/dataset/76363295-69d5-406b-90bf-d7b9e8bebfd9 (accessed 01/2023)

[3] The British Geological Survey (BGS) Onshore GeoIndex. available at: http://mapapps2.bgs.ac.uk/geoindex/home.html (accessed 01/2023)

[4] Stantec (2020). Phase 1 Geoenvironmental and Geotechnical Desktop Study, Tees Valley ERF, Grangetown Prairie, Redcar, TS10 5QW, ref. RT-NN-2725-5QW

[5] Arcadis (2020). Phase II Environmental Site Assessment, Grangetown Prairie Area, Former Steelworks, Redcar, ref. 10035117-AUK-XX-XX-RP-ZZ-0062-01-Prairie_ESA

Table 3.1: Summary of Ground Conditions Encountered by Stantec (2020) and Arcadis (2020)

Strata	Description	Depths of Stratum (mbgl)
Made Ground	(Grass over) topsoil	0.0 to 0.4
	Concrete (potentially reinforced with or without rebar or found as a slab) or brick*.	0.1 to 1.8
	Reworked sandy/gravelly clay, or clayey / silty sand, gravel or rare cobbles/boulders of brick, macadam, tile, coal, slag, ash, concrete, wood, rebar, mortar, cloth/fabric, plastic, sandstone/mudstone and/or metal fragments. Slag and ash found in varying quantities from 0-100 %. Slag is often vesicular.	0.0 to 4.5
Tidal Flat Deposits (Alluvium)	Soft to firm brown/grey/orange or brown mottled grey clay or sandy clay. Occasional fine to coarse gravel, and pockets of yellow/brown sand noted.	1.3 to 2.6
Glaciolacustrine Deposits	Soft to firm frequently thinly or occasionally indistinctly laminated brown/grey/orange or brown mottled grey clay. Occasional fine sand noted on laminae.	2.5 to 6.7
Glacial Till	Firm to very stiff occasionally friable dark brown/brown/red/brown clay or sandy/gravelly silt or clay with rare sub-angular cobbles or yellow brown clayey sand or fine or coarse frequently loose sand or sand and gravel or dense grey-brown very sandy gravel. Gravel is fine to coarse and sub-angular to sub-rounded. Gravel and cobbles include sandstone, limestone, gypsum and flint, with gravel of coal noted as possible Made Ground.	6.7 to 11.0
Mercia Mudstone Group	Extremely weak dark red mudstone with some gypsum interbedding (recovered as gravelly sand).	11.0 to 12.0

* Concrete was found to be widespread across the site (though not in a continuous layer) and is likely to be present as localised footings, previous foundations and broken slabs used for previous infill material.

The site is situated within the Triassic Rocks (undifferentiated) rock unit which is characterised as a low productivity aquifer. The Tidal Flat Deposits are designated a Secondary A Aquifer.

Trial pits from the Arcadis Phase II site investigation at the neighbouring site indicated shallow groundwater within the Made Ground at depths between 0.3 mbgl to 3.5 mbgl. This was believed to be perched groundwater within granular horizons and subsurface structures. Borehole logs from the investigation indicated groundwater in the superficial deposits from 1.1 mbgl to 3.0 mbgl (or 3.7 mAOD to 7.1 mAOD). Groundwater was also found in the bedrock at depths as high as 4 mbgl. It may therefore be inferred that the direction of groundwater flow is towards the north and northeast.

The site is not situated within a groundwater Source Protection Zone (SPZ).

3.4 Flood Zone Classification

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 Guidance (NPPG), and are as follows:

> *Zone 1: Low Probability. According to the NPPG, land in this zone is considered to have less than 1-in-1000 annual probability of river or sea flooding in any year.*

Zone 2: Medium Probability. According to the NPPG, land in this zone is considered to have between a 1-in-100 and 1-in-1000 annual probability of river flooding in any year (between 1% and 0.1%) or between a 1-in-200 and 1-in-1000 annual probability of sea flooding in any year (0.5% to 0.1%).

Zone 3a: High Probability. According to the NPPG, land in this zone is considered to have a 1-in-100 or greater annual probability of river flooding in any year (>1%) or a 1-in-200 or greater annual probability of flooding from the sea in any year (>0.5%).

Zone 3b: The Functional Floodplain. According to the NPPG, land in this zone is used for water flow or storage in times of flood. This flood zone should be identified by a Strategic Flood Risk Assessment (SFRA). It is considered to have a 1-in-20 or greater chance of river flooding in any year which is >5%. Another probability, however, can also be agreed between the Local Planning Authority (LPA) and the EA.

According to the Flood Map for Planning[6] the site is entirely within Zone 1, illustrated in Figure 3, in Appendix 1. There are no other Flood Zones within at least 500 m. Fluvial flood risk to the site is therefore considered to be low (<0.1%).

3.5 Flood Defences

The site is not in an area benefiting from flood defences according to the EA Flood Map for Planning[6].

3.6 Surface Water (Pluvial) Flood Risk

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

The EA's Long-Term Flood Risk Map[7] identifies areas in England and Wales at potential risk of surface water (pluvial) flooding. The surface water flood maps define flood risk as follows:

High Risk. Considered to have a greater than 1-in-30 annual probability of surface water flooding in any year (>3.3%).

Medium Risk. Considered to have between a 1-in-30 and 1-in-100 annual probability of surface water flooding in any year (between 3.3% and 1%).

Low Risk. Considered to have between a 1-in-100 and 1-in-1000 annual probability of surface water flooding in any year (between 1% and 0.1%).

Very Low Risk. Considered to have a less than 1-in-1000 annual probability surface water flooding in any year (<0.1%).

The EA mapping indicates the majority of the site area is at 'Very Low Risk' of surface water flooding. Some small areas of 'Low' risk of surface water flooding are interspersed through the site and surrounding area.

The EA risk of flooding from surface water data is presented in Figure 4, in Appendix 1.

[6] Environment Agency Flood Map for Planning, available at: https://flood-map-for-planning.service.gov.uk/ (accessed 01/2023)
[7] Environment Agency Long-Term Flood Risk Map, available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map (accessed 01/2023)

3.7 Reservoir and Artificial Flood Risk

According to the EA's Long-Term Flood Risk Map[8] the site is not identified as being at risk of flooding from reservoirs.

3.8 Historic Flooding

According to DEFRA spatial data[9] the site is not situated within an area of historic flooding. There is no historic flooding indicated by EA data within at least 1 km of the site. Additionally, there are no historic flooding incidents and no foul or combined sewer flooding events within at least 500 m of the site, as indicated in the Redcar and Cleveland Strategic Flood Risk Assessment (SFRA)[10].

3.9 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 enough for the water table to intersect the ground surface and inundate low lying land and/or infrastructure below ground. 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.

Detailed Map 35 of the Redcar and Cleveland SFRA[10], which uses the EA's Areas Susceptible to Groundwater Flooding (AStGWF) dataset, indicates that the proposed development is situated within an area of <25% risk of groundwater emergence. Additionally, the recorded groundwater levels from the previous nearby ground investigations would suggest groundwater flooding at the surface is unlikely as the majority of recorded groundwater depths were greater than 1 mbgl, however groundwater height varied considerably in places, suggesting uneven perched groundwater. This may be affected by the composition of Made Ground.

Groundwater flood risk at the surface is therefore considered to be low to medium depending on local topography and ground conditions.

3.10 Existing Drainage

The surrounding sewerage service is operated by Northumbrian Water. The site has no existing foul or surface water connections identified on sewer records. It is therefore considered that, as the site has been cleared, all surface runoff currently infiltrates to ground and/or runs off to adjacent roads and sites.

The primary drainage features near to the site are the Holme Beck culvert and the Knitting Wife Beck. No current drainage connections from the site to these features have been identified.

3.11 Existing Flood Risk Summary

A summary of the existing risk of flooding from all sources is provided in Table 3.2 below.

Table 3-2: Summary of Baseline Flood Risk

Sources of Flooding	High	Medium	Low	Comments
Tidal / fluvial			x	The site is entirely within Flood Zone 1. There are no other Flood Zones within at least 500 m. The

[8] UK Government (2022). Check the long term flood risk for an area in England, available at: https://www.gov.uk/check-long-term-flood-risk (accessed 01/2023)

[9] DEFRA Spatial Data Services Platform, Historic Flood Map, available at: https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/HistoricFloodMap&Mode=spatial (accessed 01/2023)

[10] Redcar and Cleveland Strategic Flood Risk Assessment, available at: https://www.redcar-cleveland.gov.uk/resident/planning-and-building/local-plan/Pages/Redcar-and-Cleveland-Strategic-Flood-Risk-Assessment.aspx (accessed 03/2022)

Sources of Flooding	High	Medium	Low	Comments
				Redcar and Cleveland SFRA indicates that the site is not within an area at risk of tidal flooding.
Surface water and drainage flood risk			x	There is no known history of flooding from reservoirs or sewers. EA surface water flood data indicates a predominantly 'very low' risk of surface water flooding across the site. Small, scattered areas of low risk are present. Therefore, the risk across the site should be considered low.
Groundwater		x	x	Ground investigations in the immediate area show there is discontinuous perched groundwater within the Made Ground at depths within 1 m of the surface. Additionally, shallow groundwater is found within the superficial deposits at elevations as high as 7.1 mAOD. The perched groundwater in the Made Ground may pose a moderate to high risk of flooding at the surface. However, this would probably be localised and dependent upon topography and the Made Ground constituents. Groundwater within the superficial deposits is less likely to pose a flooding risk at ground level but would be a risk at or close to the identified elevations (3.7 – 7.1 mAOD). It is considered that the nearby data from the adjacent site is representative of the BA site. Overall groundwater flooding risk to the site is considered to be Low to Medium.
Artificial sources			x	The site is not within an area at risk of flooding from reservoirs.

4. FLOOD RISK ASSESSMENT OF DEVELOPMENT

4.1 Tidal and Fluvial Flood Risk

As summarised in Section 3.4, the site is situated within Flood Zone 1 and has a <0.1% annual probability of flooding from rivers and the sea. This status is unaffected by the proposed development i.e., the development does not increase flood risk, either to itself or neighbouring locations.

4.2 Reservoirs, Canals and Other Artificial Sources

The site is not within an area at risk of flooding from reservoirs or other artificial sources (see Section 3.7) and vulnerability is not expected to increase over the lifetime of the development provided that no significant changes in the presence of surrounding artificial sources occur.

4.3 Sequential Test

Development in the context of flood risk is regulated through the planning process via the NPPF. A Sequential Test and potentially an Exception Test would be required if the proposed development is within Flood Zone 2 or Flood Zone 3. Additionally, waste treatment developments are regarded as 'less vulnerable' by the NPPF.

Given that the site is situated in Flood Zone 1, and given the nature of the proposed development, the Sequential Test and Exception Test are not required under the NPPF and the proposed development is considered suitable for Flood Zone 1.

Flooding from fluvial, tidal, and artificial sources are considered to present a low risk to the proposed land use.

4.4 Surface Water Runoff

The existing site is brownfield with no positive drainage network present. As a result of the proposed development, the impermeable area on the site will increase, thus increasing surface water runoff rates. Additionally, surface water runoff rates are anticipated to increase in the future as a result of the effects of climate change. Therefore, a drainage strategy needs to be developed for the site to manage surface water runoff and mitigate potential flooding to the site or downstream receptors.

The drainage strategy is outlined in Section 5.

4.5 Groundwater

The risk of groundwater flooding at the surface is low-to-medium depending on surface elevations and localised ground conditions. Because of the potential variable ground conditions on site, the exact risk of groundwater flooding in specific locations of the proposed development may be difficult to determine.

5. OUTLINE SURFACE WATER DRAINAGE STRATEGY

5.1 Disposal of Surface Water

As a result of the proposed development, impermeable surface area at the site will increase due to the presence of buildings, storage bays, vehicle access roads, and other impermeable structures and surfaces. This will increase surface water discharge above that of the existing brownfield which, according to a site visit undertaken by Ramboll in 2022 and 2023, constitutes bare ground/stockpiles as a result of completed remediation works on the site and on adjacent land. Following an ecological validation survey in January 2023, also undertaken by Ramboll, it was confirmed that the nature of the site remains unchanged, with the majority of the site being used as stockpiling, with just a small strip of remnant vegetation along the side of the haul road. As such, excess surface water from the development will require adequate disposal to mitigate the occurrence of surface water flooding on site.

Surface water drainage systems need to be developed in line with sustainable development collectively referred to as Sustainable Drainage Systems (SuDS). The objective of SuDS is to minimise the impact of the development on the quantity and quality of site run off and maximise amenity and biodiversity opportunities. Surface water sustainable drainage systems will be designed and installed in accordance with current UK National Planning Policy Frameworks (NPPF) requirements and Planning Policy Statement 25 (Note- Retracted but still referenced PPS 25) and associated CIRIA 521, 522, 523, 625, 626, 609, 697 and 753 and associated reference documents.

The disposal of surface water drainage from the proposed development will be in accordance with the following drainage hierarchy, each of which has been considered in turn:

1. Store rainwater for later use.
2. Use infiltration techniques, such as porous surfaces in non-clay areas.
3. Attenuate rainwater in ponds or open water features for gradual release.
4. Attenuate rainwater by storing in tanks or sealed water features for gradual release.
5. Discharge rainwater direct to a watercourse.
6. Discharge rainwater to a surface water sewer/drain.
7. Discharge rainwater to the combined sewer.

The required storage to allow the water to be held back to control the discharge can be provided by means of Sustainable Urban Drainage Systems. Because the site layout of the proposed development has not yet been finalised, spaces available for infiltration cannot be reliably determined at this time. Additionally, due to existing site contamination from previous site use, and the limitations of remediation at depth, infiltration within the lower strata is not permissible due to the risk of contamination of ground water. The possibility of infiltration is also limited due to the ground conditions.

There are no combined sewers presently serving the site according to Northumbrian Water's records (Appendix 3). The nearest combined sewer lines are approximately 300 m from the site.

Following the aforementioned drainage priorities, it is proposed to attenuate surface water runoff on site and discharge the surface water at a controlled rate to Holme Beck. Additionally, the Knitting Wife Beck exists as a possible alternative route for discharge. It should be noted that the practicality and location of ponds and open drainage features for attenuation cannot be determined at this time due to the site layout being unconfirmed.

It is proposed to limit the post-development runoff for all return periods up to and including the 1% annual probability (1 in 100 year) including a 40% increase to allow for climate change rate to the existing greenfield Qbar rate. The H R Wallingford greenfield runoff rate estimation tool applying the IH 124 methodology was used to calculate estimated greenfield runoff rates. The full estimation report is included in Appendix 4. Results are summarised as follows:

Table 5.1: Estimated greenfield runoff rates

Storm event	Greenfield runoff rate (l/s)
Qbar	16.3
1 in 1	14.0
1 in 30	28.6
1 in 100	34.0

5.2 Estimated Surface water storage

In order to manage surface water runoff generated by the development of the site and to limit the discharge rates to Qbar greenfield rate, attenuation storage will be required. Because the final site layout is unknown at this time, a 'worst case' scenario of 100% impermeable surface cover is assumed and this will be considered further at the detailed design stage. The H R Wallingford surface water storage volume estimation tool applying the IH 124 methodology was used to calculate estimated attenuation volumes required. The full estimation report is included in Appendix 5. Results are summarised as follows:

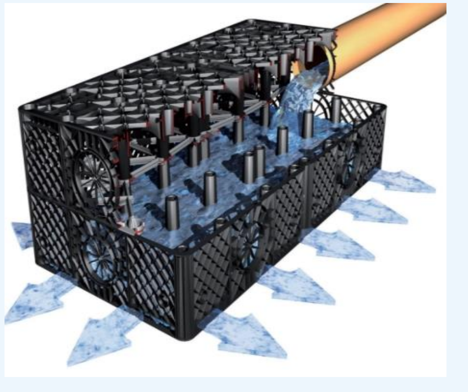
Table 5.2: Estimated surface water storage

Storage category	Estimated storage volumes (m^3)
Attenuation storage (1 in 100)	3500
Long-term storage (1 in 100)	940
Total storage (1 in 100)	**4400**

5.3 Assessment of Attenuation Options

For sustainable management of surface water runoff from a new development, the use of Sustainable Drainage Systems (SuDS) is recommended. The SuDS options potentially available for attenuating surface water runoff generated by the development of the site is presented in Table 5.3.

Table 5.3: SuDS options

SuDs hierarchy	Appropriateness (Y/N)		Advantages / Disadvantages	Illustration
Store rainwater for later use	Y	Uses rainwater coming from roofs to supply process and could be also used for toilets, washing machines and irrigation systems. Harvested rainwater would be stored in tanks and is substituted for potable water mains supply, reducing both site discharge and water consumption.	Advantages: Provides source control of storm water runoff, reduces demand on mains water. Disadvantages: Use is dependent on demand requirements, contributing surface area, and seasonal rainfall characteristics.	
Use infiltration techniques	N	Allows surface water runoff to seep into the ground at a restricted rate. Attenuation is then further enhanced by providing attenuation tanks below the infiltration systems. Due to existing site contamination from previous site use, and the limitations of remediation at depth, infiltration within the lower strata is not permissible to infiltrate due to the risk of contamination of ground water. The possibility of infiltration is also limited due to the	Advantages: Infiltration can contribute to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes Disadvantages: The rate which water can be infiltrated depends on the infiltration capacity of the surrounding soils.	

SuDs hierarchy	Appropriateness (Y/N)		Advantages / Disadvantages	Illustration
		ground conditions at the site.		
Attenuate rainwater in ponds or open water features for gradual release	Y	Provides both attenuation and treatment of surface water runoff.	Advantages: They can support emergent and submerged aquatic vegetation along their shoreline which helps enhance treatment processes and has amenity and biodiversity benefits. Disadvantages: If Pond is not designed with suitable upstream pre-treatment, it may increase the likelihood of bad odour and rapid silt accumulation.	
Attenuate water by storing in tanks or sealed water features for gradual release.	Y	Attenuation storage tanks are used to create a new below-ground void space for the temporary storage of water before infiltration or controlled release, or use.	Advantages: The inherent flexibility in size and shape of the geo-cellular storage system means that they can be tailored to suit the specific characteristics of any site. This system offers potential for installation beneath roads, car parks and recreational area. Disadvantages: The level of accessibility and maintainability can be hindered depending on the location.	

SuDs hierarchy	Appropriateness (Y/N)	Advantages / Disadvantages	Illustration
Discharge rainwater direct to watercourse	Y	Holme Beck is located within 300m of the proposed development site; therefore the watercourse is considered to be of reasonable distance from the proposed development to allow for the discharge of surface water runoff. Surface water runoff will be restricted using SuDs features such as rainwater harvesting, permeable paving, geo-cellular tanks and a lined pond with flow control installed at strategic points before discharging into the Holme Beck culvert.	
Discharge rainwater to a surface water drain	Not Relevant	No existing surface water drains are located within the immediate area.	
Discharge rainwater to combined sewer	Not Relevant	No surface water within this development will discharge into a combined sewer.	

6. OUTLINE FOUL WATER DRAINAGE STRATEGY

6.1 Existing Foul Drainage

The site and immediate surroundings are unoccupied and there are no foul drainage connections to the site. The nearest foul sewers include a combined sewer in the industrial area 300 m south and a foul sewer at Eston Road approximately 400 m south-west. Both are part of the Northumbrian Water sewer network.

A map of the Northumbrian Water sewer utilities is provided in Appendix 3.

6.2 Proposed Points of Discharge

Connections could be made to the proposed sewer adjacent to the proposed Tees Valley ERF site, on Eston Road. South of the site, connections would necessitate works on third party land and connections would need to be made with agreement by the landowner or by a request from Northumbrian Water. For this reason, it is proposed to connect via the combined sewer on Eston Road.

6.3 Estimation of Flow

The foul flows from the development have been estimated based on the proposed development area of 47,400 m^2 (4.74 ha) and the guidance included in Sewers for Adoption stating that a 0.5 l/s/ha for normal industrial premises (i.e., not wet industry).

The calculation of peak flow is provided below:

Area = 47,400 m^2 (4.74 ha)
Peak rate = 4.74 x 0.5 = approx. 2.37 l/s

This rate would be consistent with the expected staff occupancy during operation of 8 shift staff plus 2 trade occupants per day.

6.4 Summary of Proposed Foul Drainage

The proposed foul drainage has been based on currently available information and should be revised as appropriate once further information becomes available, including on the final site layout, final development area, construction sequence of works and detailed private and public sewer records. In particular, an initial task should be to assess if the proposed foul network at the adjacent ERF site is of suitable capacity and condition to be used.

Once the proposed foul drainage design has been finalised, a connection application should be made to Northumbrian Water. This will confirm the acceptability of the points of discharge and proposed loadings. Details of all connectivity layout and pumping requirements are to be determined during this connection period with Northumbrian Water.

7. CONCLUSION

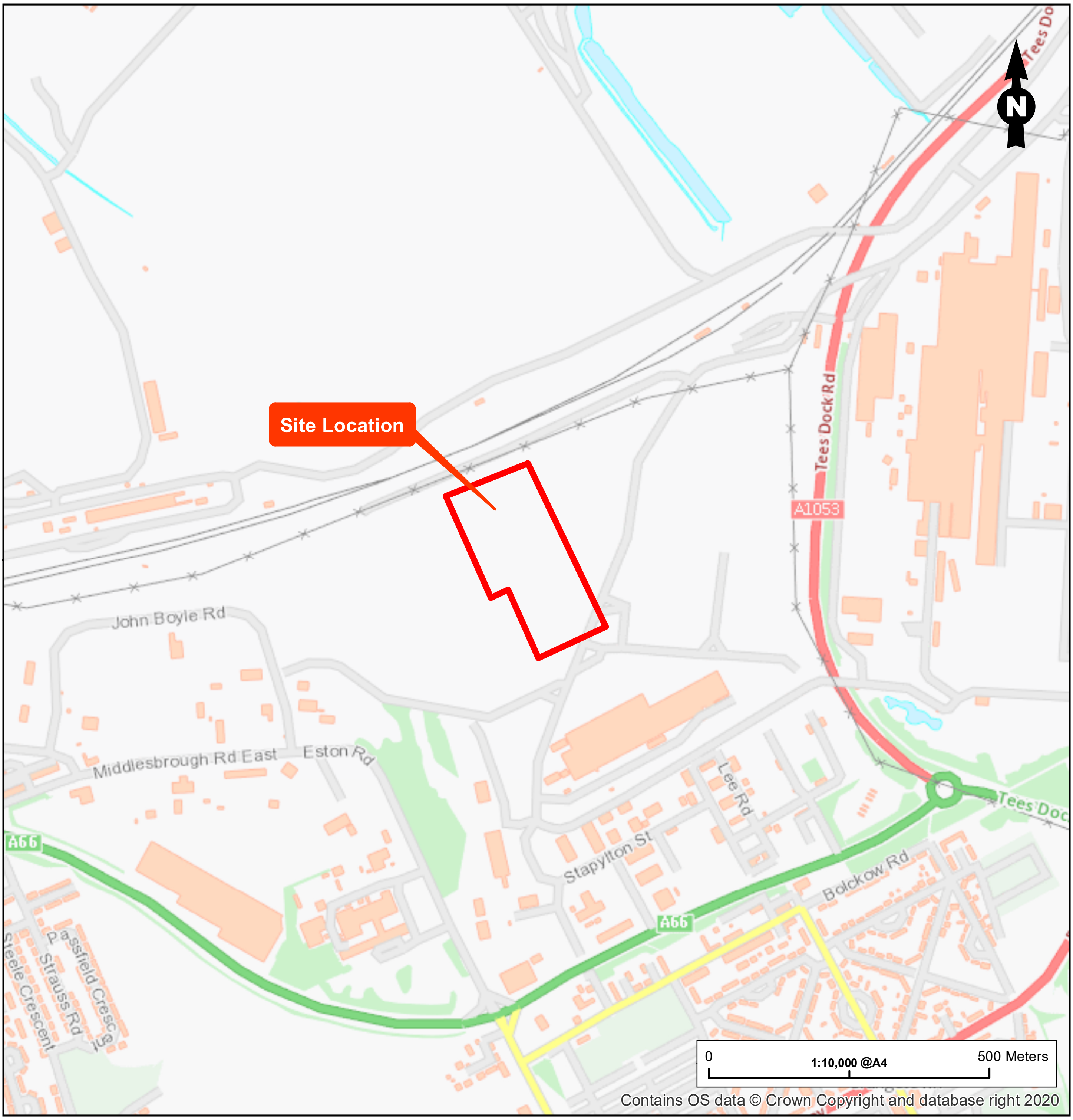
Ramboll was commissioned by Viridor Waste Limited to prepare a flood risk assessment with an outline surface water drainage strategy and an outline foul drainage strategy for the proposed development of a BA facility on a site at Grangetown Prairie near Tees Valley.

The site is situated within Flood Zone 1 and is at a low risk of flooding from rivers and the sea. The risk of groundwater flooding at the surface is low to medium depending on local elevation and specific ground composition. This risk is not expected to increase as a result of the proposed development. The risk of surface water flooding is low and should remain low assuming a drainage strategy is implemented to manage the increase in runoff discharge resulting from the additional impermeable surface cover. Given the site is situated in Flood Zone 1, the Sequential Test and Exception Test are not required under the NPPF and the proposed development is considered suitable.

The outline surface water drainage strategy proposes to attenuate runoff discharge on site and to discharge surface waters to the Holme Beck. A total storage requirement of 4,400 m^3 is estimated to achieve greenfield rate for a 1 in 100-year scenario assuming the whole site is impermeable. Specific forms of SuDS and attenuation cannot be determined at this time until further site details are confirmed which will be considered at the detailed design stage,

The outline foul water drainage strategy proposes connections to be made to the existing Northumbrian Water combined sewer on Eston Road. A peak rate of 2.37 l/s is estimated based on present information about the proposed development. This rate would be consistent with the expected staff occupancy during operation of 8 shift staff plus 2 trade occupants per day

FIGURE 1 SITE LOCATION



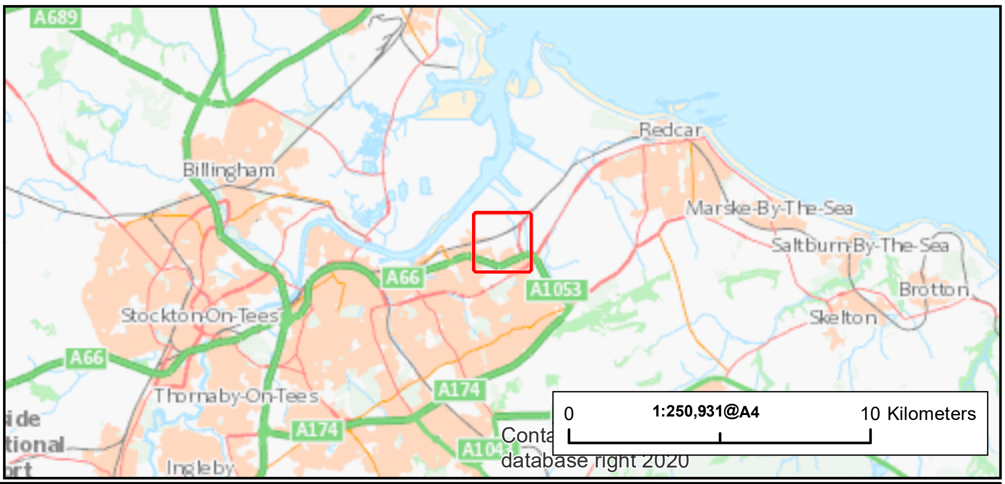


Figure Title: Figure 1: Site Location	Project Name: Tees Valley BA	Date: February 2023	RAMBOLL
		Scale: As shown	
Project Number: 1620013801	Client: Viridor Waste Ltd	Issue: 3	Prepared By: DP

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

FIGURE 2 LIDAR 1M DTM

Legend

Site Boundary

LiDAR DTM 1m (mAOD)

Value

High : 25
20
15
10
5
Low : 0

Figure Title
LiDAR DTM 1m

Project Name
Tees Valley BA

Project Number	Figure No.
1620013801	2
Date	Prepared By
February 2023	DP
Scale	Issue
1:2,000 @A3	3

Client
Viridor Waste Ltd

RAMBOLL

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

FIGURE 3 FLOOD MAP FOR PLANNING