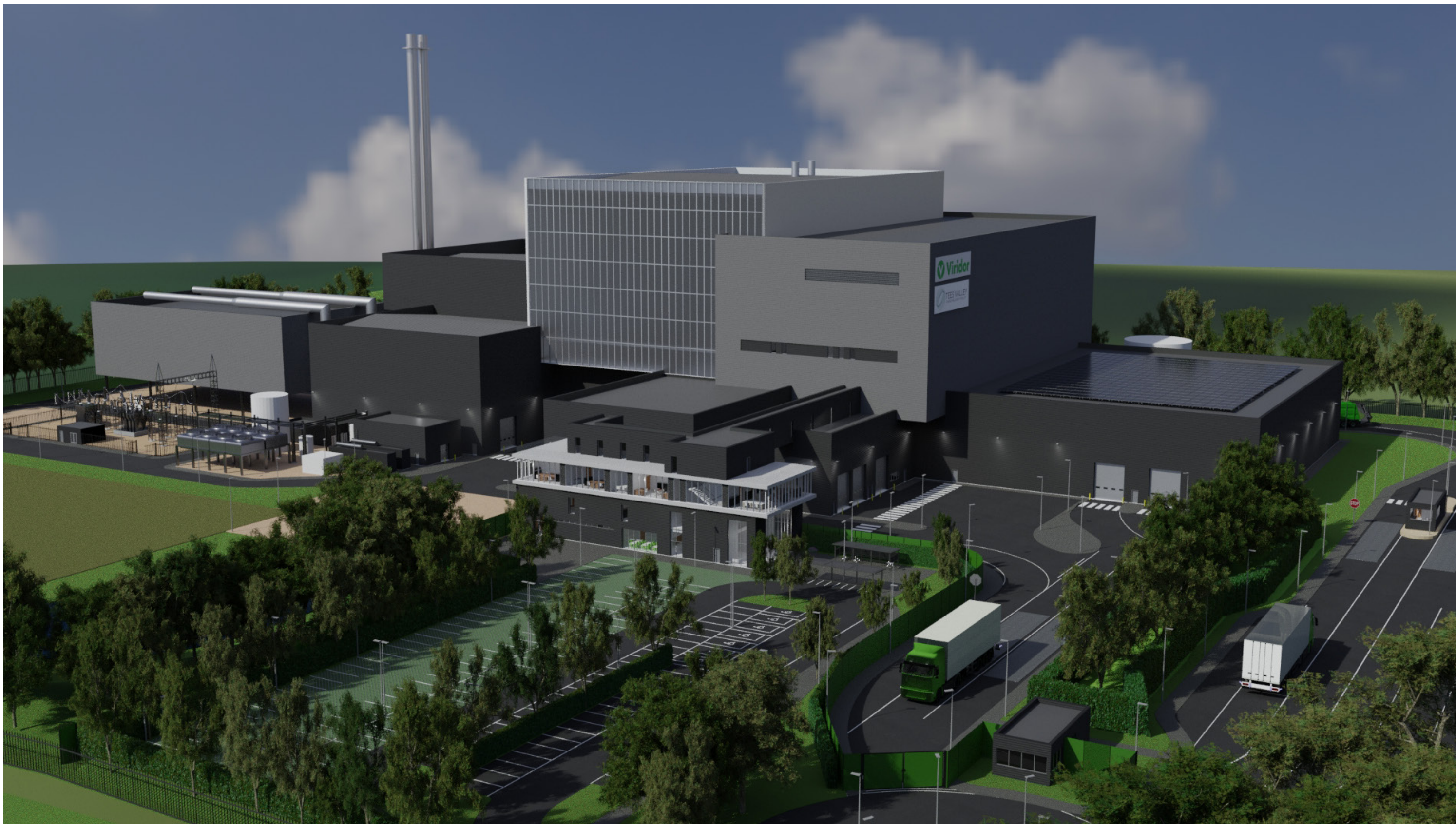

Sustainable Urban Drainage Systems Technical Note

Tees Valley Energy Recovery Facility
Grangetown Prairie, Dorman Point
Prepared on behalf of Viridor Tees Valley Limited
March 2023

Intended for
Viridor Tees Valley Limited

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Report

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SUSTAINABLE URBAN DRAINAGE SYSTEMS TECHNICAL NOTE
TEES VALLEY ENERGY RECOVERY FACILITY, GRANGETOWN PRAIRIE, DORMAN POINT

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SUSTAINABLE URBAN DRAINAGE SYSTEMS TECHNICAL NOTE
TEES VALLEY ENERGY COVERY FACILITY

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CONTENTS

1. INTRODUCTION

1.1 Objective

The objective of this document is to provide a detailed description of the surface water drainage system for the proposed Tees Valley Energy Recovery Facility development at Grangetown, Redcar, Tees side (NZ 54449 21337). The document is to be presented to key project stakeholders and to support the reserved matters application by setting out the philosophy that will be adopted during future detailed design phases for drainage design.

1.2 Constraints and Limitations

This report has been prepared for exclusive use of the design team for the purpose of explaining the proposed drainage strategy and the associated constraints and opportunities that have been integrated within the Energy Recovery Facility (ERF) development.

The information contained in this report is based on a review of existing information. No other warranty whether express or implied is made to third parties in respect of the information presented within this report. Any liability arising out of the use by the design team or any third party of this report for purposes not wholly connected with the above shall be the responsibility of the design team and such third party who shall indemnify Ramboll UK against all claims, costs, damages and losses arising out of such use.

2. SITE INFORMATION

2.1 Site location overview

The site is currently brownfield and lies within the south west corner of the STDC regeneration area within the Grangetown Prairie Zone. The extent of the ERF outline permission (R/2019/0767/OOM) covers around 10 ha of land that is roughly rectangular in shape. The site is situated between John Boyle Road to the west, Tees Dock Road to the east, the A66 to the south and the railway line to the north. Further to this, Dorman Point Way is a newly constructed road that lies to the south of the proposed ERF site. The site subject to the reserved matters application sits within the area of the outline permission and covers an area of 8.87 ha, at 10m above Ordnance Datum.

The ERF site is a previously developed industrial site that was formerly used for the production of iron and steel (occupied by Eston Iron Works and Cleveland Steel Works). 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.

2.2 Existing drainage

The current site is not served by a dedicated positive drainage system and it is assumed that all storm run-off currently infiltrates to the ground and/or runs off to any adjacent drainage.

The primary drainage feature adjacent to the site is the Holme Beck culvert. Holme Beck flows northward at the western bound of the site and outfalls into Cleveland Channel. Knitting Wife culvert is located 450m east of the site and also outfalls into Cleveland Channel.

2.3 Site Topography and Geology

The existing site was previously occupied by a steelworks company, and is known to comprise of reclaimed land, made up of slag with up to 2.8m of Made Ground also comprising ash and demolition rubble with this giving rise to a range of contaminants including heavy metals, abnormal pH levels and sulphate/sulphides. Additionally, Sandy Silty Clays up to a depth of 3.5m, Glaciolacustrine deposits and Glacial Till are also present on site to an unconfirmed depth. The site has been remediated. The need for further remediation will be determined in due course.

3. DESIGN PARAMETERS

It is proposed that all below ground surface water drainage for the development will be collected and conveyed via gravity fed positive drainage where possible and discharged off site to the Holme Beck culvert.

Self-cleansing velocity in the surface water drainage networks will be achieved in all instances and flows will generally be kept above 1 m/s respectively within the pipelines to ensure that self-cleansing velocities are achieved. This is subject to the exact condition, location, and level of the existing off-site below ground drainage and sewerage network.

The development will be drained by dedicated and fully segregated surface and foul water systems designed in accordance with the following documents and in line with UK best practice where appropriate;

- Building Regulations - Approved document H
- BS EN 12056 : Parts 1-5 : Gravity Drainage Systems Inside Buildings
- BS EN 752: Drain and Sewer Systems outside buildings
- Sustainable Drainage Systems - Design manual for England and Wales (CIRIA)
- Design and Construction Guidance – DCG, (formally Sewers for Adoption)
- Sewerage Sector Guidance document (SSG) where drainage systems are to be offered for Adoption.
- BS 8000-14: Workmanship on Building Sites: Code Of Practice For Below Ground Drainage
- The Local Authorities guidelines, requirements and regulations

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 development aims to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

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.

To give a design life of 60 years, with minimum embodied energy, the buried pipe work will generally be vitrified clay where possible and cast iron when laid below or casting within or through foundations or the buildings structures. Chambers will generally be either polypropylene inspection chambers (if less than 1.2m to invert) or pre-cast concrete manholes (deeper than 1.2m to invert and in vehicle access areas), this is subject to availability of space. Non-entry polypropylene inspection chambers will be used where required up to depth of 3.0m. Foul drains will generally be DN150 to minimise the risk of blockage while connections from appliances and stacks will generally be DN100 to maintain self-cleansing flows.

The actual below ground drainage sizes will be determined once the flow rates are available from building services engineers, during the detailed design development stages.

4. PROPOSED DRAINAGE

4.1 Existing Surface Water Discharge Rate

The existing surface water runoff rate for this site has been calculated by return period as follows:

Table 1: Existing Surface Water Discharge Rates.

Storm Event	Average Rainfall intensity (mm/hr)	Discharge Rates (l/s)
1 in 1	12.800	367.32
1 in 30	30.811	884.18
1 in 100	40.510	1162.51

4.2 Proposed Surface Water Discharge Rates

The proposed development will increase the impermeable area and therefore the surface water runoff rate. It is proposed that in line with UK design guidance and best practice the site will improve, reduce and better the discharge rate for this catchment to the Greenfield run off rate (Q bar). This has been derived from the HR Wallingford IH 124 methodology and based on an assumption that the ground will be "Made Ground". This results of this calculation by return period is as follows:

Table 2: Proposed Surface Water Discharge Rates.

Storm Event	Greenfield Run off Rate (l/s)
Q_{Bar}	43.21
1 in 1	37.16
1 in 30	75.61
1 in 100	102.39

The surface water attenuated to the above (Q bar) rate of 43.21 l/s will discharge to the Holme Beck subject to approval.

4.3 SUDS Analysis

The MicroDrainage modelling system was used to configure approximate storage estimates based on the greenfield run off rates estimation method as specified by HR Wallingford taking account of the impermeable areas. The greenfield runoff rate estimation tool from HR Wallingford was developed to facilitate easy calculation of greenfield runoff rates for new developments. It has been calculated that the proposed storm water attenuation system will require between 2284 and 3312m^3 of storage volume, this being calculated in order to retain a 1 in 100-year 24-hour storm event (inclusive of a 40% allowance for Climate Change) without causing any surface flooding on the site.

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. Due to existing site contamination, 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. Additionally, the possibility of infiltration is also limited due to the ground condition. It has been identified that the following options may be available as an attenuation medium to provide the large volumes required:

- Lined Pond
- Lined Below Ground Attenuation Tank
- Rainwater Harvesting for use in post processing

A surface water drainage sketch is included in the Appendix 1. This design is based on the following assumed catchments discharging into the two attenuation options.:
Catchment 1 (Pond): 21452m^2
Catchment 2 (Tank): 23407m^2

These catchments have been designed to minimise the contributing impermeable area through the use of soft landscaping and gravelled areas which will be allowed to drain naturally.

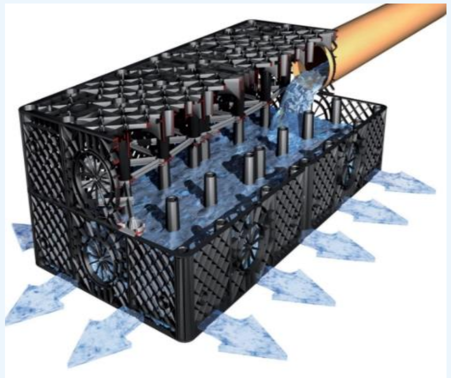
The surface water drainage system will connect to Holme Beck culvert as designed by Stantec and is understood to be approximately 4m depth below ground and runs at a gradient of 1:100 over a 3m length.

The benefit of this hybrid approach is that it allows the utilisation of the lined pond to serve all impermeable areas in close proximity with all connections achieved by gravity. The tank, being below surface level, can then be used to serve the areas of the site that are further away and would preclude a connection to the pond without making the pond excessively deep.

Due to the anticipated depth of the upstream network and tank it will be necessary to pump the discharge from the tank to the Holme Beck. Dependent on the final pond arrangement and landscape levels it may also be necessary to pump the discharge from the pond if a connection to the Holme Beck culvert cannot be achieved by gravity.

In producing this strategy, a feasibility assessment of viable SuDS measures has been undertaken to ensure that surface water is appropriately managed given the existing site constraints. Table 3 below outlines how each element of the drainage hierarchy has been considered during the development of the surface water strategy.

Table 3: Assessment of SuDs features

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 will be 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.	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.	

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 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.	
Discharge rainwater direct to watercourse	Y	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	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 combined sewer	Not Relevant	No surface water within this development will discharge into a combined sewer

5. FIRE WATER

As part of the drainage strategy, it is necessary to consider the treatment of fire water for the Tees Valley Development. Fire fighters must have immediate access to adequate supplies of water. The access to, and proximity of, those water supplies directly affects the resources that fire, and rescue authorities need to provide in protecting and mitigating their communities from the effects of fire. Therefore, a significant volume of water must be considered. The below sections detail the risks fire water poses and how it is proposed to capture and dispose of this water.

5.1 Surface water contamination prevention

Due to the nature of the site, there is a risk of fire and water used to fight this could enter the surface water drainage system which discharges to the Holme Beck. This fire water is potentially contaminated as a result of the fire; therefore, specific measures have been taken to prevent fire water entering the Holme Beck . These measures include the use of penstock valves incorporated on the outfalls into Holme Beck to allow total isolation of the drainage to the Beck to prevent fire water from contaminating the surface water system.

5.2 Fire water storage volume

The proposed sprinkler system has a supply tank of volume 1860m^3 storage. The proposed surface water system has been designed to accommodate this and an additional 10m^3 of storage for fire tenders.

This total volume of "used" fire water, 1870m^3, will be stored to prevent it from entering the existing watercourse and allow it to be removed from the site by tanker. It is anticipated that the fire water will enter the drainage system through the surface level features such as gullies, if the SuDs attenuation features are not full then any available water will be stored in the SUDs feature. If SUDs features are full then additional storage is provided in the free board of the pond, the pipe network and within the raised kerbs.

5.3 Assessment of Storage in SUDs Features During Non-Critical Storms

Further analysis has been conducted to assess the capabilities of the SuDs attenuation system should the firewater require storage, see Table 4. The SUDS storage will only be full in the critical return period, 100 years + 40% climate change, where the full volume of 2969m^3 is required. In all the lower, non-critical return periods there is available volume within the tanks and pond. These available volumes for fire water storage are shown in the table below.

Table 4: Analysis available storage for fire water by storm event.

Storm Event	Available Storage for Fire Water (m^3)
1 in 1	2447
1 in 10	1178
1 in 30	559.3
1 in 100 + 40% cc	0

The available storage available shown above has been calculated as the difference between the storage required for a 1 in 1 year, 1 in 10 year and 1 in 30 storm and the total attenuation capacity. Table 4 demonstrates that the attenuation system has sufficient capacity to store the majority of the proposed fire water up to but not including the 1 in 30-year return period. In storms of 1 in 30 year or above the emergency fire water storage situation will be incurred as detailed below.

5.4 Emergency fire water storage

As stated in section 5.2, if the SUDs features are full (during a 1 in 30 and 1 in 100 year + 40% CC storm) then fire water storage will be provided within the freeboard of the pond. The proposed lined pond has 300mm of freeboard included within its design which provides an additional volume of 445m^3 should emergency storage be required for fire water. Any remaining fire water will additionally be stored within the pipe network and will be retained at surface level by raised kerbs.

This analysis demonstrates the development has sufficient capacity to store the firewater should it be required.

6. GROUND CONTAMINATION

6.1 Source Documentation

Remediation of the wider Grangetown Prairie (and by extension the site) has been designed for a generic commercial land use. The details of the remediation design are outlined in the following report:

- Arcadis (2020). Remediation Options Appraisal and Enabling Works and Remediation Strategy Report (DRAFT), Grangetown Prairie Area, Former Steelworks, Redcar, ref. 10035117-AUK-XX-XX-RP-ZZ-0066-01-Prairie ROA and Strategy[1];
- Arcadis (2021). Remediation and Earthworks Verification Report, South Tees Development Corporation, ref, 10035117-AUK-XX-XX-RP-ZZ-0351-03-TVERF_Verification[2].

6.2 Remediation Activities

A summary of the enabling works and remediation activities that have been undertaken across the wider Grangetown Prairie site is included in the Arcadis ROA and Strategy is presented as Table 5 below.

[2] Arcadis (2021). Remediation and Earthworks Verification Report, South Tees Development Corporation, ref, 10035117-AUK-XX-XX-RP-ZZ-0351-03-TVERF_Verification.

Table 5: Remediation Activities

Remediation Activities	Benefit
Enabling works	
Removal and processing of relic underground structures and foundations for reuse, to a depth of 2.5 mbgl. The requirement to remove areas of deeper structures or foundations if encountered, to be assessed on a case by case basis.	Remove potential sources of risk to human health in soils across Grangetown Prairie (arsenic, asbestos, NAPL, cyanide) and improve geotechnical suitability of site for development
Screening and crushing of Made Ground materials in order to make suitable for re-use.	
Treatment of excavated soils impacted with NAPL in line with recommended processes identified within the ROA.	
Segregation of soils with ACM for treatment and reuse.	
Segregation and processing of refractory materials and potentially expansive slag deposits for re-use.	Remove potential contaminant source across Grangetown Prairie and improve geotechnical suitability of site for development
Dewatering of below-ground structures and excavations with management, treatment and disposal of water.	Net reduction of contaminated groundwater on site via off-site disposal.
Backfill of excavations to leave the site safe and level, with verified Made Ground, certified demolition arisings, crushed concrete or imported fill.	Restoration of site to foundation level following enabling works
Remediation	
Remediation of soils impacted with contaminants above Remediation Criteria through capping of materials to manage source-pathway receptor linkages	Removes pathway between residual contaminants in soils (if any remain following enabling works) and future site users

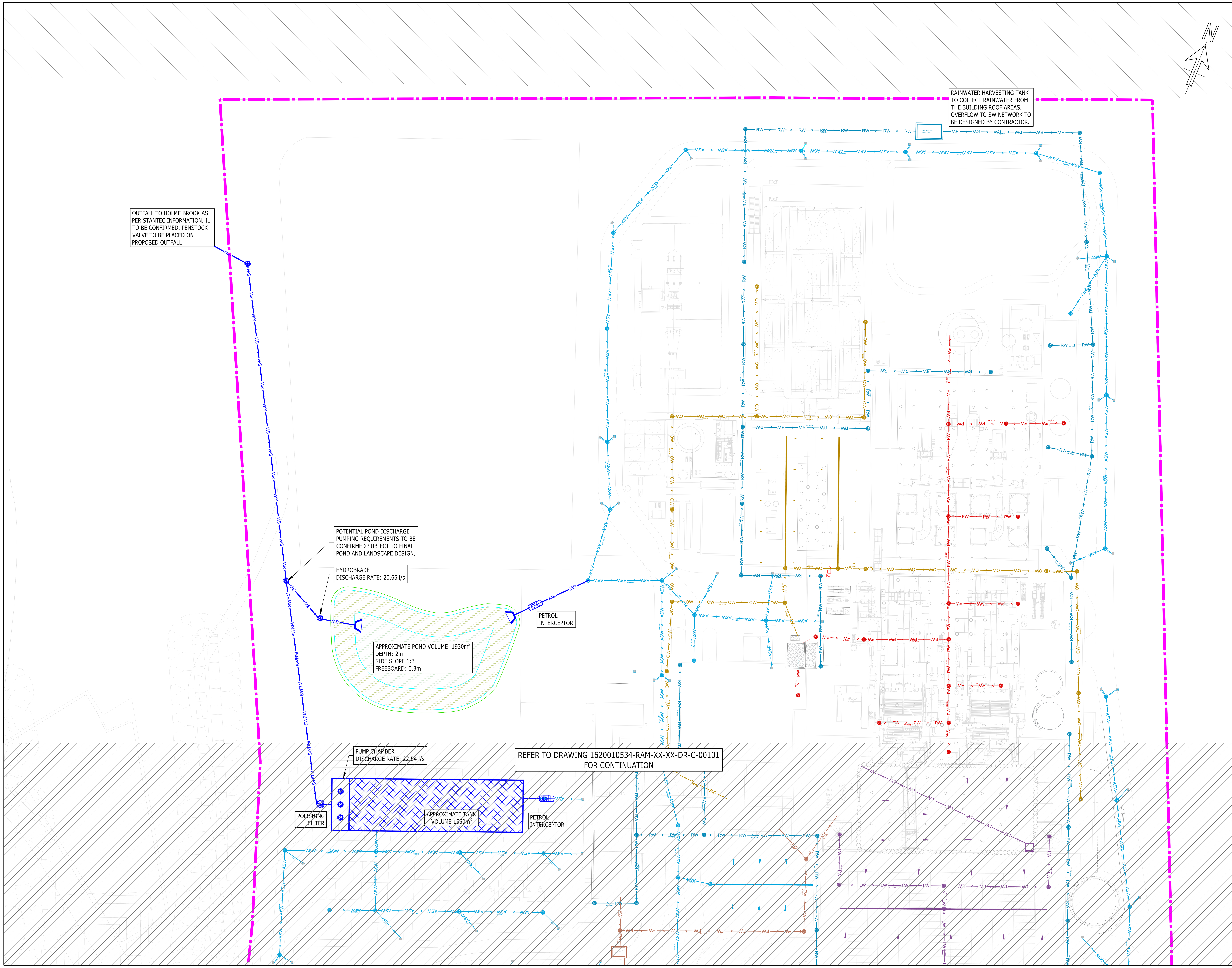
Made Ground was to be excavated, treated and replaced across the site as indicated in Table 4. The potential ground contamination risks identified in the updated CSM presented as part of this report align with those identified across the wider Grangetown Prairie by Arcadis.

6.3 SuDs

The localised permeable surfaces may have the potential to promote localised increases in soil leaching through infiltration of surface water into the underlying strata. The surrounding area is considered by Arcadis and Stantec to be of low sensitivity due to the industrial setting, low permeability of underlying geology and distance to potentially sensitive receptors. Provided that the upper ~2.5 m of soil has been remediated to the Water Resources compliance criteria to be confirmed by the Arcadis DQRA as required by Section 7.3 of the ROA and Strategy, which has been demonstrated to have been completed in the Verification Report,, it is expected that the potential for leaching of additional contaminants to groundwater via the permeable surfaces will be minimised.

It is recommended that excavations undertaken during construction of the SuDS (including the lined pond, attenuation tank and localised permeable surfaces) should be undertaken following the completion of the enabling works outlined by the ROA and Strategy. This should be undertaken in line with the Works approach detailed in Section 7.3 of the ROA and Strategy, in particular recommendations for groundwater management and unexpected contamination. A watching brief and validation sampling exercise should be undertaken during the excavation of the SuDS in line with the compliance criteria outlined in Section 7.3.7 of the ROA and Strategy. Provided that the upper ~2.5 m of soil has been remediated to the Water Resources compliance criteria to be confirmed by the Arcadis DQRA as required by Section 7.3 of the ROA and Strategy, which has been demonstrated to have been completed in the Verification Report, it is expected that the potential for leaching of additional contaminants to groundwater via the SuDS will be minimised.

APPENDIX 1
SURFACE WATER DRAINAGE LAYOUT



Notes

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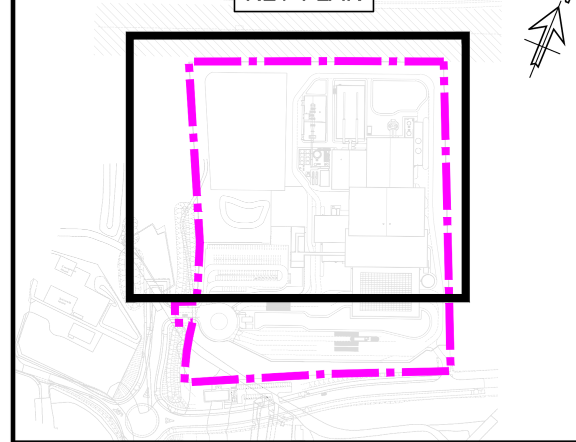
   - ACCIONA UNDERGROUND NETWORKS DRAWING RECEIVED 15.09.2021.
5. THE ONSITE NETWORK SHOWN IN THE DRAWING IS BASED ON ACCIONA UNDERGROUND NETWORKS DRAWING AND HAS BEEN MODIFIED TO ALIGN WITH SUDS FEATURES.

KEY:

- SITE BOUNDARY
- ACCIONA STORM WATER DRAINAGE
- ACCIONA ROOF WATER DRAINAGE
- ACCIONA PROCESS WATER DRAINAGE
- ACCIONA OILY WATER DRAINAGE
- ACCIONA SEWAGE WATER DRAINAGE
- ACCIONA LEACHED WATER DRAINAGE
- SURFACE WATER DRAINAGE
- SURFACE WATER RISING MAIN
- ATTENUATION TANK
- ATTENUATION POND

KEY PLAN



Rev	Description	Date	By / Chk	App
P03	STAGE 2 ISSUE	03.03 2023	EA DS	SP
P02	STAGE 2 ISSUE	15.10 2021	MES DS	LS
P01	PRELIMINARY ISSUE	26.05 2021	KT DS	DS

STAGE 2

TEES VALLEY ENERGY RECOVERY FACILITY

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PRELIMINARY SUDS ATTENUATION STRATEGY SHEET 1

Project No:	Scale (@A1):	Drawn:	Date:
1620010534	1:500	KT	MAY 2021

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RAM-XX-XX-DR-C-00100	P03

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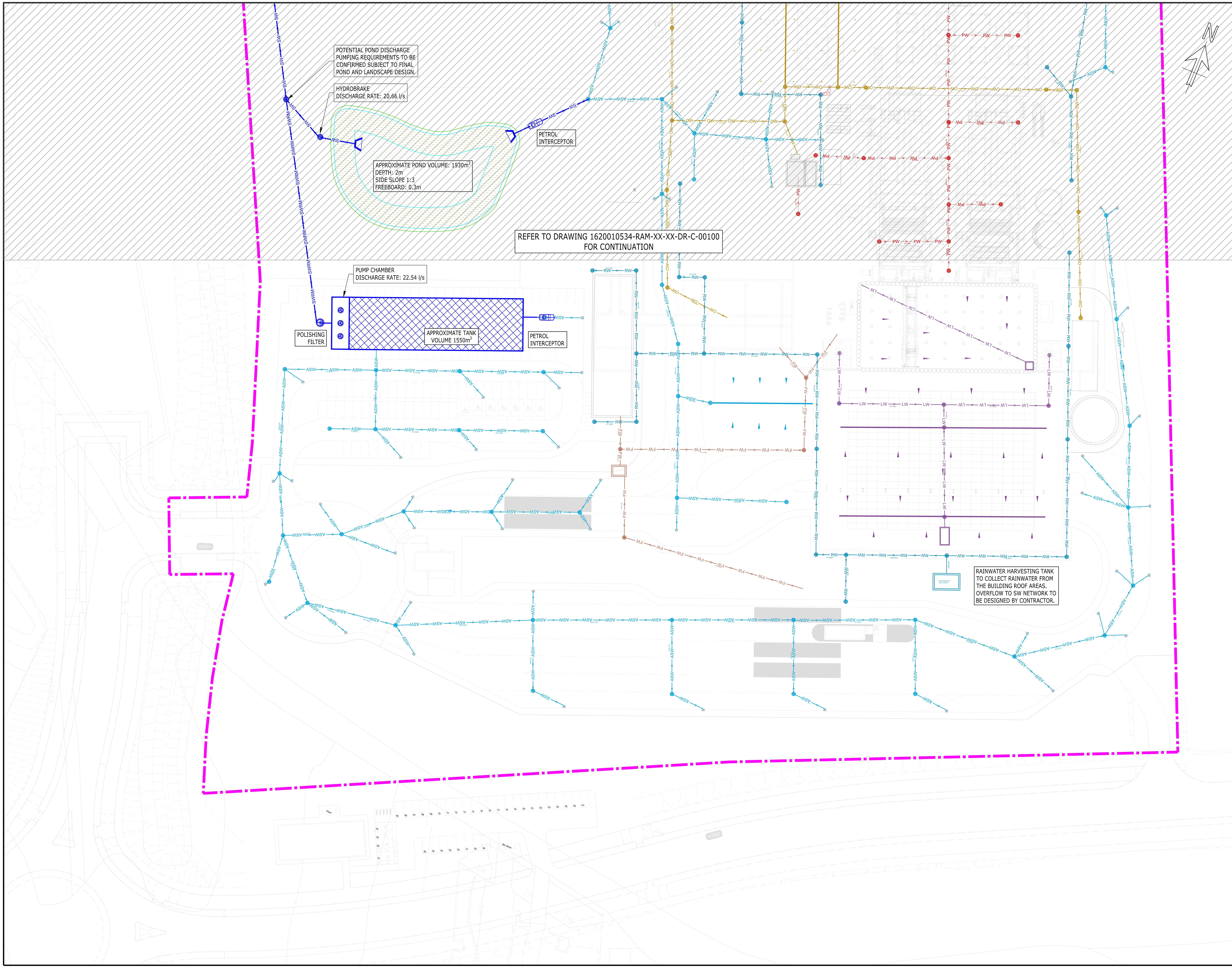

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- SURFACE WATER RISING MAIN
- ATTENUATION TANK
- ATTENUATION POND

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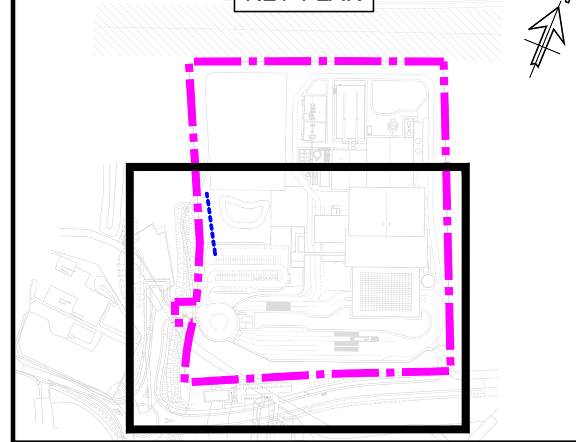

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