QinetiQ – Fort Halstead

Proposed QinetiQ Enclave Surface Water Drainage Strategy

Report reference- 30002236-BHK-XX-XX-RP-C-0001

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Approval and Revision History

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Document Title:	Proposed QinetiQ Enclave – Surface Water Drainage Strategy
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Contents

1 Scope

1.1 Introduction

This document provides the strategy for the surface water drainage design of the proposed QinetiQ enclave at Fort Halstead and has been produced to support a detailed planning application for the site.

Works to the proposed QinetiQ enclave comprise the erection of perimeter security fence, erection of a new reception building, creation of a new main site entrance along Crow Road, refurbishment of existing buildings including plant installation, creation of a new surface level car park and access, installation of two new explosive magazine stores and surrounding Pendine block walls, demolition of existing buildings, installation of 6 no. storage containers, installation of new site utilities, landscaping and ecological works.

This report captures the design philosophies and parameters that form the basis of the surface water design for the new external works, which comprise a staff car park, a plant room and the main site access road, visitor parking and gatehouse area.

1.2 Limitations

Note that there are currently limitations to this strategy as follows:

- The ground investigation to ascertain the infiltration / permeability rates for the deep bore soakaway design is outstanding; and
- The level of drainage modelling carried out to date is preliminary at this stage and is subject to further refinement once the design enters the next stage.

2 Site Description

The Fort Halstead site is located on the North Downs to the north-west of Sevenoaks, Kent.

The site address post code is TN14 7BU. Figure 1 below shows the site location:

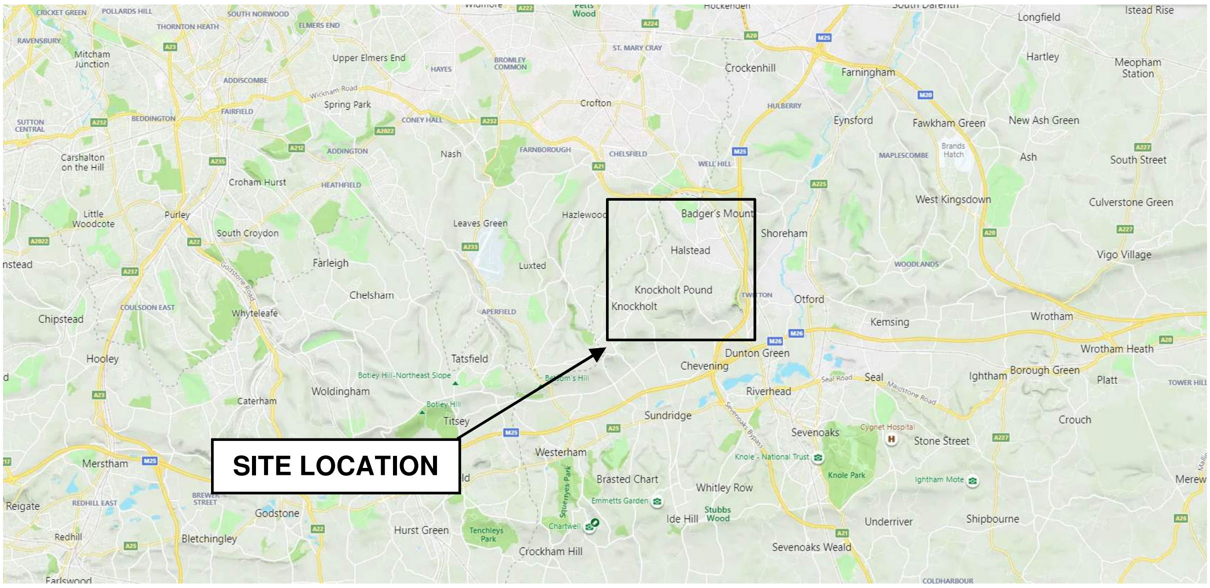


Figure 1 – Location Plan (Source: Bing Maps)

The QinetiQ enclave is situated in the south-west quadrant of the site, as indicated in Figure 2 below.

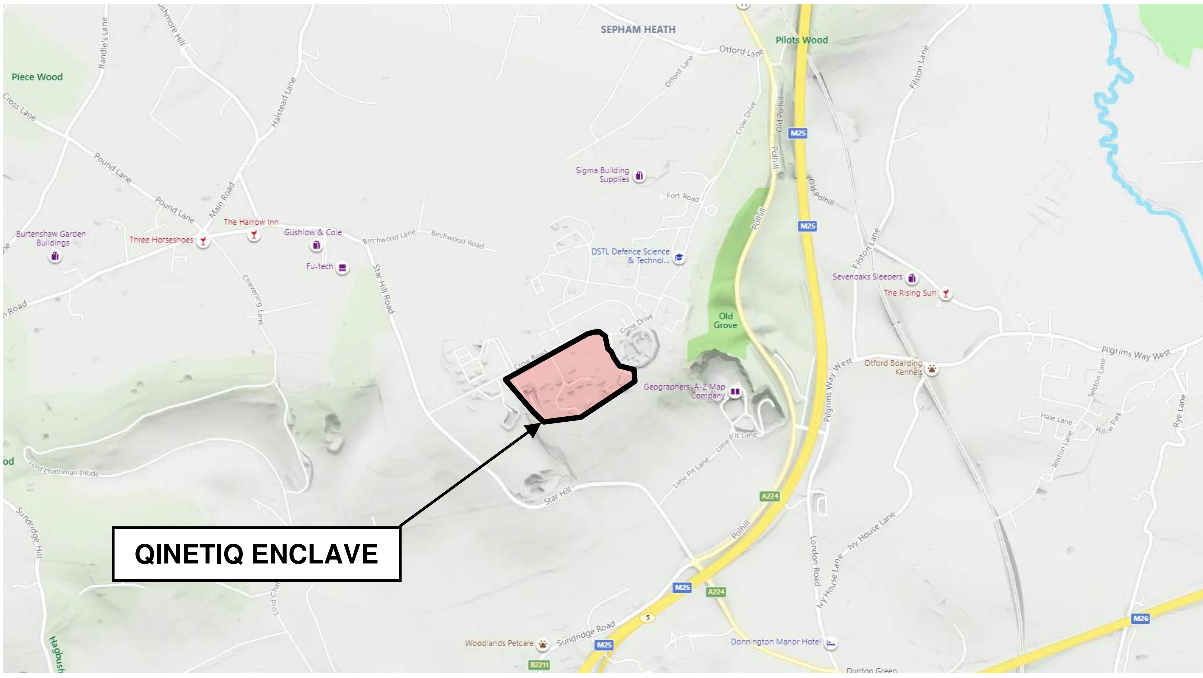


Figure 2 – Site Plan (Source: Bing Maps)

2.1 Existing Site Information

The external works are along the north side of the QinetiQ enclave, where the site topography is predominantly level, falling approx. 2 metres from west to east over a distance of about 250m.

To the west of Building X78, there is a grassed area with some mature trees. Between Buildings X78 and X48, there are some areas of hardstanding where buildings have been demolished, and an existing electrical sub-station and access road.

The ground conditions are known to comprise superficial deposits of clay with flints (approx. 5m to 6m deep) underlain by chalk bedrock. The thickness of the chalk bedrock is extensive as it forms part of the primary aquifer in the area, however it is known that the chalk outcrops along the south side of the QinetiQ enclave. Further details can be found in Appendix A.

3 Existing Drainage Infrastructure

3.1 Existing Features/Networks

There are 3 types of existing drainage networks associated with the QinetiQ enclave:

- Surface (roof & pavement)
- Domestic Foul
- Chemical (Building X48 only)

Archive records from the early 1990s for Buildings X78, X79 & X48 at the north of the proposed QinetiQ enclave show the existing surface run-off utilising large diameter soakaways for discharging at source. These are typically 2.5m internal diameter and between 7.5m to 8.5m deep. This has been verified by a drainage/CCTV survey carried out in 2020 by Warner Surveys, indicating 3 no. soakaways for X78, 1 no. for X79 and 4 no. for X48. According to the record drawings, these soakaways penetrate 2.5m into the underlying chalk. There is no information available on the infiltration / permeability rate used for the design of this system.

Existing roads and paved areas adjacent to Building X78 drain into road gullies and then into the existing surface water network.

3.2 Existing Flood Risk

Hydrock has prepared a flood risk statement for the QinetiQ enclave site (ref. 10730-HYD-XX-XX-RP-FR-0001 dated 27th May 2021) and has concluded that the site is within Flood Zone 1 and at low risk of flooding from all assessed sources. The proposed development is therefore concluded to meet the flood risk requirements of the National Planning Policy Framework, in terms of the Sequential and Exception Tests.

4 Proposed Surface Water Drainage

4.1 Contributing Areas

The areas of proposed surface water drainage are indicated in Figure 3 below.

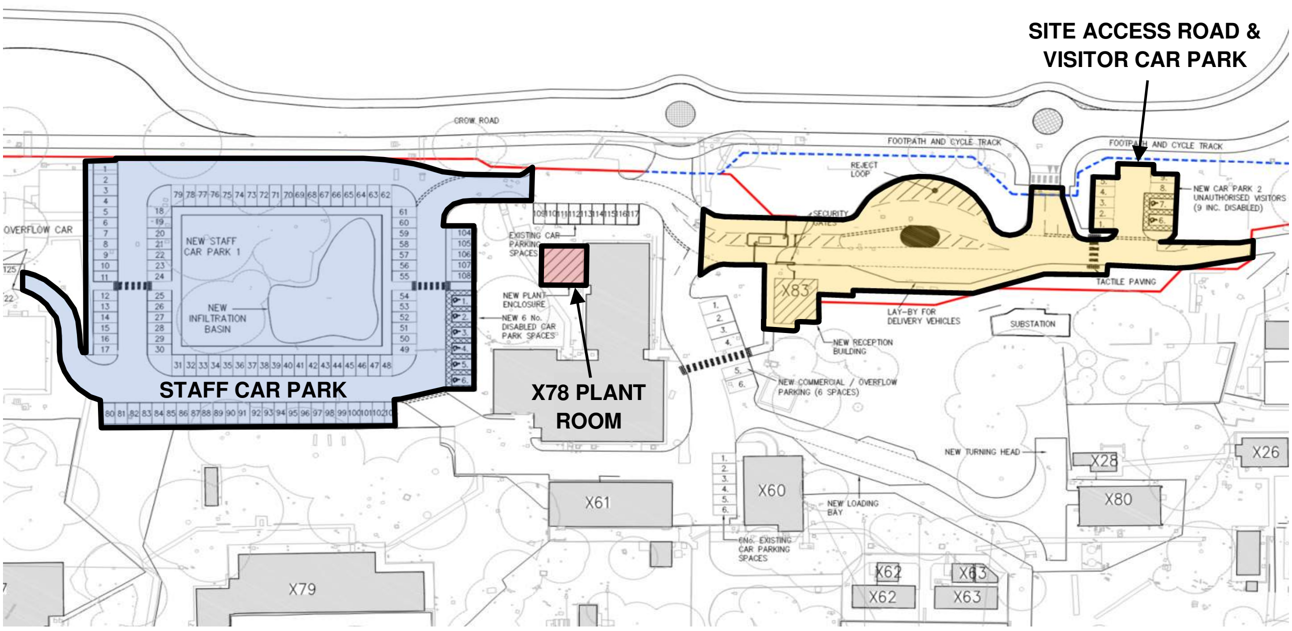


Figure 3 – Areas of proposed SW drainage along the north side of the QinetiQ enclave

The contributing areas and impermeable areas of each zone are set out in the following table:

Zone	Contributing Area	New Impermeable area	Existing Impermeable area
Staff car park	0.463 ha	0.310 ha	0.048 ha
X78 plant room	0.008 ha	0.008 ha	0.001 ha
Site access road & visitor car park	0.214 ha	0.202 ha	0.034 ha
Total	**0.685 ha**	**0.520 ha**	**0.083 ha**

Table 1 - Areas in key zones

The additional surface water run-off from the staff car park, site access road, gatehouse area & visitor car park will be accommodated in two new surface water drainage systems, for the staff car park and the site access road & visitors car park. The new surface water management system will be designed to drain the site effectively without putting pressure on existing surface water systems and allows for the interception of hydrocarbons from roads and parking areas.

The additional surface water run-off from the X78 plant room area will be accommodated within the existing surface water drainage system, discharging to an existing large diameter soakaway.

The site catchment area for the staff car park mostly consists of current greenfield areas which will become new impermeable areas to form the new roads and car parking areas. The site access road and visitor car park will be formed on areas where former buildings have been demolished, which is a mixture of soft and hard landscaping.

4.2 Below Ground Design Parameters

The following criteria has been used in the design of the below ground drainage system:

- FSR rainfall data for storm event simulation;
- M5-60 = 20.1mm (Fig 6.1. of Design and Analysis of Urban Storm Drainage – Wallingford Procedure, Volume 1 October 1981);
- Ratio R = 0.35 (Fig 6.2. of Design and Analysis of Urban Storm Drainage – The Wallingford Procedure, Volume 1 October 1981);
- Volumetric runoff coefficient for roof and hard-standing areas, C_V = 0.75;
- Routing coefficient for roof and hard-standing areas, C_R = 1.30;
- Time of entry for roof and impermeable surface areas will be 5 minutes (Design and Analysis of Urban Storm Drainage" – The Wallingford Procedure, Volume 1 October 1981, Section 7.10);
- Pipe roughness value 'k_s' = 0.6mm for surface water pipes (Clause B3.1.3, SSG Appendix C);
- Minimum pipe diameter for the main drain runs = 150mm (excluding building connections); and
- Minimum flow velocity of 1.0 m/s at pipe full flow to avoid siltation (Clause C7.2.3, SSG Appendix C)

4.3 Pavements

For the staff car park area, pavement run-off is to road gullies and a filter drain along the south side, then through a by-pass separator prior to discharging via an infiltration basin to soakaways.

The main site access road, gatehouse area and visitor car park drainage, pavement run-off is to road gullies and a filter drain to the north of the HGV reject loop, then through a by-pass separator prior to discharging via an attenuation tank to soakaways.

4.4 Roofs

Roof run-off from the new X78 plant room will be captured and conveyed by conventional gutter and downpipes to the existing below ground drainage network which discharges directly into an existing soakaway.

4.5 Soakaway System

The new soakaway system located in the central area of the staff car park comprises an infiltration basin with a gravel filter bed and several deep bore soakaways.

The new soakaway system located to the east of the visitor car park comprises cellular storage units forming an attenuation tank, over several deep bore soakaways.

Infiltration rate testing for the soakaway design has been specified and is due to be carried out on site to allow the detailed design and sizing of the soakaways. For the RIBA Stage 3 design, an infiltration rate of 3.0×10^{-5} m/s has been assumed; however, it is strongly recommended that this rate is confirmed through further testing. There is no information available for the original soakaway design dating from the early 1990s.

(Reference 1: Geo-environmental Data Review & Assessment – Executive Summary and Sections 5.6, 6.4 & 10)

4.6 Proposed Layouts and Design

Refer to the RIBA Stage 3 Proposed Drainage Layouts & Details drawings shown in Appendix B:

30002236-BHK-00-XX-DR-C-7201 Sheet 1 (for the staff car park area)
30002236-BHK-00-XX-DR-C-7202 Sheet 2 (for site access road, gatehouse area & visitor car park)
30002236-BHK-00-XX-DR-C-7203 Details Sheet 1

4.7 Hydraulic modelling

The proposed surface water networks have been modelled and simulated using Innovyze Microdrainage 2019.1. The actual attenuation volumes for the soakaways and all SuDS techniques discussed in section 5.1 have been verified to give the minimum and maximum volume storage requirements for the storage discharge designs using an assumed infiltration rate for chalk material of 3×10^{-5} m/s (0.108 m/hr).

SuDS system and associated drainage conveyancing systems should be able to accommodate the critical storm whilst minimising any flooding risks for 1 in 100-year rainfall storm event plus 40% Climate Change.

Surface water attenuation to be designed for and simulated for the following:

- 1:30 year rainfall event; and
- 1:100 year rainfall event + 40% climate change

Modelling has been undertaken for the two main catchments in source control. The modelling results with incorporated SuDS techniques can be summarised for the two main catchment areas as follows:

Area	Storm Event	Climate Change	Status
Main Car Park	2 years		OK
	30 years		OK
	100 years	40%	Surcharged
Main Site Access Road & Visitors Car Park	2 years		OK
	30 years		OK
	100 years	40%	OK

Table 2 - Summary of Hydraulic Modelling results

An extract from the results table in MicroDrainage Source Control is shown below. The results show modelling of one sixth of the impermeable area and this was used to model and size a single deep borehole soakaway. This represents an initial higher level assessment based on the infiltration rate assumed in section 4.4. It is expected that this assessment will be reduced if a lower return period is accepted and confirmation of improved infiltration rates is obtained.

In accordance with BRE 365 a soakaway should be able to discharge from full to half volume within 24 hours in readiness for any subsequent storm inflow. According to the results below this drain time is achieved in less than 24 hours for a 1 in 100 year plus 40% Climate Change storm event.

Micro Drainage

Summary of Results for 100 year Return Period (+40%)

Sort by Event

Half Drain Time : 1406 minutes.

Storm Event	Rain (mm/hr)	Time to Vol Peak (mins)	Max Water Level (m)	Max Depth (m)	Flooded Volume (m³)	Max Filtration (l/s)	Σ Max Outflow (l/s)	Maximum Volume (m³)	Status
15 min Summer	132.574	19	213.045	8.245	0.0	0.2	0.2	12.2	O K
30 min Summer	89.043	34	213.186	8.386	0.0	0.2	0.2	16.3	O K
60 min Summer	57.005	64	213.335	8.535	0.0	0.2	0.2	20.7	O K
120 min Summer	35.167	124	213.482	8.682	0.0	0.2	0.2	25.0	O K
180 min Summer	26.084	182	213.560	8.760	0.0	0.2	0.2	27.2	O K
240 min Summer	20.967	242	213.608	8.808	0.0	0.2	0.2	28.6	O K
360 min Summer	15.431	362	213.671	8.871	0.0	0.2	0.2	30.5	O K
480 min Summer	12.393	482	213.707	8.907	0.0	0.2	0.2	31.5	O K
600 min Summer	10.446	602	213.727	8.927	0.0	0.2	0.2	32.1	O K
720 min Summer	9.079	722	213.736	8.936	0.0	0.2	0.2	32.4	O K
960 min Summer	7.270	960	213.735	8.935	0.0	0.2	0.2	32.4	O K
1440 min Summer	5.305	1224	213.702	8.902	0.0	0.2	0.2	31.4	O K
15 min Winter	132.574	19	213.096	8.296	0.0	0.2	0.2	13.7	O K
30 min Winter	89.043	33	213.255	8.455	0.0	0.2	0.2	18.3	O K
60 min Winter	57.005	64	213.422	8.622	0.0	0.2	0.2	23.2	O K
120 min Winter	35.167	122	213.591	8.791	0.0	0.2	0.2	28.2	O K
180 min Winter	26.084	180	213.681	8.881	0.0	0.2	0.2	30.8	O K
240 min Winter	20.967	240	213.738	8.938	0.0	0.2	0.2	32.4	O K
360 min Winter	15.431	356	213.815	9.015	0.0	0.2	0.2	34.7	O K
480 min Winter	12.393	472	213.861	9.061	0.0	0.2	0.2	36.0	O K
600 min Winter	10.446	590	213.889	9.089	0.0	0.2	0.2	36.8	O K
720 min Winter	9.079	702	213.906	9.106	0.0	0.2	0.2	37.3	O K
960 min Winter	7.270	930	213.917	9.117	0.0	0.2	0.2	37.7	O K
1440 min Winter	5.305	1358	213.892	9.092	0.0	0.2	0.2	36.9	O K

Table 3 - Extract of summary of results for a soakaway from staff car park - Source Control

The drainage for the staff car parking area is to be is to be collected via pipework, gullies, catchpits and channelled through the oil interceptor and outfall to the dry basin underlain with gravel filter material (see drawing no. 30002236-BHK-00-XX-DR-C-7204). The basin is to provide a maximum storage volume of 280m³. Several deep borehole soakaways of 1m diameter are to be evenly distributed along the basin to discharge surface runoff to 8 metres below the base of the infiltration basin.

Drainage for the main site main access road and visitor car park will be collected via gullies, filter drains, catchpits, manholes and through an oil interceptor to a geo-cellular storage unit. This will have a maximum capacity of 135m³ and will discharge the surface water via deep borehole soakaways evenly distributed at the base of the cellular units.

The oil interceptors will incorporate a non-return valve to prevent back surcharge of upstream pipes and to help in controlling contaminated discharges to the soakaways in the event of a major oil spillage. The oil interceptors will be fitted with high-level alarm sensors for monitoring and maintenance purposes.

In conclusion, the drainage networks modelled for the staff car park and the site access road / visitor car park areas with surface water disposal to deep bore soakaways locally are satisfactory. When information on improved infiltration rates is available, and a lower return rate is accepted, the design can be developed for RIBA Stage 4 incorporating a reduced number of smaller diameter soakaways.

4.8 Alternative solutions

As outlined in Section 5.1, the National Planning Policy Framework (NPPF) provides a hierarchical approach to surface water disposal in the following order of priority:

Infiltration

As an alternative to soakaways locally, there could be an option to construct swales and grass lined channels to follow the natural topography, allow the surface water to collect away from the car parks and site access road, and provide deep bore soakaways at these locations. However, this would involve considerable lengths of additional below ground drainage crossing existing site roads and services, and extensive removal of mature trees in the southern area of the QinetiQ enclave. Whilst feasible, there are considerable disadvantages compared to the preferred scheme.

Another alternative would be to avoid concentrating the deep bore soakaways in one location but to place them in various open areas. Although possible, the available open spaces are limited, and might require additional oil interceptors to help manage the quality of the flow. Remote soakaways in this area would also be limited by the presence of mature trees, which would not allow enough space for infiltration basins or underground tanks, both of which are SuDS features of the preferred scheme.

Discharge to watercourses

The distances to the nearest watercourses are approx. 1.1 km east and 1.5 km south of the site and would likely require discharges to be pumped. Consequently, it is unlikely that these would provide suitable outfalls compared with the preferred scheme.

Public sewers

There are no public surface water sewers within the vicinity of the site and no information available on other surface water infrastructure. The nearest possible outfall would be to a balancing pond believed to serve the M25 motorway, requiring extensive off-site civil engineering and approvals. Both the timescale and financial cost would be substantial compared with the preferred scheme.

5 Sustainable Drainage Systems (SuDS)

5.1 Selection Assessment

The SuDS selection assessment for the site has been carried out following the guidelines from CIRIA C753 The SuDS Manual and in accordance with Building Regulations Part H surface water disposal hierarchy as below:

	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
Most Sustainable	Living roofs	✔	✔	✔
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✔	✔	✔
	Filter strips and swales	✔	✔	✔
	Infiltration devices - soakaways - infiltration trenches and basins	✔	✔	✔
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviors	✔	✔	
Least Sustainable	Tanked systems - over-sized pipes/tanks - storms cells	✔		

Table 4 – SuDS hierarchy

In accordance with National Planning Practice Guidance (NPPG) which clarifies that SuDS should be provided for all major developments, the hierarchy of drainage options is reasonably practicable, as follows:

i. Into the ground (infiltration);

ii. To a surface water body;

iii. To a surface water sewer, highway drain or another drainage system; and

iv. To a combined sewer.

The use of SuDS has been included in the design. SuDS sets out to address the quality and quantity of the surface water runoff as well as introducing ways of improving the quantity, quality, amenity value and biodiversity potential of the external works. The key features where SuDS are likely to be considered and introduced will be the proposed impermeable surfaces of the development (i.e. the car parking areas and the site access road).

To understand exactly which SuDS techniques could be used on the site, a SuDS selection assessment has been undertaken. The following techniques are to be incorporated in the removal of surface water from the proposed site parking areas and access ways:

i. Infiltration group;

ii Filtration group; and

iii Detention group.

For the new car parking areas and access roads the following SuDS techniques are to be incorporated:

SuDS Technique	**Considerations**	**Applicable to Project?**
Filter Trenches	The filter trenches help collect surface runoff and is recommended to help remove particulate pollutants for the collection and removal of surface runoff, helping to filter pollutants from the surface water runoff.	Yes
Soakaways	The proposed site is made up of superficial deposits of Clay with flints underlain by Chalk bedrock. The upper level geology consists of made ground over clay, which has very low permeability. Due to the deep underlying chalk formation, deep bore soakaways are to be constructed for the discharge of all the surface runoff generated from the site.	Yes
Basins and Ponds	The new staff car parking area has enough space in the centre sufficient to include a basin or pond. A dry basin with underlying granular material is proposed to allow temporary storage and conveyance through perforated pipes to the underlying deep bore soakaways.	Yes
Geo-cellular Storage Units	For the access road and visitor's car park areas, due to the insufficient space for an above ground basin or pond to retain water before discharge to infiltration ponds, underground geo-cellular units are proposed.	Yes
Oil Separators	These are to be incorporated as part of the treatment train to prevent hazardous chemical, sediment and petroleum products from entering the groundwater system. These will be installed together with automatic monitors as required by BS EN 858.	Yes

Table 5 – SuDS technique review

The area west of Building X78 (proposed Staff Car Park) consists of a total area of approximately 3060 m^2 which is considered to accommodate the natural runoff in the area. As such this area is expected to be re-used to take runoff from the surrounding new impermeable pavements incorporating additional SuDS features to help introduce the required management train of flows before they can discharge into the ground.

Runoff from car parking impermeable areas, circulatory routes and access roads will be collected through French drains and gullies. This will be directed through an oil interceptor located at the south end of the car park which outfalls to a granular basin that filtrates runoff into the deep bore soakaways into the underlying permeable strata. These systems act to prevent surface pollutants from contaminating the underlying ground, together with the proposed oil interceptor before discharge to the soakaways.

5.2 Pollution Mitigation

The design has addressed potential sources of pollution that pose a risk to the water table. This has been done by using the analytical methodology set out in Chapter 26 of the SuDS Manual C753.

Chapter 26 of the SuDS Manual allows the assessment of water quality / level of pollution by considering the impact of Total suspended solids, Metals and Hydrocarbons by means of a Pollution Hazard Index. Once this is derived it is then possible to identify the analytical value of a mitigation technique(s) by means of a SuDS Mitigation Index to ensure adequate protection is provided. The successful design of a quality-based SuDS solution is obtained when:

Total SuDS Mitigation index ≥ Pollution Hazard index **Equation 1**

Calculation of the Pollution Hazard Index:

This is derived from Table 26.2 of the SuDS Manual which outlines different pollution hazard indices for different land use classifications. The relevant data for the Enclave site is summarised in the following table:

Enclave Land use locations	Pollution Hazard Level	Total Suspended Solids Pollution Index derived from Table 26.2	Metals Pollution Index derived from Table 26.2	Hydro-Carbons Pollution Index derived from Table 26.2
Car parking	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change, all roads except low traffic roads and trunk roads / motorways	Medium	0.7	0.6	0.7
Building roofs typical	Low	0.3	0.4	0.05

Table 6 – Extract from Table 26.2 of C753 Pollution Hazard Indices for different land use classifications

Calculation of the Total Mitigation Index:

The total mitigation index is calculated by assessing the mitigation potential of the different SuDS components that are expected to be introduced to help reduce the Pollution Hazard Index. In this case the data from Table 26.4 of the SuDS Manual can be used as a basis of determining this. Table 7 below provides a summary of the total mitigated index from each SuDS component expected to be introduced.

Enclave Land use locations	Perceived Hazard Pollution Level	SuDS Component Combination Considered	Total Mitigation against Suspended Solids	Total Mitigation against Metals	Total Mitigation against Hydrocarbons
Staff car park West (108 spaces)	Low	Filter Drain Infiltration basin By-Pass Separator	0.5	0.4	0.4
Access road & visitor car park (9 spaces)	Medium	Filter Drain By-Pass Separator	0.7	0.6	0.7
Building roofs typical	Low	Granular surround to deep soakaway	0.4	0.4	0.4

Table 7 – Extract from Table 26.4 Indicative SuDS Mitigation Indices for discharges to groundwater

Note to Table 7: Values reflect mitigation index of the first component + 0.5 (the mitigation index of the second and third component).

Comparison of Pollution Hazard Index against the Total Mitigation Index:

Table 6 and Table 7 can now be compared to ensure Equation 1 is satisfied. The results are shown in Table 8 below.

Enclave Land use locations	Assessment against	Pollution Hazard Index from Table 6	Total Mitigation Index from Table 7	Is the Total Mitigation index ≥ The Pollution Hazard Index?
Staff car park West (108 spaces)	Total Suspended Solids	0.5	0.5	Yes
	Metals	0.4	0.4	Yes
	Hydrocarbons	0.4	0.4	Yes
Access road & visitor car park (9 spaces)	Total Suspended Solids	0.7	0.7	Yes
	Metals	0.6	0.6	Yes
	Hydrocarbons	0.7	0.7	Yes
Building roofs typical	Total Suspended Solids	0.3	0.4	Yes
	Metals	0.4	0.4	Yes
	Hydrocarbons	0.05	0.4	Yes

Table 8 – Comparison of Pollution Hazard Index against Total Mitigation Index

It can therefore be seen from the results in Table 8 that the proposed mitigation measures outlined in Table 7 are expected to provide adequate pollution control to the surface water runoff against total suspended solids, metals and hydrocarbons at the three Enclave land use locations.

6 Access and Maintenance

Preliminary access and maintenance requirements are provided below for the drainage of roads and hard standings, soakaways and storage tanks. This will be developed in RIBA Stage 4 when the drainage design details are finalised.

6.1 Roads and Hard Standings

Reference	Routine Maintenance & Inspections	Repair / Replacement
Roads & hard standings	• Visual inspection • Visited and cleaned • Removal of silt and other sediments	The most likely long-term replacement works will be to damaged kerb units and to the surfacing.

6.2 Deep Bore Soakaways

Maintenance Schedule	Required Action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and manhole rings	Annually
	Trimming any roots that may be causing blockages	Annually
Occasional maintenance	Remove sediment and debris from pre-treatment components and manhole rings	As required based on inspections
Remedial Actions	Reconstruct soakaway if performance deteriorates or failure occurs	As required
Monitoring	Check soakaway to ensure emptying is occurring	Annually

6.3 Geo-cellular Storage Tanks

Maintenance Schedule	Required Action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly	Monthly for 3 months, then annually
Remedial Actions	Repair inlets, outlets and vents	As required
Monitoring	Check all inlets, outlets and vents to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

7 Conclusion

The drainage of the proposed new car parking areas and site access road can be managed by the infiltration, slowing and conveyancing to the proposed deep borehole soakaways. This is based on Based on the prevailing ground conditions as investigated through the British Geological Survey (see Appendix A - Geotechnical Assessment), Furthermore, the relatively flat topography of the site promotes infiltration and conveyance of surface runoff via filter drains and the infiltration basin helps ensure that the natural treatment processes work effectively

The SuDS system to be incorporated in the managing of surface water runoff from parking areas will filtrate through the following:

- **French drains with 150mm diameter pipes and catchpits** – Infiltration trenches filled with permeable granular material designed to promote infiltration into the underlying porous pipe to the base of trench that conveys runoff to the outfall.
- **By-pass Oil interceptor**
- **Infiltration basin** - Shallow grass-lined slopes with permeable granular material to base to help remove hydrocarbons and filtration media to the deep bore soakaways.
- **Discharge to the deep soakaways** – A minimum spacing of the localised deep bore soakaways has been kept for the effectiveness of the soakaways and to reduce the risk of instability. The soakaways should be evenly spaced to discourage significant volumes of water concentrating in a small area.

The attenuation volume needed for the west staff car park basin equals approximately 280m^3 and the attenuation needed for the small visitor car park/access road equals approximately 135m^3. This attenuation is needed to accommodate the anticipated increase in impermeable area of 0.437 Ha.

Although alternatives to soakaways have been considered, these would result in extensive drainage systems to convey surface water away from the site or towards the southern part of the QinetiQ enclave. The provision of soakaways is similar to the existing surface water drainage design along the north side of the QinetiQ enclave which allows surface water to be disposed locally.

With respect to helping to managing pollution risk on site, it is considered that there will be a need to introduce an oil interceptor in the staff car parking area. This will be a proprietary system be in accordance with Environment Agency Guidelines for pollution prevention.

As identified in Section 4, infiltration tests will need to be carried out to provide information for the detailed design of soakaways. Testing will be in accordance with the falling head permeability test to BS EN ISO 22282-2: 2012 and BS EN ISO 17892-11:2019 to confirm that soakaways are suitable in the proposed zones. A 5-metre exclusion zone should be kept from the edge of the proposed or existing buildings in the siting of soakaways. Within the infiltration basin for effectiveness and efficiency, a minimum distance of 10 metres is to be kept between the deep bore soakaways to encourage filtration and this has been considered for the site. The current designed infiltration rate has been taken as 3 x 10-5 m/s but it is strongly recommended that further testing is carried out on site to confirm this rate.

A SuDS maintenance and operational strategy should be considered on selection and implementation of the drainage SuDS strategy. Removal of sediment from catchpits, associated gullies and manholes and long-term jetting of the piped network and geocellular unit. A maintenance schedule is provided in Section 6 which will be finalised on the completion of RIBA Stage 4.

8 Policy and Guidance

The drainage networks for the new development have been designed in accordance with the following:

Policy

Standard	Issue	Description
NPPF	2019	The National Planning Policy Framework
NPPF-PPG		NPPF Planning Practice Guidance
Best Practice Guidance (NTSSD)		Non-statutory technical standards for sustainable drainage

Guidance

Standard	Issue	Description
BS EN 752	2017	Drain and sewer systems outside buildings
BS EN 858-1 & 2	2002/3	Seperator systems for light liquids (e.g. oil & petrol)
BS EN 1295-1	2020	Structural design of buried pipelines
BS EN 12056:1-5	2000	Gravity Drainage Systems inside Buildings
A guide for master planning sustainable drainage into developments		Prepared by the Lead Local Flood Authorities of the South East of England
CIRIA C753	2015	CIRIA SuDS Manual - 2015
Building Regulations Part H	2015	The Building Regulations 2010 – Part H: Drainage and waste disposal
Sewage Sector Guidance, Water UK	2019	Appendix C - Design and Construction Guidance for foul and surface water sewers offered for adoption

9 Computer Software Authorisation

List of Software Used

SUPPLIER	PROGRAMME SUITE	PURPOSE	VERSION	DATE OF AUTHORISATION	SUPPLIER
INNOVYZE	MicroDrainage MDL Bundle A	DRAINAGE DESIGN	2019.1	20.02.2019	1721002226

10 References

No.	Document Name	Date	Source
1	Geo-environmental Data Review & Assessment	21 May 2021	Hydrock

APPENDICES

APPENDICES	Title
Appendix A	Geotechnical Assessment
Appendix B	Drainage Layouts & Details

Appendix A – Geotechnical Assessment

- British Geological Survey (BGS) Geology of Britain online mapping indicates the site to comprise of superficial deposits of the Clay-with-flints Formation (Figure 17.1) underlain by bedrock of the Newhaven Chalk Formation, Seaford Chalk Formation and Lewes Nodular Chalk Formation (Figure 17.2). These Chalk Formations are part of the White Chalk Subgroup and were formerly categorised as the Upper Chalk Formation.

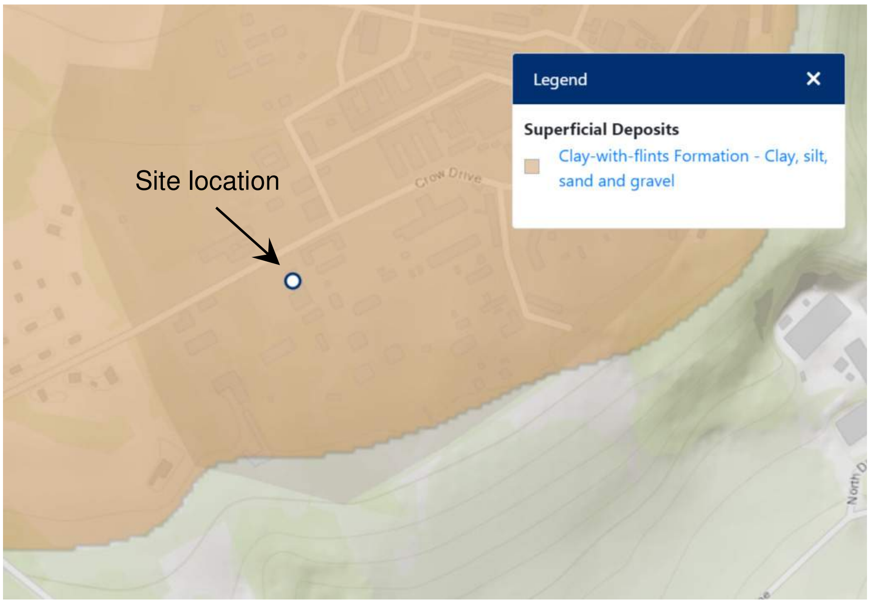


Figure 17.1: Superficial Geology (BGS Geology of Britain)

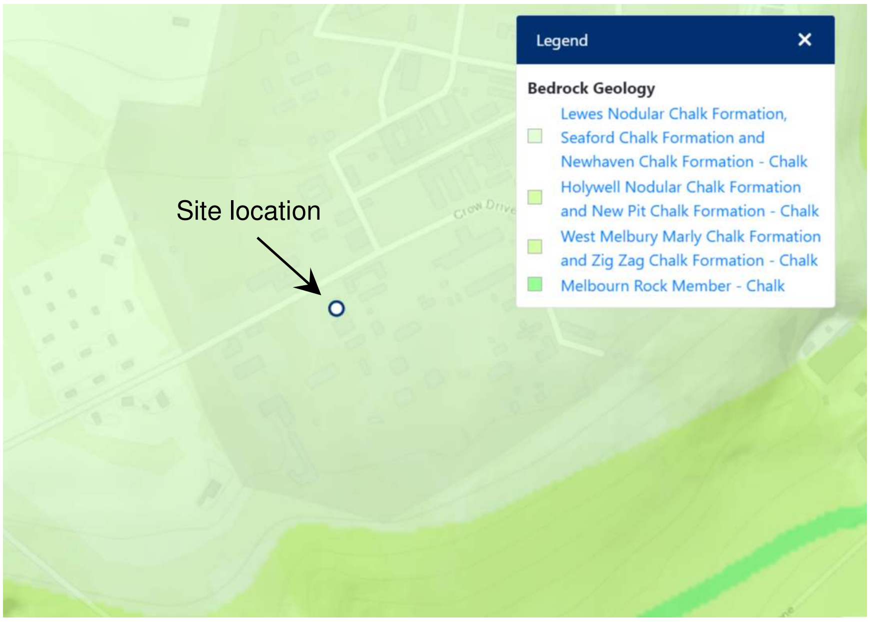


Figure 17.2: Bedrock Geology (BGS Geology of Britain)

- As illustrated in Figure 17.1, approximately 200 m south from the site, superficial deposits are indicated to be absent with bedrock geology comprising the New Pit Chalk Formation underlain by the Holywell Nodular Chalk Formation of the White Chalk Subgroup. It can therefore be inferred that the thickness of the Clay-with-flints Formation reduces in a southerly direction from the site. Further south, the bedrock geology transitions through the Melbourn Rock Member at the base of the Holywell Nodular Chalk Formation to the Grey Chalk Group comprising the Zig Zag Chalk Formation underlain by the West Melbury Marly Chalk Formation.

- The 1:50,000 BGS solid and drift geological map 287 "Sevenoaks", published in 1997, confirmed the site superficial and bedrock geology to be Clay-with-flints Formation and Upper Chalk Formation (Newhaven Chalk Formation, Seaford Chalk Formation and Lewes Nodular Chalk Formation) respectively, as interpreted from BGS Geology of Britain. An extract from map 287 is shown in Figure 17.3.

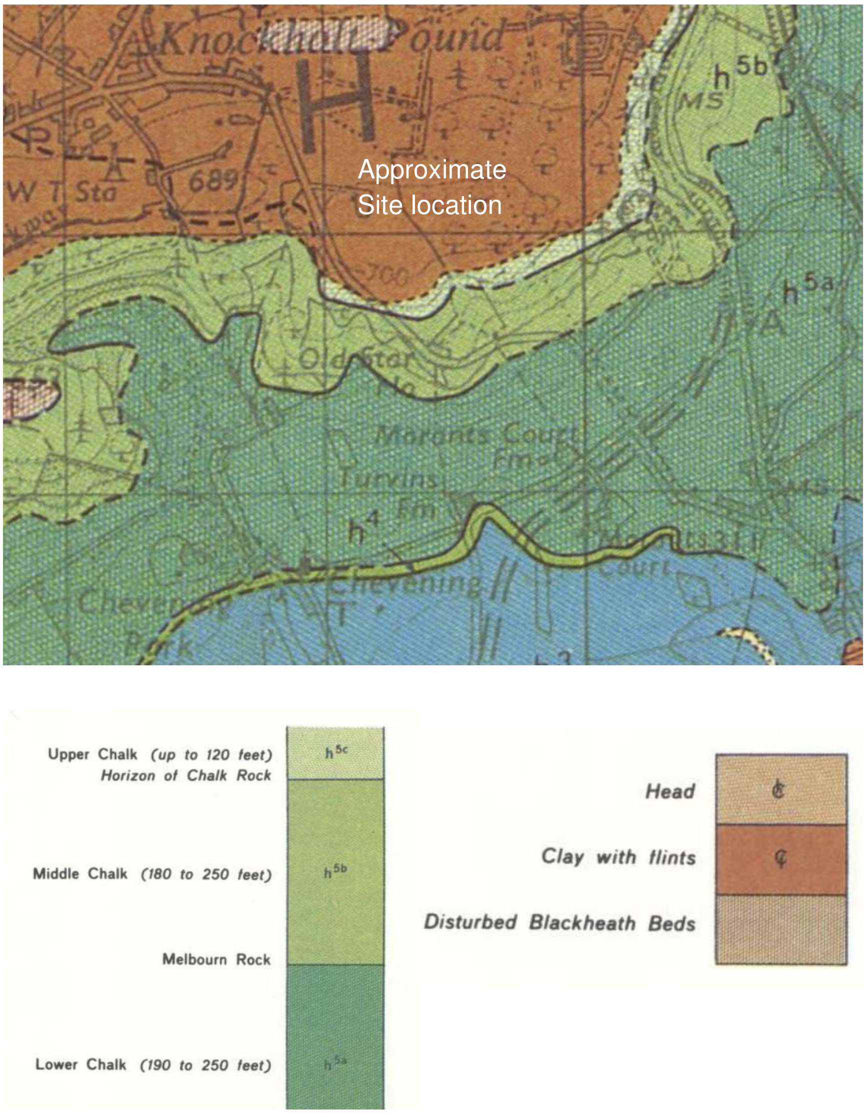


Figure 17.3: Superficial and Bedrock Geology (Extract from BGS map 287 "Sevenoaks")

- Historical BGS boreholes TQ45NE230 (211 m away), TQ45NW20 (212 m away), TQ45NW19 (449 m away) and TQ55NW240 (457 m away) were indicated to be in the vicinity of the site. However, logs for these boreholes were not publicly available for consultation.

- A site-specific ground investigation is necessary to identify the thickness and properties of the Clay-with flints deposits and the underlying Chalk. A specification detailing the ground investigation requirements will be issued separately.

- A search using the MAGIC website (https://magic.defra.gov.uk/) indicated the following site designations:
    - It is located in Kent Downs, which is classified as an area of outstanding natural beauty, and within the London Area Greenbelt.
    - The bedrock is a principal groundwater aquifer. However, the site is not within a source protection zone.
    - Groundwater vulnerability to contamination is low due to the presence of low-permeability cohesive superficial deposits.
    - There is a risk of solution features in the Chalk. However, the impact of solution features is considered negligible considering the nature of the proposed works.

- According to the Flood Map for Planning online tool (https://flood-map-for-planning.service.gov.uk/), the site is in Flood Zone 1 with a low probability of river flooding (less than 1 in 1,000 annual probability of flooding).

- According to the Zetica risk map (Figure 17.4), there is a high risk of encountering unexploded ordnance (UXO) at this site.

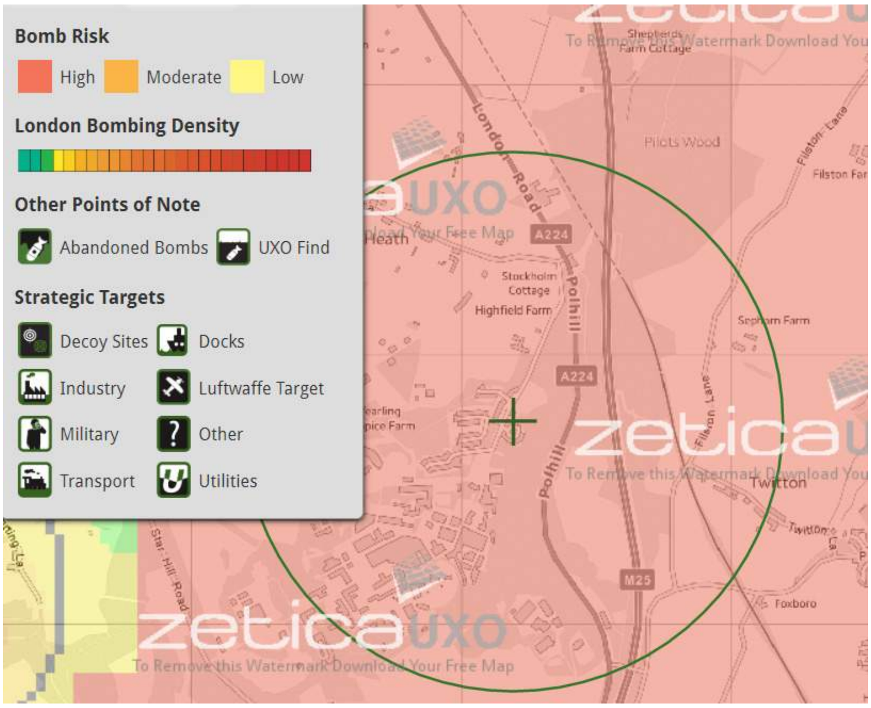
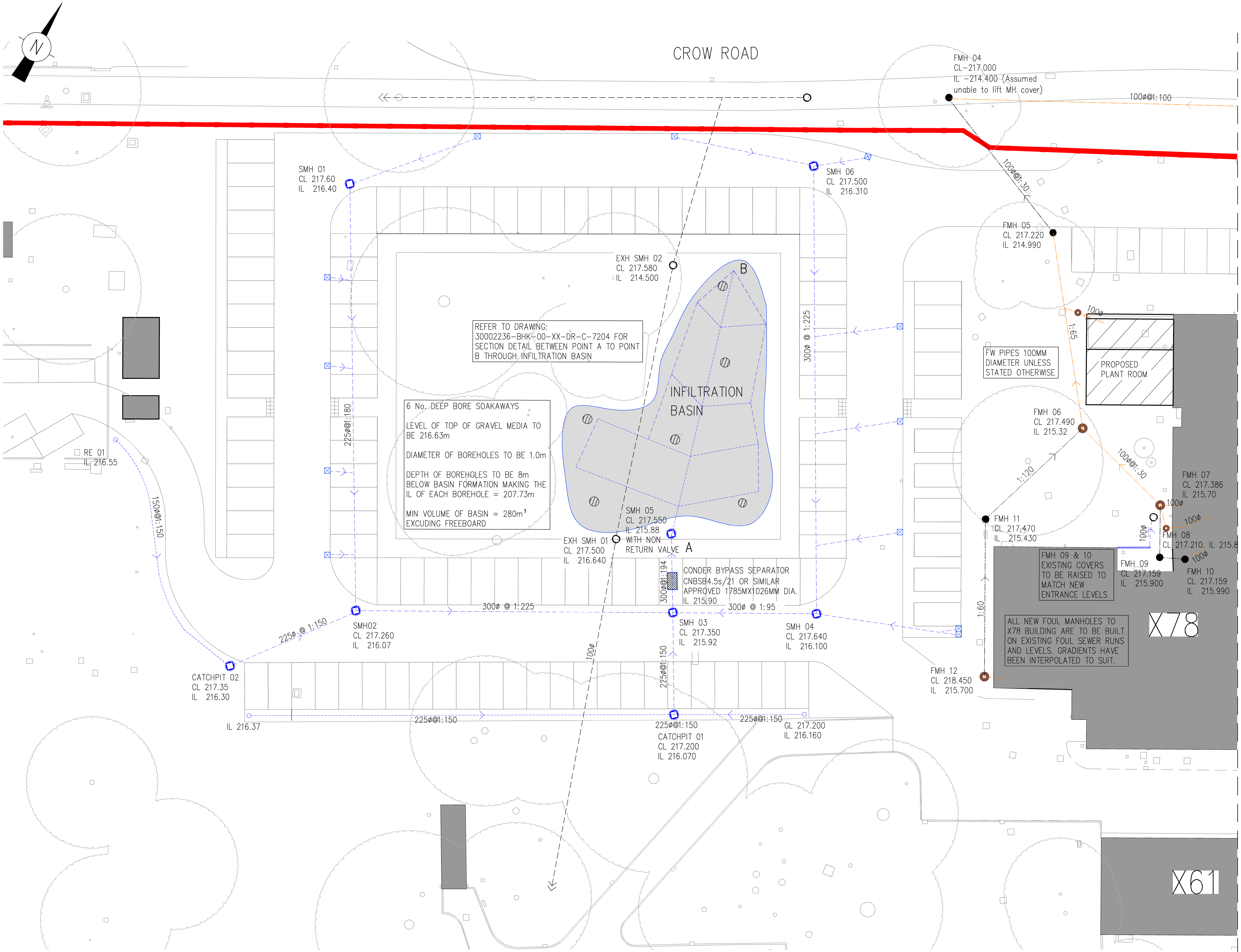


Figure 17.4: Zetica UXO risk map

- Hazards related to mining are not present on this site.

Appendix B - Drainage Layouts & Details



FOR CONTINUATION OF DRAWINGS SEE: 30002236-BHK-00-XX-DR-C-7202

0 — 100
This drawing may have been reduced — original scale : 100mm

Reference Drawings | Legend | Notes

REFERENCE DRAWINGS:

- 30002236-BHK-00-XX-DR-C-7101 – SITE PREPARATION PLAN
- 30002236-BHK-00-XX-DR-C-7202 – DRAINAGE LAYOUT SHT 2
- 30002236-BHK-00-XX-DR-C-7402-03 – ROADS & CAR PARK LAYOUT SHT 1-2
- 30002236-BHK-00-XX-DR-C-7404 – PAVEMENT & HARDSTANDING LAYOUT
- 30002236-BHK-00-XX-DR-C-7405-08 – FENCE LINE LAYOUT SHT 1-4
- 30002236-BHK-00-XX-DR-C-7409-10 – SITE LEVELS SHT 1-2
- 30002236-BHK-00-XX-DR-C-7411-12 – VEHICLE TRACKING SHT 1-2

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE
2. ALL LEVELS ARE IN METRES (M) UNLESS NOTED OTHERWISE.
3. REFERENCE SHOULD BE MADE TO CCTV SURVEY BY WARNERS SURVEYS 16/09/2020 REF:UM/820/5926 PART 1 OF 2 AND PART 2 OF 2.
4. ALL DRAINAGE TO BE PRODUCED WITH ROCKER PIPES. REFER TO STANDARD DETAIL ON: 30002236-BHK-00-XX-DR-C-7203.
5. CURRENT DESIGN OF EACH DEEP BOREHOLE SOAKAWAY IS BASED ON AN INFILTRATION RATE OF 3 X10-5 M/S, AN ASSUMED CHALK STRATA OF 5m BASED AT THE BOTTOM OF THE BOREHOLE AND A FoS= 2.
6. AS THE INFILTRATION RATE IS ASSUMED AT THIS TIME, IT IS STRONGLY RECOMMENDED THAT FURTHER GROUND INVESTIGATION IS UNDERTAKEN TO CONFIRM THE INFILTRATION RATE PRIOR TO COMPLETING DETAILED DESIGN.

LEGEND

- NEW FENCE LINE
- PROPOSED STORM WATER DRAINAGE
- PROPOSED FOUL DRAINAGE
- EXISTING STORM DRAINAGE
- EXISTING FOUL DRAINAGE
- PROPOSED PERFORATED PIPE
- PROPOSED GULLY
- PROPOSED SOAKAWAY
- PROPOSED OIL INTERCEPTOR
- PROPOSED DRY BASIN
- PROPOSED RODDING EYE
- PROPOSED ACO RAINDRAIN B125

FOR CLIENT REVIEW

Revision	Description	Drawn	Date	Checked	Approved
P01	RIBA STAGE 3 ISSUE	MC	23/10/2020	DT	NW

Revisions

QINETIQ

Project: FORT HALSTEAD REDEVELOPMENT WORK PACKAGE 7

Title: PROPOSED DRAINAGE LAYOUT SHEET 1

Scale	Drawn	Checked	Approved
1:200 (when plotted @ A1)	MC	DT	NW
	Date 23/10/2020	Date 23/10/2020	Date 23/10/2020

CAD Ref S:\Warwick\Projects\30002236\09_CAD\03_BH\04_civil\Model Information (WIP)

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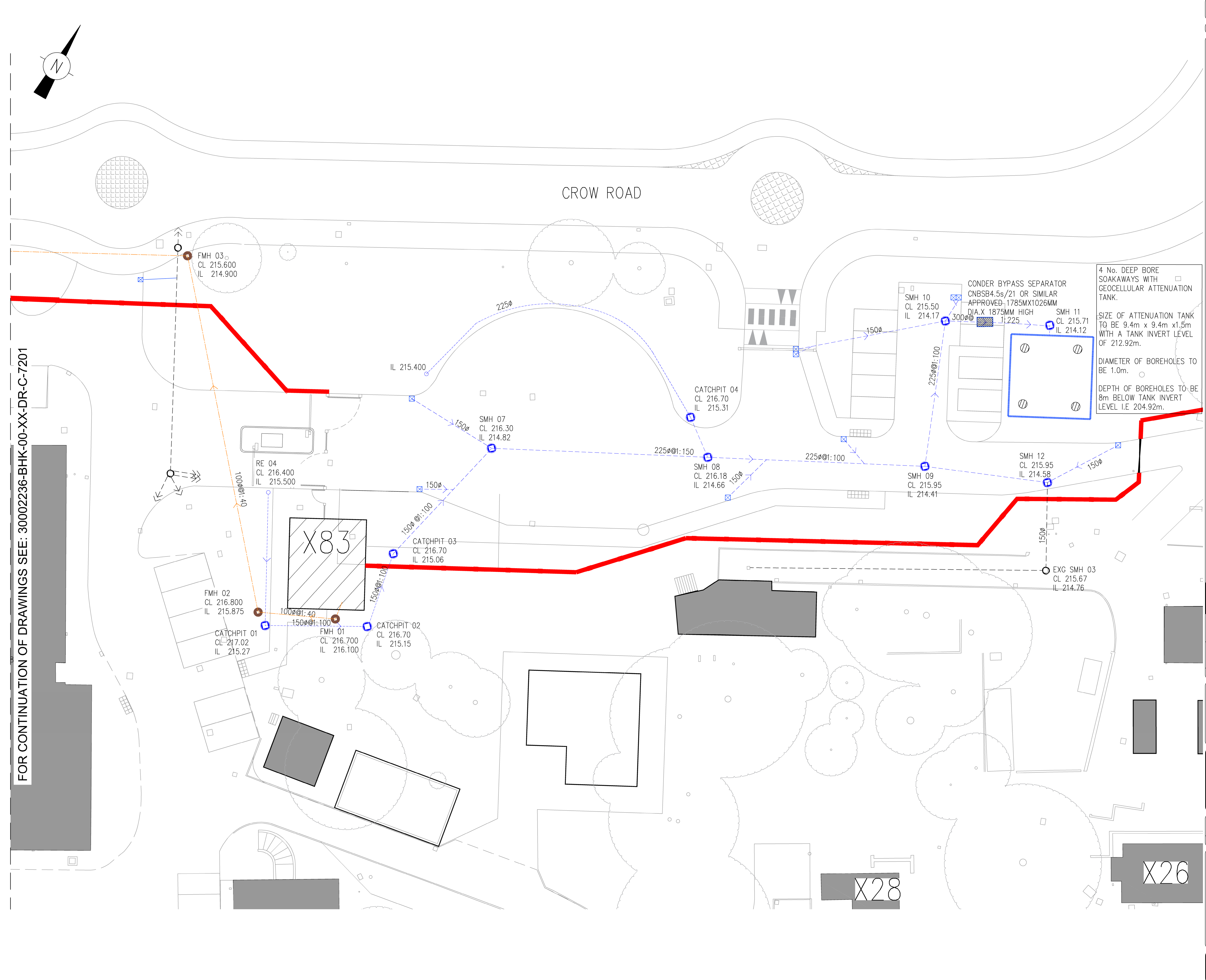
Project number	Drawing number	Revision
30002236	BHK-00-XX-DR-C-7201	P01



0 — 100
This drawing may have been reduced — original scale : 100mm

Reference Drawings | Legend | Notes

REFERENCE DRAWINGS:

30002236-BHK-00-XX-DR-C-7101 – SITE PREPARATION PLAN
30002236-BHK-00-XX-DR-C-7201 – DRAINAGE LAYOUT SHT 1
30002236-BHK-00-XX-DR-C-7402-03 – ROADS & CAR PARK LAYOUT SHT 1-2
30002236-BHK-00-XX-DR-C-7404 – PAVEMENT & HARDSTANDING LAYOUT
30002236-BHK-00-XX-DR-C-7405-08 – FENCE LINE LAYOUT SHT 1-4
30002236-BHK-00-XX-DR-C-7409-10 – SITE LEVELS SHT 1-2
30002236-BHK-00-XX-DR-C-7411-12 – VEHICLE TRACKING SHT 1-2

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE
2. ALL LEVELS ARE IN METRES (M) UNLESS NOTED OTHERWISE.
3. REFERENCE SHOULD BE MADE TO CCTV SURVEY BY WARNERS SURVEYS 16/09/2020 REF:UM/820/5926 PART 1 OF 2 AND PART 2 OF 2.
4. ALL DRAINAGE TO BE PRODUCED WITH ROCKER PIPES. REFER TO STANDARD DETAIL ON: 30002236-BHK-00-XX-DR-C-7203.
5. CURRENT DESIGN OF EACH DEEP BOREHOLE SOAKAWAY IS BASED ON AN INFILTRATION RATE OF 3 X10-5 M/S, AN ASSUMED CHALK STRATA OF 5m BASED AT THE BOTTOM OF THE BOREHOLE AND A FoS= 2.
6. AS THE INFILTRATION RATE IS ASSUMED AT THIS TIME, IT IS STRONGLY RECOMMENDED THAT FURTHER GROUND INVESTIGATION IS UNDERTAKEN TO CONFIRM THE INFILTRATION RATE PRIOR TO COMPLETING DETAILED DESIGN.

LEGEND

- NEW SECURITY FENCE LINE
- PROPOSED STORM WATER DRAINAGE
- PROPOSED FOUL DRAINAGE
- EXISTING STORM DRAINAGE
- PROPOSED PERFORATED PIPE
- PROPOSED GULLY
- PROPOSED DEEP BORE SOAKAWAY
- PROPOSED RODDING EYE

FOR CLIENT REVIEW

Revision	Description	Drawn	Date	Checked	Approved
P01	RIBA STAGE 3 ISSUE	MC	23/10/2020	DT	NW

Revisions

QINETIQ

Project: FORT HALSTEAD REDEVELOPMENT WORK PACKAGE 7

Title: PROPOSED DRAINAGE LAYOUT SHEET 2

Scale 1:200 (when plotted @ A1)	Drawn MC	Checked DT	Approved NW
	Date 23/10/2020	Date 23/10/2020	Date 23/10/2020

CAD Ref S:\Warwick\Projects\30002236\09_CAD\03_BH\04_civil\Model Information (WIP)

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www.bakerhicks.com

Project number	Drawing number	Revision
30002236	BHK-00-XX-DR-C-7202	P01

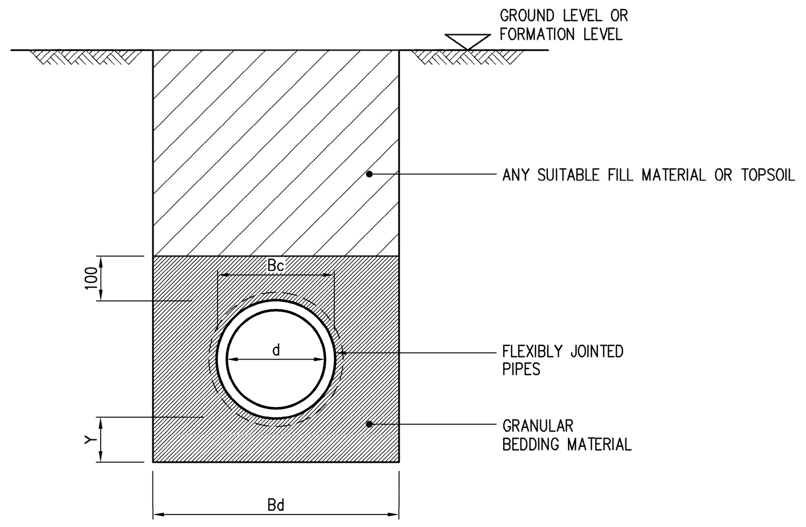
GRANULAR BEDDING AND SURROUND MATERIALS

PIPE SIZE (DIAMETER)	BEDDING MATERIAL AGGREGATE TO B.S. 882 – TABLE 4
100	10mm SINGLE SIZE
200	10 OR 14mm SINGLE SIZE OR 14 TO 5mm GRADED
200 AND GREATER	10, 14 OR 20mm SINGLE SIZE OR 14 TO 5mm GRADED OR 20 TO 5mm GRADED

CONCRETE SURROUND MATERIALS CONCRETE MIX TO B.S.8110 TABLE 6.1

SULPHATE CLASSIFICATION			
CLASS 1 OR LESS	CLASS 2	CLASS 3	CLASS 4
C20 MINIMUM CEMENT CONT. 220KG/Cu.m	C20 MINIMUM CEMENT CONT. 325KG/Cu.m	C25 MINIMUM CEMENT CONT. 325KG/Cu.m	C30 MINIMUM CEMENT CONT. 350KG/Cu.m
O.P. CEMENT		S.R.P. CEMENT	

PIPE BEDDING AND SURROUND MATERIALS

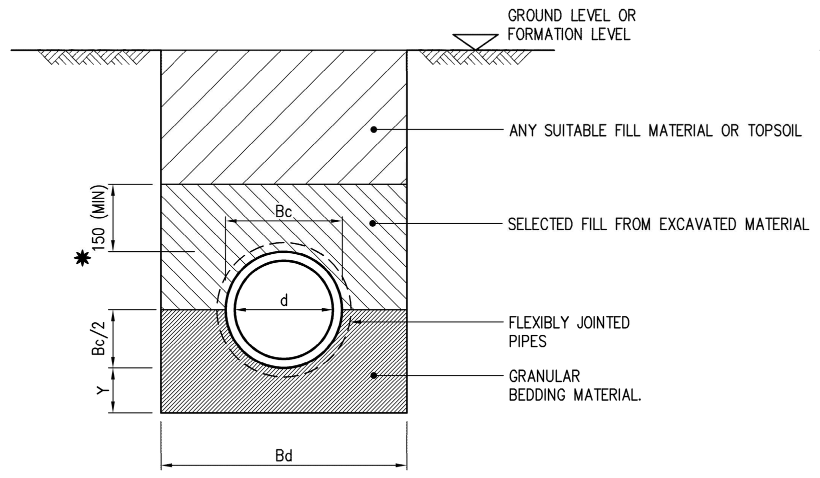


NOTES

Bc = EXTERNAL DIAMETER OF PIPE BARREL
Bd = TRENCH WIDTH = Bc + 300 (PREFERRED) OR Bc + 600 (MAX)

TRENCH BOTTOM FINISH	UNDER BARREL	UNDER SOCKET
EVEN	Y = 100	Y = 50
UNEVEN (E.G. ROCK BANDS)	Y = 200	Y = 150

CLASS 'S' BEDDING
SCALE 1:10

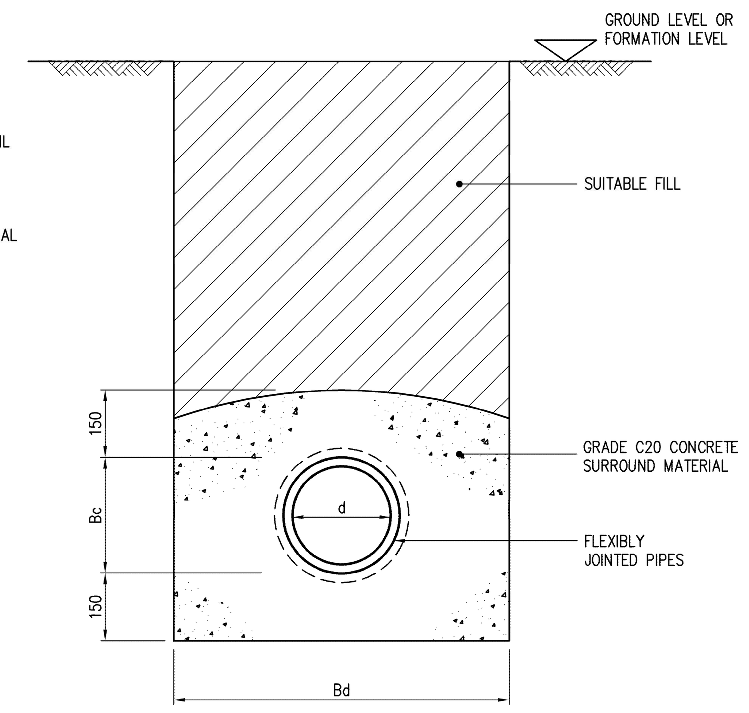


NOTES

Bc = EXTERNAL DIAMETER OF PIPE BARREL
Bd = TRENCH WIDTH = Bc + 300 (PREFERRED) OR Bc + 600 (MAX)
✱ 250 MIN FOR ADOPTABLE SEWERS

TRENCH BOTTOM FINISH	UNDER BARREL	UNDER SOCKET
EVEN	Y = 100	Y = 50
UNEVEN (E.G. ROCK BANDS)	Y = 200	Y = 150

CLASS 'B' BEDDING
SCALE 1:10

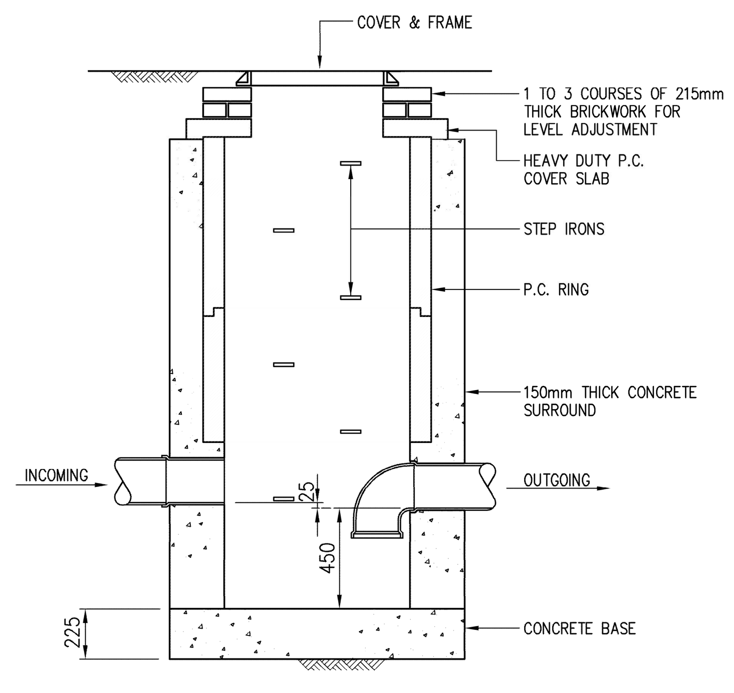


NOTES

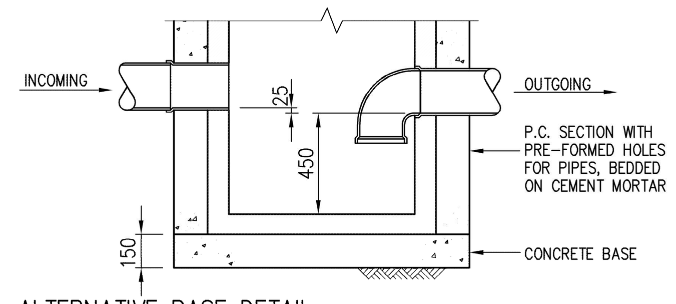
Bc = EXTERNAL DIAMETER OF PIPE BARREL
Bd = TRENCH WIDTH = Bc + 300 (PREFERRED) OR Bc + 600 (MAX)

A 25mm GAP SHALL BE FORMED IN THE CONCRETE SURROUND AT THE OUTER END OF THE SOCKET AT EACH FLEXIBLE JOINT – SEE SHEET R12–PD09 FOR DETAILS.

CLASS 'Z' BEDDING
SCALE 1:10



TYPICAL SECTION (UP TO 3000mm DEEP MAX)



ALTERNATIVE BASE DETAIL

PRECAST CONCRETE CATCHPIT
SCALE 1:20

SELECTED FILL (EXCAVATED)

SELECTED EXCAVATED FILL SHOULD BE READILY COMPACTABLE, FREE FROM TIMBER, FROZEN MATERIAL, AND VEGETABLE AND FOREIGN MATTER, AND EXCLUDING HARD LUMPS OF CLAY RETAINED ON A 100mm SEIVE AND STONES RETAINED ON A 40mm SEIVE.

SUITABLE FILL (EXCAVATED)

SUITABLE EXCAVATED FILL SHOULD BE COMPACTABLE AND FREE FROM BOULDERS, LUMPS OF CONCRETE, TIMBER AND VEGETABLE. MATTER.

SUITABLE FILL (IMPORTED)

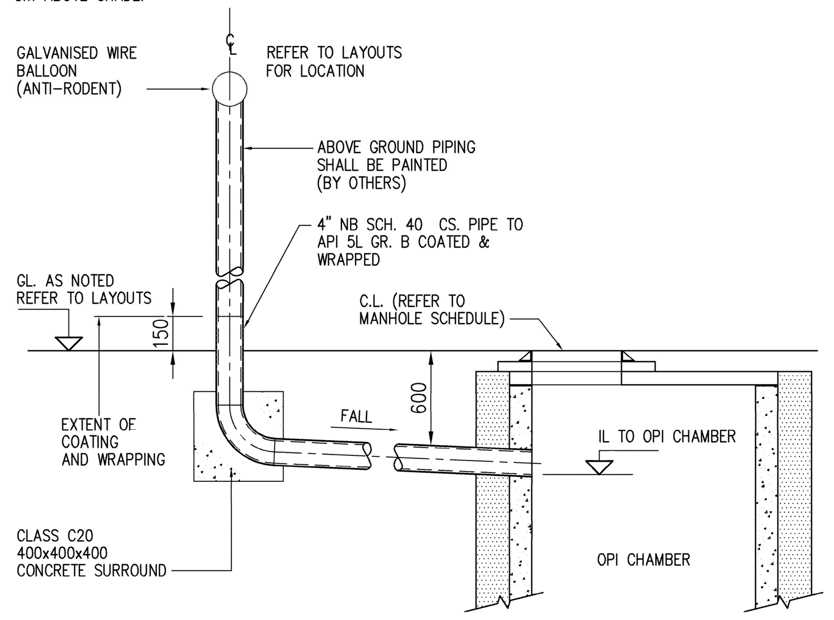
SUITABLE IMPORTED FILL SHOULD BE HARD, CLEAN GRADED GRANULAR MATERIAL PASSING THROUGH A 100mm SEIVE COMPLYING WITH DOT SPECIFICATION TYPE 6F2.

LOCATION	BACKFILL MATERIAL
UNDER ROADS & BUILDINGS	IMPORTED
LANDSCAPED & OTHER AREAS	EXCAVATED

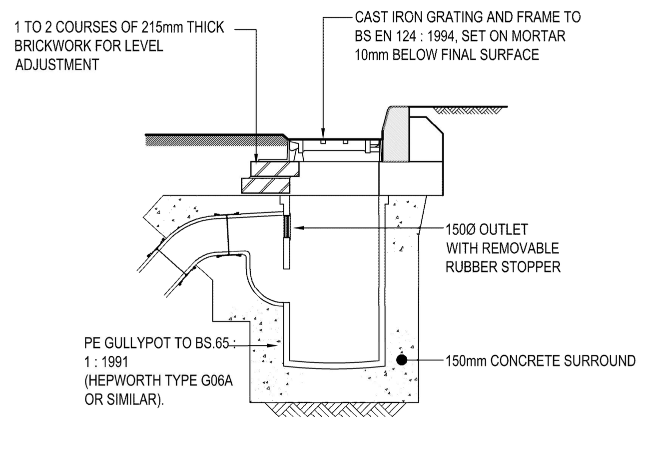
BACKFILL MATERIALS

NOTE:–
FREE STANDING VENT PIPES SHALL TERMINATE 3m ABOVE GRADE.

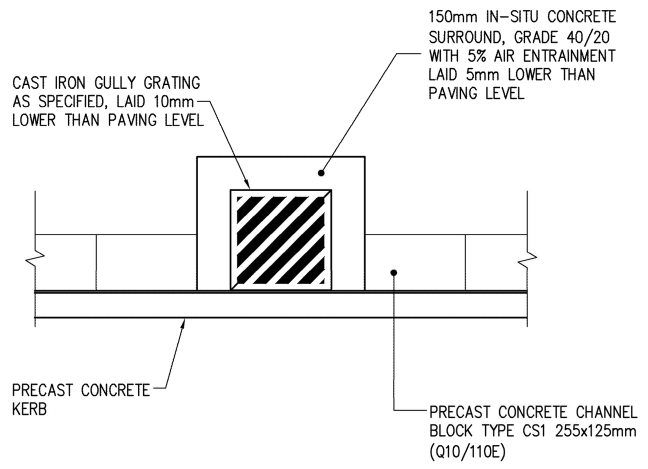
ALTERNATIVE MATERIAL : CAST IRON



VENT PIPE DETAIL TO OPI CHAMBER
SCALE 1:20



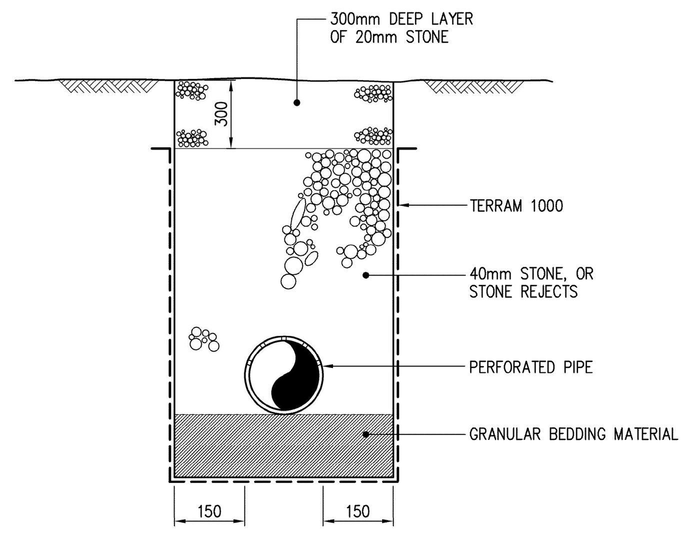
GULLY INSTALLATION DETAIL AGAINST KERB
SCALE 1:20



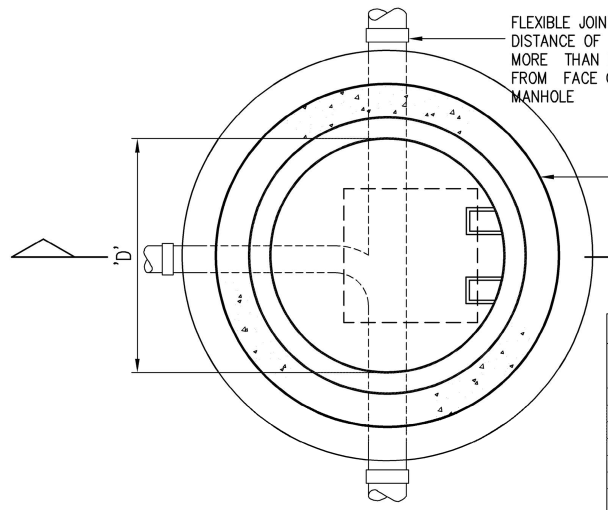
NOTES

1. SHARP SAND LAYING COURSE TO BE 3:1 SAND/CEMENT DRY MIX FOR A DISTANCE OF 1000mm FROM EDGE OF GULLY GRATING.

TYPICAL KERB/GULLY DETAIL
SCALE 1:10

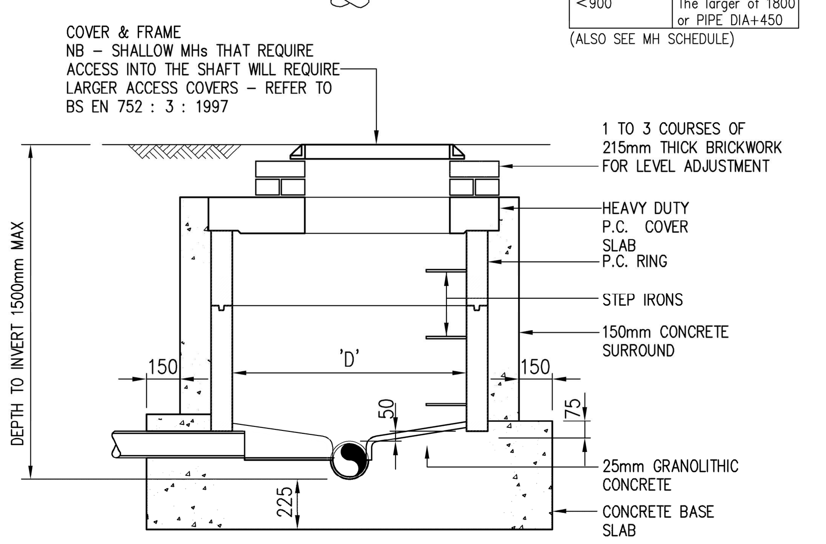


FILTER DRAIN
SCALE 1:10

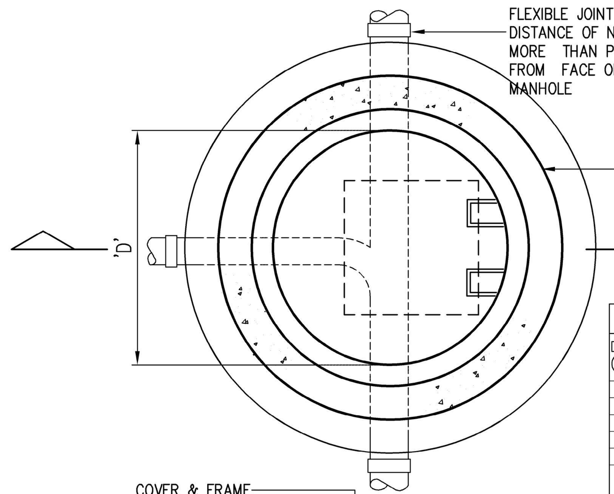


MANHOLE SIZE	
DRAIN PIPE DIA (LARGEST IN MH)	DIAMETER OF MH (D)
≤150	1050
225	1200
300	1200
375–400	1350
500–700	1500
750–900	1800
<900	The larger of 1800 or PIPE DIA+450

(ALSO SEE MH SCHEDULE)

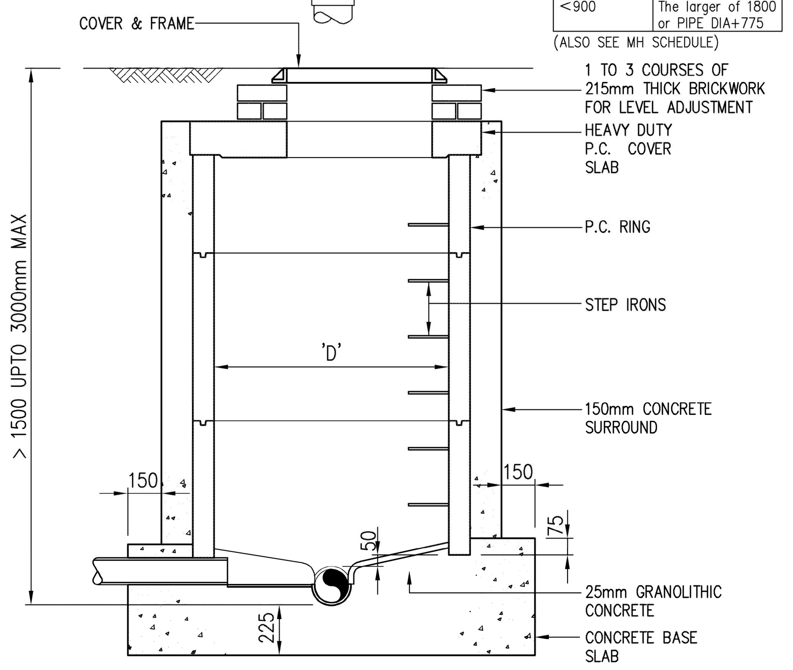


SHALLOW PRECAST CONCRETE MANHOLE UPTO 1500mm DP (R12/721A)
SCALE 1:20

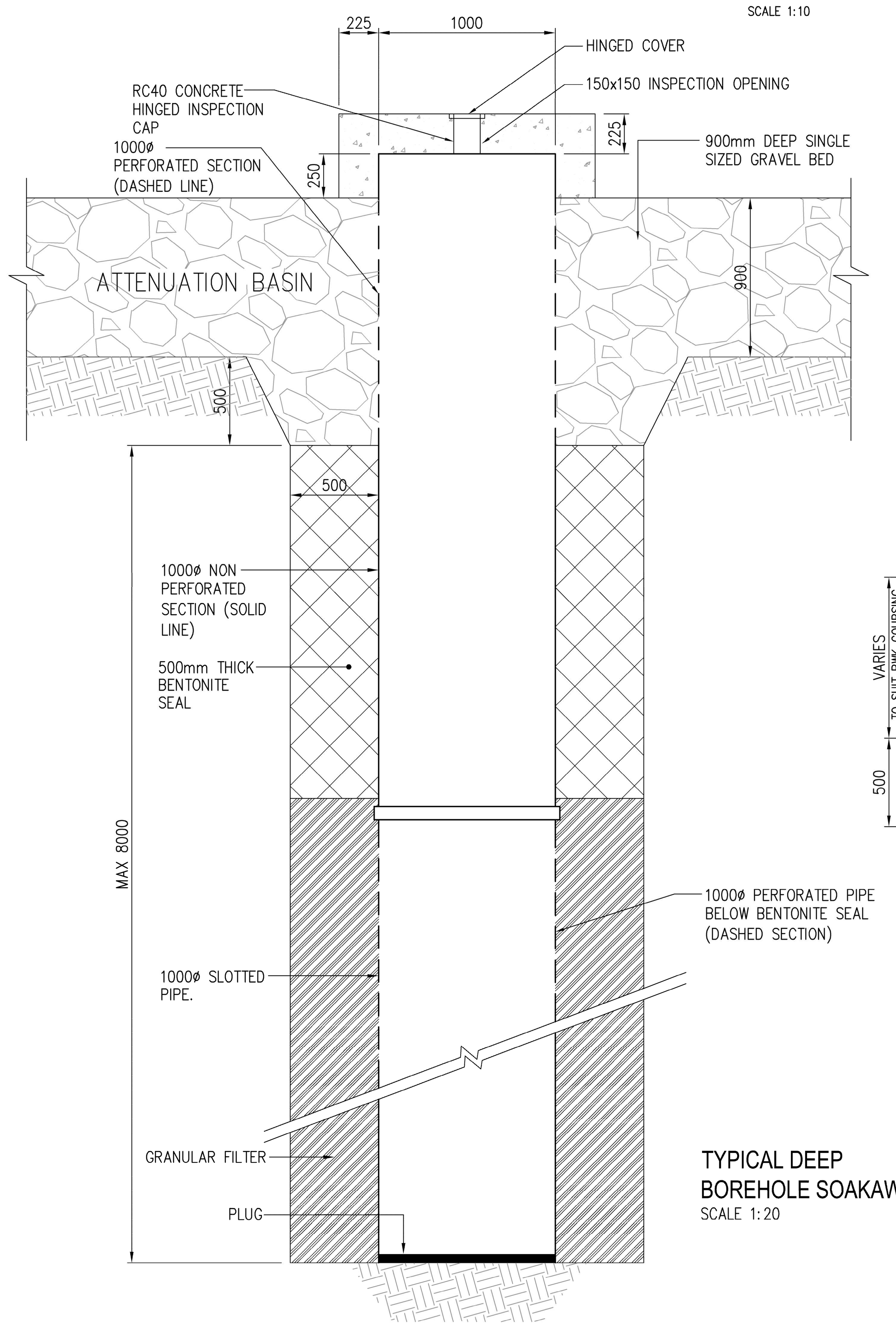


MANHOLE SIZE	
DRAIN PIPE DIA (LARGEST IN MH)	DIAMETER OF MH (D)
≤225	1200
300	1200
375–400	1350
500–700	1500
750–900	1800
<900	The larger of 1800 or PIPE DIA+775

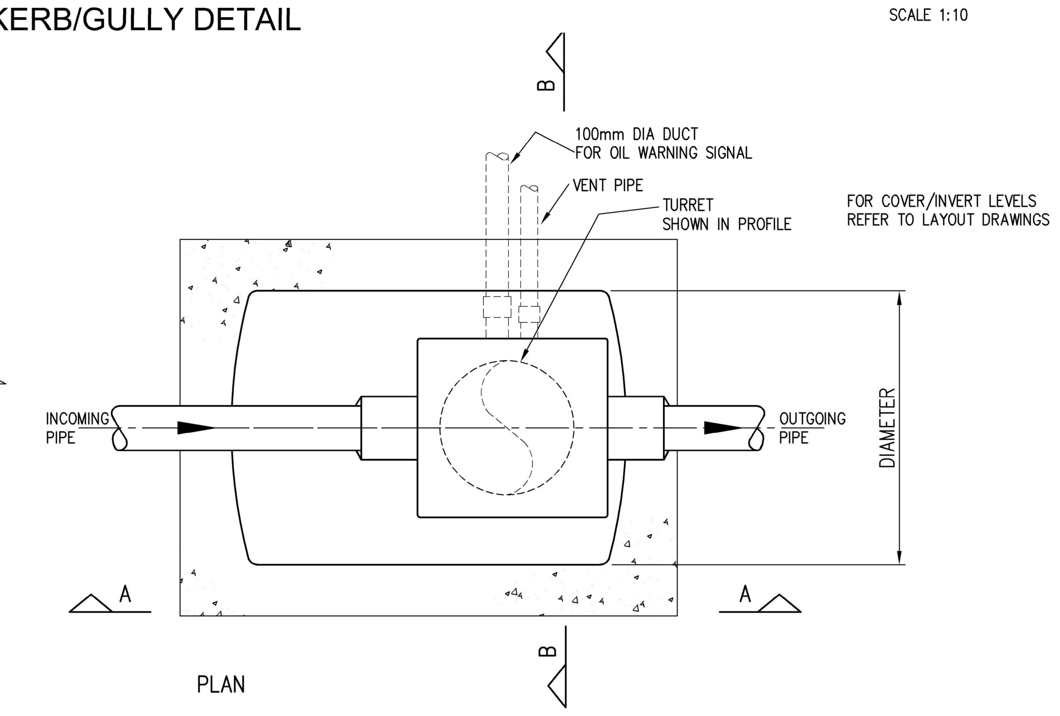
(ALSO SEE MH SCHEDULE)



MEDIUM DEPTH PRECAST CONCRETE MANHOLE >1500 UPTO 3000mm DP (R12/721A)
SCALE 1:20

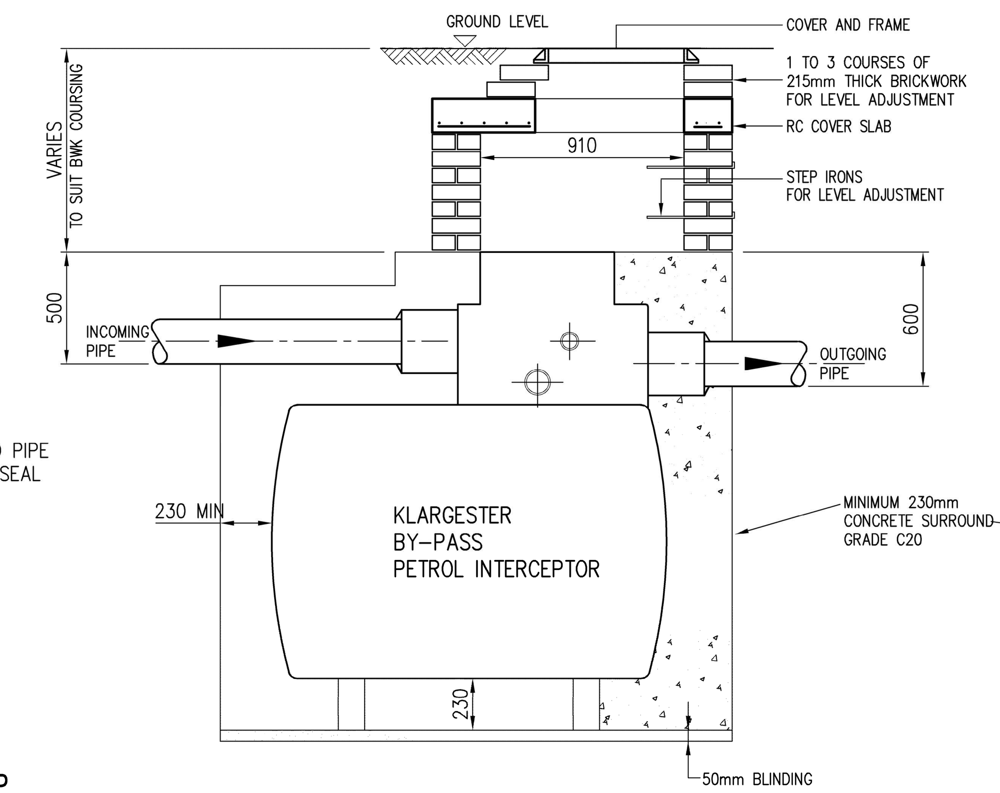


TYPICAL DEEP BOREHOLE SOAKAWAY
SCALE 1:20

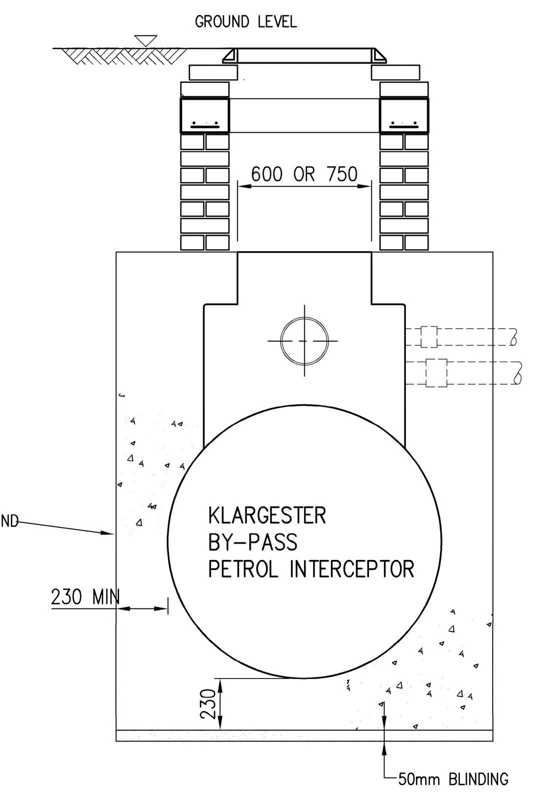


PLAN

ROCKER PIPE REFERENCE TABLE	
NOMINAL DIAMETER (mm)	EFFECTIVE LENGTH (m)
150 TO 600	0.60
675 TO 750	1.00
825 AND OVER	1.25



ELEVATION A–A



SECTION B–B

OIL/PETROL INTERCEPTOR

This drawing may have been reduced — original scale : 100mm

Reference Drawings | Legend | Notes

REFERENCE DRAWINGS:

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE
2. ALL LEVELS ARE IN METRES (M) UNLESS NOTED OTHERWISE.
3. OIL PETROL INTERCEPTOR TO BE INSTALLED WITH AN ELECTRICAL CONNECTION FOR AN EARLY WARNING ALARM SYSTEM.

FOR CLIENT REVIEW

Revision	Description	Drawn	Date	Checked	Approved
P01	RIBA STAGE 3 ISSUE	MC	23/10/2020	DT	NW

Revisions

QINETIQ

Project: FORT HALSTEAD REDEVELOPMENT PHASE 2

Title: WORK PACKAGE 7 DRAINAGE DETAILS SHEET 1

Scale	Drawn	Checked	Approved
As Shown (when plotted @ A0)	MC Date 23/10/2020	DT Date 23/10/2020	NW Date 23/10/2020

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Project number	Drawing number	Revision
30002236	BHK-00-XX-DR-C-7203	P01

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	Manchester	+44 (0)161 873 2500
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