D I Engineering

Utilities and Highways Engineering Department

Project Hydrus

SuDS Detail Design Submission

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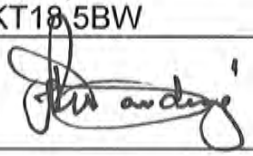
Signature	
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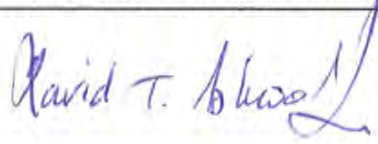
Signature	
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3	Revised terminology, illustrations	23/04/10	A Fernihough	J Dowding	K Carter	P. Sedgwick
4	Minor changes to text and illustrations and revised Appendix D	10/06/10	A Fernihough	J Dowding	S Jackman	R Westgate

Previous issues of this document are to be destroyed or marked **Superseded**

This document will be re-issued in its entirety following amendment.

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APPENDICES

Appendix A Enlarged copies of figures from the text of this Report (A3 size)

Appendix B Copies of Hydrus Project Drawings (Full size)

Appendix C MicroDrainage Design – Calculations

Appendix D Technical Note: “Dewatering during construction phase – SuDS impacts”

1 Project details

1.1 AWE Project Reference

The AWE reference for this project is “HYDRUS”.

1.2 Planning Status

This report is in support of the Hydrus planning application.

1.3 Development Location

This development site is located on the AWE site at Aldermaston.

Figure 1 below shows the location of the development site indicated with a red line. The area within the applicants ownership is denoted by the blue line.

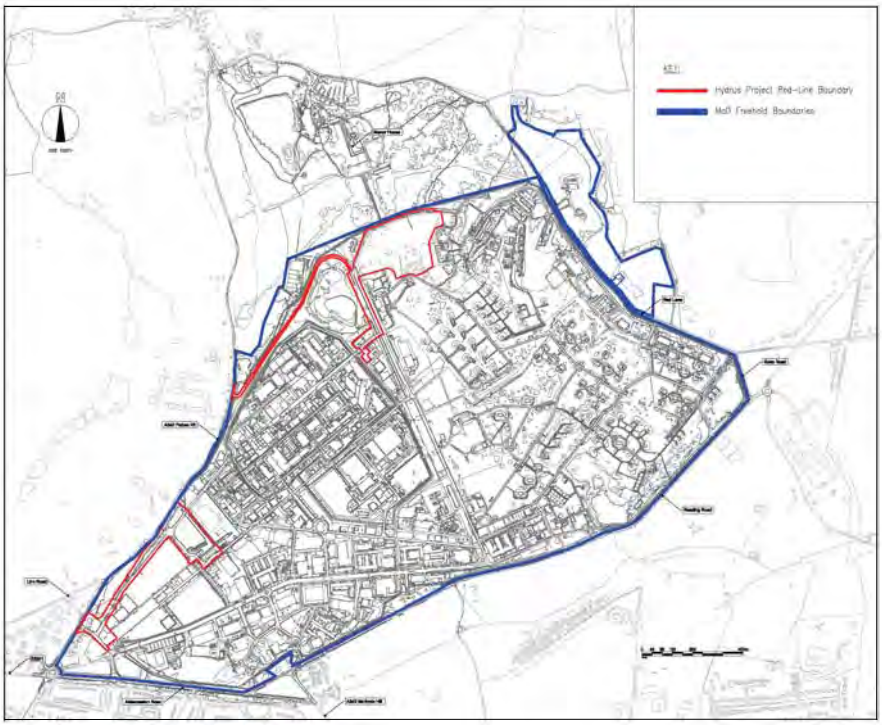
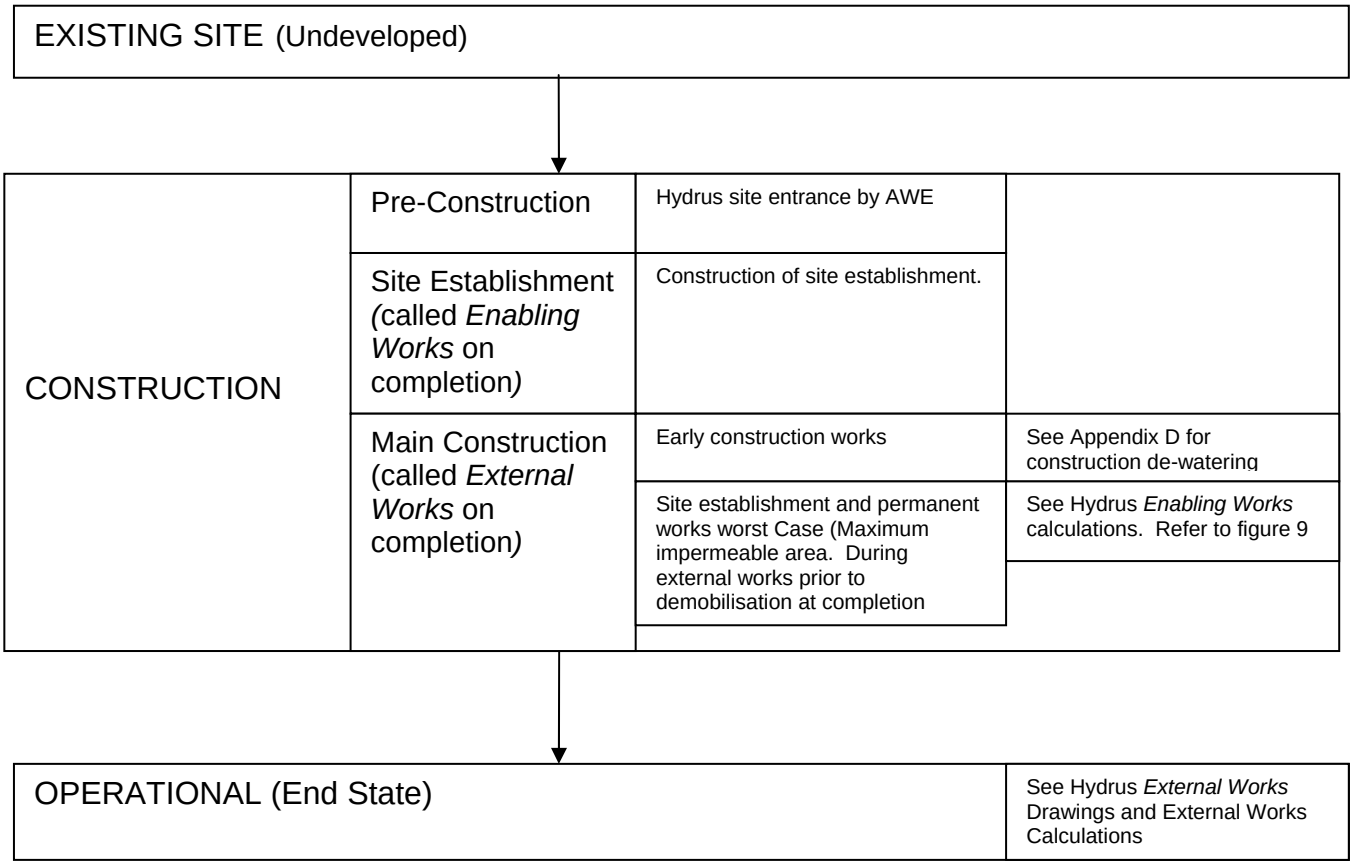


Figure 1 Aldermaston Site Overview

1.4 Project Terminology

The diagram below shows the terminology used in this report in relation to the progress through the development project.



Terminology in italics is used on drawings and design calculations in relation to the two design stages that have been considered in detail in this document.

The SuDS design set out in this report seeks to address both the Construction (enabling works) and Operational (end state) phases. The SuDS scheme will be constructed during Site Establishment (enabling works) phase and therefore be ready for use at the start of the Main Construction phase.

2 Development Site

2.1 Development Site Size

The Hydrus development site is 6.47 hectares as shown by the red line on Figure 5. For the purposes of the SuDS drainage design, the analysis has been based on the areas within the Hydrus fenceline (5.6 hectares). The 0.87 ha of existing drainage outside this fenceline which largely comprises Cwm Road and adjacent verges, is drainage that will not be changed.

2.2 Floodplain

The development site is not close to either the 100yr or the 1000yr floodplain.

2.3 Contaminated Land

The development site is not on or adjacent to contaminated land, in part or in whole. The site was previously the subject of a demolition contract, the details of which are recorded in the document “Land Quality Assessment Report following Decontamination and Demolition of Explosives Buildings at B Area North” (doc ref: A0620/01/R8/1) and “Verification Report of LQA” (doc ref: A0620/01/R9/1) by BAE.

2.4 Groundwater

Borehole data is available within the development boundary and is summarised in an electronic document:- ref MER-110-012043

The drawing Reference A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001300 (Figure 2 below) shows the location of boreholes recorded in the Geotechnical Interpretive Report (issue 3; Reference HYDFEL3/56.24/REP/00113) and other geotechnical information in relation to the development site.

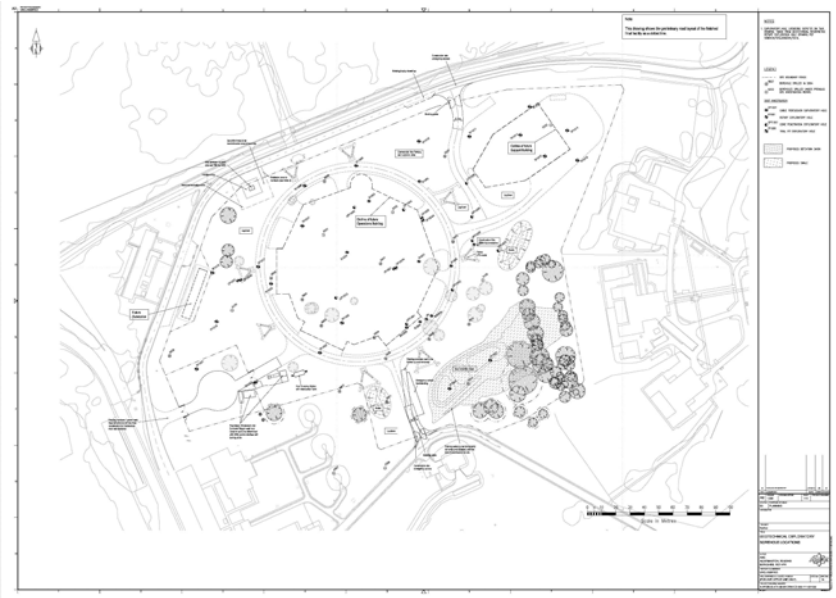


Figure 2; Hydrus; Geotechnical exploratory borehole locations

Generally the ground water levels were recorded in the region of 1 to 2m below finished ground level. However, subsequent monitoring has revealed ground water levels to be shallower than this. (Refer to cl. 4.5)

During construction dewatering will be required; the philosophy is detailed in Technical Note reference HYDFEL3/54.24/CORR/00373 to be found in Appendix D.

2.5 Soil Type

The development site is in an area of predominately shallow Silchester Gravels with underlying London Clay. Therefore, soil type 3 is assumed within the Hydrus development area. This is supported by the AWE document "SuDS Principles - A Guide for Designers, Planners and Key Stakeholders" Table 3.1 that gives the default soil type to be used for Aldermaston as type 3.

2.6 Infiltration

Infiltration tests have been undertaken within the development boundary. Whilst results appear in some cases to be satisfactory to support the design of infiltration drainage, the water levels (see cl. 2.4 above and cl. 4.5) are shallow such that the infiltration devices will not generally have satisfactory freeboard above the water level at all times of the year.

As a result, there is a serious risk that infiltration can not be relied upon to work reliably or predictably. Following discussions with AWE and their other engineering advisers, it has therefore been agreed that infiltration drainage will not be taken into account in assessing volumes of water being discharged off site in the permanent works, although some areas of infiltration drainage will be provided.

During Construction stage, however, it is proposed to drain the Contractors cabins area and some laydown and storage areas to a permeable sub-base layer 400mm thick which will contain the run-off and allow it to infiltrate, although all other hard areas are provided piped drainage collector systems.

During the permanent works, although no infiltration is taken into account in assessing volumes of run-off being discharged, the bases of the swales and detention basin are not being lined so that benefit from infiltration can be gained although not quantified.

2.7 Existing Land Use

Figure 3 gives an overview of the existing land uses over the whole of Aldermaston site. More detailed information follows.

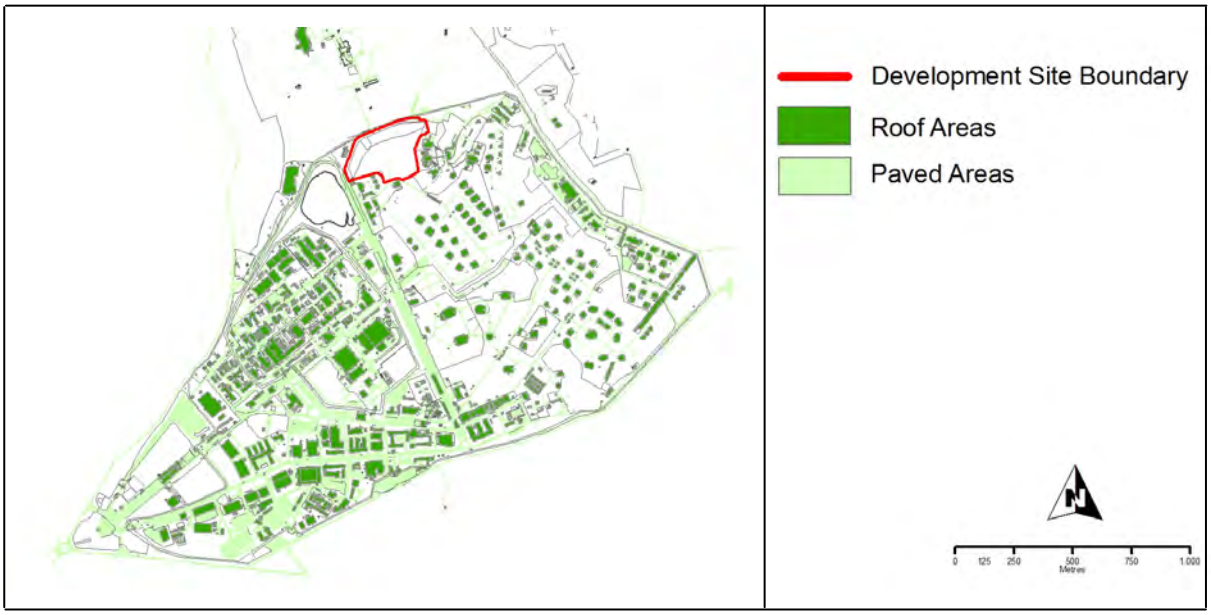


Figure 3; Aldermaston; Existing land use overview

Prior to the previous demolition works, there were roads and buildings drained via a network of drains and filter drains, eventually discharging into the AWE drain system between the Hydrus site and the Fish Pond. (See figure 4 below).

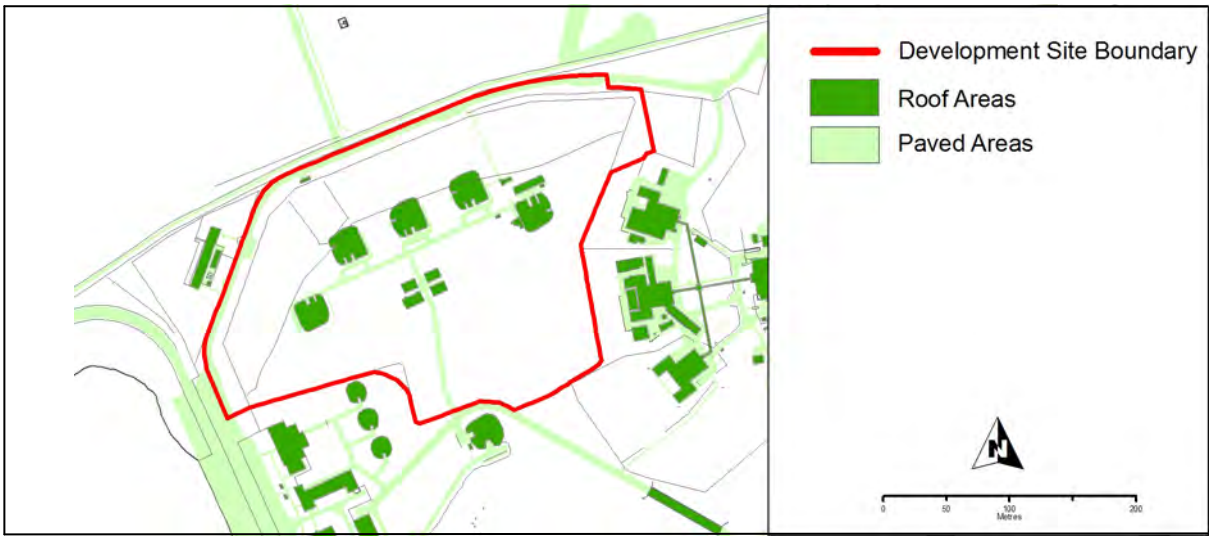


Figure 4 Hydrus site; Former land use

Post-demolition (Pre-development), there are minimal impermeable areas draining directly to an existing piped system.

The development site has been designated as greenfield and the design has not taken advantage of any former brownfield flows. Clearly this provides betterment over the existing drainage regime.

2.8 Existing Drainage

The existing ditches and watercourses close to the development site are shown on the plan (See figure 5 below).

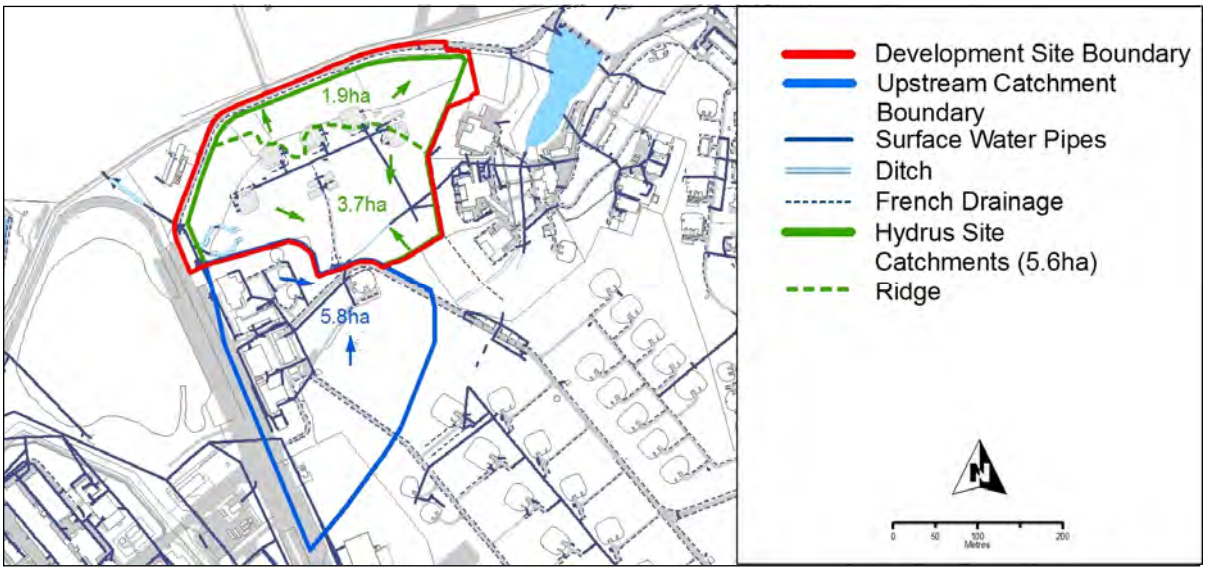


Figure 5; Hydrus Site; Existing / Former drainage and catchments

2.9 Existing Drainage Catchment

A large part (3.7 ha) of the Hydrus site is part of a larger catchment draining towards an existing ditch towards the South of the Hydrus site. The remainder of the Hydrus site (1.9 ha) is relatively flat, falling slightly to the North-West, and the North, and with slightly more gradient falling towards the East.

The catchment upstream of the Hydrus site is approximately 5.8 ha in area. This upstream catchment is made up of narrow access roads, buildings and soft landscape. Drainage of this upstream catchment is via a piped drain system that discharges via the existing culvert into the existing ditch on the Hydrus site.

2.10 Proposed Site Development

2.10.1 Hydrus Construction Site

The site at construction stage will comprise all the land uses normal for a major construction project such as office accommodation, welfare facilities, open storage, laydown, fabrication, construction vehicle and plant refuelling. Figure 6 below shows the drainage of the site entrance area which will be temporary during the construction stage of the project. This drainage is Pre-construction works to provide drainage of the Hydrus site entrance. The drainage of this small area of impermeable paving is connected via ditches/swales and orifice flow control devices to the existing surface water drainage system serving this area.

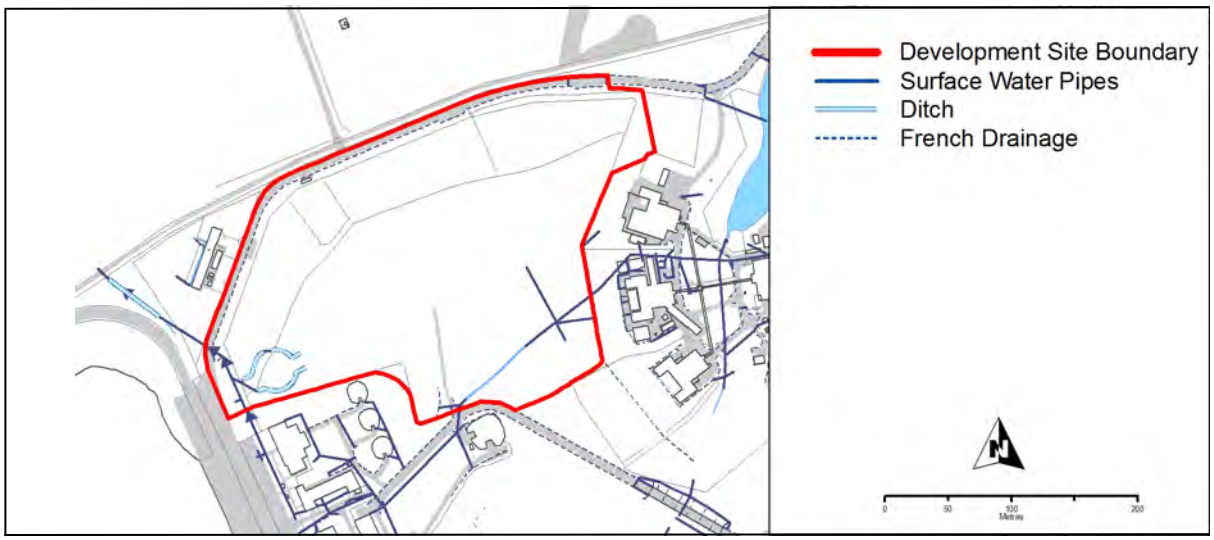


Figure 6; Temporary Drainage of Hydrus construction site entrance

The Layout of the site at completion of Site Establishment stage is shown on drawing A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001000 (Figure 7; See below). Surface finishes are largely dictated by the use to which the various sub-areas within the construction site will be put. In general, surfaces will be permeable except where there is a greater risk of pollution, for example; construction vehicle parking, vehicle and plant refuelling and washout and wheelwash areas.

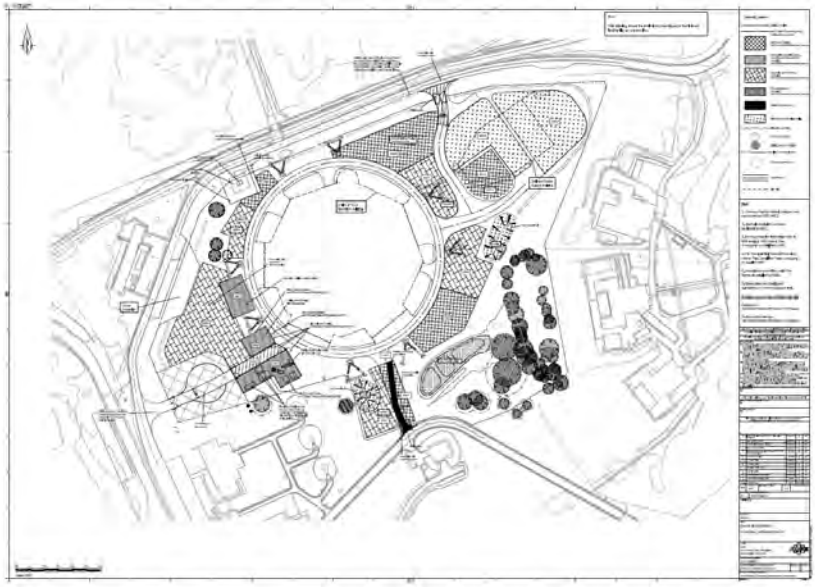


Figure 7; Hydrus; Site layout at completion of Site Establishment

Permeable laydown areas are considered to have a risk of becoming impermeable with the passage of time and trafficking by construction plant, so a network of herringbone filter drains are also provided to ensure these areas do not pond.

In the SuDS design that follows, measures have been taken that deal with the assessed risks.

2.10.2 Hydrus Operational Site (End State)

The proposed Hydrus site development is to comprise three buildings (an Operations Building, a Support Building, and a Substation) with commercial vehicle parking/delivery areas and service roads as drawing A-HYDRUS-ATK-99-XX-DRW-AR-900-111-005001 (Figure 8; See below). The former construction site entrance will be reconstructed as an emergency only access, and the turning circle will be removed and replaced with soft landscape at the end of construction.

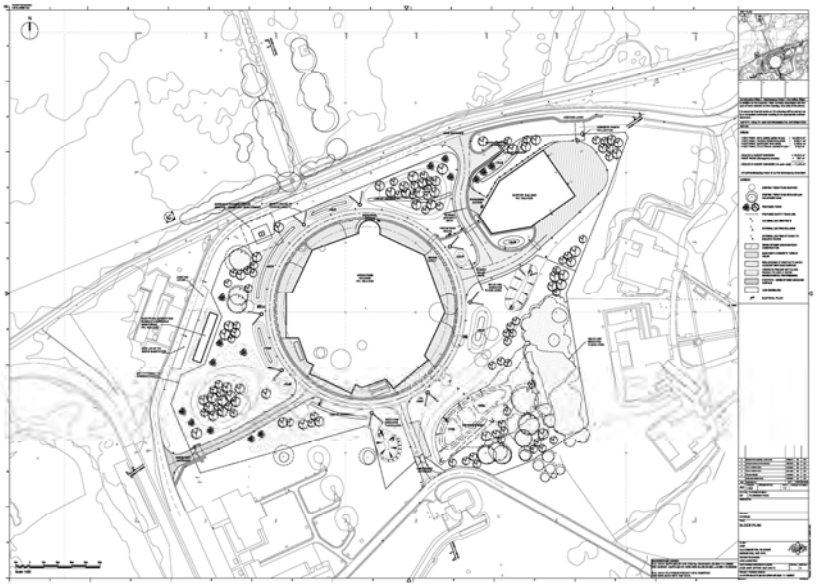


Figure 8; Hydrus; Operational site layout (End State)

3 Drainage Design

3.1 Proposed Drainage Key Elements

3.1.1 Completion of Site Establishment stage: (See section 2.10.1)

The proposed SuDS scheme for the Completion of Site Establishment stage contains the following SuDS features:

- Detention Basin
- Swales
- Cut off ditches
- Soakaways: (Granular infiltration blanket under the construction establishment area)

The proposed SuDS scheme for the Completion of Site Establishment stage contains the following controls:

- Vortex flow control devices
- Full retention oil separators
- Silt Separators (hydrodynamic separators)
- Penstocks (pollution control valves)

The proposed SuDS scheme for the Completion of Site Establishment stage contains the following elements of traditional drainage:

- Piped drainage and Filter drains with catchpits / manholes

3.1.2 Operational Stage (End State - See section 2.10.2)

The proposed SuDS scheme for the Operational Stage (End State) contains the following SuDS features:

- Detention Basin
- Swales
- Cut off ditches
- Soakaway (Note that due to uncertainty in relation to high ground water levels, some infiltration is incorporated by means of unlined detention basin and swales, but is not accounted for in calculating overall catchment flows.)
- Green Roof areas (Operations Building and Substation), but modelling assumes traditional roofs providing further benefit in the SuDS design.

The proposed SuDS scheme for the Operational Stage (End State) contains the following SuDS controls:

- Vortex flow control devices
- Orifices
- Bypass and full retention oil separators
- Hydrodynamic separators
- Penstocks (pollution control valves)

The proposed SuDS scheme for the Operational Stage (End State) contains the following elements of traditional drainage:

- Piped drainage with catchpits / manholes
- Road gullies
- Kerb and slot drain systems

3.2 Proposed Drainage: Synopsis

The proposed SuDS scheme for the development site is represented in the flow charts and layouts below. The flow charts show the SuDS features, controls features and elements of traditional drainage and demonstrate how they interact.

This main features of the scheme largely remain the same from construction through to operational stage. However, the volume of the buried attenuation with restricted outflow will be

constructed in stages as the hard surfaces of the floor slabs for the building are constructed. The soakaway area under the site cabins will be abandoned and replaced with soft landscaping after construction. A small amount of permeable paving is incorporated in the operational stage of the project for untrafficked hard surface areas around the perimeter of the building. Figure 9 below shows the site in the worst case (Maximum impermeable area) during the latter parts of construction, before laydown areas and construction accommodation has been removed.

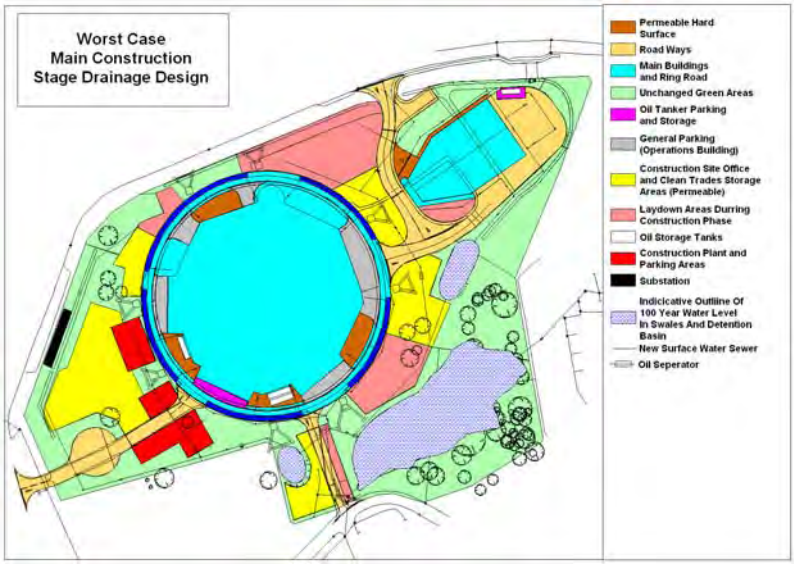


Figure 9

3.2.1 General description of SUDS Drainage

3.2.1.1 Detention Basin, Swales and Existing Watercourse

The Hydrus Detention Basin and East and West Swales will be constructed at the same stage as the Site Establishment and will be functional throughout the Hydrus Main Construction stage and will remain functional during the Operational Stage (End State).

Refer generally to the Layouts and Schematics in 3.2.1, 3.2.2 and 3.2.3 below. The Hydrus detention basin is located in a natural depression on the site. Within this depression, a watercourse currently exists as an open ditch. The discharge into this ditch is from an upstream culvert (300mm dia), and where it leaves the Hydrus site it enters an existing downstream culvert (300mm dia.). The new detention basin is designed to receive an upstream flow from the existing culvert which will in future be controlled by a vortex flow control device in a flow splitting chamber. The flow entering the detention basin will be restricted to the upstream green field run-off as given by Q Bar calculations. Any surplus flow from the upstream catchment will be discharged via a new bypass culvert, and will be reintroduced to the existing culvert downstream of the detention basin. Hydraulic modelling of the upstream catchment has been provided by AWE Utilities and Highway Engineering Department.

The detention basin discharge is limited by a discharge vortex flow control device to the sum of the Hydrus green field run-off (10.8 l/s) and the upstream catchment green field run-off (17.1 l/s), as given by the green field Q Bar calculations. The detention basin volume is designed to be approximately 2100m³, during the Main Construction (worst case) stage of the project, but may be reduced to 1800m³ for the operational stage (resulting from removal of construction hardstandings and offices). This storage volume will be utilized mostly during the long duration storms (the 1440 minute critical duration in a 1 in 100 year storm being the worst case).

Based on hydraulic modelling analysis work carried out by AWE Utilities and Highway Engineering Department, the downstream pipe is currently surcharged to a depth of 370mm in the 1 in 100 year 60 minute storm. In order to ensure the downstream pipe system is not subjected to increased flows resulting from the head of stored water in the Detention Basin increasing the surcharge in these pipes, an additional vortex flow control device will be installed in a chamber on the upstream storm flows bypass pipe. This vortex flow control device will be sized to ensure flows in the downstream pipes can not exceed those of the Pre-development drainage system and will restrict flows to a total of 180 l/s. In a storm event, the surcharge that builds up behind the flow control in the upstream storm flow bypass pipe, will discharge via an overflow pipe to the detention basin at a level that will be below the invert of the incoming upstream drainage system, so there will not be an adverse effect on the existing upstream drainage system

In order to enhance the treatment train, the base of the detention basin will be divided into three shallower basins, each approximately 300mm deep, such that discharge of all “first flush” flow to the basin passes through these in turn. The volume of these basins along with the volume in the base of the two swales provides all the interception storage for the site.

The Eastern Swale will have a vortex flow control device to limit the outflow to 25l/s. The volume of the Eastern swale is 145m³. The swale volume is designed to enable the full capacity to be used during the short duration storms and assists with delaying the flow to the detention basin during the longer duration storms.

The Western swale will have a vortex flow control device to limit outflow to 20l/s. The volume of the Western swale is 120m³. The swale volume is designed to enable the full capacity to be used during the short duration storms and assist with delaying the flow to the detention basin during the longer duration storms. Whilst the volume of this swale could be reduced slightly following the construction stage (after removal of construction hardstandings and cabin areas), there is no intention to change it.

3.2.1.2 Description of the Hydrus Construction Site drainage (Refer to diagram 1 below and Fig 10 in section 3.3)

The Construction Site drainage will be constructed in an Enabling Works contract at the same stage as the Site Establishment stage and will remain functional throughout the Hydrus Main Construction stage.

The Construction Access road and Coach turning circle are being designed by AWE. These are temporary provisions during the construction stage (although some of the pavement will be retained to provide a 7.3 metre wide Emergency Access Road during the Operational Stage). The Run-off from this area during construction will be by overland flow into ditches on both sides of the road. From here the flow is directed to bagwork headwalls with flow control devices at the West end of the ditches, entering a piped system and then discharging into an existing AWE surface water sewer running in a North Westerly direction. The reason that this drainage is Pre-Construction, separate from the remainder of the Construction stage SUDS system is that it is constructed before any other site works can commence, to provide site access control. At the end of the Construction stage, the retained 7.3 metre wide Emergency Access Road will be kerbed, provided with trapped gullies and connected to pipe drainage discharging to the Western Swale. The remainder of this area will be restored to its former state, with drainage pipes removed and ditches filled.

There are two other site entrance locations. One is located at the North East of the site and one is an existing access at the South of the site. Both of these will be approximately 20 metres of roadway including bellmouth junction constructed in impermeable bitumen macadam construction. Beyond that on the North East access, there will be a crushed hardcore approximately 300mm thick access track linking up with the laydown areas. For the South

entrance, there is an existing concrete road that will be retained during the Construction Stage, with additional width being provided using crushed hardcore 300mm thick. This road will be extended to link up to the construction laydown areas.

The fueling area will be an impermeable concrete paved area isolated from surrounding areas. This area will fall to a central channel drain that will discharge to a full retention interceptor provided with automatic shut off valve and high level alarm as required in the Environment Agency Pollution Prevention Guidelines 3 (EA PPG3). This interceptor will discharge to the Western Swale.

The vehicle/plant parking area will be a concrete paved area drained to channel drains that will also discharge to the full retention interceptor provided for the fueling area described in the previous paragraph.

The area of crushed granular material on and around which the contractors site accommodation cabins and welfare facilities are placed will be 400mm thick Highways Agency type 3 sub-base to provide a total infiltration area with storage capacity within the voids of the granular material.

All other laydown areas are constructed in well graded crushed hardcore, and whilst they may provide some infiltration, for the purposes of the drainage design it has been assumed that with time the surface will become impermeable. Drainage of these has therefore been allowed for by providing a herringbone arrangement of filter drains.

The Electricity Substation is planned to be constructed at the start of the construction stage. Its roof drains to the Western Swale. Transformers are housed inside the building and are within brickwork bunded areas. (The transformers will be filled with Midel insulating fluid which is biodegradable and low environmental risk.)

Due to the fact that the maximum impermeable area exists part way through construction, when all the construction areas are in use and when the new buildings and roads are completed but not fitted out, the design of the Main Construction Worst Case stage drainage takes account of this scenario. As a result of this, during construction the provision of the attenuation storage around the Operations Building will be planned such that as the floor slabs are constructed, the construction of the adjacent attenuation storage precedes it and is already available.

The Emergency Vehicle parking area alongside the detention basin will be constructed of crushed hardcore. In the event of a fire, the detention basin pollution control valve can be closed, and if there is any significant volume of water available in the detention basin, then the Fire Service can consider pumping from there as an additional source of fire fighting water.

For the purpose of the calculations for the flows to the Detention Basin and the Detention Basin sizing the following impermeabilities have been assumed for the different areas during construction.

Area Use (During Construction - Maximum impermeable area)	Area (ha)	Impermeability %
Construction Establishment area and other infiltration working / storage areas.	0.39	0
Wooded Area and other soft landscape areas un-developed during construction.	2.34	20
Fuelling Area, Wheel Wash and Concrete Wagon Wash Out	0.14	100
Road and Delivery Areas.	0.82	85
Laydown Areas.	0.49	85
Building Roofs	1.38	95

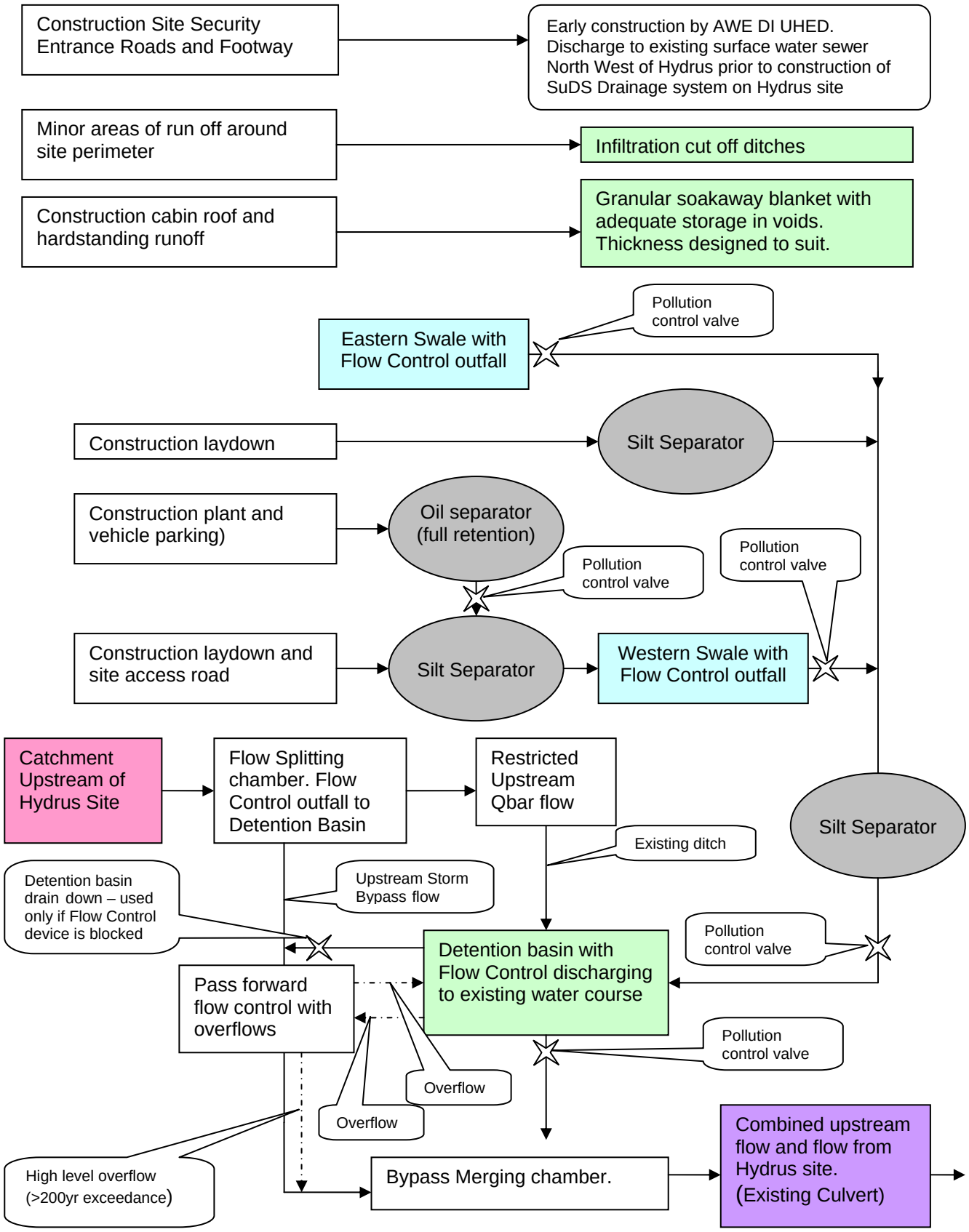


Diagram 1 SuDS Drainage schematic for Hydrus at Completion of Site Establishment stage

3.2.1.3 Description of the Hydrus Operational Site drainage (Refer diagram 2 below and figure 11 in section 3.3)

The Hydrus Operational Stage (End State) drainage will be constructed during the main Hydrus construction contract. The construction of the subsurface attenuation units under the Operations Building circulatory road will be carried out as the construction of the floor slabs progress to ensure that the storage remains matched to the impermeable areas throughout the construction period.

The road access to the North East of the site will be readjusted at the end of the construction stage, and extended as part of the Operational stage site road layout. Kerbs will be constructed at the edges of the road and trapped gullies and slot drainage installed to collect Run-off. This will then drain via pipes and via a vortex flow control device, to discharge to the Detention Basin

The road access to the South of the site will be reconstructed at the end of the construction stage. The remaining parts of the old concrete road will be broken up and will be removed. This road will be reconstructed in impermeable bitumen macadam construction and will be extended to join the Operational building circulatory road. Kerbs will be installed and drainage will be via trapped gullies or channel drains discharging via pipes to the Hydrodynamic silt separator and then on to the detention basin.

The construction access road will be reduced to a 7.3 metre wide emergency only access road and the coach turning area will be broken up and removed. Kerbs will be constructed at the edges of the road and trapped gullies or channel drainage installed to collect Run-off. This will then be discharged to the Western Swale.

The Operations Building circulatory road is subject to infrequent usage by slow moving road traffic. This road and access will be controlled by a security gated entrance. Levels of silt and other contaminants in the run-off are expected to be significantly less than would be seen on normal site roads due to this controlled low level of usage. The discharge from this road will be directly to the piped drainage system, through the Hydrodynamic silt separator and then into the detention basin.

The Support Building roof and its surrounding paved areas will drain to the Eastern Swale.

The Electricity Substation roof drainage remains as unchanged from the construction stage, and will drain to the Western swale.

The Operations Building roof, road drainage, vehicle hardstandings and delivery areas all drain to the buried attenuation units, situated under the access road. This attenuation will have an orifice restriction on the discharge to restrict the flow and will also be provided with a high level overflow. The volume of the attenuation is 540m^3 and is designed to enable the full capacity of the attenuation to be used during the short duration storms and assist with delaying the flow to the detention basin during the longer duration storms.

Tanks will be installed outside the Operational Building and the Workshops (in the Support Building) that at times will contain electrical insulator oils. These tanks require a means for filling / emptying by road tankers, although this is anticipated to occur very rarely. The tanks will be double skinned tanks, so are not contained within a bunded area. However the road tanker delivery bay will be a concrete pavement laid to fall to a drainage channel. Around the perimeter of this area a drive over bund (“road hump”) of half battered kerbs laid on their side and back to back will be constructed. These oil delivery areas will be drained through a full retention oil separator with automatic shut off and high level alarm as required in the Environment Agency Pollution Prevention Guidelines 3 (EA PPG3).

Vehicle hardstandings and delivery areas will be drained through a bypass oil separator as required in EA PPG3 and these will be provided with a high level alarm. Where an oil delivery pipe between a tank and the building is laid below finished ground level, it will be double skinned and contained within a sealed concrete trench that will have a sump at a low point. The oil delivery areas will generally be designed to meet with the Guidance in EA PPG 2

All flows from swales and from piped drainage systems will pass through a Hydrodynamic silt separator before entering the detention basin. This will enable remaining silts to be collected, which protects the basin.

The Emergency Vehicle parking area alongside the detention basin will be constructed of crushed hardcore.

In the event of a fire, the detention basin pollution control valve can be closed, and if there is any significant volume of water available in the detention basin, then the Fire Service can consider pumping from there as an additional source of fire fighting water. Note that any fire fighting water used inside the Operations building would be retained inside, and sampled to ensure there is no contamination before being discharged to the detention basin. Any contaminated water would be tankered away for treatment and appropriate safe disposal.

For the purpose of the calculations for the flows to the Detention Basin and the Detention Basin sizing the following impermeabilities have been assumed for the different areas during the Hydrus Operational stage.

Area Use	Area (ha)	Impermeability %
Wooded Area and other soft landscape	3.21	20
Building Roofs	1.38	95
Road and Delivery areas	0.82	85
Permeable areas (Ignored in calculations:- conservative)	0.15	20

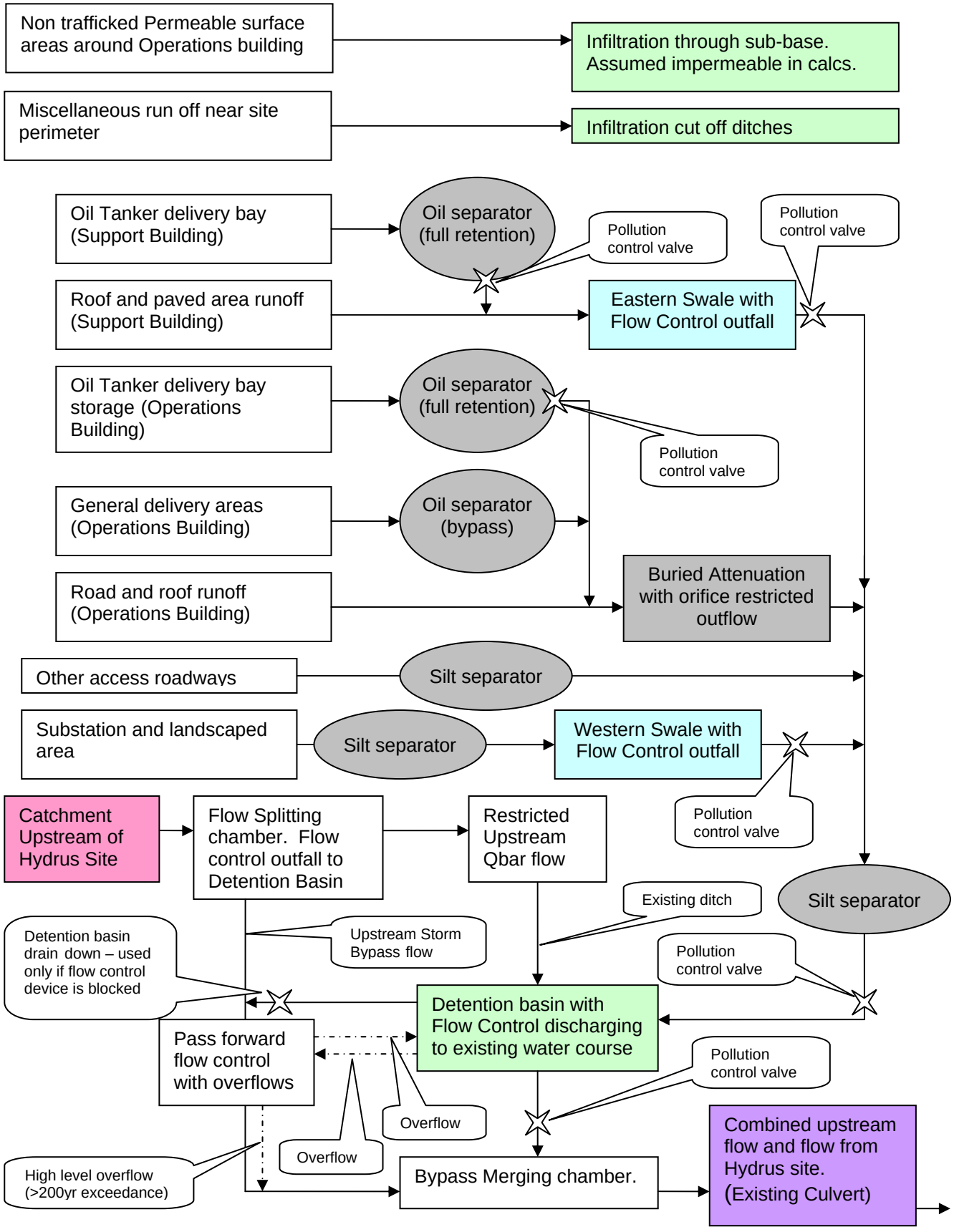


Diagram 2 SuDS Drainage schematic for Hydrus Operational Site (End State)

3.3 Proposed Drainage Detail

Drawing A-HYDRUS-ATK-99-DRW-CD-520-111-001006 shows the plan layout of the proposed drainage system for the Construction Site (Completed Enabling Works). (See figure10 below)

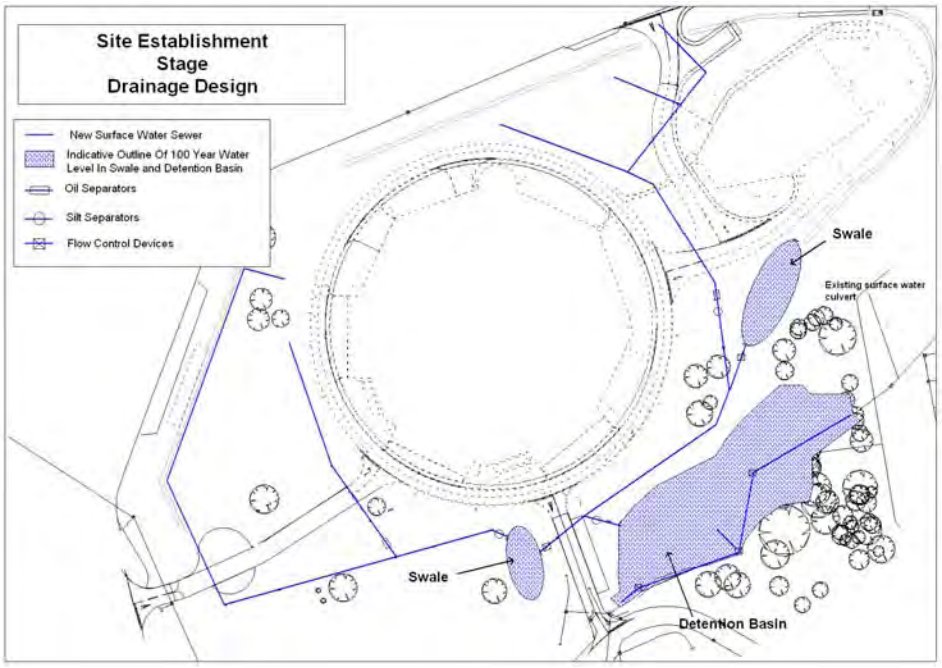


Figure 10

Drawing A-HYDRUS-ATK-99-DRW-CD-520-111-001506 shows the plan layout of the proposed drainage system for the completed Hydrus Project. (See figure 11 below)

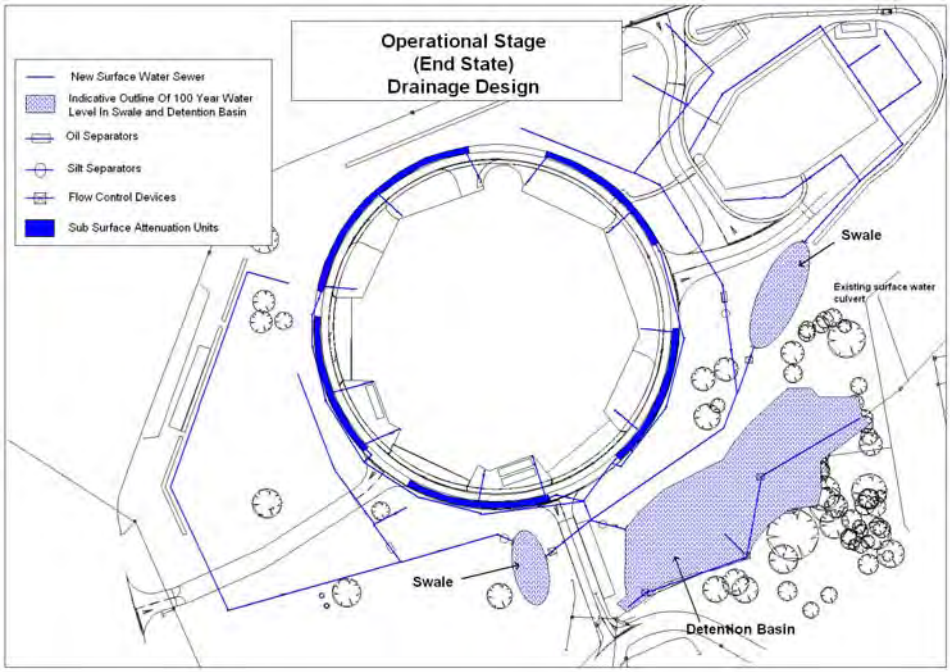


Figure 11

4 Design Compliance

This section demonstrates that the proposed SuDS scheme is compliant with the SuDS Principles Document and PPS 25.

Analysis has been carried out using Microdrainage Software. The Calculations are contained in Appendix D

The design takes account of an upstream catchment, with a Qbar flow maintained through the existing watercourse in the Hydrus Detention Basin, and the balance of storm flows diverted in a culvert to bypass the Detention Basin. The outflow from the Hydrus Detention basin will be limited to the sum of the upstream catchment Qbar added to the Hydrus Qbar flows by means of a flow control device.

4.1 Flood Protection- Levels of Service

The levels of service that are required for this development site are in accordance with the AWE SUDS Principles document.

The analysis carried out using Microdrainage Software includes a climate change factor of 10% for the Enabling Works stage and 20% for the Operational stage. The analysis shows that, for the proposed SuDS design:

- There is no flooding to the Roads on a 1 in 30 year event
- There is no flooding to the Car Park areas on a 1 in 10 or 1 in 30 year event
- There is no flooding to the Buildings on a 1 in 30 or a 1 in 100 year event

This complies with the AWE drainage system design requirements.

The management of flood exceedance impact criteria is also met because only acceptable flooding is predicted on a 1 in 100 year event, all flows are contained.

- The maximum flood depth to the non-arterial roads on a 1 in 100 year event is 0.012m
- The maximum flood depth to the Car Park areas on a 1 in 100 year event is 0.012m

The management of flood exceedance impact criteria is also met in considering the results from a 200 year storm. Whilst some flooding occurs, this is limited to roads and low points away from buildings.

Thus the design is compliant with the AWE required flood protection levels of service.

4.2 Interception Storage

For both the Construction Stage and the Operational Stage (End State), Interception storage of the first 5mm of rainfall will be provided in the bases of the Swales and the Detention Basin. Compliance is achieved with the provision of a total volume of 147m³ of interception storage.

4.3 Attenuation Storage

Since Long Term Storage is not being provided, flows from the development site need to be restricted to Qbar, thus the permitted peak flows from the Hydrus development site are 10.8l/s.

Permitted peak flows based on Qbar from the upstream development are 17.1 l/s and these are added to the Hydrus figures to set the vortex flow control device flow rate for the Hydrus Detention Basin.

The SuDS scheme has been designed to meet the above flow criteria for construction and operational stages. As a result, attenuation storage is required and this has been provided in the form of underground storage (under the circulatory road), and the SuDS features, in particular in the Swales and in the Detention Basin. From the analysis, the predicted peak flows from the site contributions are given below:

Main Construction Stage Worst Case (Maximum Impermeable Areas)

1 in 1 year Predicted Peak Flow of 9.2 l/s

1 in 100 year Predicted Peak Flow of 10.8 l/s

1 in 100 year +10% Predicted Peak Flow of 10.8 l/s

Operational stage (End State)

1 in 1 year Predicted Peak Flow of 9.2 l/s

1 in 100 year Predicted Peak Flow of 10.8l/s

1 in 100 year +20% Predicted Peak Flow of 10.8 l/s

It can be seen that the predicted peak flows are at or below the permitted peak flows in all cases, so compliance is achieved. Refer to the Microdrainage design calculations (Appendix D) for substantiation of the details of these flows

4.4 Long Term Storage

The requirement for long term storage is that at least 900m³ is stored on a 1 in 100 year 6 hour storm event, and that the peak discharge rate from the Detention Basin would be 34.5 l/s. The discharge from the storage based on 2 l/s/ha would be 7.8 l/s based on an area of 3.9 ha.

Having taken account of the Project and Site constraints, as well as economics relating to the benefits from the use of Long Term Storage, the decision has been taken not to provide long term storage and to control discharge from the Detention Basin to Qbar (10.8 l/s), which will be achieved using a flow control device.

4.5 Infiltration

The data recorded to date in relation to the ground water levels shows them to be relatively close to ground level, generally in the region of 0.5 to 2 metres below existing ground level. As a

result, taking account of this and the other constraints in relation to available and appropriate space on the site, and operational constraints we have not found it practicable to design a large scale soakaway scheme.

However, to achieve some benefits from infiltration, it has been agreed that during construction stage, the Site Construction Accommodation can be placed on top of a HA Type 3 subbase layer which will provide adequate storage for the Run-off from the roofs and hard areas. This is quantifiable and has been taken account of in the Microdrainge calculations. Also because this is not a vehicular area, it is anticipated that it will remain largely permeable throughout the construction period.

For the completed project, there are hard paved areas around the Operations Building that are not trafficked, and these and some footways will be laid as permeable paving with permeable subbase. It is perceived and accounted for, that in an extreme storm event, these may overflow but would then contribute to the road drainage by overland flow.

In addition, the Detention Basin and the Swales will be left unlined in order that some benefit from infiltration in these devices may be achieved.

These latter two infiltration opportunities are not readily quantifiable and therefore whilst being incorporated in the design, they have not been taken account of in calculating storage volumes and detention basin discharge.

4.6 Operation and Maintenance

The SuDS features have been designed in line with the AWE SuDS Principles Document and there are no features that require unusual operation or maintenance.

It is of note that the Detention Basin outlet flow control device would be submerged and inaccessible for significant storms including the 100 year storm. For this reason, an additional drain down pipe has been incorporated leading to the bypass drain system. This will be controlled with a penstock on the discharge into a manhole. The manhole is outside the area of the 96.5m AOD water level for the basin and will be accessible by foot. This drain down would only need to be operated should the flow control device or screen get blocked. This penstock will be locked shut at all other times.

4.7 Treatment Train

A treatment train approach to drainage systems for the Hydrus site has been adopted where possible.

A pollution scoring system has been provided within the AWE SuDS Principles document. This has been used to determine the score for both Site Establishment Completion Stage and for Operational Stage (End State) are both below 1 and therefore are compliant.

Of particular note is the fact that the number of vehicles permitted access to the Hydrus site will be very low. The use of the word “Roads” in the context of this site is in terms of a hard surfaced vehicle access route. As such, even the delivery areas are unlikely to be subject to more than occasional deliveries, so the Land Use Pollution Factor of 2.4 in the AWE SuDS Principles document for normal roads may be considered to be conservative.

4.8 Amenity and Ecology

Swales and a detention basin have been used as the primary SuDS features in the design. The existing ditch is also being retained with a managed green field flow to ensure the ecological benefit of this is maintained during dry weather. While detention basins offer the potential for increased amenity, the benefit of both swales and detention basins to the ecology is perhaps more apparent with the wetland and grassed areas often resulting in important species of plant or vegetation colonizing these areas.

The swales and detention basin have been designed in series where possible so that the depth and shape of the swales and basin can vary, providing a more aesthetic environment, but more importantly, the water quality process of swales and basin in series results in a much better discharge quality and create different communities of species. To further improve matters, the base of the detention basin will be sculpted to form three individual shallow basins which address infiltration storage volume requirements, and will also provide additional stages in the treatment train.

The high level of maintenance employed on this site should ensure that the best possible value is gained from the improvements in both amenity and ecology.

4.9 Safety and Risk Assessment

The SuDS features have been designed in line with the AWE SuDS Principles document and there are no unusual features that will result in unacceptable health and safety risks.

Appendix A

Enlarged copies of figures from the text of this Report (A3 size)

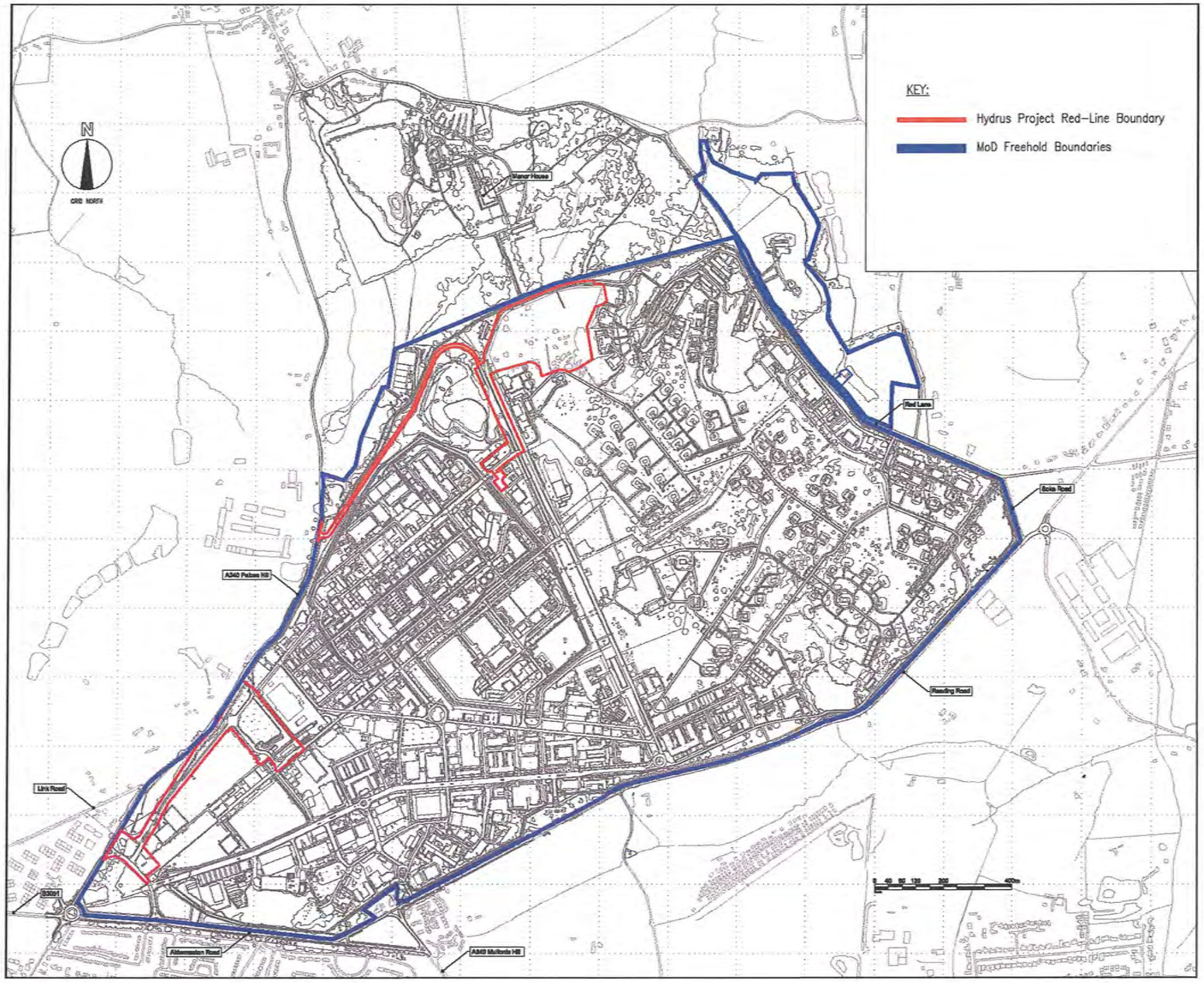


Figure 1 Aldermaston; Site overview

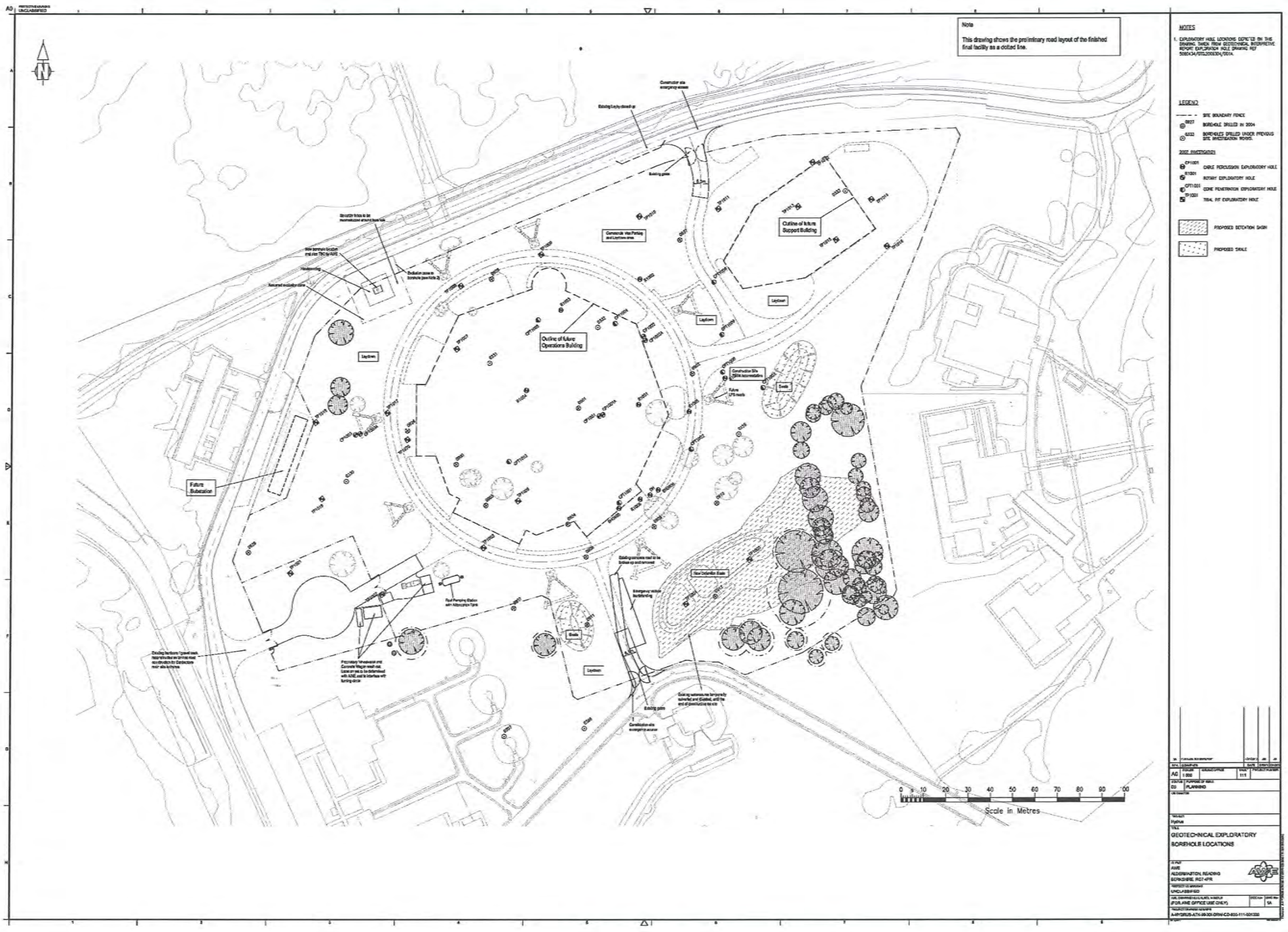


Figure 2 Hydrus; Geotechnical exploratory borehole locations

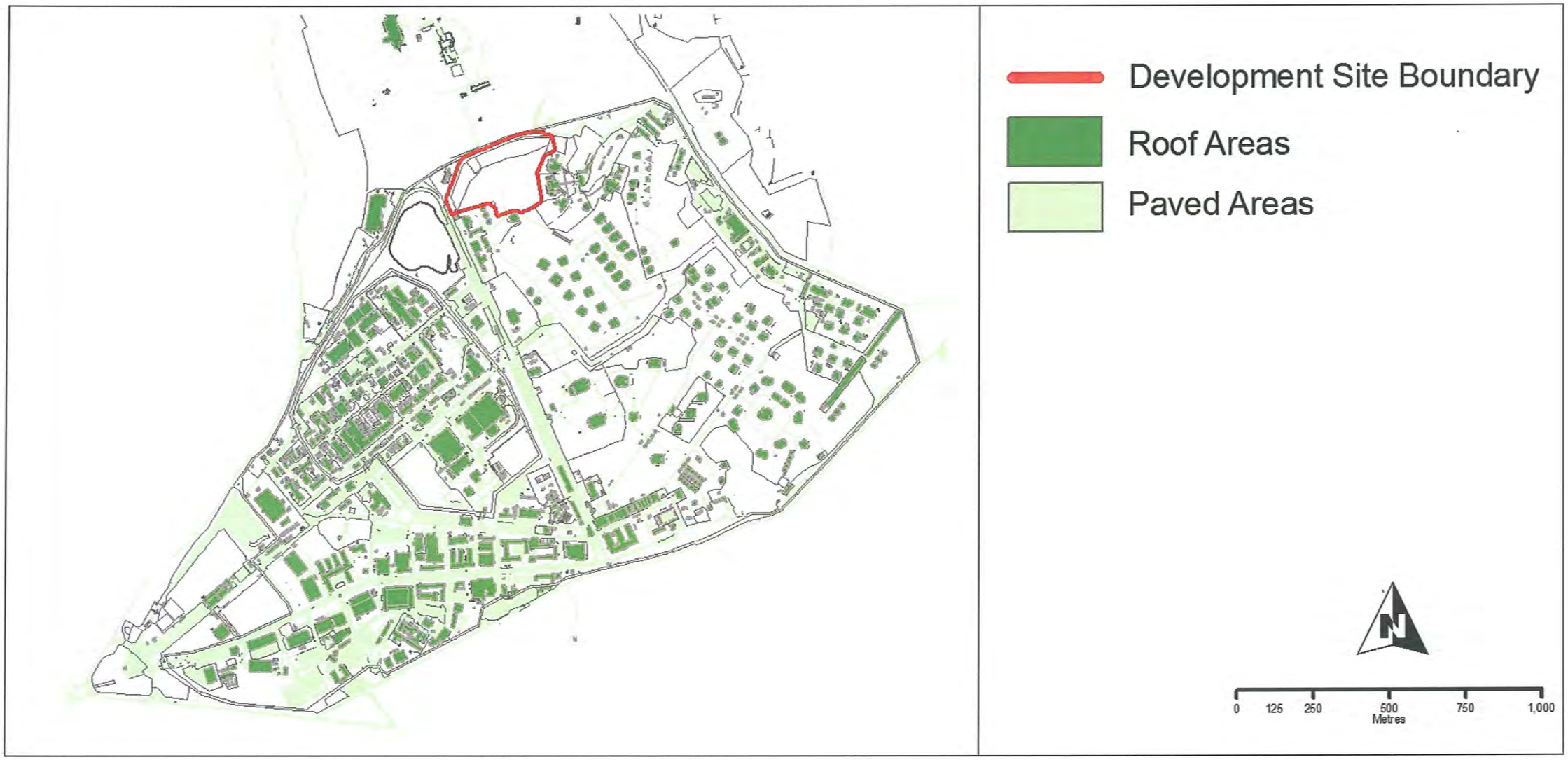


Figure 3 Aldermaston; Existing land use overview

Figure 4 Hydrus site; Former land use

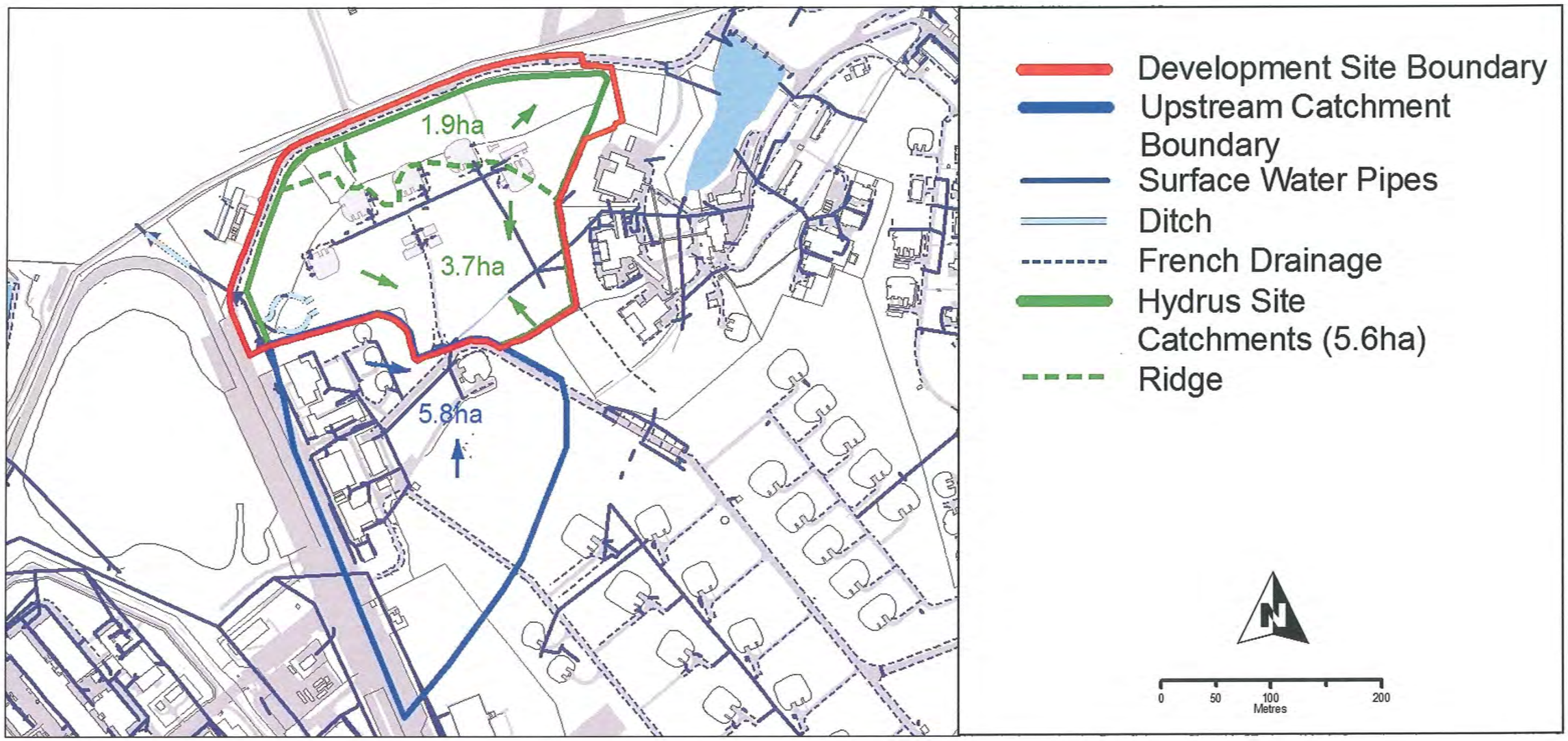


Figure 5 Hydrus site; Existing / Former drainage and catchments

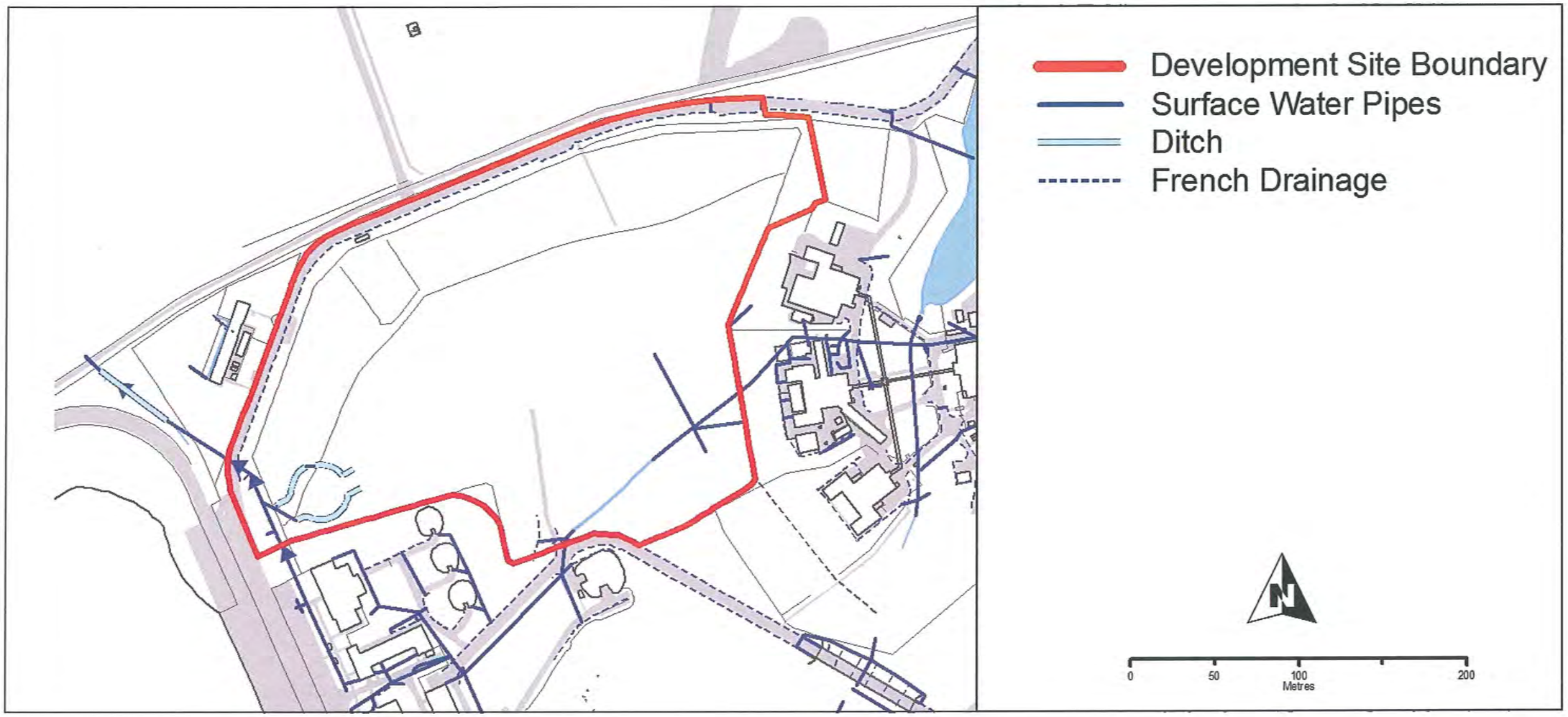


Figure 6 Temporary Drainage of construction site entrance

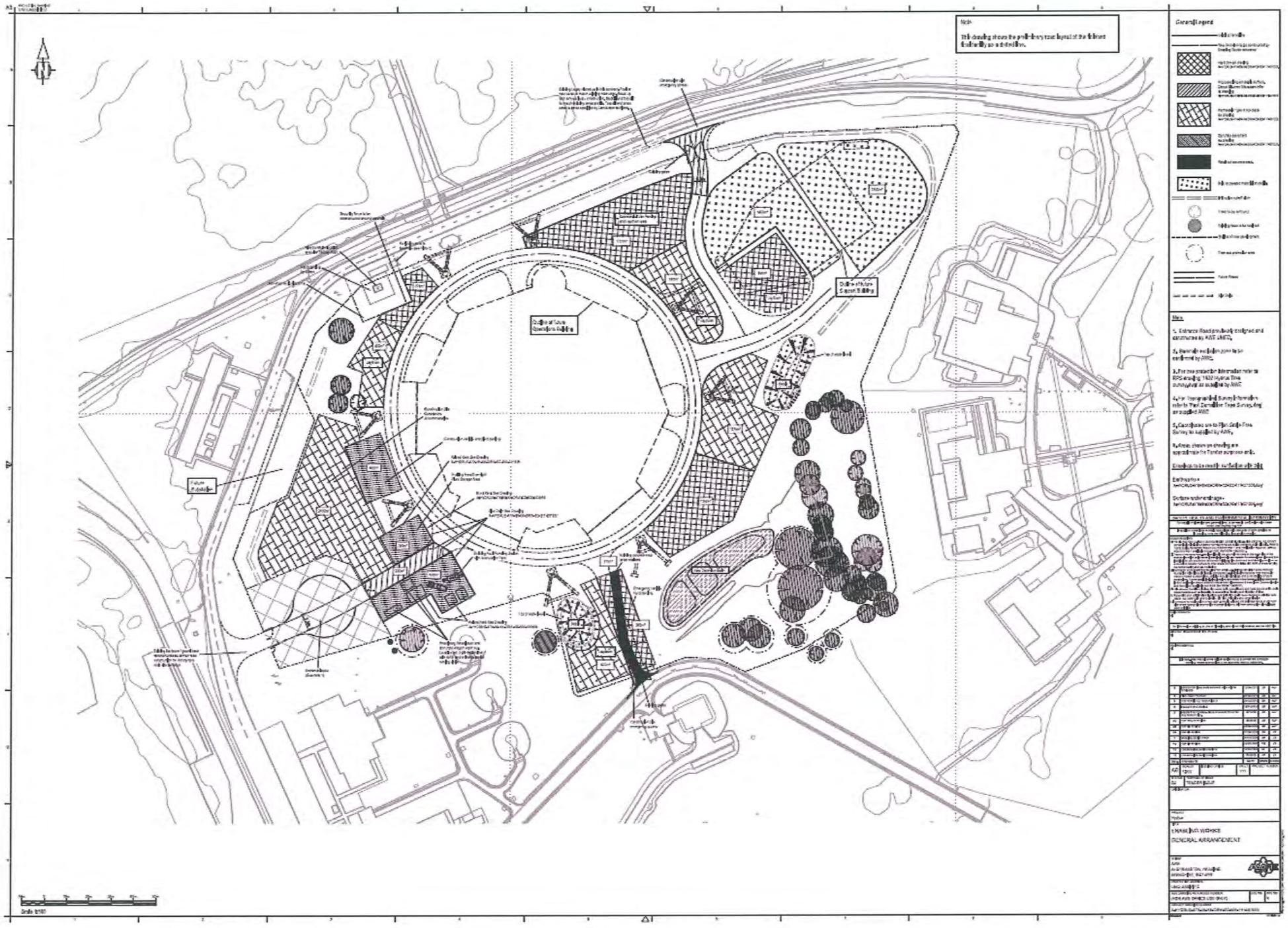


Figure 7 Hydrus Site Layout at completion of Site Establishment stage

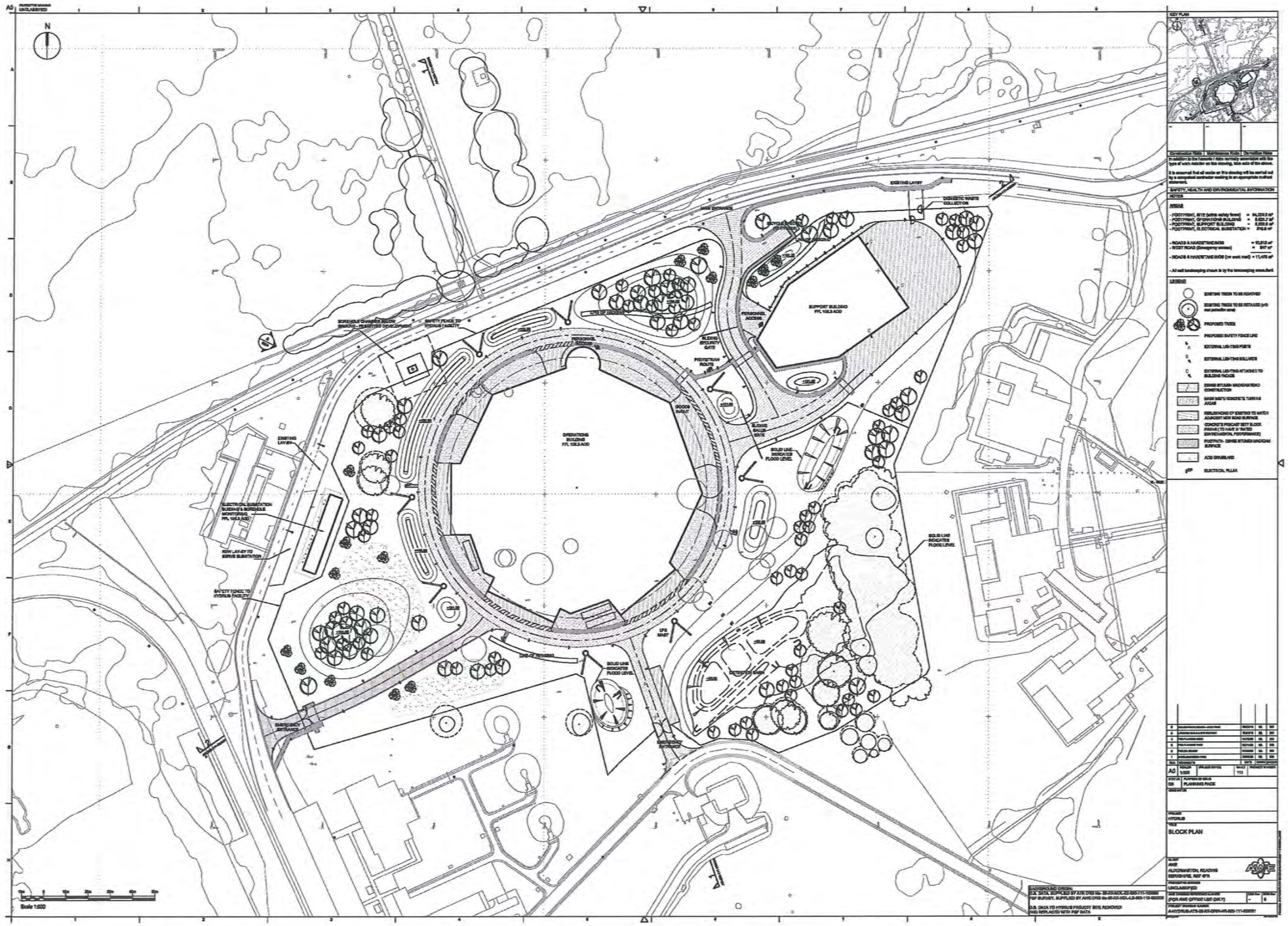


Figure 8 Hydrus Operational Site Layout (End State)

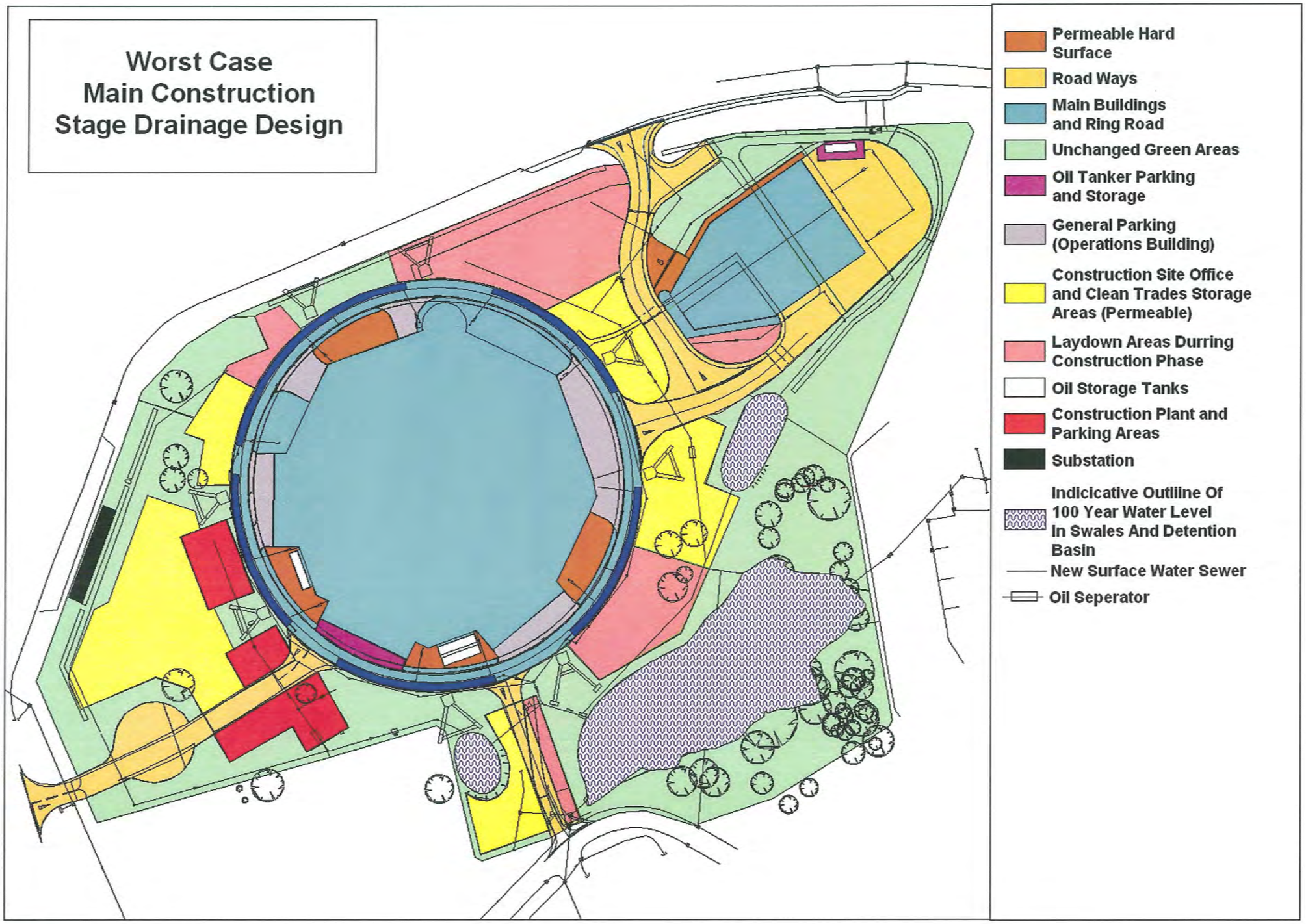

Worst Case
Main Construction
Stage Drainage Design
Permeable Hard Surface
Road Ways
Main Buildings and Ring Road
Unchanged Green Areas
Oil Tanker Parking and Storage
General Parking (Operations Building)
Construction Site Office and Clean Trades Storage Areas (Permeable)
Laydown Areas Durring Construction Phase
Oil Storage Tanks
Construction Plant and Parking Areas
Substation
Indicicative Outliine Of 100 Year Water Level In Swales And Detention Basin
New Surface Water Sewer
Oil Seperator

Figure 9

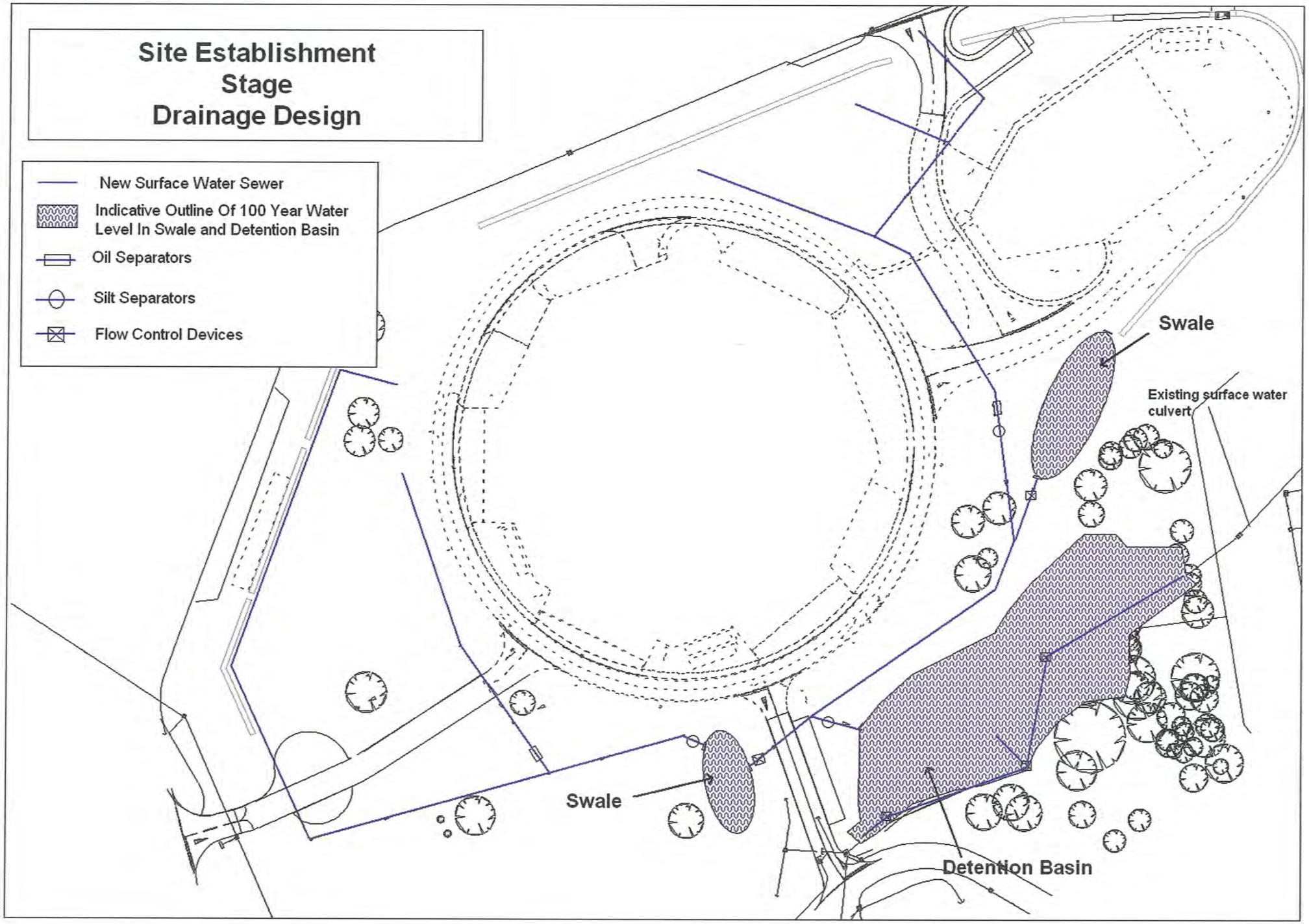

Site Establishment
Stage
Drainage Design
New Surface Water Sewer
Indicative Outline Of 100 Year Water Level In Swale and Detention Basin
Oil Separators
Silt Separators
Flow Control Devices
Swale
Existing surface water culvert
Swale
Detention Basin

Figure 10

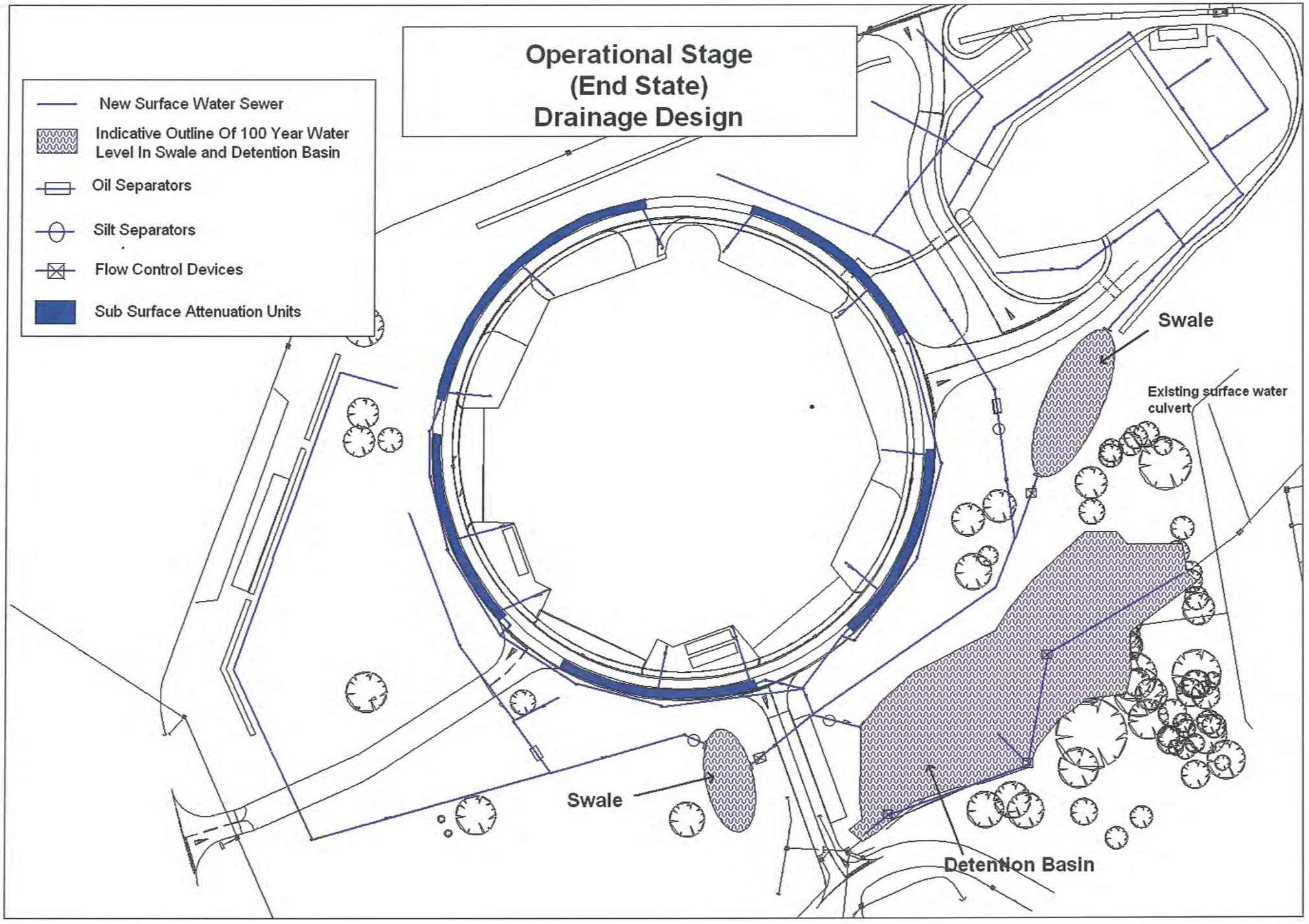

Operational Stage
(End State)
Drainage Design
New Surface Water Sewer
Indicative Outline Of 100 Year Water Level In Swale and Detention Basin
Oil Separators
Silt Separators
Flow Control Devices
Sub Surface Attenuation Units
Swale
Existing surface water culvert
Swale
Detention Basin

Figure 11

Appendix B

Copies of Hydrus Project Drawings (Full size) -

Included separately within Planning Application pack

Drawing Reference No.	Title/Description
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001000	Enabling Works - General Arrangement
A-HYDRUS-ATK-99-XX-DRW-CD-520-111-001006	Enabling Works - Surface Water Drainage Layout
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001026	Swale (West)
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001027	Swale (East)
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001028	Inlet/Outlet Structure – Pipe Headwall Details
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001029	Detention Basin Outfall Structure
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001041	Enabling Works Surface Water Longitudinal Sections Sheet 1 of 4
A-HYDRUS -ATK-99-XX-DRW-CD-900-111-001042	Enabling Works Surface Water Longitudinal Sections Sheet 2 of 4
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001043	Enabling Works Surface Water Longitudinal Sections Sheet 3 of 4
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001044	Enabling Works Surface Water Longitudinal Sections Sheet 4 of 4
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001046	Surface Water Ditch Bypass Long Sections
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001060	Enabling Works Basin Cross Sections Sheet 1 of 3
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001061	Enabling Works Basin Cross Sections Sheet 2 of 3
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001062	Enabling Works Basin Cross Sections Sheet 3 of 3
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001506	External Wks - Surface Water Drainage Layout
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001530	External Wks - Oil Delivery Bay Standard Details
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001540	External Wks - Typical Road Cross Section
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001541	External Wks – Surface Water Longitudinal Sections Sheet 1 of 4
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001542	External Wks - Surface Water Longitudinal Sections Sheet 2 of 4
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001543	External Wks - Surface Water Longitudinal Sections Sheet 3 of 4
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001544	External Wks - Surface Water Longitudinal Sections Sheet 4 of 4
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001900	Drainage Pipe Bedding Details
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001901	Manhole detail - Chamber type 2
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001902	Manhole detail - Chamber Type 3
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001903	Rampdrop Detail for Manholes
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001904	Backdrop Detail For Manholes
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001905	Protection of Pipes Adjacent to Buildings
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001915	Drainage Details - Road Gully
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001924	Catchpits
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001925	Enabling Works - Drainage Details - Interceptor
A-HYDRUs-ATK-99-XX-DRW-CD-900-111-001935	Downstream defender - 2.0m Chamber Diameter
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001936	Downstream defender - 2.55m Chamber Diameter
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001937	Downstream defender - 3.0m Chamber Diameter
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001944	Hydro Brake Chamber General Arrangements
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001958	Surface Water Attenuation Facility – Culvert detail
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001962	Enabling Works - Upstream Catchment Diversion Chamber
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001963	Enabling Works - Bypass Overflow Chamber
A-HYDRUS-ATK-99-XX-DRW-CD-900-111-001964	External Works - Drainage Details - Interceptor
A-HYDRUS-ATK-99-XX-DRW-AR-900-111-005001	Block Plan (*External Works General Arrangement*)

Appendix C

MicroDrainage Design - Calculations

Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes11.4\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes11.4\STANDARD.MHS

FEH Rainfall Model

Return Period (years)	2
Site Location	GB 459450 164350 SU 59450 64350
C (1km)	-0.029
D1 (1km)	0.311
D2 (1km)	0.287
D3 (1km)	0.367
E (1km)	0.306
F (1km)	2.523
Maximum Rainfall (mm/hr)	20
Foul Sewage (l/s/ha)	0.00
O'flow Setting (*Foul only)	0
Volumetric Runoff Coeff.	1.00
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	0.000
Min Cover Depth for Optimisation (m)	0.000
Min Vel for Auto Design Only (m/s)	1.00
Min Slope for Optimisation (1:X)	500
Minimum Outfall Invert (m)	0.000
Ground Level at Outfall (m)	0.000
Outfall Manhole Name	
Outfall Manhole Dia/Length (mm)	0
Outfall Manhole Width (mm)	0

Designed with Level Inverts

©1982-2009 Micro Drainage

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	225	1	100.200	99.075	0.900	1050
1.001	o	225	2	100.300	98.975	1.100	1050
1.002	o	225	4	100.300	98.885	1.190	1050
1.003	o	300	6	100.500	98.754	1.446	1050
1.004	o	300	11	100.500	98.614	1.586	1200
1.005	o	450	12	100.500	98.416	1.634	1350
2.000	o	300	12	100.300	99.100	0.900	1050
2.001	o	300	13	100.400	98.940	1.160	1050
3.000	o	300	14	100.500	99.300	0.900	1050
2.002	o	300	15	100.500	98.823	1.377	1050
1.006	o	450	16	100.500	98.164	1.886	1350
1.007	o	450	17	100.500	98.004	2.046	1350
1.008	o	600	18	99.500	97.969	1.381	10000
1.009	o	150	19	99.300	97.829	1.321	10000
4.000	o	300	20	100.000	98.800	0.900	1050
4.001	o	300	20	100.000	98.633	1.067	1050
4.002	o	300	20	99.500	98.300	0.900	1050
5.000	o	225	20	99.400	98.250	0.925	1050
4.003	o	300	20	99.500	98.100	1.100	1050
6.000	o	225	20	99.400	98.250	0.925	1050
6.001	o	225	20	99.250	98.125	0.900	1050
4.004	o	375	20	99.000	97.859	0.766	1350
4.005	o	375	20	99.000	97.829	0.796	1350
7.000	o	300	20	100.000	98.800	0.900	1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	20.00	200.0	2	100.300	98.975	1.100	1050
1.001	21.00	233.3	4	100.300	98.885	1.190	1050
1.002	36.00	274.8	6	100.500	98.754	1.521	1050
1.003	36.00	257.1	11	100.500	98.614	1.586	1200
1.004	46.50	234.8	12	100.500	98.416	1.784	1350
1.005	70.00	277.8	16	100.500	98.164	1.886	1350
2.000	40.00	250.0	13	100.400	98.940	1.160	1050
2.001	27.00	230.8	15	100.500	98.823	1.377	1050
3.000	15.00	250.0	15	100.500	99.240	0.960	1050
2.002	18.00	225.0	16	100.500	98.743	1.457	1350
1.006	40.00	250.0	17	100.500	98.004	2.046	1350
1.007	7.00	200.0	18	99.500	97.969	1.081	10000
1.008	22.50	160.7	19	99.300	97.829	1.321	10000
1.009	25.00	21.4	20	97.500	96.661	0.689	1350
4.000	25.00	149.7	20	100.000	98.633	1.067	1050
4.001	46.00	138.1	20	99.500	98.300	0.900	1050
4.002	20.00	100.0	20	99.500	98.100	1.100	1050
5.000	15.00	200.0	20	99.500	98.175	1.100	1050
4.003	20.00	83.0	20	99.000	97.859	0.841	1350
6.000	25.00	200.0	20	99.250	98.125	0.900	1050
6.001	20.00	200.0	20	99.000	98.025	0.750	1350
4.004	16.00	533.3	20	99.000	97.829	0.796	1350
4.005	22.00	149.7	20	99.500	97.682	1.443	1350
7.000	22.00	176.0	20	99.800	98.675	0.825	1050

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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
7.001	o	300	20	99.800	98.675	0.825	1050
7.002	o	300	20	99.500	98.525	0.675	1050
4.006	o	375	20	99.500	97.682	1.443	1350
4.007	o	600	20	99.500	97.607	1.743	10000
4.008	o	225	20	99.500	97.507	1.768	10000
8.000	o	300	20	99.500	98.300	0.900	1050
8.001	o	300	20	99.500	98.175	1.025	1050
9.000	o	300	20	99.500	98.300	0.900	1050
8.002	o	300	20	99.500	98.104	1.096	1050
10.000	o	300	20	99.500	98.300	0.900	1050
10.001	o	300	20	99.500	98.163	1.037	1050
10.002	o	300	20	99.895	98.054	1.541	1200
8.003	o	300	20	100.000	97.904	1.796	1200
8.004	o	300	20	100.000	97.776	1.924	1200
8.005	o	300	20	100.000	97.616	2.084	1200
8.006	o	375	20	99.000	97.498	1.127	1350
4.009	o	375	20	99.500	97.328	1.797	1350
4.010	o	375	20	98.500	97.228	0.897	1350
11.000	o	300	20	100.000	98.800	0.900	1050
11.001	o	2400	20	99.980	98.490	0.690	3000
12.000	o	300	20	100.000	98.800	0.900	1050
11.002	o	2400	20	99.980	98.408	0.772	3000
13.000	o	300	20	100.000	98.800	0.900	1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
7.001	28.00	186.7	20	99.500	98.525	0.675	1050
7.002	12.00	120.0	20	99.500	98.425	0.775	1350
4.006	32.00	426.7	20	99.500	97.607	1.518	10000
4.007	45.00	450.0	20	99.500	97.507	1.843	10000
4.008	10.00	149.3	20	99.500	97.440	1.835	1350
8.000	20.00	160.0	20	99.500	98.175	1.025	1050
8.001	12.00	169.0	20	99.500	98.104	1.096	1050
9.000	30.00	200.0	20	99.500	98.150	1.050	1050
8.002	40.00	200.0	20	100.000	97.904	1.796	1200
10.000	22.00	160.6	20	99.500	98.163	1.037	1050
10.001	22.00	201.8	20	99.895	98.054	1.541	1200
10.002	6.00	214.3	20	100.000	98.026	1.674	1200
8.003	11.00	85.9	20	100.000	97.776	1.924	1200
8.004	20.00	125.0	20	100.000	97.616	2.084	1200
8.005	26.00	220.3	20	99.000	97.498	1.202	1350
8.006	42.50	250.0	20	99.500	97.328	1.797	1350
4.009	25.00	250.0	20	98.500	97.228	0.897	1350
4.010	90.00	157.9	20	97.500	96.658	0.467	1350
11.000	14.00	47.0	20	99.980	98.502	1.178	3000
11.001	37.00	451.2	20	99.980	98.408	0.772	3000
12.000	14.00	47.0	20	99.980	98.502	1.178	3000
11.002	46.00	464.6	20	99.980	98.309	0.871	3000
13.000	14.00	47.0	20	99.980	98.502	1.178	3000

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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
11.003	o	300	20	99.980	98.309	1.371	3000
11.004	o	300	20	99.980	98.287	1.393	1050
11.005	o	300	20	99.980	98.246	1.434	1050
11.006	o	300	20	99.980	98.176	1.504	1200
11.007	o	300	20	99.980	98.065	1.615	1200
14.000	o	300	20	100.000	98.900	0.800	1050
14.001	o	2400	20	99.980	98.490	0.690	3000
15.000	o	300	20	100.000	98.900	0.800	1050
14.002	o	300	20	99.980	98.363	1.317	3000
14.003	o	300	20	99.980	98.343	1.337	1050
11.008	o	300	20	99.980	97.949	1.731	1200
11.009	o	300	20	99.980	97.841	1.839	1200
11.010	o	300	20	99.980	97.741	1.939	1200
16.000	o	300	20	99.980	98.900	0.780	1050
16.001	o	2400	20	99.980	98.490	0.690	3000
17.000	o	300	20	99.980	98.900	0.780	1050
16.002	o	300	20	99.980	98.363	1.317	3000
16.003	o	300	20	99.980	98.343	1.337	1050
18.000	o	300	20	99.980	98.900	0.780	1050
18.001	o	2400	20	99.980	98.490	0.690	3000
19.000	o	300	20	100.240	98.900	1.040	1050
18.002	o	300	20	100.580	98.363	1.917	3000
18.003	o	300	20	100.580	98.343	1.937	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
11.003	3.00	136.4	20	99.980	98.287	1.393	1050
11.004	7.00	170.7	20	99.980	98.246	1.434	1050
11.005	13.00	185.7	20	99.980	98.176	1.504	1200
11.006	21.00	189.2	20	99.980	98.065	1.615	1200
11.007	29.00	250.0	20	99.980	97.949	1.731	1200
14.000	17.00	47.0	20	99.980	98.538	1.142	3000
14.001	56.00	440.9	20	99.980	98.363	0.817	3000
15.000	15.00	47.0	20	99.980	98.581	1.099	3000
14.002	3.00	150.0	20	99.980	98.343	1.337	1050
14.003	3.00	150.0	20	99.980	98.323	1.357	1200
11.008	27.00	250.0	20	99.980	97.841	1.839	1200
11.009	25.00	250.0	20	99.980	97.741	1.939	1200
11.010	41.00	150.2	20	99.000	97.468	1.232	1350
16.000	14.00	47.0	20	99.980	98.602	1.078	3000
16.001	56.00	440.9	20	99.980	98.363	0.817	3000
17.000	14.00	47.0	20	99.980	98.602	1.078	3000
16.002	3.00	150.0	20	99.980	98.343	1.337	1050
16.003	10.00	149.3	20	99.000	98.276	0.424	1350
18.000	14.00	47.0	20	99.980	98.602	1.078	3000
18.001	56.00	440.9	20	100.580	98.363	1.417	3000
19.000	14.00	47.0	20	100.580	98.602	1.678	3000
18.002	3.00	150.0	20	100.580	98.343	1.937	1200
18.003	36.00	145.2	20	100.189	98.095	1.794	1200

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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
18.004	o	300	20	100.189	98.095	1.794	1200
18.005	o	300	20	99.980	97.914	1.766	1200
18.006	o	300	20	99.980	97.714	1.966	1200
20.000	o	300	20	99.980	98.900	0.780	1050
20.001	o	2400	20	99.980	98.490	0.690	3000
21.000	o	300	20	99.980	98.900	0.780	1050
20.002	o	300	20	99.980	98.363	1.317	3000
18.007	o	375	20	99.980	97.672	1.933	1350
11.011	o	375	20	99.000	97.468	1.157	1350
1.010	o	375	20	97.500	96.658	0.467	1350
1.011	o	450	22	96.400	95.158	0.792	1350
1.012	o	525	23	96.400	94.600	1.275	1500
1.013	o	525	24	96.400	94.549	1.326	1500
1.014	o	525	84	96.400	93.623	2.252	1500
1.015	o	525	85	96.400	93.212	2.663	1500
1.016	o	525	90	96.400	93.171	2.704	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
18.004	28.00	154.7	20	99.980	97.914	1.766	1200
18.005	30.00	150.0	20	99.980	97.714	1.966	1200
18.006	4.00	95.2	20	99.980	97.672	2.008	1350
20.000	14.00	47.0	20	99.980	98.602	1.078	3000
20.001	56.00	440.9	20	99.980	98.363	0.817	3000
21.000	14.00	47.0	20	99.980	98.602	1.078	3000
20.002	3.00	150.0	20	99.980	98.343	1.337	1350
18.007	19.00	95.0	20	99.000	97.472	1.153	1350
11.011	8.00	17.0	20	97.500	96.997	0.128	1350
1.010	15.00	10.0	22	96.400	95.158	0.867	1350
1.011	25.00	100.8	23	96.400	94.910	1.040	1500
1.012	25.00	490.6	24	96.400	94.549	1.326	1500
1.013	33.10	35.7	84	96.400	93.623	2.252	1500
1.014	41.10	100.0	85	96.400	93.212	2.663	1500
1.015	20.00	487.8	90	96.400	93.171	2.704	1500
1.016	20.00	487.8		0.000	93.130	-93.655	0

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MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
1	100.200	1.125	1050	1.000	99.075	225			
2	100.300	1.325	1050	1.001	98.975	225	1.000	98.975	225
4	100.300	1.415	1050	1.002	98.885	225	1.001	98.885	225
6	100.500	1.746	1050	1.003	98.754	300	1.002	98.754	225
11	100.500	1.886	1200	1.004	98.614	300	1.003	98.614	300
12	100.500	2.084	1350	1.005	98.416	450	1.004	98.416	300
12	100.300	1.200	1050	2.000	99.100	300			
13	100.400	1.460	1050	2.001	98.940	300	2.000	98.940	300
14	100.500	1.200	1050	3.000	99.300	300			
15	100.500	1.677	1050	2.002	98.823	300	2.001	98.823	300
							3.000	99.240	300
16	100.500	2.336	1350	1.006	98.164	450	1.005	98.164	450
							2.002	98.743	300
17	100.500	2.496	1350	1.007	98.004	450	1.006	98.004	450
18	99.500	1.531	10000	1.008	97.969	600	1.007	97.969	450
19	99.300	1.471	10000	1.009	97.829	150	1.008	97.829	600
20	100.000	1.200	1050	4.000	98.800	300			
20	100.000	1.367	1050	4.001	98.633	300	4.000	98.633	300
20	99.500	1.200	1050	4.002	98.300	300	4.001	98.300	300
20	99.400	1.150	1050	5.000	98.250	225			
20	99.500	1.400	1050	4.003	98.100	300	4.002	98.100	300
							5.000	98.175	225
20	99.400	1.150	1050	6.000	98.250	225			
20	99.250	1.125	1050	6.001	98.125	225	6.000	98.125	225
20	99.000	1.141	1350	4.004	97.859	375	4.003	97.859	300
							6.001	98.025	225
20	99.000	1.171	1350	4.005	97.829	375	4.004	97.829	375
20	100.000	1.200	1050	7.000	98.800	300			
20	99.800	1.125	1050	7.001	98.675	300	7.000	98.675	300
20	99.500	0.975	1050	7.002	98.525	300	7.001	98.525	300
20	99.500	1.818	1350	4.006	97.682	375	4.005	97.682	375
							7.002	98.425	300
20	99.500	1.893	10000	4.007	97.607	600	4.006	97.607	375
20	99.500	1.993	10000	4.008	97.507	225	4.007	97.507	600
20	99.500	1.200	1050	8.000	98.300	300			
20	99.500	1.325	1050	8.001	98.175	300	8.000	98.175	300
20	99.500	1.200	1050	9.000	98.300	300			
20	99.500	1.396	1050	8.002	98.104	300	8.001	98.104	300
							9.000	98.150	300
20	99.500	1.200	1050	10.000	98.300	300			
20	99.500	1.337	1050	10.001	98.163	300	10.000	98.163	300
20	99.895	1.841	1200	10.002	98.054	300	10.001	98.054	300

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MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
20	100.000	2.096	1200	8.003	97.904	300	8.002	97.904	300
							10.002	98.026	300
20	100.000	2.224	1200	8.004	97.776	300	8.003	97.776	300
20	100.000	2.384	1200	8.005	97.616	300	8.004	97.616	300
20	99.000	1.502	1350	8.006	97.498	375	8.005	97.498	300
20	99.500	2.172	1350	4.009	97.328	375	4.008	97.440	225
							8.006	97.328	375
20	98.500	1.272	1350	4.010	97.228	375	4.009	97.228	375
20	100.000	1.200	1050	11.000	98.800	300			
20	99.980	1.490	3000	11.001	98.490	2400	11.000	98.502	300
20	100.000	1.200	1050	12.000	98.800	300			
20	99.980	1.572	3000	11.002	98.408	2400	11.001	98.408	2400
							12.000	98.502	300
20	100.000	1.200	1050	13.000	98.800	300			
20	99.980	1.671	3000	11.003	98.309	300	11.002	98.309	2400
							13.000	98.502	300
20	99.980	1.693	1050	11.004	98.287	300	11.003	98.287	300
20	99.980	1.734	1050	11.005	98.246	300	11.004	98.246	300
20	99.980	1.804	1200	11.006	98.176	300	11.005	98.176	300
20	99.980	1.915	1200	11.007	98.065	300	11.006	98.065	300
20	100.000	1.100	1050	14.000	98.900	300			
20	99.980	1.490	3000	14.001	98.490	2400	14.000	98.538	300
20	100.000	1.100	1050	15.000	98.900	300			
20	99.980	1.617	3000	14.002	98.363	300	14.001	98.363	2400
							15.000	98.581	300
20	99.980	1.637	1050	14.003	98.343	300	14.002	98.343	300
20	99.980	2.031	1200	11.008	97.949	300	11.007	97.949	300
							14.003	98.323	300
20	99.980	2.139	1200	11.009	97.841	300	11.008	97.841	300
20	99.980	2.239	1200	11.010	97.741	300	11.009	97.741	300
20	99.980	1.080	1050	16.000	98.900	300			
20	99.980	1.490	3000	16.001	98.490	2400	16.000	98.602	300
20	99.980	1.080	1050	17.000	98.900	300			
20	99.980	1.617	3000	16.002	98.363	300	16.001	98.363	2400
							17.000	98.602	300
20	99.980	1.637	1050	16.003	98.343	300	16.002	98.343	300
20	99.980	1.080	1050	18.000	98.900	300			
20	99.980	1.490	3000	18.001	98.490	2400	18.000	98.602	300
20	100.240	1.340	1050	19.000	98.900	300			
20	100.580	2.217	3000	18.002	98.363	300	18.001	98.363	2400
							19.000	98.602	300
20	100.580	2.237	1200	18.003	98.343	300	18.002	98.343	300
20	100.189	2.094	1200	18.004	98.095	300	18.003	98.095	300

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MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
20	99.980	2.066	1200	18.005	97.914	300	18.004	97.914	300
20	99.980	2.266	1200	18.006	97.714	300	18.005	97.714	300
20	99.980	1.080	1050	20.000	98.900	300			
20	99.980	1.490	3000	20.001	98.490	2400	20.000	98.602	300
20	99.980	1.080	1050	21.000	98.900	300			
20	99.980	1.617	3000	20.002	98.363	300	20.001 21.000	98.363 98.602	2400 300
20	99.980	2.308	1350	18.007	97.672	375	18.006 20.002	97.672 98.343	300 300
20	99.000	1.532	1350	11.011	97.468	375	11.010 16.003 18.007	97.468 98.276 97.472	300 300 375
20	97.500	0.842	1350	1.010	96.658	375	1.009 4.010 11.011	96.661 96.658 96.997	150 375 375
22	96.400	1.242	1350	1.011	95.158	450	1.010	95.158	375
23	96.400	1.800	1500	1.012	94.600	525	1.011	94.910	450
24	96.400	1.851	1500	1.013	94.549	525	1.012	94.549	525
84	96.400	2.777	1500	1.014	93.623	525	1.013	93.623	525
85	96.400	3.188	1500	1.015	93.212	525	1.014	93.212	525
90	96.400	3.229	1500	1.016	93.171	525	1.015	93.171	525
	0.000	-93.130	0		OUTFALL		1.016	93.130	525

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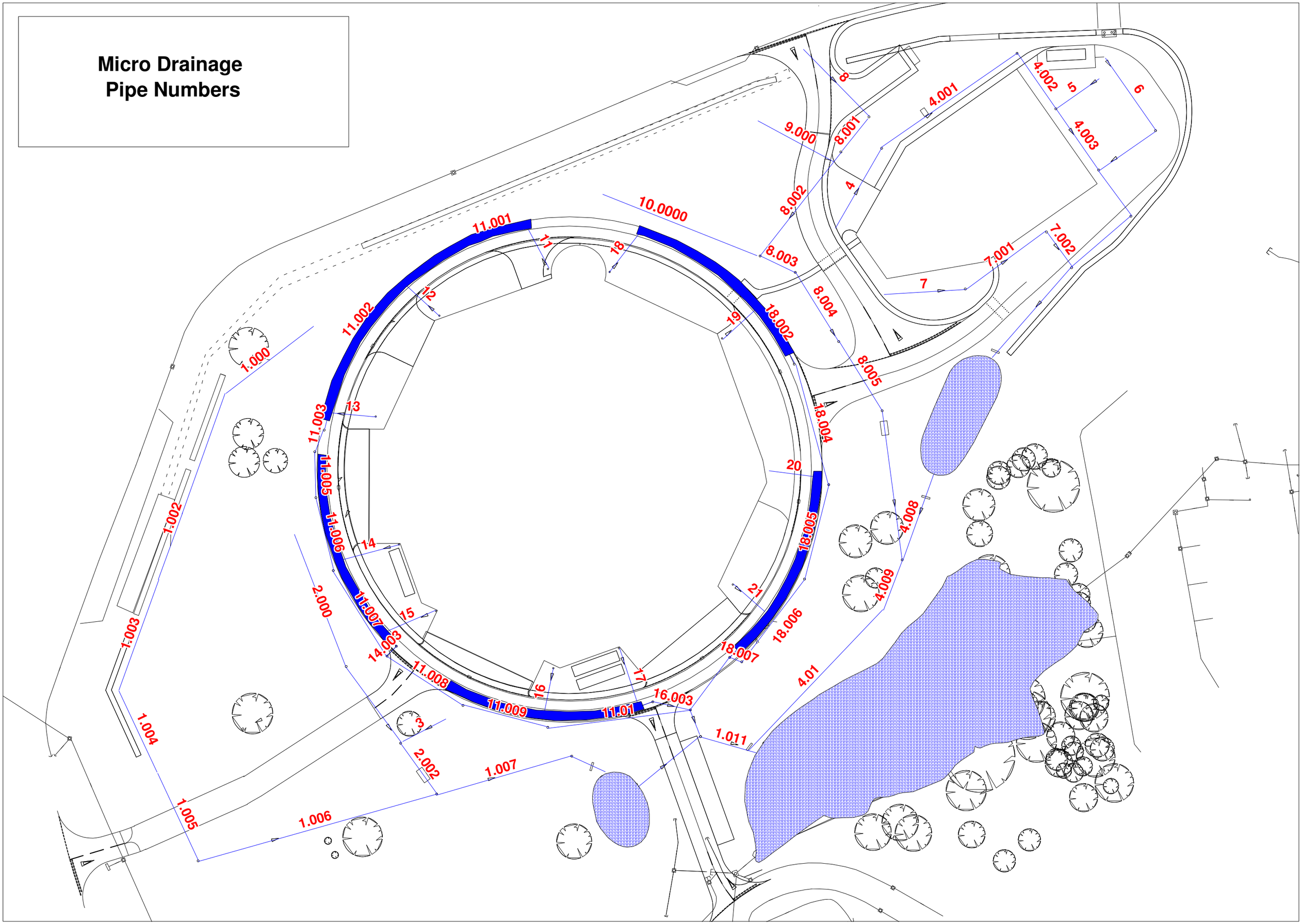
Pipe Numbers



Global Variables

Region	FEH Rainfall Model
Return Period (yrs)	100
Site Location	GB 459450 164350 SU 59450 64350
C(1km)	-0.029
D1(1km)	0.311
D2(1km)	0.287
D3(1km)	0.367
E(1km)	0.306
F(1km)	2.523
Volumetric Runoff Coef	1.000
Profile Type	Summer
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	960
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m³/ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	10
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	7
Number of On-Line Controls	13

Starting Storm file name

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Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.016		94.046	93.221	1200	0

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On-Line Controls (Orifice)

US/PN	Volume (m^3)	Ctrl MH Name	Invert (m)	Dia (m)	Discharge Coefficient
11.002	79.120	20	98.309	0.080	0.600
13.000	0.846	20	98.309	0.080	0.600
14.001	97.520	20	98.363	0.080	0.600
15.000	0.917	20	98.363	0.080	0.600
16.001	97.520	20	98.363	0.080	0.600
17.000	0.846	20	98.363	0.080	0.600
18.001	97.520	20	98.363	0.080	0.600
19.000	0.846	20	98.363	0.080	0.600
20.001	97.520	20	98.363	0.080	0.600
21.000	0.846	20	98.363	0.080	0.600

On-Line Controls (Hydro-Brake®)

US/PN	Volume (m^3)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.008	92.078	19	97.829	Md4	0.150	0.400	16.0	0.2	12.7
								0.4	16.1
								0.6	14.3
								0.8	15.7
								1.0	17.5
								1.4	20.7
								1.8	23.5
								2.2	25.9
								2.6	28.2
								3.0	30.3
4.007	414.224	20	97.507	Md4	0.174	0.400	25.0	0.1	4.1
								0.2	15.0
								0.3	23.8
								0.4	25.0
								0.5	22.6
								0.6	21.1
								0.7	21.0
								0.8	21.7
								0.9	22.7
								1.0	23.8
								1.2	26.0
								1.4	28.0
								1.6	30.0
								1.8	31.8
								2.0	33.5
								2.2	35.1
1.012	5.087	89	94.859	Md4	0.101	1.800	10.8	0.2	6.5
								0.4	5.4
								0.6	6.2
								0.8	7.2
								1.0	8.0
								1.4	9.5
								1.8	10.7
								2.2	11.9
								2.6	12.9
								3.0	13.9

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Off-line Pipe Controls

DS/PN	Loop PN	MH Loss	Height above DS PN (m)	Section Type	Diam. (mm)	Len. (m)	Slope (1:x)	k (mm)
11.003	11.004	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
14.002	11.008	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
16.002	16.003	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
18.002	18.003	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
20.002	18.007	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
22.001	23.000	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
23.000	1.012	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600

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Storage Pond at pipe 1.013 USMH 89

Storage Pond Invert Level (m) 94.640

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.0	1100.0	0.5	1150.0	1.0	1220.0	1.5	1270.0	2.0	0.0	2.5	0.0
0.1	1100.0	0.6	1150.0	1.1	1230.0	1.6	1280.0	2.1	0.0		
0.2	1100.0	0.7	1160.0	1.2	1240.0	1.7	1290.0	2.2	0.0		
0.3	1140.0	0.8	1200.0	1.3	1250.0	1.8	1300.0	2.3	0.0		
0.4	1140.0	0.9	1210.0	1.4	1260.0	1.9	0.0	2.4	0.0		

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Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes11.4\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes11.4\STANDARD.MHS

FEH Rainfall Model

Return Period (years)	2
Site Location	GB 459450 164350 SU 59450 64350
C (1km)	-0.029
D1 (1km)	0.311
D2 (1km)	0.287
D3 (1km)	0.367
E (1km)	0.306
F (1km)	2.523
Maximum Rainfall (mm/hr)	0
Foul Sewage (l/s/ha)	0.00
O'flow Setting (*Foul only)	0
Volumetric Runoff Coeff.	1.00
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	0.000
Min Cover Depth for Optimisation (m)	0.000
Min Vel for Auto Design Only (m/s)	1.00
Min Slope for Optimisation (1:X)	500
Minimum Outfall Invert (m)	0.000
Ground Level at Outfall (m)	0.000
Outfall Manhole Name	
Outfall Manhole Dia/Length (mm)	0
Outfall Manhole Width (mm)	0

Designed with Level Inverts

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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	225	1	100.200	99.075	0.900	1050
1.001	o	225	2	100.300	98.975	1.100	1050
1.002	o	225	4	100.300	98.885	1.190	1050
1.003	o	300	6	100.500	98.754	1.446	1050
1.004	o	300	11	100.500	98.614	1.586	1200
1.005	o	450	12	100.500	98.416	1.634	1350
2.000	o	300	12	100.300	99.100	0.900	1050
2.001	o	300	13	100.400	98.940	1.160	1050
3.000	o	300	14	100.500	99.300	0.900	1050
2.002	o	300	15	100.500	98.823	1.377	1050
1.006	o	450	16	100.500	98.164	1.886	1350
1.007	o	450	17	100.500	98.004	2.046	1350
1.008	o	600	18	99.500	97.969	1.381	10000
1.009	o	150	19	99.300	97.829	1.321	10000
4.000	o	300	20	100.000	98.800	0.900	1050
4.001	o	300	20	100.000	98.633	1.067	1050
4.002	o	300	20	99.500	98.300	0.900	1050
5.000	o	225	20	99.400	98.250	0.925	1050
4.003	o	300	20	99.500	98.100	1.100	1050
6.000	o	225	20	99.400	98.250	0.925	1050
6.001	o	225	20	99.250	98.125	0.900	1050
4.004	o	375	20	99.000	97.859	0.766	1350
4.005	o	375	20	99.000	97.829	0.796	1350
7.000	o	300	20	100.000	98.800	0.900	1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	20.00	200.0	2	100.300	98.975	1.100	1050
1.001	21.00	233.3	4	100.300	98.885	1.190	1050
1.002	36.00	274.8	6	100.500	98.754	1.521	1050
1.003	36.00	257.1	11	100.500	98.614	1.586	1200
1.004	46.50	234.8	12	100.500	98.416	1.784	1350
1.005	70.00	277.8	16	100.500	98.164	1.886	1350
2.000	40.00	250.0	13	100.400	98.940	1.160	1050
2.001	27.00	230.8	15	100.500	98.823	1.377	1050
3.000	15.00	250.0	15	100.500	99.240	0.960	1050
2.002	18.00	225.0	16	100.500	98.743	1.457	1350
1.006	40.00	250.0	17	100.500	98.004	2.046	1350
1.007	7.00	200.0	18	99.500	97.969	1.081	10000
1.008	22.50	160.7	19	99.300	97.829	1.321	10000
1.009	25.00	21.4	20	97.500	96.661	0.689	1350
4.000	25.00	149.7	20	100.000	98.633	1.067	1050
4.001	46.00	138.1	20	99.500	98.300	0.900	1050
4.002	20.00	100.0	20	99.500	98.100	1.100	1050
5.000	15.00	200.0	20	99.500	98.175	1.100	1050
4.003	20.00	83.0	20	99.000	97.859	0.841	1350
6.000	25.00	200.0	20	99.250	98.125	0.900	1050
6.001	20.00	200.0	20	99.000	98.025	0.750	1350
4.004	16.00	533.3	20	99.000	97.829	0.796	1350
4.005	22.00	149.7	20	99.500	97.682	1.443	1350
7.000	22.00	176.0	20	99.800	98.675	0.825	1050

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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
7.001	o	300	20	99.800	98.675	0.825	1050
7.002	o	300	20	99.500	98.525	0.675	1050
4.006	o	375	20	99.500	97.682	1.443	1350
4.007	o	600	20	99.500	97.607	1.743	10000
4.008	o	225	20	99.500	97.507	1.768	10000
8.000	o	300	20	99.500	98.300	0.900	1050
8.001	o	300	20	99.500	98.175	1.025	1050
9.000	o	300	20	99.500	98.300	0.900	1050
8.002	o	300	20	99.500	98.104	1.096	1050
10.000	o	300	20	99.500	98.300	0.900	1050
10.001	o	300	20	99.500	98.163	1.037	1050
10.002	o	300	20	99.895	98.054	1.541	1200
8.003	o	300	20	100.000	97.904	1.796	1200
8.004	o	300	20	100.000	97.776	1.924	1200
8.005	o	300	20	100.000	97.616	2.084	1200
8.006	o	375	20	99.000	97.498	1.127	1350
4.009	o	375	20	99.500	97.328	1.797	1350
4.010	o	375	20	98.500	97.228	0.897	1350
11.000	o	300	20	100.000	98.800	0.900	1050
11.001	o	2400	20	99.980	98.490	0.690	3000
12.000	o	300	20	100.000	98.800	0.900	1050
11.002	o	2400	20	99.980	98.408	0.772	3000
13.000	o	300	20	100.000	98.800	0.900	1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
7.001	28.00	186.7	20	99.500	98.525	0.675	1050
7.002	12.00	120.0	20	99.500	98.425	0.775	1350
4.006	32.00	426.7	20	99.500	97.607	1.518	10000
4.007	45.00	450.0	20	99.500	97.507	1.843	10000
4.008	10.00	149.3	20	99.500	97.440	1.835	1350
8.000	20.00	160.0	20	99.500	98.175	1.025	1050
8.001	12.00	169.0	20	99.500	98.104	1.096	1050
9.000	30.00	200.0	20	99.500	98.150	1.050	1050
8.002	40.00	200.0	20	100.000	97.904	1.796	1200
10.000	22.00	160.6	20	99.500	98.163	1.037	1050
10.001	22.00	201.8	20	99.895	98.054	1.541	1200
10.002	6.00	214.3	20	100.000	98.026	1.674	1200
8.003	11.00	85.9	20	100.000	97.776	1.924	1200
8.004	20.00	125.0	20	100.000	97.616	2.084	1200
8.005	26.00	220.3	20	99.000	97.498	1.202	1350
8.006	42.50	250.0	20	99.500	97.328	1.797	1350
4.009	25.00	250.0	20	98.500	97.228	0.897	1350
4.010	90.00	157.9	20	97.500	96.658	0.467	1350
11.000	14.00	47.0	20	99.980	98.502	1.178	3000
11.001	37.00	451.2	20	99.980	98.408	0.772	3000
12.000	14.00	47.0	20	99.980	98.502	1.178	3000
11.002	46.00	464.6	20	99.980	98.309	0.871	3000
13.000	14.00	47.0	20	99.980	98.502	1.178	3000

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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
11.003	o	300	20	99.980	98.309	1.371	3000
11.004	o	300	20	99.980	98.287	1.393	1050
11.005	o	300	20	99.980	98.246	1.434	1050
11.006	o	300	20	99.980	98.176	1.504	1200
11.007	o	300	20	99.980	98.065	1.615	1200
14.000	o	300	20	100.000	98.900	0.800	1050
14.001	o	2400	20	99.980	98.490	0.690	3000
15.000	o	300	20	100.000	98.900	0.800	1050
14.002	o	300	20	99.980	98.363	1.317	3000
14.003	o	300	20	99.980	98.343	1.337	1050
11.008	o	300	20	99.980	97.949	1.731	1200
11.009	o	300	20	99.980	97.841	1.839	1200
11.010	o	300	20	99.980	97.741	1.939	1200
16.000	o	300	20	99.980	98.900	0.780	1050
16.001	o	2400	20	99.980	98.490	0.690	3000
17.000	o	300	20	99.980	98.900	0.780	1050
16.002	o	300	20	99.980	98.363	1.317	3000
16.003	o	300	20	99.980	98.343	1.337	1050
18.000	o	300	20	99.980	98.900	0.780	1050
18.001	o	2400	20	100.000	98.490	0.710	3000
19.000	o	300	20	100.240	98.900	1.040	1050
18.002	o	300	20	100.580	98.363	1.917	3000
18.003	o	300	20	100.580	98.343	1.937	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
11.003	3.00	136.4	20	99.980	98.287	1.393	1050
11.004	7.00	170.7	20	99.980	98.246	1.434	1050
11.005	13.00	185.7	20	99.980	98.176	1.504	1200
11.006	21.00	189.2	20	99.980	98.065	1.615	1200
11.007	29.00	250.0	20	99.980	97.949	1.731	1200
14.000	17.00	47.0	20	99.980	98.538	1.142	3000
14.001	56.00	440.9	20	99.980	98.363	0.817	3000
15.000	15.00	47.0	20	99.980	98.581	1.099	3000
14.002	3.00	150.0	20	99.980	98.343	1.337	1050
14.003	3.00	150.0	20	99.980	98.323	1.357	1200
11.008	27.00	250.0	20	99.980	97.841	1.839	1200
11.009	25.00	250.0	20	99.980	97.741	1.939	1200
11.010	41.00	150.2	20	99.000	97.468	1.232	1350
16.000	14.00	47.0	20	99.980	98.602	1.078	3000
16.001	56.00	440.9	20	99.980	98.363	0.817	3000
17.000	14.00	47.0	20	99.980	98.602	1.078	3000
16.002	3.00	150.0	20	99.980	98.343	1.337	1050
16.003	10.00	149.3	20	99.000	98.276	0.424	1350
18.000	14.00	47.0	20	100.000	98.602	1.098	3000
18.001	56.00	440.9	20	100.580	98.363	1.417	3000
19.000	14.00	47.0	20	100.580	98.602	1.678	3000
18.002	3.00	150.0	20	100.580	98.343	1.937	1200
18.003	36.00	145.2	20	100.189	98.095	1.794	1200

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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
18.004	o	300	20	100.189	98.095	1.794	1200
18.005	o	300	20	99.980	97.914	1.766	1200
18.006	o	300	20	99.980	97.714	1.966	1200
20.000	o	300	20	99.980	98.900	0.780	1050
20.001	o	2400	20	99.980	98.490	0.690	3000
21.000	o	300	20	99.980	98.900	0.780	1050
20.002	o	300	20	99.980	98.363	1.317	3000
18.007	o	375	20	99.980	97.672	1.933	1350
11.011	o	375	20	99.000	97.468	1.157	1350
1.010	o	375	20	97.500	96.658	0.467	1350
1.011	o	450	22	96.800	95.158	1.192	1350
1.012	o	525	24	96.400	94.910	0.965	1500
1.013	o	525	89	96.550	94.640	1.385	1500
1.014	o	525	90	96.550	93.714	2.311	1500
1.015	o	525	91	96.400	93.303	2.572	1500
1.016	o	525	91	96.400	93.262	2.613	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
18.004	28.00	154.7	20	99.980	97.914	1.766	1200
18.005	30.00	150.0	20	99.980	97.714	1.966	1200
18.006	4.00	95.2	20	99.980	97.672	2.008	1350
20.000	14.00	47.0	20	99.980	98.602	1.078	3000
20.001	56.00	440.9	20	99.980	98.363	0.817	3000
21.000	14.00	47.0	20	99.980	98.602	1.078	3000
20.002	3.00	150.0	20	99.980	98.343	1.337	1350
18.007	19.00	95.0	20	99.000	97.472	1.153	1350
11.011	8.00	17.0	20	97.500	96.997	0.128	1350
1.010	15.00	10.0	22	96.800	95.158	1.267	1350
1.011	20.00	80.6	24	96.400	94.910	1.040	1500
1.012	25.00	490.2	89	96.550	94.859	1.166	1500
1.013	33.10	35.7	90	96.550	93.714	2.311	1500
1.014	41.10	100.0	91	96.400	93.303	2.572	1500
1.015	20.00	487.8	91	96.400	93.262	2.613	1500
1.016	20.00	487.8		0.000	93.221	-93.746	0

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MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
1	100.200	1.125	1050	1.000	99.075	225			
2	100.300	1.325	1050	1.001	98.975	225	1.000	98.975	225
4	100.300	1.415	1050	1.002	98.885	225	1.001	98.885	225
6	100.500	1.746	1050	1.003	98.754	300	1.002	98.754	225
11	100.500	1.886	1200	1.004	98.614	300	1.003	98.614	300
12	100.500	2.084	1350	1.005	98.416	450	1.004	98.416	300
12	100.300	1.200	1050	2.000	99.100	300			
13	100.400	1.460	1050	2.001	98.940	300	2.000	98.940	300
14	100.500	1.200	1050	3.000	99.300	300			
15	100.500	1.677	1050	2.002	98.823	300	2.001	98.823	300
							3.000	99.240	300
16	100.500	2.336	1350	1.006	98.164	450	1.005	98.164	450
							2.002	98.743	300
17	100.500	2.496	1350	1.007	98.004	450	1.006	98.004	450
18	99.500	1.531	10000	1.008	97.969	600	1.007	97.969	450
19	99.300	1.471	10000	1.009	97.829	150	1.008	97.829	600
20	100.000	1.200	1050	4.000	98.800	300			
20	100.000	1.367	1050	4.001	98.633	300	4.000	98.633	300
20	99.500	1.200	1050	4.002	98.300	300	4.001	98.300	300
20	99.400	1.150	1050	5.000	98.250	225			
20	99.500	1.400	1050	4.003	98.100	300	4.002	98.100	300
							5.000	98.175	225
20	99.400	1.150	1050	6.000	98.250	225			
20	99.250	1.125	1050	6.001	98.125	225	6.000	98.125	225
20	99.000	1.141	1350	4.004	97.859	375	4.003	97.859	300
							6.001	98.025	225
20	99.000	1.171	1350	4.005	97.829	375	4.004	97.829	375
20	100.000	1.200	1050	7.000	98.800	300			
20	99.800	1.125	1050	7.001	98.675	300	7.000	98.675	300
20	99.500	0.975	1050	7.002	98.525	300	7.001	98.525	300
20	99.500	1.818	1350	4.006	97.682	375	4.005	97.682	375
							7.002	98.425	300
20	99.500	1.893	10000	4.007	97.607	600	4.006	97.607	375
20	99.500	1.993	10000	4.008	97.507	225	4.007	97.507	600
20	99.500	1.200	1050	8.000	98.300	300			
20	99.500	1.325	1050	8.001	98.175	300	8.000	98.175	300
20	99.500	1.200	1050	9.000	98.300	300			
20	99.500	1.396	1050	8.002	98.104	300	8.001	98.104	300
							9.000	98.150	300
20	99.500	1.200	1050	10.000	98.300	300			
20	99.500	1.337	1050	10.001	98.163	300	10.000	98.163	300
20	99.895	1.841	1200	10.002	98.054	300	10.001	98.054	300

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MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
20	100.000	2.096	1200	8.003	97.904	300	8.002	97.904	300
							10.002	98.026	300
20	100.000	2.224	1200	8.004	97.776	300	8.003	97.776	300
20	100.000	2.384	1200	8.005	97.616	300	8.004	97.616	300
20	99.000	1.502	1350	8.006	97.498	375	8.005	97.498	300
20	99.500	2.172	1350	4.009	97.328	375	4.008	97.440	225
							8.006	97.328	375
20	98.500	1.272	1350	4.010	97.228	375	4.009	97.228	375
20	100.000	1.200	1050	11.000	98.800	300			
20	99.980	1.490	3000	11.001	98.490	2400	11.000	98.502	300
20	100.000	1.200	1050	12.000	98.800	300			
20	99.980	1.572	3000	11.002	98.408	2400	11.001	98.408	2400
							12.000	98.502	300
20	100.000	1.200	1050	13.000	98.800	300			
20	99.980	1.671	3000	11.003	98.309	300	11.002	98.309	2400
							13.000	98.502	300
20	99.980	1.693	1050	11.004	98.287	300	11.003	98.287	300
20	99.980	1.734	1050	11.005	98.246	300	11.004	98.246	300
20	99.980	1.804	1200	11.006	98.176	300	11.005	98.176	300
20	99.980	1.915	1200	11.007	98.065	300	11.006	98.065	300
20	100.000	1.100	1050	14.000	98.900	300			
20	99.980	1.490	3000	14.001	98.490	2400	14.000	98.538	300
20	100.000	1.100	1050	15.000	98.900	300			
20	99.980	1.617	3000	14.002	98.363	300	14.001	98.363	2400
							15.000	98.581	300
20	99.980	1.637	1050	14.003	98.343	300	14.002	98.343	300
20	99.980	2.031	1200	11.008	97.949	300	11.007	97.949	300
							14.003	98.323	300
20	99.980	2.139	1200	11.009	97.841	300	11.008	97.841	300
20	99.980	2.239	1200	11.010	97.741	300	11.009	97.741	300
20	99.980	1.080	1050	16.000	98.900	300			
20	99.980	1.490	3000	16.001	98.490	2400	16.000	98.602	300
20	99.980	1.080	1050	17.000	98.900	300			
20	99.980	1.617	3000	16.002	98.363	300	16.001	98.363	2400
							17.000	98.602	300
20	99.980	1.637	1050	16.003	98.343	300	16.002	98.343	300
20	99.980	1.080	1050	18.000	98.900	300			
20	100.000	1.510	3000	18.001	98.490	2400	18.000	98.602	300
20	100.240	1.340	1050	19.000	98.900	300			
20	100.580	2.217	3000	18.002	98.363	300	18.001	98.363	2400
							19.000	98.602	300
20	100.580	2.237	1200	18.003	98.343	300	18.002	98.343	300
20	100.189	2.094	1200	18.004	98.095	300	18.003	98.095	300

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MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
20	99.980	2.066	1200	18.005	97.914	300	18.004	97.914	300
20	99.980	2.266	1200	18.006	97.714	300	18.005	97.714	300
20	99.980	1.080	1050	20.000	98.900	300			
20	99.980	1.490	3000	20.001	98.490	2400	20.000	98.602	300
20	99.980	1.080	1050	21.000	98.900	300			
20	99.980	1.617	3000	20.002	98.363	300	20.001 21.000	98.363 98.602	2400 300
20	99.980	2.308	1350	18.007	97.672	375	18.006 20.002	97.672 98.343	300 300
20	99.000	1.532	1350	11.011	97.468	375	11.010 16.003 18.007	97.468 98.276 97.472	300 300 375
20	97.500	0.842	1350	1.010	96.658	375	1.009 4.010 11.011	96.661 96.658 96.997	150 375 375
22	96.800	1.642	1350	1.011	95.158	450	1.010	95.158	375
24	96.400	1.490	1500	1.012	94.910	525	1.011	94.910	450
89	96.550	1.910	1500	1.013	94.640	525	1.012	94.859	525
90	96.550	2.836	1500	1.014	93.714	525	1.013	93.714	525
91	96.400	3.097	1500	1.015	93.303	525	1.014	93.303	525
91	96.400	3.138	1500	1.016	93.262	525	1.015	93.262	525
	0.000	-93.221	0		OUTFALL		1.016	93.221	525

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Global Variables

Region	FEH Rainfall Model
Return Period (yrs)	1
Site Location	GB 459450 164350 SU 59450 64350
C(1km)	-0.029
D1(1km)	0.311
D2(1km)	0.287
D3(1km)	0.367
E(1km)	0.306
F(1km)	2.523
Volumetric Runoff Coef	1.000
Profile Type	Summer
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	15
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m³/ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	20
Inlet Coefficient	0.800
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	7
Number of On-Line Controls	13

Starting Storm file name

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Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.016		93.955	93.130	1200	0

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On-Line Controls (Orifice)

US/PN	Volume (m^3)	Ctrl MH Name	Invert (m)	Dia (m)	Discharge Coefficient
11.002	79.120	20	98.309	0.080	0.600
13.000	0.846	20	98.309	0.080	0.600
14.001	97.520	20	98.363	0.080	0.600
15.000	0.917	20	98.363	0.080	0.600
16.001	97.520	20	98.363	0.080	0.600
17.000	0.846	20	98.363	0.080	0.600
18.001	97.520	20	98.363	0.080	0.600
19.000	0.846	20	98.363	0.080	0.600
20.001	97.520	20	98.363	0.080	0.600
21.000	0.846	20	98.363	0.080	0.600

On-Line Controls (Hydro-Brake®)

US/PN	Volume (m^3)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.008	92.078	19	97.829	Md4	0.150	0.400	16.0	0.2	12.7
								0.4	16.1
								0.6	14.3
								0.8	15.7
								1.0	17.5
								1.4	20.7
								1.8	23.5
								2.2	25.9
								2.6	28.2
								3.0	30.3
4.007	414.224	20	97.507	Md4	0.161	0.400	20.0	0.1	4.0
								0.2	13.8
								0.3	20.3
								0.4	20.0
								0.5	17.9
								0.6	17.1
								0.7	17.5
								0.8	18.3
								0.9	19.3
								1.0	20.3
								1.2	22.2
								1.4	23.9
								1.6	25.6
								1.8	27.1
								2.0	28.6
								2.2	30.0
1.012	5.087	24	94.549	Md4	0.101	1.800	10.8	0.2	6.5
								0.4	5.4
								0.6	6.2
								0.8	7.2
								1.0	8.0
								1.4	9.5
								1.8	10.7
								2.2	11.9
								2.6	12.9
								3.0	13.9

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Off-line Pipe Controls

DS/PN	Loop PN	MH Loss	Height above DS PN (m)	Section Type	Diam. (mm)	Len. (m)	Slope (1:x)	k (mm)
11.003	11.004	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
14.002	11.008	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
16.002	16.003	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
18.002	18.003	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
20.002	18.007	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
22.001	23.000	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600
23.000	1.012	0.600	0.600	Pipe / Conduit	150	4.000	33.0	0.600

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Storage Pond at pipe 1.013 USMH 24

Storage Pond Invert Level (m) 94.549

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.0	1100.0	0.5	1160.0	1.0	1240.0	1.5	1290.0	2.0	0.0	2.5	0.0
0.1	1100.0	0.6	1200.0	1.1	1250.0	1.6	1300.0	2.1	0.0		
0.2	1100.0	0.7	1210.0	1.2	1260.0	1.7	0.0	2.2	0.0		
0.3	1140.0	0.8	1220.0	1.3	1270.0	1.8	0.0	2.3	0.0		
0.4	1150.0	0.9	1230.0	1.4	1280.0	1.9	0.0	2.4	0.0		

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Appendix D

Technical Note: “Dewatering during construction phase – SuDS impacts”

Technical Note

ATKINS

Project:	Hydrus (AWE)	**To:**	Graham Barter
Subject:	Dewatering During Construction Phase - SuDS Impacts	**From:**	Anthony Fernihough
Date:	20/04/2010	**cc:**	**Atkins -** John Dowding, Chris Moore, Paul Davies,
Ref:	**HYDFEL3/54.24/CORR/00373 rev.3**		**AWE -** Brendan Turner, Steven Drew, David Carr, David Ashworth, Jill Garner, Andrew Goodhand, John Steele

1. Purpose

This Technical Note sets out initial findings and defined requirements in relation to the Construction Dewatering stage of the project.

AWE have requested that Atkins reconsider the SuDS design to allow for the implications of the Project Construction Team dewatering proposals and to identify how much of the SuDS system needs to be constructed before commencing dewatering. As a result, Atkins has modelled the additional construction stage by allowing for:-

- laydown areas
- excavated material to be stored on site, in the area of the future support building
- more infiltration laydown areas
- Construction phasing: - areas of construction to be initiated prior to the completion of the permanent drainage system.

2. SuDS Requirements

AWE has determined with Atkins in the main body of the SuDS Detailed Design Submission MER-110-17257 that the primary SuDS facilities need to be constructed and operational prior to construction of the temporary lay-down areas and construction of any of the permanent works. These SuDS facilities are east & west swale, detention basin, bypasses piping and control structures. However, it is agreed by the Project Construction Team that permeable laydown areas may be constructed in advance of the SuDS facilities.

The Enabling Works SuDS design, as described in the SuDS Detailed Design Submission MER-110-17257 (Atkins Reference – HYDFEL3/54.24/REP/00192), is adequate for the "Worst Case" 100 year storm design for the later stage of construction when maximum temporary and permanent works impermeable areas co-exist. The design takes into account the total of all impermeable areas, assuming all SuDS elements are in place before the area is developed. The proposed construction site layout drawing is as detailed on drawing A-HYDRUS-ATK-99-XX-DRW-CD-530-111-001000, and shows the different surfaced construction areas that have been included into the MicroDrainage model.

All water quality provisions and designs are being addressed as described in the Construction Environmental Management Plan (CEMP) MER-110-017361

3. Construction Phasing Requirements

The construction programme for the IVA and Hardened Structures area now requires the bulk excavation to be undertaken before the sub-surface attenuation units are constructed. Analysis of the geotechnical data has shown that initial dewatering of the Operations Building foundation excavations will take approximately

Plan Design Enable

two weeks at an abstraction rate of about 10 l/s. Further steady state flows (once fully de-watered) are likely to reduce to less than 2 l/s. De-watering will only be required during construction of the Operations Building foundations predicted to be completed within the first year of construction.

The foundation excavation will be protected where practicable from the effects of high intensity short duration storms by pumping from the excavation into a temporary attenuation facility within the footprint of the Operations building. Pumping from the temporary attenuation facility to the SuDS facility will be limited to 50 l/s (see section 4.1)

4. Modelling & Design Calculations

The proposed SuDS schematic for the period of construction of the IVA and Hardened Structure area when the culverts are not available is described below and shown in Figure 1. All calculations have been undertaken using MicroDrainage with 10 percent increased flow for climate change.

Under the pre-construction (existing) undeveloped site conditions, the maximum storm flows seen in the ditch discharge pipework have been analysed by AWE to be approximately 215l/s, but once the bypass is installed the discharge flow rate will be controlled and reduced to 180l/s with the excess flows being attenuated (refer to SuDS Detailed Design Submission – MER-110-17257). This reduction in discharge flow rates more than adequately provides for the additional 10 l/s from the initial groundwater dewatering and the 2l/s for up to a year, and still provides betterment even in the early construction stages of this project. However, it is proposed that these de-watering flows will be discharged (possibly requiring consent) in to the Detention Basin, so that the additional flow would only impact on downstream flows if the detention basin overflowed in an exceedence storm event (greater than 1:100 year), and in respect of this it is considered to be of minimal risk, and should it happen, the downstream flows would still be less than those resulting from the un-developed Hydrus site in a similar storm event.

As the IVA slab and Hardened Structure are built within an area where groundwater is being managed, the surface water captured within the foundation excavation for the Operations Building area requires pumping to a temporary attenuation facility as the sub-surface storage units will not be available for use. See 4.1 below.

Table 2 (below) gives the maximum flow rate and volumes for the storms for the area within the excavation area. Note that the higher flow rates are associated with the short storms and vice versa.

Storm event	15 Minute Storm		30 Minute Storm		60 Minute Storm		120 Minute Storm		240 Minute Storm		360 Minute Storm	
	Peak Flow (l/s)	Total volume (m^3)	Peak Flow (l/s)	Total volume (m^3)	Peak Flow (l/s)	Total volume (m^3)	Peak Flow (l/s)	Total volume (m^3)	Peak Flow (l/s)	Total volume (m^3)	Peak Flow (l/s)	Total volume (m^3)
1 in 1 year	169.9	75.24	147.5	93.3	103.9	115.56	69.9	142.8	46.6	178.32	35.4	200.52
1 in 2 years	215.8	95.64	184.9	116.94	129.4	143.16	85.3	174.72	56	214.32	42.2	240.84
1 in 5 years	258.7	126.3	240.5	151.68	165.9	182.88	107.4	220.32	69.4	264.72	51.8	295.2
1 in 10 years	370.5	163.86	307.4	194.04	208.8	230.28	133.3	272.4	84.8	324.24	62.7	358.92
1 in 20 years	475.8	210.12	388.7	245.52	260.4	286.56	163.7	335.52	102.6	391.2	75.2	429.12
1 in 30 years	549.3	242.58	444.9	280.92	296.3	325.92	184.3	378	114.6	437.28	83.6	477
1 in 50 years	657.1	290.28	526.7	332.94	347.2	381.6	213.7	438.24	131.6	503.76	95.3	544.32
1 in 100 years	837	369.36	661.4	416.76	430	471.84	260.9	534.72	158.4	604.32	113.8	650.88

Table 2 – Maximum flow rates and Total Volume for storms for the Operations building area

4.1 Temporary Attenuation Facility

It is proposed that a temporary lined attenuation facility or tanks will be constructed in the remaining unexcavated area within the proposed Operations Building footprint. These could be constructed as above ground structures, but the final choice will be made during the Project Construction Teams temporary works design. The flow will be pumped from the temporary attenuation to the SuDS system (directly to the main detention basin) at approximately 50 l/s, this is approximately the discharge from the sub-surface attenuation units to the SuDS system, hence no additional demand is placed on the SuDS system in the temporary situation. MicroDrainage analysis for this area defines the critical duration storm as the approximately a 30 minute storm and Table 3, below, is the required attenuation volumes.

Storm Event	Max attenuation size (m^3)
1 in 1 year	43.3
1 in 2 years	58.4
1 in 5 years	82.6
1 in 10 years	113.6
1 in 20 years	153.7
1 in 30 years	183.6
1 in 50 years	227.8
1 in 100 years	302

Table 3 – Temporary attenuation volume

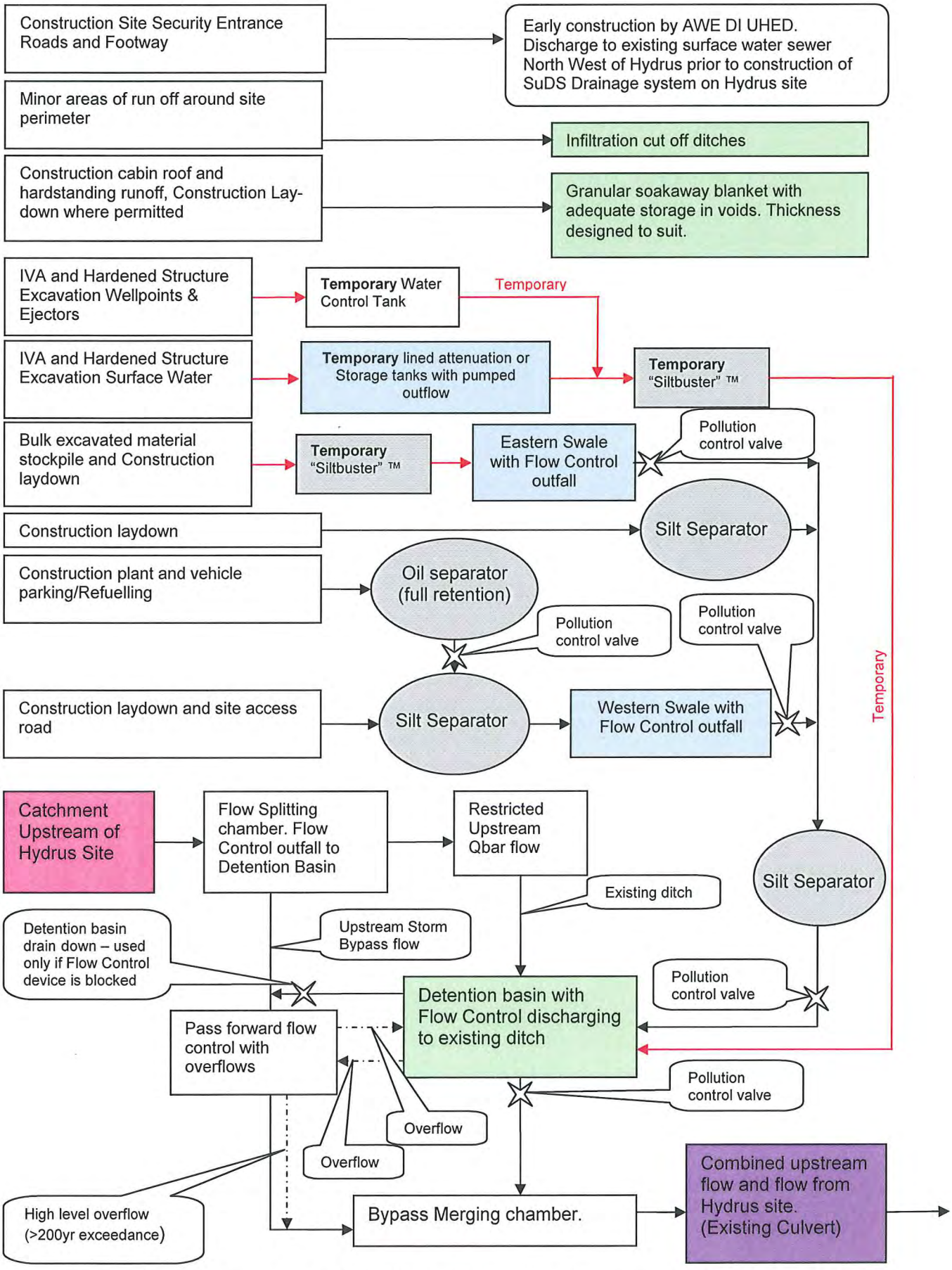

Figure 1 - SuDS Drainage schematic for Hydrus incorporating Excavation of IVA & Hardened Structure

5. Outputs

- The proposed SuDS facilities designed are sufficient for worst case Enabling and External Works designs.
- No construction or temporary lay-down area (except permeable laydown areas) are to be constructed until the key elements of the SuDS system are operational.
- The water quality from the excavated material storage and construction dewatering (including sump pumping) will be verified and managed continually throughout the construction phase as identified within the Construction Environmental Management Plan (CEMP) MER-110-017361.
- Separate consents / licenses may be required to abstract / discharge groundwater from the wellpoints and ejectors.
- The design basis for the temporary attenuation is that a maximum of 50 l/s will be pumped from the temporary attenuation to the SuDS Detention Basin.
- The maximum attenuation required for a 1 in 100 year storm over the Operations Building area is 302m³, assuming the pumping to the detention basin is maintained at 50 l/s.