East West Rail Phase 2

Drainage Strategy

Section: Temporary Compound A1 (Section 2A), Land to the East of Bicester Road, North of Section 2A.

Document Number:

133735_2A-EWR-OXD-CC_A1-RP-DH-000001 (ProjectWise no.)

133735-EWR-REP-EDR-000022 (eB no.)

Rev B01

East West Rail Phase 2

Temporary Compound A1 in (Section 2A), Land to the East of Bicester Road, North of Section 2A, Drainage Strategy

July 2019

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Document History

Project Number: 133735		**DOCUMENT REF:** **133735_2A-EWR-OXD-CC_A1-RP-DH-000001 (ProjectWise no.)** **133735-EWR-REP-EDR-000022 (eB no.)**				
Revision	**Purpose and description**	**Originated**	**Checked**	**Reviewed**	**Authorised**	**Date**
B01	For Approval	M Shudri	B Wilding P Lawrence	A Rose M Lawrence	J Baldock	15/07/2019

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Glossary

AEP	Annual Exceedance Probability
AW	Anglian Water
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
CBR	California Bearing Ratio
CC	Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EWR	East West Rail Alliance
FRA	Flood Risk Assessment
HP	High Pressure
IDB	Internal Drainage Board
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mbgl	Metres below ground level
NPPF	National Planning Policy Framework
NR	Network Rail Infrastructure Limited
OCC	Oxfordshire County Council
OXD	Oxford Branch Line
PFRA	Preliminary Flood Risk Assessment
RoFSW	Risk of Flooding from Surface Water
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems

Executive summary

Site Name and Address	Compound A1 Bicester Road, Bicester, Oxfordshire, OX26 5DP (nearest postcode)			
Grid Reference:	SP 60333 23097		**Size (hectares):**	Approximately 4.13ha

Current Use:	Greenfield	X	**Proposed Use:**	Residential	
	Brownfield (disused)			Commercial/Retail	
	Industrial			Industrial	
	Commercial			Hospital	
	Landfill			Educational	
	Rail			Rail	
	Residential			Landfill	
	Other			Other (Construction)	X

Comment:	Site previously greenfield and used for agriculture.	**Comment:**	Temporary Compound A1 to provide welfare facilities, plant and material storage together with facilitating construction access to the OXD railway line.
Flood Zone:	Zone 1	**Vulnerability:**	Low vulnerability
Sequential Test:	N/A	**Exception Test:**	N/A

This Drainage Strategy is compliant with the requirements set out by the Lead Local Flood Authority (LLFA) and the principles outlined in the Non-Statutory Technical Guidance; it has been produced by the East West Rail Alliance (EWR) on behalf of Network Rail (NR) in support of a planning application for the proposed Compound A1, on land west of Bicester Road.

Based on the site-specific Flood Risk Assessment (FRA), the strategy demonstrates that the site is not at significant risk of flooding and the proposed works will mitigate against the increased surface water runoff. The compound will be separated into two catchments, each discharging at the minimum runoff rate of 5l/s as recommended by the Environment Agency (EA), totalling a discharge of 10l/s for the compound.

Compound A1 will occupy greenfield land to the east of Bicester Road and to the North of the Oxford Branch (OXD) railway line. There is a topographical high point in the centre of the site; the southern half of the site falls south-eastwards towards the OXD Line, and the northern half of the site falls northwards towards the Langford Brook. The site levels vary between 72mAOD at the highest point, 69.5mAOD adjacent to the OXD Line and 70mAOD in the north. This site is located in Flood Zone 1 and is at negligible risk from ground water flooding.

The proposed compound will have a network of drainage ditches and pipes to collect surface water runoff from the site and attenuate this within two detention basins before discharging at existing greenfield runoff rates to the land drainage systems to the south and north of the site respectively. The north basin will then discharge to the west into the existing highways drainage ditch which will require consent from the highway's authority (Oxfordshire

County Council, OCC). The south basin will then discharge to the south into an existing land drainage ditch. Foul water from the proposed cabins will be collected within a cesspool that will be periodically emptied. The foul water will then be taken off site for treatment and disposal.

1. Introduction

1.1 Background

The East West Rail (EWR) Alliance, on behalf of Network Rail (NR), has prepared a drainage strategy, which incorporates a surface water management plan (SWMP) for the proposed temporary construction Compound A1 on land to the east of Bicester Road (see Figure 1-1 for location plan). Compound A1 will be operational for a period of 5 years, after which, the site will be returned to its original pre-development condition.

This Drainage Strategy for Compound A1 has been developed in accordance with the site-specific Flood Risk Assessment (FRA Reference: 133735-EWR-REP-EEN-000180) and the Environmental Appraisal Report (EAP Reference: 133735-EWR-REP-EEN-000176). The strategy will focus on the disposal of surface water runoff and foul effluent by detailing the planned use of Compound A1 and its anticipated impact on the site's existing drainage regime and will be compliant with guidance set out by Oxfordshire County Council (OCC).

Figure 1-1 Compound A1 Site Location Plan

1.2 Report Scope

The scope of this report is to provide a drainage strategy to support the NR planning application for Compound A1. This will be achieved by summarising the planned works on the compounds and providing detail on how the surface water and foul effluent will be managed in accordance with local and national guidance. Development of the strategy includes the following:

- Review of relevant local and national development guidance stated in Table 2-2.
- Review of pre-development use, LiDAR and topographical survey data.
- Review of factual ground investigation data.
- Undertake an assessment of pre-development surface water runoff rates.
- Identify existing drainage systems and assets.
- Identify potential outfalls from the site for both foul effluent and surface water.
- Calculate the additional foul load anticipated and identify the most appropriate disposal mechanism.
- Future maintenance requirements.

1.3 Proposed Development

Compound A1 is a 4.13ha temporary development proposed on land to the north-east of Charbridge Lane and east of Bicester Road. The proposed compound will be accessible directly from Bicester Road and will provide access to the Oxford Branch (OXD) railway line to the south of the site. A new access bellmouth and road will be provided in the southwest of the site, to allow access from Bicester Road. The proposed site layout (133735_2A-EWR-OXD-XX-DR-L-019011) is provided in Appendix A.

The site will include 42 units for office accommodation and welfare facilities in a three-storey block, a car park that will be finished with a granular (permeable) material, construction plant refuelling mobile area, and wheel wash facilities. Excavated topsoil from the compound site will be stockpiled in the south western part of the site, for later reinstatement. The compound will also contain a laydown area that will be used for the storage of various construction plant and materials (such as ballast and aggregates).

2. Policy Context

2.1 Rainfall Return Periods

Rainfall is a natural process that can present a range of different risks depending on its form. The Department of Food and Rural Affairs (DEFRA) define the risks presented by rainfall and associated flood risk according to an Annual Exceedance Probability (AEP), or as having a 'return period.'

Return period includes the statistical probability of an event occurring and the scale of the potential consequences. The 10-Year, 50-Year and the 100-Year return periods have a 10%, 2% and 1% chance of occurring in any given year, respectively. However, over a longer period the probability of flooding is considerably greater.

Table 2-1 below provides a summary of the relevant AEP and corresponding return period events of sensitivity.

Table 2-1 Definition of AEP and 'Return Period' Rainfall Events

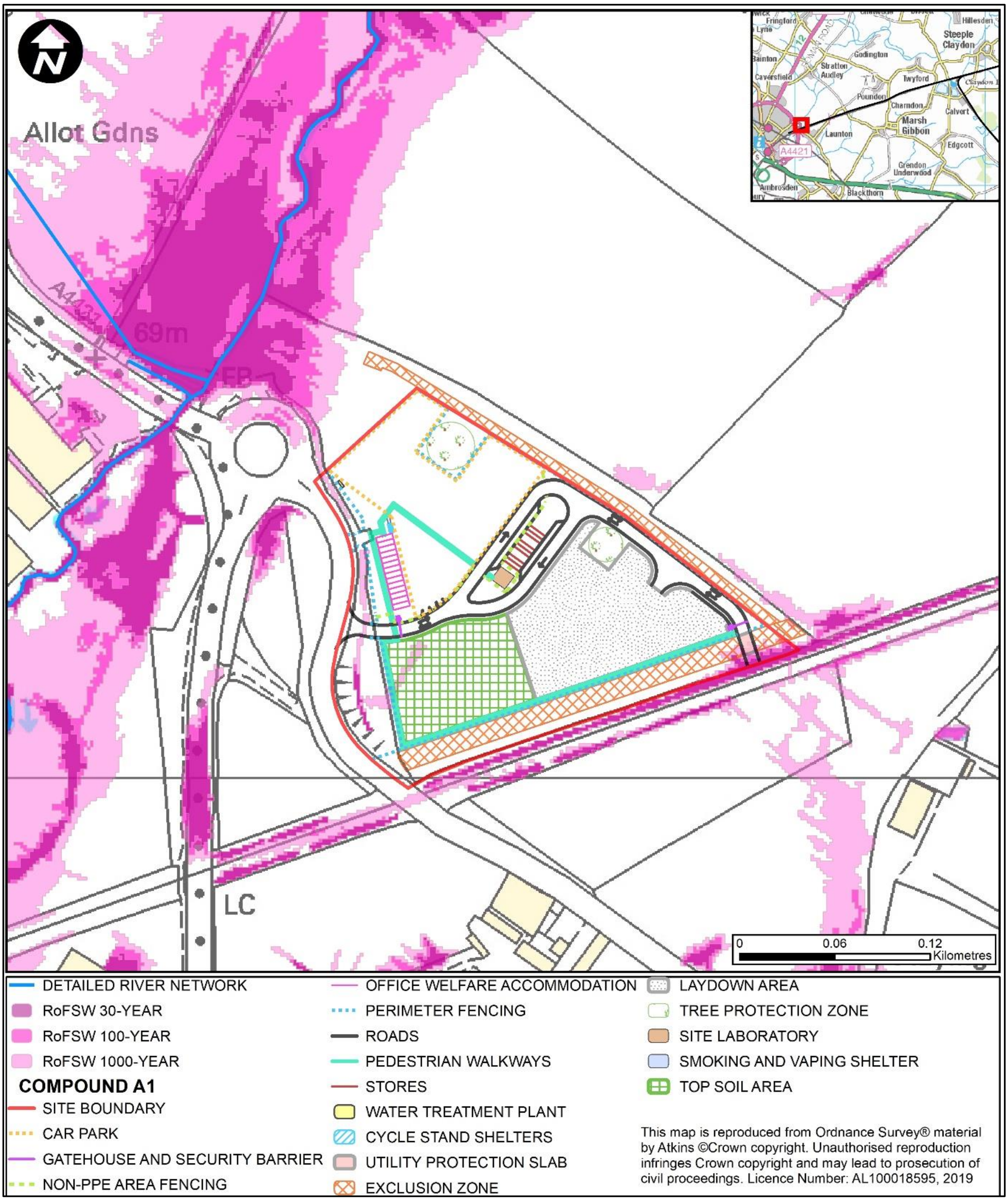
AEP (%)	Return Period (Years)
100%	1 in 1 Year
10%	1 in 10 Years
2%	1 in 50 Years
1%	1 in 100 Years
0.5%	1 in 200 Years
0.1%	1 in 1000 Years

2.2 Summary of Flood Risk Assessment

The site-specific FRA that has been produced is compliant with the requirements of the National Planning Policy Framework (NPPF) and the associated planning practice guidance.

The key findings of this assessment concluded that Compound A1 is located fully within fluvial Flood Zone 1. The EA Flood Map for Planning (provided in Appendix B) identifies that the area to the north-west of the compound is in fluvial Flood Zones 2 and 3; these flood zones however, do not impact the proposed compound. Hydraulic modelling for the 1% AEP plus climate change (CC) event has also confirmed that fluvial flooding will not pose a risk to adjacent land or the operational activities of the compound. The Risk of Flooding from Surface Water (RoFSW) maps (refer to Figure 2-1) identifies that the site lies in an area of very low flood risk, excluding the eastern most corner of the site which is shown to be at high risk of surface water flooding (at risk, at the 3.3% annual chance event). The area indicated to be at the highest risk of surface water flooding partly falls within the access route to the railway line. The FRA concluded however, that there are no impacts to safe access and egress from the site which is from Bicester Road.

Figure 2-1 RoFSW Flooding Modelled for Compound A1 layout



2.3 Local Development Policies

In order to inform the strategy, a review has been undertaken of relevant local and national development policies as detailed in Table 2-2.

Table 2-2 Local Development Policies and National Guidance to Inform the Report

Document Name	Published By	Date
Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire	Oxfordshire County Council	November 2018
Non-Statutory Technical Standards for Sustainable Drainage Systems	Local Authority SuDS Officer Organisation (LASOO)	2016

The key points extracted from the guidance pertinent to the proposed development are summarised in the following sections.

2.1.1 Oxfordshire County Council Developer Guidance

- For developments on greenfield sites, the peak runoff rate from the development for the 1 in 1 Year rainfall event and the 1 in 100 Year rainfall event should never exceed the peak greenfield runoff rate.
- The greenfield runoff rate will need to be agreed with the Lead Local Flood Authority (LLFA) (OCC) and should take into account the 1 in 1 Year, 1 in 30 Year and 1 in 100 Year rainfall events, including climate change allowances.
- All flow control devices restricting the rate of flow should have a bypass feature to manage flows when a blockage occurs. An overflow shall be provided from any basin/pond etc safely routing flows to the discharge location.
- Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 Year, 6 Hour rainfall event should never exceed the greenfield runoff volume for the same event.
- Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with Section 4 to Section 5 of the Oxfordshire County Council developer guidance, the runoff volume must be discharged at a rate that does not adversely affect flood risk.
- The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 Year rainfall event.
- The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 Year rainfall event are managed in exceedance routes that minimise the risks to people and property.
- Flow across the site must be diverted away from buildings and main access-egress routes. This flooding should be assessed to ascertain if is safe for the site's users. All drainage schemes must suitably demonstrate that flooding will not occur to any habitable building for the worst case 1 in 100 Year plus climate change event. The depth and rate of flow of the flood water should be compared to Table 4 of

"Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose" May 2008.

- The drainage system must be designed to accommodate overland flow from adjacent land if this is likely to be intercepted or affected by the development. All developments must clearly identify surface water from adjacent land has been considered appropriately and mitigation measures employed to prevent risk.
- The designs of all elements of the surface water drainage system must be accompanied by a maintenance schedule that sets out how and when each element of the system should be inspected and maintained, who is responsible for the maintenance, and when each element may need replacement. The layout of the development must demonstrate that there is sufficient access to carry out maintenance activities.

2.1.2 Non-statutory Technical Standards for Sustainable Drainage Systems

- Surface water drainage will be disposed in accordance with the SuDS hierarchy.
- Incorporate appropriate climate change allowances into the proposed drainage designs.
- The Non-Statutory Technical Standards for SuDS, states that surface water should be disposed of in accordance with the following hierarchy:
  - i. Infiltration.
  - ii. Disposal into an existing watercourse.
  - iii. Disposal into a surface water sewer.
  - iv. Disposal into a combined sewer.

2.4 EA Climate Change

The Environment Agency (EA) identifies the need for new developments to mitigate against climate change in order that the development will continue to not increase flood risk to the surrounding area. The EA guidance[1] refers to the estimated climate change allowances published by DEFRA (March 2019), that are provided in Table 2-3 below.

Table 2-3 EA Climate Change for Peak Rainfall

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

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

Based on the 5 year operational use of the compound and the LLFA guidance, the Central value for climate change of 5% will be adopted in order to estimate the post development runoff for the compound. Sensitivity checks will also be performed using the Upper End value of +10%.

3. Existing Site Information

3.1 Site Location

The proposed compound is located approximately 2km east of Bicester, and to the north-east of Charbridge Lane, grid reference SP 60333 23097. The entrance to the site will be via Bicester Road. The site details are provided in Table 3-1 and the location of the site is indicated on an aerial photograph in Figure 3-2.

Table 3-1 Location of Site

Site Name	Location	Size (ha)	Surface Type
Compound A1	Bicester Road, OX26 5DP	4.13	Greenfield

3.2 Topography & Site Features

The proposed compound will be constructed on existing arable land to the north of the OXD line. The site is bounded by Bicester Road along its western boundary, which rises to cross the alignment of the OXD line on the existing Bicester Road Overbridge. To the south, the site is bound by the OXD Line as well as both high pressure and medium pressure gas mains with arable land forming the eastern boundary. There is an existing access bellmouth towards the northwest of the site that will be maintained but unused for the proposed site.

There is a high point in the centre of the site; the southern half of the site falls south-eastwards towards the OXD line, and the northern half of the site falls northwards towards the Langford Brook. The site levels vary between 72mAOD at the highest point, to 69.5mAOD adjacent to the OXD line and 70mAOD in the north.

A contour drawing of the existing site that highlights key features and the extents of the proposed compound is provided within Figure 3-2.

3.3 Ground Investigations and Geology

Mapped geology[2] at the site of the proposed compound consists of the Kellaways Sand Member with no mapped superficial deposits. The Kellaways Sand Member is classified as Secondary Aquifer A by the Environment Agency[3], and therefore has moderate infiltration potential.

There is a historical British Geological Survey (BGS) borehole located approximately 0.25 km to the south-west of Compound A1, on a field to the south of the OXD line. Borehole SP62SW72 was located near Charbridge Lane and extended to a depth of 5m below ground level (mbgl). The geology recorded at this location consisted of superficial deposits of silty sandy clay to a depth of 2 m, underlain by additional clay recorded as Oxford Clay Formation. Oxford Clay Formation is classified as unproductive by the Environment Agency[4], therefore having low infiltration potential.

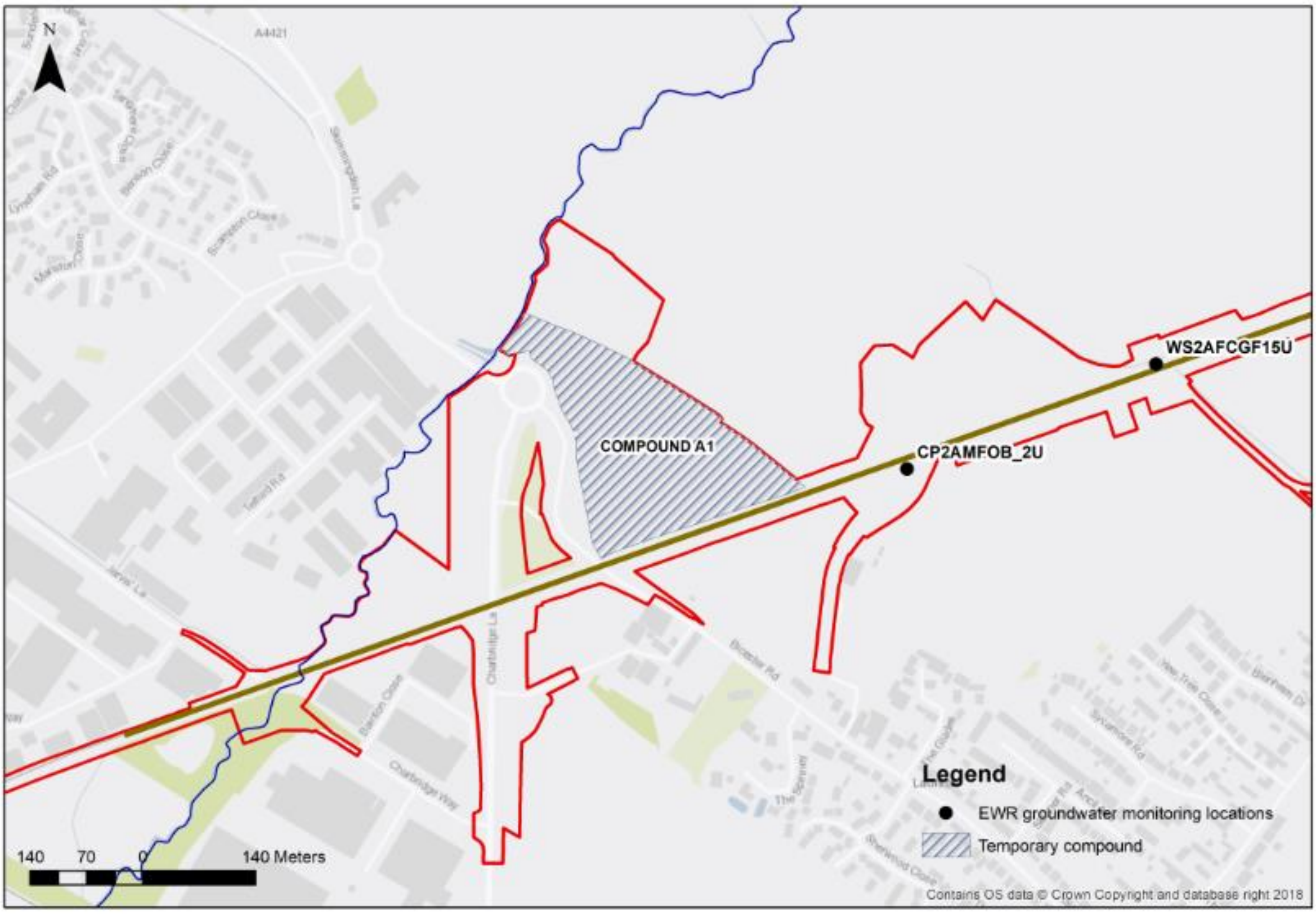
[2] BGS Geoindex: http://mapapps2.bgs.ac.uk/geoindex/home.html, date accessed March 2019
[3] https://magic.defra.gov.uk/MagicMap.aspx
[4] https://magic.defra.gov.uk/MagicMap.aspx. Date Accessed March 2019

Ground investigation has been undertaken by EWR along the rail corridor. This investigation included one borehole (CP2AMFOB_2U) approximately 130m to the east of Compound A1 on the OXD railway line (Figure 3-1). The information from this borehole and the BGS borehole is shown in Table 3-2 below.

Table 3-2 Summary Geological Logs

Monitoring location	SP62SW72[2]	CP2AMFOB_2U
	BGS	EWR
Borehole depth (m)	4.45	30.5
Geology summary (mbgl)		
Top Soil	0 – 0.3	0 – 0.15
Made Ground	-	0.15 – 0.45
Oxford Clay – Peterborough Member **(Sandy clay)**	0.3 – 3.5	0.45 – 2.40
Kellaways Sand Member **(Sandstone & siltstone)**	3.5 – 5.0 (assumed formation)	2.4 – 7.0
Kellaways Clay Member **(Sandy silty clay)**	-	7.0 – 9.1
Cornbrash Member **(Limestone)**	-	9.1 – 12.05
Forest Marble Formation **(Limestone & Mudstone)**	-	12.05 – 18.5
White Limestone Formation **(Limestone)**	-	18.5 – 29.6
Rutland Formation **(Mudstone)**	-	29.6 – 30.5

Figure 3-1 Compound A1 Existing groundwater monitoring locations



The geology recorded during the drilling of CP2AMFOB_2U supports that recorded in the BGS borehole, further to the west. However, between the A1 compound and the CP2AMFOB_2U borehole, there is a mapped boundary in the surface geology, with more permeable Kellaways Sand Formation under the compound, and less permeable Oxford Clay Peterborough Member outcropping to the east. Due to the recorded presence of clay with low permeability, and in the absence of factual GI for the compound, it is assumed that infiltration will not be a feasible method of surface water disposal.

Additional ground investigation, including soakaway testing in accordance with BRE 365 will be undertaken for the temporary compound site and the factual results will be available during the detailed design stage. This will confirm the presence of the Kellaways Sand Formation at the compound location and the infiltration potential.

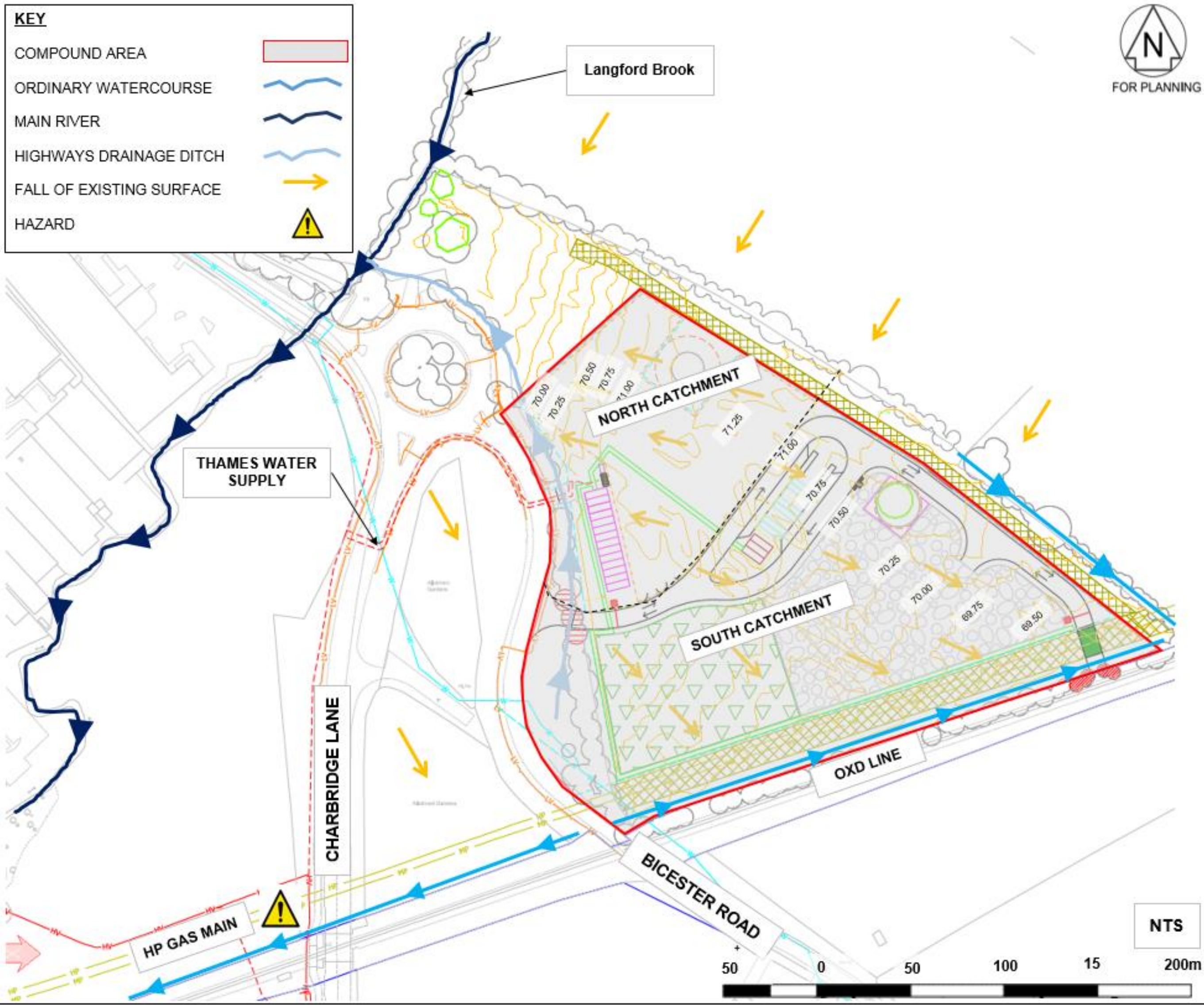
3.4 Water Environment

3.4.1 Existing Water Features

A Main River identified as Langford Brook flows in a south westerly direction approximately 85m from the northern boundary of the compound. The Brook is included in the Water Framework Directive (WFD) as a water body (GB106039030160 Good status). Additionally, a highway drainage ditch has been identified to the west of the compound. This ditch flows north along the western boundary of the compound, through a culvert below the existing bellmouth, before it discharges to Langford Brook. There are two land drainage ditches located to the south and the south-west of the compound. These flow in an easterly direction along the northern side of the OXD

Line before discharging into Summerstown Ditch and Launton and Cutters Brook[5] located approximately 1.17km to the east. The brook is a tributary of The Oxon Ray River and is included in the WFD as a water body (GB106039030120, currently Poor status).

Figure 3-2 Site Levels and Existing Water Features



3.4.2 Groundwater

As discussed in the FRA, high groundwater levels may impact the ability to dispose of surface water runoff to ground, and groundwater emergence may result in additional flow into the drainage system. Therefore, groundwater levels at the proposed compound site are being considered as part of the drainage strategy.

[5] https://www.wwf.org.uk/uk-rivers-map

Based on BGS 1:50,000 mapping, Environment Agency aquifer designation maps[6] and national scale modelling[7], the groundwater issues at the proposed compound can be summarised as follows:

- Superficial Aquifer: None
- Bedrock Aquifer: Secondary Aquifer (Kellaways Sand Formation).
- Groundwater Flood Risk: located in an area identified by national scale modelling as having negligible groundwater flood risk.
- The LLFA have indicated that the groundwater flood risk is variable.
- BGS Infiltration SuDS Map indicates that the site lies in an area where groundwater may be less than 3m below the surface of the ground.
- Source Protection Zone: none present within 500m.

Site specific geology and groundwater data for the compound are not currently available. However, groundwater levels have been monitored at one of the ground investigation borehole listed in Table 3-2, 130m to the east of Compound A1.

Groundwater monitoring is ongoing, however as shown in Table 3-3 the maximum groundwater level recorded to date is 1.28mbgl, which was recorded in January 2019 (monitoring is ongoing). This is close to the potential depth of excavation, suggesting that groundwater may be encountered during construction of the compound. However, as the existing ground levels will be retained, and drainage systems will be installed at a typical depth of 0.5m. Therefore, groundwater emergence into the drainage system is not considered to be a risk as drainage systems will be above ground water level and the low productive Kellaways Clay Member formation.

Table 3-3 Groundwater level information

Monitoring location	CP2AMFOB_2U
Borehole depth (m)	30.5
Monitored formation	Kellaways Sand Member, Kellaways Clay Member, Cornbrash Member, Forest Marble Formation, White Limestone Formation (2.0 – 30.0 mbgl)
Groundwater level monitoring period	Aug 2018 – Jan 2019
Average groundwater level	1.5 mbgl (67.9 mAOD)
Max groundwater level	1.28 mbgl (68.15 mAOD)

[6] https://magic.defra.gov.uk/MagicMap.aspx
[7] JBA Consulting (2017) Groundwater Flood Map (National), High Resolution 5m V2.3, June 2017

3.5 Existing Drainage Systems

Available utilities data and map information has confirmed that there are no public foul, surface water or combined sewers within or immediately adjacent to the site. There is an existing highway drainage system serving Bicester Road, consisting of kerbs and gullies. It is assumed that the highways gullies discharge to the highway drainage ditch to the east of Bicester Road.

The site is greenfield and no sub-surface drainage features have been identified in the surveys to date, it is assumed that there are no private drains within the boundary of the site.

3.6 Existing Surface Water Runoff

The existing site is split into two separate catchment area, with water runoff from the northern half of the existing field drains into a land drainage ditch which flows north to outfall to the Langford Brook. The southern half of the field drains in a south-easterly direction before being intercepted by a land drainage ditch flowing along the north side of the OXD railway line, which outfalls into an ordinary watercourse to the east of the site.

An estimate of the greenfield runoff rate from the site has been undertaken for each of the catchments using the greenfield runoff IH124 ICP SuDS (FSR Method) for small catchments on the HR Wallingford UK SuDS[8] website; the results are summarised in Table 3-4 below.

Due to the size of the Compound A1, the FSR method provides a more accurate representation for the existing runoff as defined in the Estimating Flood Peaks and Hydrographs for Small Catchments Phase 1[9]. The greenfield runoff rate calculations are provided in Appendix C.

Table 3-4 Existing Greenfield Runoff Rates

Rainfall Return Period	North Catchment Discharge (l/s)	South Catchment Discharge (l/s)
1 in 1 Year	0.4	0.7
1 in 2.3 Year (QBAR)	0.5	0.9
1 in 30 Year	1	2
1 in 100 Year	1.5	2.8

As the runoff rates in each catchment are low, a minimum discharge rate of 5 litres per second is to be adopted for each outfall. The value 5l/s is considered the minimal practical discharge rate to avoid onerous maintenance requirements, as recommended by Environment Agency guidance.

[8] HR Wallingford UK SuDS: http://www.uksuds.com/drainage-calculation-tools/greenfield-runoff-rate-estimation. Date Accessed January 2019.
[9] Section 5.1.5 of Estimating Flood Peaks and Hydrographs for Small Catchments Phase 1: Environment Agency: 2012

4. Drainage Strategy

4.1 Introduction

This section outlines the proposed surface and foul water drainage systems that will be constructed on the site (and that will be further developed during detailed design). It will also detail requirements for attenuation storage in order to mitigate the increased runoff from Compound A1 and set out measures to be adopted in order to maintain water quality. This section should be read in conjunction with the drainage layout drawing provided in Appendix G.

4.2 Surface Water

4.2.1 Disposal

The OCC guidance requires surface water discharges from new developments, to be restricted to the greenfield rate of runoff wherever possible. The Non-Statutory Technical Standards for SuDS, and Section 3 of The Building Regulations (2010) Part H[10] states that surface water should be disposed of in accordance with the following hierarchy:

i. Infiltration.

ii. Disposal into an existing watercourse.

iii. Disposal into a surface water sewer.

iv. Disposal into a combined sewer.

In accordance with the above hierarchy, Table 4-1 reviews the suitable surface water disposal options for the site.

Table 4-1 Surface Water Discharge Options

Method of Surface Water Discharge	Suitability for Site
Soakaway or other infiltration system	Ground conditions are unlikely to be suitable. As stated in Section 3.3, available data suggests that the maximum groundwater level across the site is 1.28mbgl combined with a low infiltration potential of Kellaways Clay Member. Therefore, the adoption of a soakaway or other infiltration system is considered unfeasible.
Watercourse	As identified in Section 3.4.1, there are existing land drainage ditches to the south of the compound and an existing highway drainage ditch to the west of the site. The drainage ditches to the south discharge into the Summerstown Ditch and Launton and Cutters Brook further east, with the highway drainage ditch discharging into the Langford Brook to the north of the site.
Surface water sewer	There are no existing public sewers in the vicinity of the compound.
Combined sewer	

[10] The Building Regulations 2010: Part H: Drainage and Waste Disposal, HM Government 2015.

Based on the above, the preferred method of disposal for surface water runoff is to discharge into the existing land drainage ditch to the south and to the highways drainage ditch to the west, creating two separate outfall points. Approval from the Highway Authority (OCC) will be required for the proposed outfall to the highway drainage ditch to the west of the site.

4.2.2 Post Development Runoff

As stated in Section 1.3 the overall construction of the compound will be made up of materials that will alter the permeability of the site and consequently increase surface water runoff. Granular material will be used to form the car park, laydown areas and paved areas will be establish for haul roads. The runoff coefficients that will be used for design of the on-site drainage systems are shown in Table 4-2 below.

Table 4-2 Compound Surface Coefficients

Surface Characteristic	Runoff Coefficient	Comments
Compound Infrastructure		
Paved areas – asphalt or concrete	1.00	N/A
Buildings – site cabins and shelters	1.00	
Granular Paved Areas – car park and welfare areas	0.50	N/A
Grassed Areas – verges and vegetated areas	0.15 (Gradient <15%)	N/A
Stockpile & Laydown Areas		
Granular Stockpiles – ballast, aggregates & crushed materials	0.50	It has been assumed that granular stockpile areas will have similar characteristics to ballasted track bed. Voids between aggregates and texture of aggregates will cause runoff reduction.
Topsoil Storage – placed on native soil	0.40	The stockpiled material will have voids resulting in runoff reduction. Stockpiled material will have gradients >15% resulting in a higher rate of runoff than pre-construction native ground.
Laydown Areas – granular material (not paved)	0.50	N/A

Based on these runoff coefficients, the impermeable area of the proposed temporary compound has been calculated for the north and south catchment areas, and the findings provided in Table 4-3 below.

Table 4-3 Compound A1 Impermeable Area Calculation

Catchments of Compound A1	Runoff Coefficient	North Catchment		South Catchment	
		Area (ha)	Impermeable area (ha)	Area (ha)	Impermeable area (ha)
Car park and area surrounding welfare facilities. Unsealed surface.	0.50	0.871	0.435	-	-
Undeveloped greenfield area next to Bicester Road and to the North of the OXD line.	0.15	0.225	0.0337	0.2258	0.0338
Topsoil storage area.	0.40	-	-	0.51	0.204
Welfare porta cabins and fuel station.	1.00	0.0875	0.0875	0.0765	0.0765
The laydown area.	0.50	-	-	0.778	0.389
Paved haul road within the site.	1.00	-	-	0.657	0.657
Total	0.47	1.184	**0.556**	2.247	**1.360**

The total area of the site is 4.13ha. The introduction of different surfaces and materials will alter the runoff characteristics of the site. The application of runoff coefficients has been used to determine the change in impermeable area from the greenfield condition. The construction of Compound A1 will result in a site-wide runoff coefficient of 0.47, which is equivalent to 1.304ha increase in impermeable area.

The required volume of surface water attenuation storage has been calculated using MicroDrainage Source Control 2018 based on the calculated impermeable area and a 5l/s discharge rate for each outfall. The estimated attenuation storage volume (upper-bound value from the results being used to provide a conservative estimate) for each catchment is:

- North Catchment Area = 286m^3
- South Catchment Area = 790m^3
- Total Attenuation Provision for Compound A1 = 1076m^3

As a sensitivity check, the total estimated storage requirement using the climate change Upper End value of +10% is 1139m^3 and represents an increase of 63m^3, when compared to the Central Value (the calculation is provided in Appendix D).

4.2.3 Use of Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) will be used across the development in order to manage surface water in accordance with current best practice. SuDS work through mimicking natural drainage systems, reducing runoff and peak flows from a site and reducing the risk of flooding. In addition to reducing flood risk, SuDS can also improve water quality (and which is discussed in Section 4.2.4).

The SuDS Manual provides a management train and indicates that flows within a development should preferably be managed using a range of SuDS techniques. However, it is important to recognise that some of the techniques in the SuDS Manual are more appropriate for use in permanent and/or longer-term developments. In this instance, providing SuDS features to offer public amenity and biodiversity benefits is not considered appropriate because this is a temporary construction compound with a short operational duration of 5 years, after which the site will be returned to its original condition. Table 4-4 sets out the techniques that have been considered for this development.

In addition, the following recommendations to improve water quality have also been adopted from the SuDS Manual:

i. Pollution prevention by avoiding contaminants mixing with run-off.
ii. Treatment **-** Implementing SuDS systems (in series where required) to treat runoff.
iii. Maintenance and remedial work - to remove captured pollutants and maintain system performance

Table 4-4 Assessment of Applicable SuDS Features

SuDS Group	SuDS Technique	Description	Suitable	Reasons
Source Control	Site layout & management	Good housekeeping and good design.	Yes	Include provision for SuDS at design stage. Include drainage facilities to control on-site and prevent off-site flooding. Storage of materials and fuel oils in accordance with best practice to reduce risk of contaminants entering the drainage system.
	Water butts	Collection of rainwater for reuse.	No	Not appropriate as there could be potential that water butts are full when it rains so attenuation will be created.
	Rainwater harvesting and re-use	Larger-scale collection of rainwater for attenuation or for reuse in appropriate ways (e.g. toilet flushing or irrigation).	No	This is unlikely to provide attenuation due to there being no guarantee that rainwater harvesting tanks will be empty during a rainfall event.
	Permeable pavement	Allow inflow of rainwater into underlying soil or construction.	No	The construction compound will be a temporary facility; the movement and loading from large construction plant are likely to easily cause damage to the pavement. Permeable pavements are more appropriate for use in permanent development.

SuDS Group	SuDS Technique	Description	Suitable	Reasons
	Green roofs	Vegetated roofs that reduce runoff volume and rate	No	Not appropriate for the temporary structures and size of roof areas that will be at this compound. Expected to provide limited benefit.
Retention	Rainwater attenuation	Collection of rainwater within storage tanks to reduce runoff rates (until tank capacity reached).	Yes	This would be a suitable solution however the preference is to avoid the construction of tanks.
Detention	Detention basin	Dry depressions designed to store water for a specified retention time and quantity	Yes	Detention basins will be suitable for this compound as there are outfalls identified to ordinary watercourses and there is sufficient space to accommodate the basin. Basins can also be used as part of SuDS treatment train for controlling sediment from the runoff from the laydown areas.
Filtration	Filter drain	Linear drains or trenches filled with permeable material, often with piped drainage in the base.	Yes	Pollution/grit/sediments can be settled out, the rate of runoff slowed and retention time for water treatment increased.
	Filter strip	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable surfaces and filter out particles.	Yes	Pollution/grit/sediments can be settled out, the rate of runoff slowed and retention time for water treatment increased.
	Bio-retention areas	Vegetated areas for collecting and treating water before discharging or infiltrating	No	Not suitable for anticipated site use as there will not be enough space within the site boundaries. This method would be more appropriate for permanent developments
	Sand filters	Treatment devices using sand beds as filter media	No	More appropriate for treatment of industrial areas.
	Silt removal devices	Manhole or other devices to remove silt	Yes	Detention basins and source control are considered to be more effective in managing silt.
Infiltration	Soakaways	Sub-surface storage and infiltration systems	No	Based on anticipated ground conditions and high ground water levels infiltration solutions

SuDS Group	SuDS Technique	Description	Suitable	Reasons
	Infiltration trenches	Similar to filter drains but allow infiltration through trench bases and sides	No	are not considered to be feasible. However, additional ground investigation will be undertaken to confirmed viability of infiltration.
	Infiltration basins	Depressions that store and dispose of water via infiltration	No	
Open Channel	Swales / cut-off ditch	Shallow, vegetated channels to conduct or retain water and provide filtration (permitting infiltration when unlined).	Yes	Open channels can be utilised to remove pollutants and for flow conveyance. Open channels can also be used for conveying exceedance flows to the land drainage ditch.
Wetland	Ponds	Depressions used for storing and treating water with permanent pool and marginal aquatic vegetation.	No	This is not considered to be an appropriate solution as often they are reliant on a continuous through-flow of water and/or high groundwater levels which are unlikely to be available on this site.
	Shallow pond or pocket wetland	Shallower ponds where runoff flows through aquatic / wetland vegetation for attenuation and infiltration, but which may dry out	No	
Other	Pipes and subsurface storage	Oversized pipes as conveyance measures and/or storage. Can be combined with sedimentation and filter media systems	Yes	To provide additional storage capacity in underground drain systems and transport flow to an outfall at the lower end of the site.

Assessment of the SuDS features has identified the available SuDS measures and has considered their potential applications within a temporary construction compound environment. Based on this, the proposed temporary drainage will comprise of a system of open channels/drainage ditches and detention basins.

4.2.4 Water Quality

Due to the nature of the activities that will be undertaken within the compound, there is the potential for surface water to become contaminated with both hydrocarbons and suspended sediment. These contaminants could have a detrimental effect on the receiving watercourse (noting that discharges from the site will be into ephemeral drainage ditches and the receiving Langford Brook currently has a good WFD status) and therefore water quality measures will be implemented prior to the commencement of any significant works or grading on the site.

Impacts to water quality can be mitigated through a combination of good site and material management techniques (with reference to CIRA reports C648[11] and C736[12]), together with the implementation of source control measures

[11] CIRIA C648 Control of water pollution from linear construction projects: technical guidance, 2006.
[12] CIRIA C736: Containment systems for the prevention of pollution, 2014.

and a SUDS treatment-train. The following measures are proposed to be adopted on the site and the requirements will be further developed during the detailed design stage.

i. Development of Site Management Plans prior to commencement of construction.
ii. Bunded or double walled fuel tanks that are located away from watercourses.
iii. Oil and fuel spill kits to be available within the compound to contain and clear up accidental spillages that may occur.
iv. The use of drip trays to be used below stationary construction plant/vehicles where required.
v. On-site wheel wash facilities will be of a closed loop type that recycles the water it uses.
vi. Silt fences or bunding to be used on the margins of laydown areas and located between stockpiles and proposed ditches.
vii. Where feasible maintaining vegetated buffer strips to intercept/trap sediment from runoff.
viii. Detention basins to incorporate a sediment forebay to enable the settlement of suspended sediments.
ix. The outlet from the detention basin to include a means of shutting off the flow into receiving watercourse.

4.2.5 Proposed Drainage Layout

In order to mitigate against increased flood risk, discharges from each basin will be limited to the minimum discharge rate recommended by the EA of 5l/s, with flows being attenuated on site up to and including the 1 in 100 Year +5% CC rainfall event in two detention basins with a total estimated storage volume of 286m^3 and 790m^3 for the north and south catchments, respectively. The detention basins will need to be sufficiently sized to allow for sedimentation processes under gravity to take place. An estimate of the required treatment volume has been calculated in the accordance with The SuDS Manual (CIRIA: C753) using MicroDrainage Source Control 2018; the calculated treatment volume is 135m^3 for the north basin and 275m^3 for the south- basin, which is less than the respective attenuation storage volume of 286m^3 and 790m^3, and therefore demonstrates that the detention basins are adequately sized (calculations are provided within Appendix E).

Drainage ditches will be strategically placed throughout the compound to drain water efficiently and will be designed to achieve no flooding during the 1 in 30 Year rainfall event. Ditch gradients will be minimised, where practicable, to reduce velocities and promote settlement of sediments before discharge into the detention basins. The highways drainage ditch to the west of the compound will require a culvert below the proposed bellmouth onto Bicester Road, equal to the size of the existing culvert below the bellmouth to the north along Bicester Road. The land drainage ditch to the south of the compound will require a culvert to convey the existing land drainage ditch flows under the proposed haul road.

The detention basins will be located in natural low spots in the south-east and north-west corners of the site. The outfall from the south-east basin will discharge to the existing land drainage ditch adjacent to the OXD Line. The north-west basin will discharge to a highway drainage dich, to the west of the site, which then outfalls to the Langford Brook. Flows will be restricted by using either an orifice plate or vortex flow control, with sizes being confirmed during the detailed design stage, to 5l/s (refer to Appendix G).

It should be noted that the “Utility Exclusion Zone” (gas mains) along the southern boundary of the compound and the OXD Line, will due to topography, need to be drained into the land drainage ditch, which will be treated as part of the existing railway drainage system on the northern side of the OXD Line. Approximately 90% of this area will remain in its current condition with no construction activity proposed and as such the existing runoff regime will be unchanged. However, where the haul road crosses this are discharges into the drainage system will be managed, and runoff treated in line with the proposals set out in Section 4.2.4. The existing bellmouth in the north of the compound will not be used for compound access and so the existing runoff regime will be maintained.

4.2.6 Exceedance Flows and Surrounding Land

For rainfall events that exceed the drainage design (1 in 30 Year rainfall event) up to and including the 1 in 100 Year rainfall event (plus climate change allowance), any surface water flooding should be fully contained and managed within the boundaries of the site and not flood areas downstream. Any exceedance flows should be controlled in a manner that will avoid flooding of buildings or vulnerable areas, plus ensure that depths and velocities involved are safe.

In order to provide a robust design and support managing exceedance flow, ditches provided around the perimeter of the site will be oversized to provide sufficient capacity to convey the 1 in 100 Year rainfall event including climate change without flooding. Ditches (with a typical cross section of 0.5m wide bed, 0.5m deep, with 1 in 1 slopes) have provisionally been sized using the peak flow provided by the Rational Method for the 1 in 100 Year rainfall event including +5% CC; a sensitivity check with 10% CC has also been undertaken and demonstrates that peak flows can be contained by the proposed section. Ditch sizes will be confirmed during the detailed design stage and provisional calculations are provided in Appendix F.

For storms with a return period greater than the 1 in 100 Year + CC rainfall event any exceedance will overtop the proposed drainage system and will flow overland to the existing land drainage ditches (to the south and west of the compound). Overflow ditches will be provided from the perimeter of the detention basins to ensure that exceedance flows are safely managed and discharged into the existing land drainage ditches.

4.3 Foul Water

4.3.1 Outfall

Part H of the Building Regulations sets out a hierarchy for the disposal of foul effluent from a site. This has been reviewed in the Table 4-5 below.

Table 4-5 Foul Water Disposal Hierarchy

Foul Disposal Method	Suitability for Site
Discharge to Sewer	There are no existing sewers on or near to Compound A1. This option is not feasible due to lack of infrastructure.
Package Treatment and Septic Tanks	The outfall from a package treatment plant for the site would be to existing land drainage ditches. However, the ditches surrounding the compound are ephemeral watercourses that will not provide dilution of the treated sewage effluent. As such, it is unlikely that such an outfall will be consented by the EA, so has been discounted as an option.
Cesspools	This option requires no outfall to be established on site.

Based upon the above, foul water effluent will be collected into a cesspool located on the site; this will need to be periodically emptied and disposed of off-site at a licenced facility.

4.3.2 Design Parameters and Calculations

Welfare facilities on the compound need to be designed for 300 staff. The foul effluent load has been derived from the British Water Flows and Loads – 4[13] and based on 60l per person per day for open industrial sites, e.g. construction, quarry, without canteen. Using these values, it has been estimated that there will be 18000l/day of foul effluent and over a 14-day period this equates to a storage requirement of 180m^3 (based on 5-day working week). These estimates will need to be reviewed at detailed design stage.

The cesspools for Compound A1 have been designed based on them being emptied every 14 days, as opposed to the 45 days specified by The Building Regulations (which is based on domestic properties). As such additional precautions will need to be taken to ensure these cesspools do not overflow; ultrasound monitors will be used to measure the top water levels and alarm if the storage is due to be exceeded.

[13] British Water Flows and Loads – 4, Sizing Criteria, Treatment Capacity for Sewage Treatment Systems

4.4 Maintenance

All detention basins and drainage ditches will be located on Compound A1. These will be maintained by the EWR Alliance on a frequency as detailed in Table 4-6Table 4-6 Surface Water and Foul Effluent Features Maintenance Schedule; the schedule will be reviewed and updated as necessary on completion of detailed design.

Table 4-6 Surface Water and Foul Effluent Features Maintenance Schedule

	Drainage Asset		
Maintenance Frequency	**Ditches**	**Detention Basin**	**Cesspool**
Weekly	Inspection and removal of debris.	Inspect inlets, outlets and overflows for blockages, clear as required.	Inspection for overflow and emptied as required (typically cesspools will require emptying fortnightly by a specialist contractor).
Monthly	Removal of litter and debris. Manage vegetation and remove nuisance plants.	Removal of litter and debris. Manage vegetation and remove nuisance plants. Inspect banksides, structures, pipework etc for evidence of physical damage. Establish appropriate silt removal frequencies on a monthly basis for the first year of operation.	Inspect tanks for damage and/or leaks.
Quarterly	None proposed at this stage. To be confirmed at detailed design stage.	None proposed at this stage. To be confirmed at detailed design stage.	N/A
Six Monthly	Inspect to identify evidence of erosion, compaction, ponding, sedimentation and contamination. Inspect for clogging or items that are blocking the route. Inspect silt accumulation rates and establish appropriate removal frequencies.	Manage other vegetation and remove nuisance plants.	N/A
Annually	None proposed at this stage. To be confirmed at detailed design stage.	Check needs for sediment removal. Inspect inlets and facility surface for silt accumulation. Check any penstocks and other mechanical devices. Remove sediment from inlets, outlet and forebay as required.	N/A

	Drainage Asset		
Maintenance Frequency	Ditches	Detention Basin	Cesspool
Remediation inspections & tasks following significant storm events	Inspect ditches for signs of erosion and damage. Repair as necessary.	Inspect the detention basin for signs of damage and check for blockages at outlets. Repair as necessary.	N/A

5. Additional Information

The design of drainage systems will be developed further based on this strategy. Based on the LLFA guidance for full planning applications further information will be supplied at the detailed design stage. This includes:

- Soakaway test results in accordance with BRE365.
- Detailed drainage layout including drainage pipe sizes, gradients and pipe quantities.
- Specific details of flow controls to be used.
- Confirmed sizing of:
    - detention basins
    - drainage ditches.
    - cesspools.
- MicroDrainage hydraulic model results, including overland exceedance depths and flow routes.
- Construction details.
- Updated maintenance schedules.

6. Conclusions

Ground investigation data has indicated that disposal of surface water by infiltration is not feasible; and so, discharge will be required into existing ordinary watercourses to the west and south of the site. Insitu soakaway tests in accordance with BRE365 and ongoing groundwater monitoring will be undertaken to inform detailed design and the results incorporated should the potential for infiltration be realised.

A number of SuDS techniques have been considered to mitigate increases in surface water runoff as a result of changes in impermeable area on the site, and due to the proposed use as a construction compound then consideration has also been given to impacts on water quality. The existing site levels require two outfall points from the basins to be provided for the compound. The northwest basin will require consent from OCC before discharging into the highway's drainage ditch. Drainage proposals include the use of drainage ditches and detention basins upstream of the two outfalls. Due to the topography of the compound, it is necessary to drain the section (approximately 30m) of the haul road beyond the proposed south east attenuation basin to the land drainage ditch which is being used as the track drainage system. Surface water runoff will be restricted to 5l/s at the two basin outfalls respectively, using either an orifice plate or vortex flow control and the design will provide a total of 1076m^3 of attenuation storage (split between two detention basins) for all events up to and including the 1 in 100 Year plus 5% climate change rainfall event.

In order to comply with OCC guidance, a range of measures have been proposed to support removal of sediments and hydrocarbons from surface water flows in order to mitigate against any potential impacts to water quality. This is proposed through the use of site management techniques and the establishment of a treatment train; measures include silt fences and a detention basin incorporating forebays. Exceedance flows will be managed through the use of oversized ditches, which will return this water to the existing land drainage systems to the south-east and north-west of the Compound A1. The size of infrastructure required will be confirmed as part of detailed design.

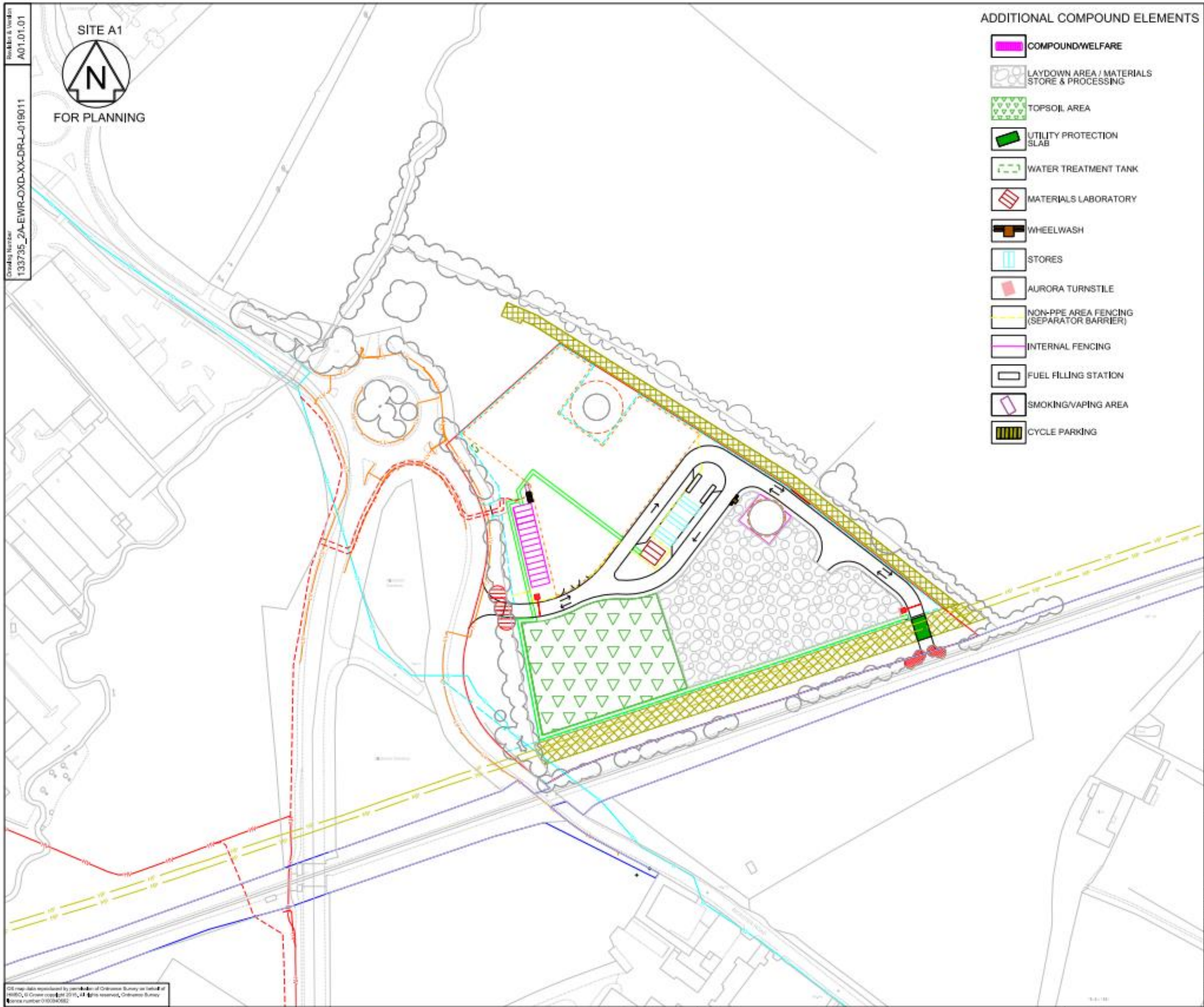
It has been identified that there are no public foul sewers on or near the site for disposal of foul effluent from the site. A cesspool will therefore be provided with a storage capacity of 180m^3; this will require periodic emptying.

The on-site drainage systems will be maintained by the EWR Alliance for the duration that the compound is operational; preliminary maintenance schedules have been provided and will be updated as part of detailed design.

Appendices

Appendix A. Compound Layout

Appendix A contains an indicative CAD drawing of the proposed Compound A1 layout. This includes the topsoil storage and laydown areas as well as the site welfare facilities, access points, egress points and haulage roads on Compound A1.



KEY

- APPLICATION SITE BOUNDARY
- LAND IN NETWORK RAIL OWNERSHIP
- HIGH PRESSURE GAS TO BE ABANDONDED
- MEDIUM PRESSURE GAS MAIN
- HIGH VOLTAGE UNDERGROUND ELECTRIC CABLE
- LOW VOLTAGE UNDERGROUND ELECTRIC CABLE
- THAMES WATER PIPE
- THAMES WATER DECOMMISSIONED WATER PIPE
- VEGETATION TO BE REMOVED
- ROOT PROTECTION ZONE
- PROPOSED HIGH VOLTAGE UNDERGROUND ELECTRIC CABLE
- EXCLUSION ZONE
- VEGETATION IN THE VICINITY OF PROPOSED COMPOUND SITE
- CAR PARKING
- ACCESS ROADS

COMPOUND ELEMENTS

- 2.4m HIGH PERIMETER FENCING
- GATEHOUSE AND ACCESS BARRIER

Rev	Date	Description of Revisions	Drwn	Chkd	Appr
A01	05/03/19	FOR PLANNING	–	–	–

Status: WIP - Design | Suitability: S0

EWR Alliance
Connecting People

Project:
East West Rail
(Western Section)
Phase 2

Drawing Title:
A1 SITE DESIGN
LAND NORTH EAST OF
CHARBRIDGE LANE
COMPOUND OX26 5DP

Designed	–	Signed	–	Date	–
Drawn		Signed		Date	17/05/19
Checked	–	Signed	–	Date	–
Approved	–	Signed	–	Date	–

Scale(s): 1:1000
ELR - Project Chainage (Miles Yards): OXD -
Design Package Risk Classification: Normal
Sheet: 0 of 0
Alternative Reference:
Revision: A01
Drawing Number: 133735_2A-EWR-OXD-XX-DR-L-019011

Sheet Size A1 594 x 841

Appendix B. EA Flood Map for Planning

Appendix B contains the EA Flood Map for Planning from a fluvial perspective. The map identifies nearby watercourses and their potential flood risk to the surrounding area.

Environment Agency

Flood map for planning

Your reference
Compound A1

Location (easting/northing)
460333/223097

Scale
1:2500

Created
26 Mar 2019 6:54

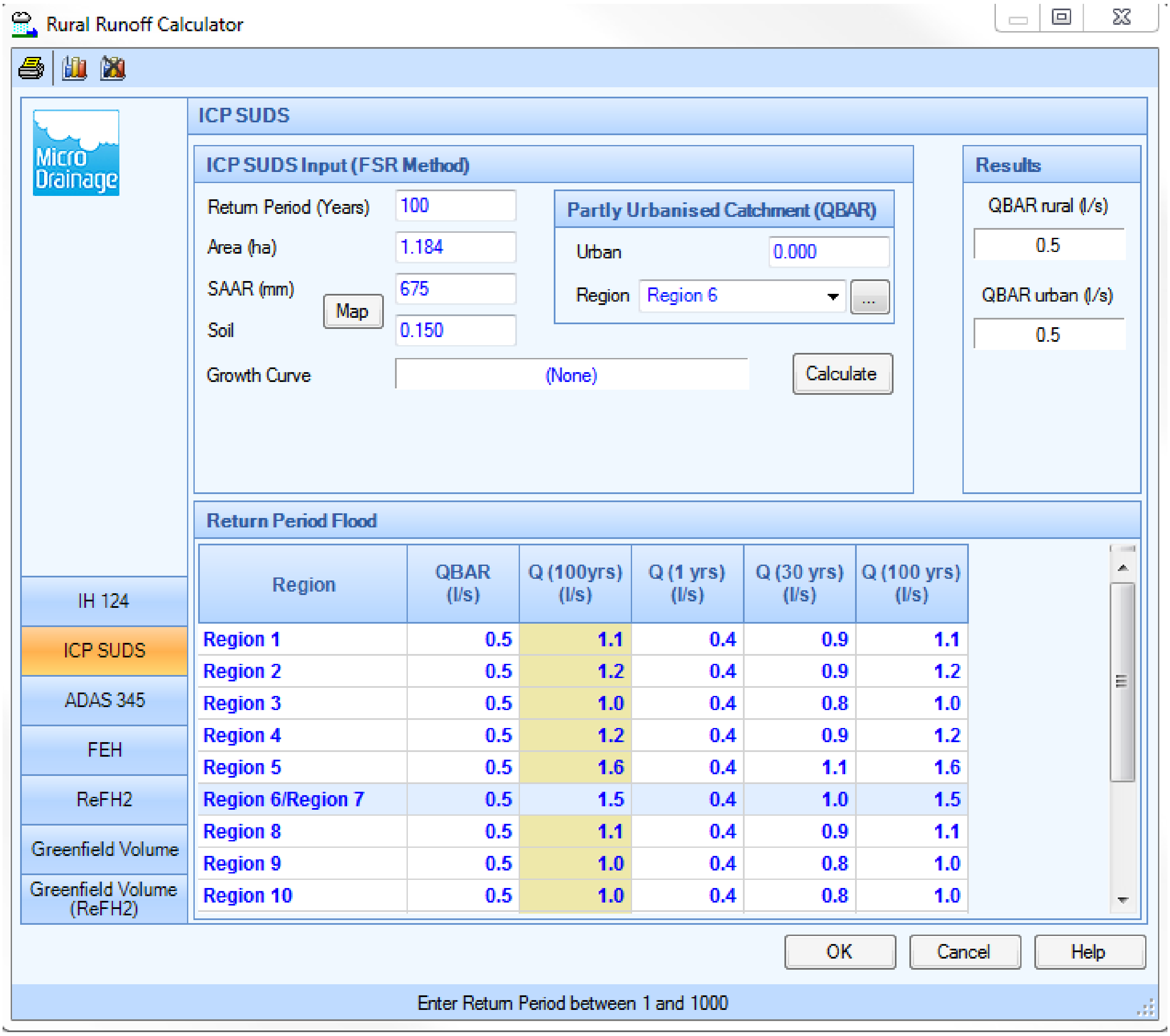
- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 20 40 60m

Appendix C. Greenfield Runoff Calculations

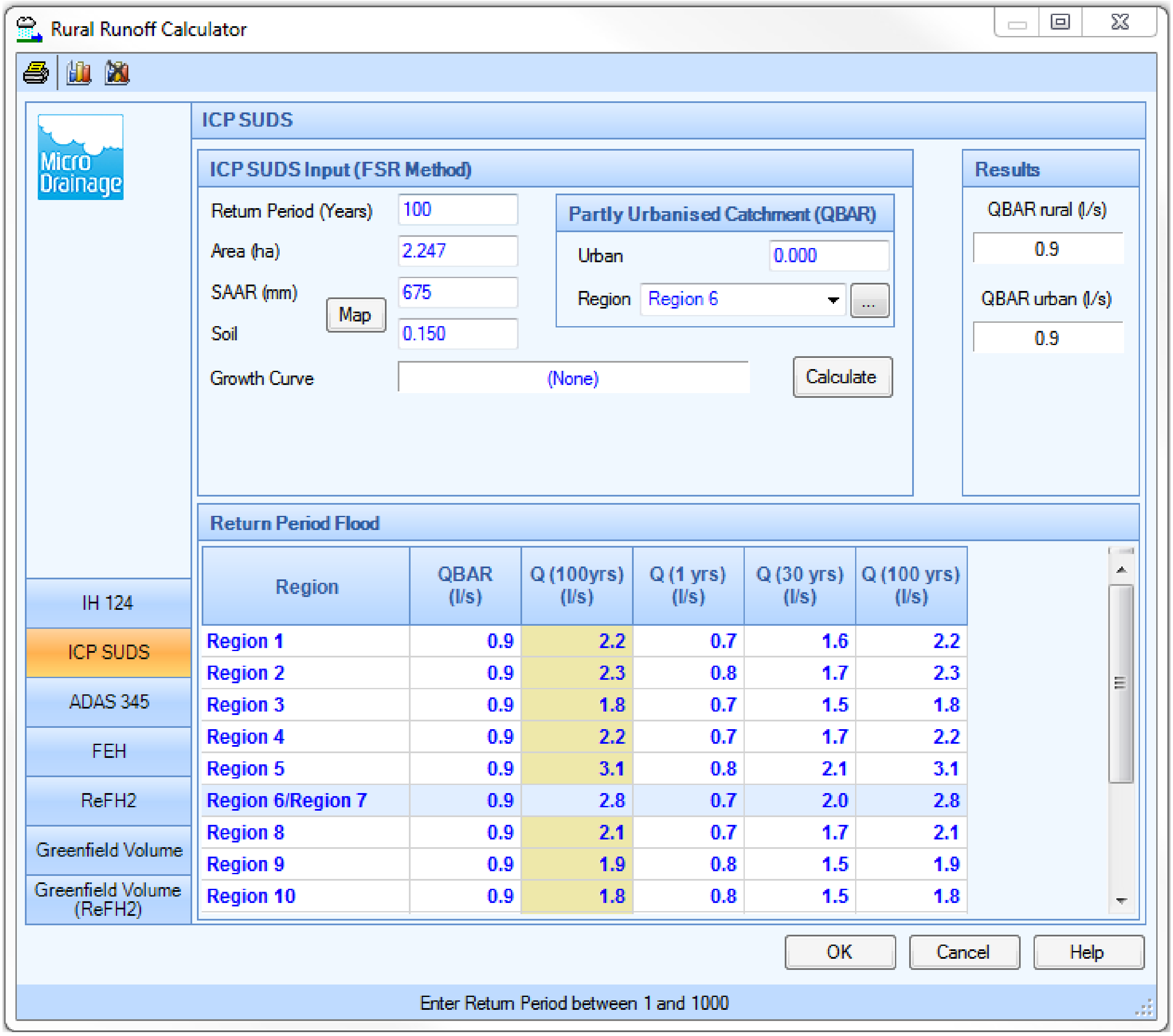
Appendix C contains ICP SuDS Estimate. These results are indicative of the existing greenfield runoff rates that must be adhered to throughout the 5 Year period. To comply with LLFA guidance these runoff rates must not be exceeded.

North Catchment:



Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	0.5	1.1	0.4	0.9	1.1
Region 2	0.5	1.2	0.4	0.9	1.2
Region 3	0.5	1.0	0.4	0.8	1.0
Region 4	0.5	1.2	0.4	0.9	1.2
Region 5	0.5	1.6	0.4	1.1	1.6
Region 6/Region 7	0.5	1.5	0.4	1.0	1.5
Region 8	0.5	1.1	0.4	0.9	1.1
Region 9	0.5	1.0	0.4	0.8	1.0
Region 10	0.5	1.0	0.4	0.8	1.0

South Catchment:



Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	0.9	2.2	0.7	1.6	2.2
Region 2	0.9	2.3	0.8	1.7	2.3
Region 3	0.9	1.8	0.7	1.5	1.8
Region 4	0.9	2.2	0.7	1.7	2.2
Region 5	0.9	3.1	0.8	2.1	3.1
Region 6/Region 7	0.9	2.8	0.7	2.0	2.8
Region 8	0.9	2.1	0.7	1.7	2.1
Region 9	0.9	1.9	0.8	1.5	1.9
Region 10	0.9	1.8	0.8	1.5	1.8

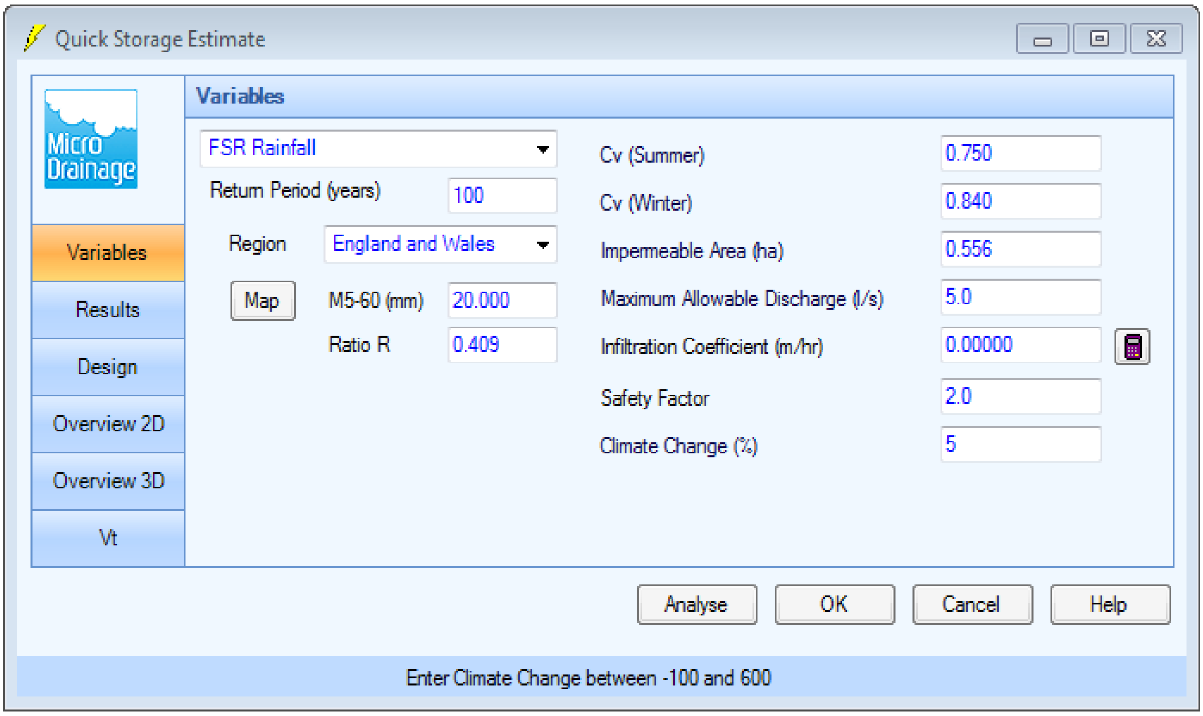
Appendix D. Surface Water Storage Estimates

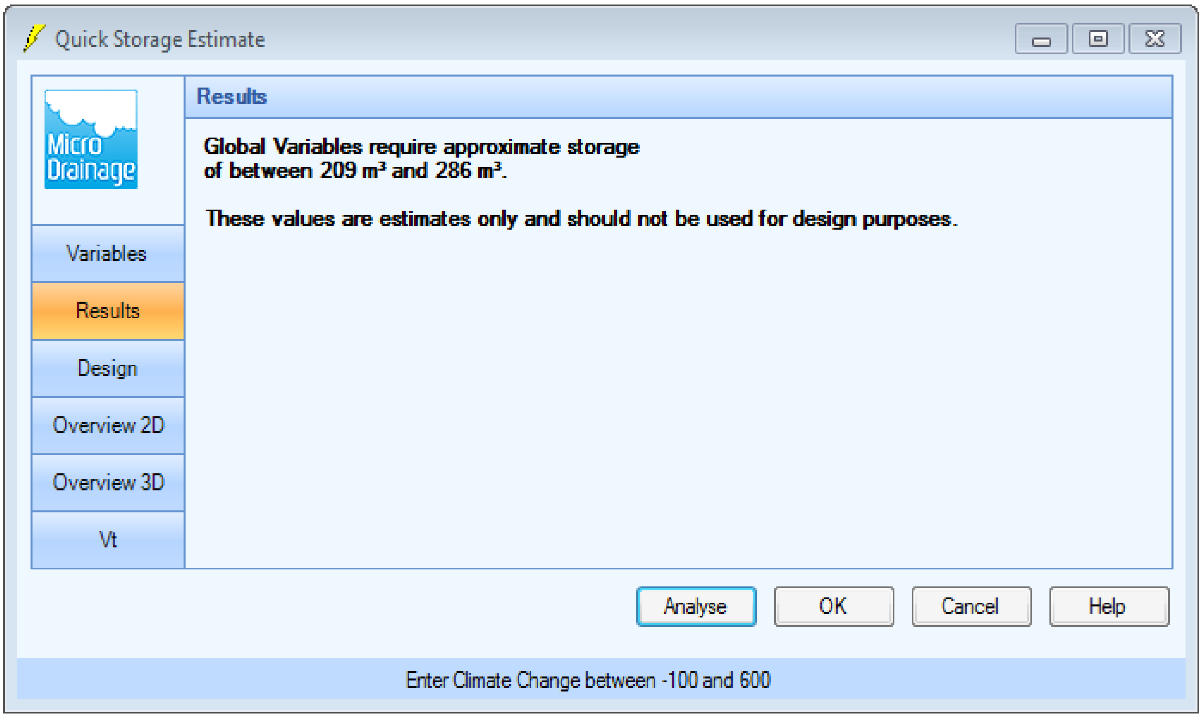
Appendix D contains the calculations performed using MicroDrainage Source Control 2018. The calculation produces the required volume of attenuation, in order to restrict the runoff from the site post construction, to the existing greenfield runoff rate including climate change.

North-West Detention Basin.

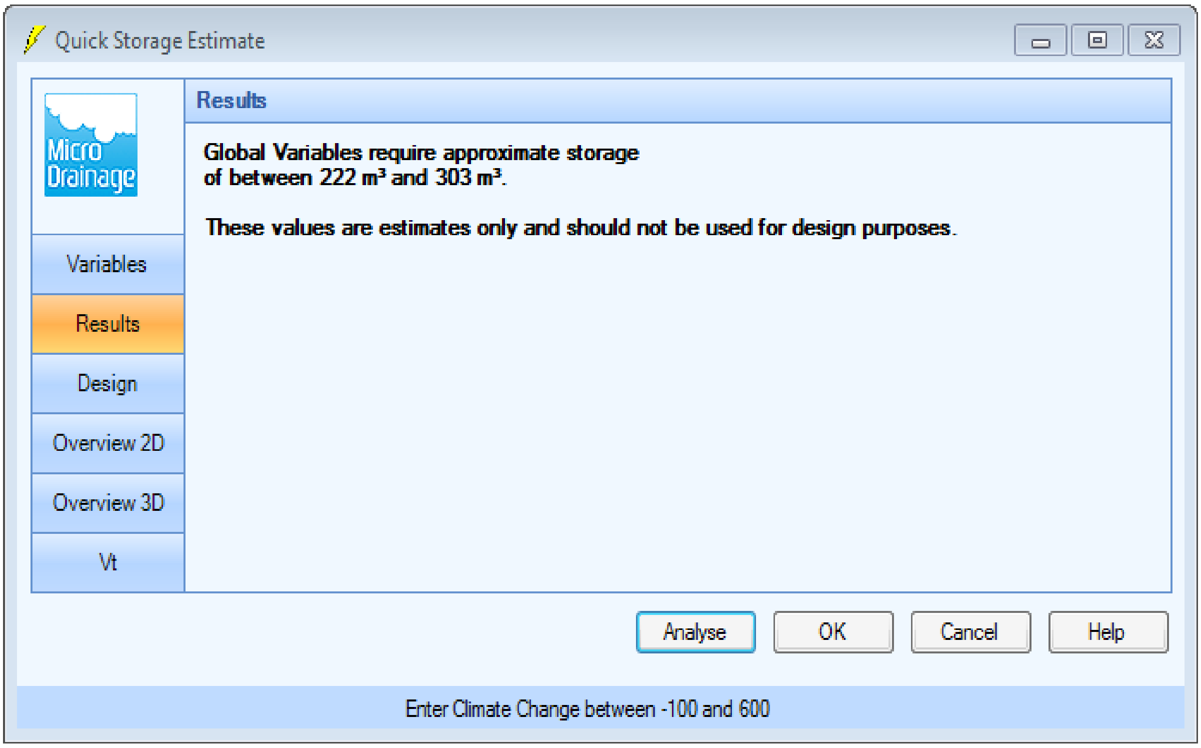
Catchments of Compound A1 Draining into the North-West Detention Basin	Area (ha)	Runoff Coefficient	Impermeable Area (ha)
Car park and area surrounding welfare facilities.	0.871	0.50	0.435
Undeveloped greenfield next to Bicester Road (west side).	0.225	0.15	0.0337
The welfare porta cabins.	0.0875	1.00	0.0875
Total	1.1835	0.469	**0.5562**

Calculation for the 5% CC:





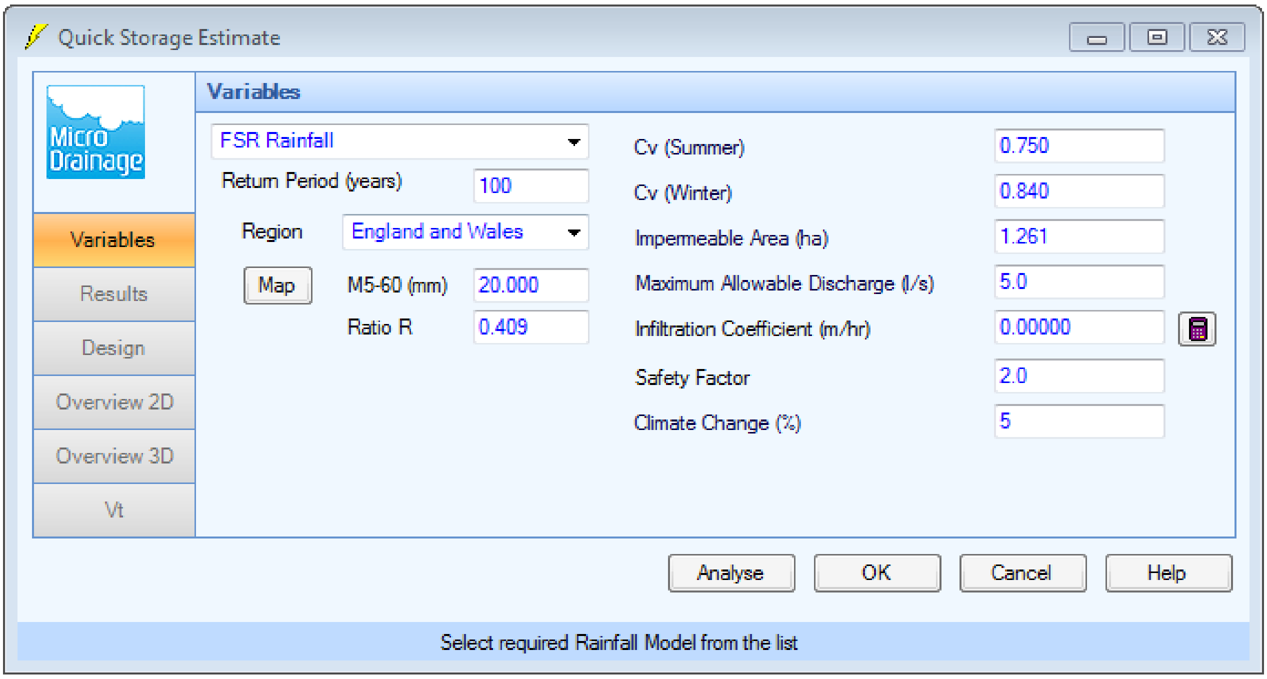
Calculation for the 10% CC:

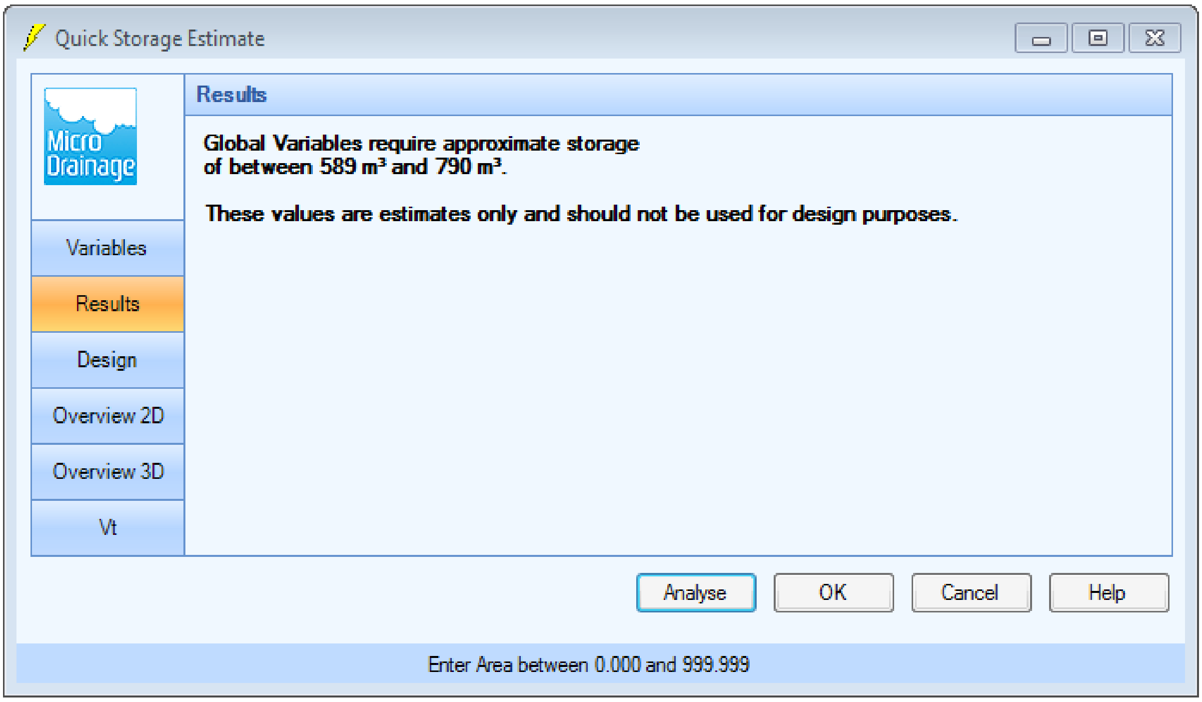


South-East Detention Basin 2:

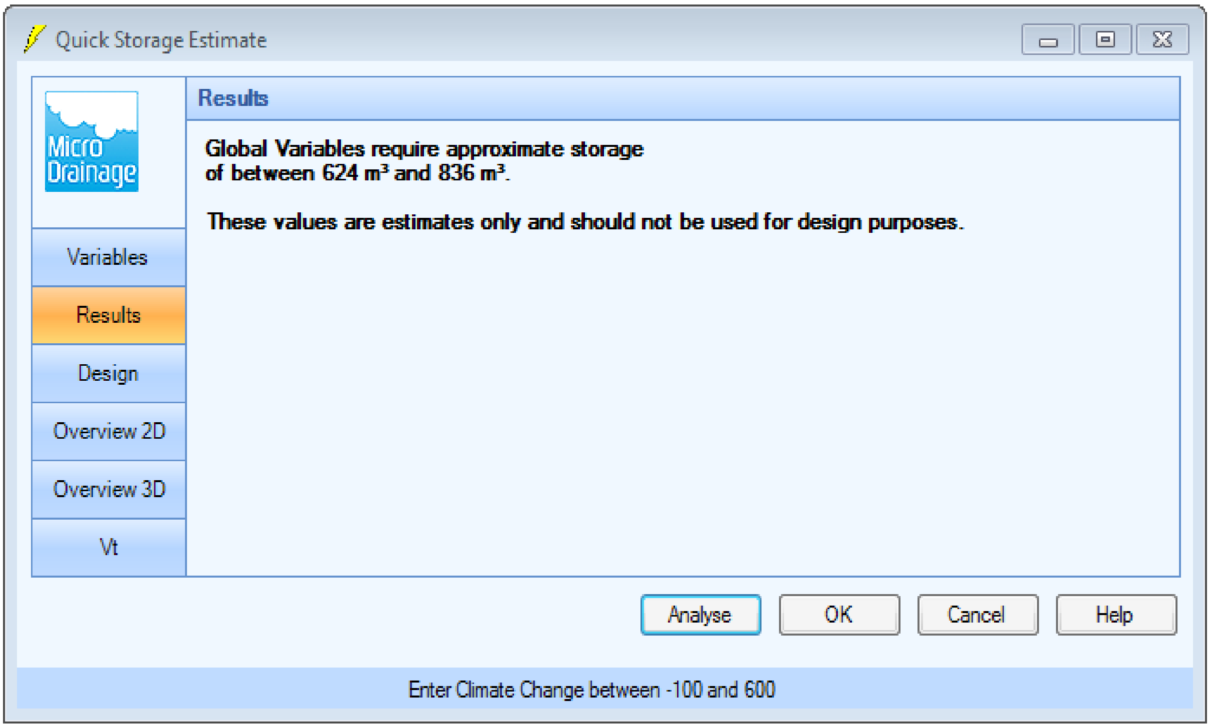
Catchments of Compound A1 Draining into the South-East Detention Basin	Area (ha)	Runoff Coefficient	Impermeable Area (ha)
Undeveloped greenfield next to Bicester Road and to the North of the OXD line.	0.2258	0.15	0.0338
The topsoil storage area.	0.51	0.40	0.204
Fuel Station	0.0765	1.00	0.0765
The laydown area.	0.778	0.50	0.389
Geobind treated material forming the road within the site.	0.657	0.85	0.558
Total	2.247	0.561	**1.2613**

Calculation for the 5% CC:





Calculation for the 10% CC



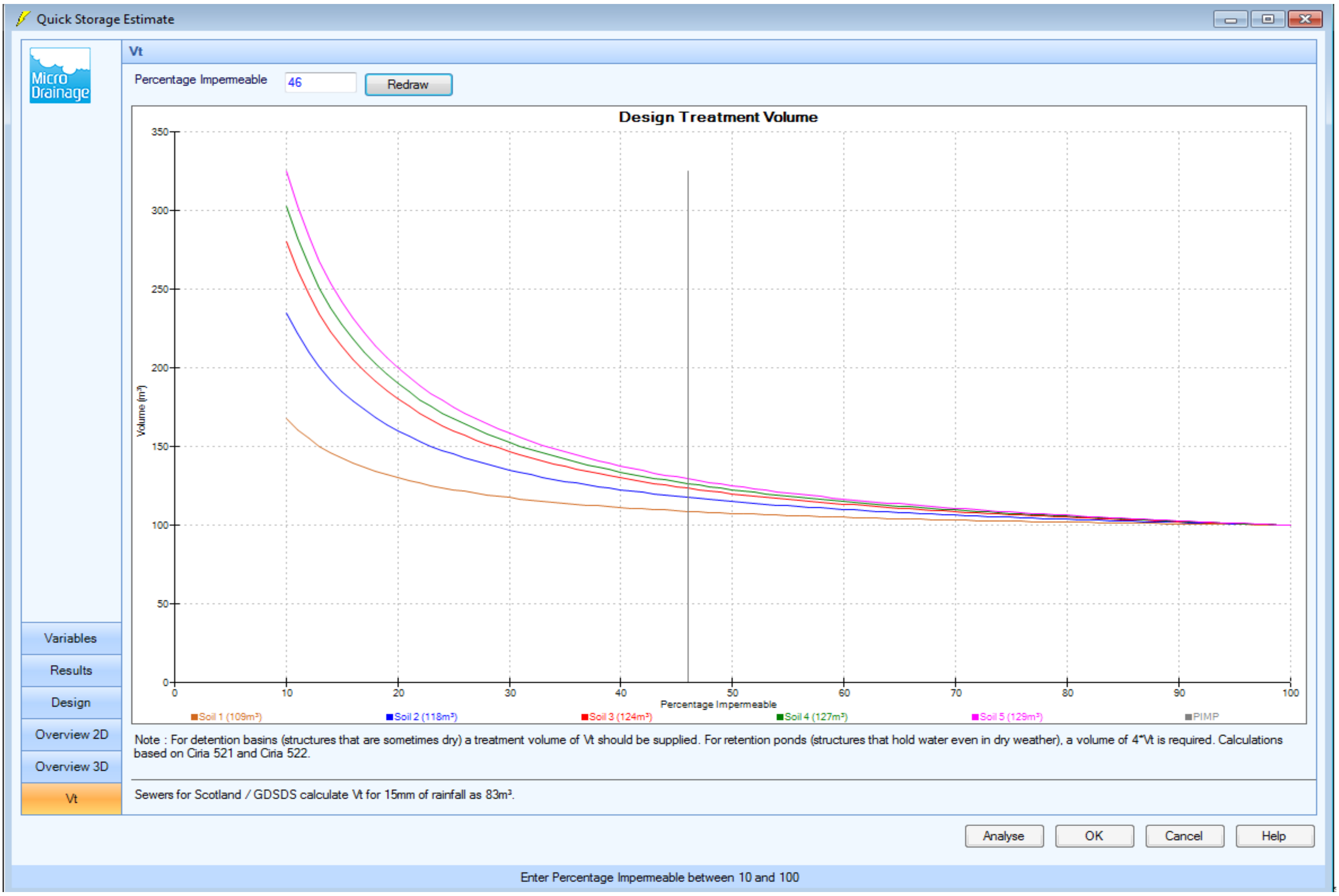
Compound A1 Increased Impermeable Area Calculation:

Catchments of Compound A1	Area (ha)	Runoff Coefficient	Impermeable Area (ha)
Car park and area surrounding welfare facilities.	0.871	0.50	0.435
Undeveloped greenfield area next to Bicester Road and to the North of the OXD line.	1.15	0.15	0.173
Topsoil storage area.	0.51	0.40	0.204
welfare porta cabins.	0.164	1.00	0.164
The laydown area.	0.778	0.50	0.389
Geobind treated material forming the road within the site.	0.657	0.85	0.558
Total	4.13	0.47	**1.923**

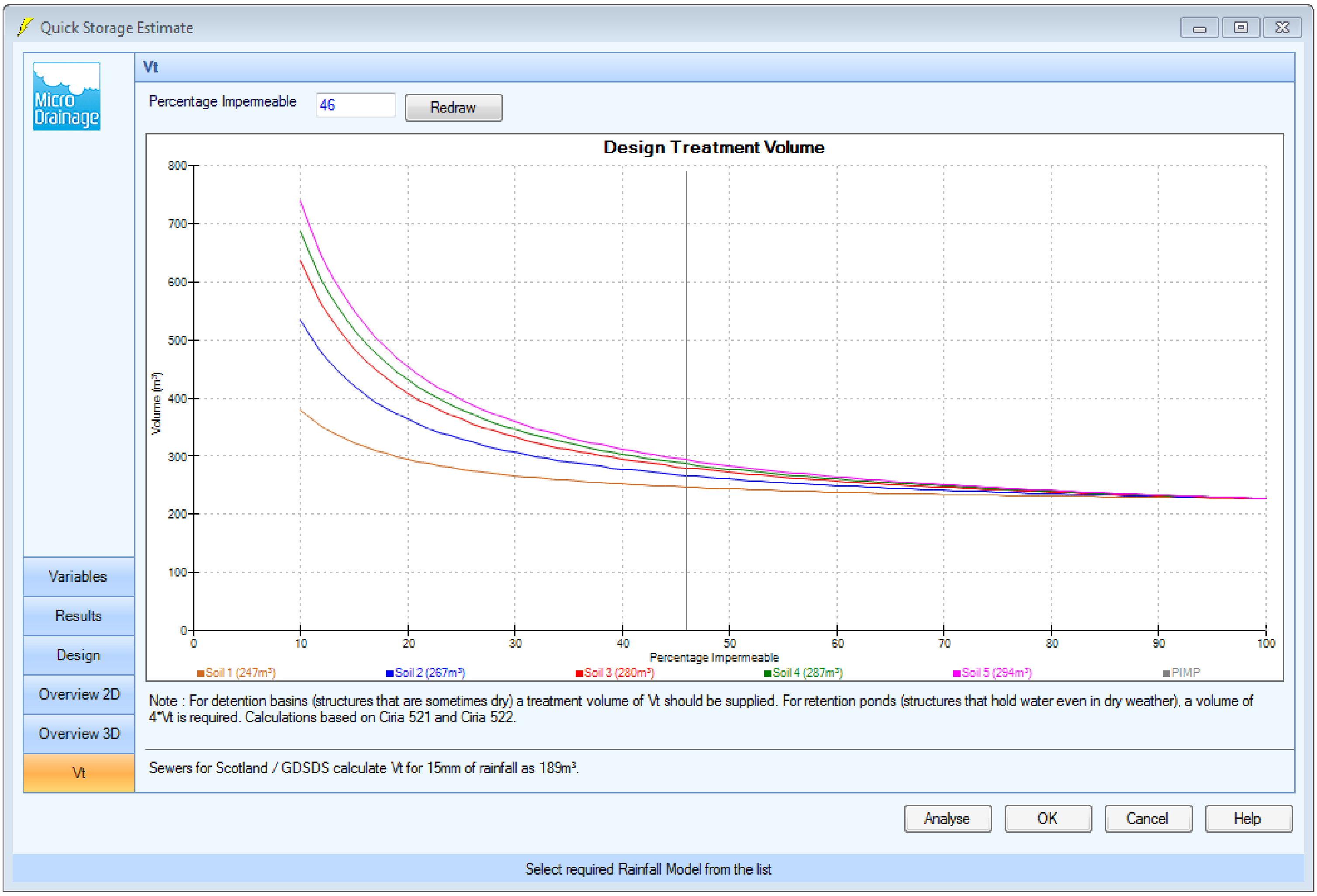
Appendix E. Surface Water Runoff Treatment Attenuation

Appendix E contains the calculations performed using MicroDrainage Source Control 2018. The calculation produces the required volume of attenuation, in order to treat the runoff before discharging into the receiving watercourse. The graph, below, gives a visual as to the size requirement dependant on the soil type and impermeable value.

Detention Basin 1 (North-West of the Site):



Detention Basin 2 (South-East of the Site):



Appendix F. Drainage Ditch Calculations

Appendix F contains the calculations performed using The Rational Method and Open Channel Software. The rational method calculation produces flow rates (including climate change), for the largest area of runoff into a drainage ditch on the compound. This is then input into Open Channel (overleaf) which informs the sizing of the largest drainage ditch required.

Catchments of Compound A1 Draining into the South-East Detention Basin	Area (ha)	Runoff Coefficient	Impermeable Area (ha)
Undeveloped greenfield next to Bicester Road and to the North of the OXD line.	0.226	0.15	0.034
Topsoil storage area.	0.51	0.40	0.204
Fuel Station	0.077	1.00	0.077
Material Laydown area.	0.778	0.50	0.389
Soil Stabilisation treated material, forming the road within the site.	0.53	0.85	0.45
Total	2.247	0.561	**1.153**

Rational Method: Q = CiA

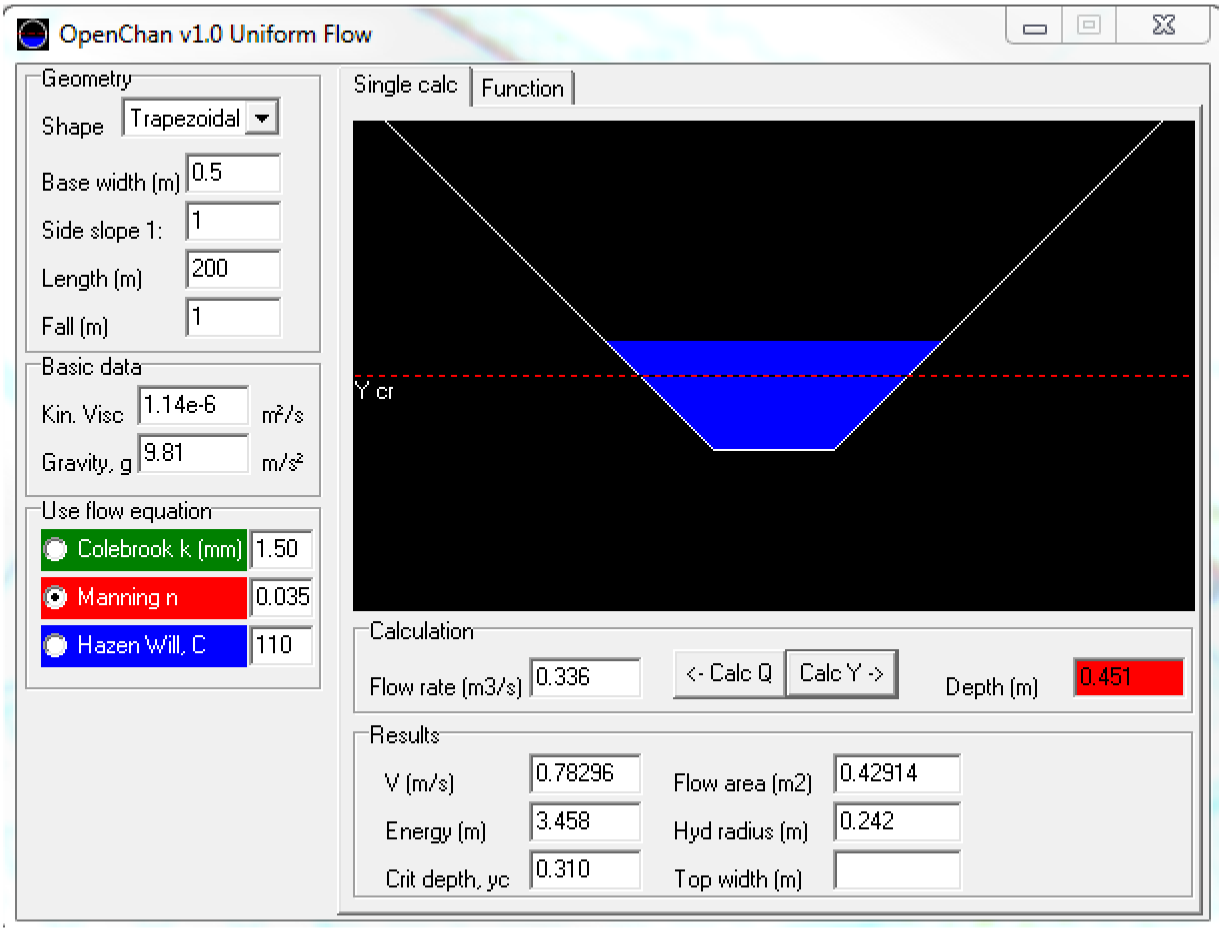
1 in 100 Year rainfall intensity = 100mm/h

C = 2.78

The equation for runoff: $Q = 2.78\ X\ 100\ X\ 1.153 = 320l/s$

Including Central value Climate Change +5%: $Q = 320\ X\ 1.05 = 336l/s$

Sensitivity check for Climate Change, Upper End value +10%: $Q = 336\ X\ 1.10 = 352l/s$

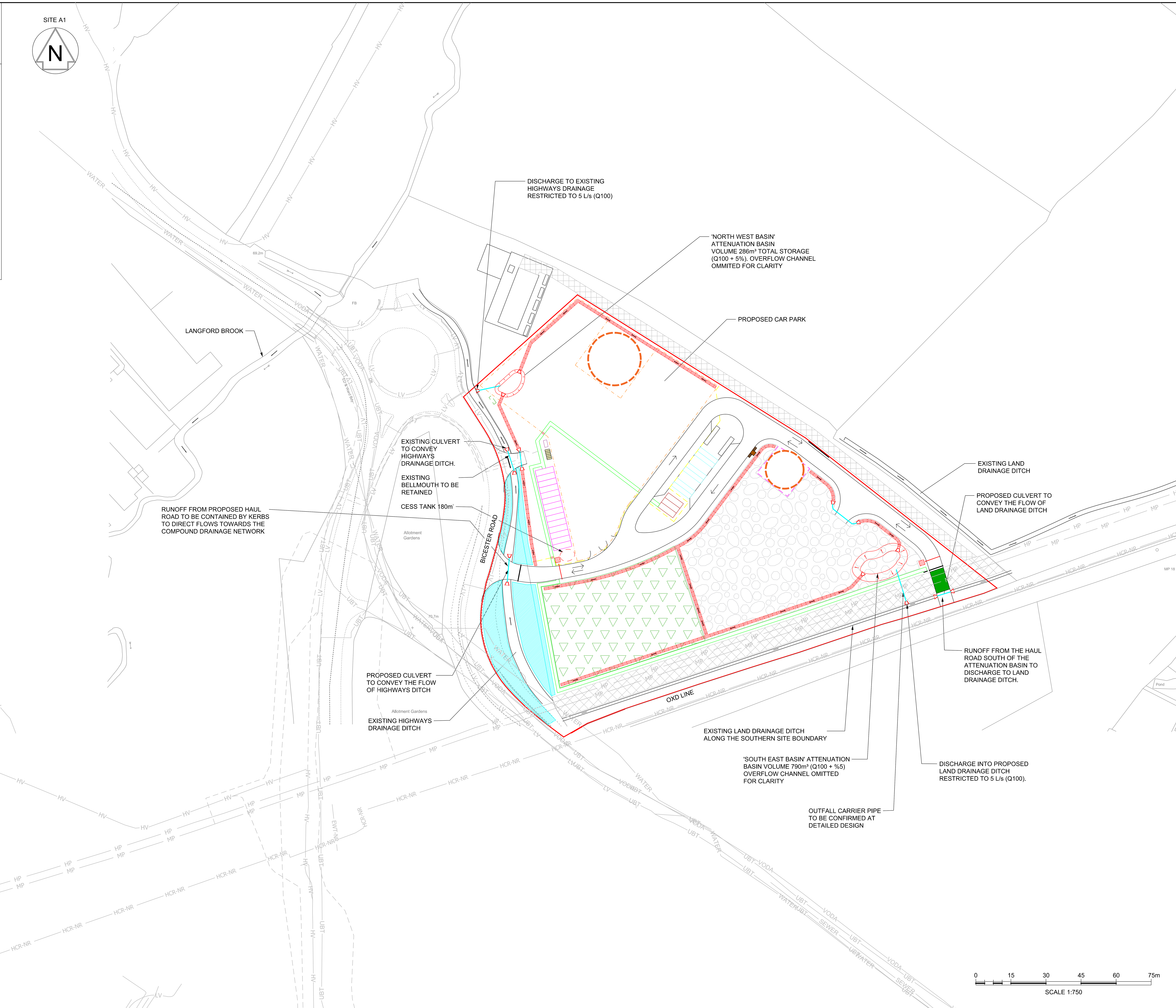

OpenChan v1.0 Uniform Flow
Geometry
Shape
Trapezoidal
Base width (m)
0.5
Side slope 1:
1
Length (m)
200
Fall (m)
1
Basic data
Kin. Visc
1.14e-6
m²/s
Gravity, g
9.81
m/s²
Use flow equation
Colebrook k (mm)
1.50
Manning n
0.035
Hazen Will, C
110
Single calc
Function
Y cr
Calculation
Flow rate (m3/s)
0.336
<- Calc Q
Calc Y ->
Depth (m)
0.451
Results
V (m/s)
0.78296
Flow area (m2)
0.42914
Energy (m)
3.458
Hyd radius (m)
0.242
Crit depth, yc
0.310
Top width (m)

Appendix G. Drainage Strategy Drawing

Appendix G contains drawing of the indicative drainage layout for Compound A1. This drawing includes the location of the detention basins and drainage ditches.

Revision & Version P01.01.01

Drawing Number 133735_RW-EWR-XX-A1-DR-DH-001100



NOTES:

1. FOR COMPOUND DETAILS REFER TO DRAWING: 133735_2B-EWR-OXD-XX-DR-L-019011
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAINAGE STRATEGY 133735-EWR-REP-EDR-000022
3. EXISTING RUNOFF REGIME TO BE MAINTAINED

KEY:

- HP — HIGH PRESSURE GAS MAIN
- HCR — NR HISTORIC CABLE ROUTE
- LV — ELEC LOW VOLTAGE U/GROUND
- MP — MEDIUM PRESSURE GAS MAIN
- UBT — BT UNDERGROUND CABLE
- VODA — TELECOMS VODAPHONE
- WATER — THAMES WATER SUPPLY
- EXISTING WATERCOURSE
- PROPOSED DRAINAGE DITCH
- PROPOSED HEADWALL
- CARRIER PIPE
- LAYDOWN AREA
- TOPSOIL STORAGE AREA
- VEGETATION TO BE REMOVED
- COMPOUND APPLICATION BOUNDARY
- TREE PROTECTION ZONE
- UTILITIES EXCLUSION ZONE
- NO PROPOSED CONSTRUCTION ACTIVITY (SEENOTE 3)

Rev	Date	Description of Revisions	Dsnd	Chkd	Appr
P01	24/04/19	FOR PLANNING	---	---	---

Status: Unassigned — Suitability: S0

EWR Alliance
Connecting People

Project: East West Rail (Western Section) Phase 2

Drawing Title: COMPOUND A1 PLANNING APPLICATION DRAINAGE PLAN

Designed	---	Signed	---	Date	---
Drawn	---	Signed	N. Hayes	Date	---
Checked	---	Signed	---	Date	---
Approved	---	Signed	---	Date	---

Scale(s): 1:750 — ELR - Project Chainage (Miles Yards): XX - A1

Design Package Risk Classification: Normal — Sheet: 0 of 0

Alternative Reference — Revision: P01

Drawing Number: 133735_RW-EWR-XX-A1-DR-DH-001100

Sheet Size A1 594 x 841

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