

ENVIRONMENT

Tilstone Industrial Limited
Gellings Road
Knowsley
Sustainable Drainage Statement

ENVIRONMENT

Tilstone Industrial Limited
Gellings Road
Knowsley
Sustainable Drainage Statement

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1. INTRODUCTION

- 1.1 A Sustainable Drainage Statement (SDS) sets out the principles of drainage design for a development and summarises the reasoning behind the chosen design. This includes consideration of national and local guidance, justification of specific flow rates, volumes of attenuated storage, and the appropriate level of treatment to be provided to surface water runoff.
- 1.2 This SDS has been produced by BWB Consulting on behalf of Tilstone Industrial Limited in respect of a site, comprising two parcels of land, located off Gellings Road, Knowsley. The development is understood to involve the construction of commercial units, associated parking, service yards and a Petrol Filling Station (PFS) within an existing industrial area off Gellings Road. The proposed development layout is included as **Appendix 1**.
- 1.3 A Flood Risk Assessment has been developed for the site, reference [GRK-BWB-ZZ-XX-RP-YE-0001_FRA] and this Sustainable Drainage Statement accompanies this overarching document.
- 1.4 This SDS is intended to support an outline planning application and as such the level of detail included is commensurate and subject to the nature of the proposals.
- 1.5 The location of the site is illustrated within **Figure 1.1**, with contextual information provided within **Table 1.1**.

Table 1.1: Site Details

Site Name	Gellings Road
Location	Knowsley
NGR (approx.)	342135, 396375
Application Site Area (ha)	1.48
Development Area (ha)	1.06
Development Type	Commercial
Lead Local Flood Authority	Knowsley Council
Local Planning Authority	Knowsley Council
Sewerage Undertaker	United Utilities

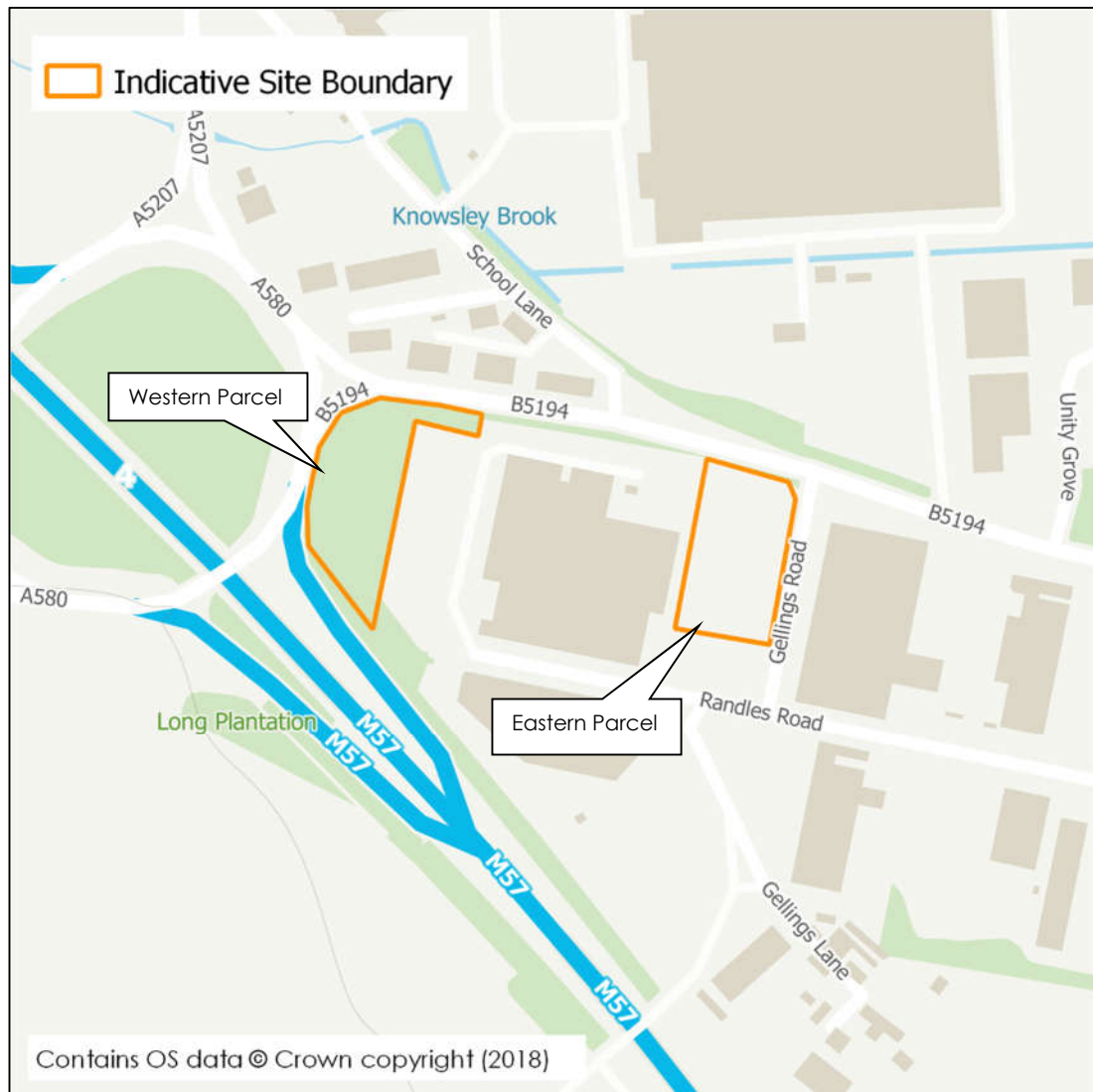


Figure 1.1: Site Location

Sustainable Drainage Guidance

- 1.6 Sustainable Drainage Systems (SuDS) aim to mimic the natural runoff regime. A Sustainable Drainage Strategy (SDS), with appropriate SuDS mechanisms must be included with all planning applications.
- 1.7 Knowsley Council SuDS Guidance for Developers¹ and the Non-Statutory Technical Standards for Sustainable Drainage Systems² as published by DEFRA have been utilised to inform this strategy.
- 1.8 The SuDS guidance advises that consultation with United Utilities is sought to determine any discharge restrictions relating to foul water discharge.

¹ SuDS Guidance for Developers, Knowsley Council (August 2016)

² 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems

2. EXISTING CONDITIONS

- 2.1 The study site comprises two parcels of land either side of an existing removals and storage facility located within an industrial area off the B5194 in Knowsley. The development sites are bound by Randles Road to the south, Gellings Road to the east and the B5194 to the north and west. Commercial land surrounds the site to the north and east, and undeveloped land exists to the west and south.
- 2.2 Currently, access to both parcels can be gained via Randles Road.
- 2.3 The M57 is located south of the site, with Junction 4 located immediately to the west. The site is located approximately 1.1km west of Knowsley Village, 2.5km south of Kirkby town centre, and 9.0km north of Liverpool City Centre.
- 2.4 Review of the topographical survey, included as **Appendix 2**, shows the site to fall generally from north to south. The western parcel has a high point of 24.09m AOD in the north-eastern corner and a low point of 20.89m AOD in the south-western corner. The eastern parcel has a high point of 25.17m AOD in the north-eastern corner and a low point of 22.65m AOD along the western boundary of the site. The topographical survey shows there to be no existing drainage features within the site boundary.
- 2.5 Figure 2.1 and **Figure 2.2** show the current condition of the sites. The western parcel of land is densely vegetated and slopes towards the west. The eastern parcel has a mix of open spaces and vegetated areas and slopes gradually from east to west.
- 2.6 The British Geological Survey (BGS) mapping identifies the underlying geology of the site to be Sandstone. A BRE 365 report undertaken by BWB Consulting is included as **Appendix 3** and confirms the underlying bedrock.
- 2.7 The site is understood to be greenfield. The BRE 365 report and BGS mapping suggests that runoff presently infiltrates into the ground.



Figure 2.1: Western Parcel Facing East



Figure 2.2: Eastern Parcel Facing East

Existing Runoff Rates

- 2.8 The parcel to the west is approximately 0.75ha with an approximate developable area of 0.45ha. The parcel to the east is 0.73ha, with a developable area of 0.61ha. Each parcel has its own discrete proposed drainage strategy.
- 2.9 An assessment of the equivalent greenfield surface water runoff rates from the proposed development areas has been undertaken and included within **Appendix 4**, these are also summarised within **Table 2.1**.
- 2.10 The runoff rates have been estimated using the IH124 method, with appropriate prorated adjustments for a site of less than 50ha, as recommended in Interim Code of Practice for Sustainable Drainage³. This was undertaken within Micro Drainage, which makes the necessary adjustments for small sites automatically.

Table 2.1: Existing Greenfield Runoff Rates from the Site

Return Period (Yrs.)	Western Parcel Runoff Rate (l/s)	Eastern Parcel Runoff Rates (l/s)
1	0.9	1.3
Mean Annual Flow Rate (QBAR)	1.1	1.5
30	1.8	2.6
100	2.2	3.2

Existing Runoff Volume

- 2.11 An assessment of the existing surface water runoff volumes from the area proposed for development has been made for a 1 in 100-year, 6-hour storm.
- 2.12 As the existing sites are permeable, the runoff volume has been estimated using the Source Control module within Micro Drainage to be **85.0m³** for the western parcel and **124.5m³** for the eastern parcel, results are included within **Appendix 4**.

³ The National SUDS Working Group (2004), Interim Code of Practice for Sustainable Drainage

3. SURFACE WATER DRAINAGE STRATEGY

Drainage Hierarchy

- 3.1 The Planning Policy Guidance⁴ and the SuDS Manual⁵ identify that surface water runoff from a development should be disposed of as high up the following hierarchy as reasonably practicable:
- i. into the ground (infiltration);
 - ii. to a surface water body;
 - iii. to a surface water sewer, highway drain, or another drainage system;
 - iv. to a combined sewer.
- 3.2 The aim of this approach is to manage surface water runoff close to where it falls and mimic natural drainage as closely as possible.

Infiltration Test Results

- 3.3 Infiltration tests were conducted in February 2019 by BWB Consulting. A total of three tests were carried out, one within the southern portion of the western parcel and two within the eastern parcel. The BRE 365 report is included as **Appendix 3** and details the testing locations.
- 3.4 Test SA01 was terminated at 2.50m bgl and encountered groundwater at 2.40m bgl. The test identified the geology at this location to be primarily Shirley Hill Sand Formation – sand, coarse gravel, clay. The infiltration rate was recorded to be between 0.289-0.56m/hr.
- 3.5 Test SA02 was terminated at 2.50m bgl and did not encounter groundwater. The test identified the geology at this location to be primarily Shirley Hill Sand Formation – sand, coarse gravel, clay, silt. The infiltration rate was identified to be between 0.031-0.043m/hr.
- 3.6 Test SA03 was terminated at 2.55m bgl and encountered groundwater at 2.45m bgl. The test identified the geology at this location to be primarily Shirley Hill Sand Formation – sand, clay, silt, peat. The infiltration rate was identified to be between 0.031-0.054m/hr.
- 3.7 The infiltration tests confirm that discharge of surface water from the development can be achieved via infiltration.

⁴ Planning Practice Guidance, <http://planningguidance.planningportal.gov.uk/>.

⁵ The SuDS Manual (C753). CIRIA 2015.

Sustainable Drainage Systems

- 3.8 An above ground infiltration basin has been included in the western parcel to provide ecological and environmental enhancement as well as attenuation, however due to the limited space within the eastern parcel, below ground infiltration features are necessary. Furthermore, proposed infiltration tanks have been positioned to avoid heavy or active traffic e.g. HGVs, therefore, infiltration tanks are positioned under the associated carpark rather than the HGV loading bays.
- 3.9 Proposed within the western parcel is a Petrol Fuelling Station, the infiltration basin has been positioned within the south of the parcel in lower topographical area, this allows an oil separator to be installed between the fuelling forecourt and the basin.
- 3.10 Within this development, the following features and treatment stages are proposed:
- Infiltration Basin
 - Oil Separator
 - Infiltration Tanks
- 3.11 Additional ancillary SuDS features could be included within the further detailed design.
- 3.12 An indicative surface and foul water layout for the development is shown on BWB Dwg No. GRK-BWB-ZZ-XX-RP-CD-0001_SDS, included as **Appendix 5**.

Drainage Strategy

- 3.13 Due to the spatial constraints the eastern parcel has been further divided into two drainage catchments. In total, three drainage catchments are considered and shown in **Figure 3.1**.
- 3.14 Infiltration testing was undertaken for each of the three catchments, the results of which are included as **Appendix 3** and summarised in **Table 3.1**.

Table 3.1: Soakaway Data and Infiltration Basin/Tank Characteristics

Test Location	Infiltration Rate (m/hr)
A	0.289
B	0.031
C	0.031

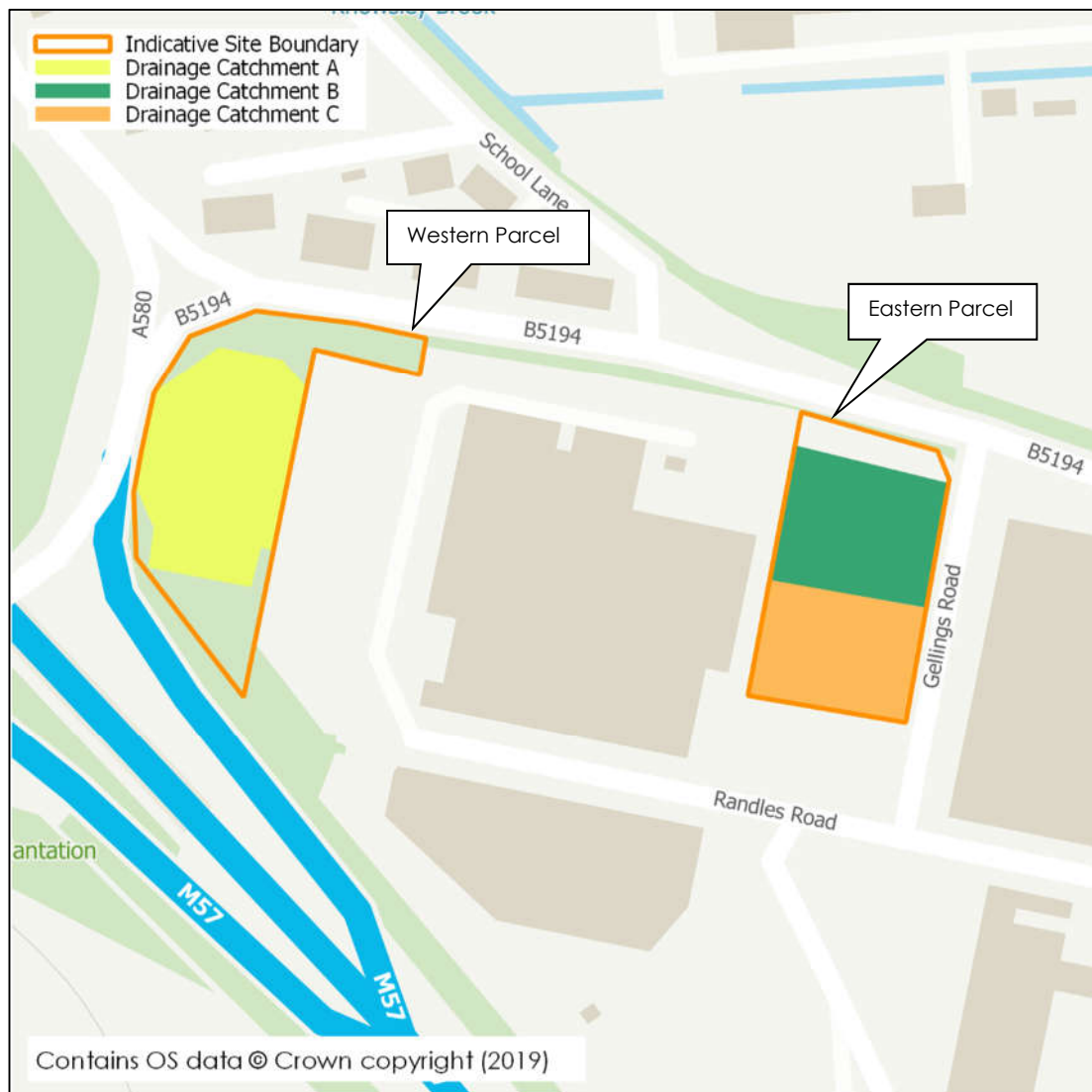


Figure 3.1: Drainage Catchments Within the Proposed Development

- 3.15 For the purpose of this outline assessment, it has been assumed that the basin and tanks will accommodate all of the necessary storage, but it may be possible to redistribute a portion of the storage within other drainage components during the detailed design of the development (e.g.: in the pipe network, swales, filter drains, etc).
- 3.16 A simulation has been run using Micro Drainage 'Source Control' to identify the necessary storage provision. The volume of storage required for the development has been calculated for storm events up to the 100 year + climate change events. The calculations included 20% for climate change, rather than 40% due to the development being commercial not residential. The results are discussed below and are included as **Appendix 6**.

Western Parcel

- 3.17 An infiltration basin has been designed for the western parcel of land (Catchment A), to be positioned within the southern portion of the site where topography is lowest. The total contributing area to Catchment A is 0.45ha and an attenuation volume of 170m³ has been provided to account for all storms up to the 1 in 100-year +20% climate change event.
- 3.18 The infiltration basin has been designed to be 1m deep with a 300mm freeboard. A distance of 1m between the invert level of the basin and the recorded groundwater level (2.40mbgl) has been allowed, as per the SuDS Manual guidance⁶.

Eastern Parcel

- 3.19 The total contributing area of the eastern parcel is 0.61ha, the parcel has been divided into two drainage catchments and therefore, two infiltration tanks have been proposed beneath the carparks within each catchment to avoid the loading bays and HGV turning circles.
- 3.20 The total contributing area of catchment B is 0.38ha and an attenuation volume of 240m³ has been provided to account for all storms up to the 1 in 100-year +20% climate change.
- 3.21 The total contributing area of catchment C is 0.23ha and an attenuation volume of 85m³ has been provided to account for all storms up to the 1 in 100-year +20% climate change.
- 3.22 The infiltration tanks have been designed with 0.9m of cover, a tank depth of 0.7m and a distance of 1m between the invert level and the recorded groundwater level (2.45mbgl).

Residual Risk and Designing for Exceedance

- 3.23 It is recommended that the final layout uses the proposed road infrastructure to provide drainage exceedance (overland flood flow) routes through the development and towards the attenuation features for events in excess of the capacity of the drainage system.
- 3.24 In the event that the capacity of the attenuation is exceeded, flood water will pool within the car parking areas and remain within the site.
- 3.25 Appropriate vegetation (grasses and shrubs) should be planted within the infiltration basin to enable stability of slope. However, vegetation should not impede maintenance.

⁶ The SuDS Manual (C753). CIRIA 2015.

4. FOUL WATER DRAINAGE

- 4.1 Consultation with the local sewerage undertaker, United Utilities, is included as **Appendix 7**, and confirms there is sufficient capacity in the local foul sewer network and a connection at an unrestricted rate will be acceptable.
- 4.2 The western parcel can connect to the foul sewer within Randles Road (MH1203). The sewer at this location is 225mm in diameter. At the time of writing, cover and invert levels of the sewers were unknown.
- 4.3 The eastern parcel will most likely connect to the foul sewer in Gellings Road (MH2304). The sewer at this location is 300mm in diameter.
- 4.4 It is proposed to drain used water from the development separately to surface water.

5. MAINTENANCE

- 5.1 Requirements for ongoing maintenance of the drainage network should form part of an Operation and Maintenance manual for the site and should be undertaken by the site management. Any specialist or proprietary products that are specified at detailed design would have a manufacturer specific maintenance regime which should be included within the document.
- 5.2 All drainage features should be located in open areas which are readily accessible.
- 5.3 Vegetation/grass within the infiltration basin should be maintained appropriately to allow establishment and promote habitat formation, without impeding the operation of the inlet structure.

6. SUMMARY

- 6.1 This statement and supporting appendices demonstrate that the drainage design for the development will comply with the relevant local and national standards, specifically the hierarchy of discharge, runoff rate and volume criterion.
- 6.2 This SDS is intended to support an outline planning application and as such the level of detail included is commensurate and subject to the nature of the proposals.

Table 6.1: Sustainable Drainage Statement Summary

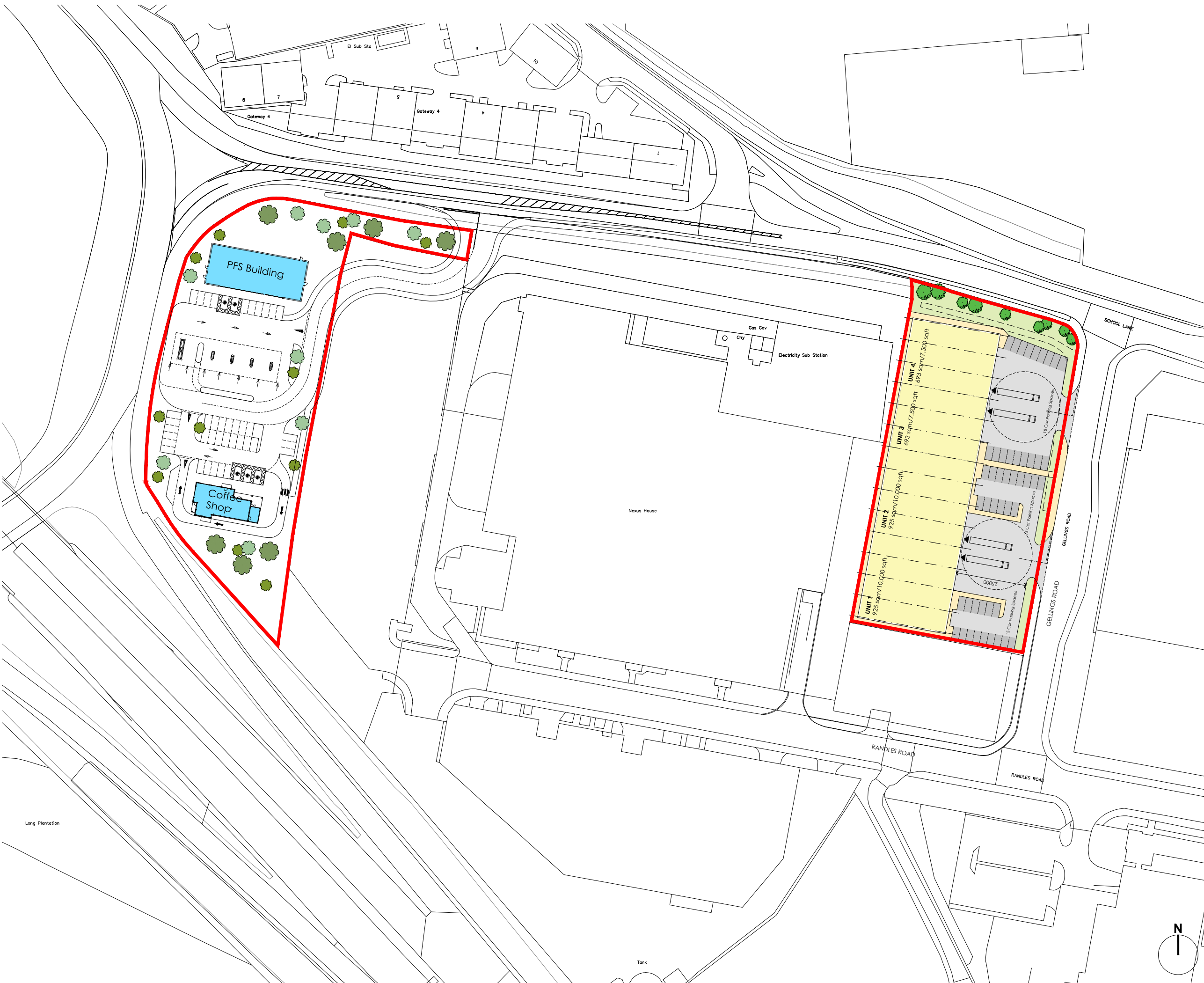
	Existing Site		Proposed Development	
Site Area (Ha)	1.48			
Impermeable Area (Ha)	0		1.06	
Outfall Location	Infiltration		Infiltration	
Infiltration Rate Range	0.031 - 0.289 m/s		0.031 - 0.289 m/s	
Total Runoff Volume (100yr RP 6-hour Storm)	West = 85.0m³	East = 124.5m³	West = 112.90 m³	East = 231.30 m³
Volume Control	-		N/A	
Proposed Storage Volume	-		West = 170m³	East = 325 m³
Interception Volume	-		West = 13.3m³	East = 22.6m³
Flow Control Type	-		None	
SuDS Features	-		Infiltration Basin Infiltration Tank Oil Separator	
Maintenance Responsibility	-		Management Company	

- 6.3 It is envisaged that the final drainage strategy will be determined during the detailed design stage, as the development layout is finalised.
- 6.4 The proposed development is located within an existing commercial development off the B5194, Knowsley. The site geology has been identified as permeable and suitable for infiltration.
- 6.5 Surface water runoff from the eastern parcel will infiltrate via tanks positioned in the car parking areas and surface water runoff from the western parcel will infiltrate via basin.

- 6.6 Three attenuation features have been designed for a 1 in 100-year +20% climate change storm event and have been positioned to avoid surface water pollution or damage of the tanks from heavy vehicles.

APPENDICES

APPENDIX 1: Proposed Layout



General Notes

All site dimensions shall be verified by the Contractor on site prior to commencing any works.

Do not scale from this drawing.

Only work to written dimensions.

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Revision A HIGHWAY AMENDMENTS 20.07.2018 LL

Scale 1:1250@A3

Status SKETCH

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Date 09.07.18

Client
Tilstone

Project
Gellings Road, Knowsley

Drawing Description
Proposed Site Plan

Drawing No. PR1118_SK05

Rev. A

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APPENDIX 2: Topographical Survey

APPENDIX 3: BRE 365 Report

Tilstone Industrial Ltd via
Savills UK Ltd,
Belvedere,
12 Booth St,
Manchester,
M2 4AW

Our Ref: RPD/PT/MCA2031
Contact: Patrick Taylor
Direct Dial: 07900 165 561

Date: 26th February 2019

Dear sir/madam

BRE3 65 Soakaway Testing – Gellings Road, Knowsley

Introduction and Objectives

BWB Consulting Ltd (BWB) was instructed by Tilstone Industrial Ltd via Savills UK Ltd to undertake BRE 365 soakaway testing in two areas along Gellings Road, Knowsley to inform potential soakaway drainage design for two new developments. The works were carried out in accordance with email correspondence between

Project Background

The project is understood to involve the proposed development of two commercial units with associated park and service yards, within an existing industrial area.

Scope of works

BWB undertook the intrusive ground investigation on 13th and 14th February 2019. The works were in accordance with techniques outlined in BS 5930:2015, BS EN ISO 1997:2004 Part 1, and BRE365 and under the full-time supervision of a suitably qualified Geo-Environmental Engineer from BWB. The ground investigation comprised the following works:

- Clearance of investigation locations by a specialist buried services tracing company;
- Collection of coordinates and elevations of exploratory hole locations;
- The advancement of three machine excavated trial pits (SA01 to SA03 inclusive) to a maximum depth of 2.50m below ground level (bgl) and subsequent use as BRE 365 Soakaway tests; and
- Logging of the arisings by a suitably qualified engineer.

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An exploratory hole location plan is presented as **Drawing 1** and exploratory hole records produced by a BWB engineer are presented as **Appendix 1**.

Ground Conditions Encountered

Made Ground

Made Ground was identified at one location (SA01) and proven to a depth of 0.40m bgl. The material encountered comprised a dark greyish brown silty organic sand with frequent rootlets. Occasional inclusions of plastic, metal cans, ceramic fragments and timber were noted.

Topsoil

Topsoil was identified at two locations (SA02 and SA03) and proven to a depth of 0.35m bgl. The material encountered comprised a dark greyish brown slightly silty organic slightly gravelly sand with frequent rootlets. Gravels were identified as medium sub-rounded quartzite.

Shirdley Hill Sand Formation

The Shirdley Hill Sand Formation (SHSF) was encountered at all three locations proven to depths of 2.35mbgl within SA02, with the base of the stratum not proven in SA01 and SA03. The material encountered varied and comprised either a yellowish-brown sand, a dark orangish brown slightly clayey sand, or at greater depths a grey mottled orangish brown, slightly gravelly, clayey sand with occasional bands of sandy clay.

Gravel was encountered as fine to coarse sub-angular sandstone.

A band of dark brown and black amorphous peat was identified at all three locations within the yellowish-brown sand at varying depths, from 0.75mbgl to 1.60mbgl and varying in thicknesses from 0.15m to 0.40m.

Chester Formation

The Chester Formation was encountered at one location (SA02) from 2.35mbgl with the base of the stratum not proven. The material encountered comprised an extremely weathered sandstone arising as a light orange mottled white gravelly sand. Gravel was medium and coarse sub-angular moderately strong sandstone.

Excavation Stability

SA02 exhibited good stability throughout excavation, however, a minor collapse was noted below 2.00mbgl and 2.20mbgl within SA01 and SA03 respectively.

Contamination Observations

No visual or olfactory evidence of contamination was identified during the ground investigation.

Groundwater

Groundwater was encountered at two of the three locations (SA01 and SA03), with damp arisings noted at 2.00mbgl and 2.40mbgl respectively. A slight seepage was identified at both locations at 2.40mbgl and 2.45mbgl.

BRE365 Soakaway Assessment

Soakaway testing has been carried out in accordance with BRE365. The invert level targeted for the works was 2.5mbgl. Therefore, both the SHSF and Chester Formation have been assessed for soakaway design. The results are summarised in **Table 1**, with data sheets presented in **Appendix 2**.

Standing water was recorded at 2.02mbgl and 2.41mbgl for SA01 and SA03 respectively.

Table 1: Summary of Soakaway Test Results

Test Location	Geology	Test no.	Permeability m/s	Permeability Classification	Drainage Characteristics
SA01	*SHSF	1	8.0×10^{-5}	Medium	Good
		2	1.6×10^{-4}	Medium	Good
		3	1.08×10^{-4}	Medium	Good
SA02	Chester Formation	1	8.7×10^{-6}	Low	Good
		2	1.2×10^{-5}	Medium	Good
		3	1.2×10^{-5}	Medium	Good
SA03	*SHSF	1	8.6×10^{-6}	Low	Good
		2	1.2×10^{-5}	Medium	Good
		3	1.5×10^{-5}	Medium	Good

* SHSF = Shirdley Hill Sand Formation

Based on the infiltration rates recorded, soakaway drainage at 2.5mbgl is likely to be a viable option for the proposed development.

I trust the above meets your requirements, however, should you require any further information, please contact me.

Yours sincerely,



Patrick Taylor BSc (Hons)

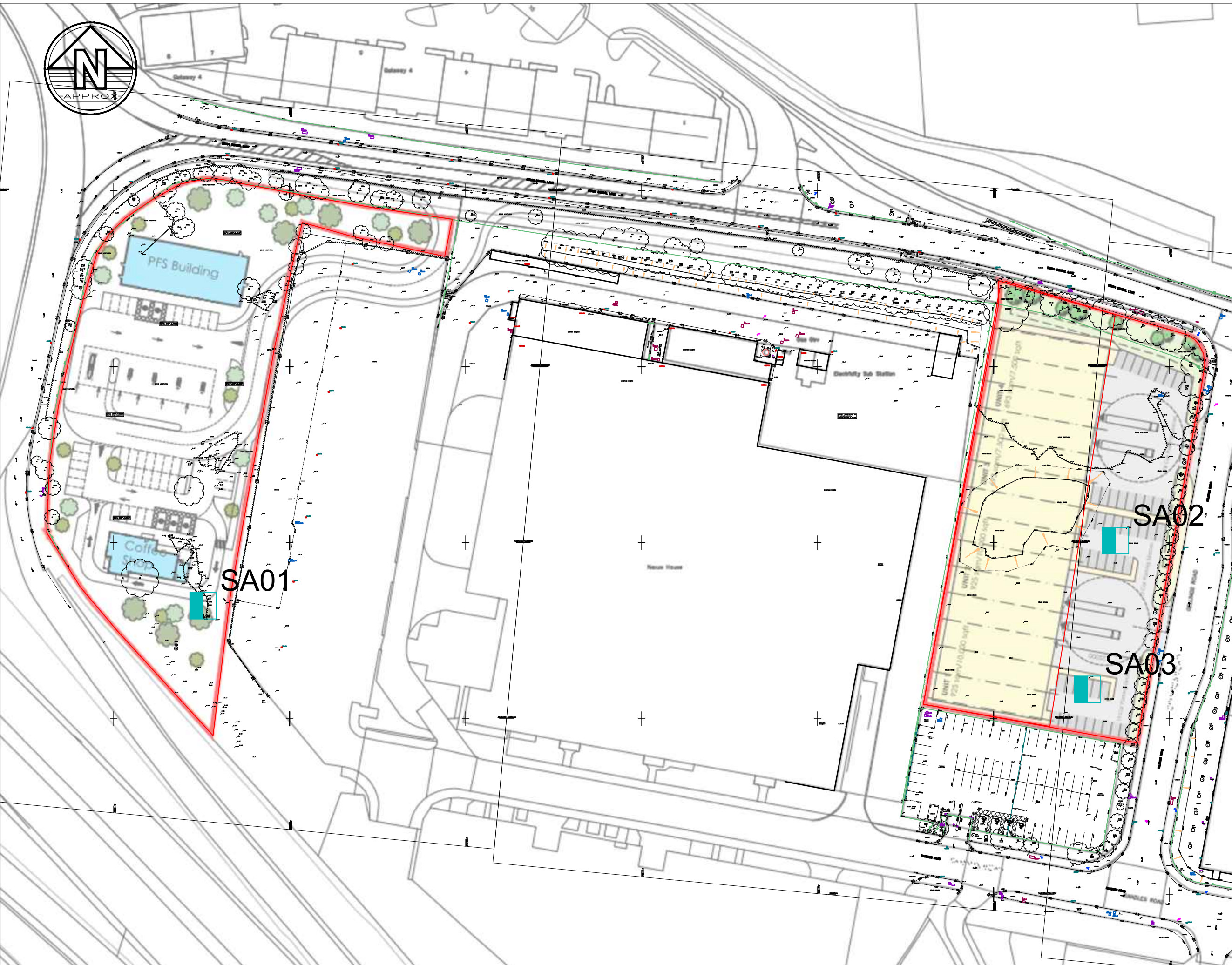
Graduate Geo-Environmental Consultant

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Enc.	Drawing 1	Exploratory Hole Location Plan
	Appendix 1	Exploratory Hole Records
	Appendix 2	BRE 365 Soakaway Assessment Sheets

ANNEX 1
EXPLORATORY HOLE LOCATION PLAN



- Notes**
1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
 2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
 3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
 4. Any discrepancies noted on site are to be reported to the engineer immediately.

Key Plan

Legend

Denotes Location of Soakaway Test

SA**

■

P1	18.02.19	FINAL ISSUE	PT	RPD
Rev	Date	Details of issue / revision	Drw	Rev

Issues & Revisions

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Client

SAVILLS UK LTD

Project Title

**GELLINGS ROAD,
KNOWSLEY**

Drawing Title

**EXPLORATORY HOLE
LOCATION PLAN**

Drawn:	P.TAYLOR	Reviewed:	R. PARKER-DUNN
BWB Ref:	MCA2031	Date:	18.02.19
Scale:	A3	Scale:	1:1
Drawing Status	DRAFT		
Project - Originator - Zone - Level - Type - Role - Number	GRK-BWB-ZZ-XX-DR-YE-0002_EHLP	Status	S1
Rev	P1		

ANNEX 2
EXPLORATORY HOLE RECORDS

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TRIAL PIT LOG

Scale: 1:25

Sheet 1 of 1

LOCATION ID: SA01

Hole Type: TP

Project Name: Gellings Road, Knowsley

Project Number: MCA2031

Client: Savills UK Ltd

Plant: JCB 3CX

Start & End Date: 13/02/2019

2.20

0.70

Pit Dimensions (m)

180

Degrees

Stability: Slight collapse below 2.0mbgl.

Ground Level (m AOD): 21.92

Eastings & Northings: 341976E 396332N

Engineer: SH

Checker: PT

Groundwater

Strike

Strike Details

Backfill

Level (m AOD)

Thickn ess

Description

Legend

Depth (m bgl)

2.4m

bgl

21.52

0.40m

Grass over dark greyish brown silty organic SAND with frequent rootlets. Occasional inclusions of metal cans, plastic, ceramic fragments and timber. (Made Ground)

0.40

20.72

0.80m

Dark grey becoming greyish brown slightly organic slightly gravelly slightly clayey SAND. Gravel is sub-angular coarse sandstone. (Shirdley Hill Sand Formation)

1.20

20.37

0.35m

Yellowish brown SAND. (Shirdley Hill Sand Formation)

1.55

20.17

0.20m

Dark brown and black amorphous PEAT. (Shirdley Hill Sand Formation)

1.75

20.02

0.15m

Yellowish brown SAND. (Shirdley Hill Sand Formation)

1.90

19.42

0.60m

Light grey slightly gravelly clayey SAND with frequent pockets of grey clay. Gravel is coarse rounded sandstone. (Shirdley Hill Sand Formation)

2.50

Hole Terminated at 2.50m bgl.

Remarks

Reason for Termination: Terminated at target depth.

Groundwater Notes: Arisings damp below 2.00mbgl. Slight seepage at 2.40mbgl.

Other Remarks: 1. No olfactory or visual evidence of contamination. 2. Trial pit constructed for BRE 365 Soakaway Testing.

Samples

Type

From (m)

To (m)

In-Situ Tests

Type

Depth (m)

Result

Samples:

Groundwater Strikes:

In-Situ Tests:

B - Bulk

D - Disturbed

ES - Environmental Sample

Groundwater Strike

Resting

Groundwater Level

HSV - Hand Shear Vane Test

PID - Photo Ionisation Detector Test

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Waterfront House

Station Street

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INFRASTRUCTURE | BUILDINGS

TRIAL PIT LOG	Scale: 1:25	Sheet 1 of 1
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Sheet 1 of 1

LOCATION ID: SA02	Project Name: Gellings Road, Knowsley		2.10 0.70 Pit Dimensions (m) 180 Degrees	
	Project Number: MCA2031			
	Client: Savills UK Ltd			
	Hole Type: TP	Plant: JCB 3CX	Start & End Date: 13/02/2019	Stability: Trial pit stable throughout excavation.
Ground Level (m AOD): 23.30		Eastings & Northings: 342236E 396352N	Engineer: SH	Checker: PT

Groundwater		Strata						Samples			In-Situ Tests		
Strike	Strike Details	Backfill	Level (m AOD)	Thickn ess	Description	Legend	Depth (m bgl)	Type	From (m)	To (m)	Type	Depth (m)	Result
					Grass over dark greyish brown slightly silty slightly organic gravelly SAND with frequent rootlets. Gravel is medium sub-rounded quartzite. (Topsoil)		0.35						
			22.95	0.40m	Yellowish brown SAND. (Shirdley Hill Sand Formation)		0.75						
			22.55	0.15m	Dark brown and black amorphous PEAT. (Shirdley Hill Sand Formation)		0.90						
			22.40	0.30m	Yellowish brown SAND. (Shirdley Hill Sand Formation)		1.20						
			22.10	1.15m	Grey mottled orangish brown slightly gravelly sandy CLAY with a low cobble content. Gravel is fine to medium rounded sandstone and quartzite. Cobbles are sub-angular strong sandstone. (Shirdley Hill Sand Formation)		2.35						
			20.95	0.15m	Extremely weathered SANDSTONE arising as a light orange mottled white gravelly SAND. Gravel is medium and coarse sub-angular moderately strong sandstone. (Chester Formation)		2.50						
			20.80		Hole Terminated at 2.50m bgl.								

Remarks		Legend		
Reason for Termination: Terminated at target depth.		Samples: B - Bulk D - Disturbed ES - Environmental Sample	Groundwater Strikes:  Groundwater Strike  Resting  Groundwater Level	In-Situ Tests: HSV - Hand Shear Vane Test PID - Photo Ionisation Detector Test
Groundwater Notes: No groundwater encountered				
Other Remarks: 1. No olfactory or visual evidence of contamination. 2. Trial pit constructed for BRE 365 Soakaway Testing.		BWB Consulting Ltd Waterfront House Station Street Nottingham NG2 3DQ	Web: bwbconsulting.com E: nottingham@bwbconsulting.com P: 0115 9241100	 CONSULTANCY ENVIRONMENT INFRASTRUCTURE BUILDINGS

TRIAL PIT LOG

Scale: 1:25

Sheet 1 of 1

Sheet 1 of 1

LOCATION ID: SA03	Project Name: Gellings Road, Knowsley		1.90 0.70 Pit Dimensions (m) 180 Degrees	
	Project Number: MCA2031			
	Client: Savills UK Ltd			
	Hole Type: TP	Plant: JCB 3CX	Start & End Date: 13/02/2019	Stability: Slight collapse below 2.20mbgl.
Ground Level (m AOD): 23.10		Eastings & Northings: 342226E 396309N	Engineer: SH	Checker: PT

[illegible]

Remarks		Legend		
Reason for Termination: Terminated at target depth.		Samples: B - Bulk D - Disturbed ES - Environmental Sample		
Groundwater Notes: Arisings damp below 2.40mbgl. Slight seepage at 2.45mbgl.		Groundwater Strikes:  Vane  Resting  Groundwater Level		
Other Remarks: 1. No olfactory or visual evidence of contamination. 2. Trial pit constructed for BRE 365 Soakaway Testing.		In-Situ Tests: HSV - Hand Shear Vane Test PID - Photo Ionisation Detector Test		
		BWB Consulting Ltd Waterfront House Station Street Nottingham NG2 3DQ Web: bwbconsulting.com E: nottingham@bwbconsulting.com P: 0115 9241100 		

ANNEX 3

SOAKAWAY PERMEABILITY ASSESSMENT SHEETS

5th Floor
Waterfront House
Station Street
Nottingham
NG2 3DQ

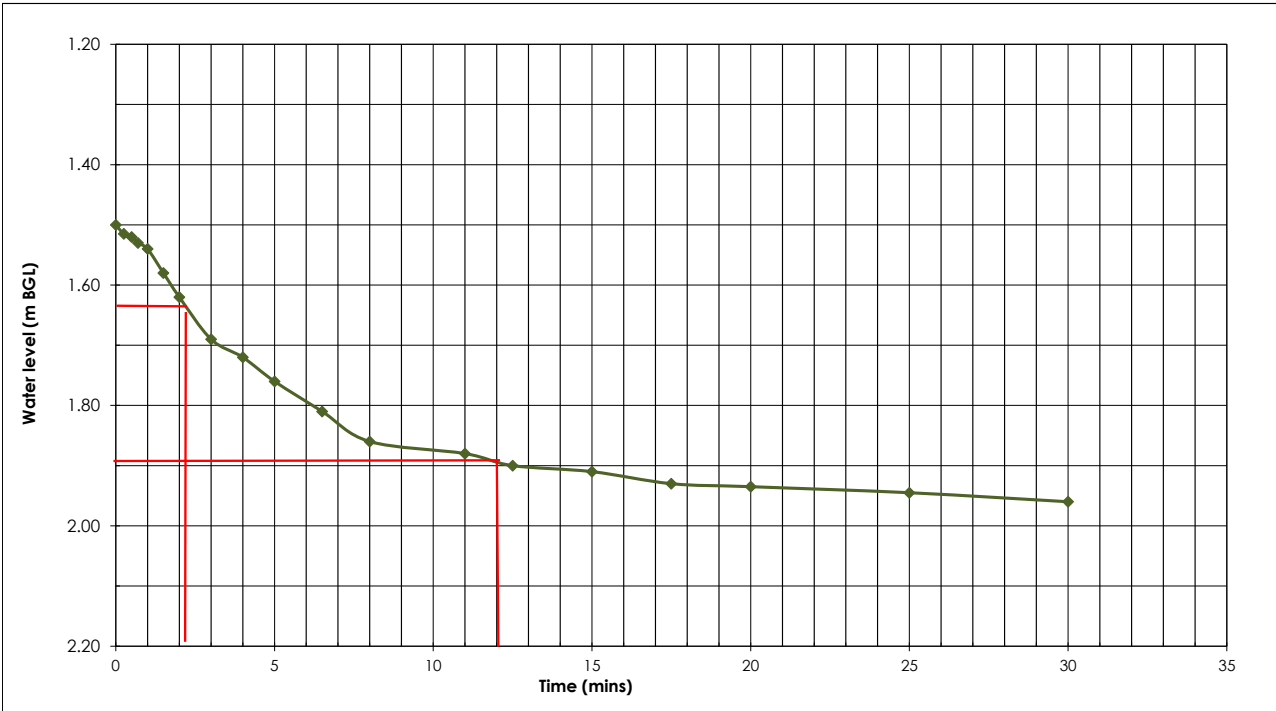
Tel: 0115 924 1100

nottingham@bwbconsulting.com
www.bwbconsulting.com

TRIAL PIT SOAKAWAY TEST

Project Information	
Project:	Gellings Road, Knowsley
Project No:	MCA2031
Client:	Savills UK Ltd
Pit reference:	SA01
Test reference:	1

TEST DATA	
Test start time:	
Pit depth (m):	2.50
Pit width (m):	0.70
Pit length (m):	2.20
Depth to standing water (m):	2.02

[illegible]

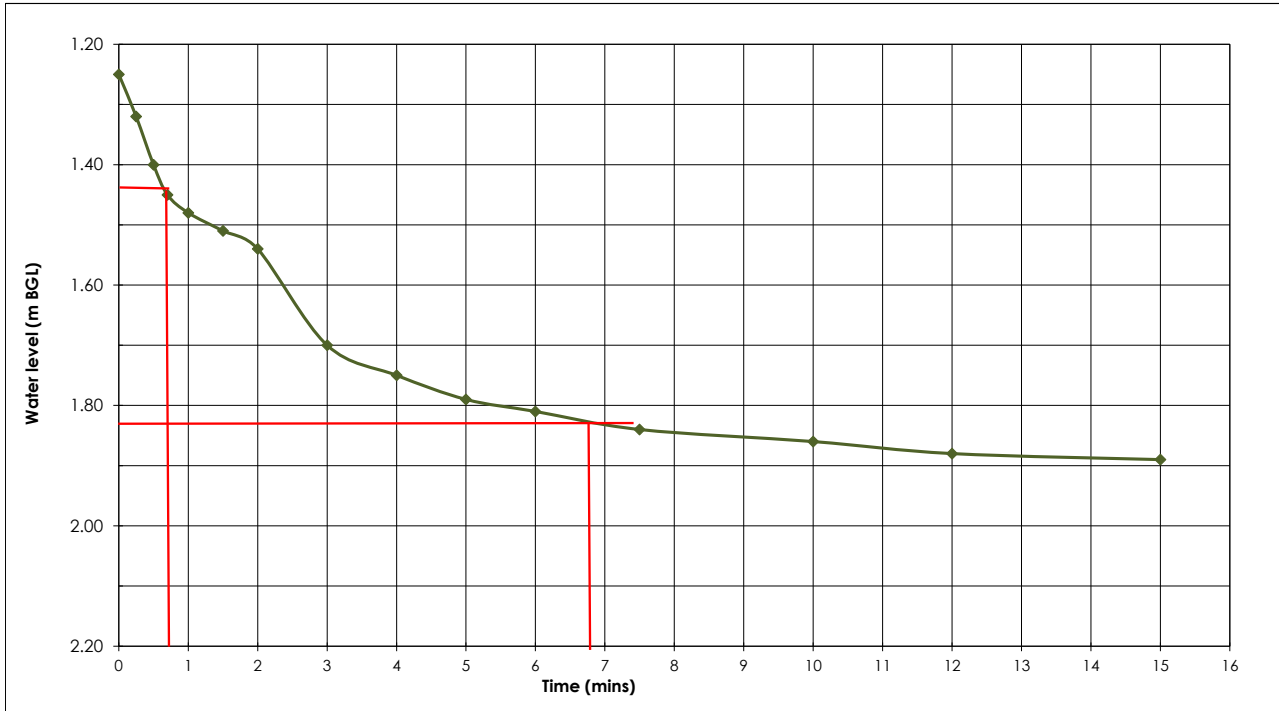
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.02
Effective depth (m)	1.50
Effective drop (m)	0.52
75% effective full depth (m)	1.63
50% effective full depth (m)	1.78
25% effective full depth (m)	1.89
t75 (min)	2.20
t50 (min)	
t25 (min)	12.00
Vp 75-25	0.40
Adjusted Vp for gravel fill	0.14
ap 50	3.048
tp 75-25	9.80
Soil infiltration rate (m/s)	8.04E-05
Soil infiltration rate (mm/hr)	2.90E+02

	Notes:
1	Pale green cells require input data.
2	<u>Method of calculation</u> Infiltration calculated to method in 'BRE Digest 365 (2007) - Soakaway Linear extrapolation is non BRE Digest

TRIAL PIT SOAKAWAY TEST

Project Information	
Project:	Gellings Road, Knowsley
Project No:	MCA2031
Client:	Savills UK Ltd
Pit reference:	SA01
Test reference:	2

TEST DATA	
Test start time:	
Pit depth (m):	2.50
Pit width (m):	0.70
Pit length (m):	2.20
Depth to standing water (m):	2.02

[illegible]

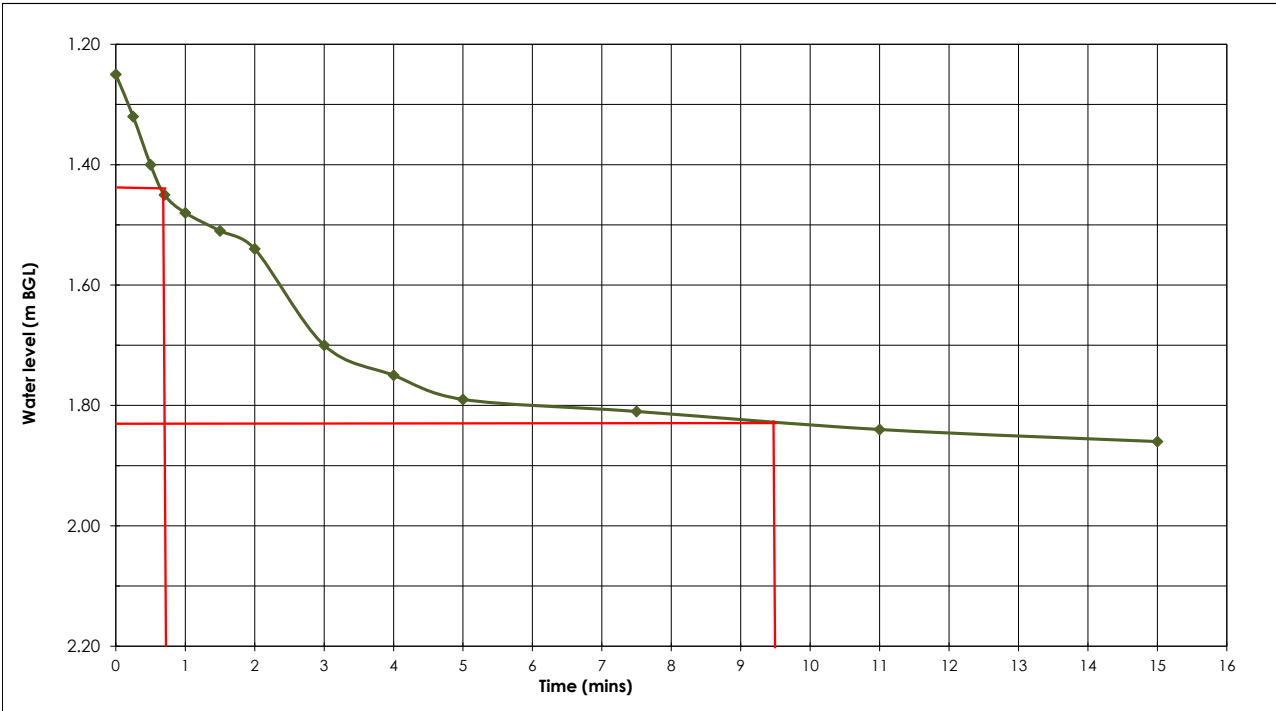
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.02
Effective depth (m)	1.25
Effective drop (m)	0.77
75% effective full depth (m)	1.44
50% effective full depth (m)	1.64
25% effective full depth (m)	1.83
t75 (min)	0.80
t50 (min)	
t25 (min)	6.80
Vp 75-25	0.59
Adjusted Vp for gravel fill	0.21
ap 50	3.773
tp 75-25	6.00
Soil infiltration rate (m/s)	1.57E-04
Soil infiltration rate (mm/hr)	5.66E+02

	Notes:
1	Pale green cells require input data.
2	Method of calculation. Infiltration calculated to method in 'BRE Digest 365 (2007) - Soakaway Linear extrapolation is non BRE Digest

TRIAL PIT SOAKAWAY TEST

Project Information	
Project:	Gellings Road, Knowsley
Project No:	MCA2031
Client:	Savills UK Ltd
Pit reference:	SA01
Test reference:	3

TEST DATA	
Test start time:	
Pit depth (m):	2.50
Pit width (m):	0.70
Pit length (m):	2.20
Depth to standing water (m):	2.02

[illegible]

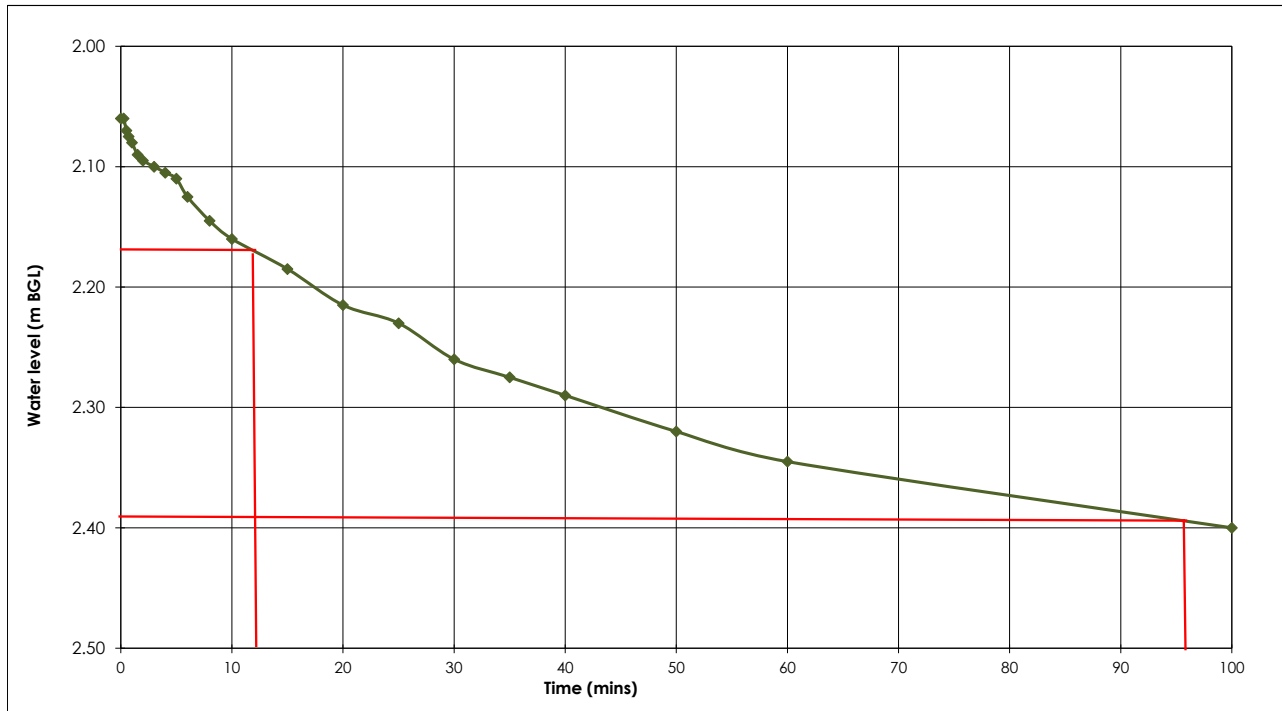
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.02
Effective depth (m)	1.25
Effective drop (m)	0.77
75% effective full depth (m)	1.44
50% effective full depth (m)	1.64
25% effective full depth (m)	1.83
t75 (min)	0.80
t50 (min)	
t25 (min)	9.50
Vp 75-25	0.59
Adjusted Vp for gravel fill	0.21
ap 50	3.773
tp 75-25	8.70
Soil infiltration rate (m/s)	1.08E-04
Soil infiltration rate (mm/hr)	3.90E+02

	Notes:
1	Pale green cells require input data.
2	<u>Method of calculation</u> Infiltration calculated to method in 'BRE Digest 365 (2007) - Soakaway' Linear extrapolation is non BRE Digest

TRIAL PIT SOAKAWAY TEST

Project Information	
Project:	Gellings Road, Knowsley
Project No:	MCA2031
Client:	Savills UK Ltd
Pit reference:	SA02
Test reference:	1

TEST DATA	
Test start time:	
Pit depth (m):	2.50
Pit width (m):	0.70
Pit length (m):	2.10
Depth to standing water (m):	N/A



Time (min)	Depth (m)
0.0	2.06
0.3	2.06
0.5	2.07
0.7	2.08
1.0	2.08
1.5	2.09
2.0	2.10
3.0	2.10
4.0	2.11
5.0	2.11
6.0	2.13
8.0	2.15
10.0	2.16
15.0	2.19
20.0	2.22
25.0	2.23
30.0	2.26
35.0	2.28
40.0	2.29
50.0	2.32
60.0	2.35
100.0	2.40

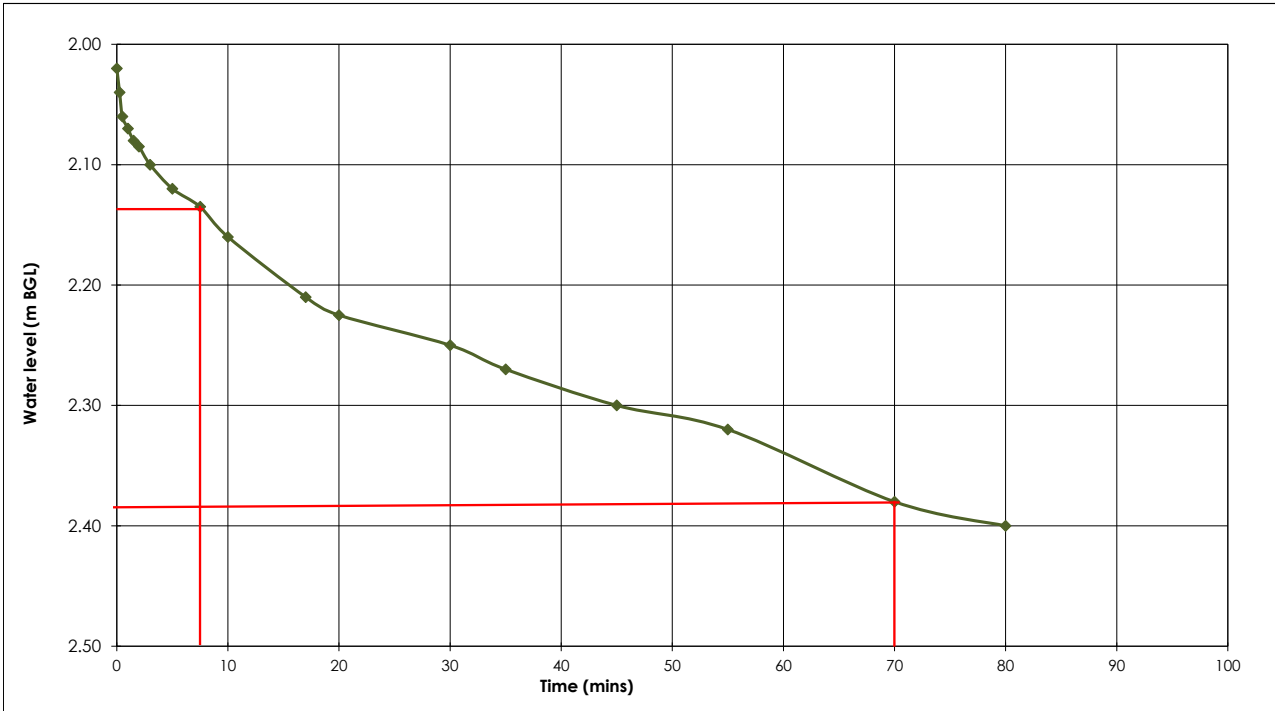
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.50
Effective depth (m)	2.06
Effective drop (m)	0.44
75% effective full depth (m)	2.17
50% effective full depth (m)	2.28
25% effective full depth (m)	2.39
t75 (min)	12.00
t50 (min)	
t25 (min)	95.00
Vp 75-25	0.32
Adjusted Vp for gravel fill	0.12
ap 50	2.702
tp 75-25	83.00
Soil infiltration rate (m/s)	8.7E-06
Soil infiltration rate (mm/hr)	3.11E+01

Notes:	
1	Pale green cells require input data.
2	Method of calculation Infiltration calculated to method in 'BRE Digest 365 (2007) - Soakaway Linear extrapolation is non BRE Digest

TRIAL PIT SOAKAWAY TEST

Project Information	
Project:	Gellings Road, Knowsley
Project No:	MCA2031
Client:	Savills UK Ltd
Pit reference:	SA02
Test reference:	1

TEST DATA	
Test start time:	
Pit depth (m):	2.50
Pit width (m):	0.70
Pit length (m):	2.10
Depth to standing water (m):	N/A

[illegible]

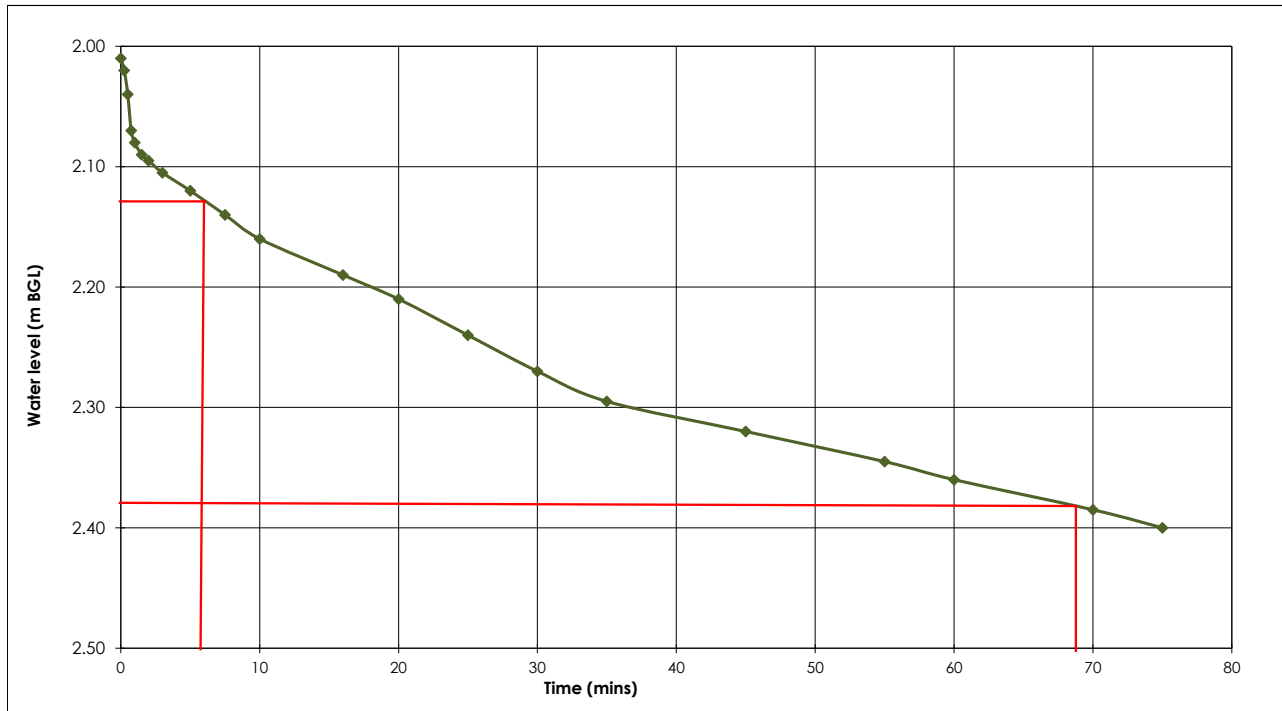
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.50
Effective depth (m)	2.02
Effective drop (m)	0.48
75% effective full depth (m)	2.14
50% effective full depth (m)	2.24
25% effective full depth (m)	2.38
t75 (min)	7.50
t50 (min)	
t25 (min)	70.00
Vp 75-25	0.35
Adjusted Vp for gravel fill	0.13
ap 50	2.814
tp 75-25	62.50
Soil infiltration rate (m/s)	1.2E-05
Soil infiltration rate (mm/hr)	4.33E+01

	Notes:
1	Pale green cells require input data.
2	<u>Method of calculation</u> Infiltration calculated to method in 'BRE Digest 365 (2007) - Soakaway Linear extrapolation is non BRE Digest

TRIAL PIT SOAKAWAY TEST

Project Information	
Project:	Gellings Road, Knowsley
Project No:	MCA2031
Client:	Savills UK Ltd
Pit reference:	SA02
Test reference:	1

TEST DATA	
Test start time:	
Pit depth (m):	2.50
Pit width (m):	0.70
Pit length (m):	2.10
Depth to standing water (m):	N/A



Time (min)	Depth (m)
0.0	2.01
0.3	2.02
0.5	2.04
0.8	2.07
1.0	2.08
1.5	2.09
2.0	2.10
3.0	2.11
5.0	2.12
7.5	2.14
10.0	2.16
16.0	2.19
20.0	2.21
25.0	2.24
30.0	2.27
35.0	2.30
45.0	2.32
55.0	2.35
60.0	2.36
70.0	2.39
75.0	2.40

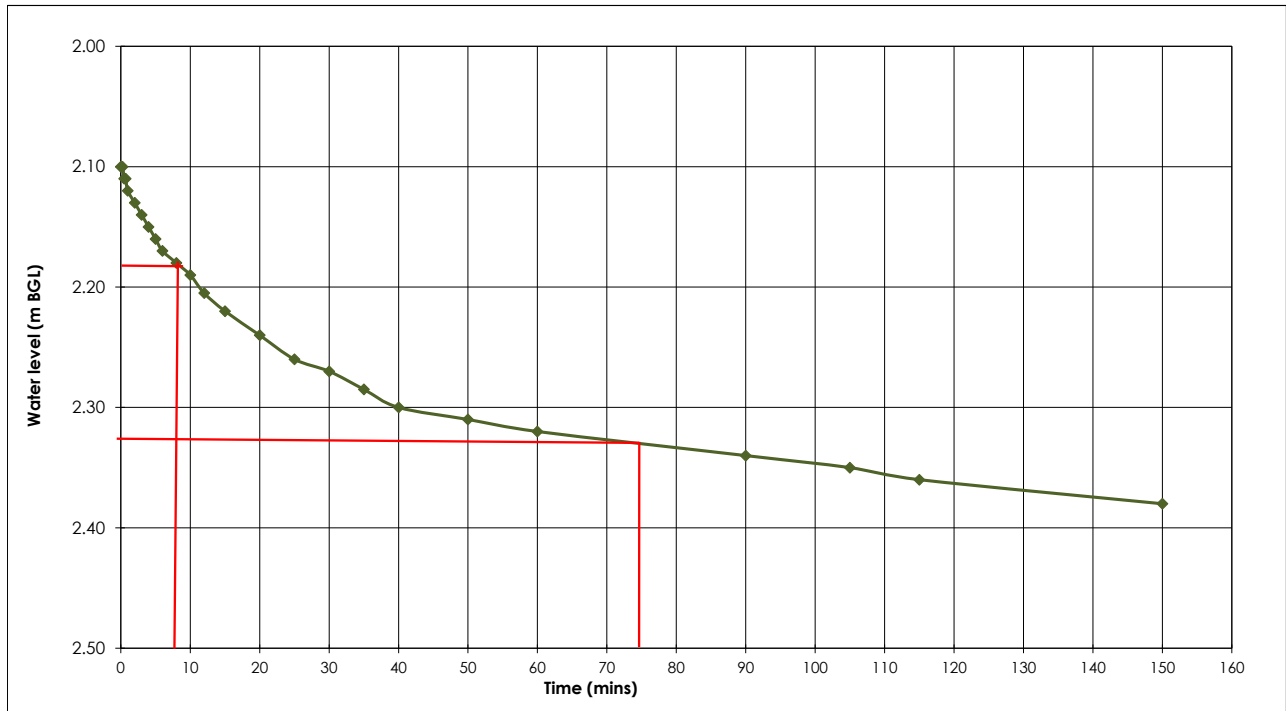
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.50
Effective depth (m)	2.01
Effective drop (m)	0.49
75% effective full depth (m)	2.13
50% effective full depth (m)	2.26
25% effective full depth (m)	2.38
t75 (min)	6.00
t50 (min)	
t25 (min)	68.00
Vp 75-25	0.36
Adjusted Vp for gravel fill	0.13
ap 50	2.842
tp 75-25	62.00
Soil infiltration rate (m/s)	1.2E-05
Soil infiltration rate (mm/hr)	4.41E+01

Notes:	
1	Pale green cells require input data.
2	Method of calculation Infiltration calculated to method in 'BRE Digest 365 (2007) - Soakaway Linear extrapolation is non BRE Digest

TRIAL PIT SOAKAWAY TEST

Project Information	
Project:	Gellings Road, Knowsley
Project No:	MCA2031
Client:	Savills UK Ltd
Pit reference:	SA03
Test reference:	1

TEST DATA	
Test start time:	
Pit depth (m):	2.55
Pit width (m):	0.70
Pit length (m):	1.90
Depth to standing water (m):	2.41



Time (min)	Depth (m)
0.0	2.10
0.3	2.10
0.5	2.11
0.7	2.11
1.0	2.12
2.0	2.13
3.0	2.14
4.0	2.15
5.0	2.16
6.0	2.17
8.0	2.18
10.0	2.19
12.0	2.21
15.0	2.22
20.0	2.24
25.0	2.26
30.0	2.27
35.0	2.29
40.0	2.30
50.0	2.31
60.0	2.32
90.0	2.34
105.0	2.35
115.0	2.36
150.0	2.38

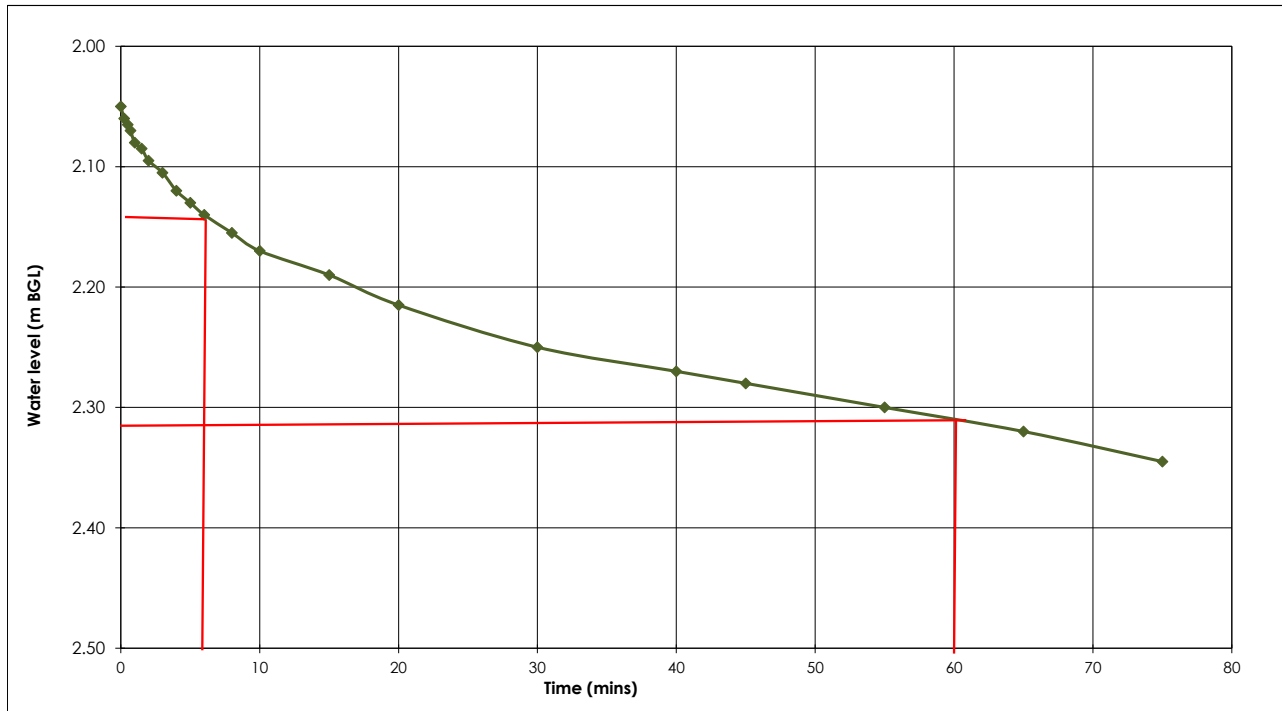
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.41
Effective depth (m)	2.10
Effective drop (m)	0.31
75% effective full depth (m)	2.18
50% effective full depth (m)	2.26
25% effective full depth (m)	2.33
t75 (min)	8.00
t50 (min)	
t25 (min)	75.00
Vp 75-25	0.21
Adjusted Vp for gravel fill	0.07
ap 50	2.136
tp 75-25	67.00
Soil infiltration rate (m/s)	8.6E-06
Soil infiltration rate (mm/hr)	3.11E+01

Notes:	
1	Pale green cells require input data.
2	Method of calculation Infiltration calculated to method in 'BRE Digest 365 (2007) - Soakaway Linear extrapolation is non BRE Digest

TRIAL PIT SOAKAWAY TEST

Project Information	
Project:	Gellings Road, Knowsley
Project No:	MCA2031
Client:	Savills UK Ltd
Pit reference:	SA03
Test reference:	2

TEST DATA	
Test start time:	
Pit depth (m):	2.55
Pit width (m):	0.70
Pit length (m):	1.90
Depth to standing water (m):	2.41



Time (min)	Depth (m)
0.0	2.05
0.3	2.06
0.5	2.07
0.7	2.07
1.0	2.08
1.5	2.09
2.0	2.10
3.0	2.11
4.0	2.12
5.0	2.13
6.0	2.14
8.0	2.16
10.0	2.17
15.0	2.19
20.0	2.22
30.0	2.25
40.0	2.27
45.0	2.28
55.0	2.30
65.0	2.32
75.0	2.35

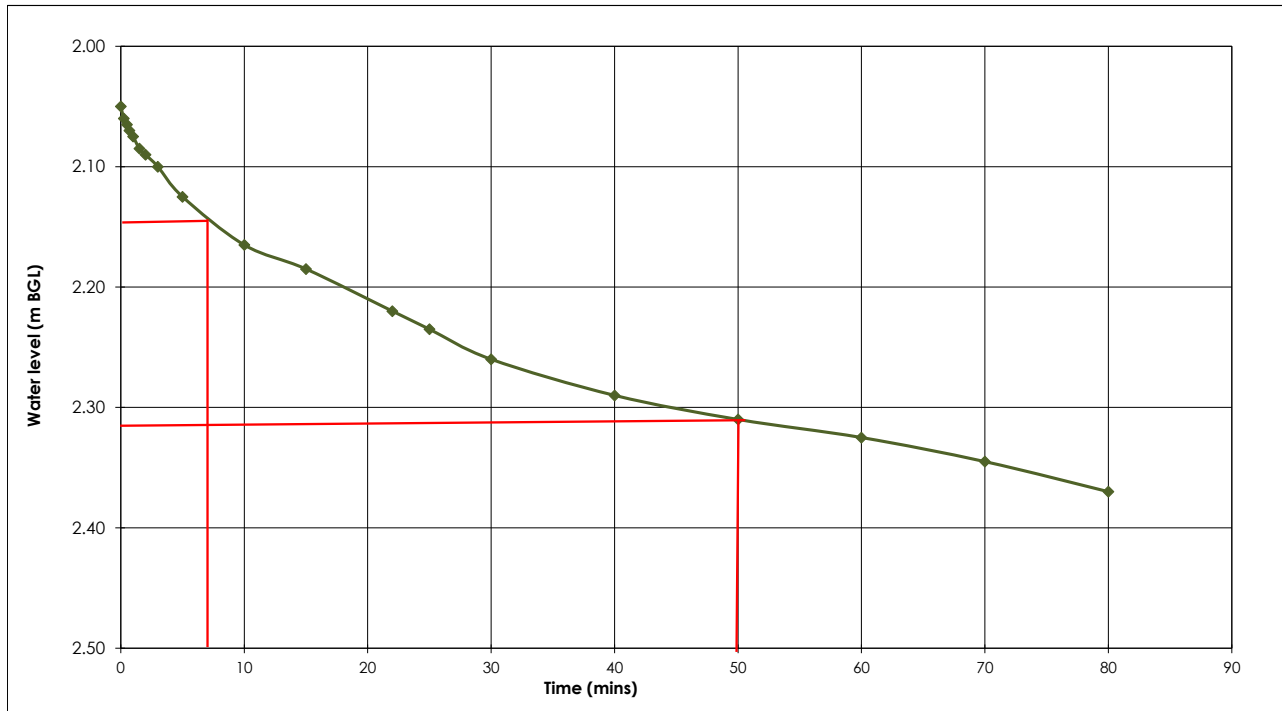
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.41
Effective depth (m)	2.05
Effective drop (m)	0.36
75% effective full depth (m)	2.14
50% effective full depth (m)	2.23
25% effective full depth (m)	2.32
t75 (min)	6.00
t50 (min)	
t25 (min)	60.00
Vp 75-25	0.24
Adjusted Vp for gravel fill	0.09
ap 50	2.266
tp 75-25	54.00
Soil infiltration rate (m/s)	1.2E-05
Soil infiltration rate (mm/hr)	4.23E+01

Notes:	
1	Pale green cells require input data.
2	Method of calculation Infiltration calculated to method in 'BRE Digest 365 (2007) - Soakaway Linear extrapolation is non BRE Digest

TRIAL PIT SOAKAWAY TEST

Project Information	
Project:	Gellings Road, Knowsley
Project No:	MCA2031
Client:	Savills UK Ltd
Pit reference:	SA03
Test reference:	3

TEST DATA	
Test start time:	
Pit depth (m):	2.55
Pit width (m):	0.70
Pit length (m):	1.90
Depth to standing water (m):	2.41



Time (min)	Depth (m)
0.0	2.05
0.3	2.06
0.5	2.07
0.7	2.07
1.0	2.08
1.5	2.09
2.0	2.09
3.0	2.10
5.0	2.13
10.0	2.17
15.0	2.19
22.0	2.22
25.0	2.24
30.0	2.26
40.0	2.29
50.0	2.31
60.0	2.33
70.0	2.35
80.0	2.37

Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.41
Effective depth (m)	2.05
Effective drop (m)	0.36
75% effective full depth (m)	2.14
50% effective full depth (m)	2.23
25% effective full depth (m)	2.32
t75 (min)	7.00
t50 (min)	
t25 (min)	50.00
Vp 75-25	0.24
Adjusted Vp for gravel fill	0.09
ap 50	2.266
tp 75-25	43.00
Soil infiltration rate (m/s)	1.5E-05
Soil infiltration rate (mm/hr)	5.31E+01

Notes:	
1	Pale green cells require input data.
2	Method of calculation Infiltration calculated to method in 'BRE Digest 365 (2007) - Soakaway Linear extrapolation is non BRE Digest

APPENDIX 4: Greenfield Runoff Rate and Volume

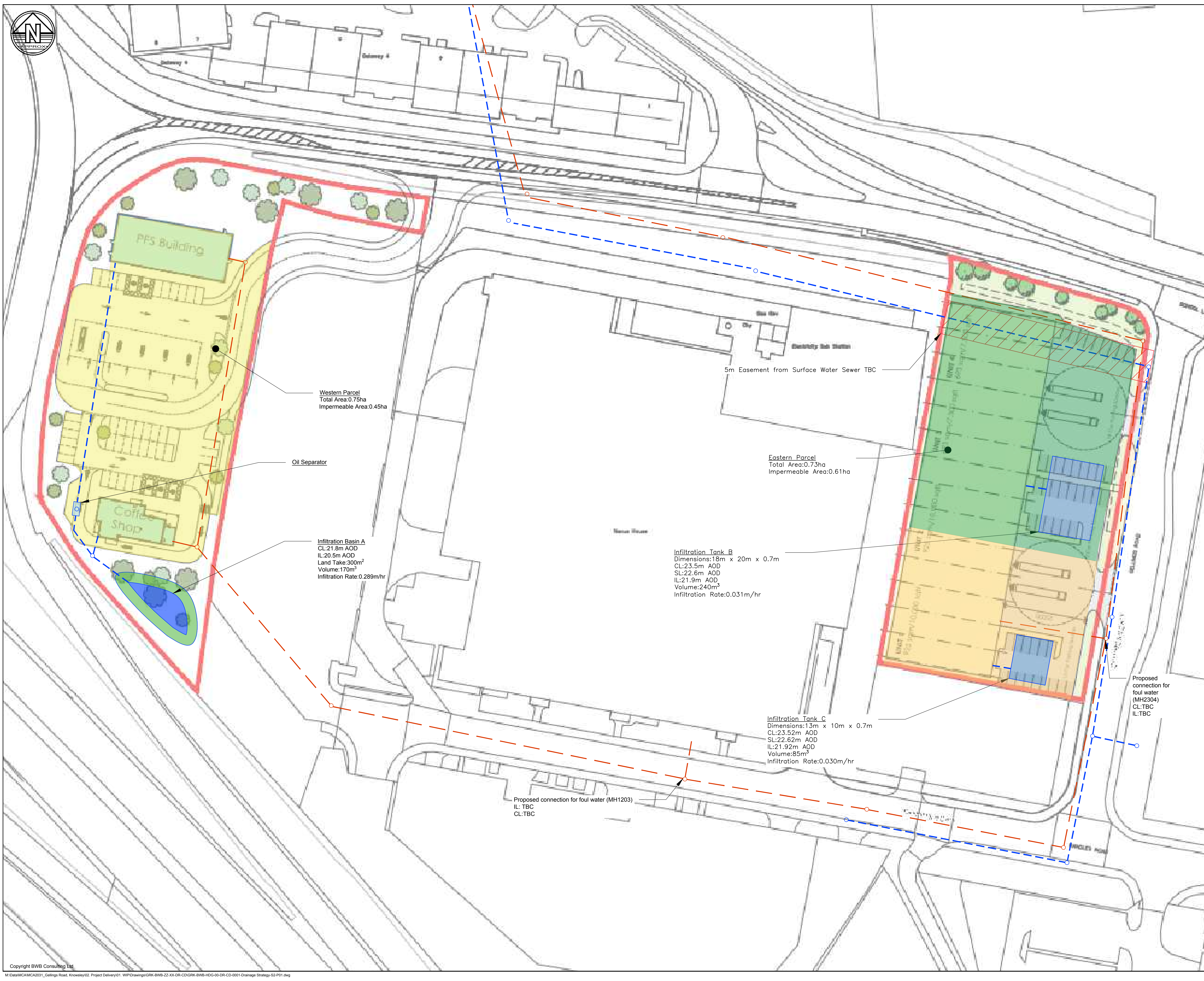
BWB Consulting Ltd		Page 1
4th Floor Carvers Warehouse 77 Dale Street Manchester M1 2HG	Gellings Road Western Parcel SA01	
Date 21/02/2019 File WESTERN A Q100 + 20.SRCX	Designed by Anna Elman Checked by Yusuf Lawson	
Micro Drainage	Source Control 2018.1.1	
ICP SUDS Mean Annual Flood Input Return Period (years)2Soil0.300 Area (ha) 0.452Urban0.000 SAAR (mm)864Region NumberRegion 10 Results1/s QBAR Rural1.1 QBAR Urban1.1 Q2 years1.0 Q1 year0.9 Q30 years1.8 Q100 years2.2		
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BWB Consulting Ltd		Page 1
4th Floor Carvers Warehouse 77 Dale Street Manchester M1 2HG	Gellings Road Eastern Parcel	
Date 20/02/2019 File Western Q100 + 20.srcx	Designed by Anna Elman Checked by Yusuf Lawson	
Micro Drainage	Source Control 2018.1.1	
ICP SUDS Mean Annual Flood Input Return Period (years)2Soil0.300 Area (ha) 0.661Urban0.000 SAAR (mm) 864 Region Number Region 10 Results 1/s QBAR Rural 1.5 QBAR Urban 1.5 Q2 years 1.4 Q1 year 1.3 Q30 years 2.6 Q100 years 3.2		
©1982-2018 Innovyze		

BWB Consulting Ltd		Page 1																																				
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ	Gellings Road Western Parcel																																					
Date 21/02/2019 File WESTERN Q100 + 20.SRCX	Designed by Anna Elman Checked by Yusuf Lawson																																					
XP Solutions																																						
Source Control 2018.1.1																																						
<u>Greenfield Runoff Volume</u> FEH Data <table> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>Storm Duration (mins)</td> <td>360</td> </tr> <tr> <td>FEH Rainfall Version</td> <td>1999</td> </tr> <tr> <td>Site Location</td> <td>GB 341500 396100 SJ 41500 96100</td> </tr> <tr> <td>C (1km)</td> <td>-0.022</td> </tr> <tr> <td>D1 (1km)</td> <td>0.316</td> </tr> <tr> <td>D2 (1km)</td> <td>0.314</td> </tr> <tr> <td>D3 (1km)</td> <td>0.319</td> </tr> <tr> <td>E (1km)</td> <td>0.286</td> </tr> <tr> <td>F (1km)</td> <td>2.506</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.00</td> </tr> <tr> <td>Area (ha)</td> <td>0.452</td> </tr> <tr> <td>SAAR (mm)</td> <td>862</td> </tr> <tr> <td>CWI</td> <td>120.345</td> </tr> <tr> <td>SPR Host</td> <td>21.840</td> </tr> <tr> <td>URBEXT (1990)</td> <td>0.1047</td> </tr> </table> Results <table> <tr> <td>Percentage Runoff (%)</td> <td>28.09</td> </tr> <tr> <td>Greenfield Runoff Volume (m³)</td> <td>85.237</td> </tr> </table>			Return Period (years)	100	Storm Duration (mins)	360	FEH Rainfall Version	1999	Site Location	GB 341500 396100 SJ 41500 96100	C (1km)	-0.022	D1 (1km)	0.316	D2 (1km)	0.314	D3 (1km)	0.319	E (1km)	0.286	F (1km)	2.506	Areal Reduction Factor	1.00	Area (ha)	0.452	SAAR (mm)	862	CWI	120.345	SPR Host	21.840	URBEXT (1990)	0.1047	Percentage Runoff (%)	28.09	Greenfield Runoff Volume (m³)	85.237
Return Period (years)	100																																					
Storm Duration (mins)	360																																					
FEH Rainfall Version	1999																																					
Site Location	GB 341500 396100 SJ 41500 96100																																					
C (1km)	-0.022																																					
D1 (1km)	0.316																																					
D2 (1km)	0.314																																					
D3 (1km)	0.319																																					
E (1km)	0.286																																					
F (1km)	2.506																																					
Areal Reduction Factor	1.00																																					
Area (ha)	0.452																																					
SAAR (mm)	862																																					
CWI	120.345																																					
SPR Host	21.840																																					
URBEXT (1990)	0.1047																																					
Percentage Runoff (%)	28.09																																					
Greenfield Runoff Volume (m³)	85.237																																					
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5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ																																						
Date 21/02/2019 08:45 File WESTERN Q100 + 20.SRCX	Designed by anna.elman Checked by																																					
XP Solutions		Source Control 2018.1.1																																				
<u>Greenfield Runoff Volume</u> FEH Data <table> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>Storm Duration (mins)</td> <td>360</td> </tr> <tr> <td>FEH Rainfall Version</td> <td>1999</td> </tr> <tr> <td>Site Location</td> <td>GB 341500 396100 SJ 41500 96100</td> </tr> <tr> <td>C (1km)</td> <td>-0.022</td> </tr> <tr> <td>D1 (1km)</td> <td>0.316</td> </tr> <tr> <td>D2 (1km)</td> <td>0.314</td> </tr> <tr> <td>D3 (1km)</td> <td>0.319</td> </tr> <tr> <td>E (1km)</td> <td>0.286</td> </tr> <tr> <td>F (1km)</td> <td>2.506</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.00</td> </tr> <tr> <td>Area (ha)</td> <td>0.661</td> </tr> <tr> <td>SAAR (mm)</td> <td>862</td> </tr> <tr> <td>CWI</td> <td>120.345</td> </tr> <tr> <td>SPR Host</td> <td>21.840</td> </tr> <tr> <td>URBEXT (1990)</td> <td>0.1047</td> </tr> </table> Results <table> <tr> <td>Percentage Runoff (%)</td> <td>28.09</td> </tr> <tr> <td>Greenfield Runoff Volume (m³)</td> <td>124.649</td> </tr> </table>			Return Period (years)	100	Storm Duration (mins)	360	FEH Rainfall Version	1999	Site Location	GB 341500 396100 SJ 41500 96100	C (1km)	-0.022	D1 (1km)	0.316	D2 (1km)	0.314	D3 (1km)	0.319	E (1km)	0.286	F (1km)	2.506	Areal Reduction Factor	1.00	Area (ha)	0.661	SAAR (mm)	862	CWI	120.345	SPR Host	21.840	URBEXT (1990)	0.1047	Percentage Runoff (%)	28.09	Greenfield Runoff Volume (m³)	124.649
Return Period (years)	100																																					
Storm Duration (mins)	360																																					
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URBEXT (1990)	0.1047																																					
Percentage Runoff (%)	28.09																																					
Greenfield Runoff Volume (m³)	124.649																																					
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APPENDIX 5: Indicative Surface and Foul Water Drainage Drawing



Drawn: A. Elman	Reviewed: Y. Lawson
BWB Ref: MCA 2031	Date: 08.03.19
Scale@A1: 1:500	
Drawing Status	
PRELIMINARY	
Project - Originator - Zone - Level - Type - Role - Number	Status Rev
GRK-BWB-ZZ-XX-RP-CD-0001	S2 P01

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APPENDIX 6: Micro Drainage Calculations

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4th Floor Carvers Warehouse 77 Dale Street Manchester M1 2HG		Gellings Road Western SA01																																																																																																																																																																																																	
Date 01/03/2019 File Western A Q100 + 20 REVI...		Designed by Anna Elman Checked by Yusuf Lawson																																																																																																																																																																																																	
Micro Drainage		Source Control 2018.1.1																																																																																																																																																																																																	
<u>Summary of Results for 100 year Return Period (+20%)</u> Half Drain Time : 116 minutes. <table><thead><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>99.486</td><td>0.786</td><td>13.3</td><td>125.4</td><td>O K</td></tr><tr><td>30 min Summer</td><td>99.551</td><td>0.851</td><td>14.1</td><td>139.7</td><td>O K</td></tr><tr><td>60 min Summer</td><td>99.591</td><td>0.891</td><td>14.6</td><td>149.0</td><td>O K</td></tr><tr><td>120 min Summer</td><td>99.589</td><td>0.889</td><td>14.6</td><td>148.4</td><td>O K</td></tr><tr><td>180 min Summer</td><td>99.573</td><td>0.873</td><td>14.4</td><td>144.7</td><td>O K</td></tr><tr><td>240 min Summer</td><td>99.552</td><td>0.852</td><td>14.1</td><td>139.9</td><td>O K</td></tr><tr><td>360 min Summer</td><td>99.505</td><td>0.805</td><td>13.5</td><td>129.7</td><td>O K</td></tr><tr><td>480 min Summer</td><td>99.461</td><td>0.761</td><td>13.0</td><td>120.2</td><td>O K</td></tr><tr><td>600 min Summer</td><td>99.421</td><td>0.721</td><td>12.5</td><td>111.9</td><td>O K</td></tr><tr><td>720 min Summer</td><td>99.384</td><td>0.684</td><td>12.1</td><td>104.4</td><td>O K</td></tr><tr><td>960 min Summer</td><td>99.316</td><td>0.616</td><td>11.3</td><td>91.2</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>99.205</td><td>0.505</td><td>9.9</td><td>71.0</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>99.079</td><td>0.379</td><td>8.5</td><td>50.2</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>98.985</td><td>0.285</td><td>7.5</td><td>36.1</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>98.858</td><td>0.158</td><td>6.1</td><td>18.9</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>98.781</td><td>0.081</td><td>5.3</td><td>9.3</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>98.748</td><td>0.048</td><td>4.7</td><td>5.4</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>98.742</td><td>0.042</td><td>4.1</td><td>4.7</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>162.794</td><td>0.0</td><td>24</td></tr><tr><td>30 min Summer</td><td>94.465</td><td>0.0</td><td>37</td></tr><tr><td>60 min Summer</td><td>54.815</td><td>0.0</td><td>62</td></tr><tr><td>120 min Summer</td><td>31.808</td><td>0.0</td><td>100</td></tr><tr><td>180 min Summer</td><td>23.135</td><td>0.0</td><td>132</td></tr><tr><td>240 min Summer</td><td>18.457</td><td>0.0</td><td>168</td></tr><tr><td>360 min Summer</td><td>13.424</td><td>0.0</td><td>236</td></tr><tr><td>480 min Summer</td><td>10.710</td><td>0.0</td><td>304</td></tr><tr><td>600 min Summer</td><td>8.989</td><td>0.0</td><td>370</td></tr><tr><td>720 min Summer</td><td>7.790</td><td>0.0</td><td>436</td></tr><tr><td>960 min Summer</td><td>6.211</td><td>0.0</td><td>566</td></tr><tr><td>1440 min Summer</td><td>4.514</td><td>0.0</td><td>816</td></tr><tr><td>2160 min Summer</td><td>3.280</td><td>0.0</td><td>1180</td></tr><tr><td>2880 min Summer</td><td>2.616</td><td>0.0</td><td>1536</td></tr><tr><td>4320 min Summer</td><td>1.905</td><td>0.0</td><td>2252</td></tr><tr><td>5760 min Summer</td><td>1.521</td><td>0.0</td><td>2944</td></tr><tr><td>7200 min Summer</td><td>1.277</td><td>0.0</td><td>3672</td></tr><tr><td>8640 min Summer</td><td>1.108</td><td>0.0</td><td>4408</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	99.486	0.786	13.3	125.4	O K	30 min Summer	99.551	0.851	14.1	139.7	O K	60 min Summer	99.591	0.891	14.6	149.0	O K	120 min Summer	99.589	0.889	14.6	148.4	O K	180 min Summer	99.573	0.873	14.4	144.7	O K	240 min Summer	99.552	0.852	14.1	139.9	O K	360 min Summer	99.505	0.805	13.5	129.7	O K	480 min Summer	99.461	0.761	13.0	120.2	O K	600 min Summer	99.421	0.721	12.5	111.9	O K	720 min Summer	99.384	0.684	12.1	104.4	O K	960 min Summer	99.316	0.616	11.3	91.2	O K	1440 min Summer	99.205	0.505	9.9	71.0	O K	2160 min Summer	99.079	0.379	8.5	50.2	O K	2880 min Summer	98.985	0.285	7.5	36.1	O K	4320 min Summer	98.858	0.158	6.1	18.9	O K	5760 min Summer	98.781	0.081	5.3	9.3	O K	7200 min Summer	98.748	0.048	4.7	5.4	O K	8640 min Summer	98.742	0.042	4.1	4.7	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	162.794	0.0	24	30 min Summer	94.465	0.0	37	60 min Summer	54.815	0.0	62	120 min Summer	31.808	0.0	100	180 min Summer	23.135	0.0	132	240 min Summer	18.457	0.0	168	360 min Summer	13.424	0.0	236	480 min Summer	10.710	0.0	304	600 min Summer	8.989	0.0	370	720 min Summer	7.790	0.0	436	960 min Summer	6.211	0.0	566	1440 min Summer	4.514	0.0	816	2160 min Summer	3.280	0.0	1180	2880 min Summer	2.616	0.0	1536	4320 min Summer	1.905	0.0	2252	5760 min Summer	1.521	0.0	2944	7200 min Summer	1.277	0.0	3672	8640 min Summer	1.108	0.0	4408
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																														
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4th Floor Carvers Warehouse 77 Dale Street Manchester M1 2HG		Gellings Road Western SA01			
Date 01/03/2019 File Western A Q100 + 20 REVI...		Designed by Anna Elman Checked by Yusuf Lawson			
Micro Drainage		Source Control 2018.1.1			
<u>Summary of Results for 100 year Return Period (+20%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
10080 min Summer	98.737	0.037	3.6	4.2	O K
15 min Winter	99.557	0.857	14.2	141.3	O K
30 min Winter	99.629	0.929	15.1	157.9	O K
60 min Winter	99.677	0.977	15.7	169.6	O K
120 min Winter	99.677	0.977	15.7	169.5	O K
180 min Winter	99.657	0.957	15.4	164.6	O K
240 min Winter	99.629	0.929	15.1	158.0	O K
360 min Winter	99.566	0.866	14.3	143.3	O K
480 min Winter	99.504	0.804	13.5	129.3	O K
600 min Winter	99.447	0.747	12.8	117.2	O K
720 min Winter	99.395	0.695	12.2	106.5	O K
960 min Winter	99.302	0.602	11.1	88.5	O K
1440 min Winter	99.154	0.454	9.4	62.2	O K
2160 min Winter	98.996	0.296	7.6	37.7	O K
2880 min Winter	98.887	0.187	6.4	22.5	O K
4320 min Winter	98.756	0.056	5.0	6.3	O K
5760 min Winter	98.742	0.042	4.1	4.7	O K
7200 min Winter	98.735	0.035	3.4	3.9	O K
8640 min Winter	98.731	0.031	3.0	3.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
10080 min Summer	0.982	0.0	5096		
15 min Winter	162.794	0.0	24		
30 min Winter	94.465	0.0	37		
60 min Winter	54.815	0.0	62		
120 min Winter	31.808	0.0	104		
180 min Winter	23.135	0.0	142		
240 min Winter	18.457	0.0	180		
360 min Winter	13.424	0.0	254		
480 min Winter	10.710	0.0	326		
600 min Winter	8.989	0.0	396		
720 min Winter	7.790	0.0	464		
960 min Winter	6.211	0.0	596		
1440 min Winter	4.514	0.0	850		
2160 min Winter	3.280	0.0	1216		
2880 min Winter	2.616	0.0	1584		
4320 min Winter	1.905	0.0	2248		
5760 min Winter	1.521	0.0	2944		
7200 min Winter	1.277	0.0	3616		
8640 min Winter	1.108	0.0	4280		
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4th Floor Carvers Warehouse 77 Dale Street Manchester M1 2HG	Gellings Road Western SA01				
Date 01/03/2019 File Western A Q100 + 20 REVI...	Designed by Anna Elman Checked by Yusuf Lawson				
Micro Drainage Source Control 2018.1.1					
<u>Summary of Results for 100 year Return Period (+20%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
10080 min Winter	98.727	0.027	2.6	3.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
10080 min Winter	0.982	0.0	5088		
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4th Floor Carvers Warehouse 77 Dale Street Manchester M1 2HG	Gellings Road Western SA01	
Date 01/03/2019 File Western A Q100 + 20 REVI...	Designed by Anna Elman Checked by Yusuf Lawson	
Micro Drainage		Source Control 2018.1.1

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 341500 396100 SJ 41500 96100
C (1km)	-0.022
D1 (1km)	0.316
D2 (1km)	0.314
D3 (1km)	0.319
E (1km)	0.286
F (1km)	2.506
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.452

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To: (ha)	From:	To: (ha)	From:	To: (ha)
0	4 0.151	4	8 0.151	8	12 0.151

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4th Floor Carvers Warehouse 77 Dale Street Manchester M1 2HG	Gellings Road Western SA01													
Date 01/03/2019 File Western A Q100 + 20 REVI...	Designed by Anna Elman Checked by Yusuf Lawson													
Micro Drainage														
Source Control 2018.1.1														
Model Details Storage is Online Cover Level (m) 100.000 Infiltration Basin Structure Invert Level (m) 98.700 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.28944 Porosity 1.00 Infiltration Coefficient Side (m/hr) 0.28944 <table><tr><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td></tr><tr><td>0.000</td><td>110.0</td><td>1.000</td><td>249.8</td><td>1.300</td><td>302.8</td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	110.0	1.000	249.8	1.300	302.8
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)									
0.000	110.0	1.000	249.8	1.300	302.8									
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5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		Gellings Road Eastern Parcel B SA02																																																																																																																																																																																																	
Date 21/02/2019 File EASTERN B Q100 + 20 REVI...		Designed by Anna Elman Checked by Yusuf Lawson																																																																																																																																																																																																	
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Summary of Results for 100 year Return Period (+20%) Half Drain Time : 1278 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>98.784</td><td>0.334</td><td>1.6</td><td>114.1</td><td>O K</td></tr><tr><td>30 min Summer</td><td>98.835</td><td>0.385</td><td>1.6</td><td>131.6</td><td>O K</td></tr><tr><td>60 min Summer</td><td>98.891</td><td>0.441</td><td>1.6</td><td>150.9</td><td>O K</td></tr><tr><td>120 min Summer</td><td>98.950</td><td>0.500</td><td>1.6</td><td>171.1</td><td>O K</td></tr><tr><td>180 min Summer</td><td>98.984</td><td>0.534</td><td>1.6</td><td>182.6</td><td>O K</td></tr><tr><td>240 min Summer</td><td>99.006</td><td>0.556</td><td>1.6</td><td>190.3</td><td>O K</td></tr><tr><td>360 min Summer</td><td>99.033</td><td>0.583</td><td>1.6</td><td>199.4</td><td>O K</td></tr><tr><td>480 min Summer</td><td>99.047</td><td>0.597</td><td>1.6</td><td>204.1</td><td>O K</td></tr><tr><td>600 min Summer</td><td>99.053</td><td>0.603</td><td>1.6</td><td>206.2</td><td>O K</td></tr><tr><td>720 min Summer</td><td>99.054</td><td>0.604</td><td>1.6</td><td>206.5</td><td>O K</td></tr><tr><td>960 min Summer</td><td>99.046</td><td>0.596</td><td>1.6</td><td>203.9</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>99.021</td><td>0.571</td><td>1.6</td><td>195.3</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>98.987</td><td>0.537</td><td>1.6</td><td>183.5</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>98.955</td><td>0.505</td><td>1.6</td><td>172.6</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>98.896</td><td>0.446</td><td>1.6</td><td>152.4</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>98.840</td><td>0.390</td><td>1.6</td><td>133.3</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>98.787</td><td>0.337</td><td>1.6</td><td>115.4</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>98.739</td><td>0.289</td><td>1.6</td><td>98.9</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>162.794</td><td>0.0</td><td>27</td></tr><tr><td>30 min Summer</td><td>94.465</td><td>0.0</td><td>41</td></tr><tr><td>60 min Summer</td><td>54.815</td><td>0.0</td><td>70</td></tr><tr><td>120 min Summer</td><td>31.808</td><td>0.0</td><td>130</td></tr><tr><td>180 min Summer</td><td>23.135</td><td>0.0</td><td>188</td></tr><tr><td>240 min Summer</td><td>18.457</td><td>0.0</td><td>248</td></tr><tr><td>360 min Summer</td><td>13.424</td><td>0.0</td><td>366</td></tr><tr><td>480 min Summer</td><td>10.710</td><td>0.0</td><td>486</td></tr><tr><td>600 min Summer</td><td>8.989</td><td>0.0</td><td>604</td></tr><tr><td>720 min Summer</td><td>7.790</td><td>0.0</td><td>722</td></tr><tr><td>960 min Summer</td><td>6.211</td><td>0.0</td><td>960</td></tr><tr><td>1440 min Summer</td><td>4.514</td><td>0.0</td><td>1182</td></tr><tr><td>2160 min Summer</td><td>3.280</td><td>0.0</td><td>1560</td></tr><tr><td>2880 min Summer</td><td>2.616</td><td>0.0</td><td>1964</td></tr><tr><td>4320 min Summer</td><td>1.905</td><td>0.0</td><td>2772</td></tr><tr><td>5760 min Summer</td><td>1.521</td><td>0.0</td><td>3576</td></tr><tr><td>7200 min Summer</td><td>1.277</td><td>0.0</td><td>4336</td></tr><tr><td>8640 min Summer</td><td>1.108</td><td>0.0</td><td>5104</td></tr></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	98.784	0.334	1.6	114.1	O K	30 min Summer	98.835	0.385	1.6	131.6	O K	60 min Summer	98.891	0.441	1.6	150.9	O K	120 min Summer	98.950	0.500	1.6	171.1	O K	180 min Summer	98.984	0.534	1.6	182.6	O K	240 min Summer	99.006	0.556	1.6	190.3	O K	360 min Summer	99.033	0.583	1.6	199.4	O K	480 min Summer	99.047	0.597	1.6	204.1	O K	600 min Summer	99.053	0.603	1.6	206.2	O K	720 min Summer	99.054	0.604	1.6	206.5	O K	960 min Summer	99.046	0.596	1.6	203.9	O K	1440 min Summer	99.021	0.571	1.6	195.3	O K	2160 min Summer	98.987	0.537	1.6	183.5	O K	2880 min Summer	98.955	0.505	1.6	172.6	O K	4320 min Summer	98.896	0.446	1.6	152.4	O K	5760 min Summer	98.840	0.390	1.6	133.3	O K	7200 min Summer	98.787	0.337	1.6	115.4	O K	8640 min Summer	98.739	0.289	1.6	98.9	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	162.794	0.0	27	30 min Summer	94.465	0.0	41	60 min Summer	54.815	0.0	70	120 min Summer	31.808	0.0	130	180 min Summer	23.135	0.0	188	240 min Summer	18.457	0.0	248	360 min Summer	13.424	0.0	366	480 min Summer	10.710	0.0	486	600 min Summer	8.989	0.0	604	720 min Summer	7.790	0.0	722	960 min Summer	6.211	0.0	960	1440 min Summer	4.514	0.0	1182	2160 min Summer	3.280	0.0	1560	2880 min Summer	2.616	0.0	1964	4320 min Summer	1.905	0.0	2772	5760 min Summer	1.521	0.0	3576	7200 min Summer	1.277	0.0	4336	8640 min Summer	1.108	0.0	5104
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Date 21/02/2019 File EASTERN B Q100 + 20 REVI...		Designed by Anna Elman Checked by Yusuf Lawson			
XP Solutions		Source Control 2018.1.1			
<u>Summary of Results for 100 year Return Period (+20%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
10080 min Summer	98.695	0.245	1.6	83.9	O K
15 min Winter	98.824	0.374	1.6	128.0	O K
30 min Winter	98.882	0.432	1.6	147.8	O K
60 min Winter	98.946	0.496	1.6	169.6	O K
120 min Winter	99.014	0.564	1.6	192.9	O K
180 min Winter	99.054	0.604	1.6	206.5	O K
240 min Winter	99.081	0.631	1.6	215.7	O K
360 min Winter	99.115	0.665	1.6	227.3	O K
480 min Winter	99.134	0.684	1.6	233.8	O K
600 min Winter	99.144	0.694	1.6	237.4	O K
720 min Winter	99.149	0.699	1.6	239.1	O K
960 min Winter	99.148	0.698	1.6	238.6	O K
1440 min Winter	99.123	0.673	1.6	230.0	O K
2160 min Winter	99.076	0.626	1.6	214.0	O K
2880 min Winter	99.030	0.580	1.6	198.5	O K
4320 min Winter	98.940	0.490	1.6	167.7	O K
5760 min Winter	98.853	0.403	1.6	138.0	O K
7200 min Winter	98.773	0.323	1.6	110.3	O K
8640 min Winter	98.700	0.250	1.6	85.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
10080 min Summer	0.982	0.0	5848		
15 min Winter	162.794	0.0	26		
30 min Winter	94.465	0.0	41		
60 min Winter	54.815	0.0	70		
120 min Winter	31.808	0.0	128		
180 min Winter	23.135	0.0	186		
240 min Winter	18.457	0.0	244		
360 min Winter	13.424	0.0	360		
480 min Winter	10.710	0.0	476		
600 min Winter	8.989	0.0	592		
720 min Winter	7.790	0.0	706		
960 min Winter	6.211	0.0	930		
1440 min Winter	4.514	0.0	1354		
2160 min Winter	3.280	0.0	1676		
2880 min Winter	2.616	0.0	2136		
4320 min Winter	1.905	0.0	3028		
5760 min Winter	1.521	0.0	3864		
7200 min Winter	1.277	0.0	4680		
8640 min Winter	1.108	0.0	5368		
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XP Solutions	Source Control 2018.1.1	

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
10080 min Winter	98.636	0.186	1.6	63.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
10080 min Winter	0.982	0.0	6056

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XP Solutions	Source Control 2018.1.1	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 341500 396100 SJ 41500 96100
C (1km)	-0.022
D1 (1km)	0.316
D2 (1km)	0.314
D3 (1km)	0.319
E (1km)	0.286
F (1km)	2.506
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.380

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To: (ha)	From:	To: (ha)	From:	To: (ha)
0	4 0.127	4	8 0.127	8	12 0.127

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XP Solutions	Source Control 2018.1.1	

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.450 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.03132 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.03132

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	360.0	360.0	0.701	0.0	360.0
0.700	360.0	360.0	1.500	0.0	360.0

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<u>Summary of Results for 100 year Return Period (+20%)</u> Half Drain Time : 133 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>98.919</td><td>0.469</td><td>6.0</td><td>62.4</td><td>O K</td></tr><tr><td>30 min Summer</td><td>98.973</td><td>0.523</td><td>6.0</td><td>69.6</td><td>O K</td></tr><tr><td>60 min Summer</td><td>99.005</td><td>0.555</td><td>6.0</td><td>73.9</td><td>O K</td></tr><tr><td>120 min Summer</td><td>98.990</td><td>0.540</td><td>6.0</td><td>71.8</td><td>O K</td></tr><tr><td>180 min Summer</td><td>98.962</td><td>0.512</td><td>6.0</td><td>68.1</td><td>O K</td></tr><tr><td>240 min Summer</td><td>98.935</td><td>0.485</td><td>6.0</td><td>64.5</td><td>O K</td></tr><tr><td>360 min Summer</td><td>98.885</td><td>0.435</td><td>6.0</td><td>57.9</td><td>O K</td></tr><tr><td>480 min Summer</td><td>98.837</td><td>0.387</td><td>6.0</td><td>51.5</td><td>O K</td></tr><tr><td>600 min Summer</td><td>98.793</td><td>0.343</td><td>6.0</td><td>45.6</td><td>O K</td></tr><tr><td>720 min Summer</td><td>98.750</td><td>0.300</td><td>6.0</td><td>39.9</td><td>O K</td></tr><tr><td>960 min Summer</td><td>98.676</td><td>0.226</td><td>6.0</td><td>30.0</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>98.568</td><td>0.118</td><td>6.0</td><td>15.7</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>98.500</td><td>0.050</td><td>6.0</td><td>6.6</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>98.490</td><td>0.040</td><td>4.8</td><td>5.3</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>98.480</td><td>0.030</td><td>3.6</td><td>3.9</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>98.474</td><td>0.024</td><td>2.9</td><td>3.1</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>98.470</td><td>0.020</td><td>2.4</td><td>2.6</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>98.467</td><td>0.017</td><td>2.1</td><td>2.3</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>162.794</td><td>0.0</td><td>24</td></tr><tr><td>30 min Summer</td><td>94.465</td><td>0.0</td><td>38</td></tr><tr><td>60 min Summer</td><td>54.815</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>31.808</td><td>0.0</td><td>110</td></tr><tr><td>180 min Summer</td><td>23.135</td><td>0.0</td><td>140</td></tr><tr><td>240 min Summer</td><td>18.457</td><td>0.0</td><td>172</td></tr><tr><td>360 min Summer</td><td>13.424</td><td>0.0</td><td>240</td></tr><tr><td>480 min Summer</td><td>10.710</td><td>0.0</td><td>308</td></tr><tr><td>600 min Summer</td><td>8.989</td><td>0.0</td><td>374</td></tr><tr><td>720 min Summer</td><td>7.790</td><td>0.0</td><td>438</td></tr><tr><td>960 min Summer</td><td>6.211</td><td>0.0</td><td>560</td></tr><tr><td>1440 min Summer</td><td>4.514</td><td>0.0</td><td>786</td></tr><tr><td>2160 min Summer</td><td>3.280</td><td>0.0</td><td>1104</td></tr><tr><td>2880 min Summer</td><td>2.616</td><td>0.0</td><td>1468</td></tr><tr><td>4320 min Summer</td><td>1.905</td><td>0.0</td><td>2196</td></tr><tr><td>5760 min Summer</td><td>1.521</td><td>0.0</td><td>2936</td></tr><tr><td>7200 min Summer</td><td>1.277</td><td>0.0</td><td>3672</td></tr><tr><td>8640 min Summer</td><td>1.108</td><td>0.0</td><td>4392</td></tr></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	98.919	0.469	6.0	62.4	O K	30 min Summer	98.973	0.523	6.0	69.6	O K	60 min Summer	99.005	0.555	6.0	73.9	O K	120 min Summer	98.990	0.540	6.0	71.8	O K	180 min Summer	98.962	0.512	6.0	68.1	O K	240 min Summer	98.935	0.485	6.0	64.5	O K	360 min Summer	98.885	0.435	6.0	57.9	O K	480 min Summer	98.837	0.387	6.0	51.5	O K	600 min Summer	98.793	0.343	6.0	45.6	O K	720 min Summer	98.750	0.300	6.0	39.9	O K	960 min Summer	98.676	0.226	6.0	30.0	O K	1440 min Summer	98.568	0.118	6.0	15.7	O K	2160 min Summer	98.500	0.050	6.0	6.6	O K	2880 min Summer	98.490	0.040	4.8	5.3	O K	4320 min Summer	98.480	0.030	3.6	3.9	O K	5760 min Summer	98.474	0.024	2.9	3.1	O K	7200 min Summer	98.470	0.020	2.4	2.6	O K	8640 min Summer	98.467	0.017	2.1	2.3	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	162.794	0.0	24	30 min Summer	94.465	0.0	38	60 min Summer	54.815	0.0	64	120 min Summer	31.808	0.0	110	180 min Summer	23.135	0.0	140	240 min Summer	18.457	0.0	172	360 min Summer	13.424	0.0	240	480 min Summer	10.710	0.0	308	600 min Summer	8.989	0.0	374	720 min Summer	7.790	0.0	438	960 min Summer	6.211	0.0	560	1440 min Summer	4.514	0.0	786	2160 min Summer	3.280	0.0	1104	2880 min Summer	2.616	0.0	1468	4320 min Summer	1.905	0.0	2196	5760 min Summer	1.521	0.0	2936	7200 min Summer	1.277	0.0	3672	8640 min Summer	1.108	0.0	4392
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Date 21/02/2019 File Eastern C Q100 + 20 REVI...		Designed by Anna Elman Checked by Yusuf Lawson			
XP Solutions		Source Control 2018.1.1			
<u>Summary of Results for 100 year Return Period (+20%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
10080 min Summer	98.465	0.015	1.8	2.0	O K
15 min Winter	98.981	0.531	6.0	70.7	O K
30 min Winter	99.046	0.596	6.0	79.2	O K
60 min Winter	99.090	0.640	6.0	85.1	O K
120 min Winter	99.085	0.635	6.0	84.5	O K
180 min Winter	99.048	0.598	6.0	79.5	O K
240 min Winter	99.012	0.562	6.0	74.7	O K
360 min Winter	98.937	0.487	6.0	64.8	O K
480 min Winter	98.863	0.413	6.0	55.0	O K
600 min Winter	98.794	0.344	6.0	45.7	O K
720 min Winter	98.729	0.279	6.0	37.2	O K
960 min Winter	98.620	0.170	6.0	22.5	O K
1440 min Winter	98.500	0.050	6.0	6.7	O K
2160 min Winter	98.487	0.037	4.4	4.9	O K
2880 min Winter	98.479	0.029	3.5	3.9	O K
4320 min Winter	98.471	0.021	2.6	2.8	O K
5760 min Winter	98.467	0.017	2.1	2.3	O K
7200 min Winter	98.464	0.014	1.7	1.9	O K
8640 min Winter	98.463	0.013	1.5	1.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
10080 min Summer	0.982	0.0	5016		
15 min Winter	162.794	0.0	25		
30 min Winter	94.465	0.0	38		
60 min Winter	54.815	0.0	64		
120 min Winter	31.808	0.0	118		
180 min Winter	23.135	0.0	150		
240 min Winter	18.457	0.0	188		
360 min Winter	13.424	0.0	262		
480 min Winter	10.710	0.0	334		
600 min Winter	8.989	0.0	402		
720 min Winter	7.790	0.0	466		
960 min Winter	6.211	0.0	582		
1440 min Winter	4.514	0.0	742		
2160 min Winter	3.280	0.0	1096		
2880 min Winter	2.616	0.0	1436		
4320 min Winter	1.905	0.0	2204		
5760 min Winter	1.521	0.0	2856		
7200 min Winter	1.277	0.0	3672		
8640 min Winter	1.108	0.0	4344		
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Date 21/02/2019 File Eastern C Q100 + 20 REVI...	Designed by Anna Elman Checked by Yusuf Lawson	
XP Solutions	Source Control 2018.1.1	

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
10080 min Winter	98.461	0.011	1.4	1.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
10080 min Winter	0.982	0.0	5000

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 341500 396100 SJ 41500 96100
C (1km)	-0.022
D1 (1km)	0.316
D2 (1km)	0.314
D3 (1km)	0.319
E (1km)	0.286
F (1km)	2.506
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.228

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To: (ha)	From:	To: (ha)	From:	To: (ha)
0	4 0.076	4	8 0.076	8	12 0.076

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Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.450 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.30960 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.30960

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	140.0	140.0	0.701	0.0	140.0
0.700	140.0	140.0	1.500	0.0	140.0

APPENDIX 7: United Utilities Correspondence

Anna Elman

From: Bethell, Thomas <Thomas.Bethell@uuplc.co.uk>
Sent: 18 February 2019 12:16
To: Anna Elman
Cc: Wastewater Developer Services
Subject: FW: PDE MCA2031 - Pre-development enquiry 4200024362 Due date 22/02/2019
Attachments: PR1118_SK05_A_Proposed Site Plan.png; MC2031 Water RFI Request Location Plan.pdf; MCA2031 - Pre-development enquiry.pdf

Dear Anna,

Our reference for this pre-development enquiry: 4200024362

We have carried out an assessment of your application which is based on the information provided; this pre development advice will be valid for 12 months

Foul

Foul will be allowed to drain to the public foul sewer network which runs around/through the site at an unrestricted rate, and at any convenient point.

Surface Water

In order to follow the drainage hierarchy outlined in Building Regulations part H3 and National Planning Practice Guidance (NPPG), surface water should be drained via infiltration systems/soakaways wherever possible. The British Geological Survey (BGS) website indicates the area is ideal for infiltration. Surface water must therefore be discharged via infiltration.

If percolation tests are carried out in accordance with BRE365 and confirm infiltration is not a suitable method of SW disposal, we would be willing to review our position.

General Information:

Please be aware that on site drainage must be designed in accordance with Building Regulations, National Planning Policy, and local flood authority guidelines, we would recommend that you speak and make suitable agreements with the relevant statutory bodies.

Connection Application

Although we may discuss and agree discharge points & rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below

<http://www.unitedutilities.com/connecting-public-sewer.aspx>

Sewer Adoption Agreement

You may wish to offer the proposed new sewers for adoption. United Utilities assess adoption application based on Sewers adoption 6th Edition and for any pumping stations our company addenda document. Please refer to link below to obtain further guidance and application pack:

<http://www.unitedutilities.com/sewer-adoption.aspx>

Please note, if you intend to put forward your wastewater assets for adoption by United Utilities, the proposed detail design will be subject to a technical appraisal by an Adoption Engineer as we need to be sure that the proposals meets the requirements of Sewers for adoption and United Utilities Asset Standards. The proposed design should give consideration to long term operability and give United Utilities a cost effective proposal for the life of the assets. Therefore, further to this enquiry should you wish to progress a Section 104 agreement, we strongly recommend that no construction commences until the detailed drainage design, submitted as part of the Section 104 agreement, has been assessed and accepted in writing by United Utilities. Any works carried out prior to the technical assessment being approved is done entirely at the developers own risk and could be subject to change.

Trade Effluent

If you intend to discharge trade effluent to the public sewer you will require a trade effluent permit. Please see United Utilities' website for details.

<https://www.unitedutilities.com/wholesale-services/trade-effluent/>

Existing Sewers Crossing the Site

A public sewer crosses this site and we will require unrestricted access to the sewer for maintenance purposes, we would ask that you maintain a minimum clearance of 3m either side from the centreline of the sewer (refer to Sewers for Adoption 6th edition, Section 2.5, Table 2.1). If you cannot achieve this then you may wish to consider diverting the public sewer.

Please refer to the link below to obtain full details of the processes involved in sewer diversion.

<http://www.unitedutilities.com/sewer-diversion.aspx>

Many thanks and kind regards,

Tom

If you have received a great service today why not tell us?

Visit: [unitedutilities.com/wow](https://www.unitedutilities.com/wow)

Thomas Bethell

Assistant Developer Engineer

United Utilities

01925 679 308

From: Anna Elman [<mailto:Anna.Elman@bwbconsulting.com>]

Sent: 08 February 2019 12:50

To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>

Subject: MCA2031 - Pre-development enquiry

Good Afternoon

Please find attached: the completed pre-development enquiry form, site location and site layout plan for a site off Gellings Road, Knowsley.

The development is in the very early stages of planning and as such some of the information within the form is currently unknown. However, any information that you can provide that may help identify potential surface and foul water drainage strategies would be greatly appreciated.

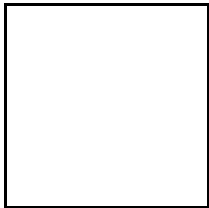
Kind Regards

Anna Elman

Graduate Consultant | BWB Consulting Limited

11 Portland Street, Manchester, M1 3HU

T 0161 233 4260 D 0161 233 4265 W www.bwbconsulting.com



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EMGateway3.uuplc.co.uk made the following annotations

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