

ENVIRONMENT

Tilstone Industrial Limited
Gellings Road
Knowsley
Sustainable Drainage Statement

ENVIRONMENT

Tilstone Industrial Limited
Gellings Road
Knowsley
Sustainable Drainage Statement

Birmingham
Livery Place, 35 Livery Street, Colmore Business District, Birmingham, B3 2PB
T: 0121 233 3322

Cambridge
14-16 High Street, Histon, Cambridge
CB24 9JD
T: 01223 235 173

Leeds
Whitehall Waterfront, 2 Riverside Way, Leeds
LS1 4EH
T: 0113 233 8000

London
11 Borough High Street
London, SE1 9SE
T: 0207 407 3879

Manchester
4th Floor Carvers Warehouse, 77 Dale Street
Manchester, M1 2HG
T: 0161 233 4260

Market Harborough
12a Woodcock House, Compass Point Market Harborough, Leicestershire, LE16 9HW
T: 01858 455020

Nottingham
Waterfront House, Station Street, Nottingham NG2 3DQ
T: 0115 924 1100

September 2021

DOCUMENT ISSUE RECORD

Document Number:	GRK-BWB-ZZ-XX-RP-CD-0001_SDS-S2-PO3
BWB Reference:	MCA-2031_SDS

Revision	Date of Issue	Status	Author:	Checked:	Approved:
P01	08/03/19	S2	Anna Elman BSc (Hons)	Yusuf Lawson BSc (Hons)	Darren Harvey BEng (Hons)
P02	08/04/19	S2	Anna Elman BSc (Hons)	Yusuf Lawson BSc (Hons)	Darren Harvey BEng (Hons)
P03	24/09/21	S2	Rowan Jobling BEng (Hons)	Matthew Bailey BSc (Hons)	Keith Alger BSc (Hons) MSc

Notice

All comments and proposals contained in this report, including any conclusions, are based on information available to BWB Consulting during investigations. The conclusions drawn by BWB Consulting could therefore differ if the information is found to be inaccurate or misleading. BWB Consulting accepts no liability should this be the case, nor if additional information exists or becomes available with respect to this scheme.

Except as otherwise requested by the client, BWB Consulting is not obliged to and disclaims any obligation to update the report for events taking place after: -

- (i) The date on which this assessment was undertaken, and
- (ii) The date on which the final report is delivered

BWB Consulting makes no representation whatsoever concerning the legal significance of its findings or the legal matters referred to in the following report.

All Environment Agency mapping data used under special license. Data is current as of September 2021 and is subject to change.

The information presented, and conclusions drawn, are based on statistical data and are for guidance purposes only. The study provides no guarantee against flooding of the study site or elsewhere, nor of the absolute accuracy of water levels, flow rates and associated probabilities.

This document has been prepared for the sole use of the Client in accordance with the terms of the appointment under which it was produced. BWB Consulting Limited accepts no responsibility for any use of or reliance on the contents of this document by any third party. No part of this document shall be copied or reproduced in any form without the prior written permission of BWB

CONTENTS

1.	INTRODUCTION.....	1
	Sustainable Drainage Guidance.....	2
2.	EXISTING CONDITIONS	3
	Existing Runoff Rates	4
	Existing Runoff Volume	5
3.	SURFACE WATER DRAINAGE STRATEGY	6
	Drainage Hierarchy	6
	Infiltration Test Results	6
	Sustainable Drainage Systems	6
4.	FOUL WATER DRAINAGE.....	8
5.	MAINTENANCE	9
6.	SUMMARY	10

FIGURES

Figure 1.1: Site Location

Figure 2.1: View from within the Site, looking towards the East

TABLES

Table 1.1: Site Details

Table 2.1: Existing Greenfield Runoff Rates from the Site

Table 6.1: Sustainable Drainage Statement Summary

APPENDICES

APPENDIX 1: Proposed Layout

APPENDIX 2: Topographical Survey

APPENDIX 3: United Utilities Sewer Records

APPENDIX 4: BRE 365 Report

APPENDIX 5: Greenfield Runoff Rate

APPENDIX 6: Greenfield Runoff Volume

APPENDIX 7: Micro Drainage Calculations

APPENDIX 8: Drainage Strategy Drawing

APPENDIX 9: United Utilities Correspondence

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 located off Gellings Road, Knowsley ('the Site'). The Proposed Development is understood to involve the construction of a single industrial unit, with associated parking and service yard, 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 SDS accompanies this overarching document.
- 1.4 This SDS is intended to support a full planning application and as such the level of detail included is commensurate and subject to the nature of the Proposed Development.
- 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)	0.82
Development Area (ha)	0.82
Development Type	Industrial
Lead Local Flood Authority	Knowsley Council
Local Planning Authority	Knowsley Council
Sewerage Undertaker	United Utilities

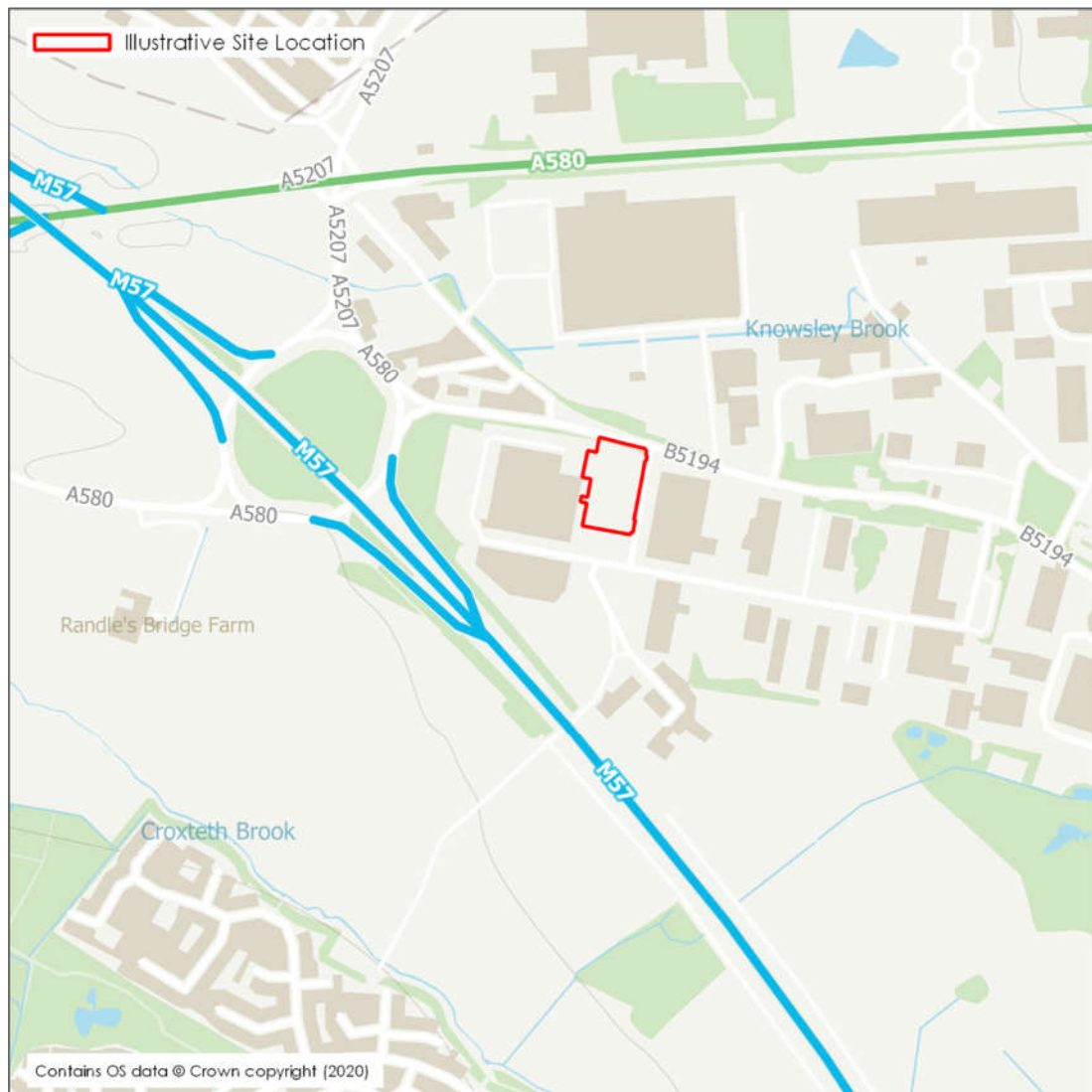


Figure 1.1: Site Location

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 Site is considered to be greenfield in nature and is located adjacent to Gellings Road to the east and Randles Road to the South. The B5194 is located to the north of the Site. Commercial land surrounds the Site to the north and east, with a car park located to the south. An existing commercial unit is located immediately to the west.
- 2.2 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.
- 2.3 A review of the topographical survey, included as **Appendix 2**, shows the Site to fall generally from north to south. Site levels range from 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, although it is understood from sewer records that there is a surface and foul water sewer crossing the northern portion of this Site. United Utilities have confirmed that a 6m easement (3m either side of the centreline) is required for their assets crossing the Site. The United Utilities sewer records are included as **Appendix 3**.
- 2.4 **Figure 2.1** shows the current condition of the Site, which is shown to comprise a mix of open spaces and vegetated areas, and slopes gradually from east to west.
- 2.5 The British Geological Survey (BGS) mapping identifies the underlying geology of the Site to be Sandstone. A BRE 365 report undertaken by BWB is included as **Appendix 4** and confirms the underlying bedrock. The results from the infiltration testing are discussed in **Section 3**.



Figure 2.1: View from within the Site, looking towards the East

Existing Runoff Rates

- 2.6 An assessment of the equivalent greenfield surface water runoff rates from the Proposed Development area has been undertaken and included within **Appendix 5**. These are also summarised within **Table 2.1** .
- 2.7 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.)	Existing Runoff Rates (l/s)
1	1.7
Mean Annual Flow Rate (QBAR)	1.9
30	3.3
100	4.0

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

Existing Runoff Volume

- 2.8 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.
- 2.9 As the existing Site is permeable, the runoff volume has been estimated using the Source Control module within Micro Drainage to be **168m³**. Results are included within **Appendix 6**.

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:
- into the ground (infiltration);
 - to a surface water body;
 - to a surface water sewer, highway drain, or another drainage system; and
 - 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. A total of three tests were carried out, two of which are relevant to this drainage strategy (SA02 & SA03). The BRE 365 report is included as **Appendix 4** and includes details of the testing locations.
- 3.4 Test SA02 was terminated at 2.50m below ground level (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.
- 3.5 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.
- 3.6 The infiltration tests confirm that discharge of surface water from the Proposed Development can be achieved via infiltration.

Sustainable Drainage Systems

- 3.7 To manage surface water as close as practicable to source, the surface water drainage strategy has been split into two catchments. Each catchment will discharge and be attenuated by a below ground infiltration tank. Results from SA02 have been used to inform the design of the northern catchment and results from SA03 have been used for the southern catchment. In both instances, in accordance with best practice, the lowest recorded infiltration rate has been used to inform the attenuation requirements.
- 3.8 A simulation has been run using Micro Drainage 'Source Control' to identify the necessary storage provision. The volume of storage required for the Proposed

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

⁵ The SuDS Manual (C753). CIRIA 2015.

Development has been calculated for storm events up to the 100 year + climate change events.

- 3.9 For the purpose of this outline assessment, it has been assumed that the 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 Proposed Development (e.g. in the pipe network, filter drains, etc.).
- 3.10 Storage has been sized with a safety factor of 5 being applied to the infiltration rates in accordance with the SuDS Manual, thus providing further redundancy in the system. However, this identifies excessive half drain down times. The same storage structures have been assessed with a lower safety factor 2 (the MicroDrainage default setting), which identifies half drain down times to be significantly below 24 hours. The results from the source control calculations are provided as **Appendix 7**.
- 3.11 Each attenuation tank has been sized to accommodate the 1 in 100-year + 40% climate change storm event and located a minimum of 5m from any existing or proposed structures. To provide sufficient treatment to flows from trafficked areas, petrol interceptors have been included into the design. As all flows will be infiltrated to ground the volume criterion is met for the Site.
- 3.12 For the contributing impermeable area of 0.659ha, an estimated 551m³ of storage is required across the Site, divided between two tanks, located within the northern and southern portions of the Site.
- 3.13 An indicative surface and foul water layout for the Proposed Development is shown on BWB Dwg No. **GRK-BWB-ZZ-XX-DR-CD-0002**, included as **Appendix 8**.

Residual Risk and Designing for Exceedance

- 3.14 It is recommended that the final layout uses the proposed road infrastructure to provide drainage exceedance (overland flood flow) routes through the Proposed Development and towards the attenuation features for events in excess of the capacity of the drainage system.
- 3.15 In the event that the capacity of the attenuation is exceeded, flood water will pool within the car parking areas and service yards and remain within the Site.

4. FOUL WATER DRAINAGE

- 4.1 Consultation with the local sewerage undertaker, United Utilities, was previously undertaken in 2019 which identified no capacity issues with the local sewerage network. The former response from United Utilities is provided as **Appendix 9**.
- 4.2 A new developer enquiry has been lodged with United Utilities to confirm that their previous response is still appropriate, however, no response has been received at the time of writing. Therefore, the nature of the Proposed Development area is such that it is expected that foul flows could be readily managed by the surrounding sewer network.
- 4.3 It is proposed to connect foul flows from the Proposed Development to the public sewer within Gellings Road. A S106 agreement should be sought prior to the connection being made.

5. MAINTENANCE

- 5.1 The maintenance responsibility of the drainage and SuDS features should be undertaken by the Site operator or a suitable appointed management company.
- 5.2 Requirements for ongoing maintenance of the drainage network should form part of the Operation and Maintenance Plan for the Site and should be undertaken by the Site management. Any specialist or proprietary products that are specified at detailed design should have a manufacturer-specific maintenance regime, which should be included within the document.
- 5.3 It is envisaged that the Operation and Maintenance Plan will be developed once the proprietary products have been specified, however, some examples are provided below.
- All drainage features should be located in open areas which are readily accessible;
 - Gullies should be inspected and de-silted at least once a year, where necessary;
 - Pipes, manholes and silt traps should be inspected and de-silted at least once a year, where necessary; and
 - The below ground tank should be regularly inspected and jetted, as appropriate, to remove silt and debris.

6. SUMMARY

- 6.1 This statement and supporting appendices demonstrate that the drainage design for the Proposed 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 a full planning application and as such the level of detail included is commensurate and subject to the nature of the Proposed Development.

Table 6.1: Sustainable Drainage Statement Summary

	Existing Site	Proposed Development	
Site Area (Ha)	0.82		
Impermeable Area (Ha)	0	0.659	
Outfall Location	Infiltration	Infiltration	
Infiltration Rate Range	0.031 - 0.289 m/s	0.031 m/s	
Volume Control	-	N/A	
Proposed Storage Volume	-	North = 323 m ³	South = 228 m ³
Flow Control Type	-	None	
SuDS Features	-	Infiltration Tank Oil Separator	
Maintenance Responsibility	-	Management Company	

- 6.3 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, however, confirmation of groundwater levels will be required in order to appropriately site soakaway drainage 1m above groundwater level.
- 6.4 It is recommended that the line and level of the existing public sewers crossing the Site is confirmed at the earliest available time in order to determine the appropriate easement zone.

APPENDICES

APPENDIX 1: Proposed Layout

General Notes

Do not scale from this drawing. Only work to written dimensions.

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

This drawing is the property of Fletcher-Rae (UK) Limited (t/a Fletcher-Rae) and copyright is reserved by them. The drawing is not to be copied or disclosed by or to any unauthorised persons without the prior written consent of Fletcher-Rae (UK) Limited.

Site Area - 0.82Ha
(2.03acres)

P3	General amendments	18/08/21		
P1	Red line boundary & fence line amended, building height increased, office elevations amended and bris soleils added, sub station added and general amendments	11/08/21		
P0	First Issue	20/07/21		
Rev.	Description	Date	ISS	APP

Scale 1 : 500 @ A2

Status

Drawn By JB

Checked By BB

Date 05/07/21

Client:

Tilstone Managing Warehouse REIT
PLC
Gellings Road
Knowsley

Sheet Name:

Proposed Site Plan

Project No. Orig. Zone Level Type Role Cls. Dwg No. Rev
19008-FRA-01-00-A-DR -90-1001 P3

fletcher|rae

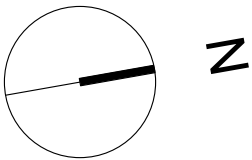
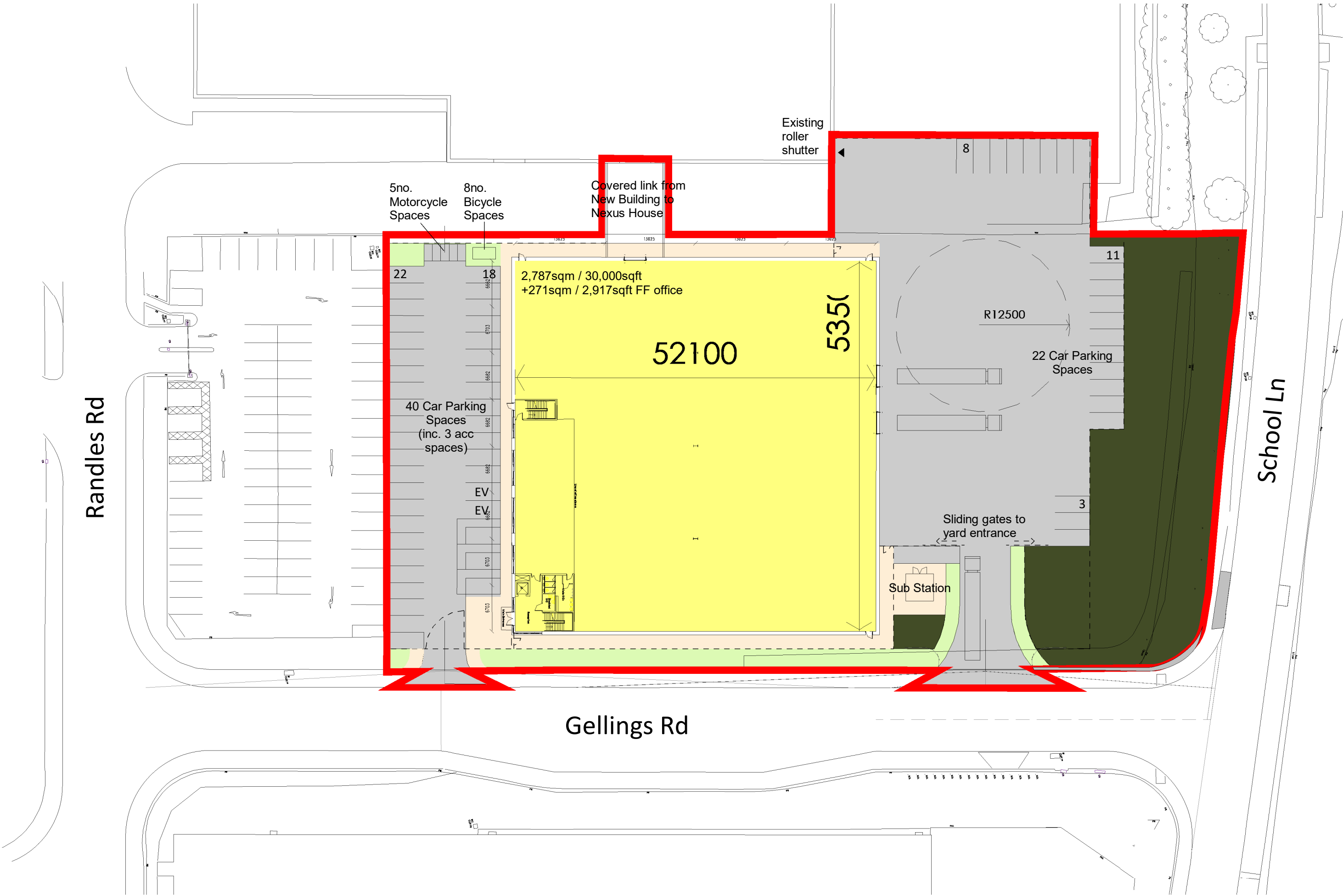
Architects | Master Planners | Designers

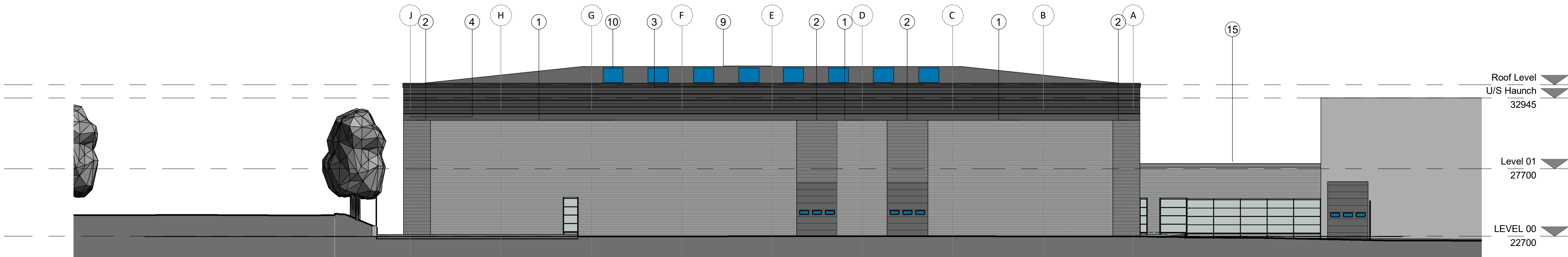
Hill Quays, 5 Jordan Street, Manchester, M15 4PY

t +44 (0) 161 242 1140
f +44 (0) 161 242 1141
w www.fletcher-rae.com
e info@fletcher-rae.com

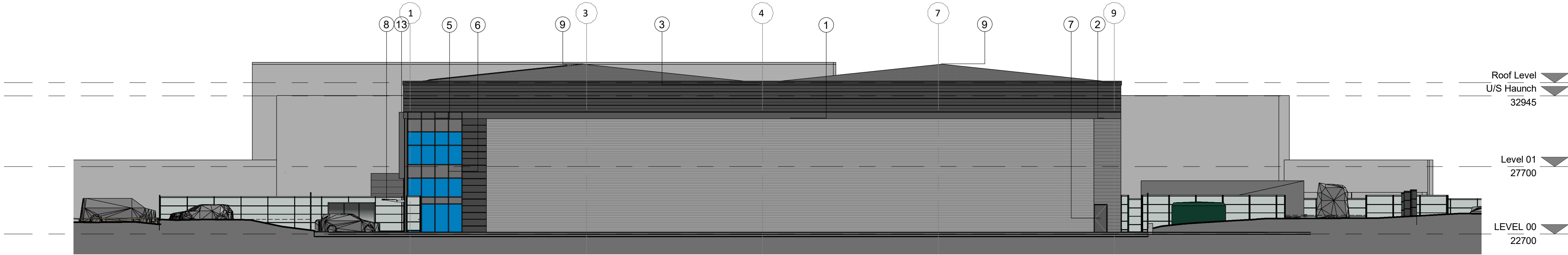
Proposed Site Plan

1 : 500

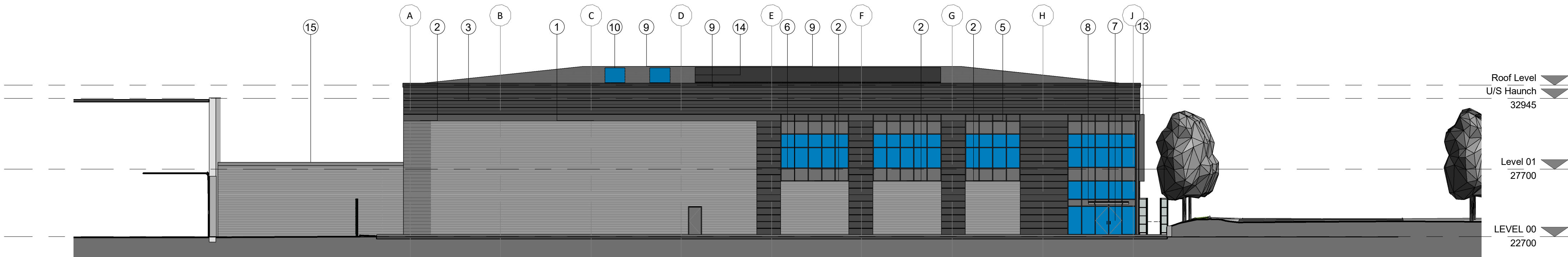




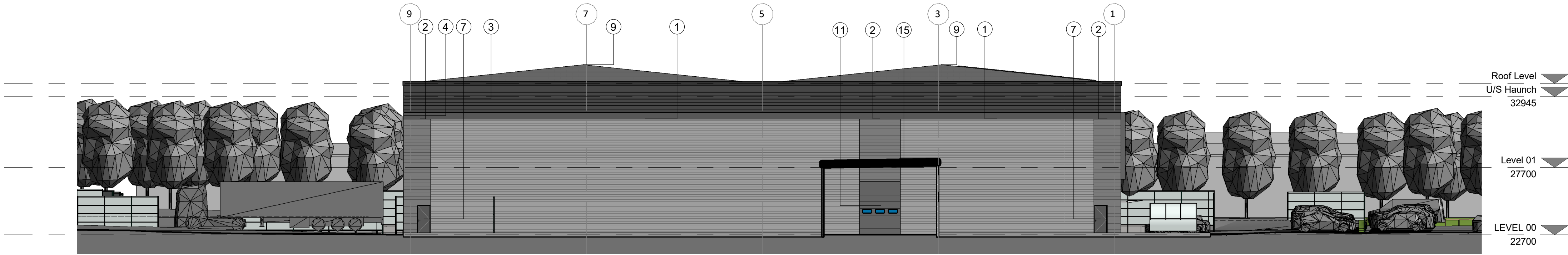
Proposed North Elevation
1 : 200



Proposed East Elevation
1 : 200



Proposed South Elevation
1 : 200



Proposed West Elevation
1 : 200

- Materials Key
- 1 - Horizontal trapezoidal cladding with colour matching flashings.
Colour - Light Grey, with preformed corners and Colour matching flashings.
 - 2 - Horizontal trapezoidal cladding with colour matching flashings.
Colour - Mid Grey, with preformed corners and Colour matching flashings.
 - 3 - Flat 500mm panel horizontal microrib cladding with shadow gaps and colour matched flashings.
Colour - Dark Grey
 - 4 - Flat 500mm panel horizontal microrib cladding with shadow gaps and colour matched flashings.
Colour - Mid Grey
 - 5 - PPC aluminium curtain walling / glazing system with double glazed units.
Colour - Frames in Dark Grey
 - 6 - PPC aluminium cladding blanking panel within curtain walling.
Colour - Dark Grey
 - 7 - Steel faced personnel / fire escape door to match colour of the surrounding cladding.
Colour - to match adjacent cladding. Internal face of door in white to match liner panel.
 - 8 - Glazed Canopy to Office Entrance
 - 9 - Composite kingspan roofing system KS1000RW with 15% rooflights. Fascia colour to match cladding below.
 - 10 - Kingspan Trapezoidal Roof Lights.
Colour - Frames in Dark Grey
 - 11 - Assa Abloy OH1042 Sectional Insulated Level Access Shutter Doors with 3 vision panels.
Colour - Dark Grey with Dark Grey frames
 - 12 - Aluminium capping to parapet
Colour - Dark Grey
 - 13 - Bris soleils formed as fins projecting from mullions
 - 14 - Area designated for Photovoltaic panels
 - 15 - Covered link to Nexus House - Light grey trapezoidal cladding to elevations. Kingspan composite monopitch roof.

General Notes

Do not scale from this drawing. Only work to written dimensions.

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

This drawing is the property of Fletcher-Rae (UK) Limited (t/a Fletcher-Rae) and copyright is reserved by them. The drawing is not to be copied or disclosed by or to any unauthorised persons without the prior written consent of Fletcher-Rae (UK) Limited.

P3	General amendments	18/08/21
P1	Red line boundary & fence line amended, building height increased, office elevations amended and bris soleils added, sub station added and general amendments	11/08/21

P0	First Issue	20/07/21	ISS	APP
Rev.	Description	Date		

Scale
Status
Drawn By
Checked By
Date
Client:

As indicated
@ A1
JB
BB
05/07/21

Tilstone Managing Warehouse REIT
PLC
Gellings Road
Knowsley

Sheet Name:
Proposed Elevations

Project No. Orig. Zone Level Type Role CIs Dwg No. Rev
19008-FRA-01-XX-A-DR-20-1004 P3
fletcher|rae
Architects | Master Planners | Designers
Hill Quays, 5 Jordan Street, Manchester, M15 4PY

t +44 (0) 161 242 1140
f +44 (0) 161 242 1141
w www.fletcher-rae.com
e info@fletcher-rae.com

APPENDIX 2: Topographical Survey

APPENDIX 3: United Utilities Sewer Records

BWB Consulting Ltd

**5th Floor, Waterfront House
Station Street,
Nottingham,
NG23DQ**

FAO:

How to contact us:

**United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP**

Telephone: 0370 7510101

E-mail: propertysearches@uuplc.co.uk

**Your Ref: MCA2031 - Gellings Road
Our Ref: UUPS-ORD-84497
Date: 12/02/2019**

Dear Sirs

Location: BOMAC ELECTRIC LTD RANGLES ROAD, KNOWSLEY BUSINESS PARK, PRESCOT, L34 9HX

I acknowledge with thanks your request dated 11/02/2019 for information on the location of our services.

Please find enclosed plans showing the approximate position of United Utilities' apparatus known to be in the vicinity of this site.

The enclosed plans are being provided to you subject to the United Utilities terms and conditions for both the wastewater and water distribution plans which are shown attached.

If you are planning works anywhere in the North West, please read United Utilities' access statement before you start work to check how it will affect our network. <http://www.unitedutilities.com/work-near-asset.aspx>.

I trust the above meets with your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please [contact us](#).

Yours Faithfully,



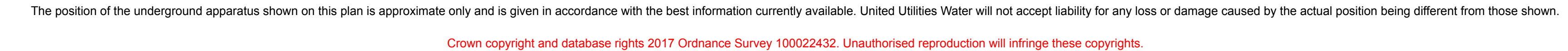
Karen McCormack
Property Searches Manager

TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

TERMS AND CONDITIONS:

- This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
- The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
- The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
- This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

[illegible]

All point assets follow the standard colour convention:

red	- combined	blue	- surface water
brown	- foul	purple	- overflow

- Manhole
- Head of System
- Extent of Survey
- Roding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- WW Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- ▽ Change of Characteristic

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic / Steel Composite
GRC	Glass Reinforced Plastic
DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Pitch Fibre
MAC	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

BOMAC ELECTRIC LTD RANGLES ROAD,
KNOWSLEY BUSINESS PARK,
PRESCOT,
L34 9HX

Printed by: Property Searches



United Utilities
helping life flow smoothly

APPENDIX 4: 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.

5th Floor
Waterfront House
Station Street
Nottingham
NG2 3DQ

Tel: 0115 924 1100

nottingham@bwbconsulting.com
www.bwbconsulting.com



**INVESTORS
IN PEOPLE** | Platinum
Until 2021

Registered office address: 5th Floor, Waterfront House, 35 Station Street, Nottingham NG2 3DQ

Registered in England and Wales Company No. 5265863

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)

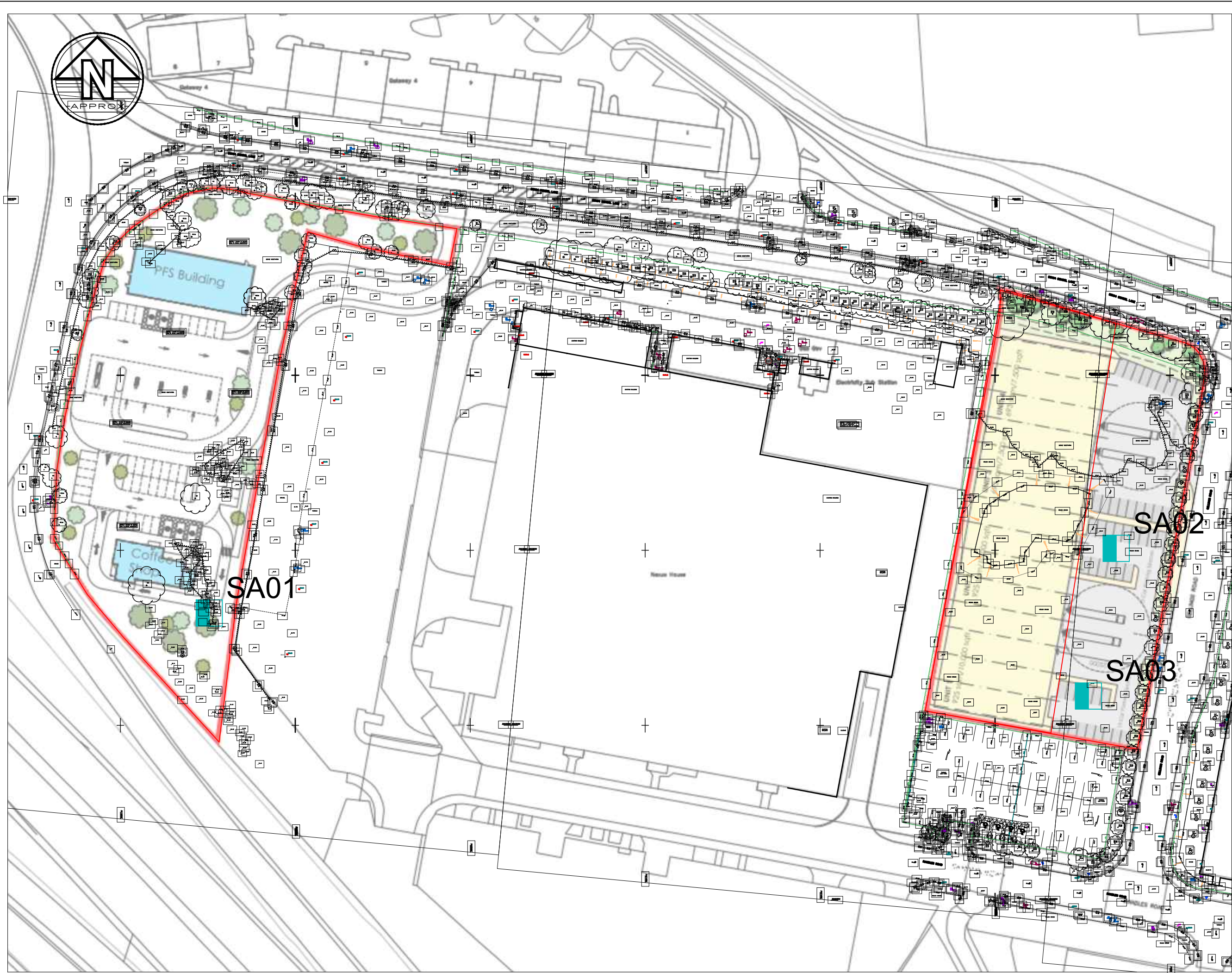
Graduate Geo-Environmental Consultant

0115 924 1100

patrick.taylor@bwbconsulting.com

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

DRAWING 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

BWB
CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

☐ Birmingham | 0121 233 3322
☐ Leeds | 0113 233 8000
☐ London | 020 7234 9122
☐ Manchester | 0161 233 4260
☒ Nottingham | 0115 924 1100
www.bwbconsulting.com

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:	1:1		
Drawing Status			
DRAFT			
Project - Originator - Zone - Level - Type - Role - Number			
GRK-BWB-ZZ-XX-DR-YE-0002_EHLP			
Status	S1	Rev	P1

APPENDIX 1
EXPLORATORY HOLE RECORDS

5th Floor
Waterfront House
Station Street
Nottingham
NG2 3DQ

Tel: 0115 924 1100

nottingham@bwbconsulting.com
www.bwbconsulting.com

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.

Strata

Samples

In-Situ Tests

Type

From (m)

To (m)

Type

Depth (m)

Result

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:

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

BWB Consulting Ltd

Waterfront House

Station Street

Nottingham

NG2 3DQ

Web:

bwbconsulting.com

E: nottingham

@bwbconsulting.com

P: 0115 9241100

BWB

CONSULTANCY | ENVIRONMENT

INFRASTRUCTURE | BUILDINGS

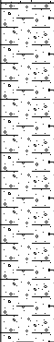
TRIAL PIT LOG

Scale: 1:25

Sheet 1 of 1

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	
				0.35m	Grass over dark greyish brown slightly silty slightly organic gravelly SAND with frequent rootlets. Gravel is medium sub-rounded quartzite. (Topsoil)	     	0.35							
				0.40m	Yellowish brown SAND. (Shirdley Hill Sand Formation)		0.75							
				0.15m	Dark brown and black amorphous PEAT. (Shirdley Hill Sand Formation)		0.90							
				0.30m	Yellowish brown SAND. (Shirdley Hill Sand Formation)		1.20							
				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							
				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							
				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	

TRIAL PIT LOG

Scale: 1:25

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

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
 2.45m bgl				0.30m	Grass over dark greyish brown slightly silty slightly organic slightly gravelly SAND with frequent rootlets. Gravel is medium sub-rounded quartzite.		0.30						
			22.80	0.15m	(Topsoil)			0.45					
			22.65		Dark brown silty SAND. (Shirdley Hill Sand Formation)			0.40m					
				0.40m	Dark orangish brown slightly clayey SAND. (Shirdley Hill Sand Formation)								
			22.25		Yellowish brown SAND. (Shirdley Hill Sand Formation)			0.85					
				0.75m									
			21.50		Dark brown and black amorphous PEAT. (Shirdley Hill Sand Formation)			1.60					
				0.40m									
			21.10	0.10m	Yellowish brown SAND. (Shirdley Hill Sand Formation)			2.00					
			21.00	0.45m	Grey mottled orangish brown slightly gravelly clayey SAND with occasional bands of sandy clay. Gravel is rounded fine to medium quartzite and sandstone. (Shirdley Hill Sand Formation)				2.10				
		20.55				2.55							
					Hole Terminated at 2.55m 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: Arisings damp below 2.40mbgl. Slight seepage at 2.45mbgl.				
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	

APPENDIX 2
SOAKAWAY PERMEABILITY ASSESSMENT SHEETS

5th Floor
Waterfront House
Station Street
Nottingham
NG2 3DQ

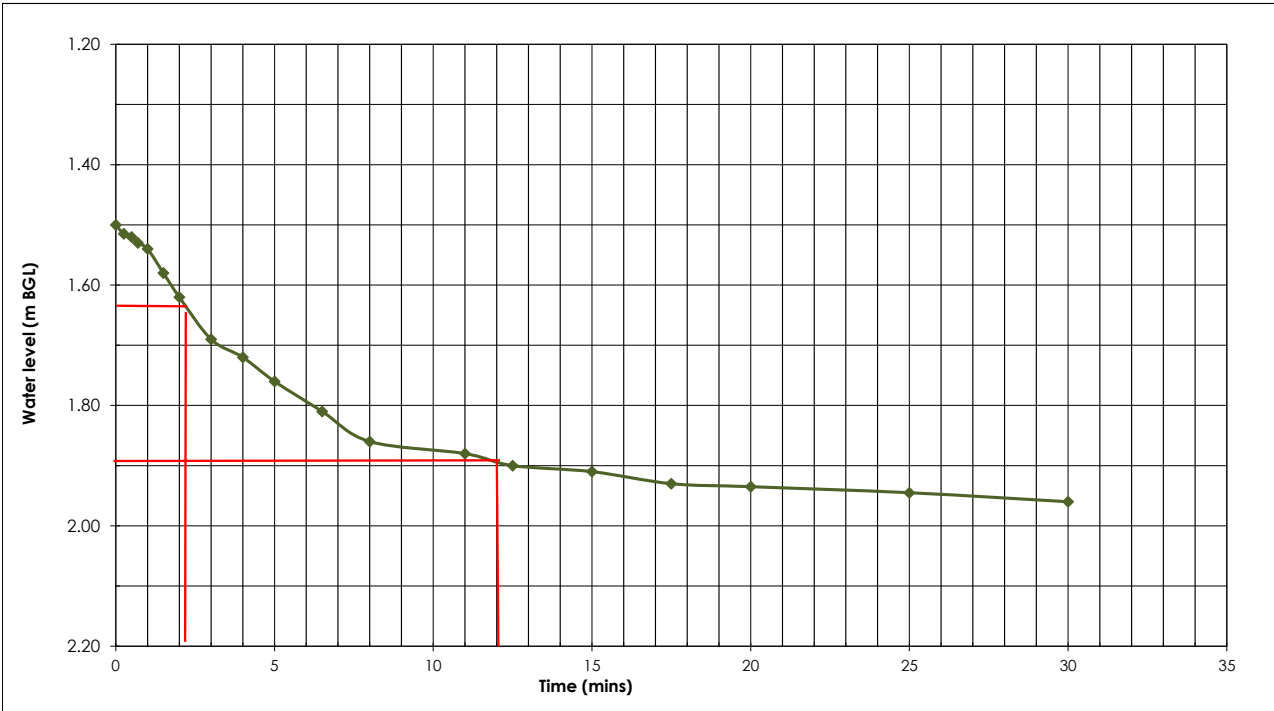
Tel: 0115 924 1100

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]

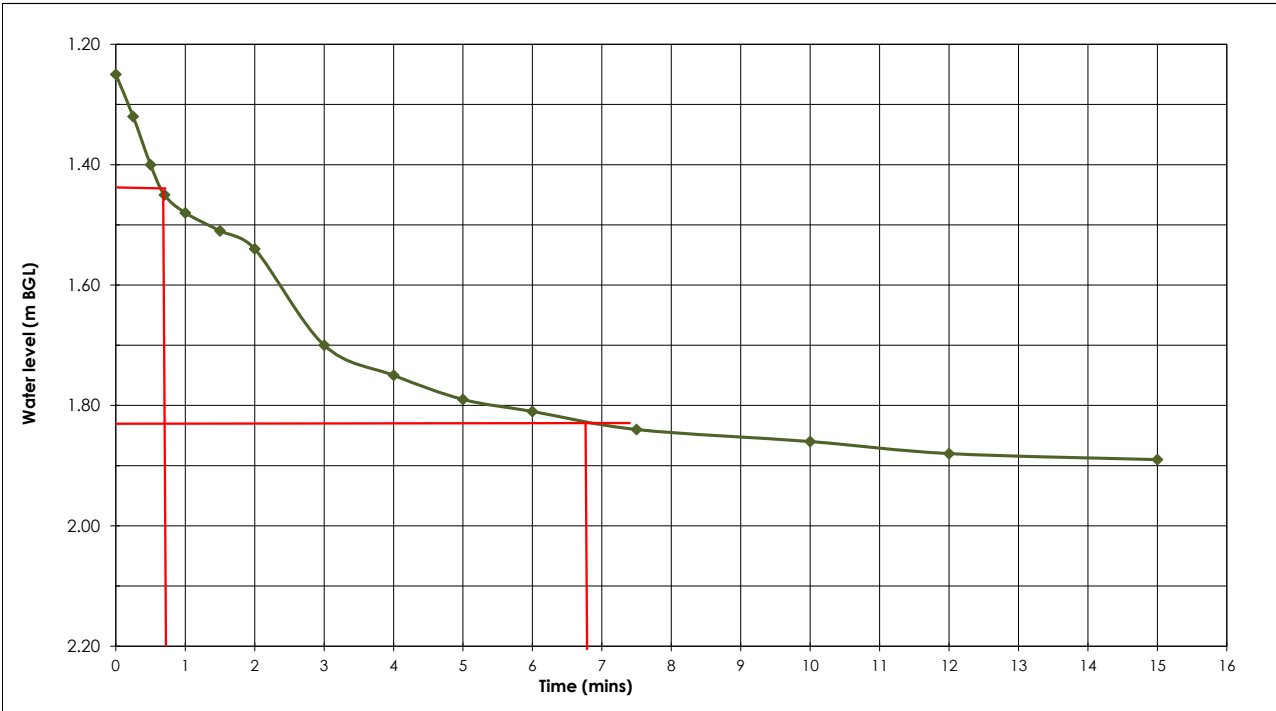
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.02
Effective depth (m)	1.50
Effective drop (m)	0.52
75% effective full depth (m)	1.63
50% effective full depth (m)	1.74
25% effective full depth (m)	1.85
t75 (min)	2.20
t50 (min)	
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]

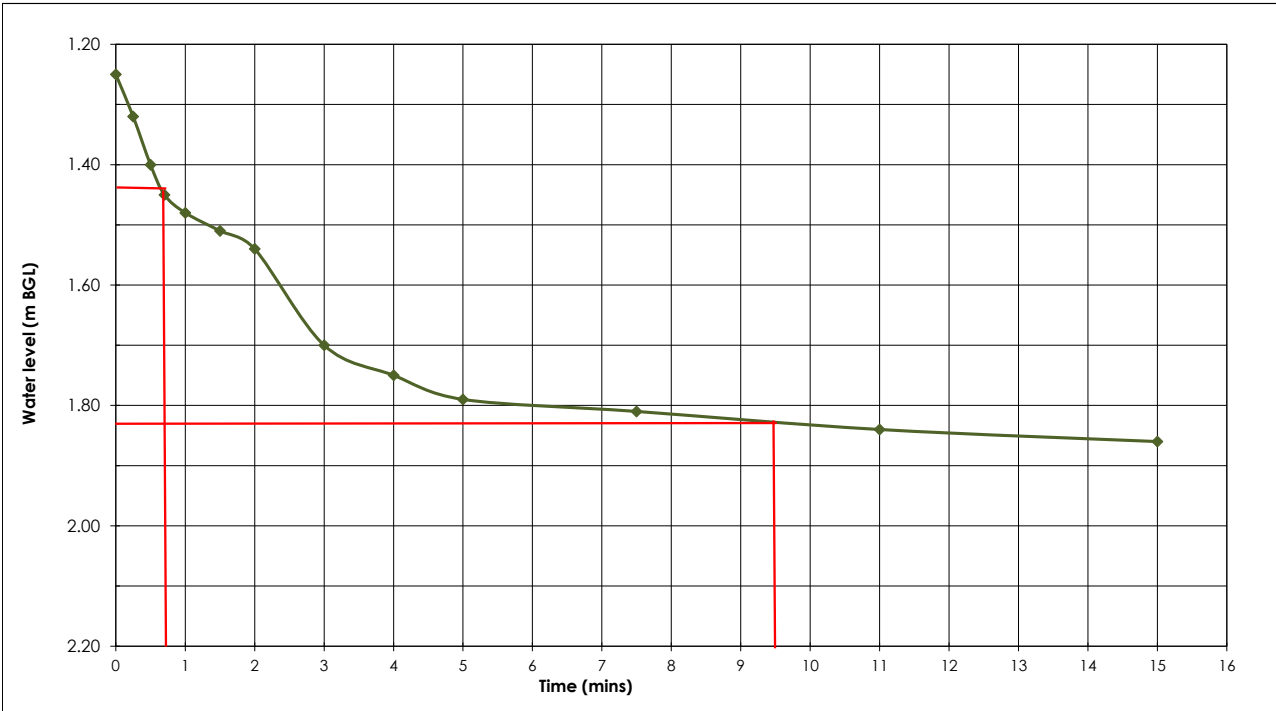
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.02
Effective depth (m)	1.25
Effective drop (m)	0.77
75% effective full depth (m)	1.44
50% effective full depth (m)	1.64
25% effective full depth (m)	1.83
t75 (min)	0.80
t50 (min)	
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	<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:	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]

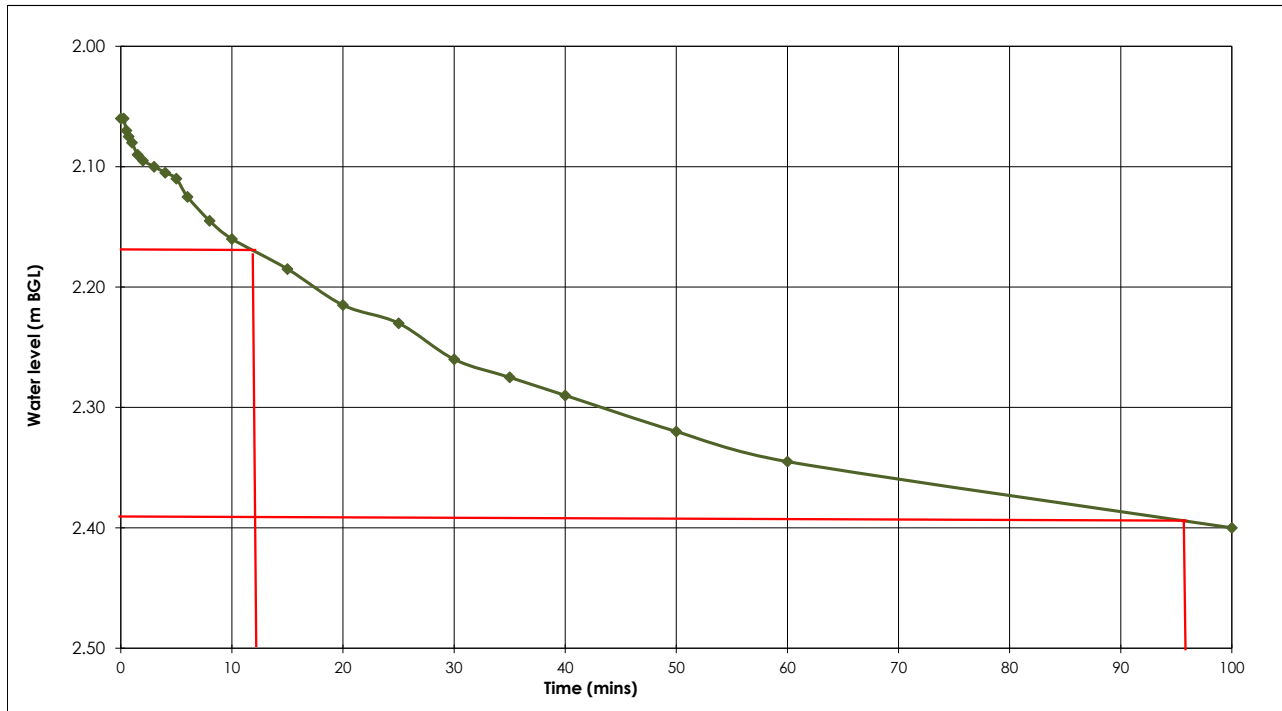
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.02
Effective depth (m)	1.25
Effective drop (m)	0.77
75% effective full depth (m)	1.44
50% effective full depth (m)	1.64
25% effective full depth (m)	1.83
t75 (min)	0.80
t50 (min)	
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

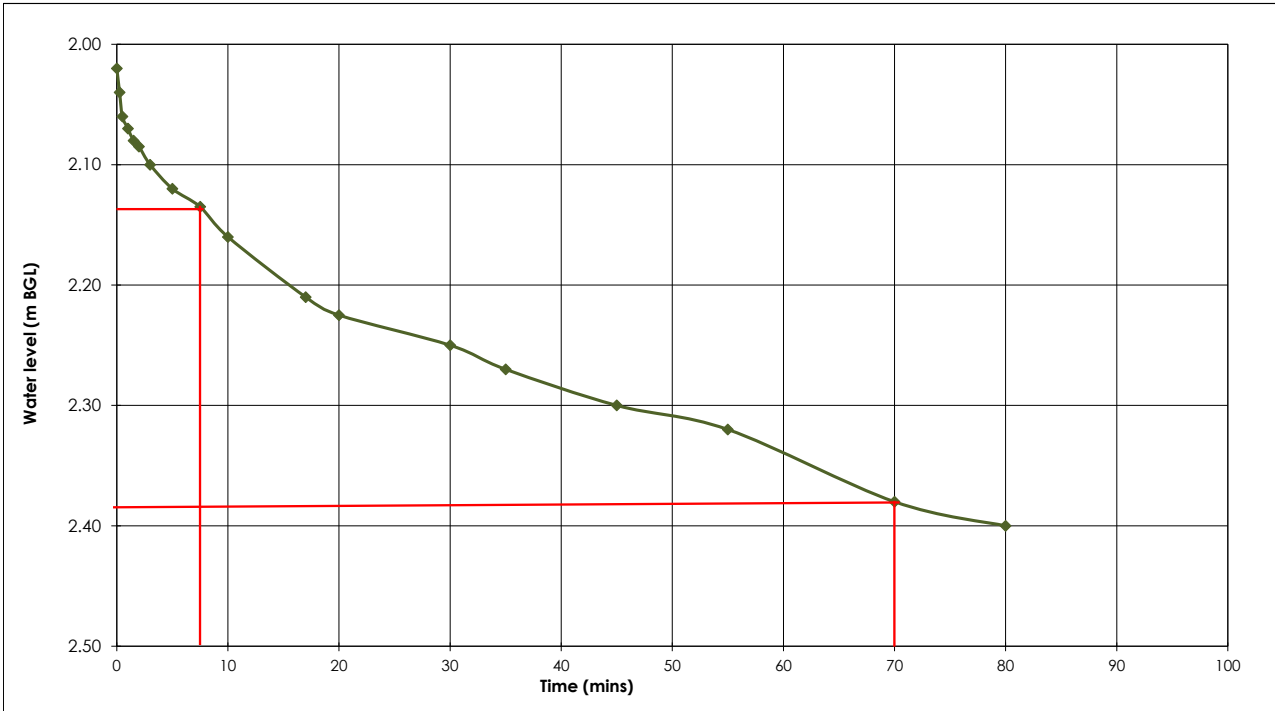
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.50
Effective depth (m)	2.06
Effective drop (m)	0.44
75% effective full depth (m)	2.17
50% effective full depth (m)	2.28
25% effective full depth (m)	2.39
t75 (min)	12.00
t50 (min)	
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]

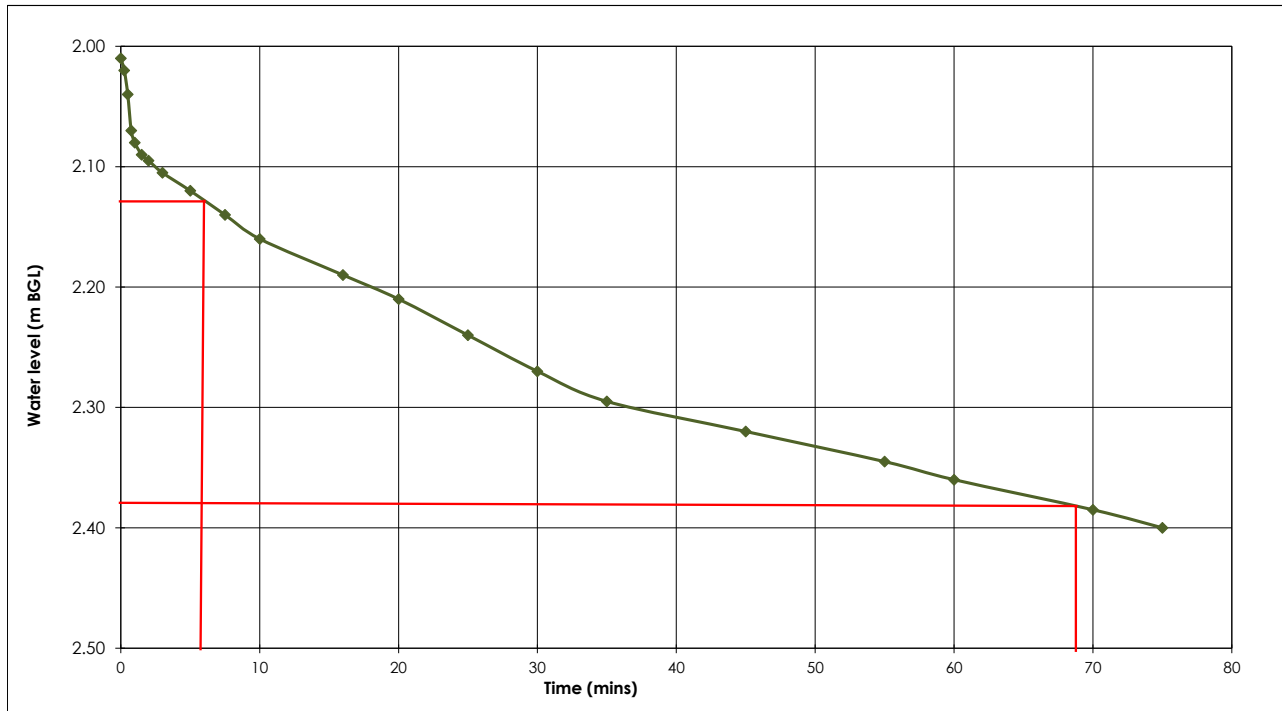
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.50
Effective depth (m)	2.02
Effective drop (m)	0.48
75% effective full depth (m)	2.14
50% effective full depth (m)	2.22
25% effective full depth (m)	2.38
t75 (min)	7.50
t50 (min)	
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

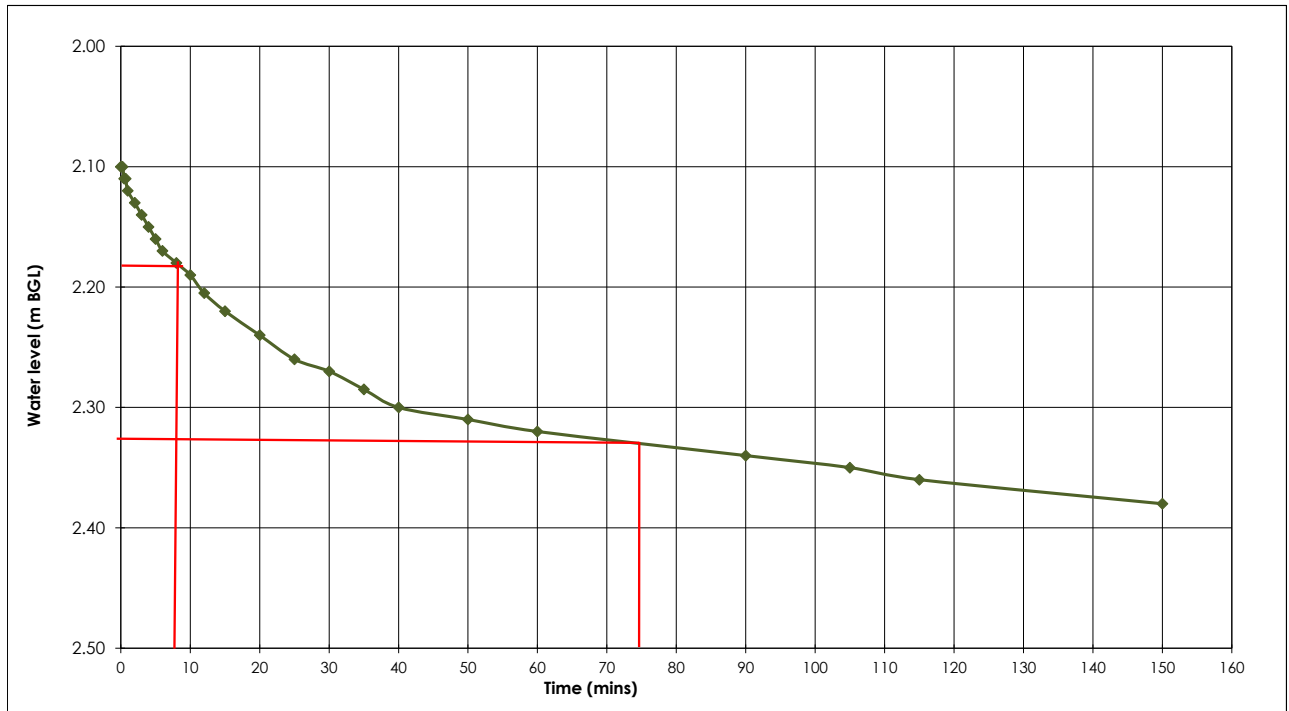
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.50
Effective depth (m)	2.01
Effective drop (m)	0.49
75% effective full depth (m)	2.13
50% effective full depth (m)	2.26
25% effective full depth (m)	2.38
t75 (min)	6.00
t50 (min)	
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

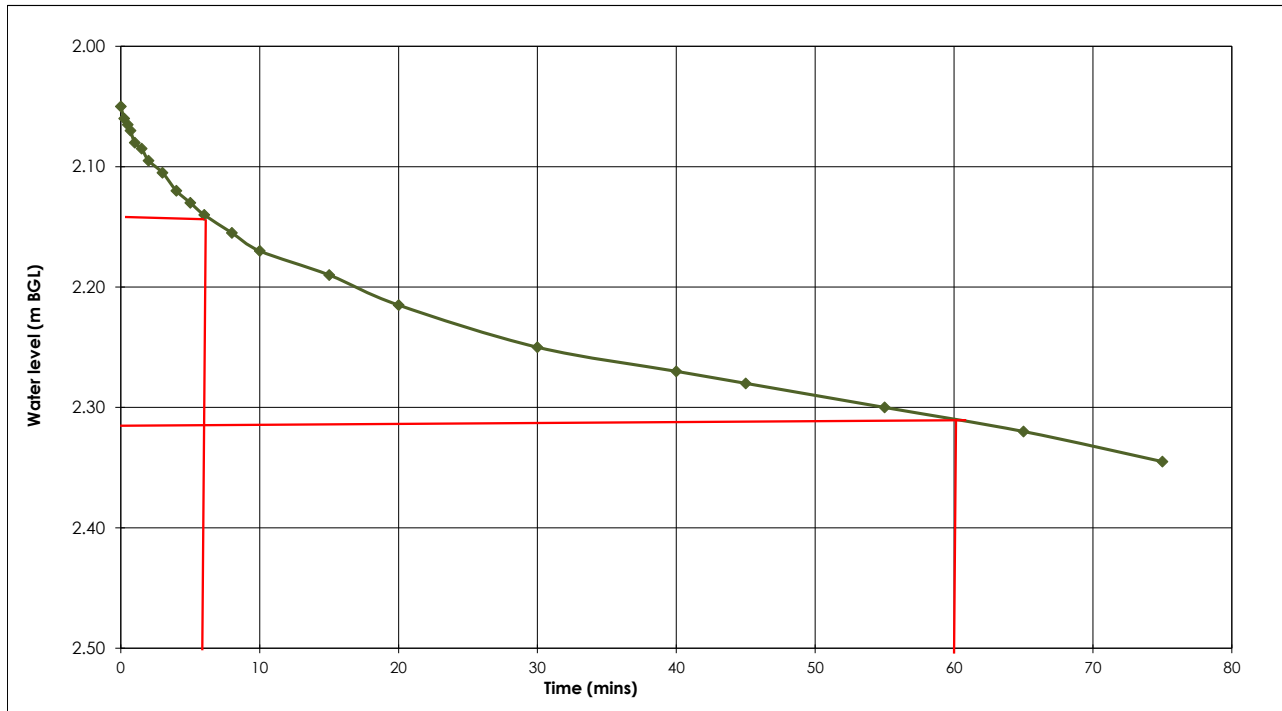
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.41
Effective depth (m)	2.10
Effective drop (m)	0.31
75% effective full depth (m)	2.18
50% effective full depth (m)	2.26
25% effective full depth (m)	2.33
t75 (min)	8.00
t50 (min)	
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

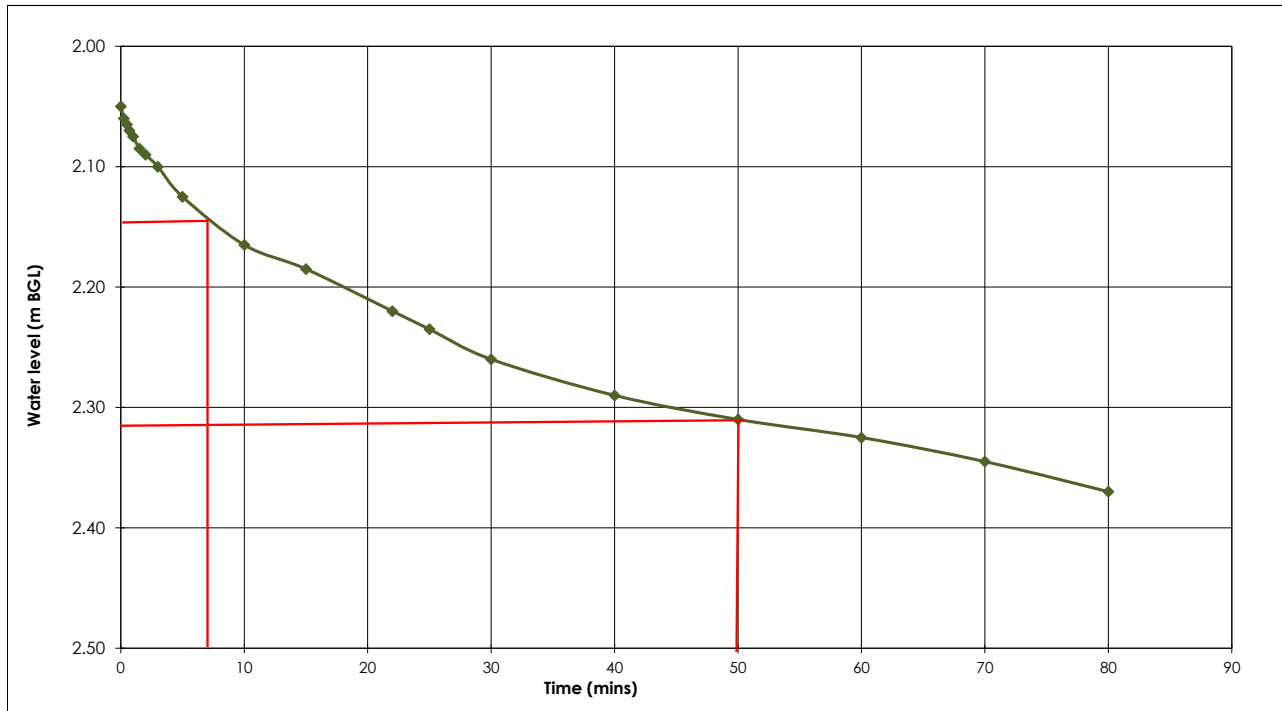
Test Information and Calculation	
Method of calculation	Linear extrapolation
Pit gravel filled? (Yes/No)	yes
Max. depth (m)	2.41
Effective depth (m)	2.05
Effective drop (m)	0.36
75% effective full depth (m)	2.14
50% effective full depth (m)	2.23
25% effective full depth (m)	2.32
t75 (min)	6.00
t50 (min)	
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 5: Greenfield Runoff Rate

BWB Consulting Ltd		Page 1
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ	MCA2031	
Date 20/09/2021 File	Designed by RJ Checked by	
Innovyze Source Control 2019.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.300
Area (ha)	0.820	Urban	0.000
SAAR (mm)	868	Region Number	Region 10

Results 1/s

QBAR Rural	1.9
QBAR Urban	1.9
Q2 years	1.8
Q1 year	1.7
Q30 years	3.3
Q100 years	4.0

©1982-2019 Innovyze

APPENDIX 6: Greenfield Runoff Volume

APPENDIX 7: Micro Drainage Calculations

BWB Consulting Ltd				Page 1																																																																																																																																																																																																																			
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		MCA2031 Gellings Road Northern Tank																																																																																																																																																																																																																					
Date 07/09/2021 File MCA2031 - NORTHERN SOAK...		Designed by RJ Checked by																																																																																																																																																																																																																					
Innovyze		Source Control 2019.1																																																																																																																																																																																																																					
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 1315 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>21.305</td><td>0.305</td><td>1.6</td><td>98.4</td><td>O K</td></tr><tr><td>30 min Summer</td><td>21.399</td><td>0.399</td><td>1.6</td><td>128.8</td><td>O K</td></tr><tr><td>60 min Summer</td><td>21.495</td><td>0.495</td><td>1.6</td><td>159.9</td><td>O K</td></tr><tr><td>120 min Summer</td><td>21.571</td><td>0.571</td><td>1.6</td><td>184.4</td><td>O K</td></tr><tr><td>180 min Summer</td><td>21.615</td><td>0.615</td><td>1.7</td><td>198.8</td><td>O K</td></tr><tr><td>240 min Summer</td><td>21.644</td><td>0.644</td><td>1.7</td><td>208.2</td><td>O K</td></tr><tr><td>360 min Summer</td><td>21.676</td><td>0.676</td><td>1.7</td><td>218.5</td><td>O K</td></tr><tr><td>480 min Summer</td><td>21.690</td><td>0.690</td><td>1.7</td><td>222.9</td><td>O K</td></tr><tr><td>600 min Summer</td><td>21.694</td><td>0.694</td><td>1.7</td><td>224.0</td><td>O K</td></tr><tr><td>720 min Summer</td><td>21.691</td><td>0.691</td><td>1.7</td><td>223.2</td><td>O K</td></tr><tr><td>960 min Summer</td><td>21.675</td><td>0.675</td><td>1.7</td><td>218.0</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>21.636</td><td>0.636</td><td>1.7</td><td>205.3</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>21.588</td><td>0.588</td><td>1.6</td><td>189.9</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>21.550</td><td>0.550</td><td>1.6</td><td>177.6</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>21.488</td><td>0.488</td><td>1.6</td><td>157.7</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>21.438</td><td>0.438</td><td>1.6</td><td>141.4</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>21.396</td><td>0.396</td><td>1.6</td><td>128.0</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>21.361</td><td>0.361</td><td>1.6</td><td>116.5</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>21.329</td><td>0.329</td><td>1.6</td><td>106.4</td><td>O K</td></tr><tr><td>15 min Winter</td><td>21.342</td><td>0.342</td><td>1.6</td><td>110.3</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>137.760</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>90.720</td><td>0.0</td><td>34</td></tr><tr><td>60 min Summer</td><td>56.980</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>33.600</td><td>0.0</td><td>124</td></tr><tr><td>180 min Summer</td><td>24.648</td><td>0.0</td><td>182</td></tr><tr><td>240 min Summer</td><td>19.740</td><td>0.0</td><td>242</td></tr><tr><td>360 min Summer</td><td>14.350</td><td>0.0</td><td>362</td></tr><tr><td>480 min Summer</td><td>11.399</td><td>0.0</td><td>482</td></tr><tr><td>600 min Summer</td><td>9.516</td><td>0.0</td><td>602</td></tr><tr><td>720 min Summer</td><td>8.202</td><td>0.0</td><td>720</td></tr><tr><td>960 min Summer</td><td>6.473</td><td>0.0</td><td>954</td></tr><tr><td>1440 min Summer</td><td>4.626</td><td>0.0</td><td>1168</td></tr><tr><td>2160 min Summer</td><td>3.313</td><td>0.0</td><td>1536</td></tr><tr><td>2880 min Summer</td><td>2.625</td><td>0.0</td><td>1956</td></tr><tr><td>4320 min Summer</td><td>1.909</td><td>0.0</td><td>2768</td></tr><tr><td>5760 min Summer</td><td>1.537</td><td>0.0</td><td>3576</td></tr><tr><td>7200 min Summer</td><td>1.311</td><td>0.0</td><td>4392</td></tr><tr><td>8640 min Summer</td><td>1.158</td><td>0.0</td><td>5184</td></tr><tr><td>10080 min Summer</td><td>1.048</td><td>0.0</td><td>5944</td></tr><tr><td>15 min Winter</td><td>137.760</td><td>0.0</td><td>19</td></tr></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	21.305	0.305	1.6	98.4	O K	30 min Summer	21.399	0.399	1.6	128.8	O K	60 min Summer	21.495	0.495	1.6	159.9	O K	120 min Summer	21.571	0.571	1.6	184.4	O K	180 min Summer	21.615	0.615	1.7	198.8	O K	240 min Summer	21.644	0.644	1.7	208.2	O K	360 min Summer	21.676	0.676	1.7	218.5	O K	480 min Summer	21.690	0.690	1.7	222.9	O K	600 min Summer	21.694	0.694	1.7	224.0	O K	720 min Summer	21.691	0.691	1.7	223.2	O K	960 min Summer	21.675	0.675	1.7	218.0	O K	1440 min Summer	21.636	0.636	1.7	205.3	O K	2160 min Summer	21.588	0.588	1.6	189.9	O K	2880 min Summer	21.550	0.550	1.6	177.6	O K	4320 min Summer	21.488	0.488	1.6	157.7	O K	5760 min Summer	21.438	0.438	1.6	141.4	O K	7200 min Summer	21.396	0.396	1.6	128.0	O K	8640 min Summer	21.361	0.361	1.6	116.5	O K	10080 min Summer	21.329	0.329	1.6	106.4	O K	15 min Winter	21.342	0.342	1.6	110.3	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	137.760	0.0	19	30 min Summer	90.720	0.0	34	60 min Summer	56.980	0.0	64	120 min Summer	33.600	0.0	124	180 min Summer	24.648	0.0	182	240 min Summer	19.740	0.0	242	360 min Summer	14.350	0.0	362	480 min Summer	11.399	0.0	482	600 min Summer	9.516	0.0	602	720 min Summer	8.202	0.0	720	960 min Summer	6.473	0.0	954	1440 min Summer	4.626	0.0	1168	2160 min Summer	3.313	0.0	1536	2880 min Summer	2.625	0.0	1956	4320 min Summer	1.909	0.0	2768	5760 min Summer	1.537	0.0	3576	7200 min Summer	1.311	0.0	4392	8640 min Summer	1.158	0.0	5184	10080 min Summer	1.048	0.0	5944	15 min Winter	137.760	0.0	19
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																		
15 min Summer	21.305	0.305	1.6	98.4	O K																																																																																																																																																																																																																		
30 min Summer	21.399	0.399	1.6	128.8	O K																																																																																																																																																																																																																		
60 min Summer	21.495	0.495	1.6	159.9	O K																																																																																																																																																																																																																		
120 min Summer	21.571	0.571	1.6	184.4	O K																																																																																																																																																																																																																		
180 min Summer	21.615	0.615	1.7	198.8	O K																																																																																																																																																																																																																		
240 min Summer	21.644	0.644	1.7	208.2	O K																																																																																																																																																																																																																		
360 min Summer	21.676	0.676	1.7	218.5	O K																																																																																																																																																																																																																		
480 min Summer	21.690	0.690	1.7	222.9	O K																																																																																																																																																																																																																		
600 min Summer	21.694	0.694	1.7	224.0	O K																																																																																																																																																																																																																		
720 min Summer	21.691	0.691	1.7	223.2	O K																																																																																																																																																																																																																		
960 min Summer	21.675	0.675	1.7	218.0	O K																																																																																																																																																																																																																		
1440 min Summer	21.636	0.636	1.7	205.3	O K																																																																																																																																																																																																																		
2160 min Summer	21.588	0.588	1.6	189.9	O K																																																																																																																																																																																																																		
2880 min Summer	21.550	0.550	1.6	177.6	O K																																																																																																																																																																																																																		
4320 min Summer	21.488	0.488	1.6	157.7	O K																																																																																																																																																																																																																		
5760 min Summer	21.438	0.438	1.6	141.4	O K																																																																																																																																																																																																																		
7200 min Summer	21.396	0.396	1.6	128.0	O K																																																																																																																																																																																																																		
8640 min Summer	21.361	0.361	1.6	116.5	O K																																																																																																																																																																																																																		
10080 min Summer	21.329	0.329	1.6	106.4	O K																																																																																																																																																																																																																		
15 min Winter	21.342	0.342	1.6	110.3	O K																																																																																																																																																																																																																		
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																				
15 min Summer	137.760	0.0	19																																																																																																																																																																																																																				
30 min Summer	90.720	0.0	34																																																																																																																																																																																																																				
60 min Summer	56.980	0.0	64																																																																																																																																																																																																																				
120 min Summer	33.600	0.0	124																																																																																																																																																																																																																				
180 min Summer	24.648	0.0	182																																																																																																																																																																																																																				
240 min Summer	19.740	0.0	242																																																																																																																																																																																																																				
360 min Summer	14.350	0.0	362																																																																																																																																																																																																																				
480 min Summer	11.399	0.0	482																																																																																																																																																																																																																				
600 min Summer	9.516	0.0	602																																																																																																																																																																																																																				
720 min Summer	8.202	0.0	720																																																																																																																																																																																																																				
960 min Summer	6.473	0.0	954																																																																																																																																																																																																																				
1440 min Summer	4.626	0.0	1168																																																																																																																																																																																																																				
2160 min Summer	3.313	0.0	1536																																																																																																																																																																																																																				
2880 min Summer	2.625	0.0	1956																																																																																																																																																																																																																				
4320 min Summer	1.909	0.0	2768																																																																																																																																																																																																																				
5760 min Summer	1.537	0.0	3576																																																																																																																																																																																																																				
7200 min Summer	1.311	0.0	4392																																																																																																																																																																																																																				
8640 min Summer	1.158	0.0	5184																																																																																																																																																																																																																				
10080 min Summer	1.048	0.0	5944																																																																																																																																																																																																																				
15 min Winter	137.760	0.0	19																																																																																																																																																																																																																				
©1982-2019 Innovyze																																																																																																																																																																																																																							

BWB Consulting Ltd				Page 2	
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		MCA2031 Gellings Road Northern Tank			
Date 07/09/2021 File MCA2031 - NORTHERN SOAK...		Designed by RJ Checked by			
Innovyze		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	21.447	0.447	1.6	144.5	O K
60 min Winter	21.556	0.556	1.6	179.7	O K
120 min Winter	21.643	0.643	1.7	207.8	O K
180 min Winter	21.695	0.695	1.7	224.5	O K
240 min Winter	21.729	0.729	1.7	235.6	O K
360 min Winter	21.769	0.769	1.7	248.4	O K
480 min Winter	21.788	0.788	1.7	254.6	O K
600 min Winter	21.796	0.796	1.7	257.2	O K
720 min Winter	21.798	0.798	1.7	257.6	O K
960 min Winter	21.787	0.787	1.7	254.4	O K
1440 min Winter	21.744	0.744	1.7	240.4	O K
2160 min Winter	21.683	0.683	1.7	220.7	O K
2880 min Winter	21.631	0.631	1.7	203.7	O K
4320 min Winter	21.538	0.538	1.6	173.7	O K
5760 min Winter	21.458	0.458	1.6	148.1	O K
7200 min Winter	21.392	0.392	1.6	126.5	O K
8640 min Winter	21.334	0.334	1.6	107.8	O K
10080 min Winter	21.284	0.284	1.6	91.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	90.720	0.0	33		
60 min Winter	56.980	0.0	64		
120 min Winter	33.600	0.0	122		
180 min Winter	24.648	0.0	180		
240 min Winter	19.740	0.0	240		
360 min Winter	14.350	0.0	356		
480 min Winter	11.399	0.0	472		
600 min Winter	9.516	0.0	588		
720 min Winter	8.202	0.0	700		
960 min Winter	6.473	0.0	924		
1440 min Winter	4.626	0.0	1340		
2160 min Winter	3.313	0.0	1664		
2880 min Winter	2.625	0.0	2108		
4320 min Winter	1.909	0.0	3024		
5760 min Winter	1.537	0.0	3864		
7200 min Winter	1.311	0.0	4680		
8640 min Winter	1.158	0.0	5448		
10080 min Winter	1.048	0.0	6248		
©1982-2019 Innovyze					

BWB Consulting Ltd		Page 4
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ	MCA2031 Gellings Road Northern Tank	
Date 07/09/2021 File MCA2031 - NORTHERN SOAK...	Designed by RJ Checked by	
Innovyze	Source Control 2019.1	

Model Details

Storage is Online Cover Level (m) 23.000

Cellular Storage Structure

Invert Level (m) 21.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.03096 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.03096

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	340.0	340.0	1.100	0.0	414.0
1.000	340.0	414.0			

©1982-2019 Innovyze

BWB Consulting Ltd				Page 1																																																																																																																																																																																																																			
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		MCA2031 Gellings Road Northern Tank																																																																																																																																																																																																																					
Date 07/09/2021 File MCA2031 - NORTHERN SOAK...		Designed by RJ Checked by																																																																																																																																																																																																																					
Innovyze		Source Control 2019.1																																																																																																																																																																																																																					
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 3832 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>21.307</td><td>0.307</td><td>0.6</td><td>99.2</td><td>O K</td></tr><tr><td>30 min Summer</td><td>21.403</td><td>0.403</td><td>0.6</td><td>130.3</td><td>O K</td></tr><tr><td>60 min Summer</td><td>21.504</td><td>0.504</td><td>0.6</td><td>162.9</td><td>O K</td></tr><tr><td>120 min Summer</td><td>21.590</td><td>0.590</td><td>0.7</td><td>190.5</td><td>O K</td></tr><tr><td>180 min Summer</td><td>21.644</td><td>0.644</td><td>0.7</td><td>207.9</td><td>O K</td></tr><tr><td>240 min Summer</td><td>21.682</td><td>0.682</td><td>0.7</td><td>220.3</td><td>O K</td></tr><tr><td>360 min Summer</td><td>21.733</td><td>0.733</td><td>0.7</td><td>236.7</td><td>O K</td></tr><tr><td>480 min Summer</td><td>21.765</td><td>0.765</td><td>0.7</td><td>247.2</td><td>O K</td></tr><tr><td>600 min Summer</td><td>21.788</td><td>0.788</td><td>0.7</td><td>254.5</td><td>O K</td></tr><tr><td>720 min Summer</td><td>21.804</td><td>0.804</td><td>0.7</td><td>259.6</td><td>O K</td></tr><tr><td>960 min Summer</td><td>21.823</td><td>0.823</td><td>0.7</td><td>266.0</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>21.837</td><td>0.837</td><td>0.7</td><td>270.4</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>21.833</td><td>0.833</td><td>0.7</td><td>268.9</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>21.815</td><td>0.815</td><td>0.7</td><td>263.4</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>21.784</td><td>0.784</td><td>0.7</td><td>253.3</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>21.764</td><td>0.764</td><td>0.7</td><td>246.7</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>21.753</td><td>0.753</td><td>0.7</td><td>243.2</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>21.747</td><td>0.747</td><td>0.7</td><td>241.2</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>21.743</td><td>0.743</td><td>0.7</td><td>240.0</td><td>O K</td></tr><tr><td>15 min Winter</td><td>21.344</td><td>0.344</td><td>0.6</td><td>111.1</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>137.760</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>90.720</td><td>0.0</td><td>34</td></tr><tr><td>60 min Summer</td><td>56.980</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>33.600</td><td>0.0</td><td>124</td></tr><tr><td>180 min Summer</td><td>24.648</td><td>0.0</td><td>184</td></tr><tr><td>240 min Summer</td><td>19.740</td><td>0.0</td><td>244</td></tr><tr><td>360 min Summer</td><td>14.350</td><td>0.0</td><td>364</td></tr><tr><td>480 min Summer</td><td>11.399</td><td>0.0</td><td>484</td></tr><tr><td>600 min Summer</td><td>9.516</td><td>0.0</td><td>602</td></tr><tr><td>720 min Summer</td><td>8.202</td><td>0.0</td><td>722</td></tr><tr><td>960 min Summer</td><td>6.473</td><td>0.0</td><td>962</td></tr><tr><td>1440 min Summer</td><td>4.626</td><td>0.0</td><td>1442</td></tr><tr><td>2160 min Summer</td><td>3.313</td><td>0.0</td><td>2160</td></tr><tr><td>2880 min Summer</td><td>2.625</td><td>0.0</td><td>2852</td></tr><tr><td>4320 min Summer</td><td>1.909</td><td>0.0</td><td>3500</td></tr><tr><td>5760 min Summer</td><td>1.537</td><td>0.0</td><td>4264</td></tr><tr><td>7200 min Summer</td><td>1.311</td><td>0.0</td><td>5048</td></tr><tr><td>8640 min Summer</td><td>1.158</td><td>0.0</td><td>5888</td></tr><tr><td>10080 min Summer</td><td>1.048</td><td>0.0</td><td>6760</td></tr><tr><td>15 min Winter</td><td>137.760</td><td>0.0</td><td>19</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	21.307	0.307	0.6	99.2	O K	30 min Summer	21.403	0.403	0.6	130.3	O K	60 min Summer	21.504	0.504	0.6	162.9	O K	120 min Summer	21.590	0.590	0.7	190.5	O K	180 min Summer	21.644	0.644	0.7	207.9	O K	240 min Summer	21.682	0.682	0.7	220.3	O K	360 min Summer	21.733	0.733	0.7	236.7	O K	480 min Summer	21.765	0.765	0.7	247.2	O K	600 min Summer	21.788	0.788	0.7	254.5	O K	720 min Summer	21.804	0.804	0.7	259.6	O K	960 min Summer	21.823	0.823	0.7	266.0	O K	1440 min Summer	21.837	0.837	0.7	270.4	O K	2160 min Summer	21.833	0.833	0.7	268.9	O K	2880 min Summer	21.815	0.815	0.7	263.4	O K	4320 min Summer	21.784	0.784	0.7	253.3	O K	5760 min Summer	21.764	0.764	0.7	246.7	O K	7200 min Summer	21.753	0.753	0.7	243.2	O K	8640 min Summer	21.747	0.747	0.7	241.2	O K	10080 min Summer	21.743	0.743	0.7	240.0	O K	15 min Winter	21.344	0.344	0.6	111.1	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	137.760	0.0	19	30 min Summer	90.720	0.0	34	60 min Summer	56.980	0.0	64	120 min Summer	33.600	0.0	124	180 min Summer	24.648	0.0	184	240 min Summer	19.740	0.0	244	360 min Summer	14.350	0.0	364	480 min Summer	11.399	0.0	484	600 min Summer	9.516	0.0	602	720 min Summer	8.202	0.0	722	960 min Summer	6.473	0.0	962	1440 min Summer	4.626	0.0	1442	2160 min Summer	3.313	0.0	2160	2880 min Summer	2.625	0.0	2852	4320 min Summer	1.909	0.0	3500	5760 min Summer	1.537	0.0	4264	7200 min Summer	1.311	0.0	5048	8640 min Summer	1.158	0.0	5888	10080 min Summer	1.048	0.0	6760	15 min Winter	137.760	0.0	19
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																		
15 min Summer	21.307	0.307	0.6	99.2	O K																																																																																																																																																																																																																		
30 min Summer	21.403	0.403	0.6	130.3	O K																																																																																																																																																																																																																		
60 min Summer	21.504	0.504	0.6	162.9	O K																																																																																																																																																																																																																		
120 min Summer	21.590	0.590	0.7	190.5	O K																																																																																																																																																																																																																		
180 min Summer	21.644	0.644	0.7	207.9	O K																																																																																																																																																																																																																		
240 min Summer	21.682	0.682	0.7	220.3	O K																																																																																																																																																																																																																		
360 min Summer	21.733	0.733	0.7	236.7	O K																																																																																																																																																																																																																		
480 min Summer	21.765	0.765	0.7	247.2	O K																																																																																																																																																																																																																		
600 min Summer	21.788	0.788	0.7	254.5	O K																																																																																																																																																																																																																		
720 min Summer	21.804	0.804	0.7	259.6	O K																																																																																																																																																																																																																		
960 min Summer	21.823	0.823	0.7	266.0	O K																																																																																																																																																																																																																		
1440 min Summer	21.837	0.837	0.7	270.4	O K																																																																																																																																																																																																																		
2160 min Summer	21.833	0.833	0.7	268.9	O K																																																																																																																																																																																																																		
2880 min Summer	21.815	0.815	0.7	263.4	O K																																																																																																																																																																																																																		
4320 min Summer	21.784	0.784	0.7	253.3	O K																																																																																																																																																																																																																		
5760 min Summer	21.764	0.764	0.7	246.7	O K																																																																																																																																																																																																																		
7200 min Summer	21.753	0.753	0.7	243.2	O K																																																																																																																																																																																																																		
8640 min Summer	21.747	0.747	0.7	241.2	O K																																																																																																																																																																																																																		
10080 min Summer	21.743	0.743	0.7	240.0	O K																																																																																																																																																																																																																		
15 min Winter	21.344	0.344	0.6	111.1	O K																																																																																																																																																																																																																		
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																				
15 min Summer	137.760	0.0	19																																																																																																																																																																																																																				
30 min Summer	90.720	0.0	34																																																																																																																																																																																																																				
60 min Summer	56.980	0.0	64																																																																																																																																																																																																																				
120 min Summer	33.600	0.0	124																																																																																																																																																																																																																				
180 min Summer	24.648	0.0	184																																																																																																																																																																																																																				
240 min Summer	19.740	0.0	244																																																																																																																																																																																																																				
360 min Summer	14.350	0.0	364																																																																																																																																																																																																																				
480 min Summer	11.399	0.0	484																																																																																																																																																																																																																				
600 min Summer	9.516	0.0	602																																																																																																																																																																																																																				
720 min Summer	8.202	0.0	722																																																																																																																																																																																																																				
960 min Summer	6.473	0.0	962																																																																																																																																																																																																																				
1440 min Summer	4.626	0.0	1442																																																																																																																																																																																																																				
2160 min Summer	3.313	0.0	2160																																																																																																																																																																																																																				
2880 min Summer	2.625	0.0	2852																																																																																																																																																																																																																				
4320 min Summer	1.909	0.0	3500																																																																																																																																																																																																																				
5760 min Summer	1.537	0.0	4264																																																																																																																																																																																																																				
7200 min Summer	1.311	0.0	5048																																																																																																																																																																																																																				
8640 min Summer	1.158	0.0	5888																																																																																																																																																																																																																				
10080 min Summer	1.048	0.0	6760																																																																																																																																																																																																																				
15 min Winter	137.760	0.0	19																																																																																																																																																																																																																				
©1982-2019 Innovyze																																																																																																																																																																																																																							

BWB Consulting Ltd				Page 2	
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		MCA2031 Gellings Road Northern Tank			
Date 07/09/2021 File MCA2031 - NORTHERN SOAK...		Designed by RJ Checked by			
Innovyze		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	21.452	0.452	0.6	146.0	O K
60 min Winter	21.566	0.566	0.7	182.7	O K
120 min Winter	21.662	0.662	0.7	213.8	O K
180 min Winter	21.723	0.723	0.7	233.6	O K
240 min Winter	21.767	0.767	0.7	247.7	O K
360 min Winter	21.826	0.826	0.7	266.7	O K
480 min Winter	21.864	0.864	0.7	278.9	O K
600 min Winter	21.890	0.890	0.7	287.5	O K
720 min Winter	21.910	0.910	0.7	293.8	O K
960 min Winter	21.935	0.935	0.7	301.9	O K
1440 min Winter	21.957	0.957	0.7	309.1	O K
2160 min Winter	21.962	0.962	0.7	310.7	O K
2880 min Winter	21.953	0.953	0.7	307.8	O K
4320 min Winter	21.920	0.920	0.7	297.1	O K
5760 min Winter	21.892	0.892	0.7	288.0	O K
7200 min Winter	21.875	0.875	0.7	282.7	O K
8640 min Winter	21.862	0.862	0.7	278.4	O K
10080 min Winter	21.851	0.851	0.7	274.9	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	90.720	0.0	34		
60 min Winter	56.980	0.0	64		
120 min Winter	33.600	0.0	122		
180 min Winter	24.648	0.0	182		
240 min Winter	19.740	0.0	242		
360 min Winter	14.350	0.0	360		
480 min Winter	11.399	0.0	478		
600 min Winter	9.516	0.0	596		
720 min Winter	8.202	0.0	714		
960 min Winter	6.473	0.0	950		
1440 min Winter	4.626	0.0	1414		
2160 min Winter	3.313	0.0	2096		
2880 min Winter	2.625	0.0	2768		
4320 min Winter	1.909	0.0	4016		
5760 min Winter	1.537	0.0	4552		
7200 min Winter	1.311	0.0	5472		
8640 min Winter	1.158	0.0	6400		
10080 min Winter	1.048	0.0	7360		
©1982-2019 Innovyze					

BWB Consulting Ltd		Page 4
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ	MCA2031 Gellings Road Northern Tank	
Date 07/09/2021 File MCA2031 - NORTHERN SOAK...	Designed by RJ Checked by	
Innovyze	Source Control 2019.1	

Model Details

Storage is Online Cover Level (m) 23.000

Cellular Storage Structure

Invert Level (m) 21.000 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.03096 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.03096

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	340.0	340.0	1.100	0.0	414.0
1.000	340.0	414.0			

©1982-2019 Innovyze

BWB Consulting Ltd				Page 1																																																																																																																																																																																																																			
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		MCA2031 Gellings Road Southern Tank																																																																																																																																																																																																																					
Date 07/09/2021 File MCA2031 - SOUTHERN SOAK...		Designed by RJ Checked by																																																																																																																																																																																																																					
Innovyze		Source Control 2019.1																																																																																																																																																																																																																					
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 1275 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>21.305</td><td>0.305</td><td>1.1</td><td>69.6</td><td>O K</td></tr><tr><td>30 min Summer</td><td>21.399</td><td>0.399</td><td>1.1</td><td>91.1</td><td>O K</td></tr><tr><td>60 min Summer</td><td>21.496</td><td>0.496</td><td>1.2</td><td>113.1</td><td>O K</td></tr><tr><td>120 min Summer</td><td>21.572</td><td>0.572</td><td>1.2</td><td>130.3</td><td>O K</td></tr><tr><td>180 min Summer</td><td>21.616</td><td>0.616</td><td>1.2</td><td>140.4</td><td>O K</td></tr><tr><td>240 min Summer</td><td>21.645</td><td>0.645</td><td>1.2</td><td>147.0</td><td>O K</td></tr><tr><td>360 min Summer</td><td>21.676</td><td>0.676</td><td>1.2</td><td>154.2</td><td>O K</td></tr><tr><td>480 min Summer</td><td>21.689</td><td>0.689</td><td>1.2</td><td>157.2</td><td>O K</td></tr><tr><td>600 min Summer</td><td>21.692</td><td>0.692</td><td>1.2</td><td>157.9</td><td>O K</td></tr><tr><td>720 min Summer</td><td>21.689</td><td>0.689</td><td>1.2</td><td>157.2</td><td>O K</td></tr><tr><td>960 min Summer</td><td>21.672</td><td>0.672</td><td>1.2</td><td>153.3</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>21.633</td><td>0.633</td><td>1.2</td><td>144.4</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>21.586</td><td>0.586</td><td>1.2</td><td>133.5</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>21.547</td><td>0.547</td><td>1.2</td><td>124.8</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>21.486</td><td>0.486</td><td>1.2</td><td>110.7</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>21.435</td><td>0.435</td><td>1.2</td><td>99.2</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>21.393</td><td>0.393</td><td>1.1</td><td>89.7</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>21.358</td><td>0.358</td><td>1.1</td><td>81.6</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>21.326</td><td>0.326</td><td>1.1</td><td>74.4</td><td>O K</td></tr><tr><td>15 min Winter</td><td>21.342</td><td>0.342</td><td>1.1</td><td>78.0</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>137.760</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>90.720</td><td>0.0</td><td>34</td></tr><tr><td>60 min Summer</td><td>56.980</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>33.600</td><td>0.0</td><td>124</td></tr><tr><td>180 min Summer</td><td>24.648</td><td>0.0</td><td>182</td></tr><tr><td>240 min Summer</td><td>19.740</td><td>0.0</td><td>242</td></tr><tr><td>360 min Summer</td><td>14.350</td><td>0.0</td><td>362</td></tr><tr><td>480 min Summer</td><td>11.399</td><td>0.0</td><td>482</td></tr><tr><td>600 min Summer</td><td>9.516</td><td>0.0</td><td>602</td></tr><tr><td>720 min Summer</td><td>8.202</td><td>0.0</td><td>720</td></tr><tr><td>960 min Summer</td><td>6.473</td><td>0.0</td><td>936</td></tr><tr><td>1440 min Summer</td><td>4.626</td><td>0.0</td><td>1152</td></tr><tr><td>2160 min Summer</td><td>3.313</td><td>0.0</td><td>1532</td></tr><tr><td>2880 min Summer</td><td>2.625</td><td>0.0</td><td>1932</td></tr><tr><td>4320 min Summer</td><td>1.909</td><td>0.0</td><td>2764</td></tr><tr><td>5760 min Summer</td><td>1.537</td><td>0.0</td><td>3576</td></tr><tr><td>7200 min Summer</td><td>1.311</td><td>0.0</td><td>4328</td></tr><tr><td>8640 min Summer</td><td>1.158</td><td>0.0</td><td>5112</td></tr><tr><td>10080 min Summer</td><td>1.048</td><td>0.0</td><td>5856</td></tr><tr><td>15 min Winter</td><td>137.760</td><td>0.0</td><td>19</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	21.305	0.305	1.1	69.6	O K	30 min Summer	21.399	0.399	1.1	91.1	O K	60 min Summer	21.496	0.496	1.2	113.1	O K	120 min Summer	21.572	0.572	1.2	130.3	O K	180 min Summer	21.616	0.616	1.2	140.4	O K	240 min Summer	21.645	0.645	1.2	147.0	O K	360 min Summer	21.676	0.676	1.2	154.2	O K	480 min Summer	21.689	0.689	1.2	157.2	O K	600 min Summer	21.692	0.692	1.2	157.9	O K	720 min Summer	21.689	0.689	1.2	157.2	O K	960 min Summer	21.672	0.672	1.2	153.3	O K	1440 min Summer	21.633	0.633	1.2	144.4	O K	2160 min Summer	21.586	0.586	1.2	133.5	O K	2880 min Summer	21.547	0.547	1.2	124.8	O K	4320 min Summer	21.486	0.486	1.2	110.7	O K	5760 min Summer	21.435	0.435	1.2	99.2	O K	7200 min Summer	21.393	0.393	1.1	89.7	O K	8640 min Summer	21.358	0.358	1.1	81.6	O K	10080 min Summer	21.326	0.326	1.1	74.4	O K	15 min Winter	21.342	0.342	1.1	78.0	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	137.760	0.0	19	30 min Summer	90.720	0.0	34	60 min Summer	56.980	0.0	64	120 min Summer	33.600	0.0	124	180 min Summer	24.648	0.0	182	240 min Summer	19.740	0.0	242	360 min Summer	14.350	0.0	362	480 min Summer	11.399	0.0	482	600 min Summer	9.516	0.0	602	720 min Summer	8.202	0.0	720	960 min Summer	6.473	0.0	936	1440 min Summer	4.626	0.0	1152	2160 min Summer	3.313	0.0	1532	2880 min Summer	2.625	0.0	1932	4320 min Summer	1.909	0.0	2764	5760 min Summer	1.537	0.0	3576	7200 min Summer	1.311	0.0	4328	8640 min Summer	1.158	0.0	5112	10080 min Summer	1.048	0.0	5856	15 min Winter	137.760	0.0	19
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																		
15 min Summer	21.305	0.305	1.1	69.6	O K																																																																																																																																																																																																																		
30 min Summer	21.399	0.399	1.1	91.1	O K																																																																																																																																																																																																																		
60 min Summer	21.496	0.496	1.2	113.1	O K																																																																																																																																																																																																																		
120 min Summer	21.572	0.572	1.2	130.3	O K																																																																																																																																																																																																																		
180 min Summer	21.616	0.616	1.2	140.4	O K																																																																																																																																																																																																																		
240 min Summer	21.645	0.645	1.2	147.0	O K																																																																																																																																																																																																																		
360 min Summer	21.676	0.676	1.2	154.2	O K																																																																																																																																																																																																																		
480 min Summer	21.689	0.689	1.2	157.2	O K																																																																																																																																																																																																																		
600 min Summer	21.692	0.692	1.2	157.9	O K																																																																																																																																																																																																																		
720 min Summer	21.689	0.689	1.2	157.2	O K																																																																																																																																																																																																																		
960 min Summer	21.672	0.672	1.2	153.3	O K																																																																																																																																																																																																																		
1440 min Summer	21.633	0.633	1.2	144.4	O K																																																																																																																																																																																																																		
2160 min Summer	21.586	0.586	1.2	133.5	O K																																																																																																																																																																																																																		
2880 min Summer	21.547	0.547	1.2	124.8	O K																																																																																																																																																																																																																		
4320 min Summer	21.486	0.486	1.2	110.7	O K																																																																																																																																																																																																																		
5760 min Summer	21.435	0.435	1.2	99.2	O K																																																																																																																																																																																																																		
7200 min Summer	21.393	0.393	1.1	89.7	O K																																																																																																																																																																																																																		
8640 min Summer	21.358	0.358	1.1	81.6	O K																																																																																																																																																																																																																		
10080 min Summer	21.326	0.326	1.1	74.4	O K																																																																																																																																																																																																																		
15 min Winter	21.342	0.342	1.1	78.0	O K																																																																																																																																																																																																																		
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																				
15 min Summer	137.760	0.0	19																																																																																																																																																																																																																				
30 min Summer	90.720	0.0	34																																																																																																																																																																																																																				
60 min Summer	56.980	0.0	64																																																																																																																																																																																																																				
120 min Summer	33.600	0.0	124																																																																																																																																																																																																																				
180 min Summer	24.648	0.0	182																																																																																																																																																																																																																				
240 min Summer	19.740	0.0	242																																																																																																																																																																																																																				
360 min Summer	14.350	0.0	362																																																																																																																																																																																																																				
480 min Summer	11.399	0.0	482																																																																																																																																																																																																																				
600 min Summer	9.516	0.0	602																																																																																																																																																																																																																				
720 min Summer	8.202	0.0	720																																																																																																																																																																																																																				
960 min Summer	6.473	0.0	936																																																																																																																																																																																																																				
1440 min Summer	4.626	0.0	1152																																																																																																																																																																																																																				
2160 min Summer	3.313	0.0	1532																																																																																																																																																																																																																				
2880 min Summer	2.625	0.0	1932																																																																																																																																																																																																																				
4320 min Summer	1.909	0.0	2764																																																																																																																																																																																																																				
5760 min Summer	1.537	0.0	3576																																																																																																																																																																																																																				
7200 min Summer	1.311	0.0	4328																																																																																																																																																																																																																				
8640 min Summer	1.158	0.0	5112																																																																																																																																																																																																																				
10080 min Summer	1.048	0.0	5856																																																																																																																																																																																																																				
15 min Winter	137.760	0.0	19																																																																																																																																																																																																																				
©1982-2019 Innovyze																																																																																																																																																																																																																							

BWB Consulting Ltd				Page 2	
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		MCA2031 Gellings Road Southern Tank			
Date 07/09/2021 File MCA2031 - SOUTHERN SOAK...		Designed by RJ Checked by			
Innovyze		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	21.448	0.448	1.2	102.2	O K
60 min Winter	21.557	0.557	1.2	127.0	O K
120 min Winter	21.644	0.644	1.2	146.9	O K
180 min Winter	21.696	0.696	1.2	158.6	O K
240 min Winter	21.730	0.730	1.2	166.4	O K
360 min Winter	21.769	0.769	1.2	175.3	O K
480 min Winter	21.788	0.788	1.2	179.6	O K
600 min Winter	21.795	0.795	1.3	181.3	O K
720 min Winter	21.796	0.796	1.3	181.4	O K
960 min Winter	21.785	0.785	1.2	178.9	O K
1440 min Winter	21.740	0.740	1.2	168.7	O K
2160 min Winter	21.680	0.680	1.2	154.9	O K
2880 min Winter	21.627	0.627	1.2	142.8	O K
4320 min Winter	21.533	0.533	1.2	121.6	O K
5760 min Winter	21.454	0.454	1.2	103.5	O K
7200 min Winter	21.387	0.387	1.1	88.3	O K
8640 min Winter	21.330	0.330	1.1	75.2	O K
10080 min Winter	21.280	0.280	1.1	63.9	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	90.720	0.0	33		
60 min Winter	56.980	0.0	64		
120 min Winter	33.600	0.0	122		
180 min Winter	24.648	0.0	180		
240 min Winter	19.740	0.0	240		
360 min Winter	14.350	0.0	356		
480 min Winter	11.399	0.0	472		
600 min Winter	9.516	0.0	588		
720 min Winter	8.202	0.0	700		
960 min Winter	6.473	0.0	924		
1440 min Winter	4.626	0.0	1328		
2160 min Winter	3.313	0.0	1644		
2880 min Winter	2.625	0.0	2104		
4320 min Winter	1.909	0.0	2984		
5760 min Winter	1.537	0.0	3856		
7200 min Winter	1.311	0.0	4680		
8640 min Winter	1.158	0.0	5448		
10080 min Winter	1.048	0.0	6248		
©1982-2019 Innovyze					

BWB Consulting Ltd		Page 3
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ	MCA2031 Gellings Road Southern Tank	
Date 07/09/2021 File MCA2031 - SOUTHERN SOAK...	Designed by RJ Checked by	
Innovyze Source Control 2019.1		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 341500 396100 SJ 41500 96100
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.273

	Time (mins)	Area
From:	To:	(ha)
	0	4 0.273

©1982-2019 Innovyze

BWB Consulting Ltd		Page 4
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ	MCA2031 Gellings Road Southern Tank	
Date 07/09/2021 File MCA2031 - SOUTHERN SOAK...	Designed by RJ Checked by	
Innovyze	Source Control 2019.1	

Model Details

Storage is Online Cover Level (m) 23.000

Cellular Storage Structure

Invert Level (m) 21.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.03096 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.03096

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	240.0	240.0	1.100	0.0	304.0
1.000	240.0	304.0			

©1982-2019 Innovyze

BWB Consulting Ltd				Page 1																																																																																																																																																																																																																			
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		MCA2031 Gellings Road Southern Tank																																																																																																																																																																																																																					
Date 07/09/2021 File MCA2031 - SOUTHERN SOAK...		Designed by RJ Checked by																																																																																																																																																																																																																					
Innovyze		Source Control 2019.1																																																																																																																																																																																																																					
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 3736 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>21.308</td><td>0.308</td><td>0.4</td><td>70.1</td><td>O K</td></tr><tr><td>30 min Summer</td><td>21.404</td><td>0.404</td><td>0.5</td><td>92.2</td><td>O K</td></tr><tr><td>60 min Summer</td><td>21.505</td><td>0.505</td><td>0.5</td><td>115.2</td><td>O K</td></tr><tr><td>120 min Summer</td><td>21.591</td><td>0.591</td><td>0.5</td><td>134.7</td><td>O K</td></tr><tr><td>180 min Summer</td><td>21.645</td><td>0.645</td><td>0.5</td><td>147.0</td><td>O K</td></tr><tr><td>240 min Summer</td><td>21.683</td><td>0.683</td><td>0.5</td><td>155.7</td><td>O K</td></tr><tr><td>360 min Summer</td><td>21.734</td><td>0.734</td><td>0.5</td><td>167.3</td><td>O K</td></tr><tr><td>480 min Summer</td><td>21.766</td><td>0.766</td><td>0.5</td><td>174.6</td><td>O K</td></tr><tr><td>600 min Summer</td><td>21.788</td><td>0.788</td><td>0.5</td><td>179.7</td><td>O K</td></tr><tr><td>720 min Summer</td><td>21.804</td><td>0.804</td><td>0.5</td><td>183.3</td><td>O K</td></tr><tr><td>960 min Summer</td><td>21.823</td><td>0.823</td><td>0.5</td><td>187.6</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>21.836</td><td>0.836</td><td>0.5</td><td>190.6</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>21.830</td><td>0.830</td><td>0.5</td><td>189.2</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>21.811</td><td>0.811</td><td>0.5</td><td>185.0</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>21.781</td><td>0.781</td><td>0.5</td><td>178.0</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>21.760</td><td>0.760</td><td>0.5</td><td>173.3</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>21.749</td><td>0.749</td><td>0.5</td><td>170.8</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>21.742</td><td>0.742</td><td>0.5</td><td>169.2</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>21.738</td><td>0.738</td><td>0.5</td><td>168.3</td><td>O K</td></tr><tr><td>15 min Winter</td><td>21.345</td><td>0.345</td><td>0.5</td><td>78.6</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>137.760</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>90.720</td><td>0.0</td><td>34</td></tr><tr><td>60 min Summer</td><td>56.980</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>33.600</td><td>0.0</td><td>124</td></tr><tr><td>180 min Summer</td><td>24.648</td><td>0.0</td><td>184</td></tr><tr><td>240 min Summer</td><td>19.740</td><td>0.0</td><td>244</td></tr><tr><td>360 min Summer</td><td>14.350</td><td>0.0</td><td>364</td></tr><tr><td>480 min Summer</td><td>11.399</td><td>0.0</td><td>484</td></tr><tr><td>600 min Summer</td><td>9.516</td><td>0.0</td><td>602</td></tr><tr><td>720 min Summer</td><td>8.202</td><td>0.0</td><td>722</td></tr><tr><td>960 min Summer</td><td>6.473</td><td>0.0</td><td>962</td></tr><tr><td>1440 min Summer</td><td>4.626</td><td>0.0</td><td>1442</td></tr><tr><td>2160 min Summer</td><td>3.313</td><td>0.0</td><td>2160</td></tr><tr><td>2880 min Summer</td><td>2.625</td><td>0.0</td><td>2796</td></tr><tr><td>4320 min Summer</td><td>1.909</td><td>0.0</td><td>3456</td></tr><tr><td>5760 min Summer</td><td>1.537</td><td>0.0</td><td>4208</td></tr><tr><td>7200 min Summer</td><td>1.311</td><td>0.0</td><td>5040</td></tr><tr><td>8640 min Summer</td><td>1.158</td><td>0.0</td><td>5880</td></tr><tr><td>10080 min Summer</td><td>1.048</td><td>0.0</td><td>6752</td></tr><tr><td>15 min Winter</td><td>137.760</td><td>0.0</td><td>19</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	21.308	0.308	0.4	70.1	O K	30 min Summer	21.404	0.404	0.5	92.2	O K	60 min Summer	21.505	0.505	0.5	115.2	O K	120 min Summer	21.591	0.591	0.5	134.7	O K	180 min Summer	21.645	0.645	0.5	147.0	O K	240 min Summer	21.683	0.683	0.5	155.7	O K	360 min Summer	21.734	0.734	0.5	167.3	O K	480 min Summer	21.766	0.766	0.5	174.6	O K	600 min Summer	21.788	0.788	0.5	179.7	O K	720 min Summer	21.804	0.804	0.5	183.3	O K	960 min Summer	21.823	0.823	0.5	187.6	O K	1440 min Summer	21.836	0.836	0.5	190.6	O K	2160 min Summer	21.830	0.830	0.5	189.2	O K	2880 min Summer	21.811	0.811	0.5	185.0	O K	4320 min Summer	21.781	0.781	0.5	178.0	O K	5760 min Summer	21.760	0.760	0.5	173.3	O K	7200 min Summer	21.749	0.749	0.5	170.8	O K	8640 min Summer	21.742	0.742	0.5	169.2	O K	10080 min Summer	21.738	0.738	0.5	168.3	O K	15 min Winter	21.345	0.345	0.5	78.6	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	137.760	0.0	19	30 min Summer	90.720	0.0	34	60 min Summer	56.980	0.0	64	120 min Summer	33.600	0.0	124	180 min Summer	24.648	0.0	184	240 min Summer	19.740	0.0	244	360 min Summer	14.350	0.0	364	480 min Summer	11.399	0.0	484	600 min Summer	9.516	0.0	602	720 min Summer	8.202	0.0	722	960 min Summer	6.473	0.0	962	1440 min Summer	4.626	0.0	1442	2160 min Summer	3.313	0.0	2160	2880 min Summer	2.625	0.0	2796	4320 min Summer	1.909	0.0	3456	5760 min Summer	1.537	0.0	4208	7200 min Summer	1.311	0.0	5040	8640 min Summer	1.158	0.0	5880	10080 min Summer	1.048	0.0	6752	15 min Winter	137.760	0.0	19
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																		
15 min Summer	21.308	0.308	0.4	70.1	O K																																																																																																																																																																																																																		
30 min Summer	21.404	0.404	0.5	92.2	O K																																																																																																																																																																																																																		
60 min Summer	21.505	0.505	0.5	115.2	O K																																																																																																																																																																																																																		
120 min Summer	21.591	0.591	0.5	134.7	O K																																																																																																																																																																																																																		
180 min Summer	21.645	0.645	0.5	147.0	O K																																																																																																																																																																																																																		
240 min Summer	21.683	0.683	0.5	155.7	O K																																																																																																																																																																																																																		
360 min Summer	21.734	0.734	0.5	167.3	O K																																																																																																																																																																																																																		
480 min Summer	21.766	0.766	0.5	174.6	O K																																																																																																																																																																																																																		
600 min Summer	21.788	0.788	0.5	179.7	O K																																																																																																																																																																																																																		
720 min Summer	21.804	0.804	0.5	183.3	O K																																																																																																																																																																																																																		
960 min Summer	21.823	0.823	0.5	187.6	O K																																																																																																																																																																																																																		
1440 min Summer	21.836	0.836	0.5	190.6	O K																																																																																																																																																																																																																		
2160 min Summer	21.830	0.830	0.5	189.2	O K																																																																																																																																																																																																																		
2880 min Summer	21.811	0.811	0.5	185.0	O K																																																																																																																																																																																																																		
4320 min Summer	21.781	0.781	0.5	178.0	O K																																																																																																																																																																																																																		
5760 min Summer	21.760	0.760	0.5	173.3	O K																																																																																																																																																																																																																		
7200 min Summer	21.749	0.749	0.5	170.8	O K																																																																																																																																																																																																																		
8640 min Summer	21.742	0.742	0.5	169.2	O K																																																																																																																																																																																																																		
10080 min Summer	21.738	0.738	0.5	168.3	O K																																																																																																																																																																																																																		
15 min Winter	21.345	0.345	0.5	78.6	O K																																																																																																																																																																																																																		
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																				
15 min Summer	137.760	0.0	19																																																																																																																																																																																																																				
30 min Summer	90.720	0.0	34																																																																																																																																																																																																																				
60 min Summer	56.980	0.0	64																																																																																																																																																																																																																				
120 min Summer	33.600	0.0	124																																																																																																																																																																																																																				
180 min Summer	24.648	0.0	184																																																																																																																																																																																																																				
240 min Summer	19.740	0.0	244																																																																																																																																																																																																																				
360 min Summer	14.350	0.0	364																																																																																																																																																																																																																				
480 min Summer	11.399	0.0	484																																																																																																																																																																																																																				
600 min Summer	9.516	0.0	602																																																																																																																																																																																																																				
720 min Summer	8.202	0.0	722																																																																																																																																																																																																																				
960 min Summer	6.473	0.0	962																																																																																																																																																																																																																				
1440 min Summer	4.626	0.0	1442																																																																																																																																																																																																																				
2160 min Summer	3.313	0.0	2160																																																																																																																																																																																																																				
2880 min Summer	2.625	0.0	2796																																																																																																																																																																																																																				
4320 min Summer	1.909	0.0	3456																																																																																																																																																																																																																				
5760 min Summer	1.537	0.0	4208																																																																																																																																																																																																																				
7200 min Summer	1.311	0.0	5040																																																																																																																																																																																																																				
8640 min Summer	1.158	0.0	5880																																																																																																																																																																																																																				
10080 min Summer	1.048	0.0	6752																																																																																																																																																																																																																				
15 min Winter	137.760	0.0	19																																																																																																																																																																																																																				
©1982-2019 Innovyze																																																																																																																																																																																																																							

BWB Consulting Ltd				Page 2	
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		MCA2031 Gellings Road Southern Tank			
Date 07/09/2021 File MCA2031 - SOUTHERN SOAK...		Designed by RJ Checked by			
Innovyze		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	21.453	0.453	0.5	103.3	O K
60 min Winter	21.567	0.567	0.5	129.2	O K
120 min Winter	21.663	0.663	0.5	151.2	O K
180 min Winter	21.724	0.724	0.5	165.1	O K
240 min Winter	21.768	0.768	0.5	175.1	O K
360 min Winter	21.826	0.826	0.5	188.4	O K
480 min Winter	21.864	0.864	0.5	197.0	O K
600 min Winter	21.891	0.891	0.5	203.1	O K
720 min Winter	21.910	0.910	0.5	207.4	O K
960 min Winter	21.934	0.934	0.5	213.1	O K
1440 min Winter	21.956	0.956	0.5	217.9	O K
2160 min Winter	21.959	0.959	0.5	218.6	O K
2880 min Winter	21.948	0.948	0.5	216.2	O K
4320 min Winter	21.913	0.913	0.5	208.2	O K
5760 min Winter	21.886	0.886	0.5	202.0	O K
7200 min Winter	21.869	0.869	0.5	198.1	O K
8640 min Winter	21.855	0.855	0.5	194.8	O K
10080 min Winter	21.843	0.843	0.5	192.2	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	90.720	0.0	34		
60 min Winter	56.980	0.0	64		
120 min Winter	33.600	0.0	122		
180 min Winter	24.648	0.0	182		
240 min Winter	19.740	0.0	242		
360 min Winter	14.350	0.0	360		
480 min Winter	11.399	0.0	478		
600 min Winter	9.516	0.0	596		
720 min Winter	8.202	0.0	714		
960 min Winter	6.473	0.0	950		
1440 min Winter	4.626	0.0	1412		
2160 min Winter	3.313	0.0	2096		
2880 min Winter	2.625	0.0	2764		
4320 min Winter	1.909	0.0	3976		
5760 min Winter	1.537	0.0	4496		
7200 min Winter	1.311	0.0	5408		
8640 min Winter	1.158	0.0	6392		
10080 min Winter	1.048	0.0	7272		
©1982-2019 Innovyze					

BWB Consulting Ltd		Page 4
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ	MCA2031 Gellings Road Southern Tank	
Date 07/09/2021 File MCA2031 - SOUTHERN SOAK...	Designed by RJ Checked by	
Innovyze	Source Control 2019.1	

Model Details

Storage is Online Cover Level (m) 23.000

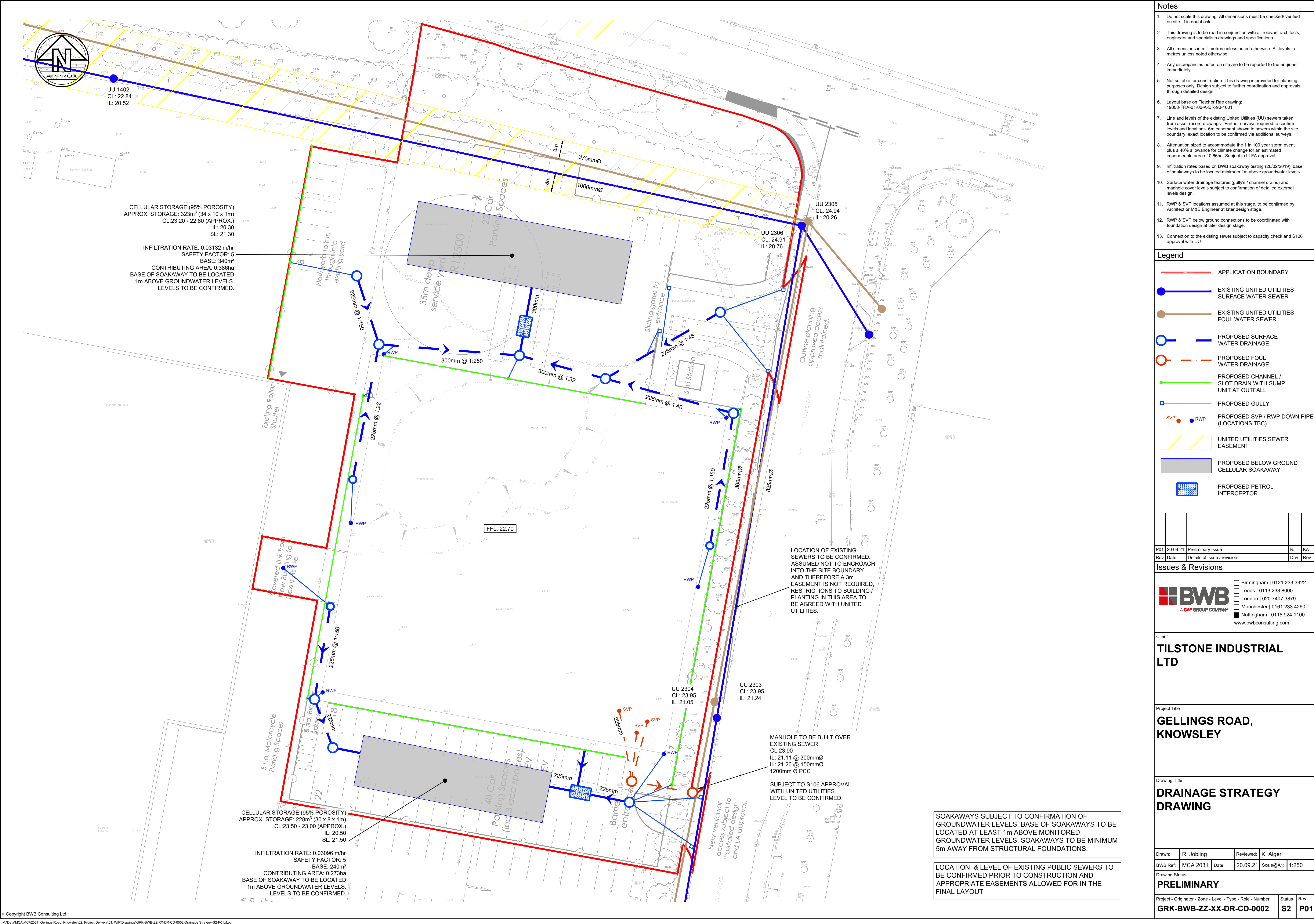
Cellular Storage Structure

Invert Level (m) 21.000 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.03096 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.03096

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	240.0	240.0	1.100	0.0	304.0
1.000	240.0	304.0			

©1982-2019 Innovyze

APPENDIX 8: Drainage Strategy Drawing



APPENDIX 9: 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.

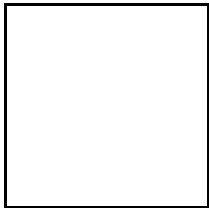
Kind Regards

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



Registered in England and Wales

Registered Office: 5th Floor, Waterfront House, Station Street, Nottingham, NG2 3DQ

Company No. 5265863

VAT Reg No. 648 1142 45

This email (including any attachments) contains confidential information. If you are not the intended recipient please notify us immediately by replying to this email and delete this email from your system without reading, using, copying or disseminating it or placing any reliance upon its contents. Email is not a secure medium and we cannot accept liability for any breaches of confidence arising through use of email. Any opinions expressed in this email (including any attachments) are those of the author and do not necessarily reflect the views of BWB Consulting Limited. We will not accept responsibility for any commitments made by our employees outside the scope of our business. We do not warrant the accuracy or completeness of such information. Viruses: please note that we do not accept any liability for viruses and it is your responsibility to scan the attachments (if any) using suitable anti-virus software.

Disclaimer

The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby notified that any disclosure, copying, distribution or taking action in relation of the contents of this information is strictly prohibited and may be unlawful.

This email has been scanned for viruses and malware, and may have been automatically archived by **Mimecast Ltd**, an innovator in Software as a Service (SaaS) for business. Providing a **safer** and **more useful** place for your human generated data. Specializing in; Security, archiving and compliance. To find out more [Click Here](#).

EMGateway3.uuplc.co.uk made the following annotations

The information contained in this e-mail is intended only for the individual to whom it is addressed. It may contain legally privileged or confidential information or otherwise be exempt from disclosure. If you have received this Message in error or there are any problems, please notify the sender immediately and delete the message from your computer. You must not use, disclose, copy or alter this message for any unauthorised purpose. Neither United Utilities Group PLC nor any of its subsidiaries will be liable for any direct, special, indirect or consequential damages as a result of any virus being passed on, or arising from the alteration of the contents of this message by a third party.

United Utilities Group PLC, Haweswater House, Lingley Mere
Business Park, Lingley Green Avenue, Great Sankey,
Warrington, WA5 3LP
Registered in England and Wales. Registered No 6559020

www.unitedutilities.com

www.unitedutilities.com/subsidiaries
