

<i>DRAINAGE DESIGN AND INFORMATION</i>			
<i>Job Title</i>	St Patricks Gardens Gravesend	Job No	WG1264
		<i>Date</i>	July 2020
<i>Prepared</i>	LG	<i>Checked</i>	GW



Client	Westridge Construction
Architect	BPTW
PM	
Other	

	Agreement Type (Reference Number)	Date Sent	Date Received
	S106 (Ref No: TBC)		
	EXISTING / HISTORIC INFORMATION - The existing site consists of an open green space, with a children’s playground. The site is fronted by Valley Drive on its Western boundary. St Patricks Gardens road bounds the other three sides of the site. The site has a fall of approximately 8m from East to West. The site has no existing connection to the Southern Water foul sewerage network. Southern Water sewer records indicate a 600mm diameter sewer within Valley Drive adjacent the site. This flows in a Northerly direction at this location. The depth of the sewer adjacent the site is not indicated on the sewer records. However, based on the invert level of upstream manholes it would be assumed to be in the order of 2m+ deep. There are a number of smaller sewers indicated on the sewer records within the gardens to the blocks of flats around St Patricks Gardens. A Ground Penetrating Radar (GPR) survey was undertaken to identify the services in the area. This shows In more detail the foul drainage network to the surrounding properties in St Patricks Gardens, and the connections off of the main sewer to the buildings. A copy of both the Southern Water Sewer Records and GPR survey are included within the Appendices. A Flood Risk Assessment / Drainage Strategy was completed by Price and Myers for Planning Application submission purposes. This briefly discussed the foul strategy for the site and indicated the foul connecting into the main Southern Water sewer within Valley Drive. WALLER GRAY PROPOSED FOUL WATER DRAINAGE – The proposed development consists of 23 residential units, within a single block of flats. The building also has cycle storage, along with a binstore and plantroom at groundfloor. It is proposed to connect the new development to the Southern Water sewerage network. It is proposed to make a single connection via a new 150mm diameter pipe at the existing foul manhole 9005 as indicated on the Southern Water sewer records. In accordance with Sewers for Adoption the peak foul discharge from the 23 residential units will be 1.06l/s. There was no existing foul connection from the site. Therefore, as a result of the proposed development, there will be an increase in foul flows offsite. Under Southern Waters revised Infrastructure Charges as of April 2018, Southern Water take responsibility for any increase in foul flows as a result of a new development, any they allow for any network upgrades within the revised charging scheme.		

The foul connection will be subject to a S106 agreement with Southern Water.

Foul water calculations and approval letters are included within the Appendices of this document.

A drainage maintenance schedule is included within the Appendices of this document, highlighting the key operations which should be undertaken so that the system remains in optimal condition.

Please read all WGC detailed design drawings and calculations listed below, in conjunction with the text above.

Gravesham Borough Council

	Agreement Type (Reference Number)	Date Sent	Date Received

EXISTING / HISTORIC INFORMATION -

The existing site consists of an open green space, with a children’s playground. The site is fronted by Valley Drive on its Western boundary. St Patricks Gardens road bounds the other three sides of the site.

The site has a fall of approximately 8m from East to West.

The Southern Water sewer records do not indicate any Surface Water sewers in close proximity to the site. A copy of the sewer records are included within the Appendices.

A Ground Penetrating Radar (GPR) survey was completed as part of the topographic survey, this picked up the below ground drainage. This survey indicates that the surface water runoff from the existing buildings around St Patricks Gardens connect their surface water runoff to the foul sewer.
A copy of the GPR survey is included within the Appendices.

The discharge of the surface water into the foul drain would be at an unrestricted rate, as the existing system does not contain flow control mechanisms.

The green open space area where the proposed building and new landscaping is to be carried out is approximately 3500m². The redline boundary for the site is larger than this, however, it includes the existing St Patricks Gardens road, which will remain unchanged and therefore is ignored from the surface water calculations.

As the site has no formal surface water drainage system, and the site is essentially just a green open space (with the exception of the playground area) the site would be considered as Greenfield. Calculated using the ICP SUD’s method the greenfield run off rates for the site are as follow (calculations attached within Appendices):

- 1 in 1yr - 0.1 l/s
- QBar - 0.1 l/s
- 1 in 30yr - 0.3 l/s
- 1 in 100yr - 0.4 l/s

The existing runoff volume is calculated to be 15.491m³ (based on a 1 in 100yr, 360 minute, winter storm event).

A Drainage Strategy and Flood Risk Assessment was completed by Price and Myers (Ref:28033). This indicated surface water discharging via infiltration methods (subject to infiltration testing). An alternative option was also indicated showing connection to the foul sewer at a restricted rate.

Geotechnical testing has been carried out to the site; this include infiltration testing. The underlying geology is identified as Chalk, at varying depths generally approximately 2m deep to the West area of the site area and shallower at a depth of approximately 0.5m to the East of the site. Infiltration testing was carried out at approximately 3m below existing ground levels. The results ranged from 1.35x10⁻⁵ and 1.71x10⁻⁴m/s.

WALLER GRAY PROPOSED SURFACE WATER DRAINAGE –

Inline with the SUD's Hierarchy the most sustainable drainage technique which can be utilised on this site is infiltration techniques.

It is proposed to utilise a cellular soakaway within the rear carpark to the new flat block. The proposed soakaway will be located a minimum of 10m from the proposed building inline with the geotechnical report. This will provide the capacity for the proposed building and main car parking area. The lowest infiltration rate of $1.35 \times 10^{-5} \text{m/s}$ has been used for the basis of the design.

The two remote carparking areas will be drained via their own respective ring soakaway. These soakaways are to be positioned a minimum of 10m from the existing building, and the design has been based on the lowest infiltration rate of $1.35 \times 10^{-5} \text{m/s}$.

The landscaped area and playground will utilise permeable constructions, where chalk was recorded at shallower depths.

The surface water drainage system has been designed to cater for storm events up to and including 1 in 100yr +40% climate change events. With all water stored below ground.

The proposed development will follow the existing contours of the land. This will ensure that overland flow paths remain unaltered as a result of the development.

A drainage maintenance schedule is included within the Appendices of this document, highlighting the key operations which should be undertaken so that the system remains in optimal condition.

Please read all WGC detailed design drawings and calculations listed below, in conjunction with the text above

PLANNING CONDITIONS

DECISION NOTICE 20190503 PLANNING CONDITIONS –

On Gravesham Borough Council Planning Decision Notice Ref:20190503 for this site the following Planning Conditions relate to the Drainage Design. In the following section, the Planning Conditions will be stated direct from the Decision Notice with an explanation of reasoning for the discharge of the Planning Condition following the respective condition.

Planning Condition 4 –

“ No development approved by this permission shall be commenced until a scheme for sustainable surface water drainage has been submitted to and approved, in writing, by the Local Planning Authority. The detailed drainage scheme submitted shall

(i) demonstrate that both the rate and volume of run-off leaving the site post-development will be restricted to that of the existing site during any rainfall event (up to and including the climate change adjusted 100yr critical storm)

(ii) demonstrate that the existing on-site surface water flow-routes and accumulation points will not be altered in such a way that the development places property at risk from flooding during any rainfall event, up to and including the climate change adjusted critical 100yr storm,

(iii) demonstrate that infiltration features are not located on parts of the site where contamination might be present

(iv) include a timetable for its implementation, and

(v) include a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public body or statutory undertaker, or any other arrangements to secure the operation of the sustainable drainage system throughout its lifetime.

The surface water drainage scheme shall thereafter be implemented in full prior to first residential occupation of the development and thereafter maintained and managed in accordance with the approved scheme.”

- (i) As the drainage for the site utilises infiltration techniques there will be no surface water leaving the site. Therefore, there will be no increase in surface water runoff leaving the site post development.
- (ii) The existing site has a relatively steep fall from East to West with a fall of 8m over 95m, this would equate to approximately a gradient of 1 in 12. The gradient across the site is slightly adjusted to take into account the path gradients and carpark. However, the fall across the site remains largely unchanged. There is a site levels drawing included within the drawing pack as well as the topographic survey which indicates existing and proposed levels.
- (iii) Contamination testing to site carried out by Soils Limited, did not indicate any significant contamination issues onsite. Boreholes were taken down to a depth of 11m, and groundwater was not encountered. Soakaways onsite are only in the region of 3m deep below ground level, therefore there is a significant unsaturated zone between the base of the soakaways and the groundwater.
- (iv) Contractor to confirm construction programme of the installation of the drainage system.
- (v) All drainage onsite will remain private. A drainage maintenance schedule is included within the Appendices of this document.

Planning Condition 19 –

“ No infiltration of surface water drainage into the ground is permitted other than with the written consent of the Local Planning Authority. The development shall be carried out in accordance with the approved details. ”

As set out in the Geotechnical Investigation the underlying chalk strata is suitable for discharge of surface water to the ground. Groundwater was not encountered during the investigation works, with boreholes taken to a depth of 11m BGL. This therefore gives an unsaturated zone of at least 7m.

Extracts from the geotechnical investigation reports are included within the Appendices.

Drawings	WG1264/201 – Drainage Layout WG1264/202 – Levels Layout WG1264/211 – Setting Out WG1264/221 – Surface Finishes WG1264/250 – Drainage Details (Sheet 1 of 2) WG1264/251 – Drainage Details (Sheet 2 of 2)
Appendices	Appendix A – Foul Water Drainage Calculations Appendix B – Topographic Survey Appendix C – Existing Drainage Layout (From GPR Survey) Appendix D – Southern Water Sewer Records Appendix E – Surface Water Drainage (Greenfield Calculations) Appendix F – Surface Water Drainage (Proposed Calculations) Appendix G – Geotechnical Report Extracts Appendix H – Drainage Maintenance Schedule

APPENDICES

Gravesham Borough Council

APPENDIX A – Foul Water Drainage Calculations

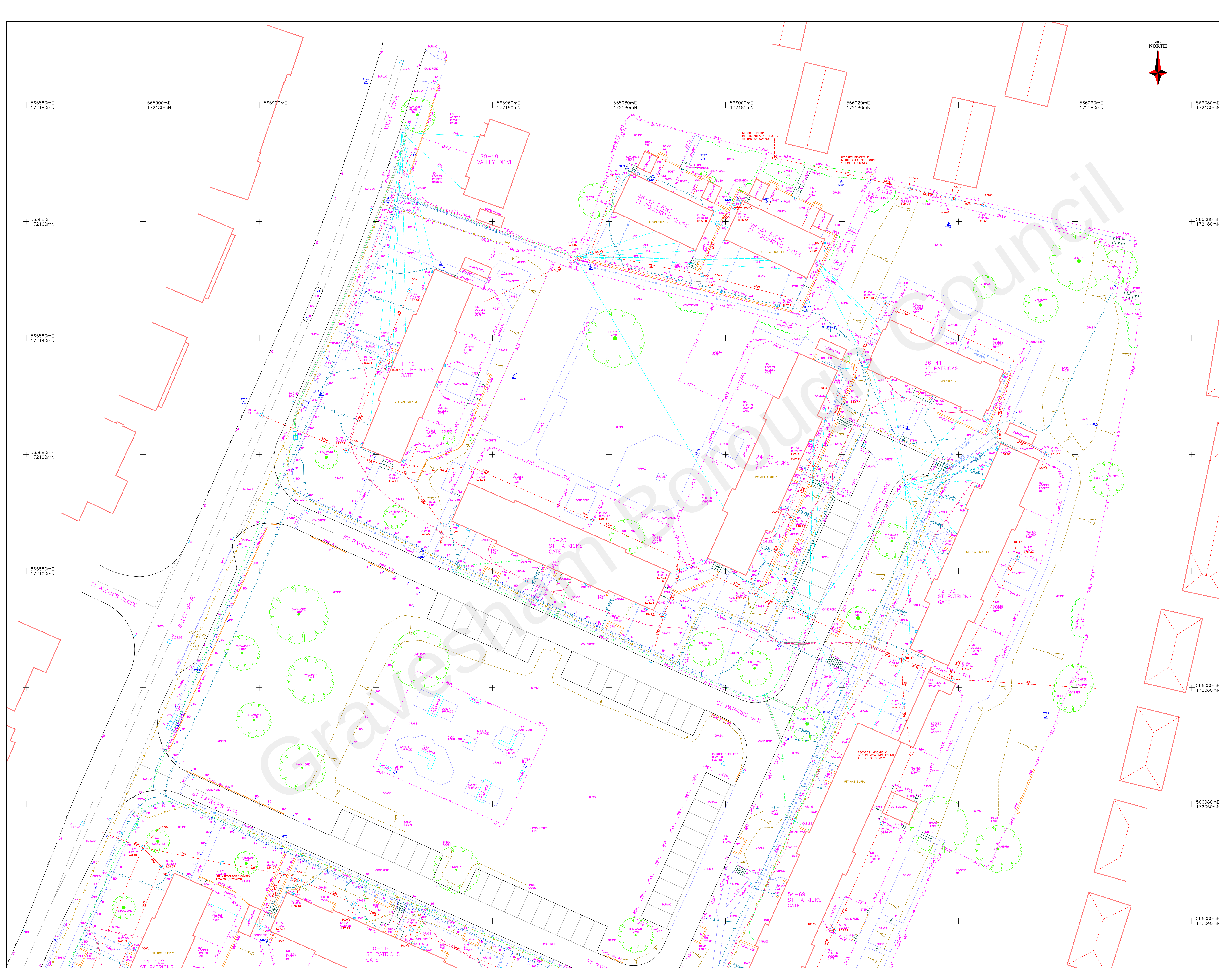
Gravesham Borough Council

JOB TITLE <i>ST PATRICES GARDENS, GRAVESHAM</i>		DATE <i>Su 20</i>
ITEM <i>Foul Water Drainage</i>	JOB NO <i>UG1264</i>	SHEET NO. <i>—</i>
PREPARED BY <i>LG</i>		CHECKED BY <i>GW</i>

Ref	Calculations
	<u>Proposed Foul Flows</u> In accordance with SEWERS FOR ADOPTION 7th Edition A PEAK Foul flow rate of 4000 LITRES/DWELLING/DAY IS TAKEN. THE PROPOSED DEVELOPMENT CONSISTS OF THE CONSTRUCTION OF 23 NEW DWELLINGS. $\therefore 23 \times 4000 = 92000 \text{ LITRES PER DAY.}$ $92000 / 24 = 3833.33 \text{ LITRES PER HOUR}$ $3833.33 / 60 = 63.88 \text{ LITRES PER MINUTE}$ $63.88 / 60 = \underline{\underline{1.065 \text{ LITRES PER SECOND.}}}$ $\therefore$ THERE WILL BE AN INCREASE IN FOUL FLOWS OFFSITE AS A RESULT OF THE DEVELOPMENT.
CDM	

Gravesham Borough Council

Gravesham Borough Council



Original Drawing Size: A0

NOTES:-
The accuracy and content of this drawing are dependent on the original specification.
The drawing is intended to be used as a guide only and is not to be used for any other purpose.
When underground services are shown, it is assumed that they have been taken within the
ground and are not to be used for any other purpose.
All services shown are assumed to be correct and are not to be used for any other purpose.
The drawing is intended to be used as a guide only and is not to be used for any other purpose.
All services shown are assumed to be correct and are not to be used for any other purpose.

LEGEND

AS	As shown	CP	Concrete Pipe	BS	Boundary Stone
BS	Boundary Stone	CP	Concrete Pipe	BS	Boundary Stone
BS	Boundary Stone	CP	Concrete Pipe	BS	Boundary Stone
BS	Boundary Stone	CP	Concrete Pipe	BS	Boundary Stone
BS	Boundary Stone	CP	Concrete Pipe	BS	Boundary Stone

STATION SCHEDULE

Station	Eastings	Northings	Level	Type
1	56596.860	172151.921	25.939	HIH Nail
2	56596.860	172151.921	25.939	HIH Nail
3	56596.860	172151.921	25.939	HIH Nail
4	56596.860	172151.921	25.939	HIH Nail
5	56596.860	172151.921	25.939	HIH Nail

ED I SURVEYS LTD

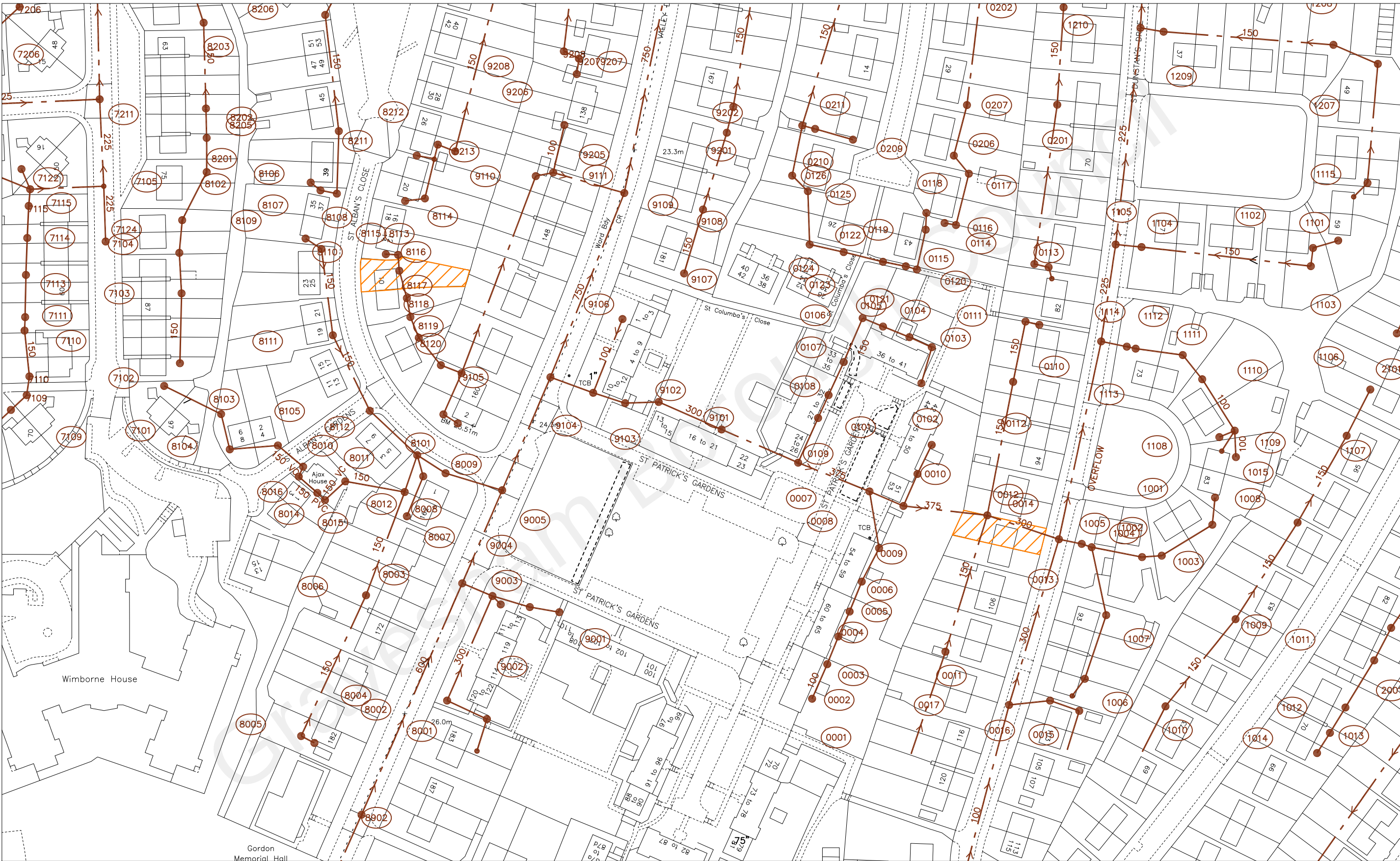
163-165 Renshaw Road, Ipswich, Suffolk, IP2 0WH
Telephone: 01473 211222 Fax: 01473 221860
Email: info@edisurveys.co.uk
Our Services: Topographic, Survey, Measure, Building, Survey, GPS, Survey, and more.
Click the link below to visit our website and find out more.
www.edisurveys.co.uk

APPENDIX D – Southern Water Sewer Records

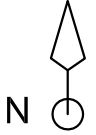
Gravesham Borough Council

SEWER RECORDS PAGE 1 OF 2

172252



171964

565736	O.S. REF. TQ6572SE	Drawn by: yadavs	The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement	 N		566206
	Title: 232113_St Columbas Close, Grav	Scale: 1:1250				
		Date: 12/01/2017	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.			

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape
0001X			100	UNK	CIRC	1014X			UNK	UNK	CIRC	8107X	32.079		100	UNK	CIRC						
0002X			UNK	UNK	CIRC	1015X			100	UNK	CIRC	8108X	32.058	30.878	150	UNK	CIRC						
0003X			UNK	UNK	CIRC	1101X			UNK	UNK	CIRC	8109X	32.27	30.94	100	UNK	CIRC						
0004X			150	UNK	CIRC	1102X			UNK	UNK	CIRC	810DX			UNK	UNK	CIRC						
0005X			UNK	UNK	CIRC	1103X			150	UNK	CIRC	8110X	31.818	30.828	150	UNK	CIRC						
0006X			UNK	UNK	CIRC	1104X			UNK	UNK	CIRC	8111X	30.072	28.942	150	UNK	CIRC						
0007X			375	UNK	CIRC	1105X			225	UNK	CIRC	8112X	28.311	26.701	UNK	UNK	CIRC						
0008X			UNK	UNK	CIRC	1107X			100	UNK	CIRC	8113X	30.157		UNK	UNK	CIRC						
0009X			375	UNK	CIRC	1108X			UNK	UNK	CIRC	8114X			UNK	UNK	CIRC						
000DX			UNK	UNK	CIRC	1109X			100	UNK	CIRC	8115X	30.098	28.4	100	UNK	CIRC						
0010X			UNK	UNK	CIRC	110DX			UNK	UNK	CIRC	8116X	29.756		UNK	UNK	CIRC						
0011X			150	UNK	CIRC	1110X			UNK	UNK	CIRC	8117X			UNK	UNK	CIRC						
0012X			300	UNK	CIRC	1111X			UNK	UNK	CIRC	8118X			UNK	UNK	CIRC						
0013X			225	UNK	CIRC	1112X			UNK	UNK	CIRC	8119X			UNK	UNK	CIRC						
0014X			150	UNK	CIRC	1113X			150	UNK	CIRC	8120X			UNK	UNK	CIRC						
0015X			UNK	UNK	CIRC	1114X			225	UNK	CIRC	8121X	25.242	23.882	UNK	UNK	CIRC						
0016X			UNK	UNK	CIRC	1115X			UNK	UNK	CIRC	8122X	25.334	24.554	100	UNK	CIRC						
0017X			300	UNK	CIRC	111DX			UNK	UNK	CIRC	8123X	25.367	24.487	100	UNK	CIRC						
0101X			UNK	UNK	CIRC	1207X			UNK	UNK	CIRC	8124X			150	UNK	CIRC						
0102X			UNK	UNK	CIRC	1208X			150	UNK	CIRC	8201X			150	UNK	CIRC						
0103X			UNK	UNK	CIRC	1209X			UNK	UNK	CIRC	8202X			150	UNK	CIRC						
0104X			UNK	UNK	CIRC	1210X			300	UNK	CIRC	8203X	33.852	32.462	150	UNK	CIRC						
0105X			100	UNK	CIRC	2001X			UNK	UNK	CIRC	8205X	31.848	30.598	150	UNK	CIRC						
0106X			150	UNK	CIRC	2101X			UNK	UNK	CIRC	8206X	30.844	29.544	150	UNK	CIRC						
0107X			UNK	UNK	CIRC	7101X	36.115	34.615	UNK	UNK	CIRC	8211X			UNK	UNK	CIRC						
0108X			UNK	UNK	CIRC	7102X	35.347	34.417	150	UNK	CIRC	8212X	29.194	27.944	150	UNK	CIRC						
0109X			UNK	UNK	CIRC	7103X	35.521	33.961	UNK	UNK	CIRC	8213X			150	UNK	CIRC						
010DX			UNK	UNK	CIRC	7104X			UNK	UNK	CIRC	8902X	26.57	24.38	600	UNK	CIRC						
0110X			UNK	UNK	CIRC	7105X			UNK	UNK	CIRC	9001X	27.778	24.628	150	UNK	CIRC						
0111X			150	UNK	CIRC	7109X			150	UNK	CIRC	9002X	26.358	24.388	150	UNK	CIRC						
0112X			150	UNK	CIRC	710DX			225	UNK	CIRC	9003X	25.906	24.368	100	UNK	CIRC						
0113X			UNK	UNK	CIRC	7110X			150	UNK	CIRC	9004X	25.768	23.848	300	UNK	CIRC						
0114X			UNK	UNK	CIRC	7111X			150	UNK	CIRC	9005X	24.948		UNK	UNK	CIRC						
0115X			UNK	UNK	CIRC	7112X	39.789		150	UNK	CIRC	9101X	27.204	25.444	UNK	UNK	CIRC						
0116X			UNK	UNK	CIRC	7113X	39.453	37.433	UNK	UNK	CIRC	9102X	86.035		300	UNK	CIRC						
0117X			UNK	UNK	CIRC	7114X			UNK	UNK	CIRC	9103Y	24.511		300	UNK	CIRC						
0118X			UNK	UNK	CIRC	7115X			UNK	UNK	CIRC	9103X	24.511	23.121	300	UNK	CIRC						
0119X			100	UNK	CIRC	7122X	38.907	37.647	100	UNK	CIRC	9104X	24.411	22.861	300	UNK	CIRC						
0120X			UNK	UNK	CIRC	7123X			UNK	UNK	CIRC	9105X	24.274		750	UNK	CIRC						
0121X			100	UNK	CIRC	7124X	37.233		225	UNK	CIRC	9106X	24.383	23.858	100	UNK	CIRC						
0122X			UNK	UNK	CIRC	7125X			100	UNK	CIRC	9107X	24.752	23.362	150	UNK	CIRC						
0123X			150	UNK	CIRC	7206X			150	UNK	CIRC	9108X	24.231	22.991	UNK	UNK	CIRC						
0124X			UNK	UNK	CIRC	7211X	36.638		225	UNK	CIRC	9109X	23.442		750	UNK	CIRC						
0125X			UNK	UNK	CIRC	8001X	26.495		300	UNK	CIRC	9110X			UNK	UNK	CIRC						
0126X			UNK	UNK	CIRC	8002X	26.071		300	UNK	CIRC	9111X	24.152		225	UNK	CIRC						
0201X			150	UNK	CIRC	8003X	25.413		UNK	UNK	CIRC	9201X			UNK	UNK	CIRC						
0202X			UNK	UNK	CIRC	8004X	26.948	26.548	100	UNK	CIRC	9202X	23.24		150	UNK	CIRC						
0206X			UNK	UNK	CIRC	8005X			150	UNK	CIRC	9205X	24.016	23.226	100	UNK	CIRC						
0207X			150	UNK	CIRC	8006X	26.183	24.663	150	UNK	CIRC	9206X	23.575		UNK	UNK	CIRC						
0209X			UNK	UNK	CIRC	8007X	25.46	24.78	100	UNK	CIRC	9207X			UNK	UNK	CIRC						
0210X			UNK	UNK	CIRC	8008X	25.443	24.533	UNK	UNK	CIRC	9208X			UNK	UNK	CIRC						
0211X			150	UNK	CIRC	8009X	25.437		225	UNK	CIRC												
1001X			UNK	UNK	CIRC	800DX			300	UNK	CIRC												
1002X			150	UNK	CIRC	8010X	29.522	28.052	150	PVC	CIRC												
1003X			UNK	UNK	CIRC	8011X	28.956	27.396	150	UNK	CIRC												
1004X			UNK	UNK	CIRC	8012X	25.447	24.107	UNK	UNK	CIRC												
1005X			UNK	UNK	CIRC	8014X			150	PVC	CIRC												
1006X			UNK	UNK	CIRC	8015X			150	VC	CIRC												
1007X			UNK	UNK	CIRC	8016X			150	PVC	CIRC												
1008X			150	UNK	CIRC	8101X			UNK	UNK	CIRC												
1009X			150	UNK	CIRC	8102X	35.2	33.17	150	UNK	CIRC												
1010X			150	UNK	CIRC	8103X			UNK	UNK	CIRC												
1011X			100	UNK	CIRC	8104X	33.649	32.029	100	UNK	CIRC												
1012X			UNK	UNK	CIRC	8105X	31.396	29.846	150	VC	CIRC												
1013X			150	UNK	CIRC	8106X	32.221		100	UNK	CIRC												

*
*

LINE STYLES / COLOURS

Brown	—	Foul
Red	—	Foul Syphon Sewer
Red	—	Foul Vacuum Main
Red	—	Foul Rising Main
Red	—	Combined
Red	—	Combined Syphon Sewer
Red	—	Combined Rising Main
Orange	—	Lateral Drain
Orange	—	Building Over Agreement Area
Dark Blue	—	Treated Effluent
Purple	—	Sludge
Purple	—	Sewer Catchment
Purple	—	Section 104 Area
Light Blue	—	Surface Water
Light Blue	—	Surface Water Rising Main
Yellow	—	Private
Green	—	Access Shaft
Green	—	Decommissioned

MATERIALS

AK	Alkathene
BAC	Bonded Asbestos Cement
BRC	Brick (Common)
BRE	Brick (Engineering)
CC	Concrete Box Culvert
CI	Cast Iron
CO	Concrete (In-Situ)
CP	Concrete (Pre-Cast)
CSB	Concrete Segments (bolted)
CSU	Concrete Segments (unbolted)
DI	Ductile Iron
GRC	Glass Reinforced Concrete
GRP	Glass Reinforced Plastic
MAC	Masonry in regular Courses
MAR	Masonry in random Courses
PE	Polyethylene
PF	Pitch Fibre
PP	Polypropylene
PVC	Polyvinyl Chloride
RPM	Reinforced Plastic Matrix
SI	Spun Iron
ST	Steel
VC	Vertical Clay
XXX	Other
ZZZ	Unknown

Manhole (SW)
Manhole (F&C)
Lamp hole (SW)
Lamp hole (F&C)
Pumping Station (SW)
Pumping Station (F&C)
Side entry manhole (SW)
Side entry manhole (F&C)
Blind shaft (SW)
Blind shaft (F&C)
Ejector station (SW)
Ejector station (F&C)
Watertight door (SW)
Watertight door (F&C)
Flushing ch. Min-e (SW)
Flushing ch. Min-e (F&C)
Flushing ch. No-e (SW)
Flushing ch. No-e (F&C)
Demarcation Chamber

LEGEND - SEWERS

Washout (SW)
Washout (F&C)
Rodding Eye (SW)
Rodding Eye (F&C)
Gauging point (SW)
Gauging point (F&C)
Intercept chamber (SW)
Intercept chamber (F&C)
Storm Tank (SW)
Storm Tank (F&C)
Vortex chamber (SW)
Vortex chamber (F&C)
Label ellipse
Dummy/S24 manhole
Outfall
Penstock chamber
Damboards
Storm Overflow
Backdrop manhole

Other (s)
Other
Change in sewer (s)
Change in sewer
Reflex valve
Flap valve
Cascade
Anode
Valve
Closed Valve
Air Valve
Hatch box (SW)
Hatch box (F&C)
Direction arrow
Emptying valve
Catchpit
Soakaway
Inlet
Balancing Pond

SHAPES (S)

A	Arched	R	Rectangular
B	Barrel	S	Square
C	Circular	T	Trapezoidal
E	Egg	U	U Shape
H	Horseshoe	X	Other

NODE REFERENCING SYSTEM

1st digit:	hundred metre easting identifier
2nd digit:	hundred metre northing identifier
3rd digit:	sewer type identifier
4th digit:	next sequential node

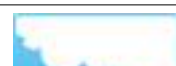
Drawn by: yadavsava

Title: 232113_St Columbas Close, Grav

Date: 12/01/2017



Gravesham Borough Council

Waller Gray		Page 1
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens Greenfield Runoff	
Date 03/08/2020 09:40 File	Designed by LG Checked by	
Innovyze	Source Control 2018.1	

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 678 Urban 0.000
Area (ha) 0.350 Soil 0.150 Region Number Region 7

Results 1/s

QBAR Rural 0.1
QBAR Urban 0.1

Q100 years 0.4

Q1 year 0.1
Q30 years 0.3
Q100 years 0.4

Waller Gray		Page 1
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens Greenfield Volume	
Date 03/08/2020 09:48 File	Designed by LG Checked by	
Innovyze	Source Control 2018.1	

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	20.000
Ratio R	0.410
Areal Reduction Factor	1.00
Area (ha)	0.350
SAAR (mm)	661
CWI	97.980
Urban	0.000
SPR	10.000

Results

Percentage Runoff (%)	7.15
Greenfield Runoff Volume (m ³)	15.491

Gravesham Borough Council

Waller Gray		Page 1
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens SA - Carpark + Building 1 in 100yr + 40% cc	
Date 03/08/2020 12:57 File WG1264 - SA.SRCX	Designed by LG Checked by	
Innovyze	Source Control 2018.1	

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

Half Drain Time : 1267 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	24.380	0.580	0.4	29.8	O K
30 min Summer	24.558	0.758	0.5	38.9	O K
60 min Summer	24.737	0.937	0.5	48.1	O K
120 min Summer	24.909	1.109	0.5	56.9	O K
180 min Summer	24.998	1.198	0.5	61.5	O K
240 min Summer	25.051	1.251	0.5	64.2	O K
360 min Summer	25.110	1.310	0.6	67.2	O K
480 min Summer	25.141	1.341	0.6	68.8	O K
600 min Summer	25.154	1.354	0.6	69.4	O K
720 min Summer	25.154	1.354	0.6	69.5	O K
960 min Summer	25.135	1.335	0.6	68.5	O K
1440 min Summer	25.082	1.282	0.5	65.8	O K
2160 min Summer	25.003	1.203	0.5	61.7	O K
2880 min Summer	24.932	1.132	0.5	58.1	O K
4320 min Summer	24.808	1.008	0.5	51.7	O K
5760 min Summer	24.697	0.897	0.5	46.0	O K
7200 min Summer	24.595	0.795	0.5	40.8	O K
8640 min Summer	24.502	0.702	0.5	36.0	O K
10080 min Summer	24.417	0.617	0.5	31.7	O K
15 min Winter	24.451	0.651	0.5	33.4	O K
30 min Winter	24.651	0.851	0.5	43.6	O K
60 min Winter	24.854	1.054	0.5	54.0	O K
120 min Winter	25.050	1.250	0.5	64.1	O K
180 min Winter	25.153	1.353	0.6	69.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	136.640	0.0	23
30 min Summer	89.730	0.0	37
60 min Summer	56.129	0.0	66
120 min Summer	33.920	0.0	126
180 min Summer	24.926	0.0	184
240 min Summer	19.911	0.0	244
360 min Summer	14.459	0.0	364
480 min Summer	11.523	0.0	482
600 min Summer	9.656	0.0	602
720 min Summer	8.354	0.0	720
960 min Summer	6.641	0.0	932
1440 min Summer	4.799	0.0	1144
2160 min Summer	3.463	0.0	1536
2880 min Summer	2.744	0.0	1956
4320 min Summer	1.974	0.0	2768
5760 min Summer	1.561	0.0	3576
7200 min Summer	1.301	0.0	4392
8640 min Summer	1.120	0.0	5184
10080 min Summer	0.987	0.0	5944
15 min Winter	136.640	0.0	22
30 min Winter	89.730	0.0	37
60 min Winter	56.129	0.0	66
120 min Winter	33.920	0.0	124
180 min Winter	24.926	0.0	182

Waller Gray		Page 2
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens SA - Carpark + Building 1 in 100yr + 40% cc	
Date 03/08/2020 12:57 File WG1264 - SA.SRCX	Designed by LG Checked by	
Innovyze	Source Control 2018.1	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
240 min Winter	25.215	1.415	0.6	72.6	O K
360 min Winter	25.289	1.489	0.6	76.4	O K
480 min Winter	25.331	1.531	0.6	78.5	O K
600 min Winter	25.352	1.552	0.6	79.6	O K
720 min Winter	25.360	1.560	0.6	80.1	O K
960 min Winter	25.354	1.554	0.6	79.7	O K
1440 min Winter	25.292	1.492	0.6	76.6	O K
2160 min Winter	25.196	1.396	0.6	71.6	O K
2880 min Winter	25.099	1.299	0.5	66.7	O K
4320 min Winter	24.920	1.120	0.5	57.5	O K
5760 min Winter	24.757	0.957	0.5	49.1	O K
7200 min Winter	24.610	0.810	0.5	41.5	O K
8640 min Winter	24.477	0.677	0.5	34.7	O K
10080 min Winter	24.359	0.559	0.4	28.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
240 min Winter	19.911	0.0	240
360 min Winter	14.459	0.0	358
480 min Winter	11.523	0.0	472
600 min Winter	9.656	0.0	588
720 min Winter	8.354	0.0	700
960 min Winter	6.641	0.0	922
1440 min Winter	4.799	0.0	1312
2160 min Winter	3.463	0.0	1644
2880 min Winter	2.744	0.0	2104
4320 min Winter	1.974	0.0	2988
5760 min Winter	1.561	0.0	3864
7200 min Winter	1.301	0.0	4688
8640 min Winter	1.120	0.0	5456
10080 min Winter	0.987	0.0	6256

Waller Gray		Page 3
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens SA - Carpark + Building 1 in 100yr + 40% cc	
Date 03/08/2020 12:57 File WG1264 - SA.SRCX	Designed by LG Checked by	
Innovyze	Source Control 2018.1	

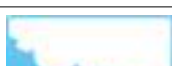
Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.800	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.118

Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)	
0 4 0.080		4 8 0.038	

Waller Gray		Page 4
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens SA - Carpark + Building 1 in 100yr + 40% cc	
Date 03/08/2020 12:57 File WG1264 - SA.SRCX	Designed by LG Checked by	
Innovyze	Source Control 2018.1	

Model Details

Storage is Online Cover Level (m) 26.200

Cellular Storage Structure

Invert Level (m) 23.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.04860 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.02430

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	54.0	54.0	1.600	54.0	121.2	1.700	0.0	121.2

Waller Gray		Page 1
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens Ring SA - Small Parking Area 1 in 100yr 40%cc	
Date 03/08/2020 12:59 File WG1264 - RING SA.SRCX	Designed by LG Checked by	
Innovyze	Source Control 2018.1	

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

Half Drain Time : 353 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	28.712	1.012	0.1	2.3	O K
30 min Summer	29.009	1.309	0.1	2.9	O K
60 min Summer	29.287	1.587	0.1	3.5	O K
120 min Summer	29.507	1.807	0.1	4.0	O K
180 min Summer	29.577	1.877	0.1	4.2	O K
240 min Summer	29.588	1.888	0.1	4.2	O K
360 min Summer	29.583	1.883	0.1	4.2	O K
480 min Summer	29.567	1.867	0.1	4.2	O K
600 min Summer	29.542	1.842	0.1	4.1	O K
720 min Summer	29.510	1.810	0.1	4.0	O K
960 min Summer	29.439	1.739	0.1	3.9	O K
1440 min Summer	29.291	1.591	0.1	3.6	O K
2160 min Summer	29.101	1.401	0.1	3.1	O K
2880 min Summer	28.948	1.248	0.1	2.8	O K
4320 min Summer	28.714	1.014	0.1	2.3	O K
5760 min Summer	28.541	0.841	0.1	1.9	O K
7200 min Summer	28.408	0.708	0.1	1.6	O K
8640 min Summer	28.301	0.601	0.1	1.3	O K
10080 min Summer	28.212	0.512	0.1	1.1	O K
15 min Winter	28.835	1.135	0.1	2.5	O K
30 min Winter	29.170	1.470	0.1	3.3	O K
60 min Winter	29.486	1.786	0.1	4.0	O K
120 min Winter	29.740	2.040	0.1	4.6	O K
180 min Winter	29.830	2.130	0.1	4.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	137.396	0.0	19
30 min Summer	90.218	0.0	33
60 min Summer	56.422	0.0	62
120 min Summer	34.083	0.0	122
180 min Summer	25.037	0.0	180
240 min Summer	19.995	0.0	228
360 min Summer	14.522	0.0	284
480 min Summer	11.573	0.0	348
600 min Summer	9.697	0.0	416
720 min Summer	8.389	0.0	484
960 min Summer	6.669	0.0	624
1440 min Summer	4.819	0.0	896
2160 min Summer	3.477	0.0	1300
2880 min Summer	2.755	0.0	1700
4320 min Summer	1.982	0.0	2464
5760 min Summer	1.567	0.0	3176
7200 min Summer	1.306	0.0	3960
8640 min Summer	1.124	0.0	4672
10080 min Summer	0.991	0.0	5440
15 min Winter	137.396	0.0	18
30 min Winter	90.218	0.0	33
60 min Winter	56.422	0.0	62
120 min Winter	34.083	0.0	120
180 min Winter	25.037	0.0	176

Waller Gray		Page 2
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens Ring SA - Small Parking Area 1 in 100yr 40%cc	
Date 03/08/2020 12:59 File WG1264 - RING SA.SRCX	Designed by LG Checked by	
Innovyze	Source Control 2018.1	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
240 min Winter	29.852	2.152	0.1	4.8	O K
360 min Winter	29.833	2.133	0.1	4.8	O K
480 min Winter	29.811	2.111	0.1	4.7	O K
600 min Winter	29.772	2.072	0.1	4.6	O K
720 min Winter	29.726	2.026	0.1	4.5	O K
960 min Winter	29.622	1.922	0.1	4.3	O K
1440 min Winter	29.415	1.715	0.1	3.8	O K
2160 min Winter	29.149	1.449	0.1	3.2	O K
2880 min Winter	28.944	1.244	0.1	2.8	O K
4320 min Winter	28.645	0.945	0.1	2.1	O K
5760 min Winter	28.435	0.735	0.1	1.6	O K
7200 min Winter	28.280	0.580	0.1	1.3	O K
8640 min Winter	28.160	0.460	0.1	1.0	O K
10080 min Winter	28.066	0.366	0.0	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
240 min Winter	19.995	0.0	230
360 min Winter	14.522	0.0	292
480 min Winter	11.573	0.0	366
600 min Winter	9.697	0.0	444
720 min Winter	8.389	0.0	520
960 min Winter	6.669	0.0	672
1440 min Winter	4.819	0.0	964
2160 min Winter	3.477	0.0	1380
2880 min Winter	2.755	0.0	1784
4320 min Winter	1.982	0.0	2552
5760 min Winter	1.567	0.0	3336
7200 min Winter	1.306	0.0	4040
8640 min Winter	1.124	0.0	4832
10080 min Winter	0.991	0.0	5544

Waller Gray		Page 3
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens Ring SA - Small Parking Area 1 in 100yr 40%cc	
Date 03/08/2020 12:59 File WG1264 - RING SA.SRCX	Designed by LG Checked by	
Innovyze Source Control 2018.1		

Rainfall Details

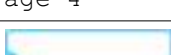
Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.009

Time (mins)	Area
From: To:	(ha)

0	4	0.009
---	---	-------

Waller Gray		Page 4
Unit 11A Hargreaves Road Eastbourne	WG1264 - St Patricks Gardens Ring SA - Small Parking Area 1 in 100yr 40%cc	
Date 03/08/2020 12:59 File WG1264 - RING SA.SRCX	Designed by LG Checked by	
Innovyze	Source Control 2018.1	

Model Details

Storage is Online Cover Level (m) 29.900

Lined Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.04860	Ring Diameter (m)	1.35
Infiltration Coefficient Side (m/hr)	0.04860	Pit Multiplier	1.5
Safety Factor	2.0	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	27.700	Cap Infiltration Depth (m)	0.000

APPENDIX G – Geotechnical Report Extracts

Gravesham Borough Council



Soakaway Investigation Report

Project Name: St Patrick's Gardens

Location: St Patrick's Gardens, Gravesend, DA12 4AW

Client: Westridge Construction Ltd

Project ID: J14457

Report Date: 21 July 2020

Report Issue: 1

SUMMARY

The site, which extended to around 0.5ha comprised the central landscaping area to the existing housing estate. It is proposed to redevelop the site with a block of flats, additional vehicle parking and a new play area. This report is to assess the soakaway potential at locations determined by the client.

This report was written to assess the soakage potential at locations determined by the client.

Geological records indicated the site to be underlain by Head and Lewes Nodular Chalk.

A Desk Study was not carried out as part of the brief for this investigation, but has been undertaken previously, by others.

An Unexploded Ordnance (UXO) risk assessment was not included in our brief.

Two phases of intrusive investigation were carried out, comprising an investigation undertaken in May 2019, by others and this current soakage investigation. All areas of the site were accessible during the fieldwork. It should not be assumed that the same ground conditions would apply to these inaccessible areas.

The soils encountered comprised Made Ground/topsoil, underlain by clay and Chalk to the west side of the site and Made Ground/topsoil, directly underlain by Chalk to the east side of the site.

Groundwater was not encountered during the course of this intrusive investigation.

BRE365 soakage tests were carried out in the four trial pits. The results obtained were found to be noncompliant for TP2 due to very slow soakage. The remaining trial pits were compliant.

As with any site, areas of contamination not identified during investigation works may come to light during the course of redevelopment. Accordingly, a discovery strategy must be in place during the redevelopment to ensure that any hitherto unknown contamination is identified and dealt with in an appropriate manner. Depending on the nature of any such contamination, it may prove necessary to reassess the remedial strategy for the site. The presence of contamination may affect the classification of waste soils, or the potential for their re-use.

This BRE365 soakage investigation was conducted and this report has been prepared for the sole internal use and reliance of Westridge Construction Ltd and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The findings and opinions conveyed via this investigation report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd. believes are reliable. Nevertheless, Southern Testing Laboratories Ltd. cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

Author	E Richardson ARSM MSc FGS	
Check / Review	P J Sugden MSc FGS	

For and on behalf of Southern Testing Laboratories Limited

DOCUMENT HISTORY AND STATUS

Issue No.	Date	Purpose or Status	Author	Check / Review
1	21-Jul-2020	Soakaway Investigation Report	ER	PJS

Copyright © 2019 Southern Testing Laboratories Ltd.

TABLE OF CONTENTS

A	INTRODUCTION	5
1	Authority	5
2	Location	5
3	Proposed Construction	5
4	Object	5
5	Scope	5
B	GEOLOGY AND WALKOVER SURVEY	6
6	Site Walkover Survey	6
C	GROUND INVESTIGATION	7
7	Strategy and Method	7
8	Weather Conditions	7
9	Soils as Found	7
10	Groundwater Observations	8
D	DISCUSSION OF GEOTECHNICAL TEST RESULTS AND RECOMMENDATIONS	8
11	Groundwater Levels	8
12	Soakaways	8

TABLE OF APPENDICES

APPENDIX A

Site Plans and Exploratory Hole Logs

APPENDIX B

Field Sampling and In-Situ Test Methods and Results

APPENDIX C

Photographs

A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in a Westridge Construction Ltd subcontract agreement, dated 28 May 2020.

2 Location

The site is located on the eastern side of Valley Drive, in Gravesend, Kent. The approximate National Grid Reference of the site is TQ 65918 72001. The site location is indicated on Figure 1 within Appendix A.

3 Proposed Construction

It is proposed to construct a block of flats, additional vehicle parking and a new play area upon the site.

4 Object

This is a site walkover and phase II geotechnical (BRE365 soakaway testing) investigation.

The object of the investigation was to assess geotechnical soil parameters (BRE365 soakaway testing) relevant to the proposed development.

5 Scope

This report presents our exploratory hole logs and test results and our interpretation of these data.

A UXO risk assessment was not requested within our brief for the investigation.

As with any site there may be differences in soil conditions between exploratory hole positions.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

The ground investigation has been completed with reference to BS 5930 Ref [4] and BS 10175 Ref [5].

Other geotechnical and contamination issues are not considered in this report.

Waste Classification of soils has not been included within the brief for the investigation.

The findings and opinions conveyed via this investigation report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd. believes are reliable. Nevertheless, Southern Testing Laboratories Ltd. cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The investigation was conducted and this report has been prepared for the sole internal use and reliance of Westridge Construction Ltd and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes.

B GEOLOGY AND WALKOVER SURVEY

5.1 Geology

The British Geological Survey Map No 271 indicates that the site geology consists of Head, underlain by Lewes Nodular Chalk.

5.1.1 Head

Head is a superficial deposit comprising a poorly sorted and poorly stratified material formed mostly by solifluction and/or hillwash and soil creep. This is a polymict deposit of gravel, sand and clay depending on the local upslope geology, from which it is derived.

5.1.2 Lewes Nodular Chalk Formation

The Lewes Nodular Chalk Formation is characterised by bands of orange-stained, hard, medium to very high density chalk interbedded with soft greyer low density chalk. There are some well-developed hardgrounds noted such as the Top Rock and Chalk Rock. A number of persistent marl and flint horizons are included within this formation. Fracturing is variable, although commonly steeply inclined and curvilinear in nature. Horizons of sub-horizontal sheet flints are also present.

The White Chalk outcrop in particular is frequently highly fractured and highly permeable, and usually has good infiltration characteristics. On the other hand, Chalk Head, highly weathered Chalk and Chalk under a low permeability superficial cover may have very poor infiltration characteristics.

Chalk is slightly soluble in water and, while it has excellent bearing properties when unweathered, this solubility can lead to deep weathering and softening, and the upper layers of chalk often have an irregular boundary with overlying strata.

The Chalk may be softened by solutioning to a depth of 5 to 15 metres and bearing capacities and engineering properties generally improve with depth. Where there is an outcrop of impermeable soil overlying the chalk there may be a dramatically increased solution effect due to concentrated surface water flow to the Chalk close to the outcrop boundary.

Solution features are common in the Chalk, and these can present significant difficulties to development on affected sites. Some risk of structural damage due to solution features must be accepted when developing sites on Chalk even where intensive site investigation work has been carried out.

Man has also worked the chalk for flints, and for other purposes, for thousands of years and any signs of old workings should be carefully investigated.

6 Site Walkover Survey

6.1 General Site Description and Boundaries

The site, which was roughly rectangular in outline, comprised the central landscaped area for the existing housing estate. The site surface consisted of grass.

The site boundaries consisted of the access roads to St Patrick's Gardens, which were located to the north, east and southern sides and Valley Drive (road) to the west boundary.

The western section of the site was noted to be slope down towards Valley Drive. A playground that was surfaced with blacktop and surrounded by fencing, was located to the centre of the site. The eastern section was set to grass.

6.2 Topography and Drainage

The site was noted to slope from east to west, with a fall in levels of around 7°, for the steepest section.

The site comprised open space and thus had no formal drainage.

6.3 Vegetation

The site surface comprised grass to the east and west, with blacktop surface to the centre, associated with the playground. London Plane trees were noted on site and to the site boundaries.

6.4 Buildings and Land Use on Site and Nearby

Terraces of three storey flats and housing were located to the north, east and southern boundaries.

6.5 Inaccessible Site Areas

All areas of the site were accessible, apart from the playground area.

6.6 Site Photographs

A series of photographs showing the site is included in Appendix C.

C GROUND INVESTIGATION

7 Strategy and Method

The strategy adopted for the intrusive investigation comprised the following:

Activity / Method	Purpose	Max Depth Range (mbgl)	Installations / Notes
TP1-4 JCB 3CX	Trial pits to investigate the shallow ground conditions and allow for assessment of soakage potential using the BRE365 method.	3.0 – 3.4	BRE365 Soakage tests undertaken: TP1 - two tests TP2 - one test TP3 - three tests TP4 - three tests

Exploratory hole locations are shown on Figure 2 in Appendix A.

In-situ test and sampling methods descriptions employed are given in Appendix B together with the test results.

8 Weather Conditions

The fieldwork was carried out on 8 July 2020, at which time the weather was generally inclement. The preceding weeks had been dry.

9 Soils as Found

The soils encountered are described in detail in the attached exploratory hole logs (Appendix A), but in general comprised a covering of Made Ground / Topsoil underlain by clay to the western end of the site only, which was underlain by Chalk throughout the site. A summary is given below.

Depth (m)	Thickness (m)	Soil Type	Description
0.0-0.1/0.8	0.1-0.8	Made Ground	Silty sandy CLAY with some gravel of flint, occasional brick and clinker noted - Made Ground or Brown silty SAND with occasional gravel of brick
0.1/0.8-1.0/2.9	0.2-2.8	Head	Silty CLAY with some fine to coarse gravel of flint. Roots and rootlets noted (TP1 and TP2)
1.0-2.3	1.3	Head	White mottled, pale brown to light brown, slightly sandy, slightly gravelly chalky CLAY. Gravel is angular to rounded, fine to coarse chalk and flint. (TP1 only)
0.3/2.3	>3	Chalk	Off white fractured blocky CHALK, with iron stained surfaces and iron stained flints, recovered as fine to coarse angular gravel of Chalk with flints

The soils found are generally in accordance with those anticipated.

9.1 Visual and Olfactory Evidence of Contamination

Evidence of possible contamination in the form of Made Ground was recorded at the location of all trial pits.

10 Groundwater Observations

Groundwater was not observed in the exploratory holes during the course of this intrusive investigation.

D DISCUSSION OF GEOTECHNICAL TEST RESULTS AND RECOMMENDATIONS

11 Groundwater Levels

Groundwater was not encountered in any of the soakage pits. Groundwater levels vary considerably from season to season and year to year, often rising close to the ground surface in wet or winter weather, and falling in periods of drought. Long-term monitoring from boreholes or standpipes is required to assess the ground water regime and this was not possible during the course of this site investigation.

It is envisaged that any seepages above the water table could be controlled within excavations by locally pumping from sumps.

12 Soakaways

Soakage testing to BRE365 was carried out in all trial pits. One filling was achieved in TP2, two in TP1 and three in trial pits TP3 and TP4.

12.1 Soakage Test Results

The BRE paper DG365, Ref [6] describes a method for site testing to determine soil infiltration rates at the proposed site of a soakaway. The in-situ test method is described in Appendix B.

Soakage tests were carried out in four locations across the site, as shown on the attached site plan Figure 2, Appendix A. The full results of the soakage tests are presented within Appendix B.

The BRE paper DG365 Ref [6], states that each pit should be allowed to drain three times to near empty, with filling on the same or consecutive days. This was not possible due to slow rates of soakage and time constraints on site.

The pit is considered full when the water level is the same as the proposed inlet invert. The time for the water level to fall from $\frac{3}{4}$ full to $\frac{1}{4}$ full is obtained and the soil infiltration rate is obtained from the following formula:

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where:

- f = The soil infiltration rate (in this case expressed in l/m²/minute);
- V_{p75-25} = The effective storage volume of water in the trial pit between 75% and 25% effective depth;
- a_{p50} = The internal surface area of the trial pit up to 50% effective depth and excluding the base area;
- t_{p75-25} = The time for the water level to fall from 75% to 25% effective depth.

The infiltration rate from each trial hole is summarised in the table below. The soakage rate in this report is expressed as $\text{l/m}^2/\text{minute}$, which is a convenient rate to use. The BRE use a unit of m/sec , which is the value in $\text{l/m}^2/\text{minute}$ divided by 60,000.

Test ID	Test Depth (mbgl)	Design Infiltration Rate		Notes
		$\text{l/m}^2/\text{minute}$	m/sec	
TP1	3.0	0.812	1.35×10^{-5}	Compliant with BRE365 as water fell to 25% of maximum water level
TP2	3.5	0.401	6.69×10^{-6}	Not compliant with BRE365 as water did not fall to 25% of maximum water level
TP3	3.0	4.73	7.88×10^{-5}	Compliant with BRE365 as water fell to 25% of maximum water level
TP4	3.0	10.26	1.71×10^{-4}	Compliant with BRE365 as water fell to 25% of maximum water level

Note: The Design Infiltration Rate is the lowest of the three tests

Where three fillings have not been carried out, a reduction factor should be applied to the result to provide a design infiltration rate.

The results will need to be examined by a Drainage Engineer to consider the infiltration drainage options for the proposed development, and determine the factor of safety to be applied, should this be required. As a general comment, the Kent Design Guide indicates that a factor of safety of at least 2 should be adopted.

Soakaways must be kept remote from structures, due to the risk of long term solutioning of the Chalk and collapse. We suggest a minimum distance of 10m between soakaways and structures. Only clean water should be allowed to enter into the soakaways, as silty water will clog fissures and joints and will reduce the efficiency of the soakaway.

All surface water discharge solutions must be discussed and approved by the relevant regulatory authorities prior to installation, in particular to Environment Agency.

In the area of TP1 and TP2, better soakage rates may be achieved by taking the depth of the soakaway chamber to a greater depth into the Chalk.

12.2 General Guidance on Design of Soakaways

The following is given as a general guidance. Any soakaway scheme may require the approval of the Environment Agency, Building Control and, where applicable, the adopting Highways Authority.

Soakaways are used to store the immediate surface water run-off from hard surfaced areas, such as roof or car parks, and allow for efficient infiltration into the adjacent soil. They should be designed to discharge their stored water sufficiently quickly to provide the necessary capacity to receive run-off from a subsequent storm. The time taken for discharge depends upon the soakaway shape and size, and the surrounding soil's infiltration characteristics.

Groundwater levels can vary considerably from season to season and year to year, often rising in wet or winter weather, and falling in periods of drought. As such, a high groundwater table may affect the storage capacity of soakaways. In addition, it should be noted that an unsaturated zone may be required between the base of soakaways and the groundwater table, by the Environment Agency. Longer term monitoring may be required to establish actual groundwater levels as part of the planning approval process.

The design of soakaways can be square, circular (conventional) or trench excavations, and may be rubble filled, perforated precast concrete ring units, plastic cells or any similar structure that collects rainwater and run-off and allow discharge directly into the ground. Depending on the geological conditions, and depth at which suitable infiltration is achieved, soakaways can also be deep bored.

Long-term maintenance and inspection must be considered during the design and construction process. Maintenance of silt traps, gully pots and interceptors will improve the long-term performance of soakaways. The use of wet well chambers within the soakaway system can further assist in pollutant trapping and extending the operating life of soakaways.

Risk of pollution to the quality of groundwater must be considered as part of the design.

Generally, roof and surface run-off should not significantly impact on groundwater quality and subject to appropriate approvals from the Environment Agency could be discharged directly to soakaways. However, although again subject to approvals from the Environment Agency, paved surface run-off for larger trafficked areas should generally be passed through a suitable form of oil interception device prior to discharge to the soakaway.

Care must be taken to ensure that the discharge of large volumes of surface run-off into the soil does not disrupt the existing sub-surface drainage patterns. Similarly in areas of sloping topography, consideration should be given to the siting of soakaways to avoid potential discharge and or flooding of down slope areas.

REFERENCES

- [1] Environment Agency, "Updated technical background to the CLEA model," 2009.
- [2] Contaminated Land: Applications in Real Environments (CL:AIRE), "Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination," 2014.
- [3] CIRIA, "C665 Assessing risks posed by hazardous ground gases to buildings," 2007.
- [4] BSI Standards, "BS 5930 Code of practice for ground investigations," 2015.
- [5] BSI Standards, "BS10175 Investigation of potentially contaminated sites – Code of practice," 2013.
- [6] Building Research Establishment (BRE), "DG365 Soakaway Design," 2016.
- [7] C. Nathanail, C. McCaffrey, A. Gillett and R. Et. N. J. Ogden, "The LQM/CIEH S4ULs for Human Health Risk Assessment," Land Quality Press, Nottingham, 2015.
- [8] EIC/AGS/CL:AIRE, "Soil Generic Assessment Criteria for Human Health Risk Assessment," 2010.
- [9] DEFRA, "SP1010 Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination," 2014.
- [10] BSI Standards, "BS 8485 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings," 2015.
- [11] CHaPD General Toxicology Unit, "Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)," Health Protection Agency, 2010.
- [12] CL:AIRE, "CL:AIRE Definition of Waste Code of Practice," [Online]. Available: <http://www.claire.co.uk/projects-and-initiatives/dow-cop>.
- [13] Environment Agency, "Waste duty of care code of practice," [Online]. Available: <https://www.gov.uk/government/publications/waste-duty-of-care-code-of-practice>.
- [14] BSI Standards, "BS 3882:2015 Specification for Topsoil," 2015.
- [15] CIRIA, "C574 Engineering in Chalk," 2002.
- [16] R. N. Mortimore, Logging the Chalk, 2014.
- [17] BSI Standards, "BS EN ISO 22475-1:2006 Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution.," 2006.
- [18] BSI Standards, "BS ISO 18400-100:2017 Soil quality. Sampling. Guidance on the selection of sampling standards," 2017.
- [19] BSI Standards, "BS ISO 18400-101:2017 Soil quality. Sampling. Framework for the preparation and application of a sampling plan," 2017.
- [20] BSI Standards, "BS ISO 18400-103:2017 Soil quality. Sampling. Safety," 2017.
- [21] BSI Standards, "BS ISO 18400-105:2017 Soil quality. Sampling. Packaging, transport, storage and preservation of samples," 2017.
- [22] BSI Standards, "BS ISO 18400-107:2017 Soil quality. Sampling. Recording and reporting," 2017.
- [23] NHBC, "NHBC Standards Plus," [Online]. Available: <http://www.nhbc.co.uk/Builders/ProductsandServices/TechZone/nhbcstandards/>.

APPENDIX A

**Site Plans and Exploratory
Hole Logs**

Gravesham Borough Co



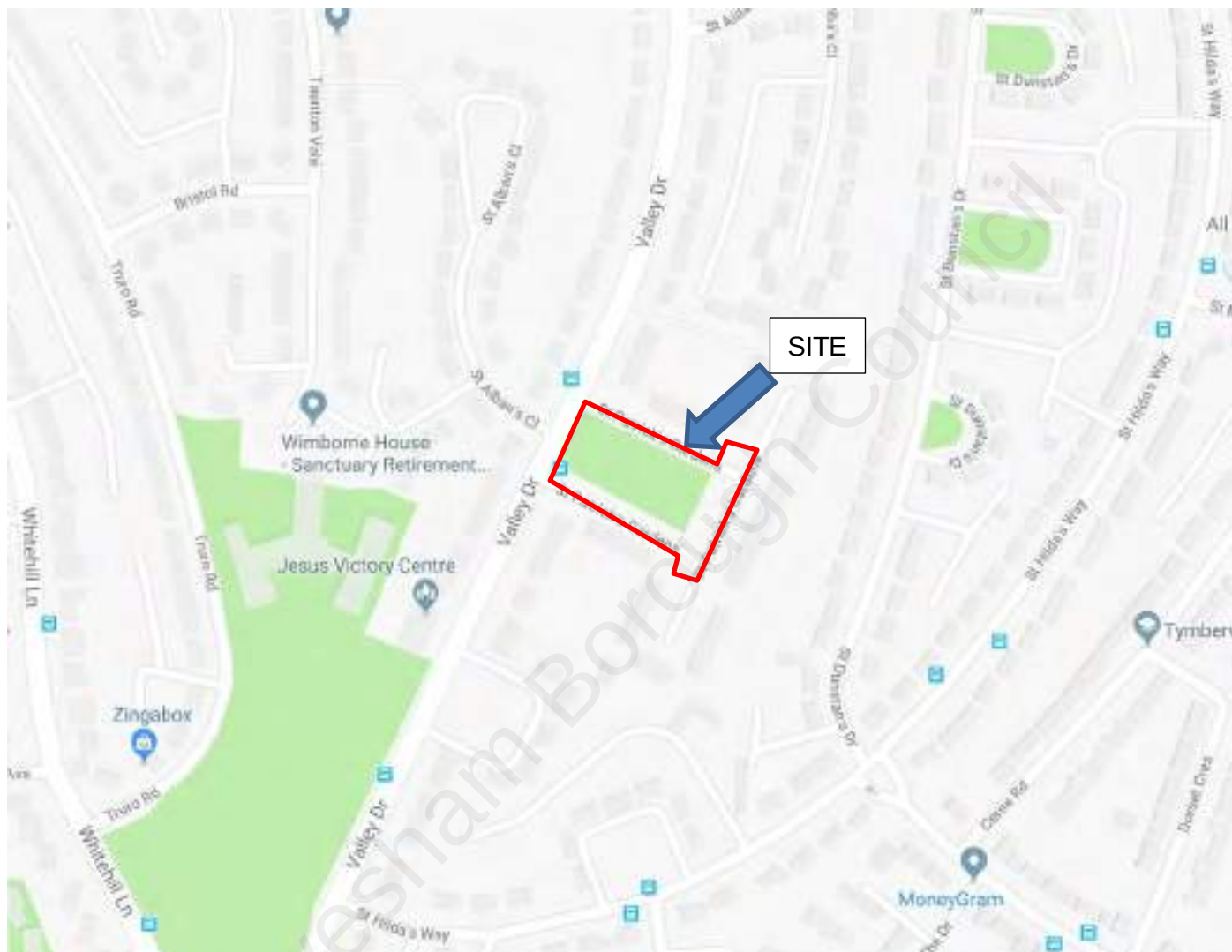
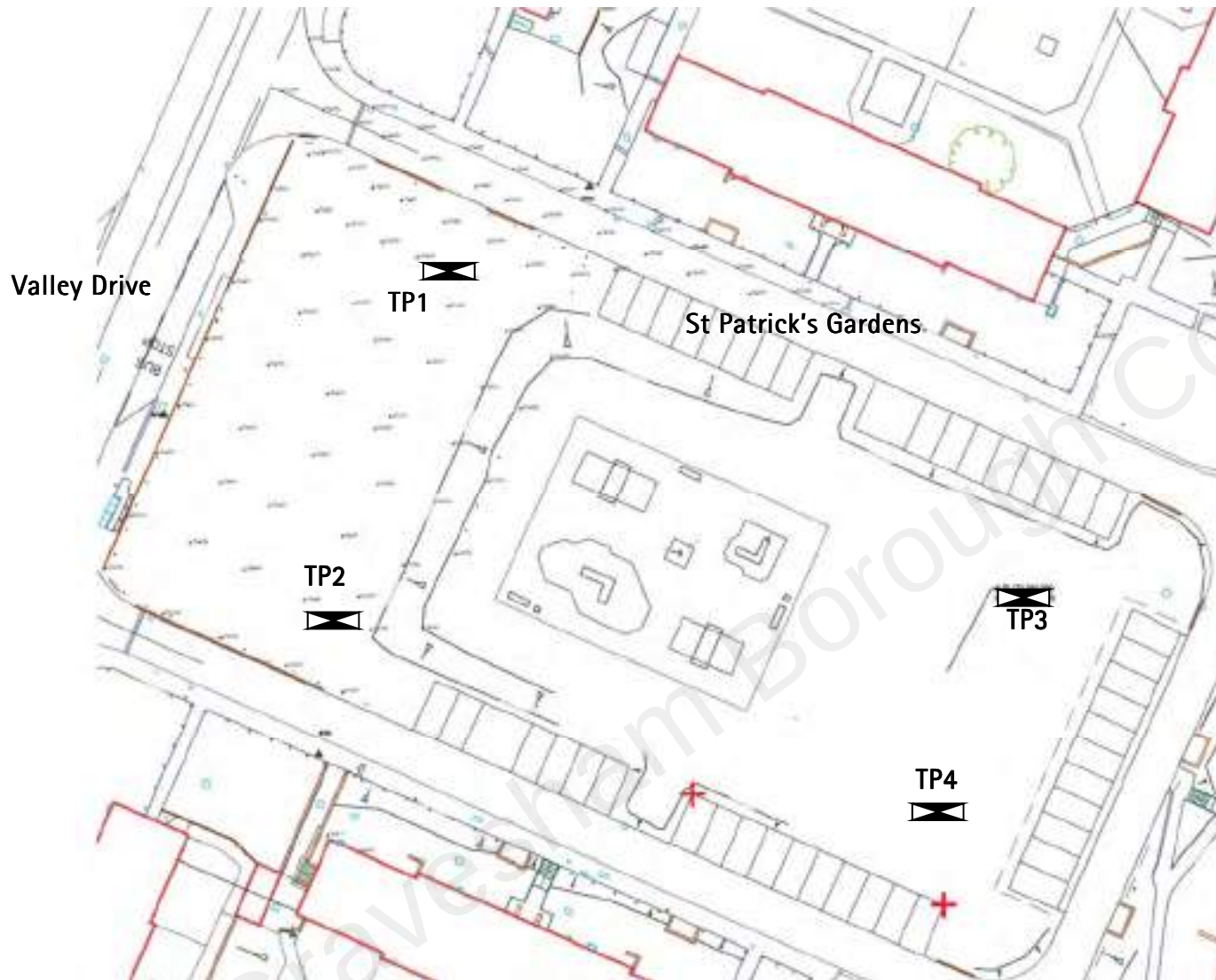


Figure 1 – Site Location Map



Job Number
J14457

Project
St Patrick's Gardens, Gravesend, Kent DA12 4AW



 Trial pit with BRE365 test

NB: Positions of Boreholes and/or Trial Pits are only indicative unless dimensioned

Site: St Patrick's Gardens, Gravesend

Date: 15 July 2020

 Southern Testing

Southern Testing: Keeble House, Stuart Way, East Grinstead, West Sussex RH19 4QA
ST Consult: Twigden Barns, Brixworth Road, Creton, Northampton NN6 8NN

 ST Consult

STL: J14457

Fig No: 2

Trial Hole Location Plan – Not to Scale

Key to Exploratory Hole Logs, Plans and Sections

Backfill Symbols		Pipe Symbols		Principal Soil Types		Principal Rock Types		Drilling Records	
Arisings		Plain Pipe		Topsoil		Mudstone		Water Strike	
Concrete		Slotted Pipe		Made Ground		Claystone		Depth Water Rose	
Blacktop		Piezometer		Clay		Siltstone		Total Core Recovery (%) [TCR]	
Bentonite		Piezometer Tip		Silt		Sandstone		Solid Core Recovery (%) [SCR]	
Gravel Filter		Filter Tip		Sand		Limestone		Rock Quality Index (%) RQD]	
Sand Filter		Extensometer		Gravel		Chalk		Fracture Index (fractures / m) [FI]	
		Inclinometers		Peat					

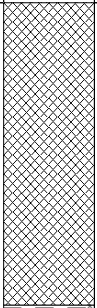
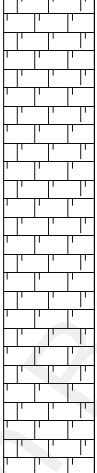
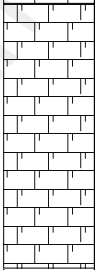
All soil and rock descriptions are in general accordance with BS5930 2015, BS EN ISO 14688-1:2002+A1:2013 and BS EN ISO 14689-1:2003. Chalk descriptions are also based on CIRIA C574 and "Logging the Chalk – R.N. Mortimer 2015". The Geology Code is only provided where a positive identification of the sample strata has been made.

Location / Method Identifiers		In-situ Test Location / Method	
BH	Borehole (undefined)	DP	Dynamic Probe
CP	Cable Percussive	CPT	Cone Penetration Test
RC	Rotary Core	CBR	In-situ CBR Test
RO	Rotary Open Hole	DCP	CBR using Dynamic Cone Penetrometer
ODC	Rotary Odex/Symmetrix drilling cased	CBRT	CBR using TRL Probe
CP+RC	Cable Percussive to Rotary Core	PB	Plate Bearing Test
SNC	Sonic	SPT (S)	Standard Penetration Test (Split Barrel Sampler)
CFA	Continuous Flight Auger	SPT (C)	Standard Penetration Test (Solid Cone)
FA	Flight Auger	N	SPT Result
VC	Vibro Core	-/-	Blows/Penetration (mm) after seating drive
WLS+RC	Windowless (Dynamic) Sampler to Rotary Core	-*/-	Total Blows / Penetration (mm)
WLS	Windowless Sampler	()	Extrapolated Value
WS	Window Sampler	PPT	Perth Penetration (In-House Method - Equivalent N Value)
HA	Hand Auger	HP / UCS	Strength from Hand Penetrometer (kN/m ²)
C	Road / Pavement Core	IVN	Strength from Hand Vane ((kN/m ²) P = peak, R = residual
IP	Inspection Pit (Hand Excavation)	PID	Photo Ionisation Detector (ppm)
TP	Trial Pit (Machine Excavated)	MEXE	Mexi-Cone CBR (%)
OP	Observation Pit (Supported Excavation Hand or Machine)		

Samples / Test Type	
B	Bulk Sample
BLK	Block Sample
C	Core Sample
CBRS	CBR Mould Sample
D	Small Disturbed Sample
ES	Environmental Sample (Soil)
EW	Environmental Sample (Water)
GS	Environmental Sample (Gas)

Samples / Test Type	
SPTLS	Standard Penetration Test Split Barrel Sample
TW	Thin Wall Push In Sample (e.g. Shelby Sampler)
U	Undisturbed Open Drive Sample (blows to take)
UT	Thin Wall Undisturbed Open Drive Sample (blows to take)
W	Water Sample (Geotechnical)
SP	Sample from Stockpile
P	Piston Sample
AMAL	Amalgamated Sample

				Start - End Date: 08/07/2020		Project ID: J14457		Machine Type: JCB 3CX		TP1 Sheet 1 of 1	
Project Name: St Patrick's Gardens, Gravesend				Remarks: BRE365 tests		Co-ordinates:		Level (m AOD):		Logger: er	
Location: Gravesend											
Client:											

Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
Depth (m)	Type	Results						
0.60	ES			(0.80)		0.80	Stiff brown silty sandy CLAY with some gravel of flint, occasional brick and clinker noted - Made Ground	1
				(0.20)		1.00	Stiff brown silty CLAY, rootlets noted	
				(1.30)		2.30	Very stiff, white mottled, pale brown to light brown, slightly sandy, slightly gravelly chalky CLAY. Gravel is angular to rounded, fine to coarse chalk and flint.	
				(0.70)		3.00	Off white fractured blocky CHALK, iron staining to surfaces with flints, recovered as fine to coarse angular gravel of Chalk with flints	
							Pit terminated at 3.00m.	3
								4

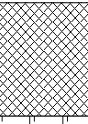
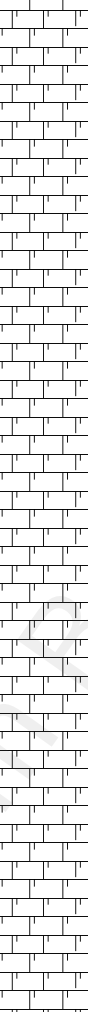
Pit Dimension (m)		Pit Stability:		Water Strikes:	
Width:	0.50	stable		dry	
Length:	1.70				
Depth:	3.00				

				Start - End Date: 08/07/2020		Project ID: J14457		Machine Type: JCB 3CX		TP2 Sheet 1 of 1	
Project Name: St Patrick's Gardens, Gravesend				Remarks: BRE365 test		Co-ordinates:		Level (m AOD):		Logger: er	
Location: Gravesend											
Client:											

Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
Depth (m)	Type	Results						
0.70				(0.10)		0.10	Brown silty SAND with occasional gravel - Topsoil	1
							Stiff brown silty CLAY with some fine to coarse gravel of flint, roots and rootlets noted	
								
								
				(2.80)				2
				(0.50)		2.90	Structureless chalk, recovered as cream to white, slightly gravelly, CHALK. Gravel is sub-angular to sub-rounded, fine to medium, weak, moderate density chalk clasts. Occasional sub-rounded, medium to coarse, rinded flint gravel. Occasional light brown to orange oxide staining in patches.	3
						3.40	Pit terminated at 3.50m.	4

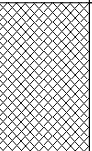
Pit Dimension (m)		Pit Stability:		Water Strikes:	
Width:	0.50	stable		dry	
Length:	2.00				
Depth:	3.50				

				Start - End Date: 08/07/2020		Project ID: J14457		Machine Type: JCB 3CX		TP3 Sheet 1 of 1	
Project Name: St Patrick's Gardens, Gravesend				Remarks: BRE365 tests		Co-ordinates:		Level (m AOD):		Logger: er	
Location: Gravesend											
Client:											

Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
Depth (m)	Type	Results						
0.15	ES			(0.30)		0.30	Grey brown silty fine sandy CLAY with occasional fine to coarse gravel of flint, occasional metal, glass and gravel of brick noted, roots and rootlets - Made Ground	
				(2.70)		3.00	Off white fractured blocky CHALK, iron staining to surfaces with flints. Recovered as fine to coarse angular gravel of Chalk	
							Pit terminated at 3.00m.	

Pit Dimension (m)		Pit Stability:		Water Strikes:	
Width:	0.50	stable		dry	
Length:	2.00				
Depth:	3.00				

				Start - End Date: 08/07/2020		Project ID: J14457		Machine Type: JCB 3CX		TP4 Sheet 1 of 1	
Project Name: St Patrick's Gardens, Gravesend				Remarks: BRE365 tests		Co-ordinates:		Level (m AOD):		Logger: er	
Location: Gravesend											
Client:											

Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
Depth (m)	Type	Results						
0.20	ES			(0.40)		0.40	Pale grey brown silty fine SAND with occasional gravel of flint - Made Ground / Topsoil	1
				(2.60)		3.00	Off white fractured blocky CHALK, iron staining to surfaces with flints, recovered as fine to coarse angular gravel of Chalk	2
							Pit terminated at 3.00m.	3
								4

Pit Dimension (m)		Pit Stability:		Water Strikes:	
Width:	0.50	stable		dry	
Length:	2.00				
Depth:	3.00				

APPENDIX B

**Field Sampling and In-Situ
Test Methods and Results**

Gravesham Borough Co

B

Soil and Rock Descriptions

All soil and rock descriptions are in general accordance with BS5930 Ref [4].

Anthropogenic soils ('made ground' or 'fill') describe materials which have been placed by man and can be divided into those composed of reworked natural soils and those composed of or containing man-made materials. 'Fill' is used to describe material placed in a controlled manner and 'made ground' is used to describe materials placed without strict engineering control.

The classification of materials such as topsoil is based on visual description only and should not be interpreted to mean that the material complies with criteria used in BS 3882 Ref [14].

Chalk descriptions are based on CIRIA C574 Ref [15] and Mortimore Ref [16].

The geology code is only provided on logs where a positive identification of the sample strata has been made.

Trial Pits and Trenches

Trial pits and trenches are unsupported excavations, mechanically excavated by machine to the required depth to enable visual examination, in situ testing and sampling as required from outside the excavation.

Hand Penetrometer Test

The handheld soil penetrometer consists of a spring loaded and calibrated plunger which is forced into cohesive soil. A reading of unconfined compression strength (equal to twice cohesion) is given on a calibrated scale. The average of a set of three readings shall be recorded.

In common with other hand methods of strength assessment it does not give an accurate indication of bearing capacity in stiff or fissured soils, because of the small test area.

Disturbed Samples

Disturbed samples were taken from exploratory holes in general accordance with BS 5930 [4] and BS EN ISO 22475-1 Ref [17] as required and stored in appropriately labelled containers. Details of the type, size and depth of sample will be recorded within the exploratory hole record. Such samples can be regarded as being between Class 5 up to Class 3 quality depending upon their method of sampling.

Environmental Samples

Environmental samples were taken from the boreholes at regular intervals in the made ground and natural soils as indicated on the exploratory hole logs. The sampling strategy was in general accordance with BS10175 Ref [5] and BS ISO 18400 Refs [18], [19], [20], [21] & [22].

These samples were collected and stored in glass jars or plastic pots and transferred to the laboratory in cool boxes as appropriate to the proposed laboratory testing.

Soakage Tests (after BRE DG365 2016)

The BRE DG365 Ref [6] paper on soakaway design allows for the design of trench soakaways as well as traditional square and circular soakaways.

The test to measure the soil infiltration rate is carried out in pits which are excavated to the full depth of the proposed soakaway. The trial pits are filled and allowed to drain to empty or near empty, three times, on the same day or on consecutive days. Water levels are recorded against time. Where the sides are unstable the pit should be filled with granular material to provide stability during the test.

Calculated soakage rates are expressed as l/m²/minute, which is a convenient rate to use. The BRE use a unit of m/sec, which is the value in l/m²/minute divided by 60,000.

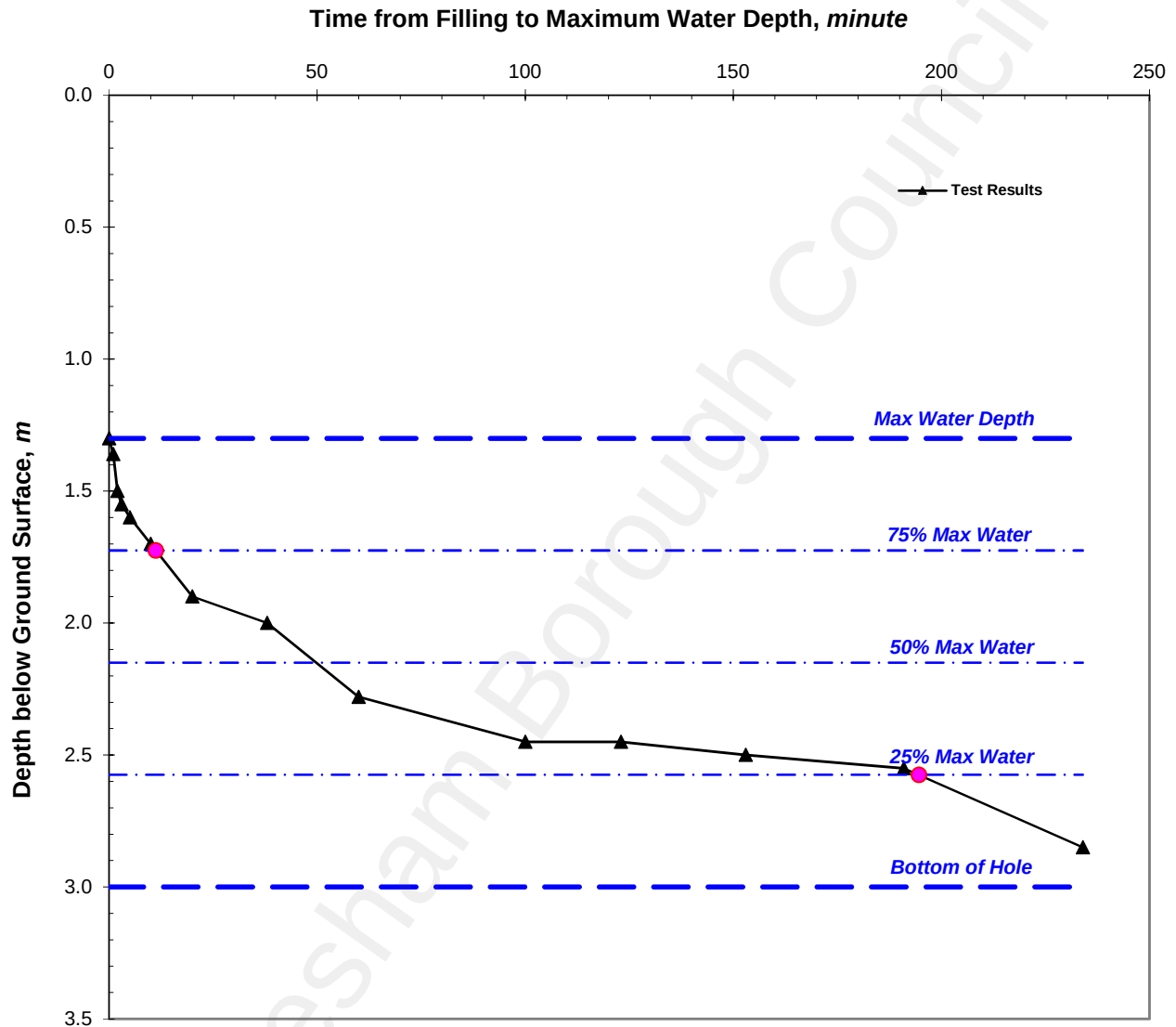
Summary Sheet

Results of BRE Digest DG365 Soakage Tests

Site : St. Patricks Gardens, Gravesend					Job No : j14457		
Client : Westridge Construction Limited					O S Reference : TQ 65918 72001		
Tested By : OS/TD				Engineer: ER		Test Date : 30/12/1899	
Hole No	Test No	Hole Depth <i>m</i>	Soakage Rate for Each Test <i>litre/m² /min</i>	Soakage Rate for Each Hole <i>litre/m² /min m/sec</i>		Water Level at Finish of Test	Remarks
TP1	No 1	3.00	0.812	0.812	1.35E-5	Nearly empty pit.	5.15 mins to fill pit 2000l used Depth to top of permeable soils was 1.2m.
TP1	No 2	3.00	1.02			Nearly empty pit.	3.40 mins to fill pit 2000l used
TP2	No 1	3.50	0.401	0.401	6.69E-6	Pit was not emptied; Non compliant value was calculated.	300l used to fill pit to depth of permeable soils Depth to top of permeable soils was 2.9m.
TP3	No 1	3.00	6.66	4.73	7.88E-5	Empty pit.	3 mins to fill pit 2000l used Depth to top of permeable soils was 0.3m.
TP3	No 2	3.00	7.81			Empty pit.	2 mins to fill pit 2000l used
TP3	No 3	3.00	4.73			Empty pit.	3.30 mins to fill pit 2000l used
TP4	No 1	3.00	17.14	10.26	1.71E-4	Empty pit.	2000l used Depth to top of permeable soils was 0.4m.
TP4	No 2	3.00	13.70			Empty pit.	4.30 mins to fill pit 2000l used
TP4	No 3	3.00	10.26			Empty pit.	4.20mins to fill pit 2000l used
Mean Value of All Calculated Soakage Rates :				4.05 <i>litre/m² /min</i>	6.75E-5 <i>m/sec</i>		

BRE Digest DG365 Soakage Test

Test Hole No: TP1
Test No: Test No 1 (Initial)



Pit Length, m	1.300	Depth to Water at Start of Test, m	1.300
Pit Width, m	0.500	Max Water Dropdown during Test, m	1.550
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	234.0
Depth to Top of Permeable Soils, m	1.200	Mean Internal Discharge Area, m ²	3.710
Depth to Groundwater Surface, m		Discharge Rate, litre/min	3.014
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	0.812
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	1.35E-05

Comments: 5.15 mins to fill pit 2000l used
Pit was nearly emptied at finish of test.

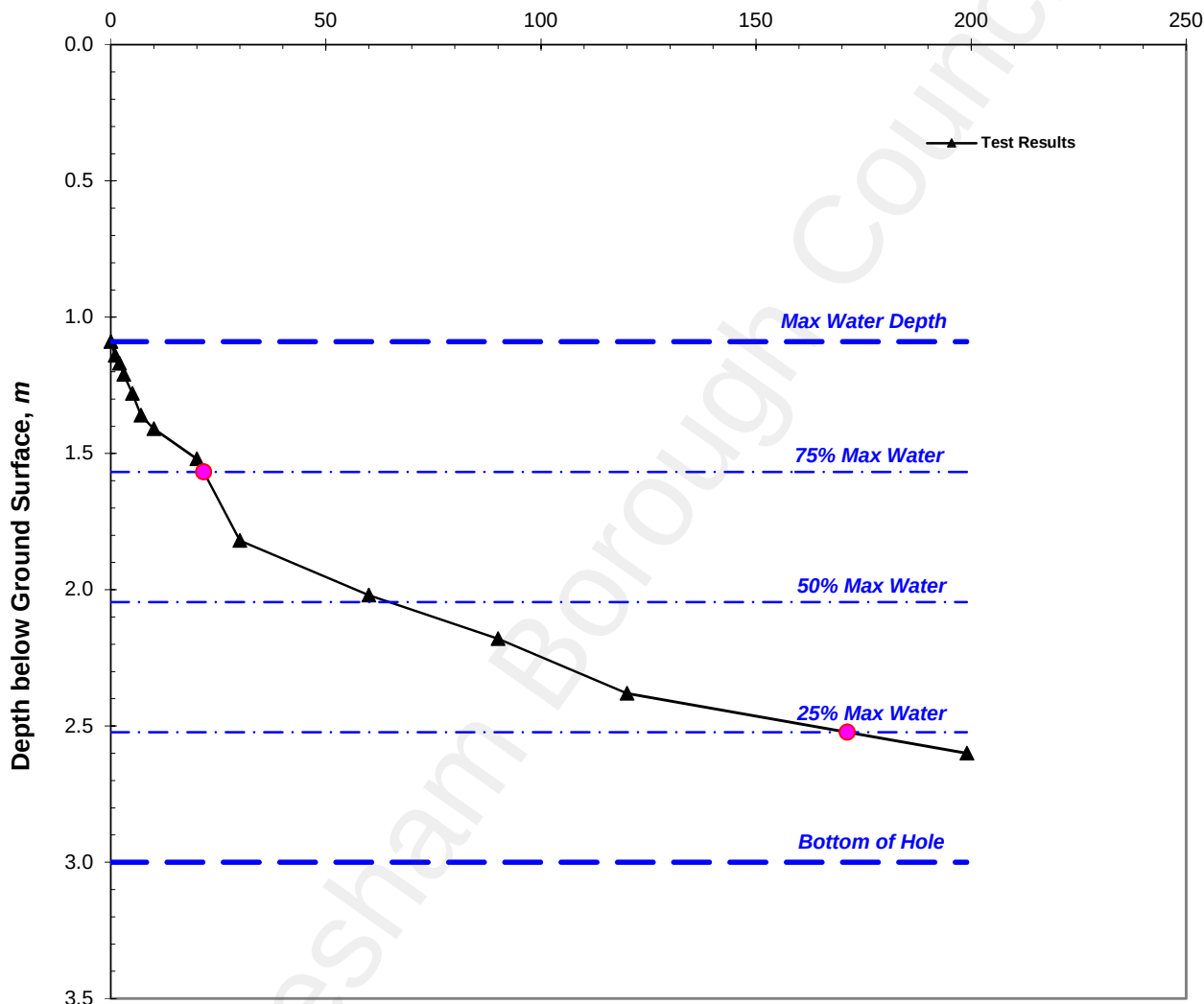
Client: Westridge Construction Limited	Job No: j14457	Test Date: 08.07.20
Site: St. Patricks Gardens, Gravesend	Tested By: OS/TD	Engineer: ER Fig. S1

BRE Digest DG365 Soakage Test

Test Hole No: TP1

Test No: Test No 2 (Repeated)

Time from Filling to Maximum Water Depth, *minute*



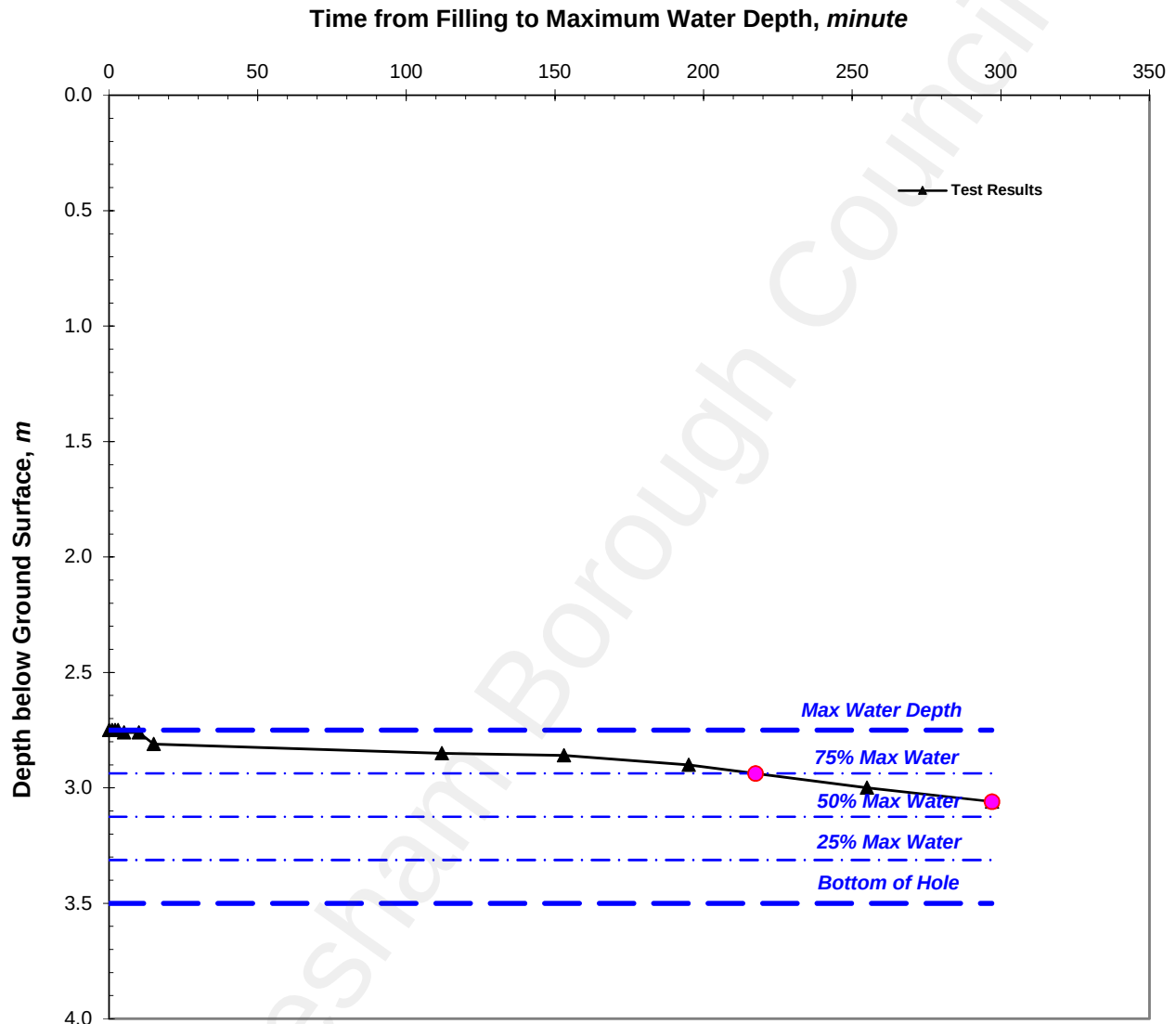
Pit Length, m	1.300	Depth to Water at Start of Test, m	1.090
Pit Width, m	0.500	Max Water Dropdown during Test, m	1.510
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	199.0
Depth to Top of Permeable Soils, m	1.200	Mean Internal Discharge Area, m ²	4.088
Depth to Groundwater Surface, m		Discharge Rate, litre/min	4.150
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	1.02
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	1.69E-05

Comments: 3.40 mins to fill pit 2000l used
Pit was nearly emptied at finish of test.

Client: Westridge Construction Limited	Job No: j14457	Test Date: 08.07.20
Site: St. Patricks Gardens, Gravesend	Tested By: OS/TD	Engineer: ER
		Fig. S2

BRE Digest DG365 Soakage Test

Test Hole No: TP2
Test No: Test No 1 (Initial)



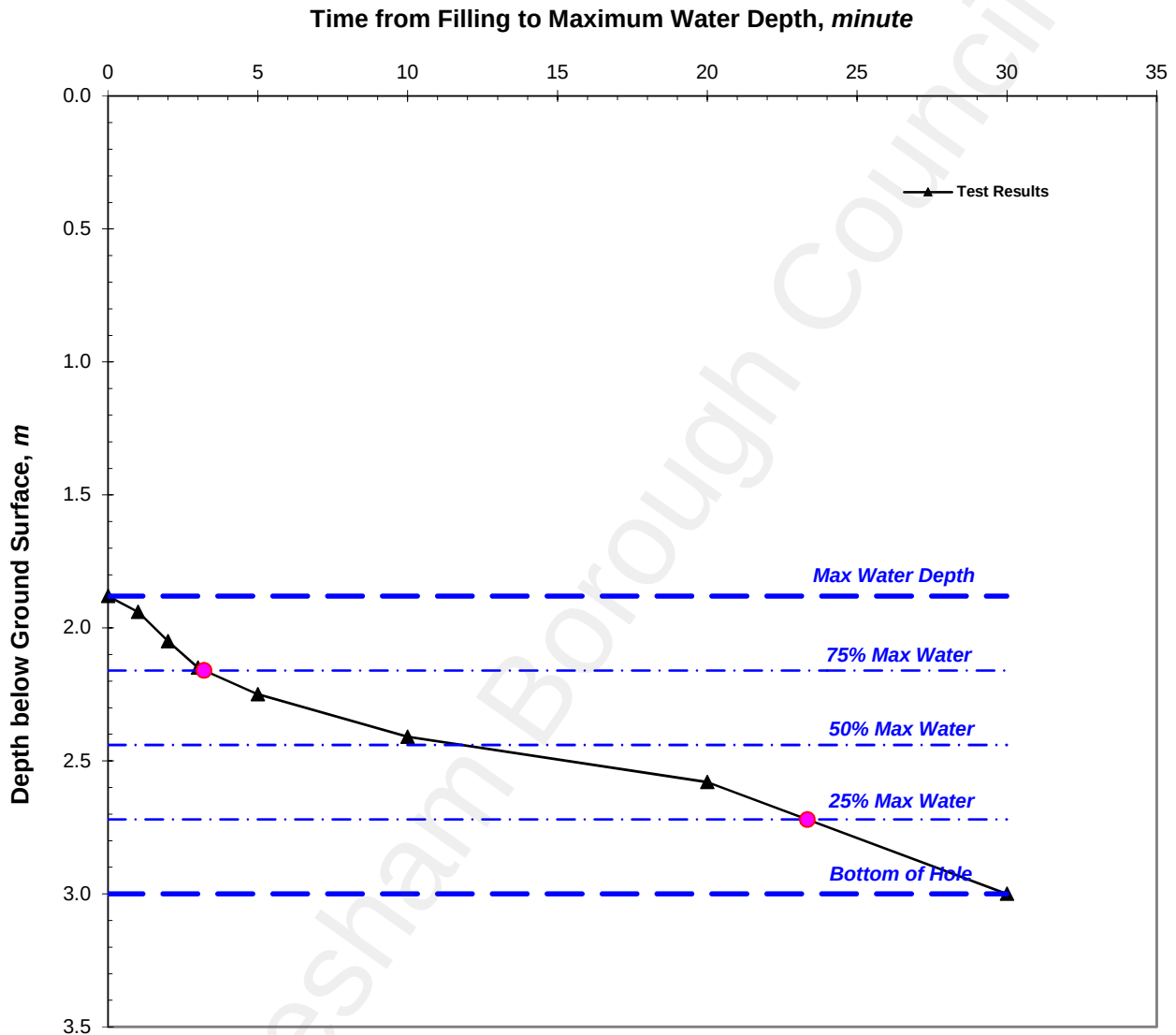
Pit Length, m	1.200	Depth to Water at Start of Test, m	2.750
Pit Width, m	0.500	Max Water Dropdown during Test, m	0.310
Depth to Pit Base, m	3.500	Total Soakage Test Time, min	297.0
Depth to Top of Permeable Soils, m	2.900	Mean Internal Discharge Area, m ²	2.304
Depth to Groundwater Surface, m		Discharge Rate, litre/min	0.925
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	0.401
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	6.69E-06

Comments: 300l used to fill pit to depth of permeable soils
Water level fell to 75% -- 50% max water depth, calculations were based on actual fall of water level achieved.
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client: Westridge Construction Limited	Job No: j14457	Test Date: 08.07.20	
Site: St. Patricks Gardens, Gravesend	Tested By: OS/TD	Engineer: ER	Fig. S3

BRE Digest DG365 Soakage Test

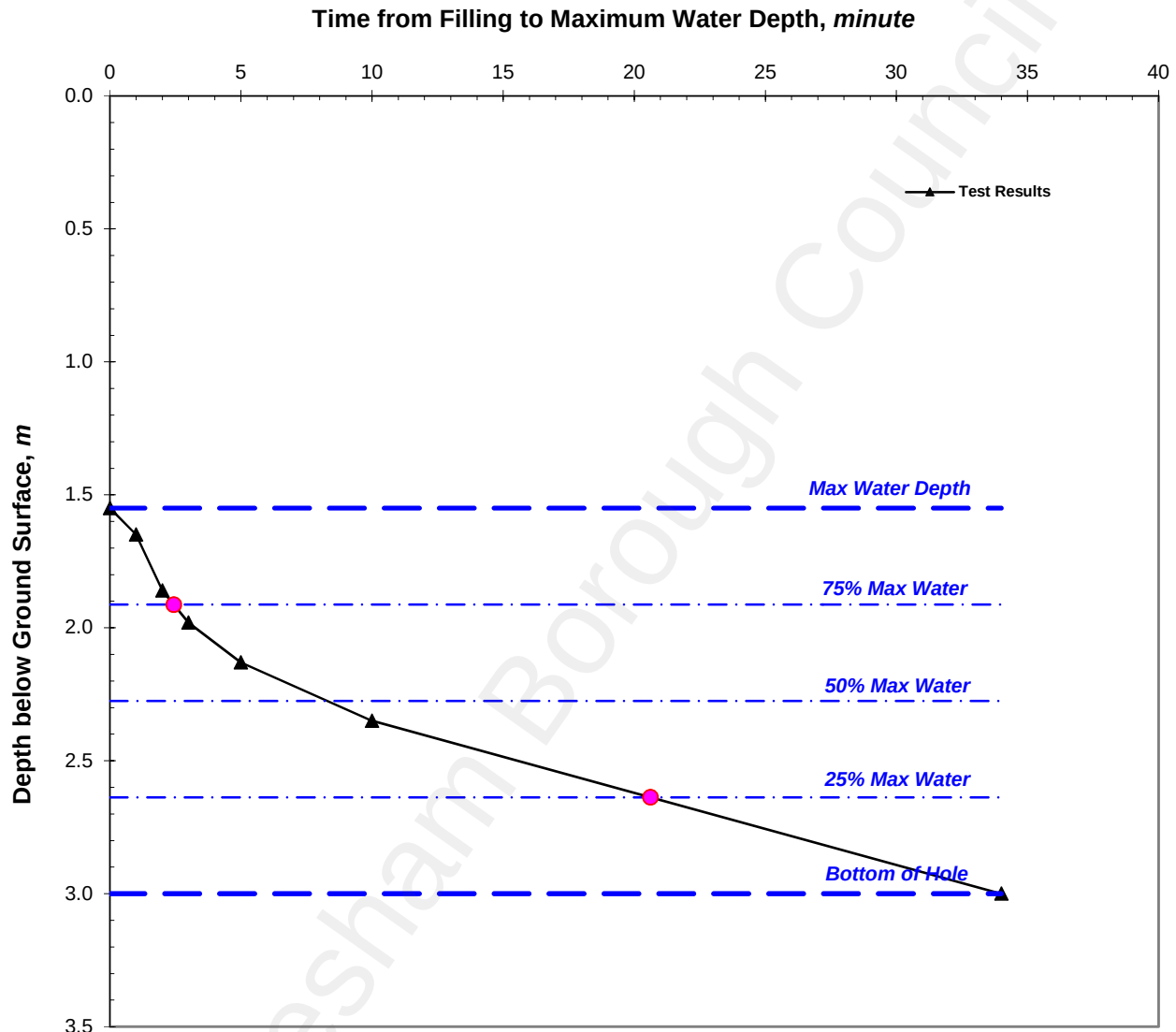
Test Hole No: TP3
Test No: Test No 1 (Initial)



BRE Digest DG365 Soakage Test

Test Hole No: TP3

Test No: Test No 2 (Repeated)



Pit Length, m	1.200	Depth to Water at Start of Test, m	1.550
Pit Width, m	0.500	Max Water Dropdown during Test, m	1.450
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	34.0
Depth to Top of Permeable Soils, m	0.300	Mean Internal Discharge Area, m ²	3.065
Depth to Groundwater Surface, m		Discharge Rate, litre/min	23.930
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	7.81
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	1.30E-04

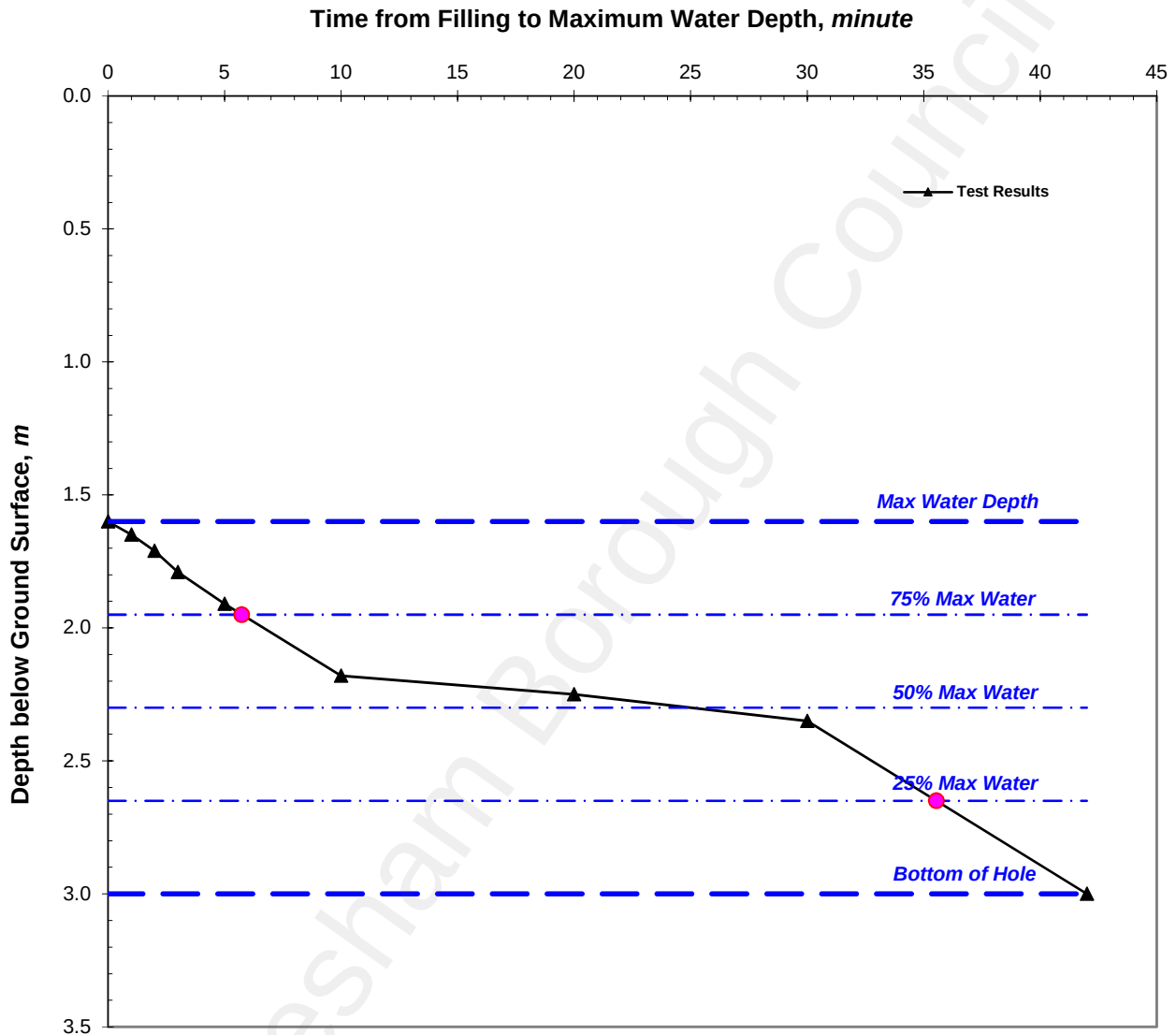
Comments: 2 Mins to fill 2000L USED
Pit was emptied at finish of test.

Client: Westridge Construction Limited	Job No: j14457	Test Date: 08.07.20
Site: St. Patricks Gardens, Gravesend	Tested By: OS/TD	Engineer: ER Fig. S5

BRE Digest DG365 Soakage Test

Test Hole No: TP3

Test No: Test No 3 (Repeated)



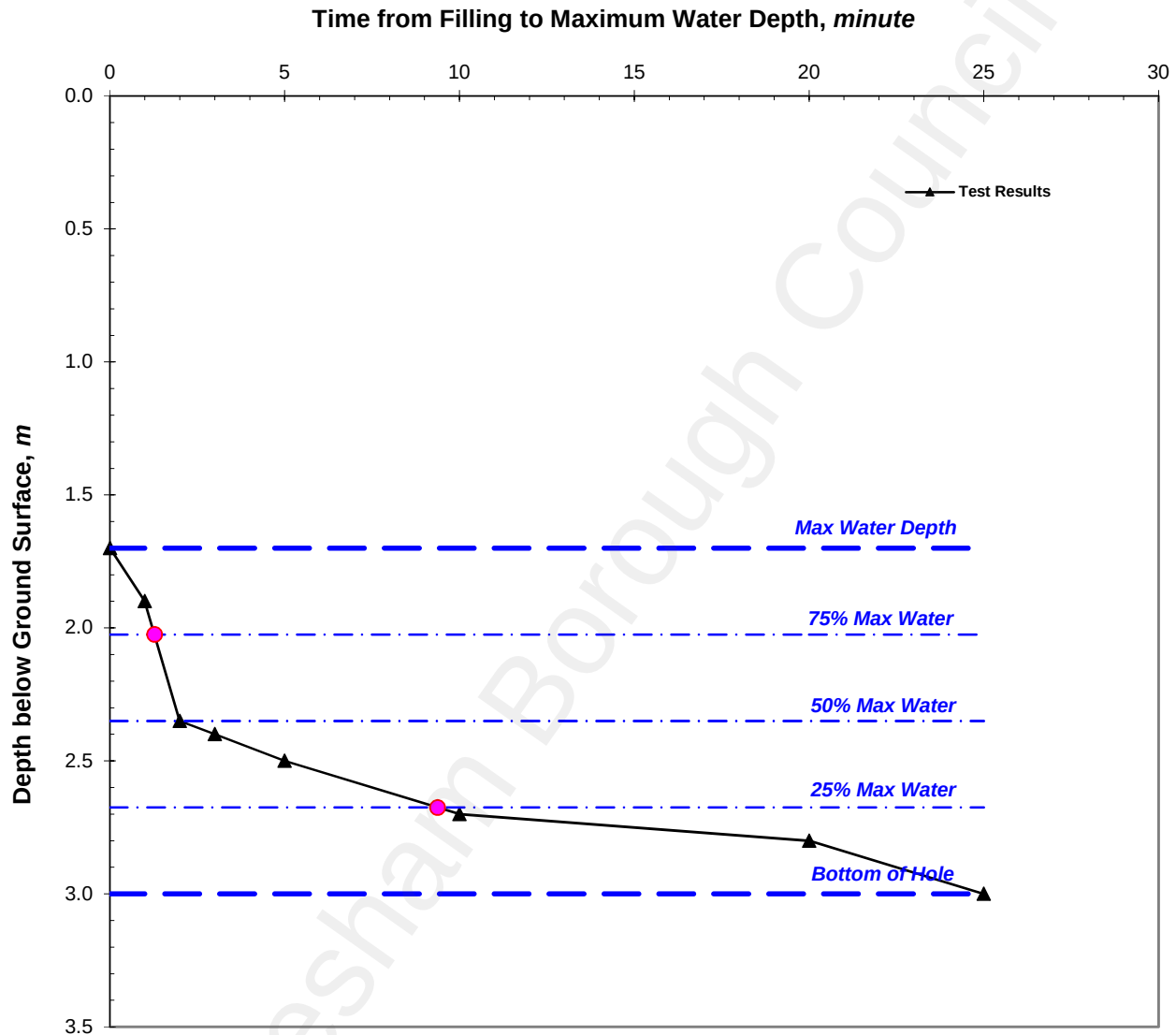
Pit Length, m	1.200	Depth to Water at Start of Test, m	1.600
Pit Width, m	0.500	Max Water Dropdown during Test, m	1.400
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	42.0
Depth to Top of Permeable Soils, m	0.300	Mean Internal Discharge Area, m ²	2.980
Depth to Groundwater Surface, m		Discharge Rate, litre/min	14.095
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	4.73
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	7.88E-05

Comments: 3.30 to fill 2000L USED
Pit was emptied at finish of test.

Client: Westridge Construction Limited	Job No: j14457	Test Date: 08.07.20
Site: St. Patricks Gardens, Gravesend	Tested By: OS/TD	Engineer: ER
		Fig. S6

BRE Digest DG365 Soakage Test

Test Hole No: TP4
Test No: Test No 1 (Initial)



Pit Length, m	1.200	Depth to Water at Start of Test, m	1.700
Pit Width, m	0.500	Max Water Dropdown during Test, m	1.300
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	25.0
Depth to Top of Permeable Soils, m	0.400	Mean Internal Discharge Area, m ²	2.810
Depth to Groundwater Surface, m		Discharge Rate, litre/min	48.165
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	17.14
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	2.86E-04

Comments: 2000L USED
Pit was emptied at finish of test.

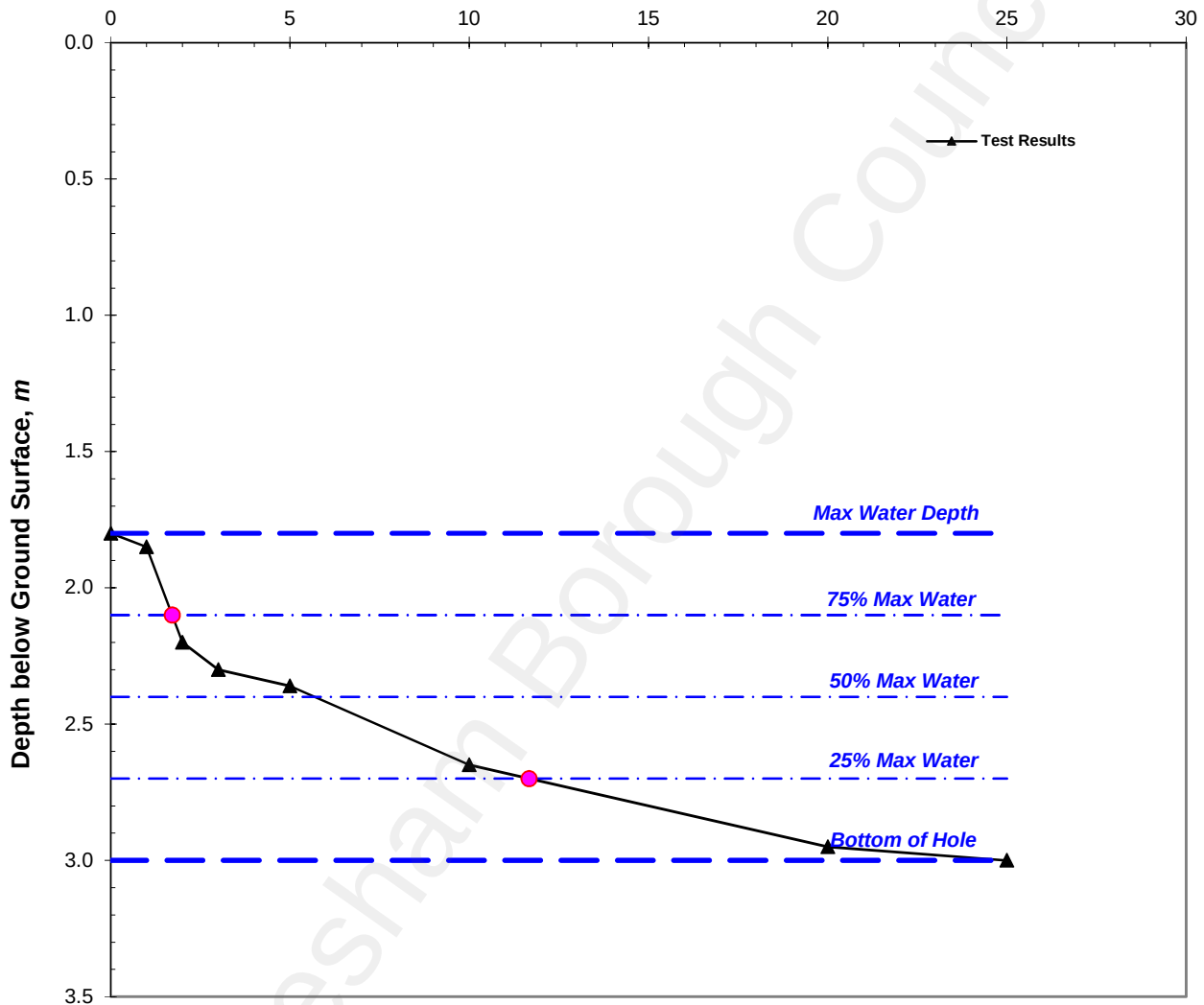
Client: Westridge Construction Limited	Job No: j14457	Test Date: 08.07.20
Site: St. Patricks Gardens, Gravesend	Tested By: OS/TD	Engineer: ER Fig. S7

BRE Digest DG365 Soakage Test

Test Hole No: TP4

Test No: Test No 2 (Repeated)

Time from Filling to Maximum Water Depth, minute



Pit Length, m	1.200	Depth to Water at Start of Test, m	1.800
Pit Width, m	0.500	Max Water Dropdown during Test, m	1.200
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	25.0
Depth to Top of Permeable Soils, m	0.400	Mean Internal Discharge Area, m ²	2.640
Depth to Groundwater Surface, m		Discharge Rate, litre/min	36.172
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	13.70
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	2.28E-04

Comments: 4.30 TO FILL 2000L USED
Pit was emptied at finish of test.

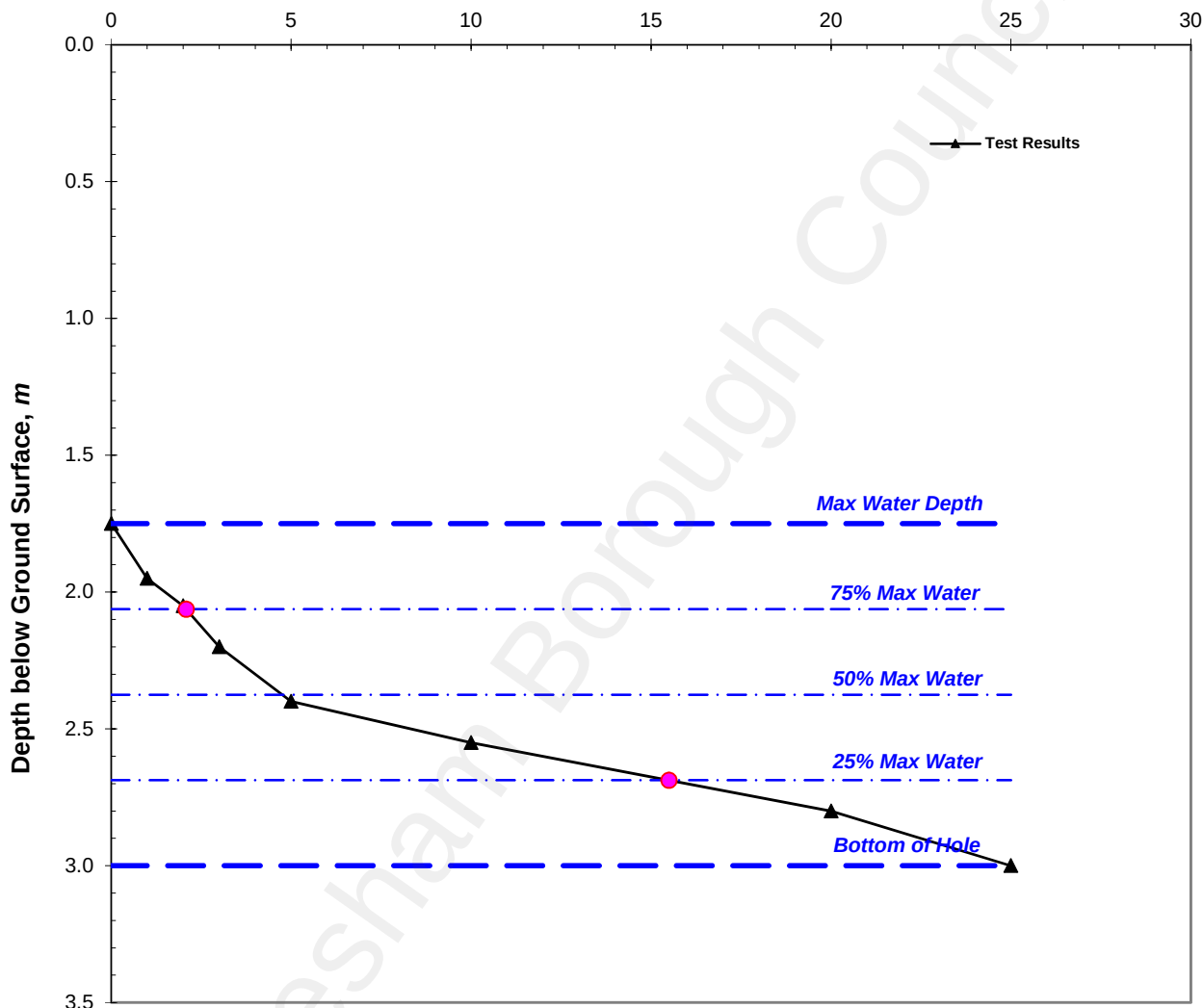
Client: Westridge Construction Limited	Job No: j14457	Test Date: 08.07.20
Site: St. Patricks Gardens, Gravesend	Tested By: OS/TD	Engineer: ER Fig. S8

BRE Digest DG365 Soakage Test

Test Hole No: TP4

Test No: Test No 3 (Repeated)

Time from Filling to Maximum Water Depth, *minute*



Pit Length, m	1.200	Depth to Water at Start of Test, m	1.750
Pit Width, m	0.500	Max Water Dropdown during Test, m	1.250
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	25.0
Depth to Top of Permeable Soils, m	0.400	Mean Internal Discharge Area, m ²	2.725
Depth to Groundwater Surface, m		Discharge Rate, litre/min	27.950
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	10.26
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	1.71E-04

Comments: 4.20 TO FILL 2000L USED
Pit was emptied at finish of test.

Client: Westridge Construction Limited	Job No: j14457	Test Date: 08.07.20	
Site: St. Patricks Gardens, Gravesend	Tested By: OS/TD	Engineer: ER	Fig. S9

APPENDIX C

Photographs



Gravesham Borough Co



Western end of site to north west



Slope to western end of site



East to playground



South west



Eastern end of site to north east



North



North



South



South



South



Looking west



west



Head Office
East Grinstead
Tel: 01342 333100
enquiries@southerntesting.co.uk

ST Consult Midlands
Northampton
Tel: 01604 500020
orsaton@stconsult.co.uk

ST Consult Thames Valley
Harrington
Tel: 01635 800 050
harrington@stconsult.co.uk

ST Consult North West
Warrington
Tel: 01825 601 735
warrington@stconsult.co.uk

APPENDIX H – Drainage Maintenance Schedule

Gravesham Borough Council

DRAINAGE MAINTENANCE SCHEDULE

Job Title	St Patricks Garden Gravesend	Job No	WG1264
		Date	July 2020
Prepared	LG	Checked	GW



Introduction

This statement details the drainage maintenance requirements for the proposed surface and foul water systems at the development above. A copy of this statement should be provided to the party responsible for maintaining the drainage system and should also be included within the Maintenance Manuals for the development.

The maintenance detailed in this document must be undertaken throughout the lifetime of the development. Failure to undertake this maintenance may result in the drainage system not operating as designed, increasing the risk of flooding.

Drawings detailing the design of the drainage system are referenced WG1264/201.

Brief Description of the Surface Water Drainage System

The below ground surface water drainage system at the above development comprises a traditional piped system, discharging to soakaways.

The proposed block of flats and main carpark discharge to a cellular soakaway within the parking area. The rainwater pipes from the front of the building connect to the rear of the building directly under the structure. The carpark area itself drains to the soakaway via a series of channel drains and road gullies connected to silt traps.

The two new sections of parking remote from the main building area are drained by ring soakaways and road gullies.

The system operates entirely by gravity and this system does not rely on moving parts to remain operational.

The surface water drainage for the site will not be offered for adoption to the statutory sewerage undertaker.

Brief Description of the Foul Water Drainage System

The below ground foul water drainage system comprises of a traditional piped system, drained entirely by gravity which outfalls to the Southern Water foul sewerage network. As the system operates entirely by gravity the system does not rely on any moving parts to remain operational.

The foul water drainage for the proposed dwelling will not be offered for adoption to the statutory undertaker.

Responsibility for Maintenance

The drainage associated with the block of flats, the communal carpark and landscaped areas, including drainage system will be the responsibility of a management company.

When a home is purchased on the development the purchaser/s will be required to enter into a legal agreement to bind all parties to co-operate with the responsibilities of that of the management company.

Each household on the development will be required to financially contribute equally for the upkeep of the shared facilities.

Maintenance Requirements

Whilst the drainage system has been designed to operate with as little maintenance as possible, there are key operations that must regularly be undertaken to ensure that it remains in optimal condition, most of which are general housekeeping tasks that should be undertaken for any drainage system, but with additional attention to the catchpits upstream of the soakaways. These operations are summarised below together with recommended frequencies:

- Periodic desilting of catchpits, gully sumps and channel drains. These should be emptied at least as follows (but with an annual inspection and additional cleansing if required): On completion of drainage works, Year 1, Year 3, then every 5 years. The desilting of these items are required to ensure the porous paving and orifice plate operate as per the design.
- Periodic jetting or rodding of pipework as required to clear blockages.
- Gratings on any gullies and channel drains to be kept clear of debris.
- Any manufacturer specific requirements for maintenance should be added to the periodic maintenance.

Cellular / Ring Soakaways

As set out in the CIRIA SuDs Manual there are additional maintenance procedures and measures which can be implemented for certain items. In the case of this site it would be related to the Cellular Soakaways. Please see below an extract from the SuD's Manual listing these additional measures:

TABLE 13.1 Operation and maintenance requirements for soakaways			
Maintenance schedule	Required action	Typical frequency	
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually	
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)	
	Trimming any roots that may be causing blockages	Annually (or as required)	
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections	
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required	
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required	
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually	
	Check soakaway to ensure emptying is occurring	Annually	

Remedial/Repair Actions

Significant storm events may cause significant damage to the drainage system. As such it may be necessary to inspect and carry out essential recovery works to return the feature to full working order.

Accidental Spillages

It is not envisaged that any materials are to be stored onsite once the development is completed, which could cause major spills and potential pollution issues within the drainage system. If this situation alters in the future a specialist will be required to be contacted to confirm if any upgrades to the existing system are required.

Minor spillages of fuels and oils from motor vehicles will be dealt with by deep trapped gullies, by collecting the hydrocarbons.

Future Alterations to the Development

Any future alterations to the drainage system should be confirmed by a specialist, as it could adversely affect the operation of the system.