DRAINAGE STRATEGY REPORT

76-78 HIGH STREET, TONBRIDGE, KENT TN9 1EE
ON BEHALF OF MCCARTHY & STONE RETIREMENT LIFESTYLES LTD
MAY2021
IDL/1070/DS/001

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DRAINAGE STRATEGY REPORT

IDL/1070/DS/001

REPORT ISSUE

Revision	Date	Notes
P01	12/05/2021	Preliminary Issue

PREPARED BY

Brijesh Mistry
Infrastructure Engineer May 2021

REVIEWED BY

Phil Tomes
Director May 2021

DISCLAIMER

CONTENTS

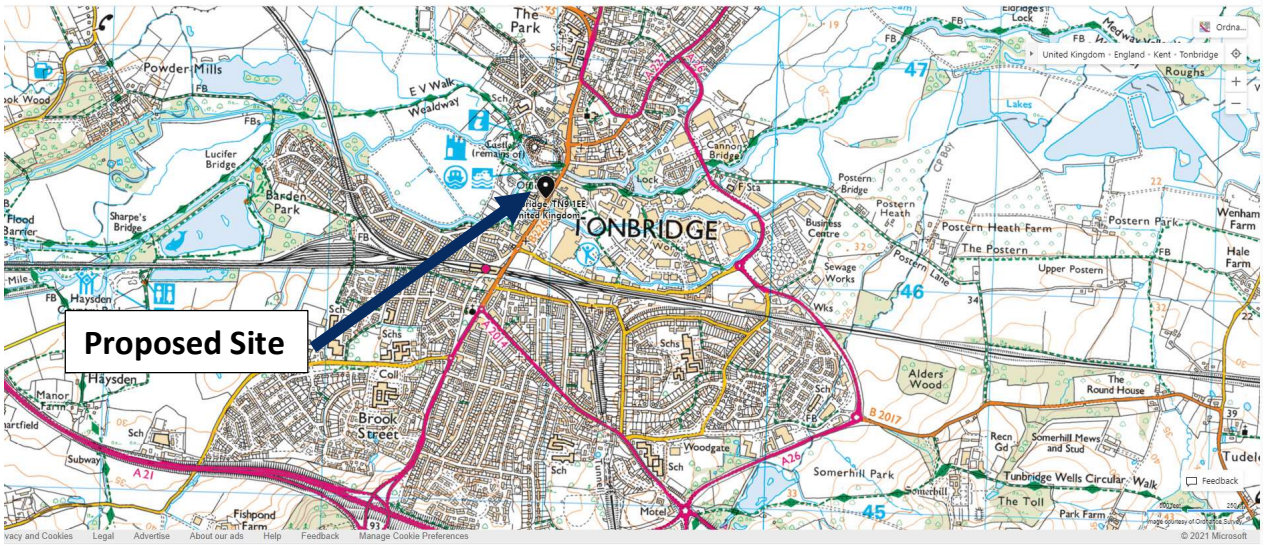
1 INTRODUCTION

1.1 Infrastructure Design Ltd has been appointed by ***McCarthy & Stone Ltd*** to prepare this Foul, Surface Water & SuDS Strategy Report to support their planning application for their proposed retirement living plus accommodation development site.

1.2 This report has been prepared in accordance with both national and local planning policy and takes guidance from Ciria 753, The SuDS Manual and The Building Regulations, Approved Document Part H.

1.3 The site is located to the northwest of High Street and 90m east of the River Medway. River Walk bounds the west, New Wharf Road to the north, High Street to the east and commercial properties are present to the northeast and south of the site. The development site is centred approximately on the Ordnance Survey (OS) national grid reference 558932mE, 146409mN. Refer to the site location extract in Figure 1 below;

Figure 1 *– Site Location Plan*



1.4 Reference Documents:-

Southern Water asset search.

Topographical Survey carried out by Laser Surveys Ltd dated Dec 2020.

Crossfield Consulting Geotechnical Environmental desk study Report No. CCL03372.CM32 appraisal was carried out in October 2020.

Rosemary White Design Ground Floor Plan SE-2739-02-AC-03 Rev E

1.5 Currently site is brownfield. The eastern part of the site is occupied by a two-storey commercial unit (Poundland). The western part of the site comprises a surface level car park, and the commercial unit finish floor level is approximately 22.64m. The car park level is relatively flat. The car park entrance is from River Walk. The northwest corner of the site is (River Walk & New Wharf Road junction) slightly higher than the rest of the site areas. Refer to Appendix C for a copy of the topographical survey.

1.6 The proposed development is a construction of retirement living accommodation comprising of four-storey blocks of apartments. The apartment block is associated with car parking areas, vehicular crossover to the car parking areas and external soft and hard landscape areas.

1.7 A new vehicle entrance will be constructed leading from New Wharf Road.

1.8 The existing site total area is 2010 m2 (0.201 hectares), and it is a 100% impermeable area. The proposed development's impermeable area is approximately 1720 m2 (0.172 hectares).

1.9 Laser Surveys have carried out a topographical survey and found the below-ground surface water drainage for the existing car park and the front of the commercial unit. It is believed that these surface areas are discharging into Southern Water surface water manhole reference no:9451 located on New Wharf Road. This surface water manhole leads towards the High Street via 150mm diameter surface water sewer. A 150mm diameter foul water sewer is located on New Wharf Road and leads towards High Street. Refer to Appendix C for a copy of the topographic survey and Appendix B for a copy of the Southern Water sewer record plan.

1.10 Reference has been made to the British Geological Survey online data, which indicates that the site is underlain by the Turnbridge Wells Sand Formation– Sandstone and Siltstone. Alluvium-clay, silt sand and gravel superficial deposits is recorded. The extract from the BGS site is included in Appendix F.

1.11 Crossfield Consulting Limited undertook a desk study appraisal of the site to identify potential constraints and ground conditions. Due to the low permeability strata, groundwater will likely be present at a relatively shallow depth, which is likely to be similar to the nearby river level; it is considered that a soakaway is not a viable option for the surface water drainage outfall. Therefore, it is recommended that an alternative drainage solution is to be identified.

1.12 The site is located within source protection zone 1.

1.13 Urban Creep has not been considered, as it is not regarded as appropriate for a development of this nature.

2 FOUL WATER DRAINAGE

2.1 The proposed foul drainage for the apartment block will be drained through the gravity drainage into the foul adoptable sewer. This gravity-fed drainage via a new manhole will discharge to the Southern Water foul sewer manhole Reference no: 9402.

2.2 The drainage strategy layout is included in Appendix D.

3 SURFACE WATER DRAINAGE & SUDS

3.1 The existing site is brownfield land; the total site area is 2010m^2(0.201 hectares)

3.2 The total site's proposed impermeable area is approximately 1720 m2(0.172Ha) from the roofs and the external paved areas. The impermeable area layout is included in Appendix D.

3.3 As mentioned in section 1.11, the infiltration technique is not a viable option to discharge the proposed surface water runoff from the site.

3.4 The nearest river is not close to the site; therefore discharging the surface water runoff from the site to the watercourse is not considered feasible.

3.5 Discharging the proposed surface water runoff to the Southern Water sewer is considered the most feasible option for the site. The existing impermeable area for the car park and Poundland is believed to be discharging into the Southern Water sewer manhole reference no:9451 freely without any flow rate restriction. The pre-development (brownfield land) surface water runoff from the site has been calculated using the Modified Rational Method using the following equation to calculate peak runoff from area: Q-2.78 Cv Cr i A

2.78 is a conversion factor to address the rainfall unit being in mm/hr

Cv = Volumetric Runoff Coefficient

Cr = Routing Coefficient

i = Rainfall Intensity (mm/hr) based on a 1 hour rainfall event.

A = Area (ha)

3.6 The tables below summarise the pre & post-development runoff rates, along with the storage volumes available within each SuDs feature.

Figure 3 Comparison of pre & post-development runoff rates

Location / Storm Event	Rainfall Intensity (mm) (From FEH 2013 web service)	Existing site Runoff Rate- brownfield site (l/s)	Proposed Runoff Rate (l/s)	Betterment
1 in 2 year	13.1	9.05	2.1	76%
1 in 30 year	37.06	25.5	4.5	82%

1 in 100 year	48.37	33.37	6.1	81%
1 in 100 year (+40%cc)		-	8.2	

76% to 82% improvement in the runoff rate

Figure 4 *Storage volumes available within each SuDS feature*

LOCATION	**SuDS DEVICE**	**AVAILABLE STORAGE**
Roads and Parking areas	Granular subbase /Permeable Paving-1005m2 x 0.35m x 0.33	116 m3
Crate storage	Crate system (113m2 x 0.8)	91 m3

3.7 The proposed residential development will incorporate the use of SuDS techniques selected for their suitability given the site layout, topographical levels and geotechnical constraints. Refer to Appendix A to view the SuDS Hierarchy.

3.8 To summarise, the following SuDS devices will be implemented on this development;

Porous Paving with granular sub base

Ground Floor parking areas. These will be detailed in accordance with Interpaved System C and be lined (no infiltration).

Crate Attenuation

Incorporating flow controls on the outlet to accommodate the runoff from all storm events up to and including the peak 1 in 100 years, plus climate changes storm.

3.8 The calculations located in Appendix E demonstrate that where the subbase is laid level, a minimum permeable stone layer of 350mm is required. Permeable Paving with a subbase lined in an impermeable membrane will be used in forming roads and parking areas. This will serve to delay runoff into the ditch outfall slowly and improve water quality in the process.

3.10 All of the roof areas will drain through conventional gravity drainage and stored within the crate attenuation tank, located within the car parking areas. The crate attenuation then will discharge to the private surface water pump chamber. Pump fed surface water discharge has been chosen due to not having enough gravity fall in the proposed drainage system to the surface water sewer. The surface water runoff will outfall at a brownfield discharge rate to the existing 150mm diameter surface water sewer located south of New Wharf Road. The sewer connection consent and sewer capacity check to be obtained from Southern Water.

3.11 The surface water discharge rate from the new development will be limited to a maximum of 8.2 l/sec for the 1 in 100 years plus climate change (40%) return period. The improvement in the proposed runoff rate compare to the existing site are between 76% to 82%.

3.12 Appendix E provides the Flow software results summary for the 1 in 2, 1 in 30 and 1 in 100 years (plus a 40% allowance for climate change) return period events for each of the networks. Refer to Appendix E for the surface water calculations and simulation.

4 ENCLOSURES

4.1 Appendix A includes the SuDS Hierarchy.

4.2 Appendix B includes a copy of the Southern Water asset search.

4.3 Appendix C includes a copy of the Topographical Site Survey.

4.4 Appendix D includes a copy of the Drainage Strategy Layouts.

4.5 Appendix E includes the Surface Water / SuDS calculations and simulation results.

4.6 Appendix F BGS Website extract

4.7 Appendix G includes the Draft Management & Maintenance Requirements

APPENDIX A – SUDS HIERARCHY

Most Sustainable	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit	Included in the scheme?	Comments
	Living roofs	√	√	√		The proposed roof finishes preclude the use of green roofs
	Basins and ponds	√	√	√		Given the proposed layout of this site, these SuDS features are not suitable.
	Filter strips and swales	√	√	√		Given the site density and insufficient space exists within the site for these types of SuDS features.
	Infiltration devices	√	√	√		Due to the soil strata and possibility of shallow grounwater it is considered that the infiltration is not a viable option for the surface water drainage outfall
	Permeable surfaces and infiltration blanket	√	√		√	Permeable Paving is proposed to be used within parking areas. This will assist in pollution reduction and the 'delay' of runoff.
Least Sustainable	**Tanked systems-Over size Pipes**	√			√	Crate storage is proposed to store extreme storm events and surface water runoff.

APPENDIX B – SOUTHERN WATER ASSET SEARCH

(c) Crown copyright and database rights 2020 Ordnance Survey 100031673 | Date: 24/11/20 | Scale: 1:1250 | Map Centre: 558957,146386 | Data updated: 16/11/20 | Our Ref: 462012 - 1 | Wastewater Plan A3

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. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2020 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer
Combined Gravity Sewer
Culverted Water Course or Treated Effluent
Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon
Combined Outfall
Surface Water Outfall
Foul Outfall
Surface Water Inlet
Combined Pumping Station
Surface Water Pumping Station
Foul Pumping Station
WWTW Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway

john.duncan@nrswa.net
Tonbridge

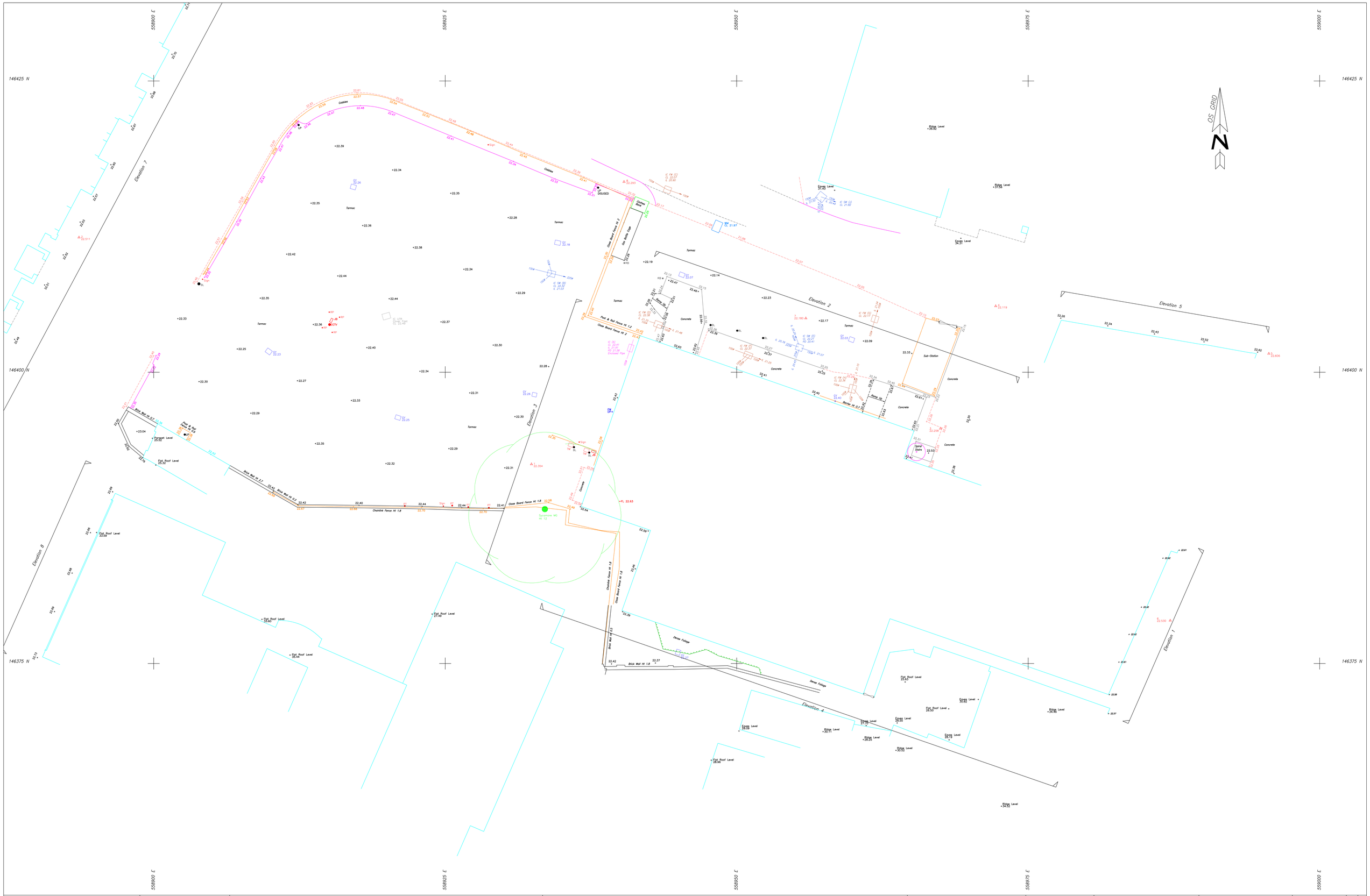
WATER for LIFE from Southern Water.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0302	F	21.88	20.40	
0303	F	21.83	20.37	
0306	F	22.11	0.00	
0307	F	21.77	19.49	
0308	F	21.95	20.05	
0309	F	21.40	19.53	
030D	F	0.00	0.00	
0310	F	21.80	19.33	
0311	F	22.25	20.96	
0312	F	22.00	19.25	
031D	F	0.00	0.00	
0401	F	22.05	20.42	
0402	F	22.04	20.46	
0403	F	22.14	21.13	
0404	F	22.63	20.56	
0405	F	22.80	20.80	
0407	F	22.47	20.65	
0408	F	0.00	0.00	
040D	F	0.00	0.00	
041D	F	0.00	0.00	
042D	F	0.00	0.00	
043D	F	0.00	0.00	
1301	F	21.89	18.12	
1302	F	22.34	18.45	
1305	F	22.04	18.99	
1306	F	22.17	18.62	
1307	F	22.15	18.38	
1308	F	21.93	18.10	
1310	F	0.00	0.00	
1311	F	0.00	0.00	
1401	F	22.14	19.48	
1402	F	22.15	19.30	
1403	F	22.10	18.94	
1404	F	22.08	19.97	
1405	F	22.18	20.15	
1406	F	0.00	0.00	
1501	F	22.86	20.56	
1502	F	23.39	20.39	
1503	F	23.71	20.26	
2301	F	22.40	17.88	
8204	F	22.47	21.31	
8205	F	22.42	21.61	
820D	F	0.00	0.00	
821D	F	0.00	0.00	
822D	F	0.00	0.00	
823D	F	0.00	0.00	
9204	F	21.82	21.01	
9205	F	22.02	21.26	
9206	F	22.55	21.14	
9208	F	22.75	21.25	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
9209	F	23.18	21.72	
9301	F	22.56	21.51	
9302	F	22.53	0.00	
9303	F	22.36	21.68	
9304	F	22.48	21.84	
9305	F	22.37	22.08	
9306	F	22.13	0.00	
9307	F	0.00	0.00	
9308	F	0.00	0.00	
9309	F	0.00	0.00	
930D	F	0.00	0.00	
9310	F	0.00	0.00	
9311	F	0.00	0.00	
9312	F	0.00	0.00	
9313	F	0.00	0.00	
9315	F	0.00	0.00	
931D	F	0.00	0.00	
933D	F	0.00	0.00	
934D	F	0.00	0.00	
9401	F	22.82	21.38	
9402	F	22.10	20.93	
9403	F	22.41	0.00	
9404	F	0.00	0.00	
9405	F	0.00	0.00	
940D	F	0.00	0.00	
0252	S	22.54	19.39	
0253	S	22.86	0.00	
0255	S	21.71	19.61	
0352	S	0.00	0.00	
0372	S	0.00	0.00	
0373	S	0.00	0.00	
0451	S	22.18	20.18	
0452	S	22.15	20.59	
0453	S	22.22	20.72	
0455	S	22.40	0.00	
0456	S	22.80	21.20	
0457	S	0.00	0.00	
0458	S	22.30	20.30	
045D	S	0.00	0.00	
046D	S	0.00	0.00	
1350	S	0.00	0.00	
1351	S	0.00	0.00	
1352	S	0.00	0.00	
1353	S	22.19	20.04	
1354	S	22.17	19.95	
1355	S	22.07	0.00	
1356	S	0.00	20.32	
1357	S	22.21	20.12	
1358	S	21.90	20.05	
1359	S	22.03	19.89	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
1450	S	22.18	20.68	
1451	S	22.24	20.62	
1452	S	22.23	20.19	
8251	S	22.14	21.57	
8252	S	22.12	19.95	
8253	S	21.06	0.00	
9254	S	21.75	0.00	
9255	S	21.85	0.00	
9262	S	0.00	0.00	
9451	S	22.18	0.00	
9452	S	21.95	20.31	

APPENDIX C – TOPOGRAPHICAL SITE SURVEY



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DATUM NOTES

CO-ORDINATES USED ARE BASED ON O/S NATIONAL GRID, OBTAINED USING THE ACTIVE GPS NETWORK AND ADJUSTED TO A LOCAL GRID WITH A SCALE FACTOR OF 1.0000

LEVELS ARE RELATED TO :- O/S ACTIVE GPS NETWORK.

SURVEY CONTROL STATIONS SHOWN △

ABBREVIATIONS (where applicable)

AV	Air Valve	DC	Drainage Channel	IC	Inspection Cover	OH	Overhead	SK	Soakaway	VP	Vent Pipe
BK	Brick	DP	Drain Pipe	IL	Invert Level	PAV	Paving	SPT	Septic Tank	WL	Water Level
BL	Bollard	EP	Electricity Pole	IN	Interceptor	PB	Post Box	ST	Silt Trap	WM	Water Meter
BS	Bus Stop	ER	Earthing Rod	I/R	Iron Railings	PE	Pipe	SV	Stop Valve	WO	Wash Out
BT	British Telecom	FB	Flower Bed	JB	Junction Box	PM	Parking Meter	SVC	Security Video Camera		
C/B	Close Boarded	FE	Fence	KO	Kerb Outlet	P/R	Post and Rail	TCB	Telephone Call Box		
CL	Cover Level	FH	Fire Hydrant	LB	Litter Bin	PT	Post	THL	Threshold Level		
CLK	Chainlink	FL	Floor Level	LP	Lamp Post	P/W	Post and Wire	TL	Traffic Light		
CO	Column	FP	Flag Pole	MH	Manhole Cover	RE	Rodding Eye	TK	Tank		
Conc	Concrete	GP	Gate Post	MK	Marker	RET	Retaining	TP	Telegraph Pole		
CP	Catch Pit	GV	Gas Valve	MS	Milestone	RS	Road Sign	UG	Underground		
CPS	Concrete Paving Slabs	Gy,G	Gully	MT	Meter	RSJ	Rolled Steel Joist	UTF	Unable To Trace Further		
CTV	Cable Television	HT	Height	MY	Mercury	SC	Stop Cock	UTR	Unable To Raise		

POUNDLAND STORE
76–78 HIGH STREET, TONBRIDGE, TN9 1EE

TOPOGRAPHICAL SURVEY

NOTES

- Drainage pipe sizes (where shown) have been gauged from the surface for safety reasons and should be regarded as approximate only.
- Tree species (where shown) should be treated with caution and expert identification is advised.
- Although this is a digital survey the accuracy and amount of detail shown is only commensurate with the graphical scale of mapping as specified. Care should be exercised when working to larger scales.
- Values shown in the vicinity of the boundaries as shown above, may not represent the extent of legally conveyed ownership.
- Whilst every effort has been made to achieve accuracy on this plan, CRUCIAL clearance dimensions, levels and invert levels should be checked prior to design and construction.
- Kerb levels have been taken in the bottom of the channel.

SHEET LAYOUT
NOT TO SCALE

2
1

SURVEYED FOR McCARTHY & STONE, PROSPECT PLACE, 85 GREAT NORTH ROAD, HATFIELD, AL9 5DA.

SURVEYOR R WARR DATE DEC 2020

NO	DATE	REVISION

DRAWING NO	G 9941/1	REV 0
DRAWING TITLE	TOPOGRAPHICAL	
SCALE	1 : 100 (A0)	
SEE ALSO DWG NOS	G 9370/1 – 6	
SHEET	1 of 3	
REF NO	G 9941	

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TOPOGRAPHICAL SURVEY

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ABBREVIATIONS (where applicable)

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BK	Brick
BL	Bollard
BS	Bus Stop
BT	British Telecom
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CL	Cover Level
CLK	Chainlink
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CPS	Concrete Paving Slabs
CTV	Cable Television
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DP	Drain Pipe
EP	Electricity Pole
ER	Earthing Rod
FB	Flower Bed
FE	Fence
FH	Fire Hydrant
FL	Floor Level
FP	Flag Pole
GP	Gate Post
GV	Gas Valve
Gy,G	Gully
HT	Height
IC	Inspection Cover
IL	Invert Level
IN	Interceptor
I/R	Iron Railings
JB	Junction Box
KO	Kerb Outlet
LB	Litter Bin
LP	Lamp Post
MH	Manhole Cover
MK	Marker
MS	Milestone
MT	Meter
MY	Mercury
OH	Overhead
PAV	Paving
PB	Post Box
PE	Pipe
PM	Parking Meter
P/R	Post and Rail
PT	Post
P/W	Post and Wire
RE	Rodding Eye
RET	Retaining
RS	Road Sign
RSJ	Rolled Steel Joist
SC	Stop Cock
SK	Soakaway
SPT	Septic Tank
ST	Silt Trap
SV	Stop Valve
SVC	Security Video Camera
TCB	Telephone Call Box
THL	Threshold Level
TL	Traffic Light
TK	Tank
TP	Telegraph Pole
UG	Underground
UTF	Unable To Trace Further
UTR	Unable To Raise
VP	Vent Pipe
WL	Water Level
WM	Water Meter
WO	Wash Out

NOTES

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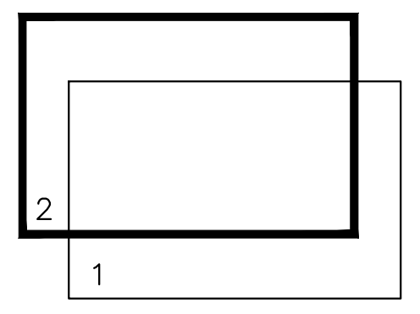
SHEET LAYOUT
NOT TO SCALE



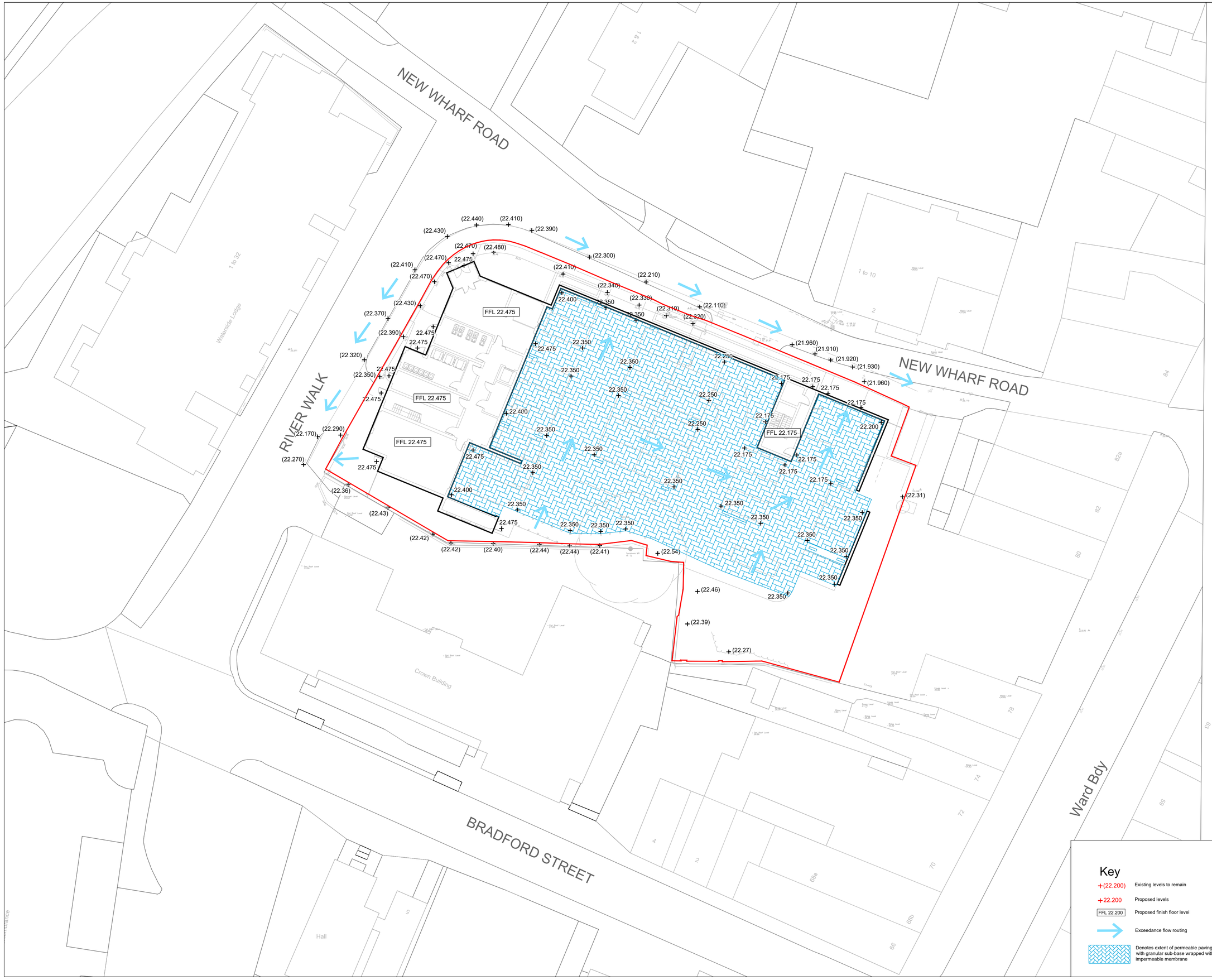
SURVEYED FOR
McCARTHY & STONE,
PROSPECT PLACE,
85 GREAT NORTH ROAD,
HATFIELD,
AL9 5DA.

SURVEYOR R WARR DATE DEC 2020

NO	DATE	REVISION

DRAWING NO	G 9941/2	REV	0
DRAWING TITLE	TOPOGRAPHICAL		
SCALE	1 : 100 (A0)		
SEE ALSO DWG NOS	G 9370/1 – 6		
SHEET	2 of 3		
REF NO	G 9941		

APPENDIX D – PROPOSED DRAINAGE STRATEGY LAYOUTS & DRAINAGE AREA PLANS



PRELIMINARY

Notes

Rev	Description	Date
-	First Issue	14.04.21

Status:

Stage 3

Scale :	1:200@A1		
Date :	April 21	Checked:	Approved:
Drawn :	IDL	BM	PT

Title :

Proposed Levels

Project :

76-78 High Street, Tonbridge, Surrey

Drg. No:	Rev:	File Ref:	1070-05-110.dwg
SE-2739-03-DE-110	-	Plot Ref:	SE-2739-03-DE-110

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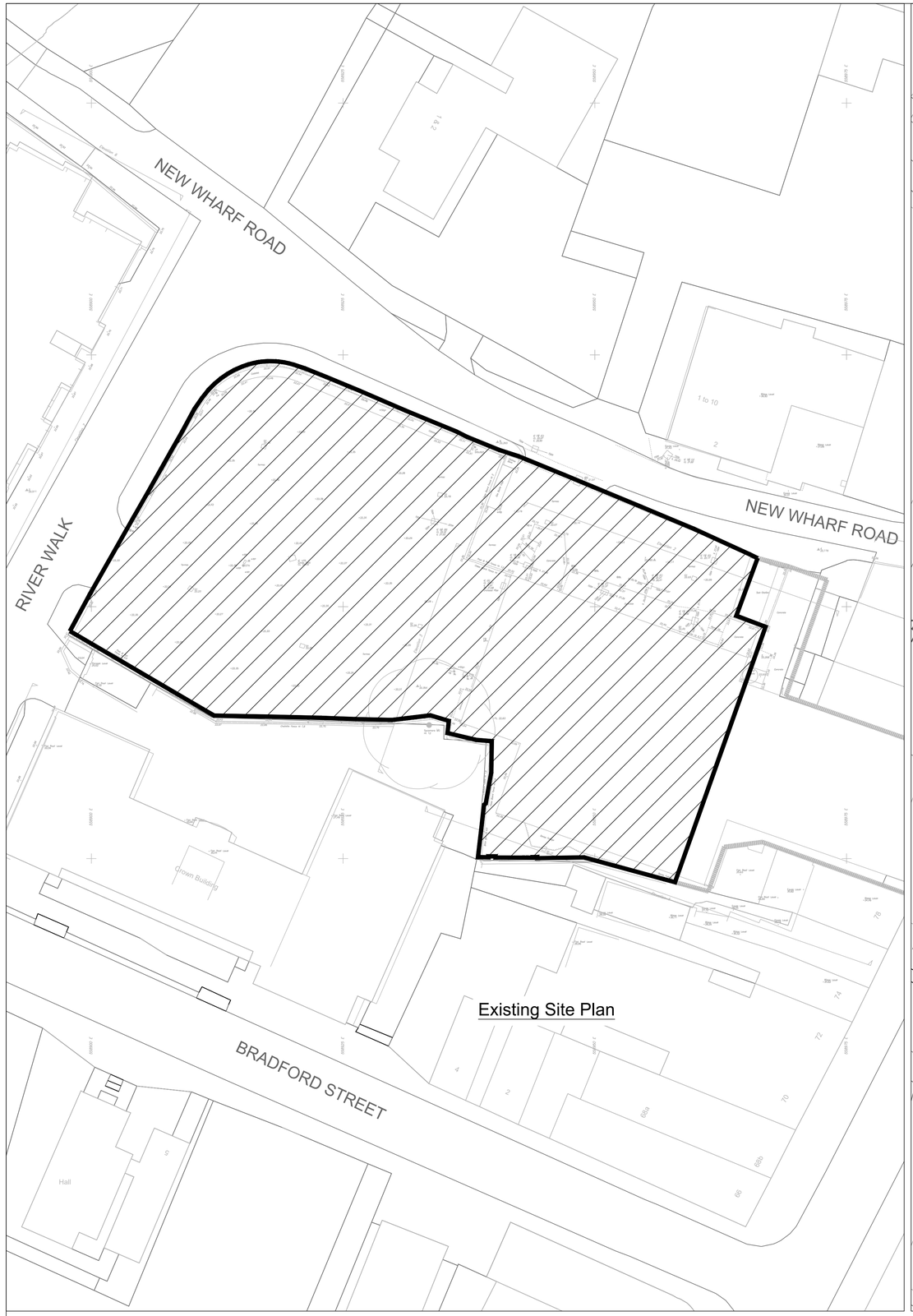
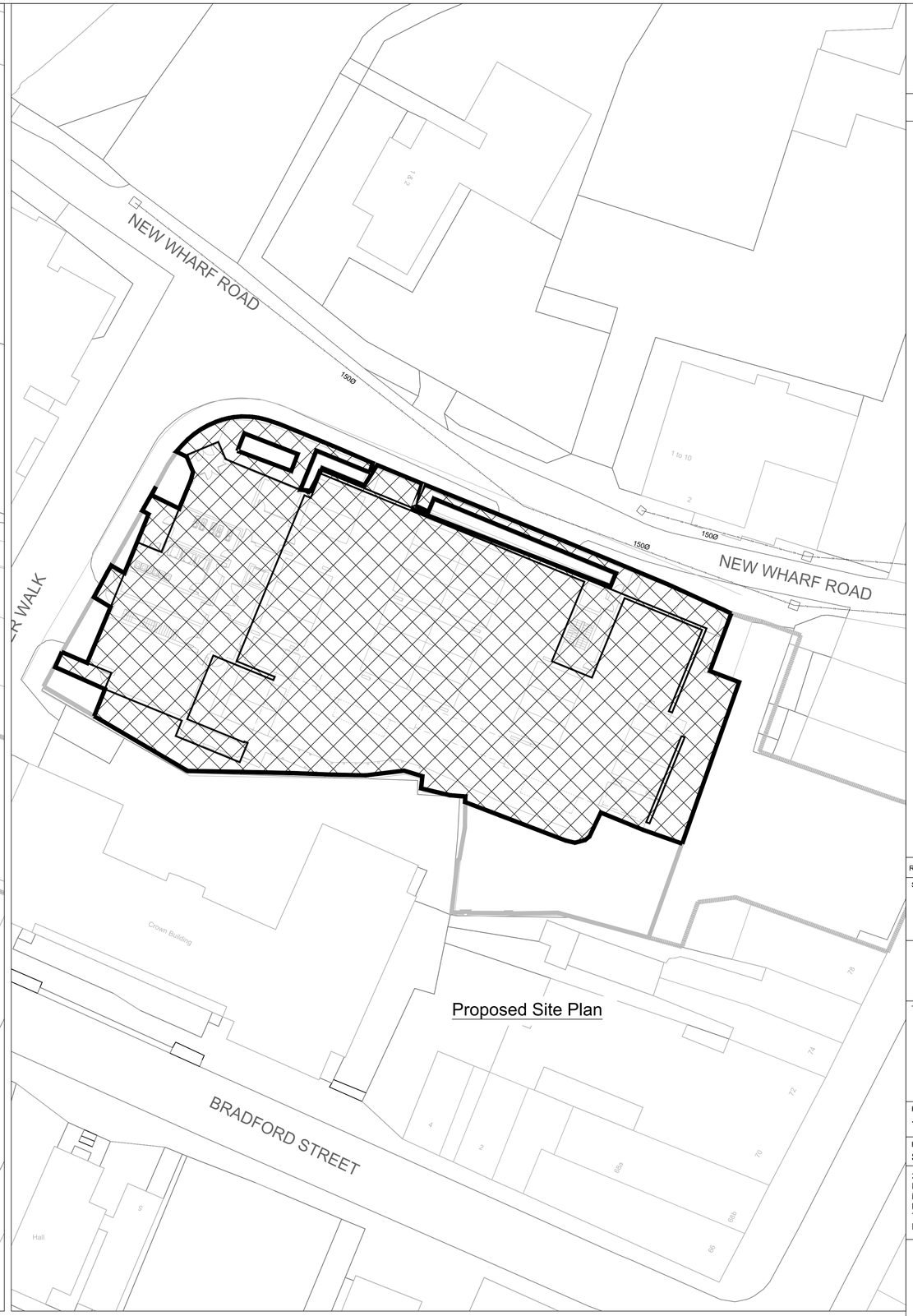




PRELIMINARY

Notes

Rev	Description	Date
A	Proposed Impermeable area revised	12.05.21
-	First Issue	14.04.21

Status:

Stage 3

Scale : 1:200@A1		
Date : Dec 20	Checked:	Approved:
Drawn : IDL	BM	PT

Title :

Drainage Areas

Project :

76-78 High Street, Tonbridge, Surrey

Drg. No:	Rev:	File Ref:	1070-07-100.dwg
SE-2739-03-DE-100	A	Plot Ref:	SE-2739-03-DE-100

33 The Point
Rockingham Road
Market Harborough
Leicestershire LE16 7QU
Tel: 01858 411570 Fax: 01858 411571
Email: info@infrades.co.uk URL: www.infrades.co.uk

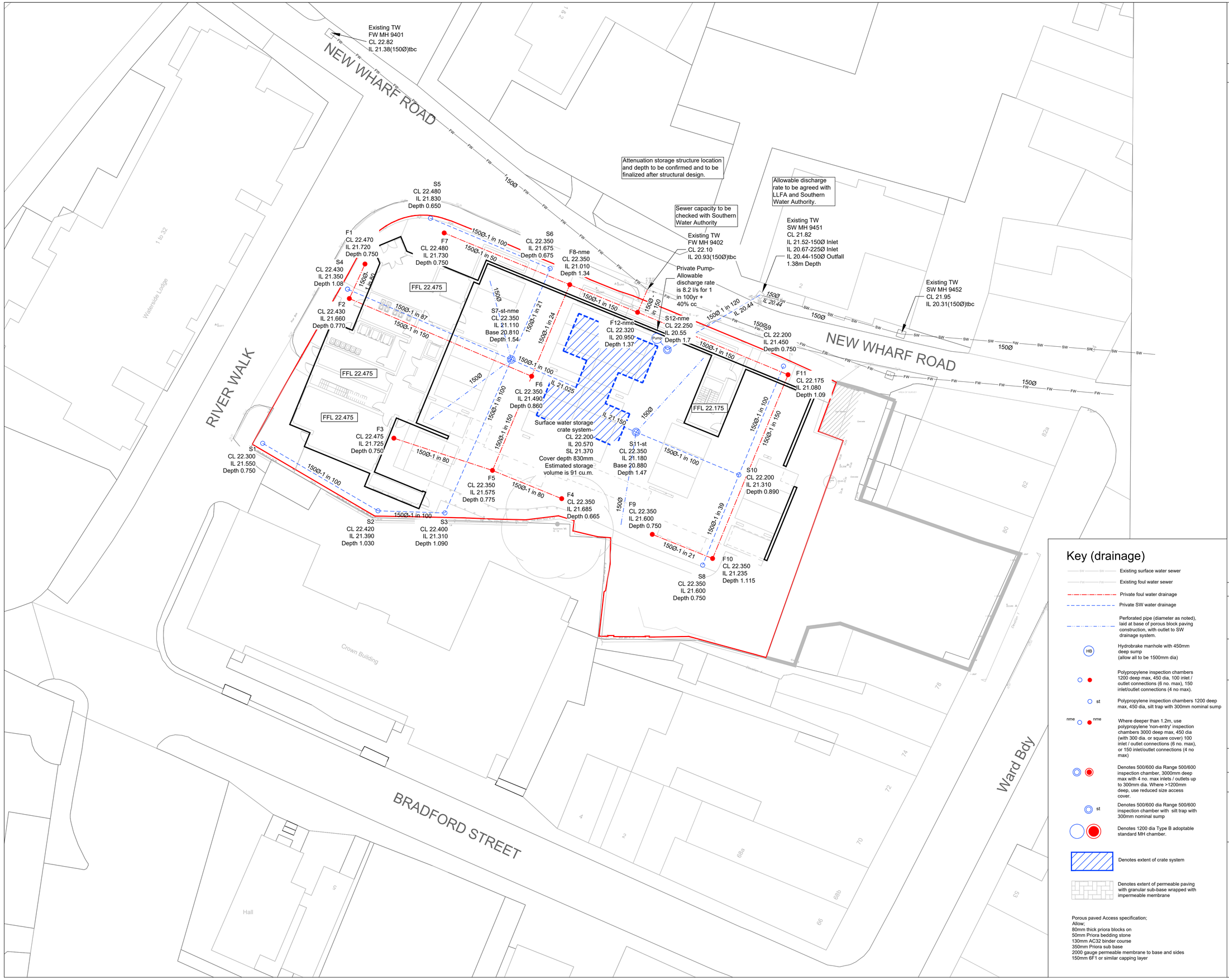
INFRASTRUCTURE DESIGN LIMITED
working for
McCARTHY STONE
life, well lived

Key

Existing Impermeable Area
Approximately-2010m2

Proposed Impermeable Area
Approximately-1720m2

PRELIMINARY



Key (drainage)

- Existing surface water sewer
- Existing foul water sewer
- Private foul water drainage
- Private SW water drainage
- Perforated pipe (diameter as noted), laid at base of porous block paving construction, with outlet to SW drainage system.
- HB — Hydrobrake manhole with 450mm deep sump (allow all to be 1500mm dia)
- Polypropylene inspection chambers 1200 deep max, 450 dia, 100 inlet / outlet connections (6 no. max), 150 inlet/outlet connections (4 no max).
- st — Polypropylene inspection chambers 1200 deep max, 450 dia, silt trap with 300mm nominal sump
- nme / nme — Where deeper than 1.2m, use polypropylene 'non-entry' inspection chambers 3000 deep max, 450 dia (with 300 dia. or square cover) 100 inlet / outlet connections (6 no. max), or 150 inlet/outlet connections (4 no max)
- Denotes 500/600 dia Range 500/600 inspection chamber, 3000mm deep max with 4 no. max inlets / outlets up to 300mm dia. Where >1200mm deep, use reduced size access cover.
- st — Denotes 500/600 dia Range 500/600 inspection chamber with silt trap with 300mm nominal sump
- Denotes 1200 dia Type B adoptable standard MH chamber.
- Denotes extent of crate system
- Denotes extent of permeable paving with granular sub-base wrapped with impermeable membrane

Porous paved Access specification;
Allow;
80mm thick priora blocks on
50mm Priora bedding stone
130mm AC32 binder course
350mm Priora sub base
2000 gauge permeable membrane to base and sides
150mm 6F1 or similar capping layer

Notes

Rev	Description	Date
A	Private SW pump added, discharge rate revised	13.05.21
-	**First Issue**	14.04.21

Status:

Stage 3

Scale :	1:200@A1		
Date :	April 21	Checked:	Approved:
Drawn :	IDL	BM	PT

Title :

Drainage Strategy Plan

Project :

76-78 High Street, Tonbridge, Surrey

Drg. No:	Rev:	File Ref:	1070-07-101.dwg
SE-2739-03-DE-101	A	Plot Ref:	SE-2739-03-DE-101

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APPENDIX E – SURFACE WATER DRAINAGE CALCULATIONS

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Crate	0.172	22.640	1500	558937.166	146405.239	2.070

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	2 year (l/s)	1.1
Summer CV	0.750	Drain Down Time (mins)	240	30 year (l/s)	2.9
Winter CV	0.840	Additional Storage (m³/ha)	20.0	100 year (l/s)	3.9
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	0.201	Betterment (%)	0
SAAR (mm)	675	QBar	1.2
Soil Index	5	Q 1 year (l/s)	
SPR	0.53	Q 30 year (l/s)	
Region	6	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node Crate Online Pump Control

Flap Valve	x	Design Depth (m)	1.600	Switch off depth (m)	0.100
Replaces Downstream Link	✓	Design Flow (l/s)	14.3		
Invert Level (m)	20.570	Switch on depth (m)	0.101		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.500	5.000	0.700	8.000	2.000	11.000

Node Crate Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	20.570	Slope (1:X)	500.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	148	Depth (m)	0.800
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.95	Length (m)	11.300		

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	Crate	172	20.779	0.209	5.9	21.8696	0.0000	OK

Link Event (Outflow)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
240 minute winter	Crate	Pump	2.1	23.7

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	Crate	136	21.024	0.454	16.7	49.0132	0.0000	OK

Link Event (Outflow)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	Crate	Pump	4.5	59.7

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	Crate	132	21.146	0.576	21.5	62.5267	0.0000	OK

Link Event (Outflow)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	Crate	Pump	6.1	77.1

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	Crate	136	21.363	0.793	30.1	86.6493	0.0000	OK

Link Event (Outflow)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	Crate	Pump	8.2	108.5

RAINFALL MODELLING FOR POINT DATA AT 558917,146410

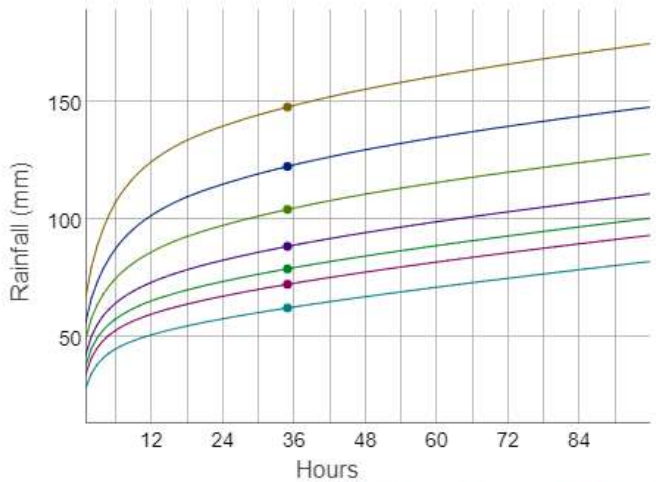
FEH 2013

Point rainfall at 558917, 146410

Design Rainfall Event Rarity

Duration	1	Hours
Return period	2	Years
Depth	13.1	mm

Calculate



35.0h (1.5days):
500yr: 147.96mm
200yr: 122.55mm
100yr: 104.17mm
50yr: 88.40mm
30yr: 78.80mm
20yr: 72.18mm
10yr: 62.09mm

Save graph as image Export design rainfall (CSV)

A design rainfall of 13.1 mm was calculated.

This design rainfall has been calculated for a return period on the annual maximum scale.

Return period options
- Annual maximum
- Peaks over threshold

Duration options
- Fixed
- Sliding

Close

RAINFALL MODELLING FOR POINT DATA AT 558917,146410

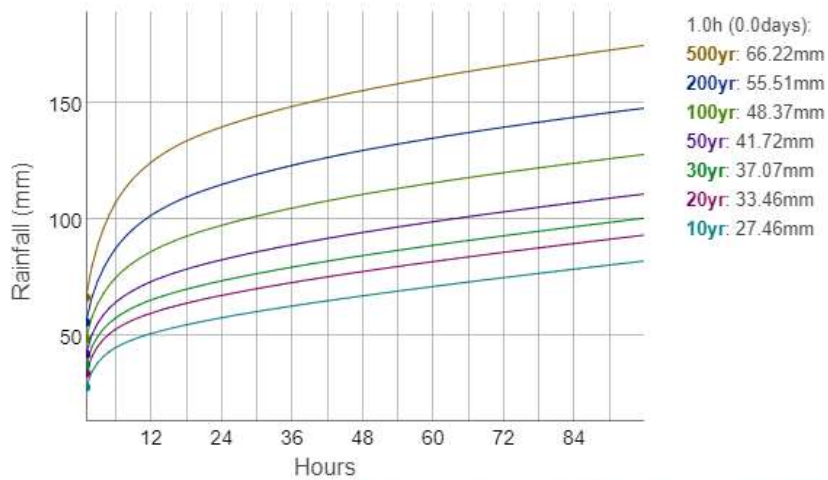
FEH 2013

Point rainfall at 558917, 146410

Design Rainfall Event Rarity

Duration	1	Hours
Return period	30	Years
Depth	37.07	mm

Calculate



1.0h (0.0days):
500yr: 66.22mm
200yr: 55.51mm
100yr: 48.37mm
50yr: 41.72mm
30yr: 37.07mm
20yr: 33.46mm
10yr: 27.46mm

Save graph as image Export design rainfall (CSV)

A design rainfall of 37.07 mm was calculated.

This design rainfall has been calculated for a return period on the annual maximum scale.

Return period options

- Annual maximum
- Peaks over threshold

Duration options

- Fixed
- Sliding

Close

RAINFALL MODELLING FOR POINT DATA AT 558917,146410

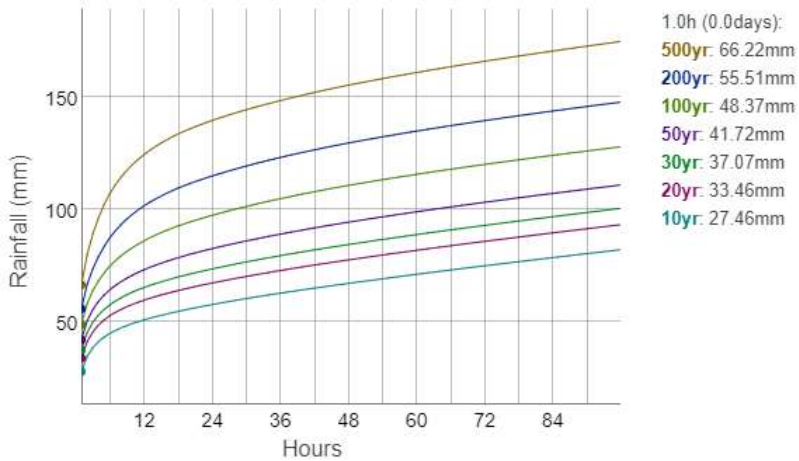
FEH 2013

Point rainfall at 558917, 146410

Design Rainfall Event Rarity

Duration	1	Hours
Return period	100	Years
Depth	48.37	mm

Calculate



1.0h (0.0days):
500yr: 66.22mm
200yr: 55.51mm
100yr: 48.37mm
50yr: 41.72mm
30yr: 37.07mm
20yr: 33.46mm
10yr: 27.46mm

Save graph as image Export design rainfall (CSV)

A design rainfall of 48.37 mm was calculated.

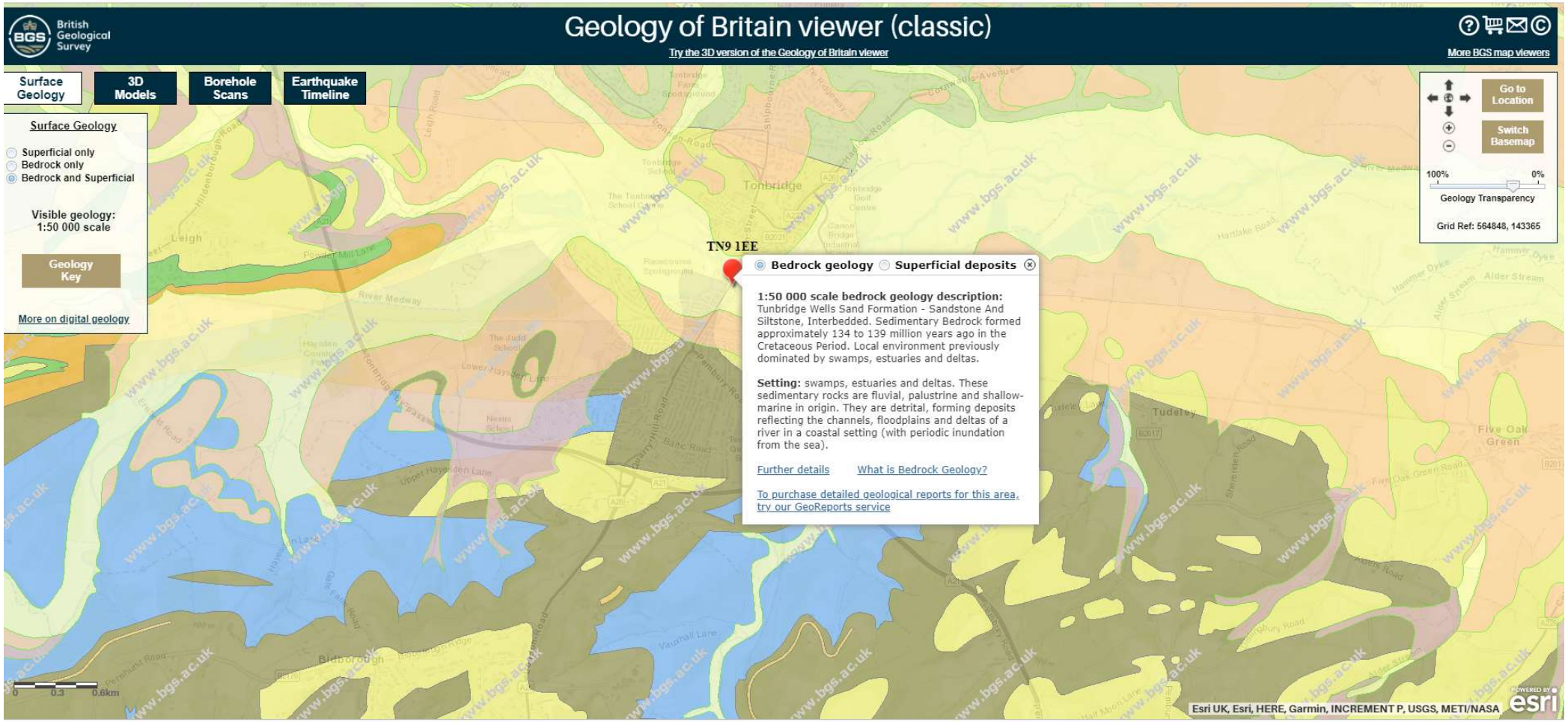
This design rainfall has been calculated for a return period on the annual maximum scale.

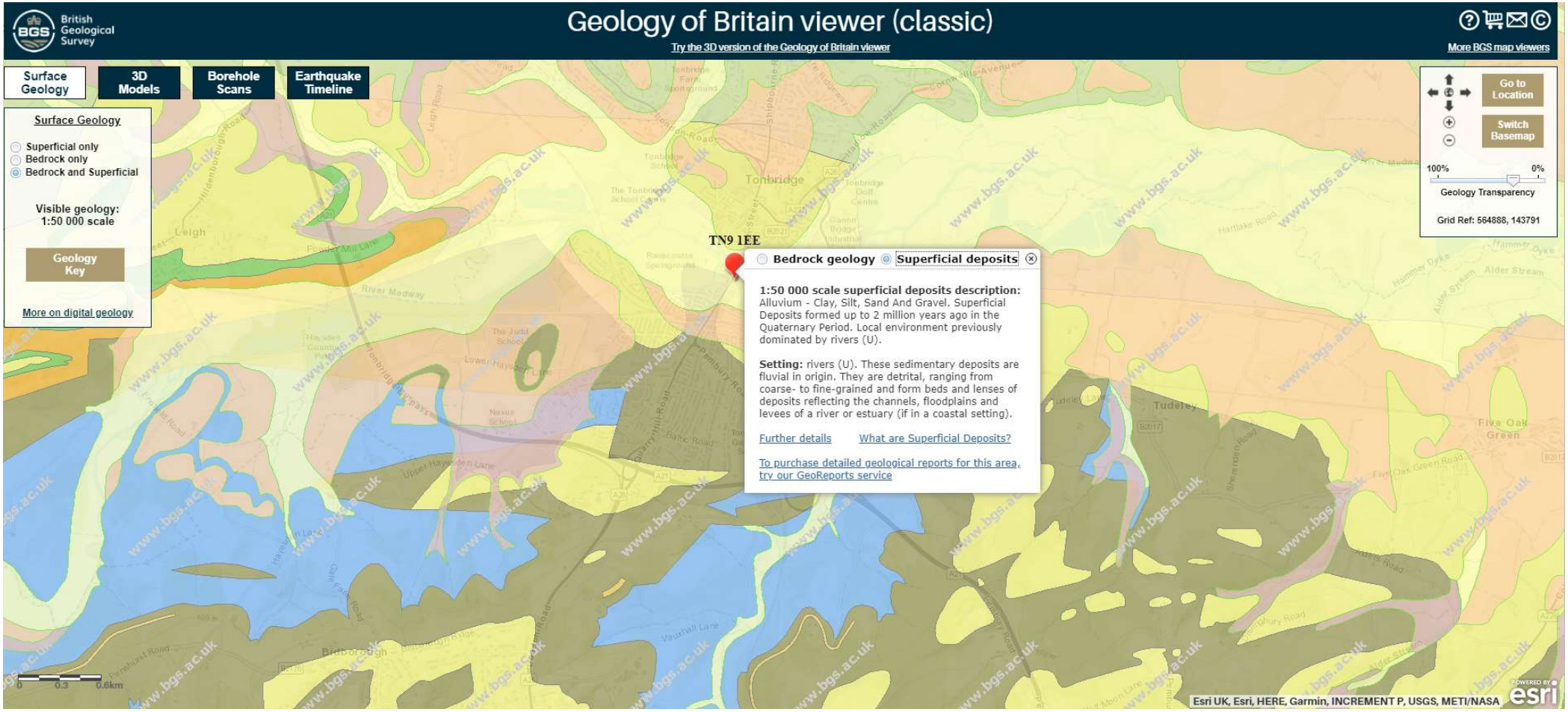
Return period options
- Annual maximum
- Peaks over threshold

Duration options
- Fixed
- Sliding

Close

APPENDIX F – BGS WEBSITE EXTRACT


British Geological Survey
Geology of Britain viewer (classic)
Try the 3D version of the Geology of Britain viewer
More BGS map viewers
Surface Geology
3D Models
Borehole Scans
Earthquake Timeline
Surface Geology
Superficial only
Bedrock only
Bedrock and Superficial
Visible geology: 1:50 000 scale
Geology Key
More on digital geology
Go to Location
Switch Basemap
100%
0%
Geology Transparency
Grid Ref: 564848, 143365
TN9 1EE
Bedrock geology
Superficial deposits
1:50 000 scale bedrock geology description:
Tunbridge Wells Sand Formation - Sandstone And Siltstone, Interbedded. Sedimentary Bedrock formed approximately 134 to 139 million years ago in the Cretaceous Period. Local environment previously dominated by swamps, estuaries and deltas.
Setting: swamps, estuaries and deltas. These sedimentary rocks are fluvial, palustrine and shallow-marine in origin. They are detrital, forming deposits reflecting the channels, floodplains and deltas of a river in a coastal setting (with periodic inundation from the sea).
Further details
What is Bedrock Geology?
To purchase detailed geological reports for this area, try our GeoReports service
Tonbridge
Tudeley
Five Oak Green
Leigh
Bidborough
0 0.3 0.6km
Esri UK, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA
esri


British Geological Survey
Geology of Britain viewer (classic)
Try the 3D version of the Geology of Britain viewer
More BGS map viewers
Surface Geology
3D Models
Borehole Scans
Earthquake Timeline
Surface Geology
Superficial only
Bedrock only
Bedrock and Superficial
Visible geology: 1:50 000 scale
Geology Key
More on digital geology
Go to Location
Switch Basemap
100%
0%
Geology Transparency
Grid Ref: 564888, 143791
TN9 1EE
Bedrock geology
Superficial deposits
1:50 000 scale superficial deposits description:
Alluvium - Clay, Silt, Sand And Gravel. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by rivers (U).
Setting: rivers (U). These sedimentary deposits are fluvial in origin. They are detrital, ranging from coarse- to fine-grained and form beds and lenses of deposits reflecting the channels, floodplains and levees of a river or estuary (if in a coastal setting).
Further details
What are Superficial Deposits?
To purchase detailed geological reports for this area, try our GeoReports service
Tonbridge
Leigh
Tudeley
Five Oak Green
Bidborough
River Medway
0
0.3
0.6km
Esri UK, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA
esri

APPENDIX G – MANAGEMENT & MAINTENANCE REGIME

The Management Company

The responsibility for maintenance of all elements of the development remain with the developers until handed over to the Management Company.

Handover of external works to the Management Company coincides with completion of the final residential unit.

The Management Company employs a specialist Managing Agent to manage the development which includes all aspects of maintenance.

*The Management Company BI registered No. **'tbc'** was incorporated in **'tbc'** and its directors are currently made up of developers representatives plus an appointment from the Managing Agent.*

*The Managing Agents are **'tbc'** who have over '**tbc**' years' experience in the industry.*

At handover the Management Company and Managing Agent receive as built information together with operating and maintenance manuals which detail all maintenance protocols.

Approximately 1 year following completion of the final unit the residents will be invited to elect members to become directors of the Management Company, the developer appointed directors at that time resign from the Management Company to be replaced by the elected representatives of the residents.

To ensure continuity and a full understanding of the development and the operation and maintenance of its various components the representative of the Managing Agent remains as a director of the Management Company and the appointment of the Managing Agents is fixed for a minimum period of two years following the date of resignation of the last developer's director.

After that two year period the Management Company have the right to re-tender the Managing Agent services but it is very rare that a change is made as our original appointments provide an excellent service.

Within the first two years from the final unit completion on the development the residents have two ways in which they can report any defects and problems which would include flooding and that is either to our Aftersales department or to the Managing Agents, the residents are issued with telephone numbers for both which include out of hours emergency response.

After two years our Aftersales contacts are normally replaced by members of the Management Company. The residents therefore have the ability to contact them or the Managing Agents which then remains through the life of the development.

Crate Attenuation

The principle means of surface water attenuation/disposal from the development is by way of cellular storage.

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the surface water drainage system;

Inspections to identify any areas not operating correctly, pollution, blocked inlets or outlets, standing water etc.

Collect and remove from site all extraneous rubbish that is detrimental to the operation or detract from the appearance of the site, including paper, bottles, cans and similar debris.

Onsite Surface Water Drainage System (generally)

The Management Company will be responsible for maintaining those private sewers that reside outside of a Freeholders responsibility, are not located within the adopted highway or not otherwise covered under the Section 38/104 Agreements.

The following measures are to be undertaken to ensure the longevity of the surface water drainage system;

Every 6 months: Remove silt build up from ***all*** catchpits and road gullies. Leaf guards should be installed to the rainwater gutters and it should be checked and cleared at the same time with other drainage inspection.

Annually: elect approx. 20% of the development's surface water inspection chambers (situated in accessible non-private areas) and inspect for blockages / silt build up. Remove silt and debris. Rotate on a 5 yearly cycle to cover all such chambers over this period.

Every 2-5 years (depending on the outcome of aforementioned inspections)

Commission a CCTV survey and report on condition of the surface water drainage system, check for structural integrity and hydraulic fluidity. Carry out promptly any remedial work as advised by CCTV company.

Private surface water Pump Chambers

Flow control chambers are to be maintained by a Management Company. Their maintenance regime shall be as follows:

Following installation of the Flow Controls any extraneous material i.e. Building materials are removed from the unit and the chamber. After the system is made live, the unit is to be inspected monthly for three months and thereafter at six monthly intervals with hose down if required.

The chambers are to be cleared checked for structural integrity at the six monthly interval. Any damage/problems should be made good as per the original design drawings.

Permeable Paving

External parking areas and access roads are to be constructed in permeable block paving in order to;

a) Delay the surface water runoff from these areas, and
b) Enhance the quality of the rainwater prior to discharge into the receiving sewer.

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the pervious pavement;

Quarterly

i) Inspect the pervious pavement for signs of ponding and ensure there is no migration of soils from adjacent landscaped areas or other deleterious material that may prematurely clog up the jointing stone situated in the gaps between the blocks. Ideally this type of inspection should be undertaken immediately following a heavy rainfall event.

ii) Commission vacuum sweeping and brushing of the pervious pavement to ensure joints are kept free of silt. Minimum 3 sweeping per year, thus;

a) End of Winter (April) – to collect winter debris
b) Mid-Summer (July/August) – to collect dust, flower and grass-type deposits.
c) After Autumn leaf fall (November)

The company commissioned to carry out this work should ensure that their vacuum equipment is adjusted accordingly to avoid removal of jointing material.

Any lost material should be replaced promptly to avoid the blocks from being dislodged.

Last Resort Remedial Action

i) Should a portion of the pervious pavement become substantially impervious due to excessive siltation, the following procedure should be followed;

a) Lift block paving and laying course
b) Break out underlying bitmac base layer and replace with similar compacted depth of course aggregate subbase material to BS EN 13242:2002 Type 4/20, wrapped in geotextile as Terram 1000 or similar.
c) Renew laying course, replace blocks and renew jointing material

NB. Material removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and as such may need to be disposed of as 'controlled waste'. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.