Flood Risk Assessment

Interbridges Site, Emsworth

On behalf of: PNH Properties

CELEBRATING 30 YEARS
1994 - 2024

Bellamy Roberts

Document Control Sheet

PNH Properties
Unit 5, Passfield Business Centre
Lynchborough Road
Liphook
Hampshire GU30 7SB

Bellamy Roberts
Clover House
Western Lane
Odiham
Hants RG29 1TU

Report Issue No.	Status	Date	Author	Authorised
MT/6096/FRA.1	1st Draft	22nd November 2024	MT	MT
MT/6096/FRA.2	Final	29th November 2024	MT	ITR

Disclaimer
The material presented in this report is confidential. This report has been prepared for the exclusive use of PNH Properties within the terms of the contract and shall not be distributed or made available to any other company or person without the knowledge and written consent of Bellamy Roberts.
Any such party relies on the report at their own risk.
© Bellamy Roberts

Bellamy Roberts

Contents

Sections

1	Introduction	1
2	Sources of Flooding	5
3	Surface & Foul Water Drainage Strategy	8
4	Maintenance & Management	11
5	Summary & Conclusions	13

Appendices

Appendix 1	Site Location Plan (6096/301)
Appendix 2	Topographical Survey
Appendix 3	Southern Water Asset Plan
Appendix 4	Ashdown SI Assessment (relevant extracts)
Appendix 5	Greenfield Runoff Rates
Appendix 6	EA Flood Map for Planning
Appendix 7	Surface & Foul Water Drainage Strategy (6096/101 Rev. A)
Appendix 8	Microdrainage Analyses

1 Introduction

1.1 Bellamy Roberts has been instructed by PNH Properties to prepare a Flood Risk Assessment in support of a planning application for proposed employment development, with associated access, parking, yards, landscaping and substation at Emsworth Business Park, New Brighton Road, Emsworth.

1.2 The site is allocated for employment use under Policy BD39 of the Havant Local Plan (2014). The stated site specific development requirements are as follows:

- Access to be provided from North Street to the satisfaction of the Highway Authority.
- Employment and Skills Plan to support planning application.
- Flood Risk Assessment to support planning application .
- Development outside of Flood Zone 1 will need to provide compensatory floodplain.
- Reduce green field runoff rates, on-site SUDS and a possible contribution to the Emsworth Flood Alleviation Scheme (Policy DM25).
- An Ecological Assessment may be required to assess the impact on Local Nature Reserve.

1.3 It is recognised that developments that are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. Current guidance on development and flood risk identifies several key aims for a development to ensure that it is sustainable in flood risk terms. These aims are as follows:

- the development should not be exposed to flood risk such that the health, safety, and welfare of the users of the development, or the population elsewhere, are threatened;
- the development should not be at a significant risk of flooding and should not be susceptible to damage due to flooding;
- safe access to and from the development should be possible during flood events;
- the development should not increase flood risk elsewhere;

- the development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences;
- the development should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk. The responsibility for any operation and maintenance required should be clearly defined;
- future users of the development should be made aware of any flood risk issues relating to the development;
- the development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, because of flood risk issues;
- the development should not lead to degradation of the environment, and
- the development should meet all the above criteria for its entire lifetime, including consideration of the potential effects of climate change.

1.4 This assessment has been prepared with due consideration of these sustainability aims.

1.5 In accordance with paragraph 173 of the NPPF (December 2023), it will be ensured that:

- the most vulnerable development is located in areas of lowest flood risk;
- the development is appropriately flood resistant and resilient;
- it incorporates sustainable drainage systems;
- Any residual risk can be safely arranged; and
- safe access and escape routes are included.

Site Location & Topography

1.6 The site is located on land to the east of the B2148 North Street. The grid reference for the centre of the site is SU 74971 06344 and for clarity, a site location plan is provided at **Appendix 1**, an extract of which is at Figure 1.

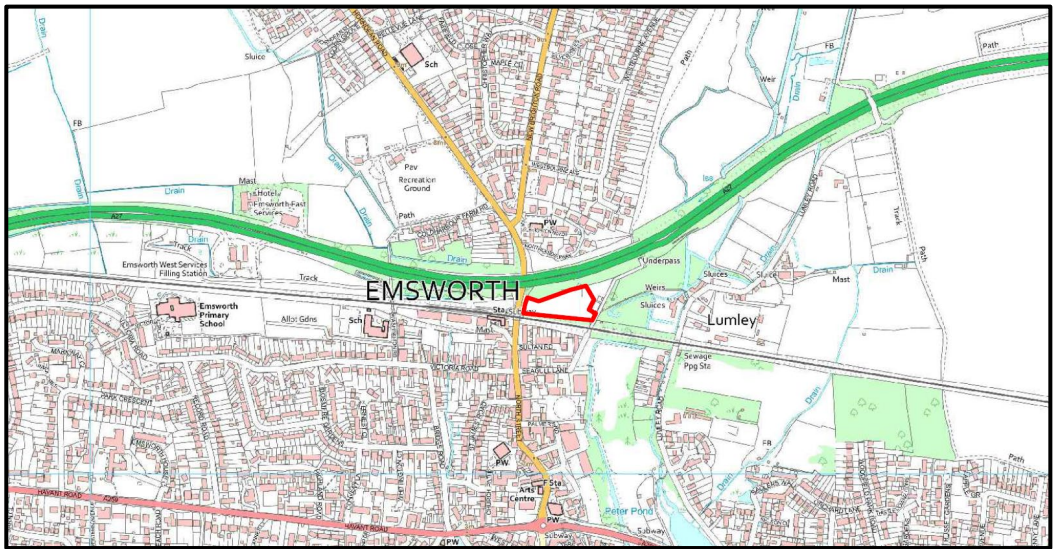


Figure 1: Site Location Plan

1.7 A topographical survey has been undertaken which shows the site generally falls towards its eastern boundary. There is a level difference of approximately 2.5m across the site, west to east. For reference, the topographical survey is provided at **Appendix 2**. The total site area is 6,750m^2.

Existing Watercourse

1.8 There are no watercourses within the boundary of the site.

Historic Flooding

1.9 There have been no recorded instances of historic flooding at the site.

Existing Sewerage Network

1.10 A plan of the existing surface and foul water sewers in the vicinity of the site has been obtained from Southern Water and is provided at **Appendix 3**. This shows the presence of a surface water sewer in North Road and that two foul sewers cross the application site.

1.11 The proposed site layout has been designed to accommodate the existing foul sewers and the required easements, including an additional 1m buffer.

1.12 In additional to the foul sewers, Network Rail has an easement along the southern boundary of the site and a gas main bisects the site west to east.

Ground Conditions

1.13 A ground condition assessment was carried out in April 2024 by Ashdown Site Investigation. The intrusive works comprised the drilling of a series of boreholes and trial pits, together with in-situ testing.

1.14 Infiltration testing was undertaken in boreholes WS02, WS05, WS06 and WS08, at a depth of 3m below ground level. Three consecutive tests was only possible in WS05 and an infiltration rate of 9.89 x 10^{-5}m/s was recorded within the river terrace deposits. However, groundwater was recorded at a depth of 1.33m.

1.15 Despite favourable infiltration rates being achieved in WS05, the high groundwater level will not allow a minimum freeboard of 1m to be achieved between the base of the infiltration feature and groundwater level. Infiltration therefore will not represent a viable means of disposing of surface water from the site.

1.16 Relevant extracts from the Ashdown Site Investigation assessment is presented at **Appendix 4**.

Greenfield Run-off Rates

1.17 The greenfield run-off rates for site are provided in Table 1. These rates have been calculated using the Microdrainage software and are presented at **Appendix 5**.

Table 1: Greenfield Runoff Rates

Rainfall Event	Greenfield Runoff Rate
Qbar	1.5 l/s
1 in 1 year	1.3 l/s
1 in 30 years	3.5 l/s
1 in 100 years	4.9 l/s

2 Sources of Flooding

River/Sea Flooding

2.1 Environment Agency mapping reveals the majority of the application site is located in flood zone 1, albeit some land in the northern part of the site is within food zone 2.

2.2 The majority of the site has a very low risk of flooding from rivers or the sea. This is defined as less than 0.001% chance of the site flooding in any given year.

2.3 The Environment Agency's flood map for planning is presented at **Appendix 6** and an extract of this is provided at Figure 2 for reference.

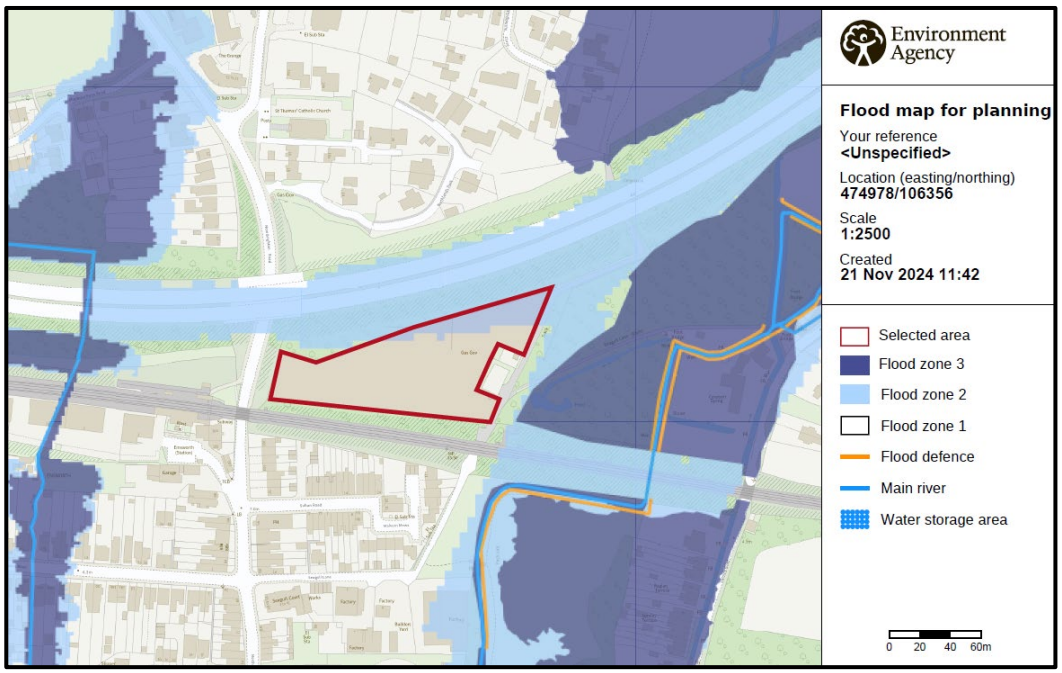


Figure 2: Flood Map for Planning (Source: EA)

2.4 The area indicated by the EA mapping to be flood zone 2 correspond to the line of the A27 dual carriageway. However, at this location, the A27 is on an embankment and not in a cutting as implied by the EA mapping. The two main river watercourses that would appear to contribute to this flood zone

classification are culverted under the A27 and cannot therefore cause the flooding to the A27 as identified on the mapping.

2.5 It is not therefore considered that the EA mapping gives an accurate representation of the site's fluvial flood risk and it is considered likely that the whole of the application site is actually flood zone 1.

Surface Water Flooding

2.6 In addition to fluvial flooding, surface water flooding must also be considered. This often occurs when intense, often short duration rainfall is unable to soak into the ground or enter the local drainage system. It is made worse when soils are saturated so that they cannot accept any more water. This type of flooding is usually short lived, localised and associated with heavy downpours of rain, and often has very little warning before it occurs. The amount of runoff is also a function of geology, slope, climate, rainfall, saturation, soil type, urbanisation and vegetation.

2.7 Environment Agency mapping reveals the majority of the site has a very low risk of surface water flooding. There is a small area in the south-eastern corner at a low risk, which is the lowest part of the site. The proposed site layout shows an open storage yard at this location which is compatible with this level of flood risk. An extract from the gov.uk surface water flood risk map is provided at Figure 3.

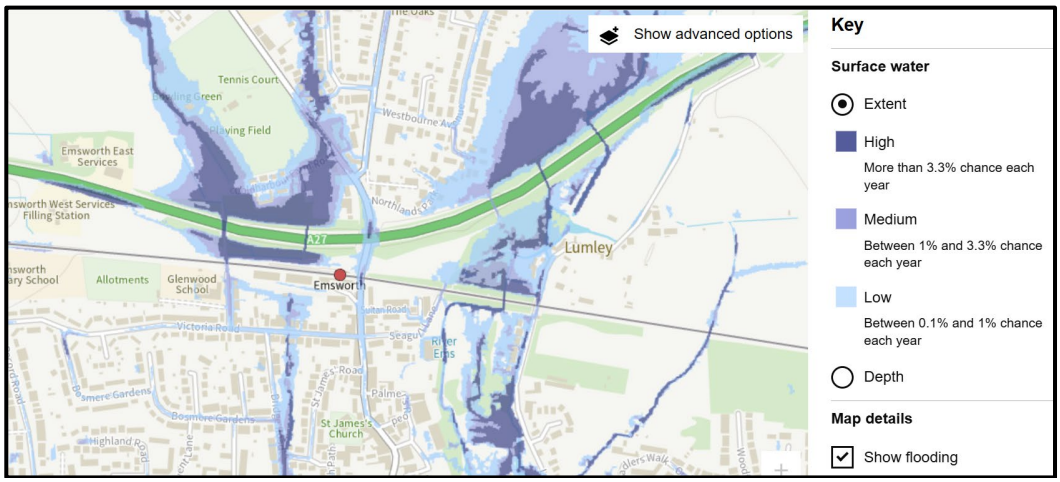


Figure 3: Surface Water Flood Risk Map (Source: EA)

Reservoir Flooding

2.8 Information from the gov.uk website advises that flooding from reservoirs is unlikely in this area.

Groundwater Flooding

2.9 Information from the gov.uk website advises that groundwater flooding is unlikely in this area.

Summary of Flood Risk

2.10 A summary of the site's flood risk is provided in Table 2.

Table 2: Summary of Flood Risk

Source of Flooding	Risk
Rivers & The Sea (Present Day)	Flood zone 2
Surface Water	Very low/low
Reservoirs	Unlikely
Groundwater	Unlikely

2.11 With reference to Planning Practice Guidance, the proposal is classified as 'less vulnerable' and such a use is appropriate in flood zone 2. However, it is not considered that the EA mapping gives an accurate representation of the site's fluvial flood risk and it is considered likely that the whole of the application site is actually flood zone 1.

2.12 In any event, the site is allocated for development within the Havant Local Plan (Policy BD39) and with reference to Planning Practice Guidance, development is exempt from the sequential test if it is a development on a site allocated in the development plan through the sequential test and:

- the proposal is consistent with site's allocated use
- there have been no significant changes to the known level of flood risk to the site, now or in the future, which would have affected the outcome of the test

2.13 The site is therefore acceptable in flood risk terms for the proposed commercial development.

3 Surface & Foul Water Drainage Strategy

Surface Water

3.1 In order to properly mitigate flood risk post-development, it is important that adequate measures are considered to ensure surface water run-off is dealt with, ensuring flood risk is not increased either on or off-site.

3.2 Surface water drainage at the site will be based on SuDS principles and in this regard, the aim will be to discharge the surface water run-off as high up the following hierarchy of drainage options as possible:

- Infiltration into the ground;
- To a surface water body, such as a river, ditch, pond or stream;
- To a surface water sewer; and
- To a combined sewer.

3.3 As set out previously, the underlying ground conditions will not allow surface water to discharge into the ground via infiltration.

3.4 There are no watercourses within the site therefore surface water will be attenuated on-site and discharged at a restricted rate into the Southern Water surface water in North Street.

3.5 All parking and courtyard areas will be permeable block paving. Such a system would be 'Type C' as no infiltration is possible at the site. Runoff from these areas will filter through the sub-base and be conveyed to the attenuation storage crates via perforated pipes.

3.6 Given the on-site levels, a surface water pumping station will be required.

3.7 The surface water drainage strategy is presented at **Appendix 7**, and includes cover/invert levels, pipe sizes and gradients.

3.8 The volume of storage required within the attenuation storage crates has been calculated using the Microdrainage software to allow for the 1 in 100-year + 45% climate change. In addition, modelling has also been undertaken for the

1 in 1-year, 1 in 10-year and 1 in 30-year + 35% climate change rainfall events. During each modelled storm event, the analysis demonstrates that no flooding occurs. The Microdrainage analysis is presented at **Appendix 8**.

Flood Exceedance

3.9 Flow routes during an exceedance event have been shown on the surface water drainage strategy at Appendix 6. This demonstrates that during an exceedance event, surface water flows will be directed along the carriageway network and towards the river/attenuation basin and away from the proposed dwellings.

Water Quality

3.10 Water quality has been assessed through the simple index approach as set out in Chapter 26 of the CIRIA SuDS Manual. Based on the guidance in Table 26.2 of the SuDS Manual, the land use classification for the site will be *commercial yard and delivery areas*. The pollution hazard indices for these land uses are as summarised in Table 3.

Table 3: Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Commercial yard and delivery areas	Medium	0.7	0.6	0.7

3.11 With reference to Table 26.3 of the SuDS Manual, the mitigation indices for the SuDS elements proposed are set out in Table 4.

Table 4: Mitigation Indices

Type of SuDS Component	Total Suspended Solids	Metals	Hydrocarbons
Permeable Pavement	0.7	0.6	0.6

3.12 Sufficient treatment will be provided to the run-off from the site.

Foul Water

3.13 Foul water from the application site will discharge to the existing Southern Water foul sewer. The proposed connection is shown on the plan presented at Appendix 7.

4 Maintenance & Management

Maintenance and Management

4.1 Maintenance of the proposed drainage system will be undertaken in accordance with the guidance set out in the CIRIA SuDS Manual 2015. Details have been provided for essential maintenance activities and the frequency of maintenance.

4.2 Maintenance of all drainage features within the site will be the responsibility of the site management company.

4.3 The maintenance schedule and frequencies for the various proposed SuDS components are summarised in Table 5.

Table 5: Maintenance Regime (Permeable Pavements)

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosphate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required

Table 5 Contd

	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three monthly, 48 hrs after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

5 Summary & Conclusions

Summary

5.1 Bellamy Roberts has been instructed by PNH Properties to prepare a Flood Risk Assessment in support of a planning application for the erection of a mixed use commercial development comprising 1 class E commercial units and two open storge areas. The site is allocated for employment use under Policy BD39 of the Havant Local Plan (2014).

5.2 Environment Agency mapping reveals the majority of the application site is located in flood zone 1, albeit some land in the northern part of the site is within food zone 2. However, for the reasons set out in this Flood Risk Assessment, it is not considered that the EA mapping gives an accurate representation of the site's fluvial flood risk and it is considered likely that the whole of the application site is actually flood zone 1.

5.3 Site specific ground investigation has revealed infiltration does not represent a viable means of disposing of surface water. In accordance with the SuDS hierarchy, surface water will be attenuated on site and discharged at a rate no greater than the existing greenfield run-off rate into the existing Southern Water surface water sewer.

Conclusions

5.4 The proposed development accords with the guidance set out at paragraph 173 of the NPPF, in that:

- the most vulnerable development is located in areas of lowest flood risk;
- the development is appropriately flood resistant and resilient;
- it incorporates sustainable drainage systems; and
- safe access and escape routes are included.

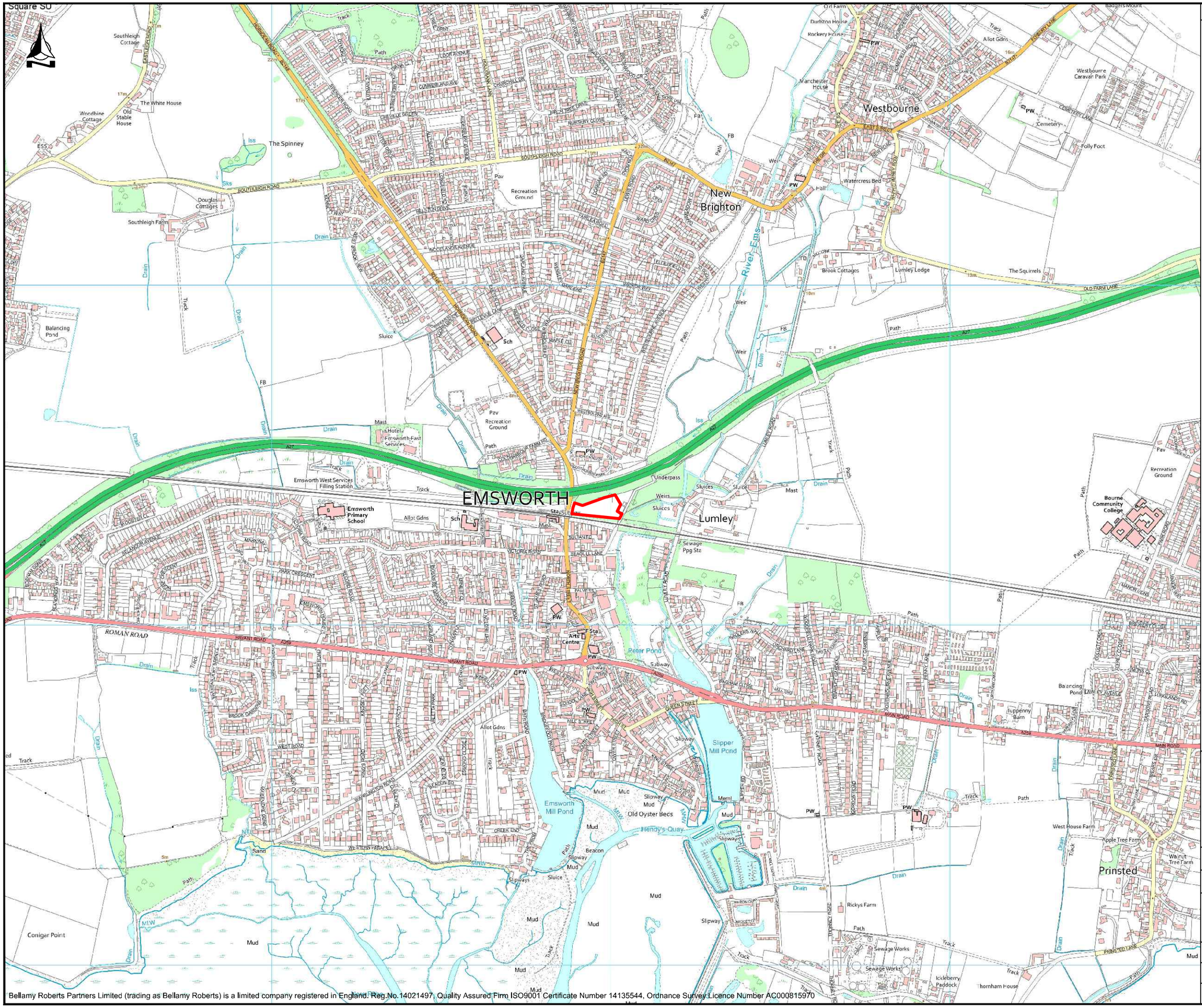
5.5 The proposed development accords with the guidance set out in the NPPF, in that the scheme incorporates sustainable drainage systems, has maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development and the scheme provides multifunctional benefits.

The scheme therefore accords with all relevant policies within the NPPF and is acceptable in flooding and drainage terms.

APPENDICES

APPENDIX 1

Site Location Plan



Notes

Site

Bellamy Roberts
Clover House
Western Lane
Odiham
Hampshire, RG29 1TU
Tel: 01256 703355
Email: info@bellamyroberts.co.uk

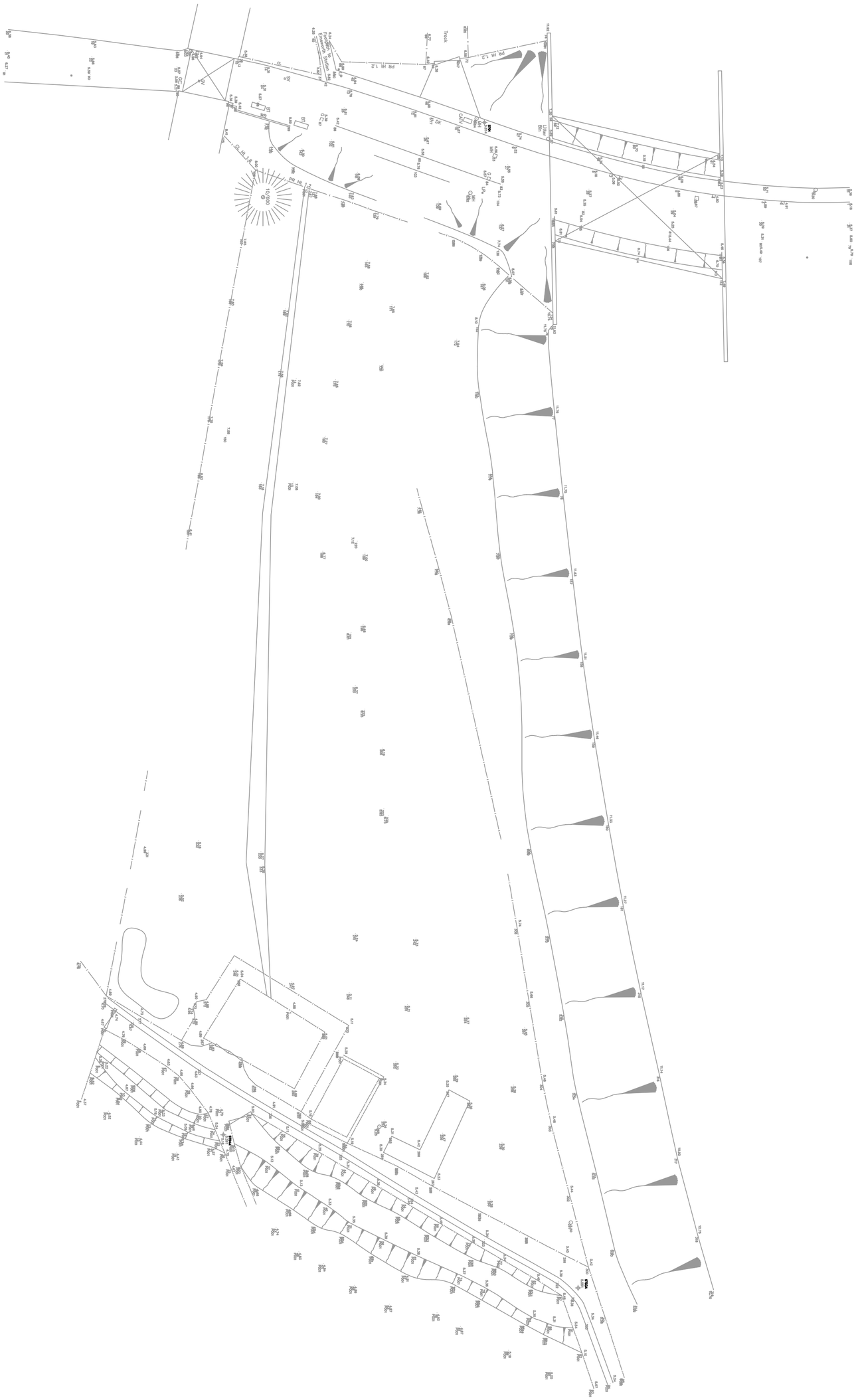
CLIENT	PNH Properties
PROJECT	Interbridges Site, Emsworth
TITLE	Site Location Plan

DRAWN BY	DESIGN BY	CHK BY
MB	-	MT
DATE 23/05/24	DRAWING No. 6096 / 301	REV No.
SCALE NTS @ A3		

Bellamy Roberts Partners Limited (trading as Bellamy Roberts) is a limited company registered in England. Reg.No.14021497. Quality Assured Firm ISO9001 Certificate Number 14135544, Ordnance Survey Licence Number AC000815970

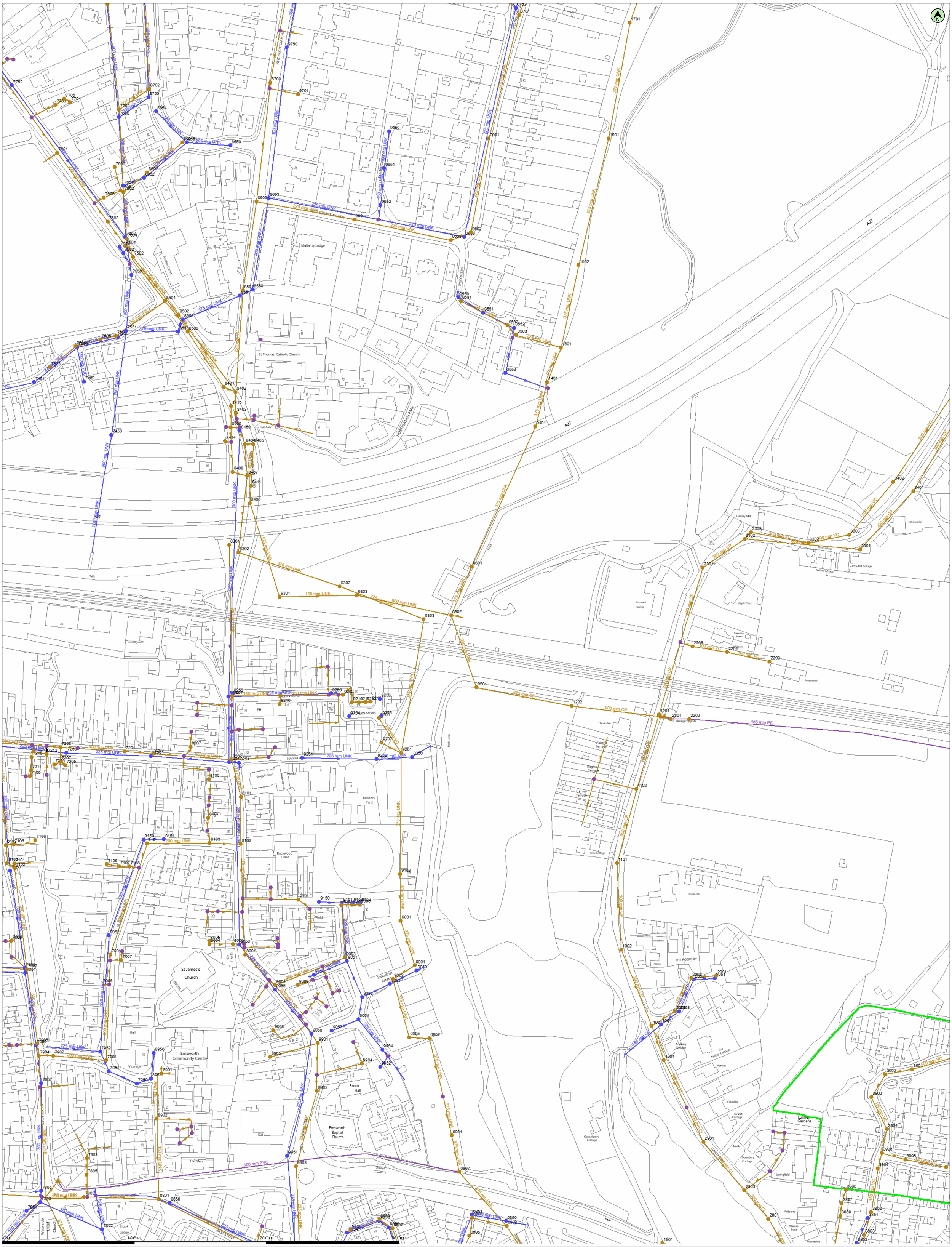
APPENDIX 2

Topographical Survey



APPENDIX 3

Southern Water Asset Plan



(c) Crown copyright and database rights 2024 Ordnance Survey AC0000808122

Data updated: 24/09/24

Scale: 1:1250

Map Centre: 475054,106312

Date: 09/10/24

Our Ref: 1589491 - 1

Wastewater Plan A1

Powered by digdat

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
Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Demarcation Chamber, Dummy Manhole or Surface Water Soakaway

matttwinberrow@bellamyroberts.co.uk

Interbridges

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 2024 Ordnance Survey AC0000808122 .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.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0001	F	4.82	1.73	
0201	F	3.82	0.36	
0301	F	5.22	2.82	
0302	F	4.71	0.00	
0303	F	4.85	2.81	
0401	F	5.70	3.44	
0501	F	7.92	6.15	
0502	F	7.07	5.80	
0503	F	7.00	5.57	
0601	F	8.62	5.96	
0602	F	8.38	5.69	
0603	F	8.41	5.64	
0701	F	9.04	0.00	
0802	F	5.90	0.91	
0805	F	6.15	3.96	
0806	F	6.10	3.72	
0807	F	4.48	0.98	
0901	F	5.12	0.00	
0902	F	4.92	1.42	
0905	F	4.92	1.57	
1001	F	4.13	1.47	
1002	F	4.01	1.61	
1101	F	3.64	1.84	
1102	F	3.77	2.04	
1201	F	4.22	0.00	
1202	F	4.15	0.15	
1401	F	5.57	3.57	
1501	F	5.70	0.00	
1502	F	6.10	3.89	
1601	F	6.39	4.31	
1701	F	6.90	4.74	
1801	F	2.83	1.46	
1901	F	3.61	1.37	
2001	F	6.17	4.65	
2002	F	5.66	4.28	
2003	F	4.80	3.64	
2201	F	7.26	0.00	
2202	F	7.89	0.00	
2203	F	0.00	0.00	
2204	F	0.00	0.00	
2205	F	0.00	0.00	
2301	F	4.94	0.00	
2302	F	6.09	4.39	
2303	F	6.53	4.46	
2801	F	2.61	0.00	
2803	F	0.00	0.00	
2901	F	2.56	0.00	
3301	F	9.74	6.64	
3302	F	8.82	4.65	
3303	F	8.86	4.78	
3401	F	9.59	6.75	
3402	F	9.63	4.96	
3802	F	4.49	1.72	
3803	F	0.00	0.00	
3806	F	5.14	3.30	
3807	F	0.00	0.00	
3808	F	0.00	0.00	
3809	F	0.00	0.00	
3901	F	6.70	5.05	
3902	F	6.39	3.93	
3903	F	6.15	3.74	
3904	F	5.74	3.53	
3905	F	5.80	4.19	
3906	F	5.40	3.38	
4904	F	6.49	4.86	
6102	F	3.78	1.48	
6103	F	0.00	0.00	
7001	F	5.93	3.67	
7002	F	3.22	0.00	
7006	F	0.00	0.00	
7007	F	0.00	0.00	
7008	F	0.00	0.00	
7009	F	0.00	0.00	
7101	F	3.57	1.67	
7102	F	3.62	1.42	
7103	F	0.00	0.00	
7105	F	0.00	0.00	
7106	F	0.00	0.00	
7107	F	0.00	0.00	
7108	F	0.00	0.00	
7109	F	0.00	0.00	
7201	F	4.73	0.00	
7205	F	0.00	0.00	
7206	F	0.00	0.00	
7207	F	0.00	0.00	
7208	F	0.00	0.00	
7210	F	0.00	0.00	
7211	F	0.00	0.00	
7212	F	3.94	0.00	
7501	F	6.31	4.65	
7502	F	6.30	0.00	
7503	F	6.65	5.34	
7504	F	6.14	5.18	
7505	F	6.00	5.04	
7506	F	5.90	4.96	
7601	F	7.50	4.90	
7602	F	6.67	0.00	
7603	F	6.42	4.69	
7604	F	6.31	4.73	
7605	F	0.00	0.00	
7606	F	0.00	0.00	
7607	F	0.00	0.00	
7701	F	0.00	0.00	
7702	F	6.63	0.00	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
7704	F	0.00	0.00	
7705	F	0.00	0.00	
7803	F	0.00	0.00	
7805	F	0.00	0.00	
7901	F	4.35	2.00	
7902	F	3.09	1.34	
7903	F	0.00	0.00	
7904	F	2.80	1.18	
7905	F	2.79	1.21	
8001	F	8.83	0.00	
8004	F	0.00	0.00	
8005	F	0.00	0.00	
8006	F	0.00	0.00	
8101	F	6.94	4.94	
8102	F	6.99	0.00	
8103	F	7.01	5.87	
8104	F	6.65	0.00	
8105	F	0.00	0.00	
8107	F	0.00	0.00	
8201	F	7.08	3.04	
8202	F	6.98	0.00	
8203	F	5.91	2.51	
8207	F	0.00	0.00	
8301	F	7.25	3.52	
8302	F	8.13	0.00	
8401	F	7.21	4.04	
8402	F	7.43	0.00	
8403	F	7.46	3.92	
8404	F	8.36	3.83	
8405	F	8.12	1.96	
8406	F	8.08	1.68	
8407	F	0.00	0.00	
8408	F	0.00	0.00	
8409	F	0.00	0.00	
8410	F	0.00	0.00	
8411	F	8.15	1.77	
8414	F	0.00	0.00	
8501	F	7.69	4.61	
8502	F	6.30	4.30	
8503	F	6.42	4.22	
8504	F	6.00	4.67	
8601	F	7.87	6.45	
8602	F	6.80	5.45	
8603	F	8.22	5.18	
8702	F	7.75	5.06	
8703	F	8.82	5.74	
8801	F	4.38	2.27	
8901	F	5.93	4.76	
8902	F	5.50	3.50	
8905	F	0.00	0.00	
9001	F	4.78	1.87	
9002	F	4.95	1.66	
9003	F	6.48	5.24	
9004	F	6.57	0.00	
9005	F	0.00	0.00	
9006	F	0.00	0.00	
9007	F	6.48	5.28	
9008	F	0.00	0.00	
9009	F	0.00	0.00	
9101	F	6.73	5.67	
9103	F	5.47	1.99	
9201	F	4.48	2.30	
9202	F	6.21	4.33	
9206	F	5.20	4.18	
9207	F	5.45	4.07	
9210	F	0.00	0.00	
9211	F	0.00	0.00	
9212	F	0.00	0.00	
9213	F	0.00	0.00	
9214	F	0.00	0.00	
9215	F	0.00	0.00	
9301	F	7.75	1.45	
9302	F	6.68	3.09	
9303	F	6.23	1.13	
9601	F	8.49	5.40	
9701	F	0.00	0.00	
9802	F	7.01	5.81	
9803	F	7.01	6.01	
9806	F	7.09	6.40	
9901	F	6.51	3.79	
9902	F	6.62	3.70	
9903	F	7.01	3.53	
9904	F	0.00	0.00	
0050	S	4.82	3.21	
0250	S	4.46	4.08	
0550	S	8.02	0.00	
0551	S	7.52	6.60	
0552	S	7.30	6.01	
0553	S	0.00	0.00	
0650	S	8.43	7.34	
0752	S	9.06	0.00	
0850	S	5.90	4.64	
0851	S	6.10	4.81	
1051	S	4.37	3.54	
2051	S	6.12	5.31	
2052	S	5.71	4.76	
2053	S	4.97	4.20	
3851	S	0.00	0.00	
3852	S	0.00	0.00	
7050	S	3.17	1.62	
7051	S	3.15	0.00	
7052	S	6.06	4.67	
7150	S	3.56	1.82	
7250	S	4.02	3.07	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
7451	S	6.86	5.05	
7452	S	5.83	5.02	
7550	S	5.74	4.24	
7551	S	5.90	0.00	
7552	S	6.37	5.12	
7553	S	6.34	5.37	
7554	S	6.14	0.00	
7555	S	5.90	4.68	
7650	S	6.83	0.00	
7651	S	6.65	4.86	
7652	S	6.31	0.00	
7752	S	8.64	8.06	
7851	S	3.07	2.17	
7852	S	2.97	0.00	
7853	S	3.37	0.00	
7855	S	0.00	0.00	
7950	S	5.66	4.30	
7951	S	4.79	3.62	
7952	S	4.38	2.93	
7954	S	2.84	1.48	
7957	S	0.00	0.00	
8050	S	6.74	5.09	
8150	S	6.79	5.46	
8151	S	6.71	5.96	
8250	S	5.79	4.29	
8251	S	6.98	0.00	
8252	S	7.12	4.59	
8253	S	7.11	5.83	
8254	S	6.89	6.09	
8450	S	7.58	4.83	
8550	S	7.66	6.27	
8551	S	7.60	5.90	
8552	S	6.41	4.97	
8553	S	6.23	0.00	
8650	S	8.18	6.73	
8651	S	7.84	0.00	
8652	S	6.79	5.64	
8653	S	8.13	0.00	
8654	S	7.59	6.44	
8750	S	7.67	0.00	
8850	S	4.79	3.98	
8950	S	6.16	5.10	
8951	S	5.92	4.68	
9050	S	6.20	4.90	
9051	S	5.55	0.00	
9052	S	5.09	0.00	
9053	S	4.91	3.21	
9054	S	5.28	3.48	
9056	S	6.64	4.90	
9057	S	6.19	3.79	
9058	S	6.55	4.83	
9150	S	6.13	4.90	
9151	S	5.45	4.75	
9152	S	0.00	0.00	
9153	S	0.00	0.00	
9250	S	6.38	4.83	
9251	S	6.25	5.02	
9252	S	4.97	4.43	
9253	S	5.47	4.51	
9254	S	5.72	4.77	
9255	S	5.20	0.00	
9650	S	8.53	7.60	
9651	S	8.54	7.46	
9652	S	8.42	7.37	
9750	S	8.88	7.11	
9854	S	7.06	5.90	
9855	S	7.03	5.72	
9856	S	7.01	5.66	
9951	S	7.26	4.55	
9952	S	0.00	0.00	
9954	S	4.87	0.00	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

7703	F	0.00	0.00	

7450	S	5.30	3.48	

APPENDIX 4

Ashdown SI Assessment (relevant extracts)

Interbridges
New Brighton Road
Emsworth
Hampshire

Combined Geotechnical and Ground Contamination Risk Assessment

Report Beneficiary:
PNH Properties Ltd
Unit 5 Passfield Business Centre
Lynchborough Road
Liphook
Hampshire
GU30 7SB

Project Reference: P16578

Report Reference: R16181

Document Control			
Issue No.	**Status**	**Issue Date**	**Notes**
1	Final	29th May 2024	

Report Section	Prepared By	Approved By
Preliminary Ground Contamination Risk Assessment	Adam Cormack HNC FGS	Steven McSwiney BA mod Geol MSc FGS
Factual Section	Georgia Roper-Doherty BSc MRes	Steven McSwiney BA mod Geol MSc FGS
Geotechnical Assessment	Adam Cormack HNC FGS	Steven McSwiney BA mod Geol MSc FGS
Quantitative Ground Contamination Risk Assessment	Adam Cormack HNC FGS	Steven McSwiney BA mod Geol MSc FGS

Head Office
Unit 3
The Old Grain Store
Ditchling Common Business Park
Ditchling
East Sussex
BN6 8SG
Tel: 01273 483119
www.ashdownsi.co.uk

Limitations

This report was prepared specifically for the Client's project and may not be appropriate to alternative schemes. The copyright for the report and licence for its use shall remain vested in Ashdown Site Investigation Limited (the Company) who disclaim all responsibility or liability (whether at common law or under the express or implied terms of the Contract between the Company and the Client) for any loss or damage of whatever nature in the event that this report is relied on by a third party, or is issued in circumstances or for projects for which it was not originally commissioned.

This report is not intended to be either an ecological, archaeological or flood risk assessment. An appropriate specialist should be consulted about any concerns that may arise in this regard.

EXECUTIVE SUMMARY

The following presents a summary of the main findings of the report. It is emphasised that no reliance should be placed on any individual point until the whole of the report has been read as other sections of the report may put into context the information contained herein.

It is understood that the site at New Brighton Road, Emsworth is to be developed into a series of commercial units with a new access road, parking, and limited areas of soft landscaping.

The site currently comprises a hummocky vacant parcel of land with several mounds along the northern and southern boundaries.

The site comprised part of an agricultural field from the time of the earliest map, dated 1869, with the southern extent part of a residential garden since circa 1897. The site was later confined between the A27 and a railway line following the construction of the road, and demolition of the associated dwelling in the late 1980s, and has remained vacant since.

Reference to geological datasets indicates that the site is expected to be underlain by the River Terrace Deposits in the west and Head Deposits in the east, overlying the London Clay Formation. The ground investigation confirmed the underlying soils to comprise a variable thickness of made ground, overlying River Terrace Deposits and, in turn, London Clay deposits. Both the River Terrace Deposits and Head are classed as Secondary A Aquifers, whilst the underlying London Clay Formation is an Unproductive Stratum. The site does not lie within a SPZ.

The geoenvironmental data identifies that the site is located within an area where between 5% and 10% of properties are above the action level requiring radon gas protection measures to be installed in new buildings.

Groundwater was recorded within two of the boreholes on completion of drilling, at depths of 1.33m and 1.30m. All other boreholes remained dry during drilling. Monitoring of stand-pipes installed at the site recorded groundwater levels to gradually rise during the three-week monitoring period to depths of between 3.60m and 3.15m. However, the data indicates that groundwater levels within the standpipes had not fully equilibrated over the monitoring period.

It is recommended that the design of precautions against shrinkage and heave for any new foundation system should assume a high volume change potential for the fine-grained River Terrace Deposits and London Clay Formation

A net allowable bearing capacity of 100kN/m^2 may be assumed for spread (pad or strip) foundations up to 2.00m across bearing within the River Terrace Deposits of at least firm consistency. Where foundations are constructed onto London Clay Formation soils of at least stiff consistency, an increased bearing capacity of 150kN/m^2 may be adopted for similarly dimensioned foundations.

A DS-2 Design Sulfate Class and an AC-2 ACEC classification should be assumed as a minimum for the design of concrete in contact with the ground where the ground will not be significantly disturbed. Where the ground will be disturbed during construction activities, a higher DS-3 and AC-3 classification should be assumed.

Ground floors should be suspended unless the conditions set out within this report can be met.

Design equilibrium California bearing ratios and moduli of subgrade reaction are presented in the report. The subgrade is not likely to be susceptible to frost heave.

Retaining structures and slopes should be designed using effective shear strength parameters. Recommended values for key parameters are presented in the report.

Infiltration testing within the River Terrace Deposits soils recorded infiltration rates ranging between 2.33×10^{-4}m/sec and 3.79×10^{-6}m/sec, whilst the London Clay Formation possesses negligible infiltration characteristics.

The preliminary contamination risk assessment identified potential pollutant linkages with regard to proposed end users of the site associated with potential for made ground to be present on the site and the radon risk identified by the geoenvironmental data.

The ground investigation did not identify any of the potential contaminants to be present at concentrations considered to pose an unacceptable risk to either end users of the site. However, a radon risk has been identified which may require radon protection measures to be installed at the site. A detailed assessment of the risk posed by radon could be undertaken which may mitigate the requirement for radon protection measures. Consultation with regulators in this regard is recommended.

TABLE OF CONTENTS

1.	**INTRODUCTION**	**1**
2.	**SITE CONTEXT**	**2**
2.1	Walkover Survey	2
2.2	Geological Data Review	2
2.3	Hydrogeological and Hydrological Data	5
3.	**GEO-ENVIRONMENTAL DATA**	**6**
3.1	Historical Industrial Sites	6
3.2	Landfill and Other Waste Sites	6
3.3	Current Industrial Land Use	7
3.4	Sensitive Land Use	8
3.5	Railway Infrastructure and Projects	8
4.	**HISTORICAL MAP AND IMAGERY REVIEW**	**8**
5.	**PRELIMINARY CONTAMINATION RISK ASSESSMENT**	**9**
5.1	Introduction	9
5.2	Contaminant Pathways Identified	9
5.3	Potential Contamination Source Identified	10
5.4	Preliminary Conceptual Model	10
6.	**SITE WORKS**	**11**
6.1	Introduction	11
6.2	Exploratory Holes	11
6.3	Sampling	11
6.4	In Situ Strength Testing	12
6.5	In Situ Infiltration Testing	12
6.6	Installations	12
6.7	Laboratory Testing	12
7.	**GROUND CONDITIONS**	**13**
7.1	Stratigraphy	13
7.2	Stability	13
7.3	Groundwater Conditions	14
8.	**GEOTECHNICAL ASSESSMENT**	**15**
8.1	Foundations	15
8.2	Ground Floors	17
8.3	Groundwater	18
8.4	Stability of Excavations	18
8.5	Aggressivity to Concrete	19
8.6	Pavement Design	20
8.7	Stormwater Infiltration Systems	21
8.8	Retaining Structures and Slopes	22
9.	**QUANTITATIVE CONTAMINATION ASSESSMENT**	**23**
9.1	Assessment Strategy	23
9.2	Analysis of Contamination Test Results	23
9.3	Quantitative Contamination Risk Assessment	25

9.4	Risks to Other Potential Receptors	25
9.5	Recommendations	25
9.6	Discovery Strategy	26

FIGURES AND APPENDICES

FIGURES

Figure 1 Site Location Plan
Figure 2 Site Plan

APPENDIX A

Proposed Development Layout

APPENDIX B

Explanatory Notes
Exploratory Hole Records
DPSH-B Dynamic Probe Records
In-situ TRL Cone Penetrometer (CBR) Test Results
Borehole In Situ Infiltration Test Results
Groundwater Monitoring Results

APPENDIX C

Geotechnical Laboratory Test Results
Contamination Laboratory Test Results

APPENDIX D

Summary of In Situ CBR Test Results
Graph of Subgrade Surface Modulus vs Depth
Graph of CBR vs Depth

APPENDIX E

Classification of Probability, Consequence and Risk

APPENDIX F

Preliminary Conceptual Model

APPENDIX G

Quantitative Conceptual Model

APPENDIX H

BGS Borehole Records

APPENDIX I

Groundsure Enviro+Geo Insight Report
Historical Maps

7. GROUND CONDITIONS

7.1 Stratigraphy

7.1.1 Surface Covering

Trial pits TP01, TP03 and TP04, and boreholes WS01, WS03, WS04 and WS06 were excavated through a surface cover of topsoil some 100mm to 300mm in thickness.

7.1.2 Made Ground

Made ground or reworked soils, generally comprising slightly gravelly and gravelly clay were recorded within exploratory holes TP02, TP05, and WS02 to WS09. The gravel fraction comprised variable quantities of flint, brick, charcoal-like material, clinker-like material, plastic, metal, sandstone and chalk. The made ground at these positions generally extended to depths of between 0.20m and 0.90m below ground level but was found to extend considerably deeper (to 2.00m below ground level) within borehole WS09. This deeper made ground included a layer of chalk fill between depths of 1.30m and 2.00m.

7.1.3 River Terrace Deposits

Underlying the made ground/surfacing, the exploratory holes, with the single exception of borehole WS09, progressed into undisturbed generally firm (and locally stiff) slightly gravelly/sandy clay deposits. The gravel fraction comprised flint and occasional chalk. Additionally, within the soils encountered within borehole WS05, strata of clayey gravel were recorded between depths of 0.20m and 0.85m, and 2.00m and 2.50m.

These deposits are considered to represent the River Terrace Deposits indicated to underlie the site on BGS geological maps.

The base of the River Terrace Deposits was generally encountered within the boreholes at depths of between 0.70m and 2.30m below ground level, but at the location of borehole WS08 these soils extended to the full depth of the borehole at 3.00m below ground level. All of the shallow trial pit holes were terminated at a depth of 1.0m below ground level within the River Terrace Deposits.

7.1.4 London Clay Formation

Beneath the River Terrace Deposits, where penetrated, the dynamic sampler boreholes encountered generally stiff clay deposits (locally becoming very stiff), within which bands of mudstone and sandstone were occasionally recorded.

These deposits continued to the full depth of investigation and are considered to represent the London Clay Formation indicated to underlie the River Terrace Deposits on BGS geological maps.

7.2 Stability

Boreholes WS05, WS08 and WS09 collapsed to depths of between 2.38m and 2.90m below ground level on completion of drilling. The remaining exploratory holes were recorded to remain stable during excavation/drilling.

7.3 Groundwater Conditions

Groundwater was recorded at depths of 1.33m and 1.30 during the drilling of boreholes WS05 and WS09, respectively. All other exploratory holes remained dry during drilling/excavation.

Monitoring of groundwater levels within the standpipes installed in boreholes WS01, WS04, and WS07 was undertaken over a period of approximately three weeks.

Borehole WS01 was recorded to remain dry during the monitoring period.

Groundwater within boreholes WS04 and WS07 was recorded to gradually rise to respective depths of 3.60m and 3.15m by the end of the monitoring period. However, the data indicates that groundwater levels within the standpipes had not fully equilibrated with the true groundwater levels by the time the dataloggers were collected.

undertaken to demonstrate, that close to the time of construction, no significant soil desiccation is present. If ground bearing floors are adopted it is recommended that the potential for differential movement, both between the floor slab and walls and across the floor slab itself, should be anticipated. Such floors should be fully debonded from walls. Formations should be adequately proof rolled and any excessively soft materials excavated and replaced with a suitable, well graded granular fill. The depth of any fill should be limited to a maximum of 600mm unless placed to an engineering specification designed to limit internal settlement of the fill materials to a tolerance to be advised by the designer.

Guidance on CBR values and a moduli of subgrade reaction are given in Section 8.6 of this report.

The detailing of services through, or under, ground-bearing floors should incorporate flexible connections and, where appropriate, enhanced falls.

8.3 Groundwater

Groundwater was recorded during the drilling of two of the boreholes at depths of 1.33m and 1.30. Groundwater levels were recorded to gradually rise within two of the stand-pipes installed at the site during the three-week monitoring period. At the end of the monitoring period groundwater had risen to depths of between 3.60m and 3.15m, however the data indicates that groundwater levels within the standpipes had not fully equilibrated over the monitoring period.

It is also noted that groundwater levels should be expected to fluctuate seasonally, especially during wetter seasons.

Where excavations are proposed to extend below the groundwater table, particularly within coarse-grained River Terrace Deposits, groundwater control will be required to maintain adequately dry working conditions and excavation stability. In such circumstances it is recommended that trial pumping from proposed excavation depths should be undertaken to fully ascertain requirements for groundwater control.

The potential for perched groundwater to be present above the groundwater table, for example within the made ground etc, should not be overlooked. It is also possible that heavy precipitation during construction could lead to the ingress of perched groundwater or surface water run-off into excavations. In such circumstances it would be expected that water entering excavations would be adequately managed by pumping from sumps or natural drainage into coarse grained River Terrace Deposits if present above the groundwater table.

8.4 Stability of Excavations

All made ground or coarse-grained natural soils exposed in excavations should be assumed to be unstable, even in the short term. Whilst fine-grained natural soils may remain stable for a short period of time if not subjected to surcharge loads (such as may be imposed by existing foundations, traffic or storage of materials), the stability of these deposits if left unsupported should be assumed to have the potential to deteriorate. Where stable excavations are required, excavations should either be suitably supported or, where space permits, side slopes could be battered back to a safe angle of repose.

All excavations requiring human entry must be shored or battered as necessary to conform to current best practice, as accepted by the Health and Safety Executive (HSE)[5]. Current legislation

[5] Relevant guidance is given on the HSE website, www.hse.gov.uk

* Thin pavement being 300mm sub-base, thick pavement being 1200mm sub-base. †Modulus based on average of all calculated moduli based on CBR values for thin sub-base.

The subgrade may be assumed not to be susceptible to frost heave.

If new roads are to be adopted the local highway authority should be consulted with reference to the acceptability of the proposed CBR figures prior to designs being finalised and construction undertaken.

8.7 Stormwater Infiltration Systems

In-situ infiltration testing[9] was undertaken in boreholes WS02, WS05, WS06, and WS08. From the test results, calculations were made to estimate the infiltration rate that could be expected for soakaways constructed to discharge into the underlying soils within the test zone.

The infiltration rates derived from the tests are summarised in the following table.

Table 19. Calculated Infiltration Rates

Exploratory Hole	Test Response Zone Depth (m)		Stratum	Infiltration Rate (f) (m/sec)	Driving Head of Water (m)
	Top	Bottom			
WS02	2.00	3.00	London Clay Formation	Negligible – no fall in water level in 67 minutes	
WS05 – Test 1	1.00	3.00*	River Terrace Deposits	1.07×10^{-4}	0.7
WS05 – Test 2	1.00	3.00*	River Terrace Deposits	1.05×10^{-4}	0.7
WS05 – Test 3	1.00	3.00*	River Terrace Deposits	9.89×10^{-5}	0.6
WS06	2.00	3.00*	London Clay Formation	1.16×10^{-7}	2.3
WS08	2.00	3.00*	River Terrace Deposits	9.03×10^{-7}	2.2

Notes: * Boreholes collapsed/unstable at base.

The value 'f' is equivalent to the soil infiltration coefficient 'q' quoted in the Construction Industry Research and Information Association (CIRIA) Report 156.

The results from the infiltration tests should be provided to engineers responsible for the design of the drainage system.

To comply with building regulations[10], point discharging infiltration systems (conventional ring or trench soakaways) are required to be constructed a minimum of 5.0m away from proposed or existing buildings.

[9] Conducted in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.
[10] The Building Regulations 2010; Part H; Drainage and Waste Disposal

APPENDIX 5

Greenfield Runoff Rates

Greenfield Runoff Volume

FSR Data

Return Period (years)	1
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.900
Ratio R	0.344
Areal Reduction Factor	1.00
Area (ha)	0.433
SAAR (mm)	794
CWI	45.000
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	17.00
Greenfield Runoff Volume (m^3)	17.271

©1982-2020 Innovyze

Greenfield Runoff Volume

FSR Data

Return Period (years)	30
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.900
Ratio R	0.344
Areal Reduction Factor	1.00
Area (ha)	0.433
SAAR (mm)	794
CWI	45.000
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	19.43
Greenfield Runoff Volume (m^3)	42.975

©1982-2020 Innovyze

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.900
Ratio R	0.344
Areal Reduction Factor	1.00
Area (ha)	0.433
SAAR (mm)	794
CWI	45.000
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	21.40
Greenfield Runoff Volume (m^3)	61.181

©1982-2020 Innovyze

APPENDIX 6

EA Flood Map for Planning

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**474978/106356**	**21 Nov 2024 11:42**

Your selected location is in flood zone 2, an area with a medium probability of flooding.

This means:

- you must complete a flood risk assessment for development in this area
- you should follow the Environment Agency's standing advice for carrying out a flood risk assessment (see www.gov.uk/guidance/flood-risk-assessment-standing-advice)

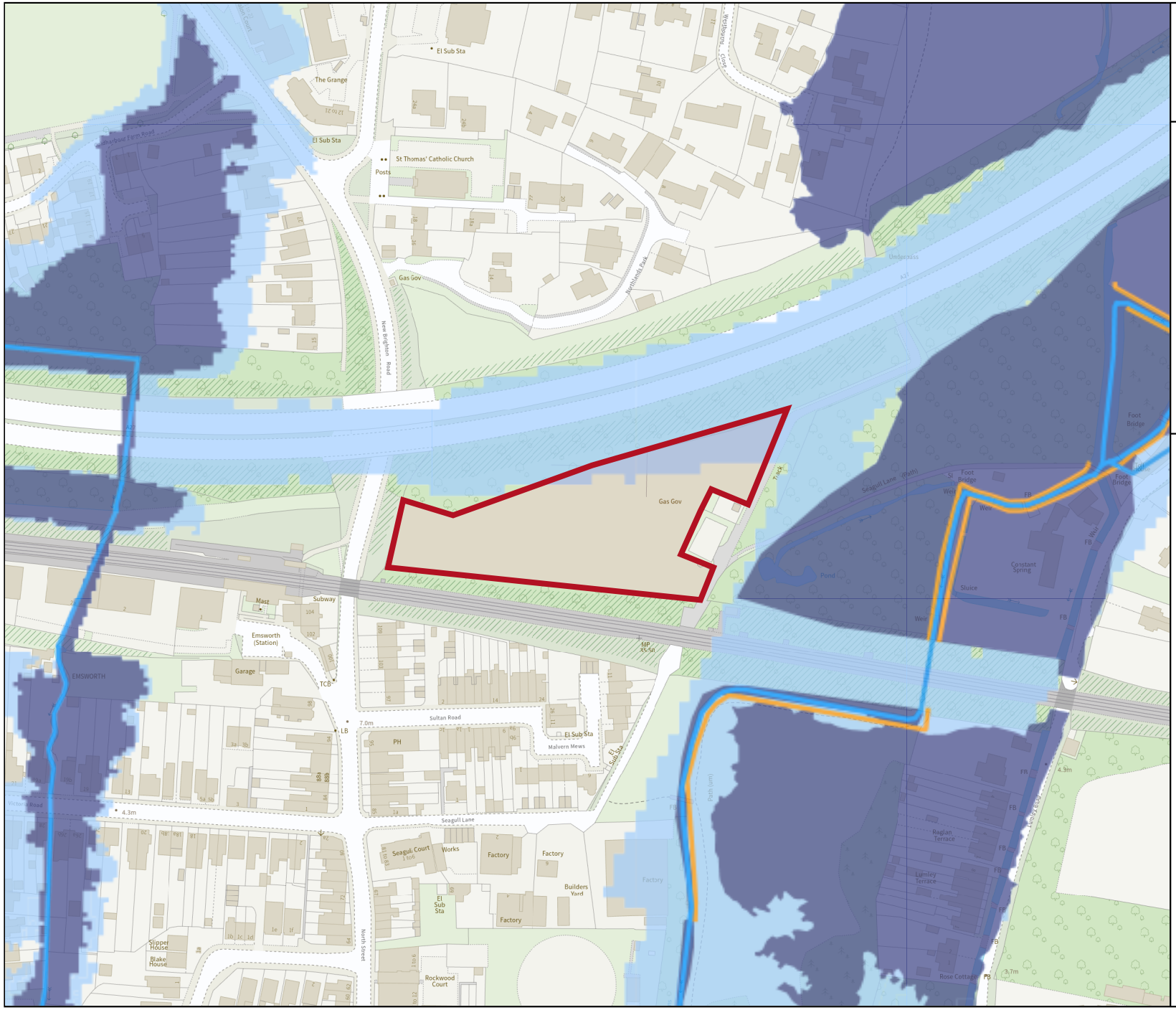
Notes

The flood map for planning shows river and sea flooding data only. It doesn’t include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence which sets out the terms and conditions for using government data. https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2024 OS AC0000807064. https://flood-map-for-planning.service.gov.uk/os-terms



Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
474978/106356

Scale
1:2500

Created
21 Nov 2024 11:42

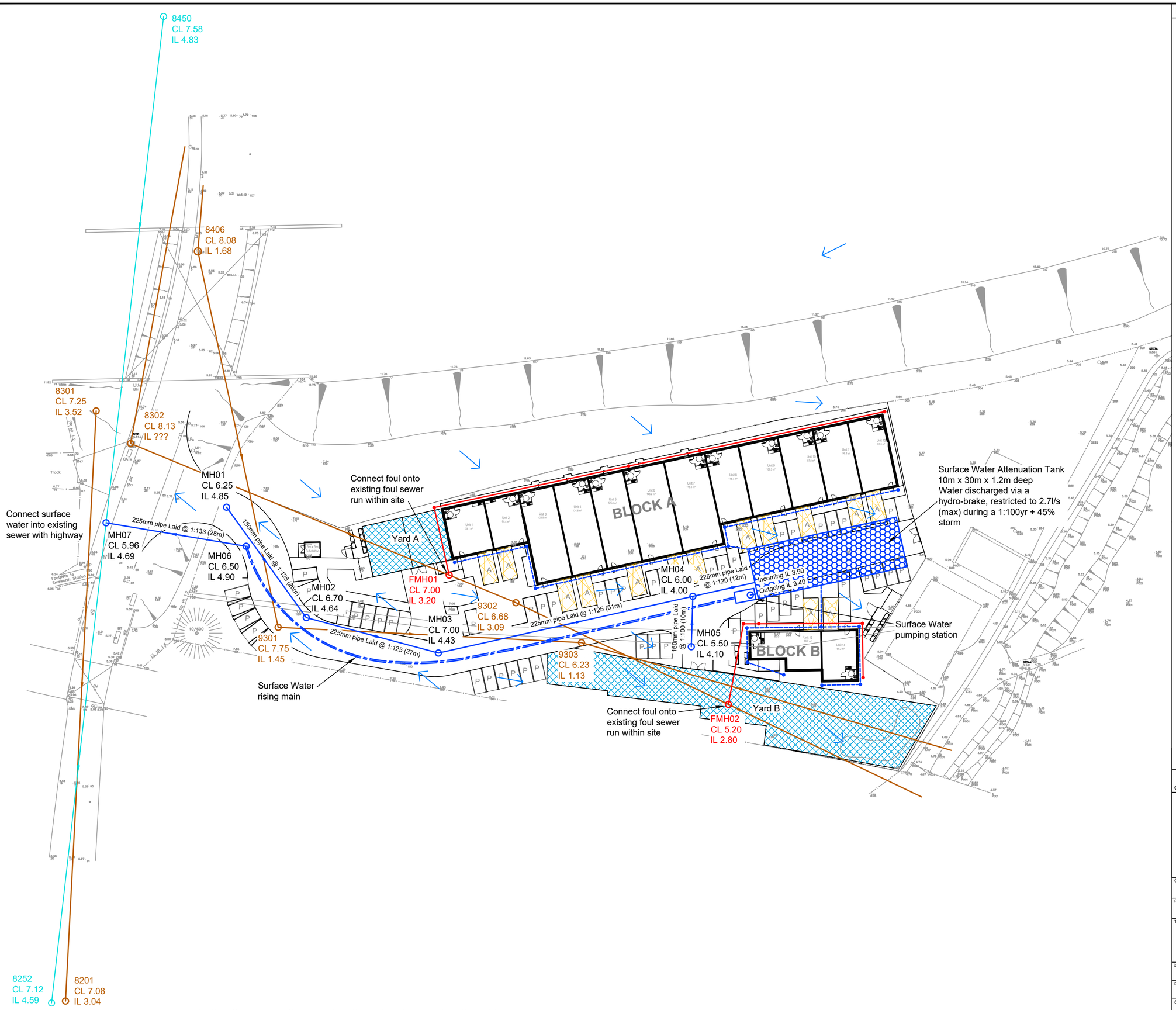
- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

© Environment Agency copyright and / or database rights 2024. All rights reserved. © Crown Copyright and database right 2024. Ordnance Survey licence number AC0000807064.

APPENDIX 7

Surface & Foul Water Drainage Strategy



Notes

Do not scale this drawing

This drawing shall be read in conjunction with all other relevant Engineering, Architectural, Landscaping details, drawings and specifications and all relevant Highway Authority Plans

Any works constructed prior to technical approval are at the contractors own risk

Yards A and B are to be permeable block paving depth by design, shallow infiltration

Deep infiltration for the remainder of the site is not expected, cellular storage is being suggested, with the capacity storing the surface water runoff from a total impermeable area of;
4330m²
Discharged into a nearby surface water sewer via a surface water pumping station at controlled rates of;
1:1yr - 1.3 l/s
1:30yr - 2.3 l/s
1:100yr - 2.7 l/s

All surface water drainage pipes to be lightweight HDPE pipes or similar to comply with HAPAS BBA, 100mmØ unless otherwise stated

All foul sewer pipes to be PVC or similar material, 150mmØ unless otherwise stated

- Proposed foul sewer
- Existing foul sewer
- Surface water sewer
- Existing water sewer
- Surface water cellular storage crates
- Permeable block paving (yard areas)
- Overland surface water exceedance flow paths

REVISION	AMENDMENT	DRN	DATE	CHK
A	Site layout revised drainage updated, drawing size and scale changed	JCB	27/11/24	ITR

Bellamy Roberts
Clover House
Western Lane
Odiham
Hampshire, RG29 1TU
Tel: 01256 703355
Email: info@bellamyroberts.co.uk

CLIENT
PNH Properties

PROJECT
Interbridges Site, Emsworth

TITLE
Drainage Strategy

DRAWN BY	DESIGN BY	CHK BY
JCB	JCB	MT

DATE	DRAWING No.	REV No.
03/07/24	6096 / 101	A

SCALE
1:500 @ A2

Bellamy Roberts Partners Limited (trading as Bellamy Roberts) is a limited company registered in England. Reg.No.14021497, Quality Assured Firm ISO9001 Certificate Number 14135544, Ordnance Survey Licence Number AC000815970

APPENDIX 8

Microdrainage Analyses

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	0.433	Urban	0.000
SAAR (mm)	725	Region Number	Region 7

Results	**l/s**
QBAR Rural	1.5
QBAR Urban	1.5
Q100 years	4.9
Q1 year	1.3
Q30 years	3.5
Q100 years	4.9

©1982-2020 Innovyze

Greenfield Runoff Volume

FSR Data

Return Period (years)	1
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.900
Ratio R	0.344
Areal Reduction Factor	1.00
Area (ha)	0.433
SAAR (mm)	794
CWI	45.000
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	17.00
Greenfield Runoff Volume (m^3)	17.271

©1982-2020 Innovyze

Greenfield Runoff Volume

FSR Data

Return Period (years)	30
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.900
Ratio R	0.344
Areal Reduction Factor	1.00
Area (ha)	0.433
SAAR (mm)	794
CWI	45.000
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	19.43
Greenfield Runoff Volume (m^3)	42.975

©1982-2020 Innovyze

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.900
Ratio R	0.344
Areal Reduction Factor	1.00
Area (ha)	0.433
SAAR (mm)	794
CWI	45.000
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	21.40
Greenfield Runoff Volume (m^3)	61.181

©1982-2020 Innovyze

Summary of Results for 1 year Return Period

Half Drain Time : 531 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	3.482	0.082	0.0	0.8	0.8	23.2	O K
30 min Summer	3.508	0.108	0.0	0.9	0.9	30.7	O K
60 min Summer	3.537	0.137	0.0	1.0	1.0	39.1	O K
120 min Summer	3.569	0.169	0.0	1.1	1.1	48.1	O K
180 min Summer	3.587	0.187	0.0	1.2	1.2	53.2	O K
240 min Summer	3.599	0.199	0.0	1.2	1.2	56.6	O K
360 min Summer	3.610	0.210	0.0	1.2	1.2	59.9	O K
480 min Summer	3.617	0.217	0.0	1.2	1.2	61.9	O K
600 min Summer	3.622	0.222	0.0	1.3	1.3	63.3	O K
720 min Summer	3.626	0.226	0.0	1.3	1.3	64.4	O K
960 min Summer	3.630	0.230	0.0	1.3	1.3	65.5	O K
1440 min Summer	3.630	0.230	0.0	1.3	1.3	65.7	O K
2160 min Summer	3.623	0.223	0.0	1.3	1.3	63.6	O K
2880 min Summer	3.613	0.213	0.0	1.2	1.2	60.6	O K
4320 min Summer	3.591	0.191	0.0	1.2	1.2	54.5	O K
5760 min Summer	3.572	0.172	0.0	1.1	1.1	49.0	O K
7200 min Summer	3.554	0.154	0.0	1.1	1.1	44.0	O K
8640 min Summer	3.539	0.139	0.0	1.0	1.0	39.6	O K
10080 min Summer	3.526	0.126	0.0	1.0	1.0	35.8	O K
15 min Winter	3.491	0.091	0.0	0.8	0.8	26.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	29.325	0.0	21.4	22
30 min Summer	19.556	0.0	29.0	37
60 min Summer	12.728	0.0	40.0	66
120 min Summer	8.138	0.0	51.4	124
180 min Summer	6.240	0.0	59.3	182
240 min Summer	5.161	0.0	65.4	242
360 min Summer	3.910	0.0	74.4	344
480 min Summer	3.211	0.0	81.5	400
600 min Summer	2.756	0.0	87.4	464
720 min Summer	2.433	0.0	92.6	528
960 min Summer	1.999	0.0	101.3	664
1440 min Summer	1.516	0.0	114.6	942
2160 min Summer	1.148	0.0	133.2	1360
2880 min Summer	0.943	0.0	145.8	1760
4320 min Summer	0.715	0.0	165.4	2552
5760 min Summer	0.589	0.0	183.0	3296
7200 min Summer	0.504	0.0	195.8	4040
8640 min Summer	0.444	0.0	206.6	4760
10080 min Summer	0.399	0.0	216.0	5544
15 min Winter	29.325	0.0	24.1	22

©1982-2020 Innovyze

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	3.521	0.121	0.0	1.0	1.0	34.4	O K
60 min Winter	3.554	0.154	0.0	1.1	1.1	43.9	O K
120 min Winter	3.590	0.190	0.0	1.2	1.2	54.1	O K
180 min Winter	3.611	0.211	0.0	1.2	1.2	60.2	O K
240 min Winter	3.625	0.225	0.0	1.3	1.3	64.1	O K
360 min Winter	3.640	0.240	0.0	1.3	1.3	68.3	O K
480 min Winter	3.647	0.247	0.0	1.3	1.3	70.4	O K
600 min Winter	3.651	0.251	0.0	1.3	1.3	71.6	O K
720 min Winter	3.655	0.255	0.0	1.3	1.3	72.6	O K
960 min Winter	3.658	0.258	0.0	1.3	1.3	73.4	O K
1440 min Winter	3.654	0.254	0.0	1.3	1.3	72.4	O K
2160 min Winter	3.639	0.239	0.0	1.3	1.3	68.0	O K
2880 min Winter	3.621	0.221	0.0	1.3	1.3	62.9	O K
4320 min Winter	3.587	0.187	0.0	1.2	1.2	53.3	O K
5760 min Winter	3.559	0.159	0.0	1.1	1.1	45.3	O K
7200 min Winter	3.535	0.135	0.0	1.0	1.0	38.4	O K
8640 min Winter	3.515	0.115	0.0	0.9	0.9	32.9	O K
10080 min Winter	3.500	0.100	0.0	0.9	0.9	28.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	19.556	0.0	32.6	36
60 min Winter	12.728	0.0	44.9	64
120 min Winter	8.138	0.0	57.7	122
180 min Winter	6.240	0.0	66.5	180
240 min Winter	5.161	0.0	73.4	236
360 min Winter	3.910	0.0	83.5	346
480 min Winter	3.211	0.0	91.4	450
600 min Winter	2.756	0.0	98.0	486
720 min Winter	2.433	0.0	103.8	560
960 min Winter	1.999	0.0	113.5	716
1440 min Winter	1.516	0.0	128.2	1024
2160 min Winter	1.148	0.0	149.3	1456
2880 min Winter	0.943	0.0	163.4	1876
4320 min Winter	0.715	0.0	185.4	2684
5760 min Winter	0.589	0.0	205.0	3464
7200 min Winter	0.504	0.0	219.3	4184
8640 min Winter	0.444	0.0	231.6	4928
10080 min Winter	0.399	0.0	242.1	5648

©1982-2020 Innovyze

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Shortest Storm (mins)	15
Ratio R	0.344	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.433

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.233	4	8	0.200

©1982-2020 Innovyze

Model Details

Storage is Online Cover Level (m) 5.200

Cellular Storage Structure

Invert Level (m) 3.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	300.0	0.0	1.201	0.0	0.0
1.200	300.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SCU-0048-2700-1200-2700
Design Head (m)	1.200
Design Flow (l/s)	2.7
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	48
Invert Level (m)	3.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	2.7
Flush-Flo™	0.069	0.8
Kick-Flo®	0.072	0.8
Mean Flow over Head Range	-	1.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	1.200	2.7	3.000	4.1	7.000	6.2
0.200	1.2	1.400	2.9	3.500	4.4	7.500	6.4
0.300	1.4	1.600	3.1	4.000	4.7	8.000	6.6
0.400	1.6	1.800	3.3	4.500	5.0	8.500	6.8
0.500	1.8	2.000	3.4	5.000	5.3	9.000	7.0
0.600	2.0	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	6.0		

©1982-2020 Innovyze

Summary of Results for 30 year Return Period (+35%)

Half Drain Time : 1005 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	3.672	0.272	0.0	1.4	1.4	77.7	O K
30 min Summer	3.762	0.362	0.0	1.6	1.6	103.0	O K
60 min Summer	3.856	0.456	0.0	1.7	1.7	130.1	O K
120 min Summer	3.953	0.553	0.0	1.9	1.9	157.6	O K
180 min Summer	4.006	0.606	0.0	2.0	2.0	172.7	O K
240 min Summer	4.040	0.640	0.0	2.0	2.0	182.3	O K
360 min Summer	4.083	0.683	0.0	2.1	2.1	194.7	O K
480 min Summer	4.107	0.707	0.0	2.1	2.1	201.4	O K
600 min Summer	4.119	0.719	0.0	2.1	2.1	205.0	O K
720 min Summer	4.125	0.725	0.0	2.1	2.1	206.6	O K
960 min Summer	4.131	0.731	0.0	2.1	2.1	208.3	O K
1440 min Summer	4.131	0.731	0.0	2.1	2.1	208.3	O K
2160 min Summer	4.115	0.715	0.0	2.1	2.1	203.8	O K
2880 min Summer	4.090	0.690	0.0	2.1	2.1	196.7	O K
4320 min Summer	4.035	0.635	0.0	2.0	2.0	181.0	O K
5760 min Summer	3.983	0.583	0.0	1.9	1.9	166.1	O K
7200 min Summer	3.936	0.536	0.0	1.9	1.9	152.9	O K
8640 min Summer	3.895	0.495	0.0	1.8	1.8	141.1	O K
10080 min Summer	3.858	0.458	0.0	1.7	1.7	130.5	O K
15 min Winter	3.705	0.305	0.0	1.4	1.4	87.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	97.032	0.0	72.6	23
30 min Summer	64.753	0.0	93.6	37
60 min Summer	41.383	0.0	132.0	66
120 min Summer	25.649	0.0	163.4	126
180 min Summer	19.154	0.0	182.7	184
240 min Summer	15.496	0.0	196.7	244
360 min Summer	11.496	0.0	217.5	362
480 min Summer	9.289	0.0	232.2	482
600 min Summer	7.867	0.0	242.5	600
720 min Summer	6.866	0.0	249.6	688
960 min Summer	5.535	0.0	258.4	796
1440 min Summer	4.080	0.0	264.5	1044
2160 min Summer	3.003	0.0	349.2	1456
2880 min Summer	2.414	0.0	373.8	1876
4320 min Summer	1.772	0.0	406.8	2684
5760 min Summer	1.422	0.0	442.8	3512
7200 min Summer	1.200	0.0	466.9	4256
8640 min Summer	1.044	0.0	487.4	5024
10080 min Summer	0.929	0.0	504.9	5840
15 min Winter	97.032	0.0	80.7	22

©1982-2020 Innovyze

Summary of Results for 30 year Return Period (+35%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	3.805	0.405	0.0	1.6	1.6	115.6	O K
60 min Winter	3.912	0.512	0.0	1.8	1.8	146.0	O K
120 min Winter	4.022	0.622	0.0	2.0	2.0	177.3	O K
180 min Winter	4.083	0.683	0.0	2.1	2.1	194.6	O K
240 min Winter	4.122	0.722	0.0	2.1	2.1	205.8	O K
360 min Winter	4.174	0.774	0.0	2.2	2.2	220.5	O K
480 min Winter	4.203	0.803	0.0	2.2	2.2	229.0	O K
600 min Winter	4.221	0.821	0.0	2.3	2.3	234.0	O K
720 min Winter	4.231	0.831	0.0	2.3	2.3	236.7	O K
960 min Winter	4.235	0.835	0.0	2.3	2.3	238.1	O K
1440 min Winter	4.231	0.831	0.0	2.3	2.3	236.7	O K
2160 min Winter	4.204	0.804	0.0	2.2	2.2	229.2	O K
2880 min Winter	4.165	0.765	0.0	2.2	2.2	218.2	O K
4320 min Winter	4.082	0.682	0.0	2.1	2.1	194.3	O K
5760 min Winter	4.004	0.604	0.0	2.0	2.0	172.2	O K
7200 min Winter	3.937	0.537	0.0	1.9	1.9	153.1	O K
8640 min Winter	3.879	0.479	0.0	1.8	1.8	136.5	O K
10080 min Winter	3.829	0.429	0.0	1.7	1.7	122.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	64.753	0.0	101.7	37
60 min Winter	41.383	0.0	147.8	66
120 min Winter	25.649	0.0	182.8	124
180 min Winter	19.154	0.0	204.1	182
240 min Winter	15.496	0.0	219.4	240
360 min Winter	11.496	0.0	241.3	356
480 min Winter	9.289	0.0	255.4	470
600 min Winter	7.867	0.0	264.6	582
720 min Winter	6.866	0.0	271.3	690
960 min Winter	5.535	0.0	280.0	894
1440 min Winter	4.080	0.0	285.4	1112
2160 min Winter	3.003	0.0	391.1	1580
2880 min Winter	2.414	0.0	418.3	2020
4320 min Winter	1.772	0.0	450.8	2896
5760 min Winter	1.422	0.0	495.9	3744
7200 min Winter	1.200	0.0	522.9	4536
8640 min Winter	1.044	0.0	545.9	5280
10080 min Winter	0.929	0.0	565.8	6056

©1982-2020 Innovyze

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Shortest Storm (mins)	15
Ratio R	0.344	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+35

Time Area Diagram

Total Area (ha) 0.433

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.233	4	8	0.200

©1982-2020 Innovyze

Model Details

Storage is Online Cover Level (m) 5.200

Cellular Storage Structure

Invert Level (m) 3.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	300.0	0.0	1.201	0.0	0.0
1.200	300.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SCU-0048-2700-1200-2700
Design Head (m)	1.200
Design Flow (l/s)	2.7
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	48
Invert Level (m)	3.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	2.7
Flush-Flo™	0.069	0.8
Kick-Flo®	0.072	0.8
Mean Flow over Head Range	-	1.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	1.200	2.7	3.000	4.1	7.000	6.2
0.200	1.2	1.400	2.9	3.500	4.4	7.500	6.4
0.300	1.4	1.600	3.1	4.000	4.7	8.000	6.6
0.400	1.6	1.800	3.3	4.500	5.0	8.500	6.8
0.500	1.8	2.000	3.4	5.000	5.3	9.000	7.0
0.600	2.0	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	6.0		

©1982-2020 Innovyze

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 1232 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	3.780	0.380	0.0	1.6	1.6	108.3	O K
30 min Summer	3.909	0.509	0.0	1.8	1.8	145.2	O K
60 min Summer	4.048	0.648	0.0	2.0	2.0	184.6	O K
120 min Summer	4.187	0.787	0.0	2.2	2.2	224.3	O K
180 min Summer	4.261	0.861	0.0	2.3	2.3	245.5	O K
240 min Summer	4.308	0.908	0.0	2.4	2.4	258.7	O K
360 min Summer	4.369	0.969	0.0	2.4	2.4	276.2	O K
480 min Summer	4.404	1.004	0.0	2.5	2.5	286.2	O K
600 min Summer	4.424	1.024	0.0	2.5	2.5	291.9	O K
720 min Summer	4.434	1.034	0.0	2.5	2.5	294.7	O K
960 min Summer	4.438	1.038	0.0	2.5	2.5	296.0	O K
1440 min Summer	4.435	1.035	0.0	2.5	2.5	294.9	O K
2160 min Summer	4.412	1.012	0.0	2.5	2.5	288.3	O K
2880 min Summer	4.378	0.978	0.0	2.5	2.5	278.7	O K
4320 min Summer	4.303	0.903	0.0	2.4	2.4	257.3	O K
5760 min Summer	4.230	0.830	0.0	2.3	2.3	236.6	O K
7200 min Summer	4.167	0.767	0.0	2.2	2.2	218.6	O K
8640 min Summer	4.111	0.711	0.0	2.1	2.1	202.5	O K
10080 min Summer	4.060	0.660	0.0	2.1	2.1	188.1	O K
15 min Winter	3.826	0.426	0.0	1.7	1.7	121.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	134.992	0.0	96.8	23
30 min Summer	90.952	0.0	117.9	37
60 min Summer	58.437	0.0	186.0	66
120 min Summer	36.186	0.0	228.7	126
180 min Summer	26.895	0.0	252.2	186
240 min Summer	21.642	0.0	266.8	244
360 min Summer	15.953	0.0	285.8	364
480 min Summer	12.827	0.0	298.1	482
600 min Summer	10.820	0.0	306.6	602
720 min Summer	9.411	0.0	312.6	720
960 min Summer	7.544	0.0	319.7	862
1440 min Summer	5.513	0.0	321.9	1110
2160 min Summer	4.019	0.0	467.0	1496
2880 min Summer	3.208	0.0	495.1	1908
4320 min Summer	2.330	0.0	512.8	2728
5760 min Summer	1.855	0.0	577.5	3528
7200 min Summer	1.556	0.0	605.4	4328
8640 min Summer	1.348	0.0	629.1	5104
10080 min Summer	1.194	0.0	649.4	5856
15 min Winter	134.992	0.0	104.8	23

©1982-2020 Innovyze

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	3.971	0.571	0.0	1.9	1.9	162.8	O K
60 min Winter	4.127	0.727	0.0	2.1	2.1	207.2	O K
120 min Winter	4.285	0.885	0.0	2.3	2.3	252.2	O K
180 min Winter	4.370	0.970	0.0	2.4	2.4	276.4	O K
240 min Winter	4.423	1.023	0.0	2.5	2.5	291.6	O K
360 min Winter	4.496	1.096	0.0	2.6	2.6	312.3	O K
480 min Winter	4.539	1.139	0.0	2.6	2.6	324.6	O K
600 min Winter	4.565	1.165	0.0	2.7	2.7	332.1	O K
720 min Winter	4.581	1.181	0.0	2.7	2.7	336.5	O K
960 min Winter	4.591	1.191	0.0	2.7	2.7	339.6	O K
1440 min Winter	4.578	1.178	0.0	2.7	2.7	335.8	O K
2160 min Winter	4.545	1.145	0.0	2.6	2.6	326.4	O K
2880 min Winter	4.496	1.096	0.0	2.6	2.6	312.3	O K
4320 min Winter	4.386	0.986	0.0	2.5	2.5	280.9	O K
5760 min Winter	4.280	0.880	0.0	2.3	2.3	250.9	O K
7200 min Winter	4.189	0.789	0.0	2.2	2.2	224.9	O K
8640 min Winter	4.110	0.710	0.0	2.1	2.1	202.2	O K
10080 min Winter	4.040	0.640	0.0	2.0	2.0	182.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	90.952	0.0	126.7	37
60 min Winter	58.437	0.0	207.8	66
120 min Winter	36.186	0.0	253.7	124
180 min Winter	26.895	0.0	276.8	182
240 min Winter	21.642	0.0	290.8	240
360 min Winter	15.953	0.0	310.2	356
480 min Winter	12.827	0.0	322.7	472
600 min Winter	10.820	0.0	331.3	586
720 min Winter	9.411	0.0	337.4	698
960 min Winter	7.544	0.0	344.3	914
1440 min Winter	5.513	0.0	345.7	1156
2160 min Winter	4.019	0.0	522.4	1608
2880 min Winter	3.208	0.0	551.8	2076
4320 min Winter	2.330	0.0	560.3	2944
5760 min Winter	1.855	0.0	646.9	3808
7200 min Winter	1.556	0.0	678.1	4616
8640 min Winter	1.348	0.0	704.6	5440
10080 min Winter	1.194	0.0	727.3	6248

©1982-2020 Innovyze

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	0.344	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.433

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.233	4	8	0.200

©1982-2020 Innovyze

Model Details

Storage is Online Cover Level (m) 5.200

Cellular Storage Structure

Invert Level (m) 3.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	300.0	0.0	1.201	0.0	0.0
1.200	300.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SCU-0048-2700-1200-2700
Design Head (m)	1.200
Design Flow (l/s)	2.7
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	48
Invert Level (m)	3.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	2.7
Flush-Flo™	0.069	0.8
Kick-Flo®	0.072	0.8
Mean Flow over Head Range	-	1.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	1.200	2.7	3.000	4.1	7.000	6.2
0.200	1.2	1.400	2.9	3.500	4.4	7.500	6.4
0.300	1.4	1.600	3.1	4.000	4.7	8.000	6.6
0.400	1.6	1.800	3.3	4.500	5.0	8.500	6.8
0.500	1.8	2.000	3.4	5.000	5.3	9.000	7.0
0.600	2.0	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	6.0		

©1982-2020 Innovyze

HIGHWAY, TRANSPORTATION AND INFRASTRUCTURE CONSULTANTS

Experience and expertise working together