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civil & structural engineers

EAGLE COTTAGES, ROCKLEY, MARLBOROUGH

DRAINAGE STRATEGY

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1. INTRODUCTION

Introduction

1.1. SDS Consulting has been commissioned by the client to provide a drainage strategy to support a planning application for the proposed development. The drainage strategy has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF), the associated Planning Policy Guidelines (PPG) and local policy requirements.

1.2. This drainage strategy is intended to support a full planning application and as such the level of detail included is commensurate and subject to the nature of the proposals.

Objectives & Scope

1.3. The objective of this report is:

- Review the existing site for flood risk and drainage
- Determine the pre and post development conditions for surface water runoff
- Detail a suitable drainage strategy for the management and maintenance of the surface water generated from the proposed development

1.4. The scope of this report is to provide a drainage strategy of sufficient detail to support a planning application for the proposed development works.

Limitations

1.5. The general limitations of this report are that:

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2. SITE CONTEXT

Development Proposals

2.1. The development proposals, in which this drainage strategy is written for, comprise the demolition of the existing terrace of four cottages and replacement with 4 new dwellings at Eagle Cottages, Rockley, Marlborough, Wiltshire, SN8 1RT.

2.2. Refer to Tuttle Architectural Services drawing 1533-Eagale Cottages – 02 entitled 'Proposed Site Plan' in **Appendix A.**

Site Location

2.3. The development is located at Eagle Cottages, Rockley, Marlborough, Wiltshire, SN8 1RT. The site is a brownfield site.

2.4. The development site currently comprises of a terrace of four dwellings and associated gardens, parking and open space. The site is accessed from Free's Avenue to the west of the site. The site is bound by open farmland to the north and east, a wooded area to the south and Free's Avenue to the west. The site is located as per **Figure 1 & 2** below.

Figure 1 : Site Location Plan

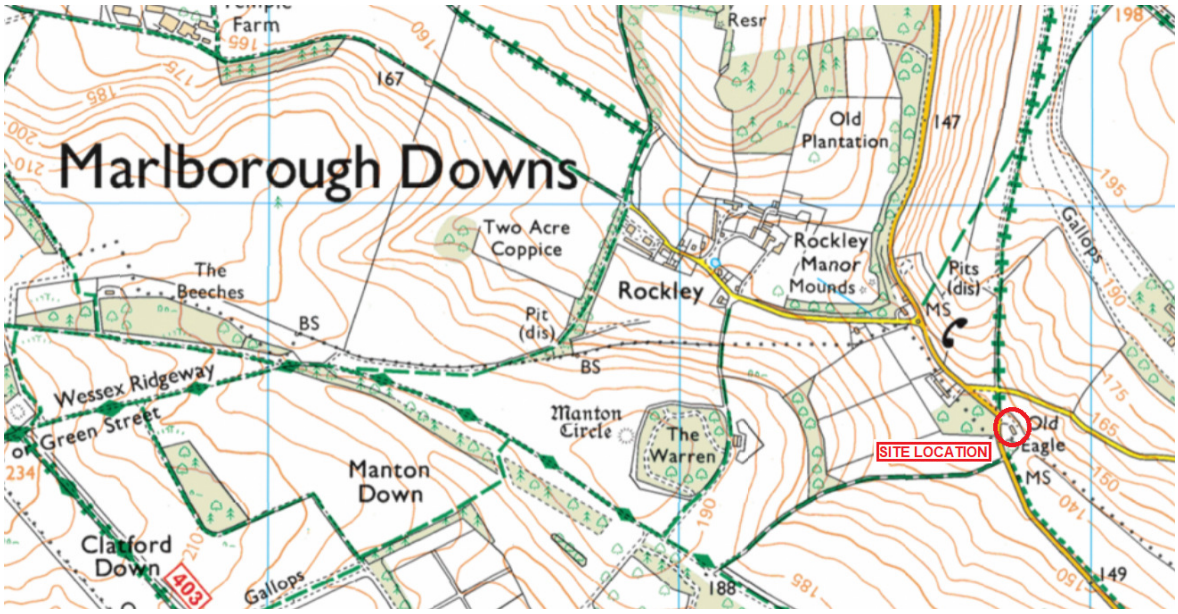


Figure 2: Approximate red line boundary

Topography

2.5. Refer to Tuttle Architectural Services drawing 1191-Existing Topo entitled 'Existing Topo' in **Appendix B** for the topographical extents of the site.

2.6. The site falls in a southerly direction with the highest elevation to the north at 144.90mAOD and the lowest elevation of 140.76mAOD to the south of the site.

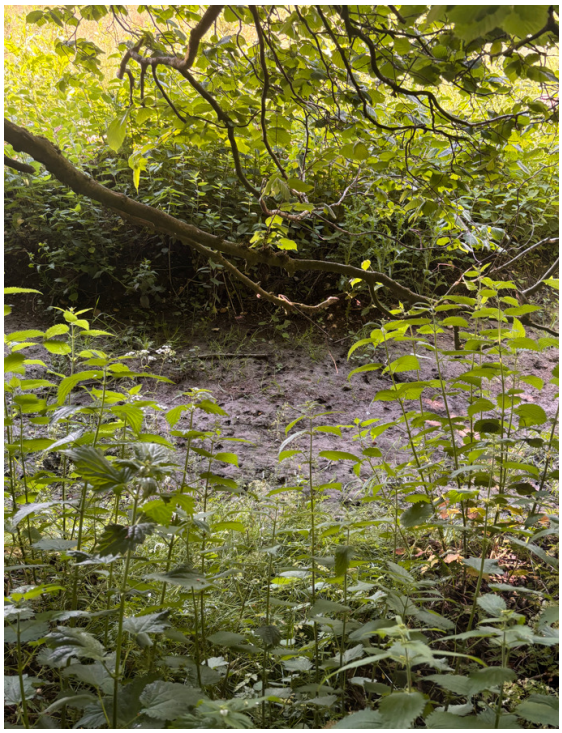
2.7. The topography externally to the site falls in a south easterly direction into a valley as depicted in **Figure 1**.

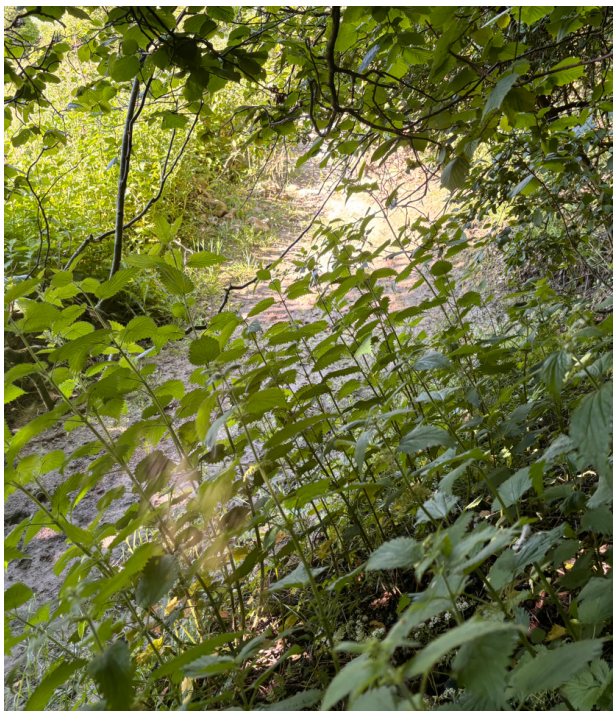
Hydrology

2.8. The site falls within the catchment of the River Og which is located approximately 1.75km to the east of the site.

2.9. There are no watercourses or ditches within the red line boundary. A ditch is located in the wooded area to the south of the site. This ditch flows in a south easterly direction along field boundaries prior to discharge into an open watercourse section which is a tributary to the River Og. Refer to **Figure 3** for images of this ditch – images are taken from the south eastern corner of the site.

Figure 3: Southern boundary ditch photo

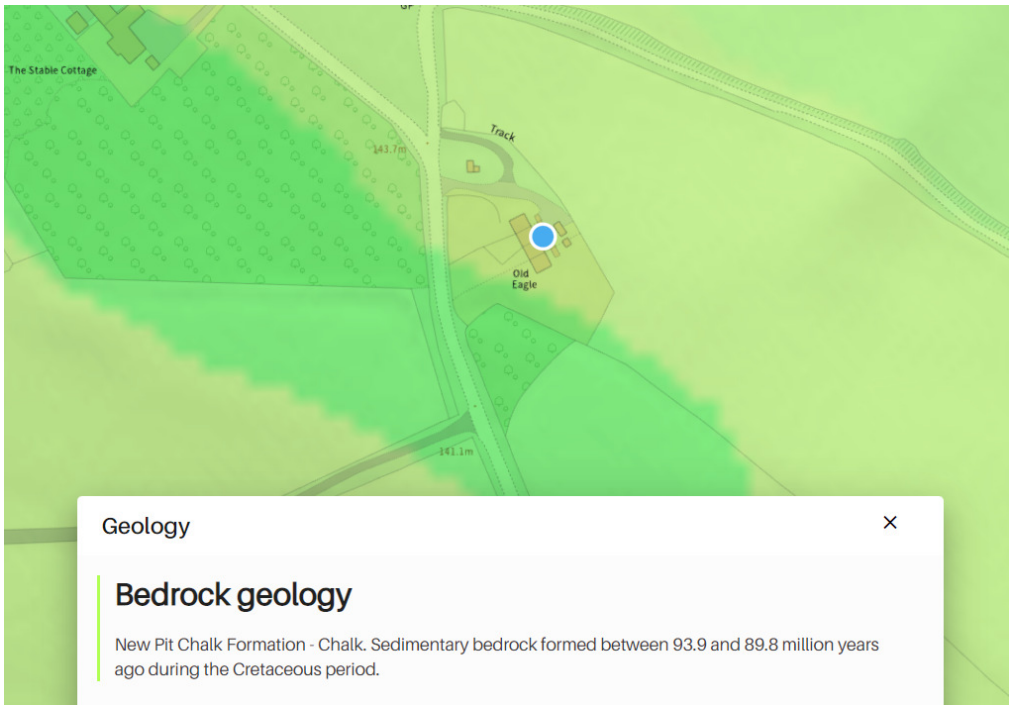




Geology

2.10. The published geological information available through the British Geological Society (BGS) online records indicates that the site is underlain by bedrock of the New Put Chalk Formation. The Holywell Nodular Chalk formation is shown to the south of the site in the wooded area (shown dark green in **Figure 4**). The site is overlain by superficial deposits of Head – Clay, silt, sand and - refer to **Figure 4**

Figure 4: BGS Geological Map



Site Investigation

2.11. Intrusive ground investigations have been undertaken within the site to inform of the infiltrating capacity.

2.12. Three soakaway pits and two trial pits were excavated in the site. Nodular chalk was encountered in SA1 at a depth of 0.6m below ground – the excavation was to a depth of 2.5m and encountered in PT1 at 0.45m below ground – the excavation was to a depth of 0.9m. All other excavations encountered topsoil's over made ground or alluvium deposits

2.13. Refer to **Appendix C** for the ground investigation report.

Infiltration testing

2.14. Infiltration testing was undertaken in SA1 (at a depth of 2.5m and within the chalk) and SA2A (at a depth of 0.9m within the alluvium which is described as slightly silty sandy gravels).

2.15. Both infiltration tests failed due to minimal drain down of waters.

2.16. Additional infiltration testing in PT1 & PT2 to a depth of 1.2 and 1.3m also failed.

2.17. Refer to **Appendix C** for the ground investigation report.

Groundwater

2.18. Groundwater was encountered within SA2 & SA3 at 0.97 and 0.66m depth respectively

Existing Drainage

2.19. The site is remote and in an unsewered area.

2.20. Foul drainage discharge is to a septic tank / cess pit. Surface water drainage discharges to the ground.

3. FLOOD RISK

3.1. Inappropriate development in flood risk areas could pose significant risks in terms of personal safety and damage to the property for the occupiers of the development or for people elsewhere. The approach taken in the assessment of flood risk at the planning stage is set out in national, regional and local planning policy and associated guidance. This section summarises the key policies and guidance relevant to the proposed development.

Policy

National Planning Policy Framework (NPPF)

3.2. The National Planning Policy Framework1 (NPPF) was first published in 2012, with a subsequent revision by the Ministry of Housing, Communities and Local Government amended in July 2018, February 2019 and July 2021 with the most recent update being made in September 2023.

3.3. The NPPF is the primary source of national planning guidance in England, setting out the Government's planning policies for England, and how they are expected to be applied by local councils.

3.4. 'Chapter 14: Meeting the challenge of climate change, flooding and coastal change' outlines the guiding principles for managing flood risk as part of the planning process, notably paragraphs 159-169.

3.5. Notably, the September 2023 key change is that the application of the Sequential Test is to be applied to all sources of flood risk as described in Paragraph 161.

3.6. The Planning Practice Guidance (PPG) is also available online and was last amended in August 2022 (for the Flood Risk and Coastal Change section) – the last amendment does not entail that the PPG is updated for the application of the sequential test specifically. The Planning Practice Guidance sets out the vulnerability to flooding of different land uses. It encourages development to be in areas of lower flood risk where possible and stresses the importance of reducing increases in flood risk off site to the wider catchment.

3.7. The Planning Practice Guidance includes a series of tables that define flood zones, the flood risk vulnerability classification of development, land uses, and 'compatibility' of development within the defined flood zones.

3.8. A Flood Risk Assessment is to be completed in line with the guidance and requirements of the NPPF and Planning Practice Guidance.

3.9. It is necessary to consider the potential consequences of flooding from all sources, which include directly from pluvial flows, rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

Wiltshire Councill Betterment Policy

3.10. The Wiltshire Council 'control of surface water discharges from ne development – Betterment policy update' document sets out Wiltshire Councils LLFA requirements relating to surface water discharge.

3.11. The current policy is written as –

> *With regards the control of surface water discharges from new development, Wiltshire Council requires post development discharges from greenfield sites to provide 20%*

betterment over pre development discharges, and post development discharges from brownfield sites to be as close as is reasonably practicable to greenfield runoff. This takes account of national policy, as outlined in the SuDS Technical Standards1, which requires the following peak flow and volume control:

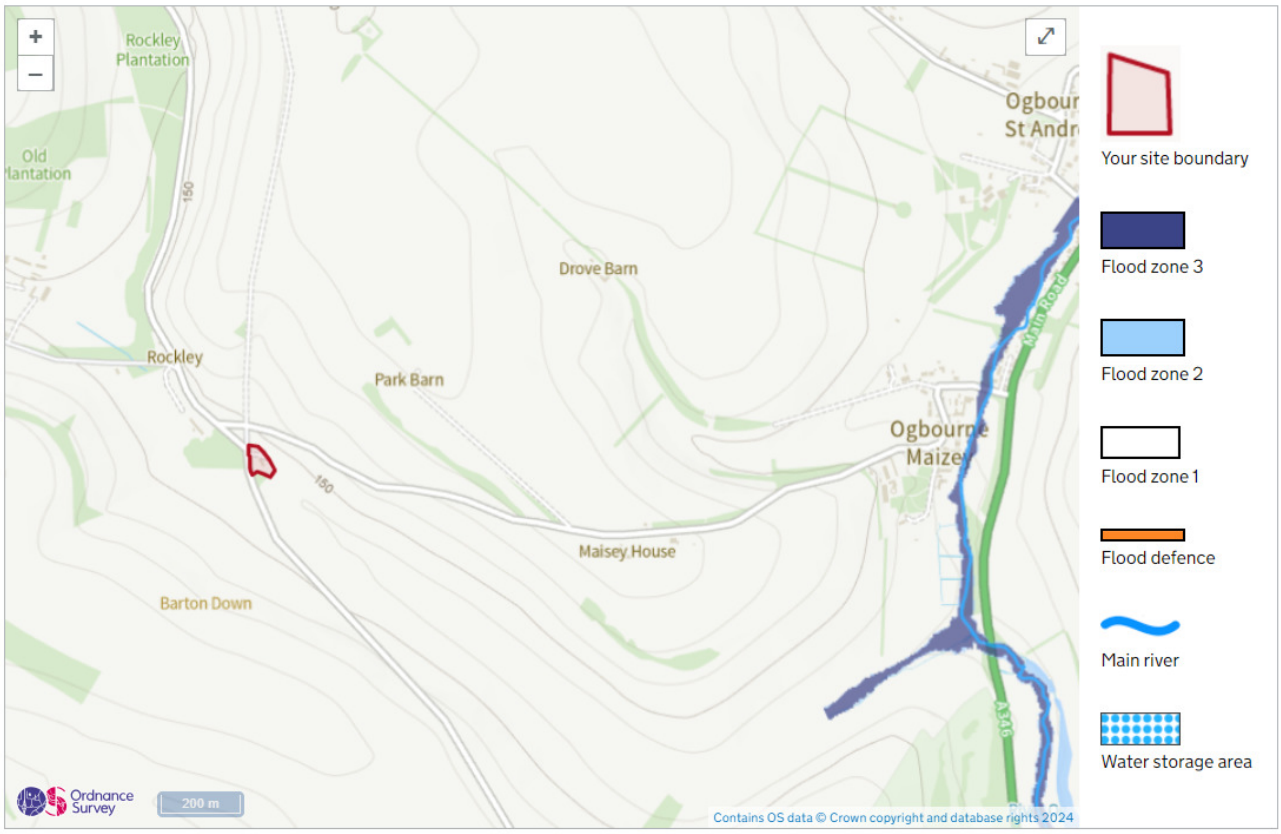
3.12. The development site is a brownfield development.

Sources of Flood Risk

Fluvial Flooding

3.13. **Figure 5** provides an extract of the Flood Risk Map for planning which identifies that the site is located in Flood Zone 1.

Figure 5: Environment Agency's Flood Map for Planning



Pluvial Flooding

3.14. The Environment Agency's Risk of Flooding from Surface Water Map indicates where surface water may be expected to flood or pond. Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

3.15. The RoFSW (Risk of Flooding from Surface Water) mapping identifies the following risk levels:

- **High Risk -** Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year (annual probability of flooding 3.3%)
- **Medium Risk -** Flooding occurring as a result of rainfall of between 1 in 100 (1%) and 1 in 30 (3.3%) chance in any given year

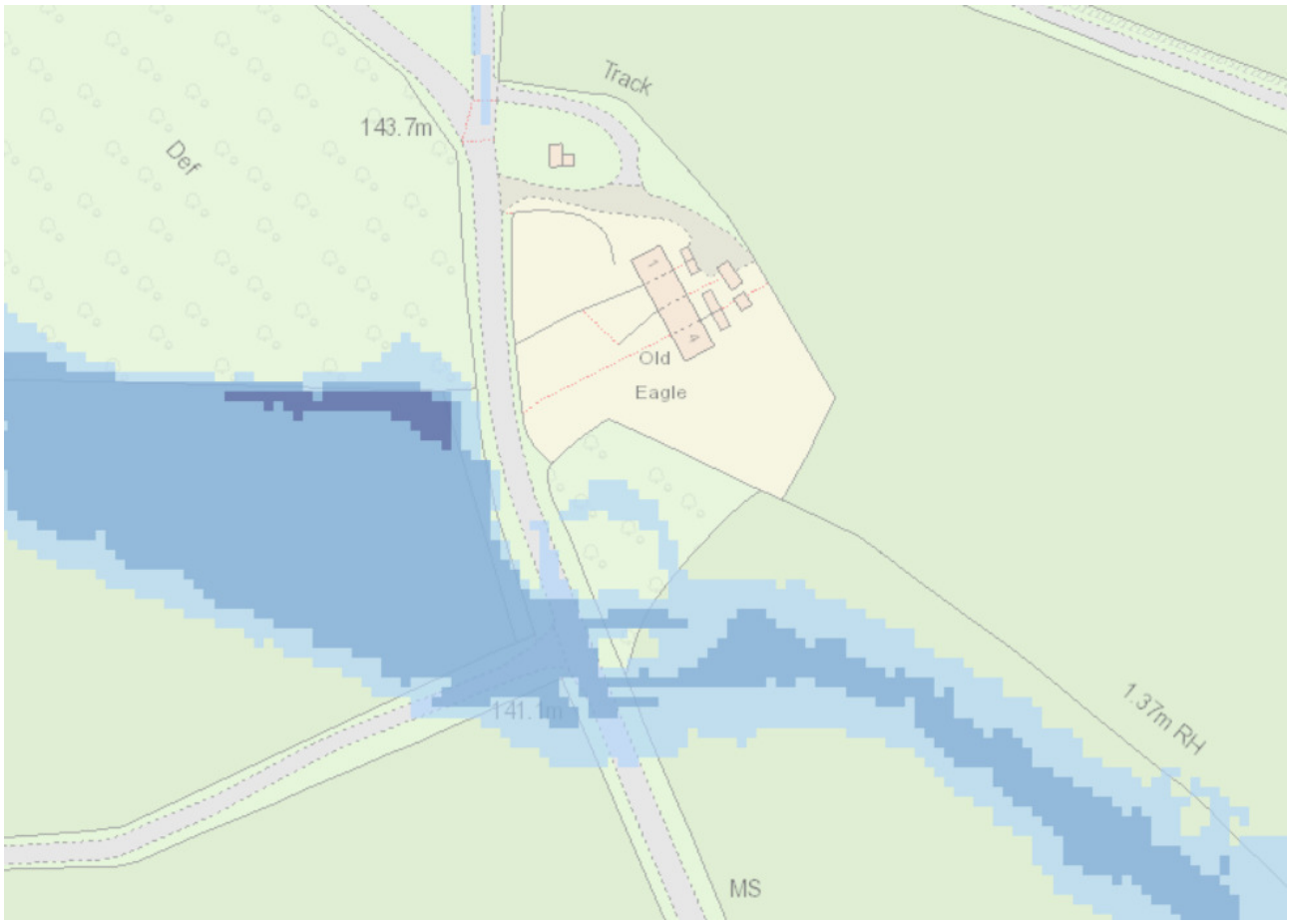
- **Low Risk -** Flooding occurring as a result of rainfall of between 1 in 1000 (0.1%) and 1 in 100 (1%) chance in any given year
- **Very Low Risk -** Flooding occurring as a result of rainfall with less than 1 in 1000 (0.1%) **chance in any given year**

3.16. **Figure 6** shows the extent of surface water flood risk as per the Wiltshire Council SFRA explorer that shows Environment agency data. The site is shown to have no risk of flooding from surface water.

3.17. A surface water flow path, which has regular flooding of the highway, is located to the south of the site. The flow path enters the ditch / watercourse that leads along the bottom of the valley towards the River Og.

3.18. The risk of flooding from surface water is shown to be low

Figure 6: Wiltshire Council SFRA explorer Risk of Flooding from Surface Water Map



Flooding from Groundwater

3.19. There are no records of groundwater flooding in the site or the surrounding area.

3.20. The risk of Flooding from Groundwater map as shown in the Wiltshire Council SFRA data explorer Appendix G, identifies that groundwater levels are anticipated to be 0.5-5m below ground level. Intrusive investigations encountered groundwater seepage at 0.6 and 0.9m depth.

Flooding from Overwhelmed Sewers and Drainage Systems

3.21. There are no records of flooding from sewers of drains

Flooding from Artificial Sources

3.22. The Environment Agency's Risk of Flooding from Reservoirs Map indicates the site is unaffected by flooding from any reservoirs.

Flood Risk Vulnerability

3.23. Annex 3: Flood Risk Vulnerability Classification categorises different types of development according to their vulnerability to flood risk. Table 2: Flood risk vulnerability and flood zone 'compatibility' (Paragraph: 079 Reference ID: 7-079-20220825), maps these vulnerability classes against the flood zones to indicate where development is appropriate and where development should not be permitted.

Figure 7: Extract of Annex 3: Flood Risk Vulnerability Classification

More vulnerable

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

3.24. With reference to Annex 3, the proposed residential development is determined to be more vulnerable.

3.25. With reference to NPPF Table 2, the proposed development is appropriate land use in Flood Zone 1.

Figure 8: Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Table 2: Flood risk vulnerability and flood zone 'incompatibility'

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✔	✔	✔	✔	✔
Zone 2	✔	Exception Test required	✔	✔	✔
Zone 3a †	Exception Test required †	X	Exception Test required	✔	✔
Zone 3b *	Exception Test required *	X	X	X	✔ *

Key:

✔ Exception test is not required

X Development should not be permitted

Sequential Test

3.26. Paragraph 167 of the NPPF states –

> *All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:*
>
> *(a) applying the sequential test and then, if necessary, the exception test as set out below;*
>
> *(b) safeguarding land from development that is required, or likely to be required, for current or future flood management;*
>
> *(c) using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and*
>
> *(d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.*

3.27. Paragraph 168 of the NPPF states -

> *The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.*

3.28. The site is located in Flood Zone 1 and is not at risk of flooding from other sources therefore the sequential test is passed.

4. SURFACE WATER MANAGEMENT

Design Principles

4.1. Key design principles in the following guidance documents steer the approach to managing surface water runoff at sites:

- Building Regulations hierarchy of drainage (H3);
- Interim Code of Practice for SuDS; and
- CIRIA best practice guidance, including the use of the 'SUDS management train'

4.2. Building Regulations hierarchy of drainage outlines the preferred methods for the disposal of surface water with infiltration methods being the preferred option. If this is not possible the next favoured option is to drain to an existing watercourse. If neither of these options are feasible, the regulations state that rainwater discharge should be directed to a sewer.

4.3. The Interim Code of Practice for SUDS provides guidance about the hydraulic design criteria for Sustainable drainage systems. This in general refers to both peak rate of runoff and the volume of runoff, post development. Prior to mitigation measures such as the use of SuDS attenuation features, both the volume and peak rate of runoff may increase post development.

4.4. The design principles for surface water management extend beyond simple hydraulic criteria. CIRIA guidance promotes the use of the SUDS management train, a concept where SUDS techniques are used to treat, convey and store surface water runoff. This approach is considered as part of the SUDS selection methodology.

Sustainable Drainage Systems

4.5. Peak surface water discharge rates to watercourses and sewers should be appropriately managed and where possible reduced. Preference should always be given to SuDS over the traditional methods of buried sewers wherever possible and practical. Sustainable Drainage Systems (SuDS) can address the four key sustainability objectives including: water quantity, water quality, amenity and biodiversity.

4.6. Paragraph 55 of the Flood Risk and Coastal Change Guidance (Reference ID: 7-055-20220825) states – *'Sustainable drainage systems (or SuDS) are designed to control surface water run off close to where it falls, combining a mixture of built and nature-based techniques to mimic natural drainage as closely as possible, and accounting for the predicted impacts of climate change. They provide benefits for water quantity, water quality, biodiversity and amenity. Many types of sustainable drainage systems are possible, contributing to reducing the causes and impacts of flooding.'*

4.7. Promoting SuDS to deal with surface water at the source, will limit the required attenuation and in turn reduce the volume of surface water in the nearby watercourse and sewer infrastructure. There may be the potential to utilise SuDS features for conveyance/attenuation of surface water flows within the proposed drainage strategy, opposed to the traditional below ground storage methods. Detailed design should confirm whether this site would be suitable for incorporation of SuDS following more detailed analysis of levels, ground conditions and attenuation requirements.

Climate Change

4.8. The NPPF requires development to take account of the impacts of climate change. The allowances to be made for climate change effects when assessing flood risk are related to the lifetime of the development.

4.9. The peak rainfall intensity allowances to be used when designing urban drainage systems have been obtained from the environment agencies web based resource tool 'Climate change allowances for peak rainfall' by searching the development management catchment for the surrounding area

4.10. The site is located in the Kennet and tributaries Management Catchment, the catchment allowances have reproduced in **Table A.** Both the central and upper end allowances need to be assessed to understand the range of impact. The total potential change anticipated for 2070, for the 1% annual exceedance rainfall event, is 25% for the central category, and 40% for the upper end category.

Table A: Peak rainfall intensity allowance

	3.3% Annual exceedance		1% Annual exceedance	
Kennet and Tributaries Management Catchment peak rainfall allowances	'2050s' (up to 2060)	'2070s' (2061 to 2125)	'2050s' (up to 2060)	'2070s' (2061 to 2125)
Central	20%	25%	20%	25%
Upper End	35%	35%	40%	40%

Surface Water Flow Balancing

Catchment Areas

4.11. The site is a greenfield parcel of land. The existing and proposed impermeable areas within the developable site boundary are described in **Table B** below–

Table B: Catchment Areas (m^2)

Catchment	Existing	Proposed
Impermeable (100% - roof /patio / concrete areas)	470	670
Impermeable (60% - gravel areas)	528	450
Permeable	2707	2585
Total	3705	3705

4.12. The redevelopment of the site increases impermeable areas.

Greenfield Runoff Rate

4.13. Greenfield runoff rates have been determined using XP Solutions' Micro Drainage software system based on the method set out in IH Report 124, and with catchment descriptors obtained from the Flood Estimation Handbook (FEH), published by the Institute of Hydrology. FSSR 2 and 14 regional growth curve factors have been used to calculate the greenfield peak flow rates for 1, 30 and 100 year return periods.

4.14. Copies of the Micro Drainage greenfield runoff calculations for the site are included in **Appendix D**. A summary of the greenfield runoff rates for the various return period events is shown in **Table C**. The mean annual peak rate of runoff, referred to as Q_{BAR} in IH Report 124, is 0.2l/s for the site area of 0.3705ha and or a soil SPR for 0.15 which represents the chalk designation of the locality. Ground investigations show an impermeable soil overlying the chalks therefore a higher SPR of has been reviewed and the mean annual peak rate of runoff, referred to as Q_{BAR} in IH Report 124, is 0.8l/s for the site area of 0.3705ha and for a soil SPR of 0.30

Table C: Greenfield Runoff Rates

Return Period (Years)	1	Q_{bar}	30	100
Greenfield Runoff Rates (l/s) 0.15 SPR	0.1	0.2	0.4	0.6
Greenfield Runoff Rates (l/s) 0.3 SPR	0.6	0.8	1.7	2.4

Pre development Peak Runoff Rate

4.15. The Modified Rational Method has been used to determine the runoff from the impermeable areas of the existing site (refer to **Table D**)–

Q=2.78CiA

Where

Q= flow (l/s)

I = rainfall intensity (mm/hr)

A = Impermeable Area (ha)

C = runoff coefficient

Table D: Pre development site Modified Rational Method permeable runoff

Return Period	Roof & concrete areas				Gravel Areas				Total flow (l/s)
	C	I	A	Flow (l/s)	C	I	A	Flow (l/s)	
1:1 year	0.95	28.809	0.047	3.576	0.6	28.809	0.0528	2.537	**6.113**
1:30 year	0.95	70.68	0.047	8.773	0.6	70.68	0.0528	6.225	**14.998**
1:100 year	0.95	91.443	0.047	11.351	0.6	91.443	0.0528	8.053	**19.404**

Post development unattenuated Peak Runoff Rate

4.16. The Modified Rational Method has been used to determine the runoff from the impermeable areas of the proposed site (refer to **Table E**)–

Table E: Post development site Modified Rational Method permeable runoff

Return Period	Roof & concrete areas				Gravel Areas				Total flow (l/s)
	C	I	A	Flow (l/s)	C	I	A	Flow (l/s)	
1:1 year	0.95	28.809	0.067	5.098	0.6	28.809	0.045	2.162	**7.260**
1:30 year +10%cc	0.95	77.748	0.067	13.757	0.6	77.748	0.045	5.836	**19.593**
1:100 year + 45%cc	0.95	132.593	0.067	23.462	0.6	132.593	0.045	9.952	**33.414**

4.17. If the site were to discharge at unattenuated rates, the post development site increase flows due to the allowance of climate change and changes in impermeable areas.

Outfall Location

4.18. In terms of what sort of sustainable drainage system should be considered, paragraph 80 in Section 21 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-080-20150323) advises that, generally, the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable (also stated within The SuDS Manual (CIRIA C753) paragraph 3.2.3):

- into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

By Infiltration

4.19. Infiltration testing, as shown in **Appendix C,** identifies that there is insufficient capacity to support infiltration SuDS and that groundwater levels are high.

To a surface water body

4.20. It is proposed that the site is to discharge surface water flows to the south eastern corner of the site and into the ditch network that runs along the field boundary in a north easterly direction towards the River Og.

4.21. The position and depth of the ditch is to be confirmed

Discharge rate

4.22. The site is a brownfield site, in accordance with Wiltshire Council betterment policy, the sites discharge rate should be as close as reasonably practical to greenfield runoff.

4.23. Greenfield runoff rates are low due to the soil classifications and are unachievable with mechanical flow devices noting that outfall location.

4.24. It is proposed that the discharge from the site is set at 1l/s for all storm events. This provides a betterment of 84%, 93% and 95% for the 1, 30 and 100 year return periods respectively.

Surface Water Drainage Strategy

4.25. The surface water drainage arising from the site is to be collected and conveyed to a variety of SuDS measures proposed for implementation within the site. Private parking areas are to be served by permeable paving with the gravel access drive being served by a filter carrier drain. All flows are then conveyed to the south east of the site where an offline attenuation pond is proposed prior to discharge to the local ditch network.

4.26. The location of the ditch and depth of the ditch is to be determined such that the outfall location is appropriate to the development proposals.

4.27. Refer to drawing 6669-C-SK01 included in **Appendix E** for the proposed drainage layout to serve the site.

4.28. The hydraulic assessment provides various scenarios up to and included the critical 1 in 100 Year storm event with additional 40% allowance for climate change. The simulations confirm that the storm can be managed and maintained within the site without flooding. The hydraulic models of the proposed surface water network and SuDS devices can be found in **Appendix F**.

Water Quality

4.29. In terms of water quality, the proposed surface water system offers a suitable level of mitigation in accordance with Environment Agency, DEFRA and CIRIA guidance.

4.30. The CIRIA SuDS Manual C753, 2015 details an approach for establishing the hazard posed by the intended land use activities and the extent to which the proposed SuDS components can reduce and mitigate the contamination risk to the receiving waterbody. Referring to Table 26.2 – 'Pollution hazard indices for different land use classifications' (CIRIA C753, 2015) the proposed development and land use results in a low pollution hazard, therefore a 'simple index' method can be used to make a qualitative assessment of the proposed SuDS management.

4.31. To ensure that there is adequate treatment, all SuDS components utilised should have a pollution mitigation index that equals or exceeds the pollution hazard index. In reference to Table 26.2, the pollution hazard index for the roof areas and driveway is -

TSS = 0.7,

Metals = 0.6,

Hydrocarbons = 0.45.

Figure 9: CIRIA C753, 2015. Table 26.2 – 'Pollution hazard indices for different land use classifications'

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Notes

1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

4.32. In reference to Table 26.3 – 'Indicative SuDS mitigation indices for discharges to surface waters' (CIRIA C753, 2015) the inclusion a pond provides a total mitigation of:

TSS = 1.4

Metals = 1.3

Hydrocarbons = 1.2

Figure 10: CIRIA C753, 2015. Table 26.3 – 'Indicative SuDS mitigation indices for discharges to surface waters'

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Notes

1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.

2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.

3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.

4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.

5 See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: **http://tinyurl.com/qf7yuj7**

6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

4.33. The inclusion of permeable paving and a pond is sufficient to provide suitable water quality mitigation.

5. SuDS MANAGEMENT & MAINTENANCE PLAN

Management & Maintenance

5.1. Maintenance refers to the inspections required to identify performance issues and plan maintenance as required, operation and maintenance of the drainage system, landscape management and waste management associated with contaminated silt and other waste materials resulting from maintenance.

5.2. CIRIA C753 The SuDS Manual provides information in Chapter 32 for the operation and maintenance of SuDS. The maintenance activities are broadly defined as regular, occasional and remedial maintenance. It is noted that some scenarios may require one-off maintenance activities. The SuDS Manual defines maintenance as –

- Regular Maintenance: consists of basic tasks carried out to a frequent and predictable schedule, including inspections/monitoring, silt or oil removal if required more frequently than once a year, vegetation management, sweeping or surfaces and litter / debris removal.
- Occasional maintenance: comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the regular tasks.
- Remedial maintenance: describes the intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised with good design, constructions and regular maintenance activities.

5.3. Maintenance regimes are to be reviewed on an annual basis to ensure that the approach adopted is meeting its objectives.

5.4. All those responsible for the maintenance operations should adhere to the relevant health and safety legislation for the activities listed within this report (including lone working, if relevant). Method statements and risk assessments should always be completed prior to the undertaking of any works.

Indicative Maintenance & Management Plan

Gravity Drains & Catchpits

5.5. Maintenance will usually be carried out manually, although a suction tanker can be used for sediment/debris removal. If maintenance is not undertaken for longs periods, deposits can become hard-packed and require more effort to remove.

Permeable Surfaces

5.6. Permeable surfaces including permeable block paving, porous asphalt, gravel or free draining soils that allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc. Permeable block paving and porous asphalt can be cleaned by suction brushing.

5.7. Regular inspection and maintenance is important for the effective operation of permeable pavements, they should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

5.8. Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. In instances where jointing material is lost, this material this should be replaced immediately.

5.9. Depending on the amount of usage and the environment that the permeable pavement has been exposed to, the laying course material may require either replacement or cleaning after a 25 to 30 year period. This would be evident if the infiltration rate of the paving became prolonged, allowing ponding to develop. If this situation should occur, the uplifting and cleaning (or replacing, depending on the costings of the activity) of the laying course may be considered. The laying course material, jointing and blocks may be reused (once cleaned), to aid in minimising costs.

5.10. Inspection and maintenance of the permeable surfaces will be dependent upon the manufacturer's recommendations and installation as per manufacturers details.

5.11. Table 20.15 of the CIRIA SuDS, reproduced in **Figure 11** below, provide the operation and management requirements of permeable paving.

Figure 11: CIRIA C753, 2015. Table 20.15

TABLE 20.15 Operation and maintenance requirements for pervious 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 glyphospate 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 50 mm of the level of the paving	As required
	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 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Pond

5.12. Ponds are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff.

5.13. They can support emergent and submerged aquatic vegetation along their shoreline which helps to enhance treatment processes and has amenity and biodiversity benefits.

5.14. Access to the pond would by via the adjacent parking and road area therefore no additional provision for access is required.

5.15. Refer to **Figure 12** for the Operation and Maintenance requirements as stated within CIRIA C753

Figure 12: CIRIA C753, 2015. Table 23.1 – 'Operation and maintenance requirements for ponds and wetlands

TABLE 23.1 Operation and maintenance requirements for ponds and wetlands

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices eg penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay.	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows.	As required

Flow Control Chambers

5.16. The flow control chamber proposed for this site is a Hydro Brake which has no moving parts and are self-activating requiring minimal maintenance. The bypass disc is the only manually operated element and is applicable for use in the event of a blockage or issue with the drainage network. It is recommended that the chamber is inspected monthly for three months after installation and bi-annually thereafter to verify the condition and operation of the unit and check for blockages within the chamber or flow control device.

5.17. Any silt or debris found during inspections should be removed and cleaned out with the use of a sump vacuum cleaner.

5.18. The table below gives a summary of the operation and maintenance requirements for flow control devices –

CONTROL CHAMBERS	
Regular Maintenance	**Frequency**
Check there is no physical damage and that control is functioning. Ensure bypass arrangements are functional. Remove Debris and silt. Undertake inspection after autumnal leaf fall to ensure functionality of control and that there are no blockages	Monthly
Remedial Works	**Frequency**
Repair physical damage if required / replace unit is damaged	As required
Monitoring	**Frequency**
Inspect chamber and flow control units to ensure that they are in good condition and operating as designed.	Annually and after large storms

Blockages & Spillages

Blockage

5.19. In the event of a blockage within the drainage network, the key risk is that of flooding to the surrounding area. The extent and location of flooding is dependent upon the location of the blockage and the associated storm event.

5.20. In the event of a blockage within the network, the network is to be drained down by use of suction equipment and the blockage removed.

5.21. If a blockage does occur and results in flooding, the exceedance flow routes are anticipated to flow in a westerly direction.

Spillages

5.22. Due to the nature of the development, the likelihood of a spillage is minimal.

5.23. Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency with residual spillage allowed to bio-remediate in the drainage system.

5.24. In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung. Contact the Environment Agency immediately.

Adoption

5.25. The drainage and SuDS within the site are to be private and the responsibility of the plot owners.

6. FOUL DRAINAGE

Existing drainage

6.1. The site is located in a remote area and not served by mains sewers. The existing plots on site have foul drainage discharge to a septic tank / cess pit

Foul Drainage Strategy

Additional foul flow & population equivalents

6.2. The development comprises 4 new two bedroom dwellings. In accordance with British Flows and Loads each 2 bedroom dwelling has a population equivalent of 5P therefore the total population equivalent is 20P but adjusted by a factor of 0.9 thus a design population equivalent of 18P

Foul treatment

6.3. A sewage treatment plant is proposed for the collection and treatment of foul flows. Sewage treatment plants introduce bacteria to the cleaning process to break down waste into a cleaner effluent before it is discharged.

6.4. The population equivalent, in accordance with the British Flows and Loads, is 18P. A Klargester BioDisc BC, Klargester BioAir 6 or similar approved will be required for installation – alternative manufacturers are to provide a sewage treatment plant that is sufficient for the population equivalent.

Effluent Discharge location

6.5. Effluent discharge is proposed to the local ditch network noting that the ground investigations identify insufficient infiltration capacity within the site.

Foul Drainage Layout

6.6. Refer to drawing 6669-C-SK01 entitled 'Drainage Strategy' in **Appendix E** for the proposed foul drainage arrangements to support the site.

General Binding Rules

6.7. The general binding rules for effluent discharge via the use of a sewage treatment plant is effective where the site lies in an unsewered area (number of properties (1) x 30m = 30m maximum distance from public sewer). The site currently falls under this requirement due to the remote nature of the site in respects to local infrastructure.

6.8. The use of a sewage treatment plant would be in general accordance with the general binding rules. The general binding rules is a term given to legally binding requirements in regulations that set the minimum standards or conditions which apply. In this case the conditions are set in the Environmental Permitting (England and Wales) (Amendment) (England) Regulations 2014.

6.9. The general binding rules consist of the conditions together with technical requirements specified by the Environment Agency in guidance to operators, compliance with which is part of the conditions. These apply to anyone who has a septic tank or sewage treatment plant that makes a small sewage discharge from January 2015.

6.10. The general binding rules set out the conditions that septic tanks and sewage treatment plants need to meet in order to be used without an environmental permit. These rules are as set out below –

General Binding rules: Small sewage discharge to a surface water	
Rule	**Site Compliance**
Only discharge 5 cubic metres or less a day in volume (rule 2)	The dwelling produces 2.25m³ daily discharge - Calculated by the EA daily Discharge Calculator
Only discharge domestic sewage (rule 3)	Sewage is from domestic applications only
Do not cause pollution of surface water or groundwater (rule 4)	Flows are treated by the sewage treatment plant to current policy requirements / standards
Use the correct treatment system (rule 6)	Sewage treatment plant specified is appropriate for use and application
Tidal areas (rule 8)	N/A
Make sure your treatment system meets the right British Standard (rule9)	Specified sewage treatment plant is in accordance with BS EN 12566
Make sure your treatment system is installed and operated correctly and has enough capacity (rule 10)	Sewage Treatment plant is specified for the population equivalent and is to be installed to manufacturers recommendations
Get your treatment system regularly maintained (rule 11)	As required in the manufacturers proposed operation and maintenance
Get your treatment system regularly emptied (rule 12)	As required in the manufacturers proposed operation and maintenance
You sell your property: tell the new owner about the sewage treatment system (rule 13)	Noted
You stop using your treatment system: make sure its decommissioned properly (rule 14)	Noted
Check if you can connect to a nearby public foul sewer (rule 15)	Site is remote with no foul sewers within 120
Make sure the discharge point is not in or near protected site (rule 17)	The development site is not located near and SSSI, SAC, SPA or RAMSAR site
Make sure the surface water has flow (rule 19)	To be confirmed
Make sure any partial drainage field is close enough to the watercourse (rule 20)	N/A
Do not discharge to a lake or pond (rule 21)	N/A
Make sure your new discharge does not use the same discharge point as any other discharge if the combined volume would exceed the general binding rule limit (rule 22)	N/A

Make sure your new discharge is not within 50 metres of any other exempt small sewage discharge (rule 23)	N/A existing system to be decommissioned

6.11. It is assessed that the foul drainage proposals are in accordance with the general binding rules and specific environmental permits are not required.

Operation and Maintenance

6.12. The following text provides a broad overview of the operation and maintenance requirements for a sewage treatment plant. Manufacturer specific information will need to be reviewed.

Maintenance - owner responsibility

6.13. The owner of the sewage treatment plant is entirely responsible for the operation of the plant and for ensuring that the quality of the effluent does not breach the Environmental Permit Standards issued by the Environment Agency.

6.14. Treatment Systems only require minimal. Most of the maintenance recommendations are based upon a visual inspection.

6.15. Manholes, drains and the emptying of treatment plants remain the responsibility of the treatment plant owner. If the plant appears not to be operating correctly, refer to the manufacturers supplied details.

7. CONCLUSIONS

7.1. This Drainage Strategy has been undertaken in respects to the demolition of the existing terrace of four cottages and replacement with 4 new dwellings at Eagle Cottages, Rockley, Marlborough, Wiltshire, SN8 1RT.

7.2. The key conclusions are:

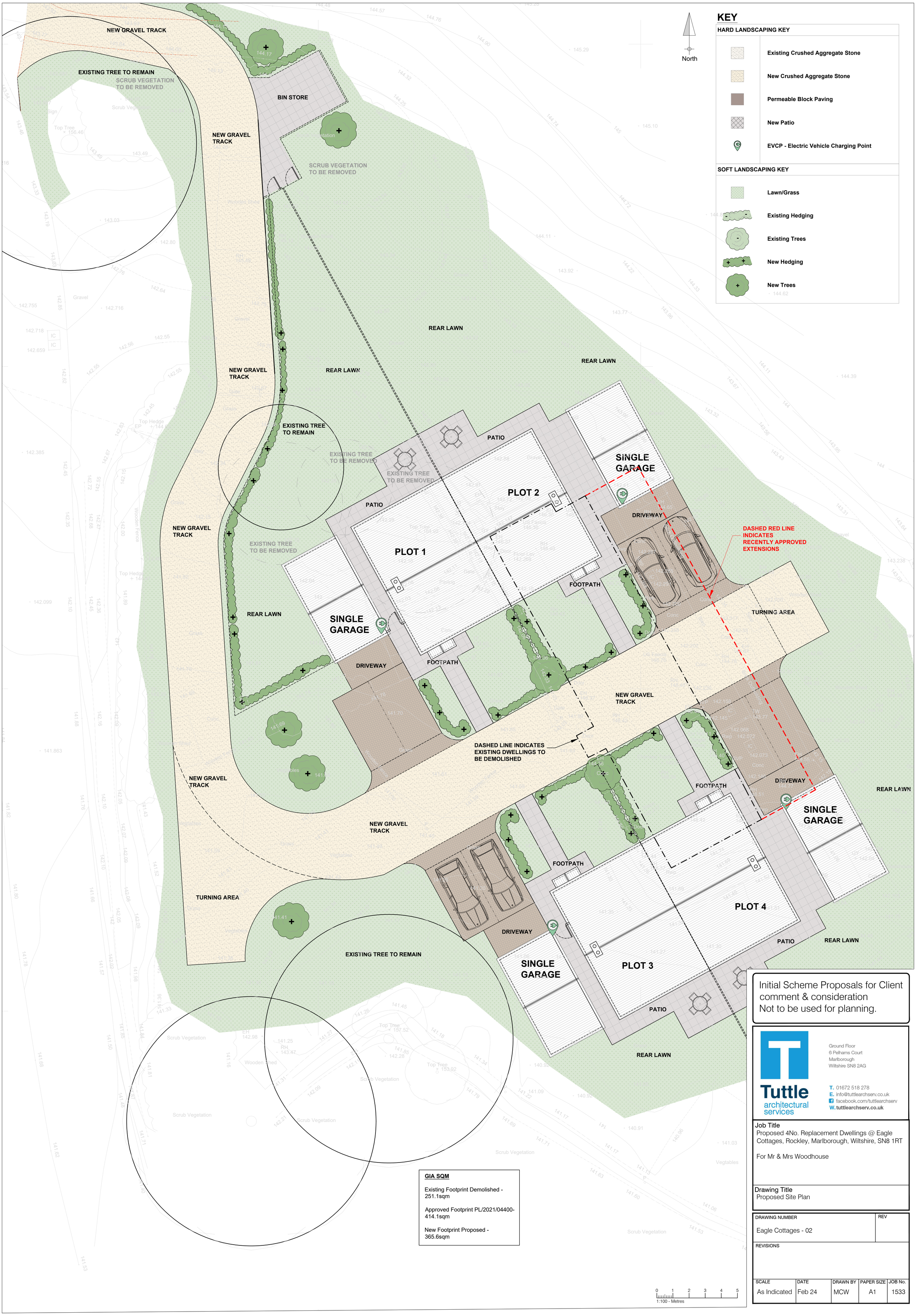
- The site is located in Flood Zone 1
- The site is not at risk of surface water flooding
- Other sources of flood risk do not present any risk to the site
- The developments flood risk classification and flood risk vulnerability is appropriate for the form of development and its location
- The development is sequentially located where considering all sources of flood risk.
- Infiltration is shown to not be applicable within the site
- Discharge is proposed to the local ditch network. Flows are to be limited to 1l/s for all storm events
- SuDS in the form of a filter carrier drain, permeable paving and a pond are to be implemented.

7.3. SuDS are incorporated within the site for the conveyance, attenuation and treatment of surface water flows.

7.4. The overall conclusions drawn from this report is that the development would be appropriately safe for its lifetime taking account of the flood risk vulnerability of its users and the development would not increase flood risk elsewhere through the implementation of an effectivity drainage strategy.

APPENDICES

APPENDIX A



KEY

HARD LANDSCAPING KEY

- Existing Crushed Aggregate Stone
- New Crushed Aggregate Stone
- Permeable Block Paving
- New Patio
- EVCP - Electric Vehicle Charging Point

SOFT LANDSCAPING KEY

- Lawn/Grass
- Existing Hedging
- Existing Trees
- New Hedging
- New Trees

GIA SQM

Existing Footprint Demolished - 251.1sqm

Approved Footprint PL/2021/04400- 414.1sqm

New Footprint Proposed - 365.6sqm

Initial Scheme Proposals for Client comment & consideration
Not to be used for planning.

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Job Title
Proposed 4No. Replacement Dwellings @ Eagle Cottages, Rockley, Marlborough, Wiltshire, SN8 1RT

For Mr & Mrs Woodhouse

Drawing Title
Proposed Site Plan

DRAWING NUMBER	REV
Eagle Cottages - 02	

REVISIONS

SCALE	DATE	DRAWN BY	PAPER SIZE	JOB No.
As Indicated	Feb 24	MCW	A1	1533

APPENDIX B

Existing Site Plan
Scale 1:200

North

1:200 [m]
0 5 10

Drawing For Planning Purposes Only
Not to be Used for Construction.

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Job Title
Proposed Extensions and Alterations @ 1-4 Eagle Cottages, Rockley, Marlborough, Wiltshire SN8 1RT

Barbury Castle Estates LLP

Drawing Title
Existing Topo

DRAWING NUMBER				REV
Existing Topo				
REVISIONS				
SCALE	DATE	DRAWN BY	PAPER SIZE	JOB No.
As Indicated	Apr 2021	CS/MCW	A1	1191

APPENDIX C

1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT

GROUND INVESTIGATION – BRE365 INFILTRATION TESTING & BS6297 PERCOLATION TESTING

Barbury Castle Estate

March 2024

P24-093inf

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ISSUE	DATE	Written by:	Comment
1	28/03/2024	Joanna Bacon BSc FGS	-
		Reviewed and approved by	
		Matt Paddock MSc FGS	
For and on behalf of Paddock Geo Engineering Limited			

CONTENTS **Ground Investigation – Infiltration Testing**

APPENDICES

A **Trial Pit Location Plan**
B **Trial Pit Logs**
C **Laboratory Analysis Results – Not used**
D **Infiltration Testing Results**
E **Site Photographs**

GROUND INVESTIGATION – BRE365 INFILTRATION TESTING & BS6297 PERCOLATION TESTING

1-4 EAGLE COTTAGES, ROCKLEY, MARLBOROUGH, SN8 1RT

Further to instructions received from Barbury Castle Estate; the Client, infiltration testing, and percolation testing have been carried out to the BRE365 methodology and BS6297 methodology, in relation to assessing the infiltration properties of the underlying ground.

Objectives

This assessment has been carried out to a scope of works as detailed by the client, prior to commencement. The assessment has been designed to assess the infiltration properties of the near surface strata and determine feasibility of soakaways and infiltration rates for SUDs and treated foul water outfall design if applicable.

Scope of Works

The planned works comprised the forming of 2no. machine excavated trial pits with infiltration testing undertaken within the pits to the BRE365 methodology.

Additionally, two further trial pits were undertaken to carry out percolation testing to the methodology detailed within BS6297: 2007+A1:2008 (Code of practice for the design and installation of drainage fields for use in wastewater treatment) for the disposal of treated wastewater outfall.

Terms of Reference

The assessment has been carried out generally in accordance with the following guidance.

- Code of Practice for Site Investigations, British Standards Institution BS5930: 2015
- BRE Digest 365 – Soakaway Design 2016
- Code of Practice for the design and installation of drainage fields for use in wastewater treatment, BS6297:2007

Sitework

The site work was carried out on the 27th March 2024 and comprised the forming of 5no. machine excavated trial pits to depths of 2.5m (SA1), 1.0m (SA2, SA3 and PT2), 0.6m (SA2A) and 0.9m (PT1) bgl to undertake infiltration testing to the BRE365 methodology. Within two of the machine excavated pits (PT1 and PT2) a smaller hand pit was dug at the base to form 0.3m cubed trial pits where percolation testing was undertaken to the BS3297 methodology. It should be noted that trial pits SA2 and SA3 were terminated due to encountering groundwater.

The trial pit SA2a was formed to test the unsaturated soils due to groundwater being encountered at shallow depth within the adjacent SA2.

The trial pits were formed in locations as indicated by the Client's Engineer and moved locally to areas clear of obstruction and any buried services following a Cable Avoidance Tool (CAT) and Signal Generator survey. The testing locations are indicated on the enclosed Exploratory Location Plan presented in Appendix A.

The trial pit arisings were logged by a Geotechnical Engineer generally in accordance with BS5930:2015. No samples were recovered from the trial pits.

The trial pit was reinstated upon completion of testing with compacted arisings.

Encountered Strata

A log of the trial pit and borehole positions and an exploratory Location Plan showing the positions investigated are presented in Appendix B and A respectively.

The strata encountered within the Trial Pits is summarised in the table below. These details are also included on the Trial Pit Logs presented in Appendix B.

Encountered Strata

Encountered Strata – Trial Pit Strata	Exploratory Hole and Basal Depth (m begl)					
	SA1	SA2	SA2A	SA3	PT1	PT2
TOPSOIL Grass over dark brown slightly organic gravelly SAND. Sand is fine, gravel consists of coarse subrounded to subangular flint.	0.60	0.35	0.35	-	0.15	-
TOPSOIL Grass over dark brown slightly organic slightly sandy slightly gravelly CLAY. Sand is fine to coarse gravel consists medium to coarse rounded chalk with occasional rootlets.	-	-	-	0.60	-	-
TOPSOIL Grass over dark brown slightly organic slightly sandy slightly gravelly CLAY. Gravel consists of medium to coarse flint and brick.	-	-	-	-	-	0.75
MADE GROUND Red brown and dark brown very sandy very gravelly CLAY with rare red brick cobbles. Sand is fine to coarse, gravel consists of rounded medium to coarse flint and brick.	-	-	-	-	0.30	-
ALLUVIUM Off white yellow brown slightly silty sandy GRAVEL. Sand is fine, gravel consists of coarse, subangular to subrounded chalk.	-	1.00	0.60	1.00	-	-
HEAD Off white slightly silty CLAY.	-	-	-	-	-	1.00
HOLLYWELL NODULAR CHALK FORMATION Structureless Chalk composed of sandy gravelly SILT. Clasts are extremely weak low density white. Matrix is off white sandy SILT.	2.50	-	-	-	0.90	
Total Depth (m bgl)	**2.50**	**1.00**	**0.60**	**1.00**	**0.90**	**1.00**

Groundwater Details

Ground water was encountered within SA2 and SA3 as a moderate inflow with a steady level after 1 hour of between 0.97m and 0.66m respectively.

It should be noted that groundwater levels may vary seasonally and with other factors. The reviewer should satisfy themselves with the groundwater levels at the time of any construction works.

Laboratory Analysis

Samples were not recovered from the arisings and laboratory analysis was not carried out.

Surface Water Soakaways

Infiltration testing was carried out within 2no. of the machine excavated trial pits to BRE365 methodology to allow an estimated infiltration factor for the site.

The trial pits were formed to depths of between 2.5m and 0.6m and filled with c. 0.30m – 0.50m of water at the base.

The testing was terminated part way through the first cycle within all the trial pits due to very slow infiltration rate and minimal water level movement over a period comprised of c.2 hours.

The results are presented in Appendix E and are summarised in the table below.

Infiltration Factors

Trial Pit	Soil Tested	Test Depth mbgl	Infiltration Factor (ms^{-1})		
			Cycle 1	Cycle 2	Cycle 3
SA1	HNCF	2.00 - 2.50	Test failed $<10^{-7}$	-	-
SA2A	Head	0.30 - 0.60	Test failed $<10^{-7}$	-	-

Note
HNCF Hollywell Nodular Chalk Formation

Percolation Testing for Discharge of Wastewater to Land

Testing locations PT1 and PT2 were machine excavated to depths of 0.90m and 1.00m. Within these machine excavated trial pits a smaller pit was hand dug with the dimensions of 0.30m x 0.30m, creating total depths at PT1 of 1.20m and PT2 at 1.30m for the purpose of undertaking percolation tests to the methodology detailed within BS6297: 2007+A1:2008 (Code of practice for the design and installation of drainage fields for use in wastewater treatment) for the disposal of treated wastewater outfall.

The exact positioning or depth of the anticipated wastewater disposal apparatus has not yet been finalised, as such, the test was undertaken in the approximate area and depth indicated by the Client's Engineer.

Percolation testing was carried out within two hand dug pits to the BS6297 methodology. The percolation pit was excavated with a void space of 0.30m cubed and filled to the surface. In both trial pits the test was terminated part way through the first cycle due to very slow infiltration.

The values are summarised below.

Trial Pit	Cycle	Depth of Test (m begl)	Percolation Value (smm-1)
PT1	1	0.90 – 1.20	Test Failed >100
PT2	1	1.00 – 1.30	Test Failed >100

General Notes

This report is produced for the sole use of the Client, and no responsibility of any kind, whether for negligence or otherwise, can be accepted for any Third Party who may rely upon it.

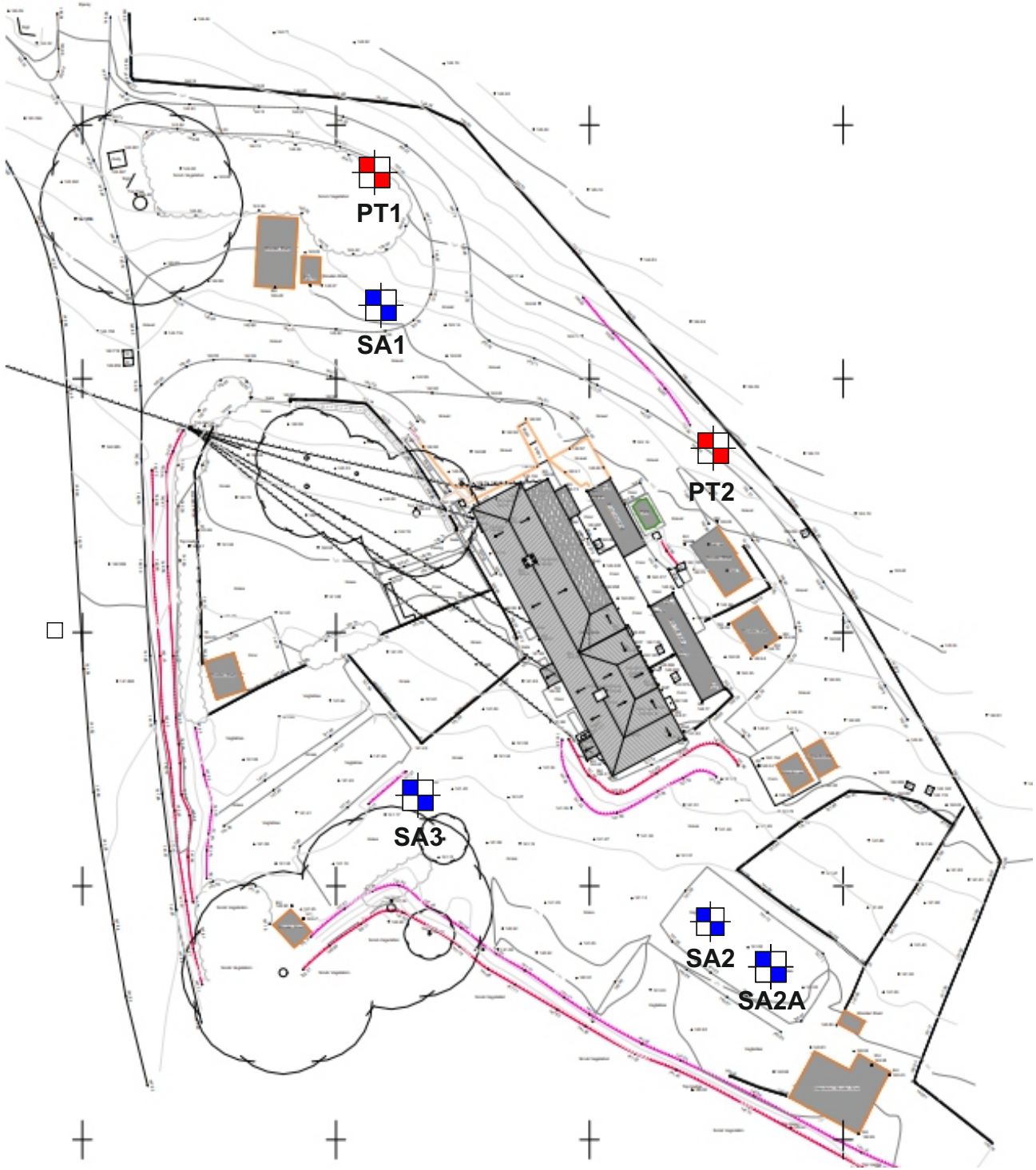
The conclusions and recommendations given in this report are based on our understanding of the future plans for the site and based on a scope of works agreed by the Client and afforded by the agreed budget. No responsibility is accepted for conditions not encountered, which are between exploratory points or outside of the agreed scope of work or if construction is commenced before regulatory approval of designs.

The report has been prepared following the guidelines and principles established in the British Standards, BS 5930, CIRIA Guidance and NHBC Standards. It necessarily relies on the co-operation of other organisations and the free availability of information and total access. No responsibility can, therefore, be accepted for conditions arising from information that was inaccurate or not available to the investigating team as a result of information being withheld or access being denied.

This report may suggest an opinion on a suspected configuration of strata or conditions between exploratory points and below the maximum depth of investigation. However, this is for guidance only and no liability can be accepted for its accuracy. Comments on the groundwater conditions are based on observations made at the time of the investigation unless otherwise stated. It should be noted, however, that groundwater levels might vary due to seasonal or other effects.

APPENDIX A

Trial Pit Location Plan



PADDOCK GEO ENGINEERING

Exploratory Position Site Plan

1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT

Barbury Castle Estate

March 2024

InfiltrationTesting Locations

Percolation Testing Locations

Not to scale.
All positions are approximate.
Based on proposed plan provided by Client.

APPENDIX B

Trial Pit Log

PADDOCK GEO ENGINEERING

Site	Trial Pit Number
1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT	PT1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	1.2 x 0.3 x 1.2		Barbury Castle Estate	P24-093
	Location	**Dates** 27/03/2024	**Engineer** PGE	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.15)	Grass over dark brown slightly organic gravelly SAND. Sand is fine, gravel consists of coarse subrounded to subangular flint. (TOPSOIL)		
					0.15 (0.15)	Red brown and dark brown very sandy very gravelly CLAY with rare red brick cobbles. Sand is fine to coarse, gravel consists of rounded medium to coarse flint and brick. (MADE GROUND)		
					0.30 (0.60)	Structureless Chalk composed of sandy gravelly SILT. Gravel is composed of fine to medium subangular to subrounded flint and chalk. Clasts are extremely weak low density. Matrix is off white yellow sandy SILT. (HOLLYWELL NODULAR CHALK FORMATION)		
					0.90	Complete at 0.90m		

Remarks

Percolation test carried out in 0.3m x 0.3m hand dug pit at the base of the machine trial pit. (0.90m to 1.20m)
Trial pit sides remained stable upon completion.
No groundwater encountered.
Trial pit backfilled with arisings.
Infiltration testing performed.

Logged in accordance BS5930:2015

Scale (approx)	Logged By	Figure No.
1:10	MIP	P24-093.PT1

Produced by the GEOtechnical DAtabase SYstem (GEODASY) © all rights reserved

PADDOCK GEO ENGINEERING				Site: 1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT	Trial Pit Number: PT2
Excavation Method: Trial Pit	Dimensions: 1.2 x 0.3 x 1.0		Ground Level (mOD)	Client: Barbury Castle Estate	Job Number: P24-093
	Location		Dates: 27/03/2024	Engineer: PGE	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.75)	Grass over dark brown slightly organic slightly sandy slightly gravelly CLAY. Gravel consists of medium to coarse flint and brick. (TOPSOIL)		
					0.75 (0.25)	Structureless Chalk composed of sandy gravelly SILT. Gravel is composed of fine to medium subangular to subrounded flint and chalk. Clasts are extremely weak low density. Matrix is off white yellow sandy SILT. (HOLLYWELL NODULAR CHALK FORMATION)		
					1.00	Complete at 1.00m		

Remarks

Percolation test carried out in 0.3m x 0.3m hand dug pit at the base of the machine trial pit. (1.0m - 1.30m)
Trial pit sides remained stable upon completion.
No groundwater encountered.
Trial pit backfilled with arisings.
Infiltration testing performed.

Logged in accordance BS5930:2015

Scale (approx)	Logged By	Figure No.
1:10	JoB	P24-093.PT2

Produced by the GEOtechnical DAtabase SYstem (GEODASY) © all rights reserved

PADDOCK GEO ENGINEERING

Site	Trial Pit Number
1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT	SA1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	2.0 x 0.3 x 2.5		Barbury Castle Estate	P24-093
	Location	**Dates** 27/03/2024	**Engineer** PGE	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.60)	Grass over dark brown slightly organic gravelly SAND. Sand is fine, gravel consists of coarse subrounded to subangular flint. (TOPSOIL)		
					0.60 (0.25)	Firm yellow brown slightly gravelly very sandy CLAY. Gravel is fine to medium flint. (HEAD)		
					0.85 (1.65)	Structureless Chalk composed of sandy gravelly SILT. Gravel is composed of fine to medium subangular to subrounded flint and chalk. Clasts are extremely weak low density. Matrix is off white yellow sandy SILT. (HOLLYWELL NODULAR CHALK FORMATION)		
					2.50	Complete at 2.50m		

Remarks

Infiltration testing performed.
Trial pit backfilled with arisings.
No groundwater encountered.
Trial pit sides remained stable upon completion.

Logged in accordance BS5930:2015

Scale (approx)	Logged By	Figure No.
1:25	MIP	P24-093.SA1

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PADDOCK GEO ENGINEERING				Site: 1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT	Trial Pit Number: SA2
Excavation Method: Trial Pit	Dimensions: 1.0 x 0.3 x 1.0		Ground Level (mOD)	Client: Barbury Castle Estate	Job Number: P24-093
	Location	Dates: 27/03/2024		Engineer: PGE	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35) 0.35	Dark brown slightly organic gravelly SAND with rare flint cobbles. Sand is fine, gravel is subangular to subrounded. (TOPSOIL)		
					(0.65) 1.00	Off white yellow brown slightly silty sandy GRAVEL. Sand is fine, gravel consists of coarse, subangular to subrounded chalk. (ALLUVIUM)		
						Complete at 1.00m		

Remarks

Infiltration testing performed.
Trial pit backfilled with arisings.
Trial pit sides remained stable upon completion.
Groundwater encountered at 0.97m

Logged in accordance BS5930:2015

Scale (approx)	Logged By	Figure No.
1:25	MIP	P24-093.SA2

Produced by the GEOtechnical DAtabase SYstem (GEODASY) © all rights reserved

PADDOCK GEO ENGINEERING				Site: 1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT	Trial Pit Number: SA2A
Excavation Method: Trial Pit	Dimensions: 1 x 0.3 x 0.6		Ground Level (mOD)	Client: Barbury Castle Estate	Job Number: P24-093
	Location		Dates: 27/03/2024	Engineer: PGE	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	Dark brown slightly organic gravelly SAND with rare flint cobbles. Sand is fine, gravel is subangular to subrounded. (TOPSOIL)		
					0.35 (0.15) 0.50	Off white yellow brown slightly silty sandy GRAVEL. Sand is fine, gravel consists of coarse, subangular to subrounded chalk. (ALLUVIUM)		
						Complete at 0.60m		

Remarks

Infiltration testing performed.
Trial pit backfilled with arisings.
No groundwater encountered.
Trial pit sides remained stable upon completion.

Logged in accordance BS5930:2015

Scale (approx)	Logged By	Figure No.
1:25	MIP	P24-093.SA2A

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PADDOCK GEO ENGINEERING				Site: 1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT	Trial Pit Number: SA3
Excavation Method: Trial Pit	Dimensions: 1.2 x 0.3 x 1.0		Ground Level (mOD)	Client: Barbury Castle Estate	Job Number: P24-093
	Location		Dates: 27/03/2024	Engineer: PGE	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.60)	Grass over dark brown slightly organic slightly sandy slightly gravelly CLAY. Sand is fine to coarse gravel consists medium to coarse rounded chalk with occasional rootlets. (TOPSOIL)		
					0.60 (0.40)	Off white slightly clayey slightly sandy GRAVEL. Gravel consists of medium to coarse rounded flint and chalk. (ALLUVIUM)		
					1.00	Complete at 1.00m		

Remarks

Ground water encountered at 0.66m.
Trial pit sides remained stable upon completion.
Trial pit backfilled with arisings.
Infiltration testing performed.

Logged in accordance BS5930:2015

Scale (approx)	Logged By	Figure No.
1:25	JoB	P24-093.SA3

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APPENDIX C

Laboratory Analysis Results – Not Used

APPENDIX D

Infiltration Testing Results

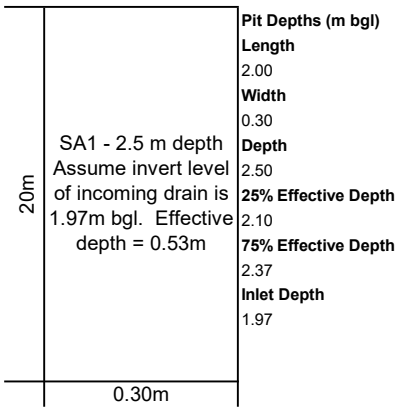
Infiltration Test to BRE365 - SA1 TEST 1

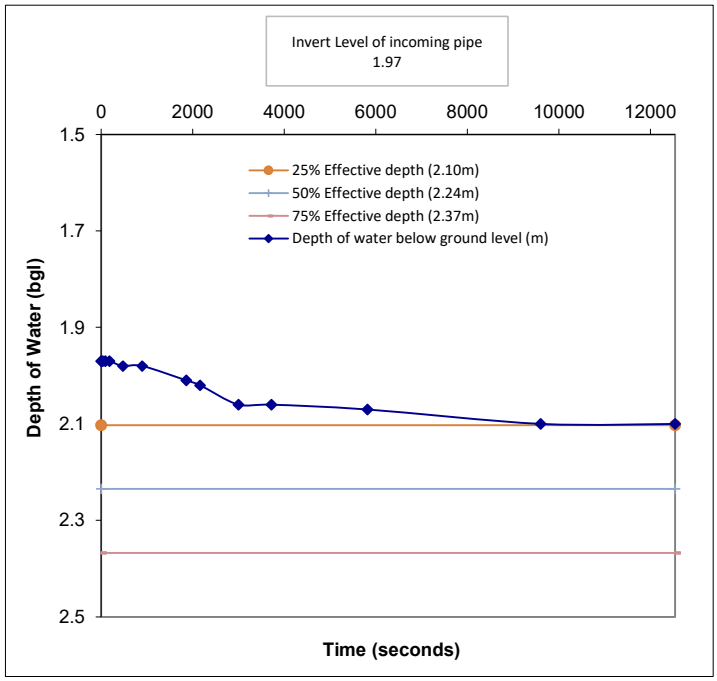
Field Data

Time	Time Elapsed (min)	Time Elapsed (sec)	Depth of Water below GL (m)
	0.0	0	1.97
	0.5	30	1.97
	1.5	90	1.97
	3.0	180	1.97
	8.0	480	1.98
	15.0	900	1.98
	31.0	1860	2.01
	36.0	2160	2.02
	50.0	3000	2.06
	62.0	3720	2.06
	97.0	5820	2.07
	160.0	9600	2.10
	209.0	12540	2.10

Location: SA1 **TEST 1**
Weather: Cold, Rain, Snow
Engineer: JB
Date: 27/03/2024

Strata Tested Chalk





CALCULATION:

Soil Infiltration Rate(f) =
Vp75-25 / (ap50 x tp75-25)

Where:
Vp75-25 = effective storage volume between 75% and 25% effective depth
2x0.3x(2.3675-2.1025)
= **0.159**

ap50 = internal area of TP upto 50% effective depth + base of TP
2(2 x) + 2(0.3 x) + (2 x 0.3)
= **1.819**

Tp75-25 = the time for water level to fall from 75% - 25% effective depth
= **N/A** secs

f= **N/A** m/s

Comment
Infiltration test terminated after c.4hrs due to failure to reach 25% in the allowed time

PADDOCK GEO ENGINEERING

Client: Barbury Castle Estate
Project No: P24-093
Project: 1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT.

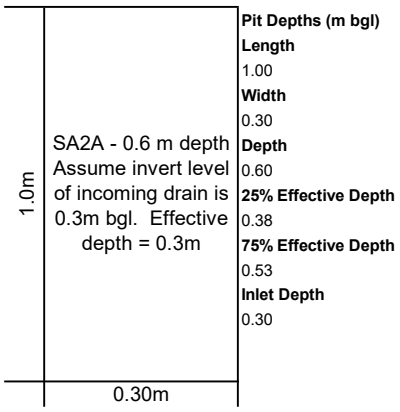
Infiltration Test to BRE365 - SA2A TEST 1

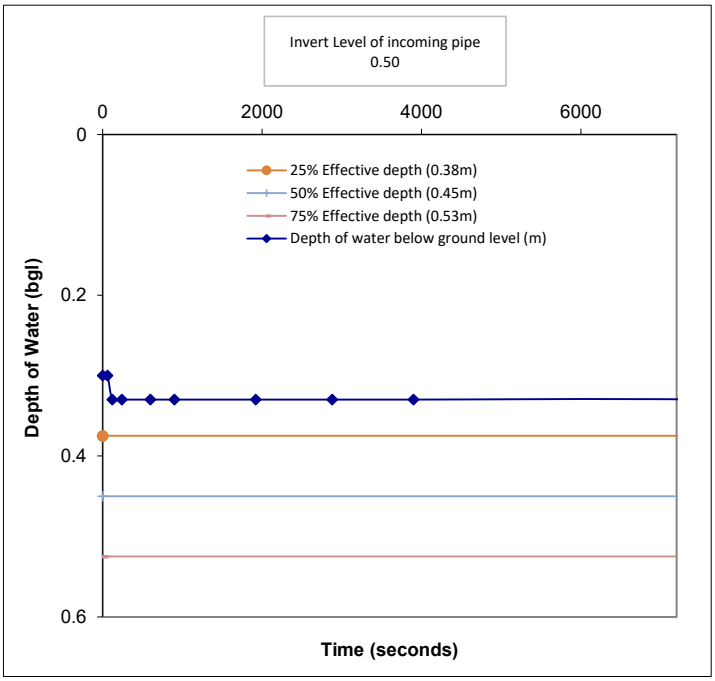
Field Data

Time	Time Elapsed (min)	Time Elapsed (sec)	Depth of Water below GL (m)
	0.0	0	0.30
	1.0	60	0.30
	2.0	120	0.33
	4.0	240	0.33
	10.0	600	0.33
	15.0	900	0.33
	32.0	1920	0.33
	48.0	2880	0.33
	65.0	3900	0.33
	127.0	7620	0.33
	210.0	12600	0.34

Location: **SA2A** **TEST 1**
Weather: Cold, Rain, Snow
Engineer: JB
Date: 27/03/2024

Strata Tested Alluvium





CALCULATION:

Soil Infiltration Rate(f) =
Vp75-25 / (ap50 x tp75-25)

Where:
Vp75-25 = effective storage volume between 75% and 25% effective depth
1x0.3x(0.525-0.375)
= **0.045**

ap50 = internal area of TP upto 50% effective depth + base of TP
2(1 x) + 2(0.3 x) + (1 x 0.3)
= **0.69**

Tp75-25 = the time for water level to fall from 75% - 25% effective depth
= **N/A** secs

f= **N/A** m/s

Comment
Infiltration test terminated after c.4hrs due to failure to reach 25% in the allowed time

PADDOCK GEO ENGINEERING

Client: Barbury Castle Estate
Project No: P24-093
Project: 1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT.

Percolation Test to BS6297 - PT1 Test 1

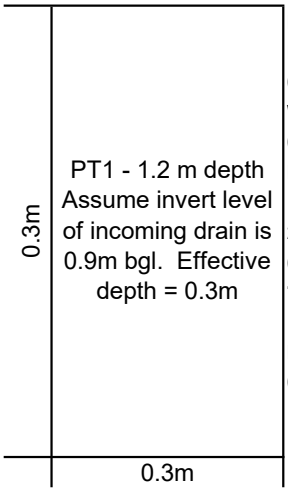
Field Data

Location: PT1 **TEST 1**
Weather: Cold, Rain, Snow
Engineer: JB
Date: 27/03/2024

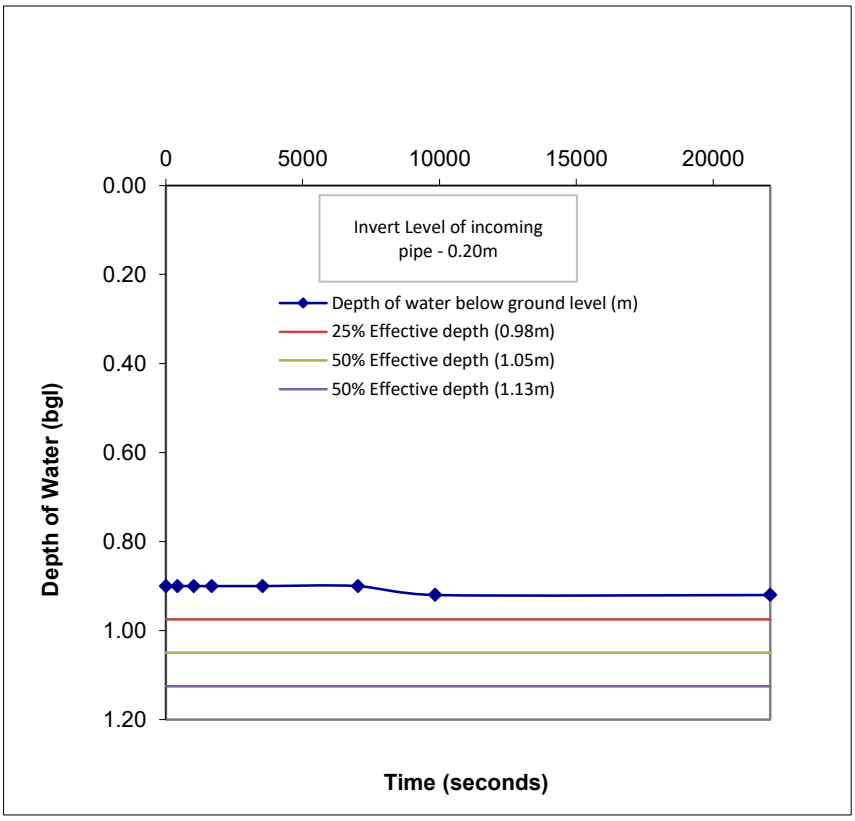
Strata Tested Chalk

Time	Time Elapsed (min)	Time Elapsed (sec)	Depth of Water below GL (m)
	0.0	0	0.90
	7.0	420	0.90
	17.0	1020	0.90
	28.0	1680	0.90
	59.0	3540	0.90
	117.0	7020	0.90
	164.0	9840	0.92
	368.0	22080	0.92

Linear extrapolated values for calculation



Pit Depths (m bgl)
Length
0.3
Width
0.3
Depth
1.20
25% Effective Depth
0.975
75% Effective Depth
1.125
Inlet Depth
0.9



CALCULATION:

Percolation Value (Vp) =
T75-25 / 150

Where:
T75-25 = time in second for level to fall from 75% to 25% full

Percolation Value (Vp) =
Test Failed

Comment
Percolation trial pit undertaken at base of trial pit of 0.90m depth. Insufficient percolation noted for calculation.

PADDOCK GEO ENGINEERING

Client: Barbury Castle Estate
Project No: P24-093
Project: 1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT

Percolation Test to BS6297 - PT1 Test 1

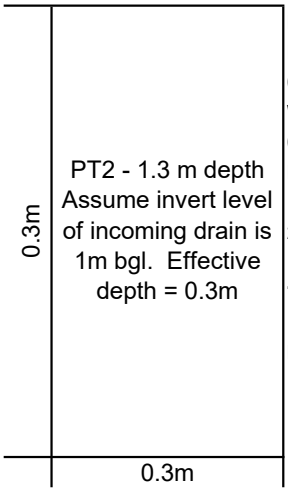
Field Data

Location: PT2 **TEST 1**
Weather: Cold, Rain, Snow
Engineer: JB
Date: 27/03/2024

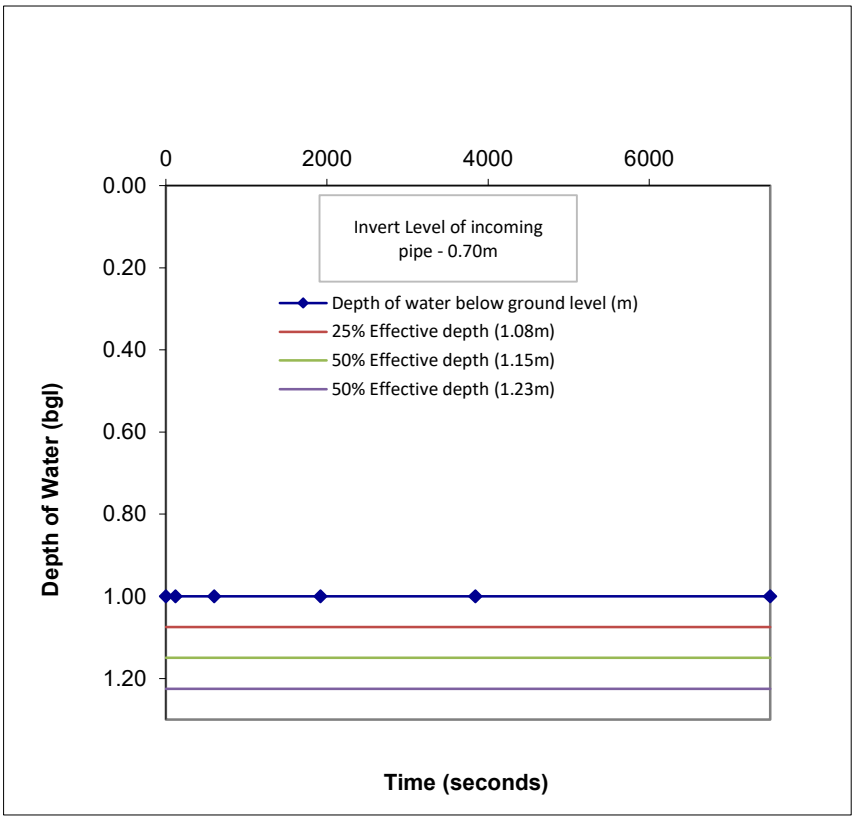
Strata Tested Chalk

Time	Time Elapsed (min)	Time Elapsed (sec)	Depth of Water below GL (m)
	0.0	0	1.00
	2.0	120	1.00
	10.0	600	1.00
	32.0	1920	1.00
	64.0	3840	1.00
	125.0	7500	1.00

Linear extrapolated values for calculation



Pit Depths (m bgl)
Length
0.3
Width
0.3
Depth
1.30
25% Effective Depth
1.075
75% Effective Depth
1.225
Inlet Depth
1



CALCULATION:

Percolation Value (Vp) =
T75-25 / 150

Where:
T75-25 = time in second for level to fall from 75% to 25% full

Percolation Value (Vp) =
Test Failed

Comment
Percolation trial pit undertaken at base of trial pit of 1.00m depth. Insufficient percolation noted for calculation.

PADDOCK GEO ENGINEERING

Client: Barbury Castle Estate
Project No: P24-093
Project: 1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT

APPENDIX E

Site Photographs

Site area— South

Site area—West

PADDOCK GEO ENGINEERING

Client:	**SDS Consulting Ltd**
Project No:	**P24-093**
Project Title:	**1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT**
Date:	**March 2024**

Site area— West

Site area— Field to East

PADDOCK GEO ENGINEERING

Client:	**SDS Consulting Ltd**
Project No:	**P24-093**
Project Title:	**1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT**
Date:	**March 2024**

SA1 soil profile

SA1 arisings

PADDOCK GEO ENGINEERING

Client:	**SDS Consulting Ltd**
Project No:	**P24-093**
Project Title:	**1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT**
Date:	**March 2024**

SA2 soil profile

SA2 arisings

PADDOCK GEO ENGINEERING

Client:	**SDS Consulting Ltd**
Project No:	**P24-093**
Project Title:	**1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT**
Date:	**March 2024**

SA2a soil profile

SA2a soil arisings

PADDOCK GEO ENGINEERING

Client:	**SDS Consulting Ltd**
Project No:	**P24-093**
Project Title:	**1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT**
Date:	**March 2024**

SA3 soil profile

SA3 soil arisings.

PADDOCK GEO ENGINEERING

Client:	**SDS Consulting Ltd**
Project No:	**P24-093**
Project Title:	**1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT**
Date:	**March 2024**

PT1 soil profile.

PT1 soil arisings.

PADDOCK GEO ENGINEERING

Client:	**SDS Consulting Ltd**
Project No:	**P24-093**
Project Title:	**1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT**
Date:	**March 2024**

PT2 soil profile

PT2 arisings

PADDOCK GEO ENGINEERING

Client:	**SDS Consulting Ltd**
Project No:	**P24-093**
Project Title:	**1-4 Eagle Cottages, Rockley, Marlborough, SN8 1RT**
Date:	**March 2024**

APPENDIX D

ICP SUDS Mean Annual Flood

Input

Return Period (years)	30	Soil	0.150
Area (ha)	0.371	Urban	0.000
SAAR (mm)	777	Region Number	Region 6

Results	**l/s**
QBAR Rural	0.2
QBAR Urban	0.2
Q30 years	0.4
Q1 year	0.1
Q30 years	0.4
Q100 years	0.5

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ICP SUDS Mean Annual Flood

Input

Return Period (years)	30	Soil	0.300
Area (ha)	0.371	Urban	0.000
SAAR (mm)	777	Region Number	Region 6

Results	**l/s**
QBAR Rural	0.8
QBAR Urban	0.8
Q30 years	1.7
Q1 year	0.6
Q30 years	1.7
Q100 years	2.4

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APPENDIX E

NOTES:

1. Drawing for information only
2. Do not scale from this drawing
3. Not to be used for construction

DRAINAGE KEY:

- Surface Water Drain
- Foul Water Drain
- Permeable paving outlet (PPG8)
- Permavoid – permeable paving inlet (PV)
- SUDS Permeable Paving (Tanked)

Rev	Date	Description	Initials	Check

SDS consulting civil & structural engineers

CLIENT:

MR & MRS WOODHOUSE c/o TUTTLE ARCHITECTURAL SERVICES

PROJECT

EAGLE COTTAGES, ROCKLEY, MARLBOROUGH

DRAWING

DRAINAGE STRATEGY

Drawing No. 6669-C-SK01

Status **For Planning**

Not for Construction

Job Number	6669	Date	MAY 2024
Scale	1:200 @ A1		
Drawn By	MTD	Checked By	LB

APPENDIX F

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	4.218	0.540	7.8	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	🔒
2.000	3.432	0.340	10.1	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	🔒
1.001	20.105	0.200	100.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	🔒
3.000	4.171	1.340	3.1	0.012	5.00	0.0	0.600	o	150	Pipe/Conduit	🔒
4.000	3.479	1.340	2.6	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	🔒
1.002	2.606	0.015	173.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.003	1.159	0.005	231.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.004	33.361	0.165	202.2	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.02	140.700	0.011	0.0	0.0	0.0	3.63	64.1	1.5
2.000	50.00	5.02	140.500	0.011	0.0	0.0	0.0	3.19	56.4	1.5
1.001	50.00	5.35	140.160	0.022	0.0	0.0	0.0	1.00	17.7	3.0
3.000	50.00	5.01	141.300	0.012	0.0	0.0	0.0	5.75	101.7	1.6
4.000	50.00	5.01	141.300	0.011	0.0	0.0	0.0	6.30	111.4	1.6
1.002	50.00	5.40	139.885	0.045	0.0	0.0	0.0	0.99	39.3	6.2
1.003	50.00	5.42	139.870	0.045	0.0	0.0	0.0	0.85	34.0	6.2
1.004	50.00	6.03	139.865	0.074	0.0	0.0	0.0	0.92	36.4	10.1

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.000	5.926	0.300	19.8	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	2.351	0.020	117.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	18.382	0.180	102.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.000	50.00	5.04	140.000	0.000	0.0	0.0	0.0	2.28	40.2	0.0
1.005	50.00	6.07	139.700	0.074	0.0	0.0	0.0	0.93	16.4	10.1
1.006	50.00	6.38	139.680	0.074	0.0	0.0	0.0	0.99	17.6	10.1

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.011	0.011	0.011
2.000	User	-	100	0.011	0.011	0.011
1.001	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.012	0.012	0.012
4.000	User	-	100	0.011	0.011	0.011
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
1.004	User	-	60	0.048	0.029	0.029
5.000	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.094	0.074	0.074

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.006	DITCH	140.500	139.500	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	6
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S5-HB, DS/PN: 1.005, Volume (m³): 3.2

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	139.700
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.0
Flush-Flo™	0.196	0.7
Kick-Flo®	0.398	0.6
Mean Flow over Head Range	-	0.8

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	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

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Storage Structures for Storm

Porous Car Park Manhole: PP1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	6.5
Max Percolation (l/s)	9.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	141.250	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: PP2, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	6.5
Max Percolation (l/s)	9.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	141.050	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: PP3, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	9.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	141.850	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: PP4, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	9.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	141.850	Cap Volume Depth (m)	0.300

Filter Drain Manhole: S4, DS/PN: 1.004

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.050
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	500.0
Invert Level (m)	139.865	Cap Volume Depth (m)	0.600
Trench Width (m)	0.6	Cap Infiltration Depth (m)	0.000
Trench Length (m)	100.0		

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Tank or Pond Manhole: POND, DS/PN: 5.000

Invert Level (m) 140.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	7.0	1.000	84.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 6
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 30, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	PP1	15 Winter	1	+0%					140.718
2.000	PP2	15 Winter	1	+0%	100/60 Winter				140.520
1.001	S1	15 Winter	1	+0%	30/15 Winter				140.204
3.000	PP3	15 Winter	1	+0%					141.315
4.000	PP4	15 Winter	1	+0%					141.315
1.002	S2	120 Winter	1	+0%	30/15 Summer				140.083
1.003	S3	120 Winter	1	+0%	30/15 Summer				140.082
1.004	S4	120 Winter	1	+0%	30/15 Summer				140.082
5.000	POND	120 Winter	1	+0%	30/15 Summer				140.080
1.005	S5-HB	120 Winter	1	+0%	1/15 Summer				140.080
1.006	S6	480 Winter	1	+0%					139.700

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	PP1	-0.132	0.000	0.03		5	1.6	OK	
2.000	PP2	-0.130	0.000	0.04		5	1.6	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	S1	-0.106	0.000	0.19			3.1	OK	
3.000	PP3	-0.135	0.000	0.02		4	1.6	OK	
4.000	PP4	-0.135	0.000	0.02		4	1.6	OK	
1.002	S2	-0.027	0.000	0.07			2.0	OK	
1.003	S3	-0.013	0.000	0.06			1.9	OK	
1.004	S4	-0.008	0.000	0.06		82	2.0	OK	
5.000	POND	-0.070	0.000	0.01			0.2	OK	
1.005	S5-HB	0.230	0.000	0.07			0.7	SURCHARGED	
1.006	S6	-0.130	0.000	0.05			0.7	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 6
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 30, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	PP1	15 Winter	30	+30%					140.733
2.000	PP2	15 Winter	30	+30%	100/60 Winter				140.537
1.001	S1	240 Winter	30	+30%	30/15 Winter				140.517
3.000	PP3	15 Winter	30	+30%					141.326
4.000	PP4	15 Winter	30	+30%					141.326
1.002	S2	240 Winter	30	+30%	30/15 Summer				140.515
1.003	S3	240 Winter	30	+30%	30/15 Summer				140.515
1.004	S4	240 Winter	30	+30%	30/15 Summer				140.515
5.000	POND	240 Winter	30	+30%	30/15 Summer				140.511
1.005	S5-HB	240 Winter	30	+30%	1/15 Summer				140.515
1.006	S6	240 Winter	30	+30%					139.702

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	PP1	-0.117	0.000	0.11		6	5.0	OK	
2.000	PP2	-0.113	0.000	0.14		6	5.0	OK	
1.001	S1	0.207	0.000	0.11			1.8	SURCHARGED	
3.000	PP3	-0.124	0.000	0.07		6	5.1	OK	
4.000	PP4	-0.124	0.000	0.07		6	5.1	OK	
1.002	S2	0.405	0.000	0.13			3.6	SURCHARGED	
1.003	S3	0.420	0.000	0.12			3.6	SURCHARGED	
1.004	S4	0.425	0.000	0.12			4.1	SURCHARGED	
5.000	POND	0.361	0.000	0.02			0.6	SURCHARGED	
1.005	S5-HB	0.665	0.000	0.08			0.8	SURCHARGED	
1.006	S6	-0.128	0.000	0.05			0.8	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 6
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 30, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	PP1	240 Winter	100	+40%					140.763
2.000	PP2	240 Winter	100	+40%	100/60 Winter				140.763
1.001	S1	240 Winter	100	+40%	30/15 Winter				140.763
3.000	PP3	15 Winter	100	+40%					141.332
4.000	PP4	15 Winter	100	+40%					141.332
1.002	S2	240 Winter	100	+40%	30/15 Summer				140.761
1.003	S3	240 Winter	100	+40%	30/15 Summer				140.760
1.004	S4	240 Winter	100	+40%	30/15 Summer				140.760
5.000	POND	240 Winter	100	+40%	30/15 Summer				140.756
1.005	S5-HB	240 Winter	100	+40%	1/15 Summer				140.757
1.006	S6	240 Winter	100	+40%					139.703

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	PP1	-0.087	0.000	0.03		34	1.3	OK	
2.000	PP2	0.113	0.000	0.04		136	1.3	SURCHARGED	
1.001	S1	0.453	0.000	0.15			2.6	SURCHARGED	
3.000	PP3	-0.118	0.000	0.10		6	7.2	OK	
4.000	PP4	-0.118	0.000	0.10		6	7.1	OK	
1.002	S2	0.651	0.000	0.19			5.2	SURCHARGED	
1.003	S3	0.665	0.000	0.17			5.2	SURCHARGED	
1.004	S4	0.670	0.000	0.19			6.4	SURCHARGED	
5.000	POND	0.606	0.000	0.03			0.9	FLOOD RISK	
1.005	S5-HB	0.907	0.000	0.09			0.9	SURCHARGED	
1.006	S6	-0.127	0.000	0.06			0.9	OK	

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