



Civil & Infrastructure Engineering Design

**Land adjacent Sefter School House,
Sefter Road, Pagham, PO21 3EE**

Drainage Strategy and SuDS Statement

Prepared For: Hamilton Homes and Developments Ltd

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Drainage Strategy and SuDS Statement

Contents

1.0	INTRODUCTION	3
2.0	EXISTING SITE	4
2.1	Geotechnical	4
2.2	Ground Conditions	5
2.3	Hydrology	5
2.4	Hydrogeology.....	5
3.0	PLANNING POLICY CONTEXT.....	7
3.1	National Planning Policy.....	7
3.2	Strategic Flood Management	7
4.0	FLOOD RISK AND EXISTING SURFACE WATER DRAINAGE.....	10
4.1	Flood Risk	10
4.2	Existing Surface Water Drainage	11
5.0	SURFACE WATER MANAGEMENT	12
5.1	Design Principles	12
5.2	Sustainable Drainage Systems	12
5.3	Non-statutory technical standards for sustainable drainage systems.....	13
5.4	Pre Development Run Off	14
5.5	Post Development Run Off	14
5.6	Proposed Discharge Location.....	15
5.7	Surface Water Drainage Strategy	16
6.0	FOUL WATER DRAINAGE STRATEGY	21
7.0	CONCLUSION.....	22

Drainage Strategy and SuDS Statement

Tables

Table 1 Catchment Areas	14
Table 2 Summary of Greenfield runoff rates and volumes	14
Table 3 Summary of Post Development runoff prior to mitigation	15
Table 4 SuDS Hierarchy approach	16
Table 5 Pollution Hazard Indices (CIRIA Report C753 Table 26.2)	19
Table 6 Indicative SuDS mitigation indices for discharges to surface water sewers	19

Appendices

Appendix A	Topographical Survey
Appendix B	Ground Investigation Extracts
Appendix C	Environment Agency Flood Map
Appendix D	ADC SFRA Mapping
Appendix E	Southern Water Asset Search
Appendix F	Catchment Areas
Appendix G	Development Runoff
Appendix H	Drainage Strategy
Appendix I	Micro Drainage Hydraulic Model
Appendix J	Maintenance and Management
Appendix K	Exceedance Flows

Drainage Strategy and SuDS Statement

1.0 Introduction

Adama Consulting Limited have been instructed on behalf of Hamilton Homes and Developments Limited to prepare a Drainage Strategy and Sustainable Urban Drainage (SuDS) Statement in support of a planning application for the re-development of land adjacent Sefter School House, Sefter Road in Pagham.

Full planning permission is sought from ARUN District Council (ADC) for the erection of six residential dwellings with access, parking and associated works.

The purpose of this statement is to provide sufficient information to ADC in regard to surface water management in line with the requirements of the Lead Local Flood Authority (LLFA), National Planning Policy Framework (NPPF) and Policies DM2 and DM3 of the ADC adopted Local Plan.

The report outlines the proposed surface water drainage and SUDs strategy for implementation on the development demonstrating that a scheme incorporating SUDs techniques has been devised and hydraulically assessed to manage and maintain a 1 in 100 year storm return with additional allowance for climate change.

The surface water drainage strategy has been developed in line with the National Planning Policy Framework (NPPF), EA standing advice and requirements of the LLFA. The strategy is based on a reduction in the surface water run-off rates thus ensuring that the re-development does not increase the risk of flooding from the site.

The report will also outline the foul water drainage strategy to be implemented on the scheme.

Limitations

The general limitations of this assessment are that:

- A number of data sources have been used in compiling this report. Whilst Adama Consulting believe them to be trustworthy; it is unable to guarantee the accuracy of the information that has been provided by others.
- This report is based on information available at the time of preparation. There is potential for further information to become available, which may create a need to modify conclusions drawn in this report.

Drainage Strategy and SuDS Statement

2.0 Existing Site

The application site is situated on a parcel of land off Sefter Road in Pagham and can be found on National Grid reference SZ 89529 99483.

The surrounding area is generally a mixture of existing residential estates and predominately pastoral land with principal routes to nearby towns as depicted in site location **Figure 1** below.

Figure 1: Site Location Plan



Image courtesy of Promap V2. Crown Copyright 2021

The site proposed for development is Greenfield approximately 0.267 hectares (ha) in area and centred on Ordnance Survey (OS) Grid co-ordinates X (Easting) 489529 and Y (Northing) 099483.

The majority of the site is relatively flat with a range in datum level from 5.38m to 3.60m at its lowest point at the southern boundary. The northern area of the site is bound by an existing earth bund with an existing watercourse to the east.

An overview of the change in topography is presented on the Medlams Surveys Limited Topographic Survey drawing which can be found in **Appendix A**.

2.1 Geotechnical

The current review of the geotechnical aspects of the site are based on the following documents:

- British Geological Survey (BGS) – Historic Borehole Logs and geology maps;

Drainage Strategy and SuDS Statement

- Environment Agency (EA) – groundwater vulnerability maps;
- Cranfield Soil and Agrifood Institute Soilscales Data
- Constructive Evaluation Site Investigation Report (August 2021)

2.2 Ground Conditions

Geological map data published on the BGS website indicates the geology of the site to comprise of London Clay Formation – Clay, Silt and sand sedimentary bedrock with Raised Beach Deposits – Sand and gravel superficial deposits.

Intrusive investigations undertaken by Constructive Evaluation Ltd determines the local geology of the site to comprise of 1.0m thickness made ground comprising predominately slightly sandy, slightly gravelly CLAY.

Beneath the made ground material, the strata encountered comprised of slightly sandy, slightly gravelly CLAY over Raised Beach Deposits underlain by the London Clay Formation and Bognor Sand Member.

Groundwater was encountered at circa 1.0m below ground level and considered to represent a perched water table between the made ground and relatively impermeable soils beneath.

Extracts from the Constructive Evaluation site investigations can be found in **Appendix B**.

2.3 Hydrology

The nearest water feature is an existing watercourse traversing the sites eastern boundary. The nearest EA designated main river is the Pagham Rife located approximately 600m west of the site (as illustrated in Extract **Figure 2** below).

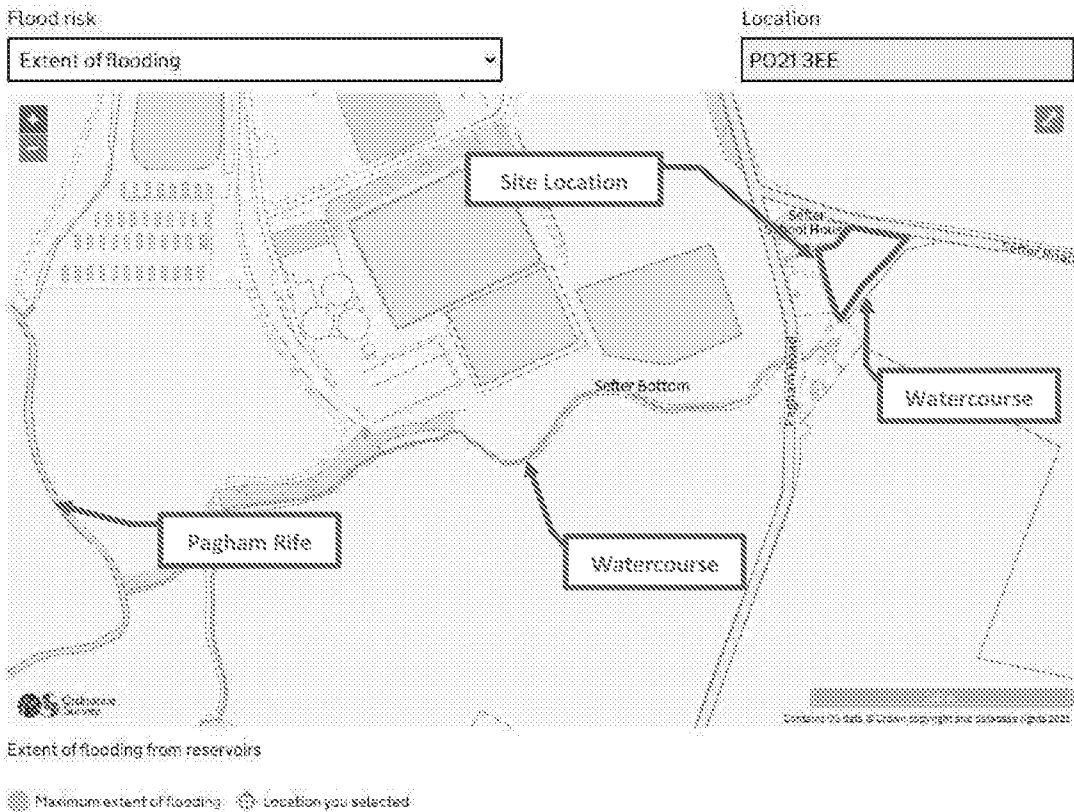
2.4 Hydrogeology

Groundwater mapping published by the EA indicates the bedrock aquifer designation as a Secondary A aquifer. The site is not located within any EA designated source protection zones and is located within a flood risk zone 1.

Soilscape (England) have identified the local geology as loamy soils with naturally high groundwater.

Drainage Strategy and SuDS Statement

Figure 2: Extract Reservoirs Flood Map from Gov.uk website



Drainage Strategy and SuDS Statement

3.0 Planning Policy Context

3.1 National Planning Policy

National Planning Policy Framework (NPPF)

The Government's National Planning Policy Framework (NPPF), was first published in March 2012, and set out the Government's policy on development and flood risk. The NPPF was updated in July 2021 retaining key elements of the 2012 publication in regard to planning for climate change and flood risk. On 6 March 2014 the Department for Communities and Local Government (DCLG) launched the Government's planning practice guidance to the NPPF as a web-based resource. The category dealing with flooding is contained in Flood Risk and Coastal Change (Reference ID: 7 Updated: 06 03 2014).

When planning for climate change, paragraph 154 of the NPPF states that new development should be planned in ways that avoid increased vulnerability to the range of impacts arising from climate change. It states that when new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaption measures, including through the planning of green infrastructure.

Paragraphs 159 to 169 of the NPPF state that inappropriate development in areas of risk of flooding should be avoided and that strategic policies should be informed by a strategic flood risk assessment (SFRA). The frameworks states that all plans should apply a sequential test approach to the location of development taking into account current and future impacts of climate change and flood risk from various sources.

3.2 Strategic Flood Management

Arun District Council Strategic Flood Risk Assessment (SFRA)

The National Planning Policy Framework confirms that Regional Planning Bodies (RPBs) or local planning authorities (LPAs) should prepare strategic Flood Risk Assessments (SFRAs) in consultation with the EA. The SFRA is then used to refine information on areas liable to flooding by taking into account other sources of flooding and the impacts associated with climate change in addition to the EA flood map data.

The document informs the Councils policies in the emerging Local Development framework and a strategic approach to the allocation of sites for development and the future management of flood risk, in line with the National Planning Policy Framework.

In September 2016 Arun District Council commissioned JBA Consulting to undertake a Level 1 and 2 SFRA. A previous report had been produced by Capita Symonds in February 2008 based on data available at that time. The current SFRA takes into account Government policy and guidance released at the time of the study to enable ADC to undertake strategic planning within the borough based on available flood risk data.

A crucial component of SFRAs is to consider what information is available on flood risk in the study area. The main sources of data for this study have been the Environment Agency, Arun District Council, West Sussex County Council and Southern Water who have provided information on flood zones, historical incidents and flood defences as well

Drainage Strategy and SuDS Statement

as policy documents for flood risk management such as the EBC Core Strategy and its relevant policy units stated within this report.

Local Planning Policy

The Arun Local Plan 2011-2031 (Adopted July 2018)

The Arun District Council Local plan was adopted by the Council in July 2018 and sets out the Council's long term vision to create a borough of opportunity for all. It highlights the strategic objectives, focussing on the key issues to be addressed, and includes delivery strategy for achieving these objectives up until 2031. The Core Strategy contains the following Policies in relation to flood risk and drainage:

"Policy W DM2 – Flood Risk

Development in areas at risk from flooding, identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment (SFRA), will only be permitted where all of the following criteria have been satisfied:

- a. The sequential test in accordance with the National Planning Policy Guidance has been met.*
- b. A site specific Flood Risk Assessment demonstrates that the development will be safe, including access, egress, without increasing flood risk elsewhere and reducing flood risk overall.*
- c. The sustainability benefits to the wider community are clearly identified.*
- d. The scheme identifies adaption and mitigation measures.*
- e. Appropriate flood warning and evacuation measures are in place; and*
- f. New site drainage systems are designed to take account of events which exceed the normal design standard i.e consideration of flood flow routing and utilising temporary storage areas.*

The reports prepared as part of the criteria above must take into account contingency allowances, taking climate change into account as set out in Flood Risk Assessments: climate change allowances section of the NPPG.

In locations where strategic flood defence or resilient and resistant construction measures are necessary within the site itself, proposals will be required to demonstrate how measures have been incorporated as an intrinsic part of the scheme in a manner which is compatible with the latest Strategic Flood Risk Assessment.

All development proposals must take account of relevant Surface Water Management Plans, Catchment Flood Management Plans and related Flood Defence Plans and strategies such as the Lower Tidal River Arun Strategy. The council may require financial contributions from development sites where measures to address flood risk or to improve environmental quality to watercourses have been identified by these plans and strategies.

Policy W DM3 – Sustainable Urban Drainage Systems

To increase the levels of water capture and storage and to improve water quality, all development must identify opportunities to incorporate a range of Sustainable Urban Drainage Systems (SUDS), appropriate to the size of development, at an early stage of the design process.

Proposals for both major and minor development proposals must incorporate SUDS within private areas of the development in order to provide source control features to the overall SUDS design. These features include;

- Green roofs*
- Permeable driveways and parking*
- Soakaways*
- Water harvesting and storage features including water butts*

Proposals for major development must also integrate SUDS within public open spaces and roads, reflecting discussion with the appropriate bodies. SUDS must therefore be integrated into the overall design of a development and must:

- a. Contribute positively to the appearance of the area, integrating access to allow maintenance of existing watercourses and the system.*
- b. Effectively manage water (including its quality)*
- c. Accommodate and enhance biodiversity by making connections to existing green infrastructure assets and*
- d. Provide amenity for local residents (ensuring a safe environment)*
- e. Retain the existing drainage network of a site and the wider area,*
- f. Be maintained in perpetuity, supported through a Maintenance and Management Plan/Regime, including its financing, agreed with the local planning authority.*

In order to ensure that SUDS discharge water from the development at the same or lesser rate, as prior to construction, developers must:

- g. Follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations and the SUDS manual produced by CIRIA.*
- h. Undertake up to six months groundwater monitoring within the winter period.*
- i. Undertake winter percolation testing in accordance with BRE365.*
- j. The proposed drainage system must be designed to ensure that there is no flooding on a 1 in 30 year storm event.*
- k. The design must also take account of the 1 in 100 year storm event plus 30% allowance for climate change, on stored volumes, to ensure that there is no flooding of properties or the public highway or inundation of the foul sewerage system. Any excess flows must be contained within the site boundary, and within designated storage areas.*

Drainage Strategy and SuDS Statement

4.0 Flood Risk and Existing Surface Water drainage

This section of the report reviews the existing risk of flooding to the site and requirements for a compliant drainage strategy to meet the requirements of the National Planning Policy Framework (NPPF July 2021) and the Planning Practice Guidance (PPG, March 2014), by interrogating the following information:

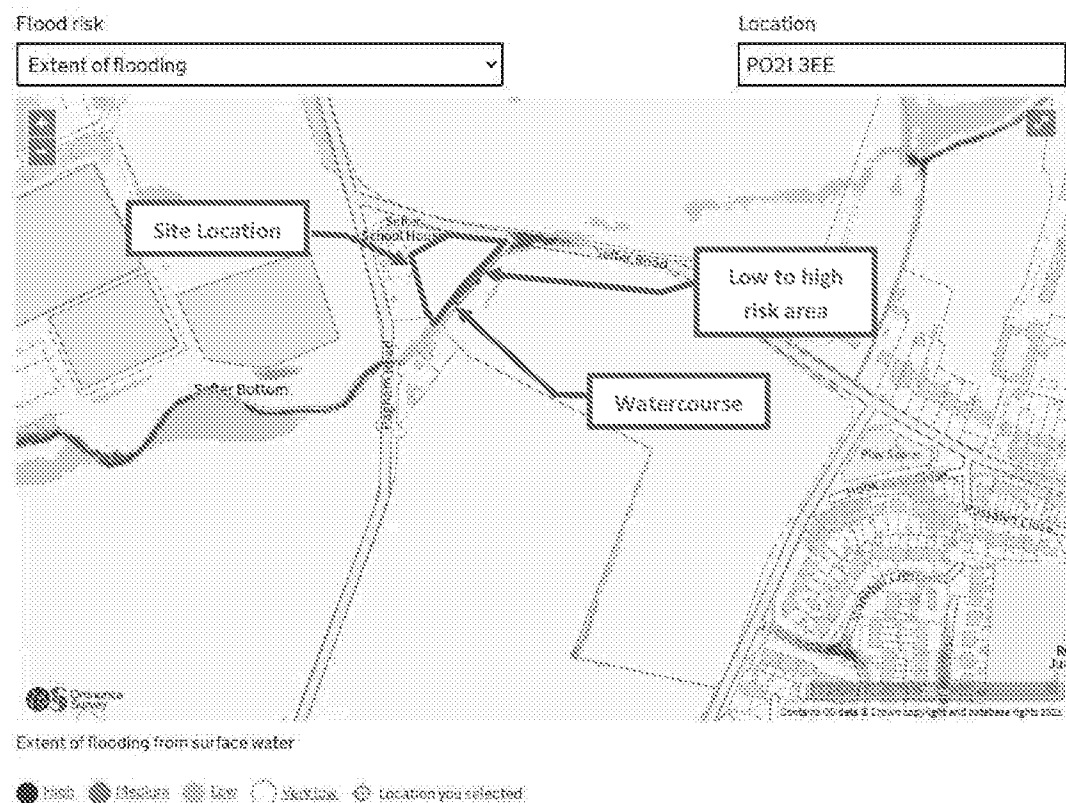
- Available topographic survey information;
- Available mapping from the Environment Agency's website;
- Southern Water asset searches
- ADC Strategic Flood Risk Assessment (SFRA) (September 2016)

4.1 Flood Risk

Based on a review of the EA's Flood Zone maps (see **Appendix C**), the development site lies wholly within Flood Zone 1 (an area considered to be at low risk of flooding from rivers and seas).

The risk of flooding from pluvial sources has been assessed and based on the mapping provided by the EA the site is at a very low risk of surface water flooding. The mapping has identified varied levels of flooding within the watercourse adjacent the site boundary as illustrated in **Figure 3** below.

Figure 3: Extract Surface Water Flood Map from Gov.uk website



Drainage Strategy and SuDS Statement

The site and surrounding area is not at risk of flooding from reservoirs as illustrated within figure 2 neither have there been any recorded incidents of sewer flooding. The site is located within an area designated to have >75% chance of groundwater flooding within the site as noted within the ADC SFRA extracts which can be found in **Appendix D**.

4.2 Existing Surface Water Drainage

An assessment of the existing surface water drainage regime for the site has been undertaken following a review of the topographic survey and Southern Water asset searches for the area.

The site is greenfield and as such does not benefit from a positively drained sewer network. Overland flows discharge towards the existing watercourse adjacent the sites western boundary.

A review of the Southern Water asset map in **Appendix E** confirms there to be no surface water sewers within or around the vicinity of the site..

5.0 Surface Water Management

West Sussex County Council are the Lead Local Flood Authority and the statutory consultee on surface water management on all planning applications within the County.

The surface water management section should ensure that there is no adverse impact on flood risk elsewhere as a result of a change in the surface water runoff regime from the re-development.

5.1 Design Principles

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'
- West Sussex LLFA Policy for the Management of Surface Water

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.

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.

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.

The West Sussex LLFA Policy for The Management of Surface Water sets out how the council as statutory consultee reviews drainage strategies and surface water management provisions associated with applications for development. The policy was last updated by the council in November 2018 and details best practice guidance documents and SUDS policies to assist developers and consultants in the production of drainage design.

5.2 Sustainable Drainage Systems

Paragraph 51 in Section 21 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-051-20150323) advises that sustainable drainage systems are designed to control surface water runoff close to where it falls and mimic natural drainage as closely as possible. Sustainable drainage systems provide opportunities to:

- reduce the causes and impacts of flooding;

Drainage Strategy and SuDS Statement

- remove pollutants from urban runoff at source;
- combine water management with green space with benefits for amenity, recreation and wildlife.

Paragraph 80 in Section 21 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-080-20150323) advises that, the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

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

5.3 Non-statutory technical standards for sustainable drainage systems

The non-statutory technical standards for the design, maintenance and operation of sustainable drainage systems to drain surface water have been published by Defra. The standards apply to systems that drain surface water from housing, non-residential or mixed-use developments for the lifetime of the developments. The non-statutory technical standards for sustainable drainage systems are to be used in conjunction with the National Planning Policy Framework, and Planning Practice Guidance on Flood Risk & Coastal Change that was revised in light of these changes in March 2015.

The Government's 'Non-statutory technical standards for sustainable drainage systems' set out peak flow control standards (S2 and S3) and volume control technical standards (S4, S5 and S6).

For the proposed development site, the following non-technical standards apply for existing greenfield development –

Peak Flow Control

Standard S2 states: For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

Volume Control

Standard S4 states: Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

Standard S6 states: Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

Drainage Strategy and SuDS Statement

5.4 Pre Development Run Off

Catchment Areas

The impermeable and permeable development site areas have been reviewed and results listed in Table 1 below. (See also drawing 21-023-001 in Appendix F).

	Permeable (Greenfield)	Impermeable (Hardstanding's)	Total
Existing Site Areas	2,672 m ²	0 m ²	2,672 m ²
Development Areas	1,407 m ²	1,265 m ²	2,672 m ²

Table 1: Catchment Areas

The proposed development will create a net increase of 1,265m² in impermeable area owing to the redevelopment.

A greenfield run-off assessment has been carried out for the sites gross area (0.267 ha) to evaluate the pre-development greenfield run-off rates and volumes in line with requirements of the LLFA. The greenfield run off calculations have been carried out using the ICP SUDS Input FSR methodology of the Micro Drainage suite and results tabled below

Event	Flow (l/s)	Greenfield Run-off Volume (m3) 6 hrs
Qbar	0.9	
1 in 1 year	0.8	
1 in 30 years	2.1	
1 in 100 years	3.0	62.121

Table 2: Summary of Greenfield runoff rates and volumes

5.5 Post Development Run Off

An assessment of the post-development run-off from the site has been calculated using parameters specified within, 'The Wallingford Procedure, Volume 4 - The Modified Rational Method' ($Q=2.78CiA$) –

Where;

C = runoff coefficient, (100% assumed for winter), Q= flow (l/s)

I = rainfall intensity (mm/hr), A = Impermeable Area (ha)

An assessment of the proposed peak discharge volume for a 360min 100 year winter storm duration (with climate change) has been carried out based upon the impermeable area, rainfall depth and coefficient of runoff. For the redeveloped site, the runoff volume is calculated as: 1.0% runoff x 0.0659m rainfall depth for 100 year 360 minute storm, x 1,265m² impermeable area x 1.4 for 40% climate change.

Drainage Strategy and SuDS Statement

Post Development Run-Off					
Event	C	I	A	Flow (l/s)	6hr 100 Year CC winter Volume
1 in 1 year	1.0	29.648	0.127	10.5	116.709 m3
1 in 30 years	1.0	72.682	0.127	25.7	
1 in 100 years	1.0	131.851 (+40%cc)	0.127	46.6	

Table 3: Summary of Post Development Runoff prior to mitigation

The post development run-off rates and volumes represent an increase to the calculated pre-development Greenfield run-off rate totals.

In accordance with the requirements of the LLFA and non-statutory technical standards for sustainable drainage systems, development flows should seek to discharge surface water run-off at a rate as close as reasonably practical to existing greenfield run-off rates.

A copy of the pre and post development parameters can be found in **Appendix G**.

5.6 Proposed Discharge Location

In accordance with the building regulations hierarchy, NPPF and SUDS best practice, the discharge location for surface water flows has been reviewed for applicability within the site:

Infiltration Drainage

BGS data has identified the site bedrock geology as London Clay Formation – Clay, Silt and sand sedimentary bedrock with Raised Beach Deposits – Sand and gravel superficial deposits.

Intrusive investigations undertaken by Constructive Evaluation Ltd in August 2021 did not include BRE 365 soakage tests to confirm the suitability of site soils for infiltration drainage. The investigations did however encounter groundwater at circa 1.0m depth which was considered to represent a perched water table between the made ground and relatively impermeable soils beneath.

Soilscape (England) have identified the local geology as loamy soils with naturally high groundwater which is also evidence by the ADC SFRA groundwater map in Appendix D.

Based on available data it is considered that infiltration drainage would not be feasible as a 1.0m saturation zone is required between the base of any infiltration device and groundwater table as set out in BRE 365 and CIRIA C753.

Discharge to a watercourse

There is an existing watercourse which runs parallel to the sites western boundary. To meet drainage hierarchy objectives and in accordance with best practice guidance a new connection is proposed to the same.

Discharge to a surface water sewer

Drainage Strategy and SuDS Statement

There are no surface water sewers within or around the vicinity of the site.

Discharge to a combined water sewer

There are no combined water sewers within or around the vicinity of the site.

6.7 Surface Water Drainage Strategy

SuDS Selection Criteria

The SuDS strategy for the site has sought to follow a hierarchy approach. This is tabulated below with comments and reasons where certain SuDS features have been included or excluded from the drainage strategy.

<u>SuDS Technique</u>	<u>Included / Excluded</u>	<u>Comments</u>
Living Roofs (green roofs)	Excluded	Green roofs have been excluded from the scheme as they would not suit the proposed block roof type.
Basin and ponds	Included	An detention basin has been included within the site for attenuation of development flows for the peak 1 in 100 year storm event (including climate change allowance).
Raingardens / Bio retention areas / Rainwater harvesting	Included	Rainwater butts are proposed for water re-use / recycling
Filter Strips and Swales	Excluded	Considered but excluded due to layout constraints.
Infiltration Devices	Excluded	Groundwater encountered at circa 1.0m depth so discounted for the scheme
Permeable surfaces	Included	Type C lined permeable surfaces have been incorporated within the scheme.
Tanked systems	Included	A Geo-cellular storage tanks has been incorporated within the scheme to attenuate peak site flows.
Proprietary treatment systems	Excluded	Not required as proposed SuDS measures are sufficient for water quality purposes.

Table 4: SuDS Hierarchy Approach

Drainage Strategy

In view of the requirements of the NPPF, PPG, ADC, LLFA and design parameters and constraints associated with redeveloping this site, a surface water drainage strategy design has been devised and hydraulically modeled to demonstrate that the scheme can be suitably implemented without increasing the level of flood risk, when the surface water drainage system experiences a 1:100-year rainfall event (including 40% allowance for climate change).

Drainage Strategy and SuDS Statement

The surface water drainage scheme has been designed to ensure:

- A reduction in the pre-development site discharge for peak storm events.
- Sustainable Urban Drainage systems are wholly incorporated within the scheme.
- Consideration is given for the improvement of water quality within the design.
- The designed drainage scheme can satisfactorily retain a critical 1 in 100 Year storm event with climate change.

Surface water drainage is to be discharged via a series of measures that utilise SuDS. These measures are –

- Roof runoff from Plots 1-6 shall discharge via a new storm drainage network which outfalls to a main private storm sewer network prior in the main access. Each plot is to have a rainwater butt for water recycling / landscape irrigation.
- The shared access and private parking areas are to be constructed utilizing Type C porous pavements with 350mm thickness clean stone sub-base filter material. Private parking bays shall be constructed with a light duty Type C permeable surface. **(The formation for all permeable paved surfaces shall be lined with an impermeable geomembrane to prevent groundwater ingress or infiltration)** The shared access and parking areas discharge via a sump gully outlets prior to connecting to the sealed pipe sewer network.
- An on-line detention pond has been incorporated within the scheme to provide treatment and attenuation provision for the 100 year storm even prior to controlled released into the downstream network.
- An offline geo-cellular storage tank has been also specified to attenuate peak surface flows

Proposed Discharge Rate

In reviewing the pre and post development runoff rates, the non-technical standards for sustainable drainage systems, and constraints associated with re-developing this site, it is proposed that the site discharges at **2.0l/s** for all storm events up to and including the peak 1 in 100 year event with additional 40% allowance for climate change.

The proposed rate provides betterment to the pre development 1 in 30 year and 1 in 100 year greenfield runoff rates. This rate can be reasonably achieved by the introduction of a hydro brake flow control device (or similar) demonstrating compliance with best practice guidance.

A scheme has been devised and hydraulically assessed incorporating the above mentioned SuDS measures. A copy of the surface water strategy developed for this scheme can be found in **Appendix H**

The hydraulic modelling is based upon micro drainage simulations under 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 when experiencing the critical 100 year storm event with additional 40% allowance for climate change. The hydraulic model of the proposed surface water network and SuDS devices can be found in **Appendix I**.

Drainage Strategy and SuDS Statement

The above plan and calculations demonstrate that a suitable means of drainage can be provided to drain the re-developed site in terms of surface water runoff in accordance with best practice guidance and standards.

The proposed drainage strategy ensures that surface water arising from the re-developed site would be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

Water Quality

It is important to address issues with regards to quality when considering surface water management. As surface water is proposed to be discharge to the existing downstream watercourses, treatment is proposed as part of a SuDS Management Train in accordance with the recommendations of the SuDS Manual (CIRIA 753) and as required by the LLFA.

Chapter 26 of the CIRIA SuDS Manual (2015) provides guidance on methods that should be used to design SuDS to meet the water quality design criteria and good practice design standards. Diffusion of urban pollution is a significant factor in compromising groundwater and receiving water standards that are required under the EA Water Framework Directive. Chapter 4 of the SuDs Manual summarises factors, which influence pollution levels in urban run-off. This summary is presented in **Figure 5**:

Factors influencing pollution levels in urban run-off
The amount and type of pollution washed off a surface will depend on many things including: • Planning activities on, above and adjacent to the surface that affect the deposition of pollutants, their retention on the surface and the extent to which they are mixed with runoff (including pollution prevention strategies) • Unplanned activities (accidents and spillages) that can cause temporary unexpected high pollution concentrations • The surface location and type, affecting wash-off rates and contaminant movement mechanisms • The drainage path • The length of the dry weather period before the rainfall event • The intensity and the duration of the rainfall, and the associated flow velocities • Any further pollutant transformations occurring during residence and conveyance within gullies, chambers, pipe or channel networks, gravels, soils and vegetation and quiescent bodies of water.

Figure 5: Extract of Box 4.1 of the SuDS Manual (CIRIA C753)

Table 4.3 of the SuDS Manual classifies the pollution hazard level for individual property driveways, roofs, low traffic roads and non-residential parking as being "low" and thus

Drainage Strategy and SuDS Statement

only requiring a "Simple index approach" in terms of the requirements for the discharge to groundwater.

The SuDS Manual summarises the steps for the simple index approach:

Step 1 – *Allocated suitable pollution hazard indices for the proposed land use*

Step 2 – *Select SuDS with a total pollution mitigation index that equals or exceeds the pollution index*

Step 3 – *Where the discharge to a protected surface waters or groundwater, consider the need for a more precautionary approach*

The SuDS Manual describes "protected surface waters" as protected surface water resources, which include those designated for drinking water abstraction or for other environmental protection reasons". Table 26.2 of the SuDS manual notes the following pollution hazard indices for the residential land use as depicted in Table 5 below:

Land Use	Pollution Hazard Level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul-de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. Less than 300 vehicle movements/day	Low	0.5	0.4	0.4

Table 5: Pollution Hazard Indices (CIRIA Report C753 Table 26.2)

The indicative SuDS mitigation indices for discharges to surface water sewers for the features proposed are summarised in Table 6 below.

Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Pond	0.7	0.7	0.5
Permeable pavement	0.7	0.6	0.7

Table 6: Indicative SuDS mitigation indices for discharges to surface water sewers (CIRIA Report C753 Table 26.3)

As the proposed mitigation indices exceed the land use pollution hazard the proposed SuDS components are considered sufficient in providing pollution risk mitigation in accordance with the SuDS Manual Ciria C753

Drainage Strategy and SuDS Statement

Long Term Maintenance & Management

Consideration has been given to the long term maintenance of the proposed drainage structures. The SuDS porous pavements, detention basin and all associated external pipework, chambers and manholes will be the responsibility of a management company.

An indicative maintenance plan has been developed for the proposed SuDS features associated with this scheme as illustrated within **Appendices J**.

Exceedance

Whilst the drainage system has been designed to a very high standard (1 in 100 Year storm event including climate change), it is possible that a more extreme event will occur and that the design standard for the system will be exceeded. It is best practice to design the drainage system to shed water, primarily into landscaped and other areas, therefore reducing the risk of flooding areas of built development during extreme events.

A strategy for directing overland flows has been carried out based upon preliminary access contours as illustrated on the exceedance flow path drawing presented in **Appendix K**.

6.0 Foul Water Drainage Strategy

Existing Foul Water Regime

An assessment of the sites existing foul water drainage regime has been undertaken by referring to the topographical survey and Southern Water asset searches for the area.

There are no public sewer assets within or around the vicinity of the site.

Foul Water Drainage Strategy

It is proposed that foul discharge associated with the 6 residential properties on this scheme discharges to a communal biotec sewerage treatment plant within the development with final outfall to the existing watercourse.

Long Term Maintenance

Consideration has been given to the long term maintenance of the proposed foul drainage network. It is anticipated that the foul water drainage network will remain private.

7.0 Conclusion

Following an inspection of the Environment Agency's website, the site is confirmed as being located wholly within a Flood Risk Zone 1 (are considered as having a low probability of flooding from rivers and seas).

In addition to flooding from rivers and the sea, this SuDS statement has considered the potential consequences of flooding from all other sources, which include directly from rainfall on the ground surface, rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

An assessment has been made of the potential risk from all sources of flooding to and from the development site, with reference to available flood risk information, for existing conditions pre-development, and post-development with the various development mitigation measures incorporated.

In regard to providing an acceptable standard of protection against flooding for new development, no flooding of properties should occur as a result of the 'design flood' corresponding to a 1 in 100 year fluvial flood event, taking climate change into account.

A sustainable drainage strategy, involving the implementation of SUDS, is proposed for managing the disposal of surface water runoff from the proposed development on the site utilizing a detention pond, permeable paving and geo-cellular storage thus meeting best practice.

The proposed drainage strategy would ensure that surface water arising from the developed site would be managed in a sustainable manner with a reduction to the sites pre-development surface water flows, while reducing flood risk to the site itself and elsewhere, taking climate change into account.

An outline foul water drainage strategy has been developed incorporating a gravity drainage network to a treatment plant with outfall to the existing watercourse.

The overall conclusions drawn from this drainage strategy and SuDS statement are;

- i. The Development is situated wholly within the Flood Risk Zone 1 area;
- ii. The Development and its occupants are not at an increased risk of flooding;
- iii. The Development does not increase the risk of flooding elsewhere;
- iv. The Development will be appropriately safe for its lifetime
- v. The Development can be drained in a sustainable manner utilising SUDS techniques;
- vi. The Development will satisfactorily manage and maintain a 1 in 100 Year storm event with allowance for climate change within the site
- vii. Consideration has been given for the improvement of water quality.

The findings of this report identify the opportunity to implement an appropriate SUDS strategy.

Appendices

Appendix A

Topographical Survey

Appendix B

Ground Investigation Extracts

INTERPRETATIVE SITE INVESTIGATION REPORT

At

Sefter Road, Pagham

On behalf of

Hamilton Homes and Developments Ltd

PROJECT REFERENCE: 21.1146

August 2021



constructiveevaluation

site investigation • building pathology

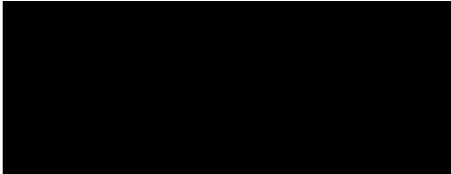


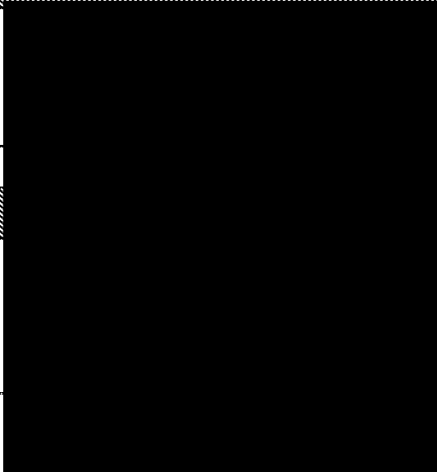
Interpretative Site Investigation Report

by

Constructive Evaluation Ltd

Units 15-16 Ford Lane Business Park, Ford, Arundel BN18 0UZ



Report Author(s)		
Isaac Betts MSc FGS (Engineering Geologist)		Date: 25/8/2021
Report Checked & Approved by		
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	Version 1	Version 2	Version 3
History			
Issued to			
Date			

Foreword

This report has been prepared by Constructive Evaluation Limited (CE) with all reasonable skill, care and diligence within the terms of the contract with the Client and should not be used in a different context. Unless specifically assigned or transferred within the terms of the agreement, CE asserts and retains all Copyright, and other Intellectual Property Rights in and over the Report and its contents.

CONTENTS

1.0	Introduction	6
1.1	SITE PROPOSAL	6
1.2	SUMMARY OF SITE INVESTIGATION	6
2.0	Site Background	7
2.1	PUBLISHED GEOLOGY	7
2.2	PHYSICAL SITE SETTING	7
3.0	Field Work	8
3.1	SOIL SAMPLE COLLECTION	8
4.0	Ground Conditions	9
4.1	OBSERVED STRATIGRAPHICAL UNITS	9
4.2	GROUNDWATER	9
4.3	FIELD EVIDENCE OF CONTAMINATION	9
5.0	In situ Testing	10
5.1	STANDARD PENETRATION TESTING	10
5.2	DYNAMIC PROBE TESTING	11
6.0	Geotechnical Laboratory Testing	12
6.1	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS	12
6.2	PARTICLE SIZE DISTRIBUTION (PSD) TESTING	12
6.3	SULPHATE AND PH ANALYSIS	12
7.0	Geotechnical Discussion	13
7.1	SOIL ENGINEERING PROPERTIES	13
7.2	SHALLOW FOUNDATIONS	13
7.3	DEEP FOUNDATIONS	13
7.4	FLOOR SLAB	14
7.5	EXCAVATIONS AND GROUNDWATER	14
7.6	CONCRETE IN AGGRESSIVE GROUND	14
7.7	FURTHER INVESTIGATION	14

FIGURES

Figure 1 – Site Location Plan

Figure 2 – Site Investigation Plan

APPENDICES

Appendix A – Site Investigation Photographs

Appendix B – Stratigraphic Logs

Appendix C - Geotechnical Laboratory Testing

Appendix D – Report Terms and Conditions

1.0 Introduction

In July 2021 Constructive Evaluation (CE) Limited was commissioned by Hamilton Homes and Developments Ltd to carry out a Site Investigation at Sefter Road, Pagham, PO21 3EE hereafter referred to as the “site”.

The purposes of this investigation and report are to identify the geotechnical properties of the ground to determine outline design parameters for foundation design.

Attention is drawn to the fact that whilst every effort has been made to ensure the accuracy of the data supplied and any analysis derived from it, there is a potential for variations in ground and groundwater conditions between and beyond the specific locations investigated. No liability can be accepted for any such variations. Furthermore, any **recommendations are specific to the client’s requirements as detailed herein and no liability will be accepted should these be used by third parties without prior consultation with Constructive Evaluation Ltd.**

A desk study as outlined in BS5930 “Code of practice for site investigations” was not requested and therefore has not been carried out.

1.1 Site Proposal

It is understood that the proposed development is the construction of a number of new residential buildings.

1.2 Summary of Site Investigation

An outline of the intrusive works instructed are summarised below:

- Up to five (5no) windowless sampler boreholes to 6mbgl or refusal

2.0 Site Background

2.1 Published Geology

Reference to the publications of the British Geological Survey (BGS), indicate the site is underlain by bedrock of the London Clay Formation. Superficial deposits of Raised Beach Deposits are recorded on site.

Raised Beach Deposits: Sand and Gravel. Superficial deposits formed up to 3 million years ago in the Quaternary Period. These sedimentary deposits are shallow-marine in origin, detrital and generally coarse grained forming beaches and bars in a coastal setting.

London Clay Formation: Clay, Silt and Sand. Sedimentary bedrock formed approximately 48 to 56 million years ago in the Palaeogene Period. These sedimentary rocks are marine in origin, detrital and range from coarse to fine grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds.

2.2 Physical Site Setting

The site comprises a triangular shaped plot of land at approximate National Grid Reference SZ 89526 99488. At the time of the site investigation the site comprised a disused field with minor construction work including a stepped trench (10mx3m) and hardstanding cover area in the north section of the site.

The majority of the site contains a cover of backfilled construction materials with some soft standing patches. The site is accessed from the north via Sefter Road and topography on site is relatively flat. The site is bound by mature and semi-mature trees of various species to the south.

The site surroundings are as follows:

- North: Sefter Road and agricultural fields,
- East: A stream trending NE-SW and agricultural fields,
- South: Residential properties and agricultural fields,
- West: Rear gardens of residential properties and agricultural fields.

A Site Location Plan is provided in **Figure 1**, with Site Investigation Photographs provided in **Appendix A**.

3.0 Field Work

The following intrusive works were carried out on 09th August 2021, supervised by an Engineering Geologist from CE:

- Four (4no) windowless sampler boreholes to a maximum of 6mbgl,
- Two (2no) super heavy dynamic probe to a maximum of 6mbgl.

A Site Investigation Plan can be found in **Figure 2**.

The ground investigation was undertaken in accordance with the scope of works agreed with our Client and in relation to statutory guidance including BS5930: 1999 Code of Practice for Site Investigations (Amendment 3: 2015) and BS10175: 2011+A1: 2013 Investigation of Potentially Contaminated Sites: Code of Practice.

3.1 Soil Sample Collection

All intrusive locations were logged, visual and/or olfactory evidence of contamination noted, and representative soil sample removed in accordance with current protocol for geotechnical parameters.

4.0 Ground Conditions

4.1 Observed Stratigraphical Units

The following anthropogenic (made ground) strata were encountered during the intrusive works:

The surface cover identified across all locations considered to be resultant from recent profiling works at the site extending to depths of 1mbgl to 1.1mbgl. The material is somewhat variable in composition; however, it is largely comprised of slightly sandy slightly gravelly CLAY. The gravels are noted to be of red brick, concrete, tile, flint, glass, metal, and inclusions of plastic.

Beneath the made ground material, the natural stratigraphic sequence is as follows:

Slightly sandy slightly gravelly Clay: greyish brown slightly sandy slightly gravelly CLAY. Gravel was noted to be of flint. This is inferred to possibly represent either a superficial deposit or the top of the weathered London Clay or a reworked fill material derived from the latter. This material was encountered in all intrusive locations to a maximum depth of 2.4mbgl in WLS3.

Raised Beach Deposits: yellowish brown gravelly SAND. This was encountered to a maximum depth of 2.7mbgl within WLS1 and WLS4.

London Clay Formation: firm to stiff fissured dark grey CLAY. The London Clay Formation is encountered below the natural soils.

Bognor Sand Member: Very dense dark grey clayey SAND. The Bognor Sand Member is encountered below the London Clay Formation.

Reference should be made to the **engineer's** logs contained within **Appendix A** for a more detailed description.

4.2 Groundwater

Groundwater was encountered within WLS3 and WLS4 recorded at 5.2mbgl and 5.4mbgl respectively. Shallow groundwater was encountered at 1.0mbgl within all inspection pits considered to represent a perched water table between the Made Ground and relatively impermeable clays beneath. Furthermore, groundwater levels may vary both seasonally and in the long term.

4.3 Field Evidence of Contamination

A suspected fragment of asbestos was noted in proximity to the inspection pit of WLS5/DP5.

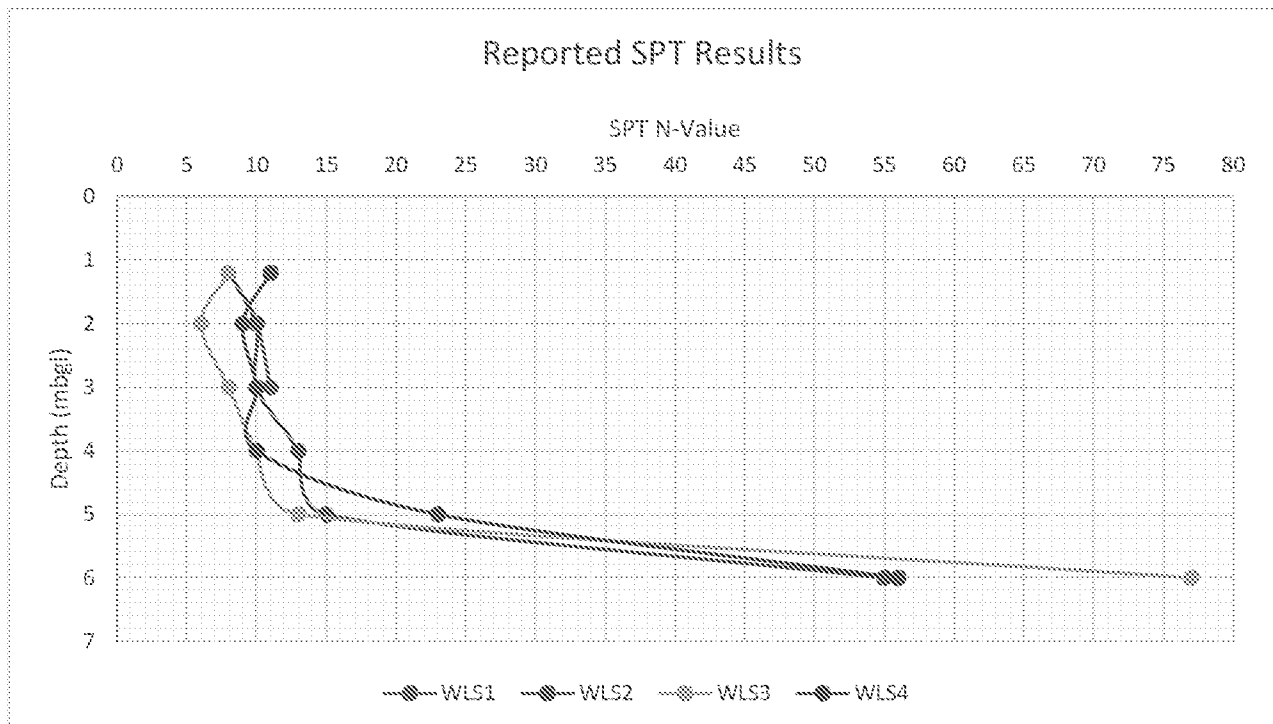
5.0 In situ Testing

5.1 Standard Penetration Testing

Standard penetration testing (SPT) was completed throughout the drilling of WLS1 to WLS4 at 1m centres.

This form of testing is completed using a 63.5kg drop hammer weight, over a 750mm drop, measuring the blow counts for six, 75mm increments. The first two values are recorded as seating blows, with the remaining four values, added together to provide an 'N-value'.

The results of the SPT testing are presented in the graph below:



Four (4no) tests were carried out within the slightly sandy slightly gravelly Clay soils returning a range of N-values of N=6 to N=11.

Within the underlying Raised Beach Deposits, SPT N-values show a range between N=9 and N=10.

Within the London Clay Formation, SPT N-values show initial values in the order of N=8-11 with a gradual increase in N-value between 2mbgl and 5mbgl to N-values between N=13 and N=23. Using the relationship described by Stroud & Butler and a moderately conservative F1 value of 4.5 these values correspond to a range of undrained shear strength of between 36kN/m² to 103.5kN/m².

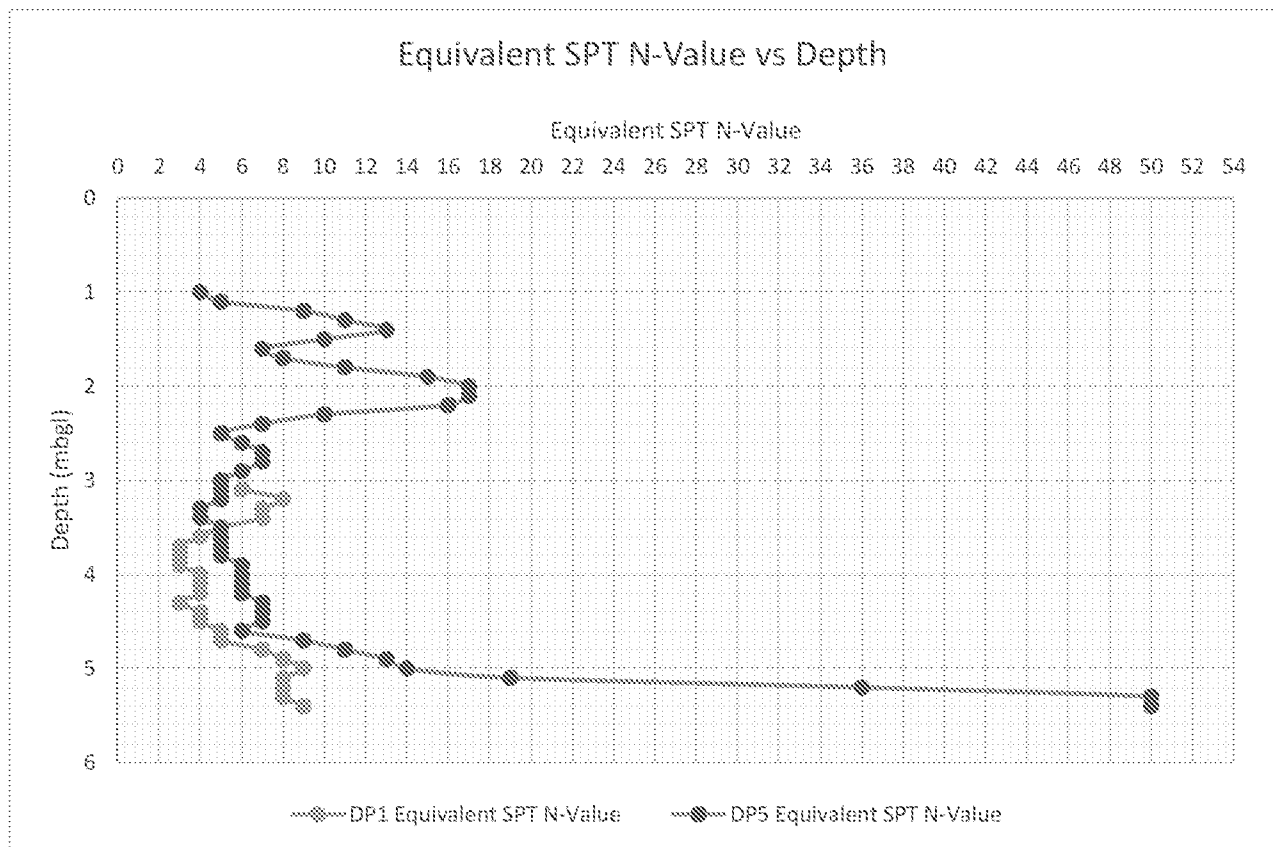
Within the underlying Bognor Sand Member, SPT N-values show a sharp increase to refusal at 6mbgl. The SPT tests carried out at 6.0mbgl in WLS2 & WLS3 returned extrapolated SPT-N values of N=55 and N=77 respectively both of which are regarded as refusals.

5.2 Dynamic Probe Testing

Two super heavy dynamic probe tests (DPSH-B) were complete during the field works. The first test was complete through the base of WLS1 from 3mbgl to 6mbgl. The second test was complete in replace of WLS5 from 1mbgl to 6mbgl.

This form of testing is completed using a 63.5kg drop hammer weight, over a 760mm drop, measuring the blow counts across 100mm increments. Due to the same parameters as an SPT the values are recorded and can be added together over 300mm to provide an equivalent 'N-value'.

The graphs below summarise the equivalent SPT N-value results:



DP1 complete through the base of WLS1 from 3mbgl shows a generally increasing equivalent N-value with depth. DP5 complete through the base of the inspection pit shows a consistent weak equivalent SPT N-values to approximately 4.5mbgl then shows a sharp increase toward 6mbgl.

For the uncorrected DPSH-B data and stratigraphic logs, see Appendix B.

7.0 Geotechnical Discussion

7.1 Soil Engineering Properties

It is understood that the proposed development is the construction of a series of new two-storey residential properties. The exact proposed loadings of the new buildings are not known; however, they are expected to be low to moderate on the basis of the anticipated nature of the development.

Two tests were carried out within the Raised Beach Deposits returning a range of SPT N values of N=9 and N=10.

Ten tests were carried out within the London Clay Formation returning a range of SPT N values between N=8 to N=23.

Two tests were carried out within the Bognor Sand Member returning refusals with extrapolated SPT N-values of N=55 and N=77 suggesting very dense materials.

The two dynamic probe (DPSH-B) tests (DP1 & DP5) correlate well with the SPT results above proving a significantly more resistant soil from approximately 5.5mbgl.

Laboratory testing has indicated that the cohesive soils are of worst case High volume change potential.

7.2 Shallow Foundations

Any foundations formed within Made Ground soils would be expected to be subject to total and differential settlement beyond tolerable limits. These soils are frequently present in a variable and inconsistent nature such that would render them unsuitable as a founding strata.

The soils of the Raised Beach Deposits are noted to be both laterally and vertically variable across the site, which in conjunction to the low SPT-N results suggest that any foundations formed upon these materials would be expected to be subject to total and differential settlement beyond tolerable limits, and as such CE would regard these materials as unsuitable as a founding stratum.

7.3 Deep Foundations

Deep foundation methods may prove more suitable to mitigate settlement beyond tolerable limits. Utilising a bored piling technique into the clayey Sand of the Bognor Sand Member to at least 6.0mbgl, an ultimate bearing capacity of up to 150kN is likely achievable.

It should be noted that the thickness of the Bognor Sand Formation remains unproven and as such it is advised that if a deep foundation option is chosen that further investigation works would be recommended to at least 1.5 times the proposed founding level of the piles and a specialist piling contractor is consulted prior to any further works.

A specialist structural engineer should be consulted for final foundation designs.

7.4 Floor Slab

The floor slab design will depend on the final foundation designs and is dependent on the underlying materials, including bearing capacity and the presence of any cohesive or Made Ground Soils.

Owing to the presence of worst case High shrinkage potential soils it is recommended that a fully suspended floor slab is adopted for the new development.

7.5 Excavations and Groundwater

Due to the potentially granular nature of the Raised Beach Deposits encountered during the site investigation, it is recommended that adequate trench support is provided in order to satisfy statutory safety regulations during any excavation works on site.

Groundwater was encountered within the upper soil profile during the site investigation and therefore dewatering is likely to be required in any excavations. Groundwater levels are dependent upon seasonal variations and levels may change after periods of heavy rainfall or prolonged drought. Where groundwater or surface water is encountered within any excavations during the construction phase it should be dealt with appropriately and removed using good engineering practices.

7.6 Concrete in Aggressive Ground

The results of laboratory testing have indicated that a design class of DS-1 and subclass of AC-1s will be suitable for buried concrete on this site. This is in response to a maximum water-soluble sulphate concentration of 155mg/l and a minimum pH value of 7.9.

7.7 Further Investigation

The low strength and variable nature of the shallow raised beach deposits suggests that a shallow foundation may not be suitable at this site. CE would suggest that a deep piled foundation design be considered and that some further investigation works may be required.

CE would recommend that at least one 10-12mbgl borehole be carried out using cable percussive or rotary techniques with the aim of providing additional soil parameters for pile design and proving the thickness and extent of the Bognor Sand Formation.

CE would also recommend that this borehole be installed with a groundwater and gas monitoring standpipe, with water levels monitored over the winter period to understand peak / high groundwater levels at the site.

Notes:

1. Do not scale from this drawing.
2. All dimensions must be checked on site prior to commencement of work.
3. Where applicable this drawing is to be read in conjunction with other consultants drawings.
4. This drawing is the copyright of Constructive Evaluation Ltd.

KEY

WLS

DP

Drawing Title:
Site Investigation Plan

Project Reference:
21.1146

Site Name:
Sefter Road, Pagham

Revision: 0
Drawn by: IB
Scale: Not to Scale



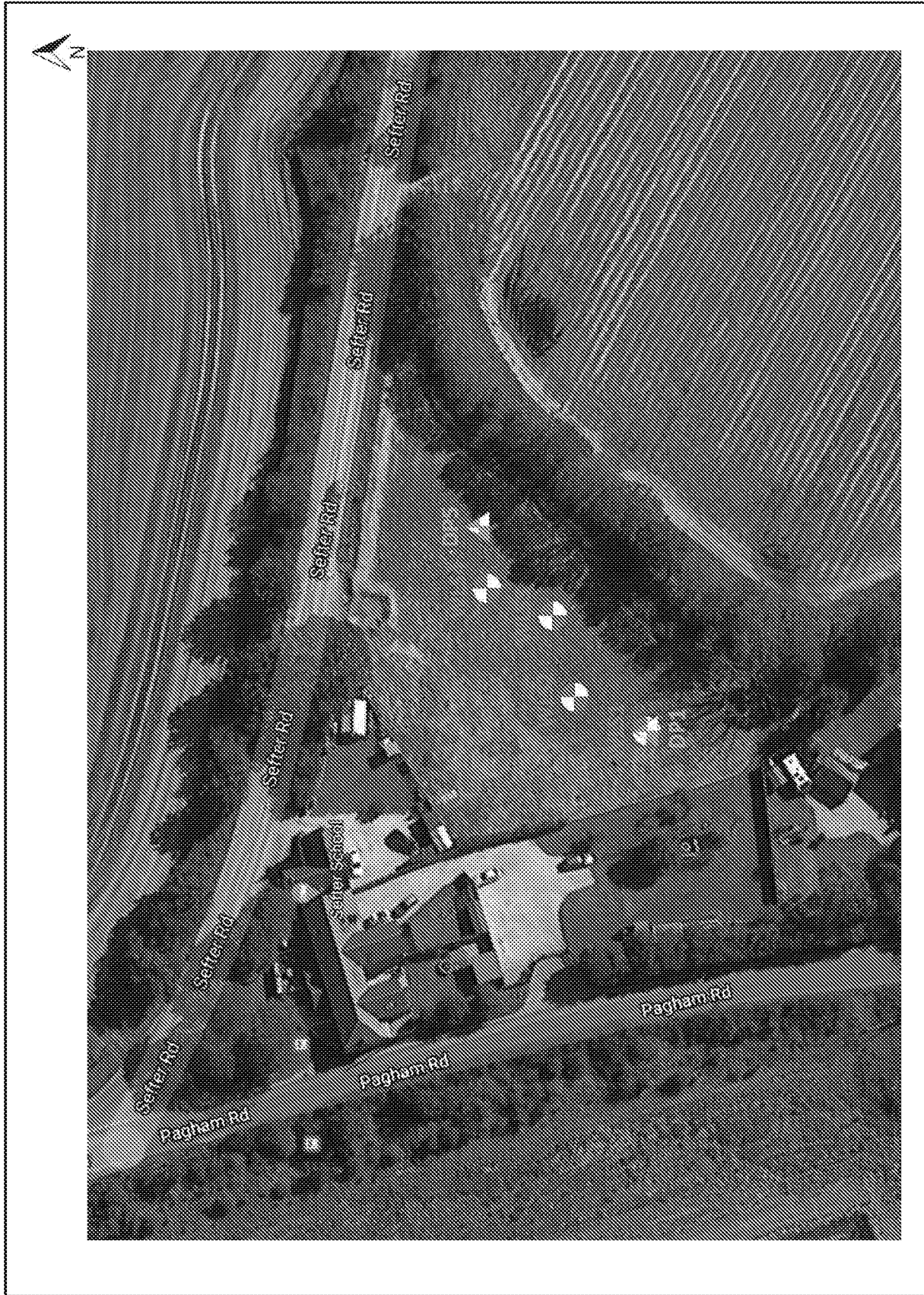



Figure 2: Site investigation plan showing the final positions of the intrusive works completed.



Borehole Log

Borehole No.

WLS1

Sheet 1 of 1

Project Name: Sefter Road

Project No.
21.1146

Co-ords: 489516E - 99462N

Hole Type
WLS

Location: Pagham

Level:

Scale
1:36

Client: David Stone

Dates: 09/08/2021

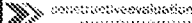
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IB

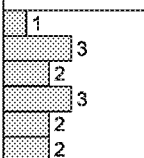
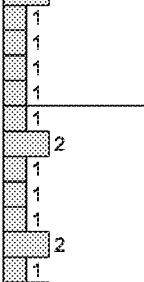
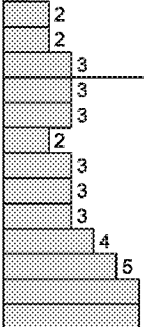
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.20	SPT	N=8 (1,2/2,2,2,2)	1.10			Greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular and sub-angular fine to coarse of red brick concrete glass flint tile and plastic. Low cobble content of angular red brick and concrete. (MADE GROUND)	1
		1.30 - 1.50	D					Firm brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is sub-angular to rounded fine to coarse of flint.	
		1.80 - 1.90	D		1.70			Firm brown mottled grey CLAY.	
		2.00	SPT	N=10 (1,3/2,3,2,3)	1.95			Loose brown gravelly SAND. Sand is fine to coarse. Gravel is sub-angular to rounded fine to coarse of flint. (RAISED BEACH DEPOSITS)	2
		2.40 - 2.60	D					<i>Becoming progressively more silty/clayey with depth.</i>	
		2.70 - 2.90	D		2.70			Stiff dark grey mottled brown slightly sandy CLAY. Sand is fine to coarse. (LONDON CLAY FORMATION)	3
		3.00	SPT	N=11 (1,3/2,3,3,3)					
					3.45			End of Borehole at 3.450m	4
									5
									6
									7

Remarks

1. Location scanned using CAT and Genny prior to breaking ground and every 0.3m to 1.2mbgl.
2. Position ceased after 3m due to collapse of borehole.
3. DPSH-B testing was complete through the base of the borehole from 3mbgl to 6mbgl.



		Probe Log		Borehole No. DP1	
Project Name: Sefter Road		Project No. 21.1146		Co-ords: 489516.00 - 99462.00	
Location: Pagham		Level:		Hole Type DP	
Client: David Stone		Dates: 09/08/2021 -		Logged By	

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
1					
2					
3					
4					
5					
6					

Remarks 1. Location scanned using CAT and Genny prior to breaking ground and every 0.3m to 1.2mbgl. 2. Testing was complete through the base of WLS1 starting from 3mbgl to 6mbgl.	Fall Height 760	Cone Base Diameter 55
	Hammer Wt 64	Final Depth 6.00
	Probe Type DPSH-B	Log Scale 1:30
		



Borehole Log

Borehole No.

WLS2

Sheet 1 of 1

Project Name: Sefter Road

Project No.
21.1146

Co-ords: 489521E - 99476N

Hole Type
WLS

Location: Pagham

Level:

Scale
1:36

Client: David Stone

Dates: 09/08/2021

Logged By
IB

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Dark greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse of red brick concrete metal plastic glass and flint. Low cobble content of angular red brick and concrete. (MADE GROUND)	
		1.20 1.30 - 1.50	SPT D	N=8 (1,2/2,2,2,2)	1.10			Soft greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is sub-angular to rounded fine to coarse of flint.	1
		1.80 - 2.00	D		1.70			Firm red mottled brown and grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is sub-angular to rounded fine and medium of flint.	2
		2.00 2.20 - 2.40	SPT D	N=10 (1,1/2,2,3,3)	2.00			Stiff grey mottled brown slightly sandy CLAY. Sand is fine to coarse. (LONDON CLAY FORMATION)	
					2.50			Stiff fissured dark grey CLAY. Fissures are randomly orientated extremely closely spaced planar smooth with low polish. (LONDON CLAY FORMATION)	3
		3.60 - 3.70	D						
		4.00	SPT	N=13 (1,4/3,3,4,3)					4
		4.60 - 4.80	D						
		5.00	SPT	N=15 (1,4/4,4,3,4)	5.20			Stiff dark grey sandy CLAY. Sand is fine to coarse. (BOGNOR SAND MEMBER)	5
		5.60 - 5.80	D						
		6.00	SPT	55 (8,10/55 for 225mm)	6.45				6
								End of Borehole at 6.450m	7

Remarks

- Location scanned using CAT and Genny prior to breaking ground and every 0.3m to 1.2mbgl.
- Borehole was cased from ground level to 2mbgl.





Borehole Log

Borehole No.

WLS3

Sheet 1 of 1

Project Name: Sefton Road

Project No.
21.1146

Co-ords: 489534E - 99480N

Hole Type
WLS

Location: Pagham

Level:

Scale
1:36

Client: David Stone

Dates: 09/08/2021

Logged By
IB

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Dark greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse of red brick concrete metal plastic glass and flint. Low cobble content of angular red brick and concrete. (MADE GROUND)	
		1.20	SPT	N=8 (2,3/2,2,2,2)	1.00			NO RECOVERY	1
		1.80 - 2.00	D		1.80				
		2.00	SPT	N=6 (1,2/1,1,2,2)				Soft greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is sub-angular to rounded fine to coarse of flint.	2
		2.30 - 2.50	D		2.40				
		2.70 - 2.90	D		2.80			Firm brown mottled grey CLAY. (LONDON CLAY FORMATION)	
		3.00	SPT	N=6 (1,2/2,2,2,2)				Stiff fissured dark grey CLAY. Fissures are randomly orientated extremely closely spaced planar smooth with low polish. (LONDON CLAY FORMATION)	3
		3.50 - 3.70	D						
		4.00	SPT	N=10 (1,2/2,2,3,3)					4
		4.60 - 4.70	D						
		5.00	SPT	N=13 (1,3/4,3,3,3)	5.20				5
		5.60 - 5.80	D					Stiff dark grey sandy CLAY. Sand is fine to coarse. (BOGNOR SAND MEMBER)	
		6.00	SPT	77 (2,5/77 for 260mm)					6
					6.45			End of Borehole at 6.450m	7

Remarks

1. Location scanned using CAT and Genny prior to breaking ground and every 0.3m to 1.2mbgl.
2. Borehole was cased from ground level to 2mbgl.



 constructiveevaluation site investigation • building pathology		Borehole Log			Borehole No. WLS4 Sheet 1 of 1	
Project Name: Sefter Road		Project No. 21.1146		Co-ords: 489538E - 99494N		Hole Type WLS
Location: Pagham		Level:		Scale 1:36		Logged By IB
Client: David Stone		Dates: 09/08/2021				

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							Greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse of red brick concrete metal plastic glass and flint. Low cobble content of angular red brick and concrete. (MADE GROUND)	1	
		1.20	SPT	N=11 (2,3/3,2,3,3)	1.05		Soft greenish grey mottled brown slightly sandy slightly gravelly glauconitic CLAY. Sand is fine to coarse. Gravel is sub-angular and sub-rounded fine to coarse of flint.		
		1.60 - 1.80	D		1.40		Loose yellowish brown gravelly SAND. Sand is fine to coarse. Gravel is sub-angular to rounded fine to coarse of flint. (RAISED BEACH DEPOSITS)		
		2.00	SPT	N=9 (1,3/2,2,2,3)				2	
		2.40 - 2.60	D		2.70				
		3.00	SPT	N=10 (1,2/2,2,3,3)			Stiff fissured dark grey CLAY. Fissures are randomly orientated extremely closely spaced planar smooth with low polish. (LONDON CLAY FORMATION)	3	
		3.60 - 3.70	D						
		4.00	SPT	N=10 (1,1/2,2,3,3)				4	
		4.50 - 4.70	D				<u>Partitions of dark grey Sand.</u>		
		5.00	SPT	N=23 (1,3/4,5,6,8)	5.10		Very dense dark grey clayey SAND. Sand is fine to coarse. (BOGNOR SAND MEMBER)	5	
	6.00	SPT	56 (1,5/56 for 225mm)	6.45		End of Borehole at 6.450m	6		
								7	

Remarks 1. Location scanned using CAT and Genny prior to breaking ground and every 0.3m to 1.2mbgl. 2. Borehole was cased from ground level to 3mbgl.		
---	--	---

Appendix C

Environment Agency Flood Map

Flood map for planning

Your reference
21-023

Location (easting/northing)
489531/99490

Created
10 Aug 2021 16:37

Your selected location is in flood zone 1, an area with a low probability of flooding.

This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

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

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

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

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2021 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>

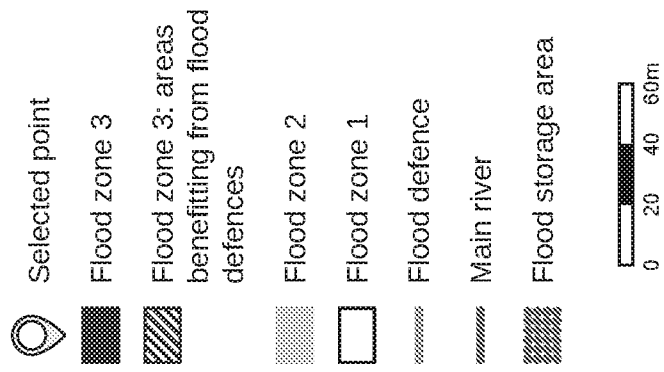
Flood map for planning

Your reference
21-023

Location (easting/northing)
489531/99490

Scale
1:2500

Created
10 Aug 2021 16:37



Page 2 of 2



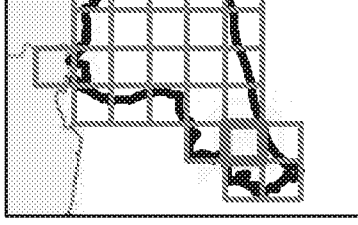
Appendix D

ADC SFRA Mapping

from a number of sources.

Please note that not all historic map data is included in this map, and that it is therefore not a definitive map. The Council for updated information.

Key



Legend

Arun District SFRA

Historic flood outline

Source of flooding

Fluvial

Coastal

0 0.125 0.25

REF	Date	Comments
A	June 2018	
B		
C		

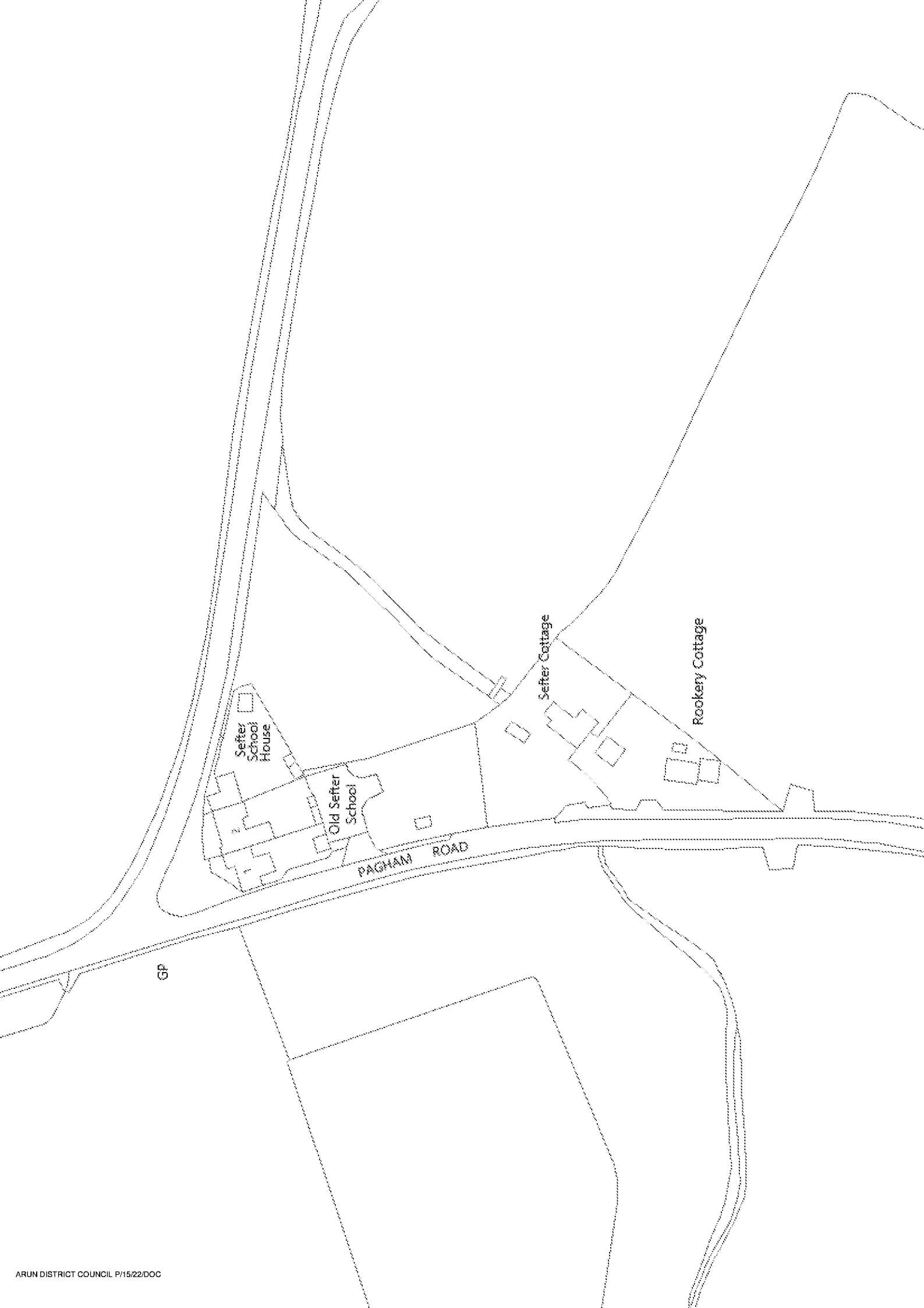
This map is based upon Ordnance Survey data and is not a substitute for a professional survey. It is provided for information only and is not to be used for legal purposes. © 2018 Arun District Council

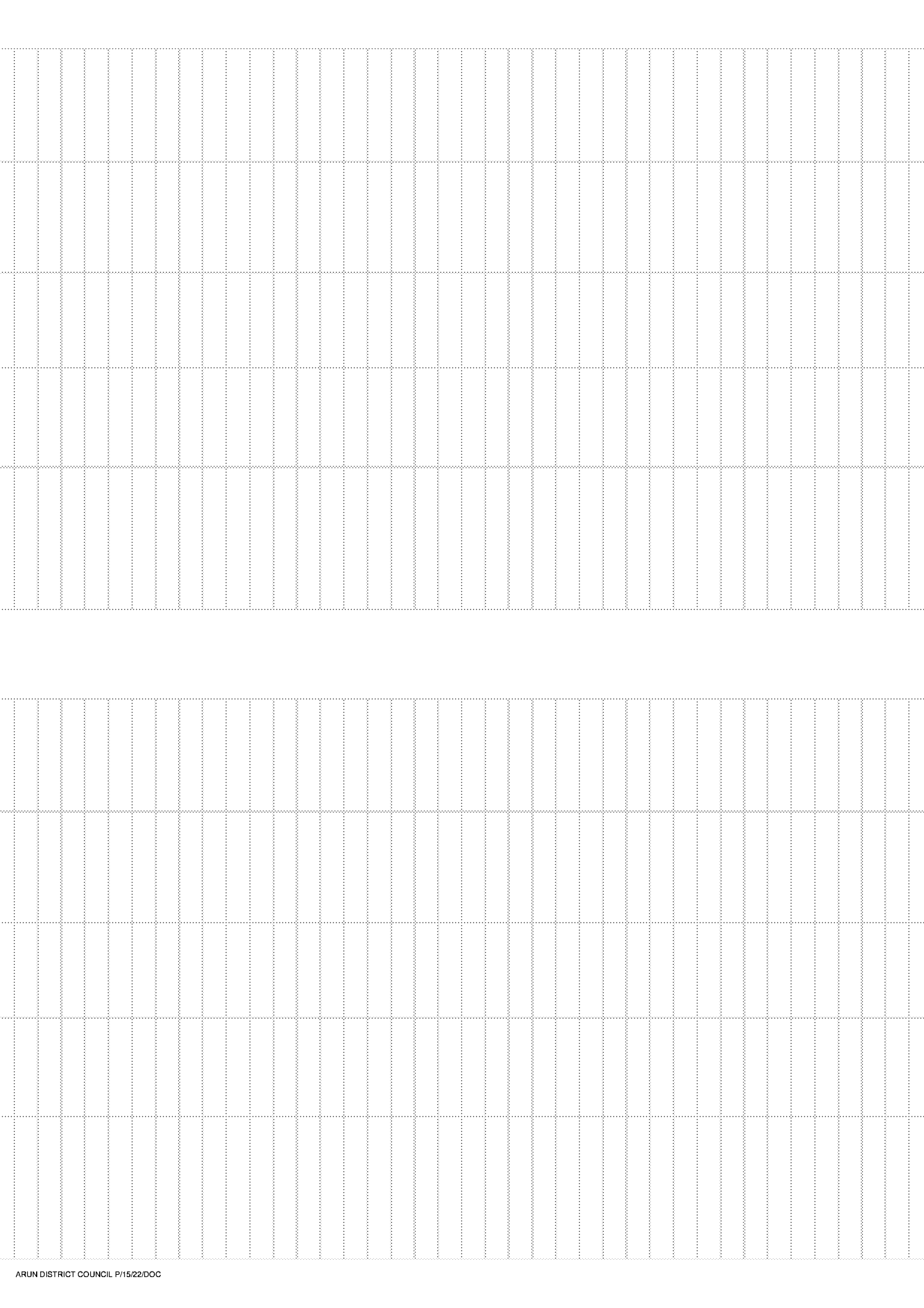
ARUN DISTRICT COUNCIL LEVEL 1 SFRA HISTORIC FLOODING



Appendix E

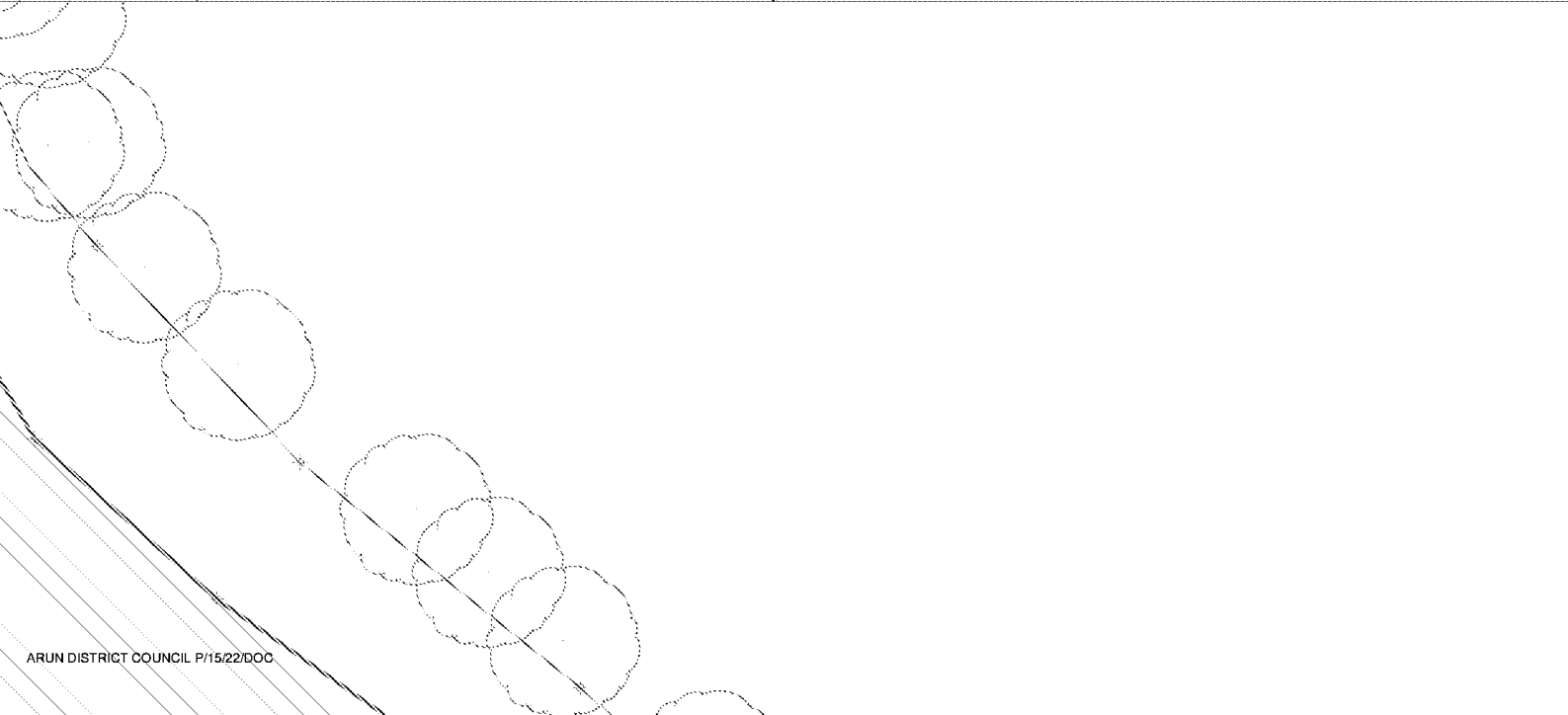
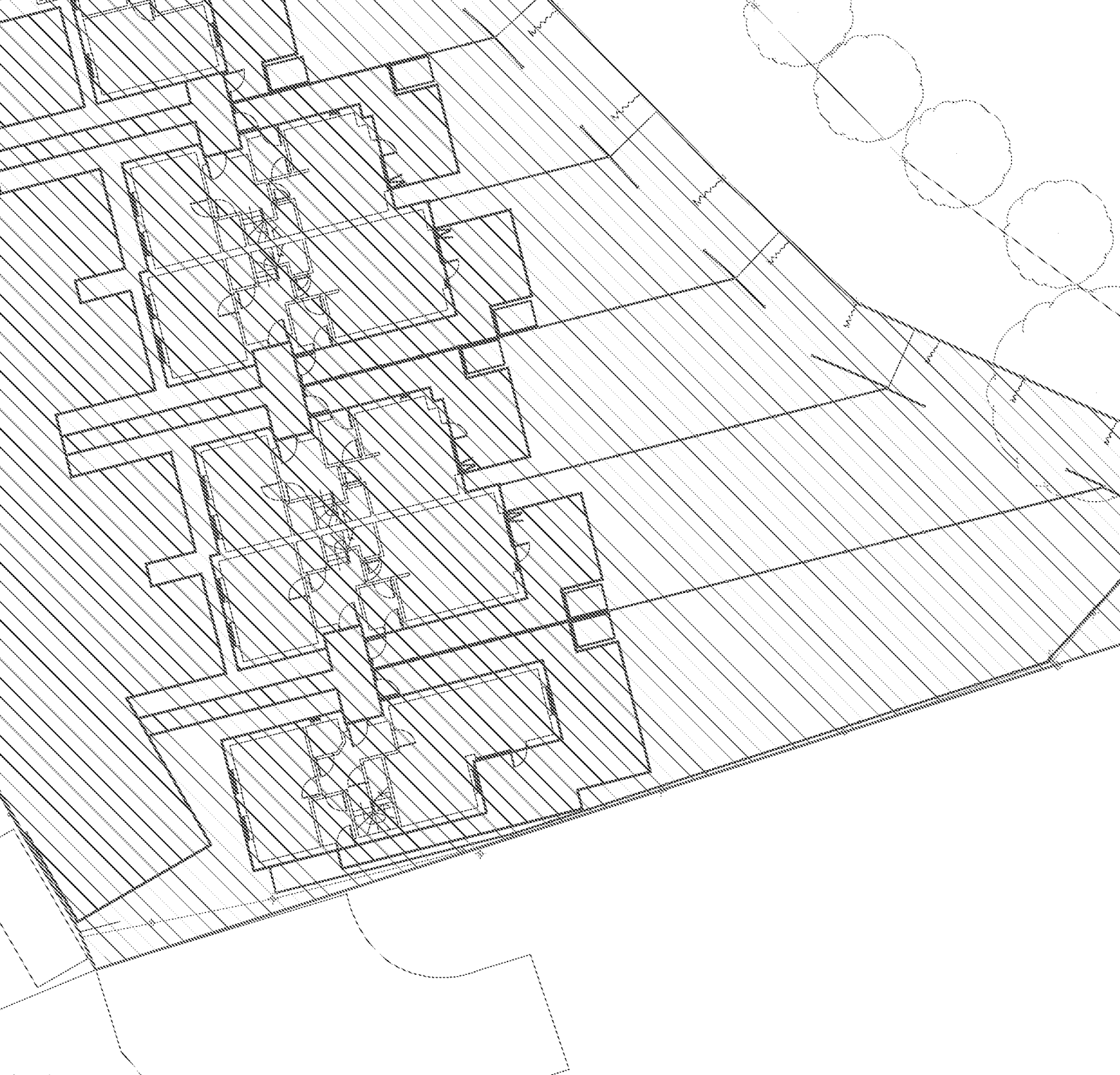
Southern Water Asset Search





Appendix F

Catchment Areas



Appendix G

Development Runoff

Adama Consulting Ltd		Page 1
Unit 34 The Enterprise Centre Cranborne Rd Potters Bar EN6 3DQ	Land at Sefton Road Greenfield Runoff	
Date 07/10/2021 File	Designed by TGL Checked by MTD	
Micro Drainage	Source Control 2020.1	

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	0.267	Urban	0.000
SAAR (mm)	724	Region Number	Region 7

Results l/s

QBAR Rural	0.9
QBAR Urban	0.9
Q100 years	3.0
Q1 year	0.8
Q30 years	2.1
Q100 years	3.0

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Adama Consulting Ltd		Page 1
Unit 34 The Enterprise Centre Cranborne Rd Potters Bar EN6 3DQ	Land at Seftor Road Greenfield Volume	
Date 07/10/2021 File	Designed by TGL Checked by MTD	
Micro Drainage	Source Control 2020.1	

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.000
Ratio R	0.350
Area Reduction Factor	1.00
Area (ha)	0.267
SAAR (mm)	727
CWI	108.484
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	36.91
Greenfield Runoff Volume (m³)	62.121

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Appendix G: Post Run-off Parameters

Rainfall Intesity

15 minute 1 year Winter I+0%
Average Rainfall Intensity 29.648 mm/hr

15 minute 30 year Winter I+0%
Average Rainfall Intensity 72.682 mm/hr

15 minute 100 year Winter I+40%
Average Rainfall Intensity 131.851 mm/hr

Rainfall Depth for 360min Storm

360 minute 100 year Winter I+0%
Average Rainfall Intensity 10.975 mm/hr

Rainfall depth = 0.010975m x 6hours

Rainfall depth = 0.0659m

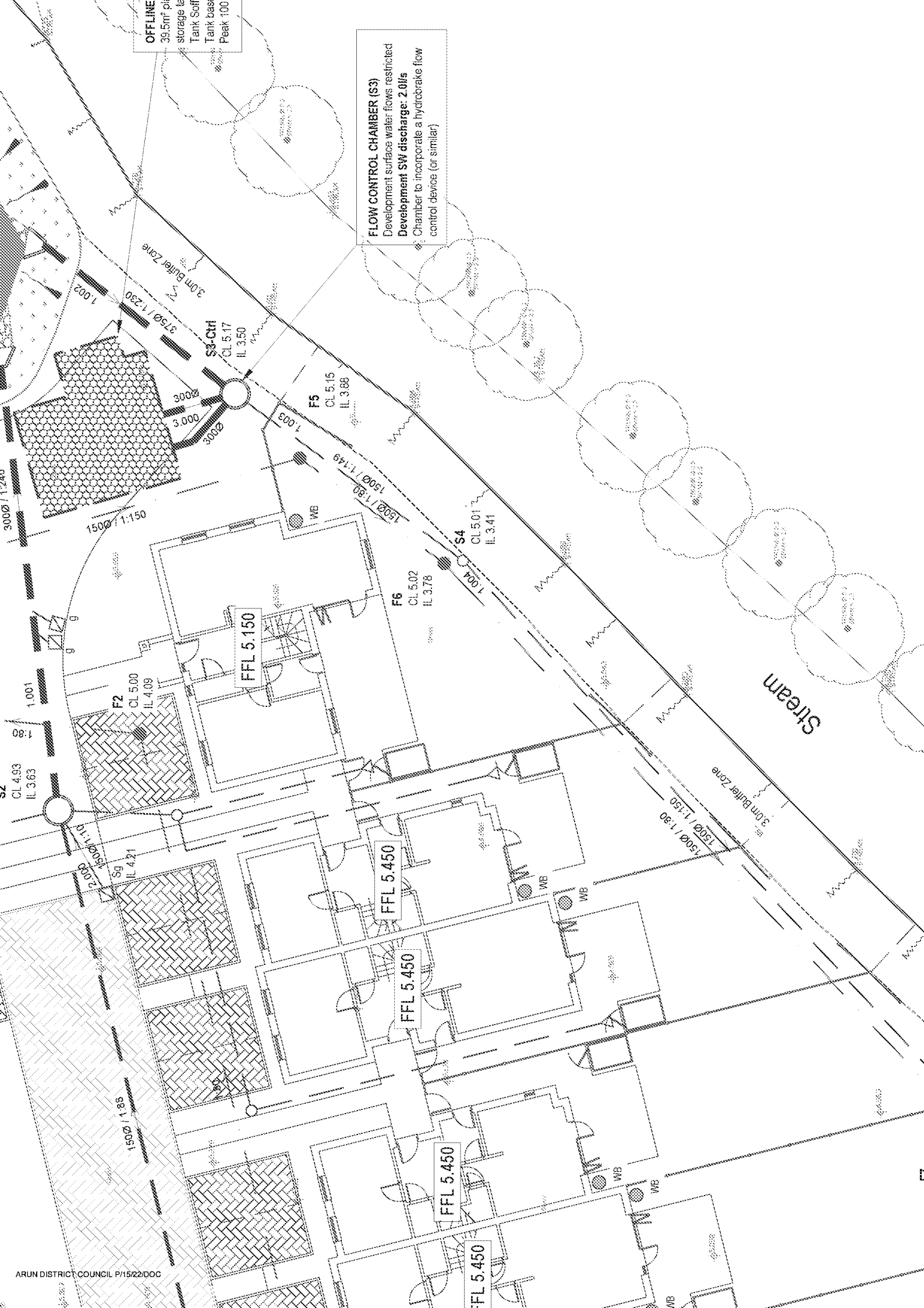
Appendix H

Drainage Strategy

OFFLINE
39.5m² pit
storage tank
Tank Soft
Tank base
Peak 100

FLOW CONTROL CHAMBER (S3)

Development surface water flows restricted
Development SW discharge: 2.0l/s
Chamber to incorporate a hydrobrake flow
control device (or similar)



Appendix I

Micro Drainage Hydraulic Model

Adama Consulting Ltd		Page 1
Unit 34 The Enterprise Centre Cranborne Rd Potters Bar EN6 3DQ	Land at Seftor Road Pagham SW Strategy - 2.0l/s	
Date 08/10/2021 File 21-023 SW Strategy.MDX	Designed by TGL Checked by MTD	
Micro Drainage	Network 2020.1	

Time Area Diagram for 21-023 SW Strategy.sws

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.060	4-8	0.067

Total Area Contributing (ha) = 0.127

Total Pipe Volume (m³) = 4.906

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Unit 34 The Enterprise Centre Cranborne Rd Potters Bar EN6 3DQ	Land at Seftor Road Pagham SW Strategy - 2.0l/s	
Date 08/10/2021 File 21-023 SW Strategy.MDX	Designed by TGL Checked by MTD	
Micro Drainage	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 21-023 SW Strategy.sws

- Indicates pipe length does not match coordinates
« - Indicates pipe capacity < flow

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	29.036	0.332	87.5	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	⊗
2.000	4.395	0.423	10.4	0.020	5.00	0.0	0.600	o	150	Pipe/Conduit	⊗
1.001	20.374#	0.085	239.7	0.072	0.00	0.0	0.600	o	300	Pipe/Conduit	⊗*
1.002	11.040#	0.048	230.0	0.002	0.00	0.0	0.600	o	375	Pipe/Conduit	⊗
3.000	3.390	0.015	226.0	0.000	5.00	0.0	0.600	oo	300	Double Pipe	⊗
1.003	12.824	0.086	149.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	⊗
1.004	34.284	0.229	149.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	⊗
1.005	13.961	0.093	150.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	⊗
1.006	5.481	0.037	148.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	⊗

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL Σ (m)	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	5.45	4.114	0.033	0.0	0.0	0.0	1.08	19.0	4.5
2.000	50.00	5.02	4.205	0.020	0.0	0.0	0.0	3.14	55.6	2.7
1.001	50.00	5.79	3.632	0.125	0.0	0.0	0.0	1.01	71.5	16.9
1.002	50.00	5.94	3.547	0.127	0.0	0.0	0.0	1.19	131.5	17.2
3.000	50.00	5.05	3.514	0.000	0.0	0.0	0.0	1.04	147.3	0.0
1.003	50.00	6.20	3.499	0.127	0.0	0.0	0.0	0.82	14.5«	17.2
1.004	50.00	6.90	3.413	0.127	0.0	0.0	0.0	0.82	14.5«	17.2
1.005	50.00	7.18	3.184	0.127	0.0	0.0	0.0	0.82	14.5«	17.2
1.006	50.00	7.29	3.091	0.127	0.0	0.0	0.0	0.82	14.6«	17.2

Adama Consulting Ltd		Page 3
Unit 34 The Enterprise Centre Cranborne Rd Potters Bar EN6 3DQ	Land at Sefton Road Pagham SW Strategy - 2.0l/s	
Date 08/10/2021 File 21-023 SW Strategy.MDX	Designed by TGL Checked by MTD	
Micro Drainage	Network 2020.1	

Online Controls for 21-023 SW Strategy.sws

Hydro-Brake® Optimum Manhole: S3-Ctrl, DS/PN: 1.003, Volume (m³): 4.4

Unit Reference	MD-SHE-0069-2000-0898-2000
Design Head (m)	0.898
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	69
Invert Level (m)	3.499
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.898	2.0
Flush-Flo™	0.273	2.0
Kick-Flo®	0.563	1.6
Mean Flow over Head Range	-	1.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.7	1.200	2.3	3.000	3.5	7.000	5.2
0.200	2.0	1.400	2.4	3.500	3.7	7.500	5.3
0.300	2.0	1.600	2.6	4.000	4.0	8.000	5.5
0.400	1.9	1.800	2.7	4.500	4.2	8.500	5.7
0.500	1.8	2.000	2.9	5.000	4.4	9.000	5.8
0.600	1.7	2.200	3.0	5.500	4.6	9.500	6.0
0.800	1.9	2.400	3.1	6.000	4.8		
1.000	2.1	2.600	3.3	6.500	5.0		

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Unit 34 The Enterprise Centre Cranborne Rd Potters Bar EN6 3DQ	Land at Sefter Road Pagham SW Strategy - 2.0l/s	
Date 08/10/2021 File 21-023 SW Strategy.MDX	Designed by TGL Checked by MTD	
Micro Drainage	Network 2020.1	

Storage Structures for 21-023 SW Strategy.sws

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

Infiltration Coefficient Base (m/hr) 0.00000
Membrane Percolation (mm/hr) 1000
Max Percolation (l/s) 49.7
Safety Factor 3.0
Porosity 0.32
Invert Level (m) 4.395
Width (m) 6.0
Length (m) 29.8
Slope (1:X) 80.0
Depression Storage (mm) 5
Evaporation (mm/day) 3
Cap Volume Depth (m) 0.350

Tank or Pond Manhole: Pond, DS/PN: 1.002

Invert Level (m) 3.547

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	13.7	0.850	88.7

Cellular Storage Manhole: CS-Tank, DS/PN: 3.000

Invert Level (m) 3.514
Infiltration Coefficient Base (m/hr) 0.00000
Infiltration Coefficient Side (m/hr) 0.00000
Safety Factor 3.0
Porosity 0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	39.5	39.5	0.801	0.0	60.1
0.800	39.5	60.1			

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	S1	1.335	0.492	0.000	1.826
2.000	Sq	0.152	0.063	17.998	18.213
1.001	S2	1.470	1.350	0.000	2.820
1.002	Pond	1.217	1.062	38.890	41.169
3.000	CS-Tank	0.233	0.341	30.033	30.607
1.003	S3-Ctrl	2.960	0.209	0.000	3.169
1.004	S4	0.254	0.598	0.000	0.852
1.005	S5	0.250	0.239	0.000	0.489
1.006	S6	0.125	0.093	0.000	0.217
Total		7.995	4.447	86.920	99.363

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Unit 34 The Enterprise Centre									
Cranborne Rd Potters Bar									
EN6 3DQ									
Date 08/10/2021				Designed by TGL					
File 21-023 SW Strategy.MDX				Checked by MTD					
Micro Drainage				Network 2020.1					
1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 21-023 SW Strategy.sws									
Simulation Criteria									
Area Reduction Factor		1.000		Additional Flow - % of Total Flow		0.000			
Hot Start (mins)		0		MADD Factor * 10m³/ha Storage		0.000			
Hot Start Level (mm)		0		Inlet Coefficient		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		3			
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		0.350			
Region England and Wales		Cv (Summer)		0.750					
M5-60 (mm)		19.000		Cv (Winter)		1.000			
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, 0, 40							
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	
1.000	S1	15 Winter	1	+0%	100/15 Winter				
2.000	Sg	30 Winter	1	+0%	100/240 Winter				
1.001	S2	15 Winter	1	+0%	30/60 Winter				
1.002	Pond	120 Winter	1	+0%	30/60 Winter				
3.000	CS-Tank	120 Winter	1	+0%	30/30 Winter				
1.003	S3-Ctrl	120 Winter	1	+0%	1/30 Winter				
1.004	S4	120 Winter	1	+0%					
1.005	S5	120 Winter	1	+0%					
1.006	S6	120 Winter	1	+0%					
PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	S1	4.167	-0.097	0.000	0.27			4.9	OK
2.000	Sg	4.233	-0.122	0.000	0.06		8	2.4	OK
1.001	S2	3.736	-0.196	0.000	0.24			15.1	OK
1.002	Pond	3.683	-0.239	0.000	0.06			5.8	OK
3.000	CS-Tank	3.683	-0.131	0.000	0.01		73	1.1	OK
1.003	S3-Ctrl	3.683	0.034	0.000	0.15			1.9	SURCHARGED
1.004	S4	3.450	-0.113	0.000	0.14			1.9	OK
1.005	S5	3.222	-0.112	0.000	0.15			1.9	OK
1.006	S6	3.131	-0.110	0.000	0.16			1.9	OK
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Unit 34 The Enterprise Centre Cranborne Rd Potters Bar EN6 3DQ	Land at Sefter Road Pagham SW Strategy - 2.0l/s																															
Date 08/10/2021 File 21-023 SW Strategy.MDX	Designed by TGL Checked by MTD																															
Micro Drainage Network 2020.1																																
<u>1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 21-023 SW Strategy.sws</u>																																
	<table><tr><th>PN</th><th>US/MH Name</th><th>Level Exceeded</th></tr><tr><td>1.000</td><td>S1</td><td></td></tr><tr><td>2.000</td><td>Sg</td><td></td></tr><tr><td>1.001</td><td>S2</td><td></td></tr><tr><td>1.002</td><td>Pond</td><td></td></tr><tr><td>3.000</td><td>CS-Tank</td><td></td></tr><tr><td>1.003</td><td>S3-Ctrl</td><td></td></tr><tr><td>1.004</td><td>S4</td><td></td></tr><tr><td>1.005</td><td>S5</td><td></td></tr><tr><td>1.006</td><td>S6</td><td></td></tr></table>	PN	US/MH Name	Level Exceeded	1.000	S1		2.000	Sg		1.001	S2		1.002	Pond		3.000	CS-Tank		1.003	S3-Ctrl		1.004	S4		1.005	S5		1.006	S6		
PN	US/MH Name	Level Exceeded																														
1.000	S1																															
2.000	Sg																															
1.001	S2																															
1.002	Pond																															
3.000	CS-Tank																															
1.003	S3-Ctrl																															
1.004	S4																															
1.005	S5																															
1.006	S6																															
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Unit 34 The Enterprise Centre
Cranborne Rd Potters Bar
EN6 3DQ

Date 08/10/2021
File 21-023 SW Strategy.MDX

Micro Drainage

Land at Seftor Road
Pagham
SW Strategy - 2.0l/s

Designed by TGL
Checked by MTD

Network 2020.1

Page 7



30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 21-023 SW Strategy.sws

Simulation Criteria

Area Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor * 10m³/ha Storage 0.000

Hot Start Level (mm) 0

Inlet Coefficient 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 3

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 0.350

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 19.000 Cv (Winter) 1.000

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, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S1	15 Winter	30	+0%	100/15 Winter			
2.000	Sg	15 Winter	30	+0%	100/240 Winter			
1.001	S2	120 Winter	30	+0%	30/60 Winter			
1.002	Pond	120 Winter	30	+0%	30/60 Winter			
3.000	CS-Tank	120 Winter	30	+0%	30/30 Winter			
1.003	S3-Ctrl	120 Winter	30	+0%	1/30 Winter			
1.004	S4	480 Summer	30	+0%				
1.005	S5	360 Summer	30	+0%				
1.006	S6	960 Winter	30	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Overflow Cap.	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	S1	4.205	-0.059	0.000	0.65		11.9	OK
2.000	Sg	4.248	-0.107	0.000	0.18	6	7.4	OK
1.001	S2	3.977	0.045	0.000	0.25		15.5	SURCHARGED
1.002	Pond	3.974	0.052	0.000	0.10		9.8	SURCHARGED
3.000	CS-Tank	3.979	0.165	0.000	0.02	163	1.6	SURCHARGED
1.003	S3-Ctrl	4.005	0.356	0.000	0.15		2.0	SURCHARGED
1.004	S4	3.450	-0.113	0.000	0.14		2.0	OK
1.005	S5	3.223	-0.111	0.000	0.15		2.0	OK
1.006	S6	3.132	-0.109	0.000	0.17		2.0	OK

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Unit 34 The Enterprise Centre Cranborne Rd Potters Bar EN6 3DQ	Land at Sefter Road Pagham SW Strategy - 2.0l/s																															
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Micro Drainage	Network 2020.1																															
<u>30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 21-023 SW Strategy.sws</u>																																
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Micro Drainage

Land at Seftor Road
Pagham
SW Strategy - 2.0l/s

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Network 2020.1

Page 9



100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 21-023 SW Strategy.sws

Simulation Criteria

Area Reduction Factor 1.000

Hot Start (mins) 0

Hot Start Level (mm) 0

Manhole Headloss Coeff (Global) 0.500

Foul Sewage per hectare (l/s) 0.000

Additional Flow - % of Total Flow 0.000

MADD Factor * 10m³/ha Storage 0.000

Inlet Coefficient 0.800

Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0

Number of Storage Structures 3

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

Region England and Wales

M5-60 (mm) 19.000

Ratio R 0.350

Cv (Summer) 0.750

Cv (Winter) 1.000

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, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S1	15 Winter	100	+40%	100/15 Winter			
2.000	Sg	240 Winter	100	+40%	100/240 Winter			
1.001	S2	240 Winter	100	+40%	30/60 Winter			
1.002	Pond	240 Winter	100	+40%	30/60 Winter			
3.000	CS-Tank	240 Winter	100	+40%	30/30 Winter			
1.003	S3-Ctrl	240 Winter	100	+40%	1/30 Winter			
1.004	S4	240 Winter	100	+40%				
1.005	S5	240 Winter	100	+40%				
1.006	S6	240 Winter	100	+40%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	S1	4.445	0.181	0.000	1.16		21.1	SURCHARGED
2.000	Sg	4.399	0.044	0.000	0.07	76	2.8	SURCHARGED
1.001	S2	4.399	0.467	0.000	0.27		17.0	SURCHARGED
1.002	Pond	4.397	0.475	0.000	0.12		12.3	FLOOD RISK
3.000	CS-Tank	4.397	0.583	0.000	0.02	451	1.9	SURCHARGED
1.003	S3-Ctrl	4.397	0.748	0.000	0.15		2.0	SURCHARGED
1.004	S4	3.451	-0.112	0.000	0.14		2.0	OK
1.005	S5	3.223	-0.111	0.000	0.15		2.0	OK
1.006	S6	3.132	-0.109	0.000	0.17		2.0	OK

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Unit 34 The Enterprise Centre Cranborne Rd Potters Bar EN6 3DQ	Land at Sefter Road Pagham SW Strategy - 2.0l/s																															
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Appendix J

Maintenance and Management



TECHNICAL NOTE

PROJECT	:	Land adjacent Sefter School House, Sefter Road, Pagham
NOTE REF.	:	Ad602-21023
NOTE TITLE	:	SuDS Maintenance and Management
AUTHOR	:	Tafari Lewis
APPROVED	:	Tafari Lewis
DATE	:	8 th October 2021

1.0 INTRODUCTION

The purpose of this file note is to ensure that the adopting authority / management company is entrusted with a robust inspection and maintenance programme to ensure the optimum operational efficiency of the surface water drainage network is maintained for the lifetime of the development.

2.0 MAINTENANCE & MANAGEMENT

This plan is developed in direct reference to CIRIA C753 The SuDS Manual.

Adopting authorities may have their own specific maintenance requirements which may not be as per the information provided within this document.

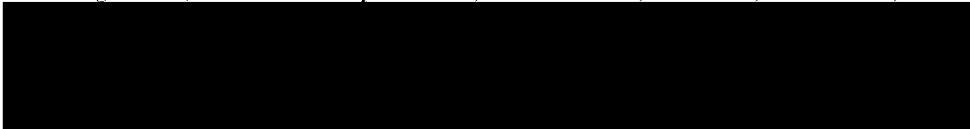
This section of the file note will review the following aspects:

- Who is to maintain / Adopt the SuDS and associated features
- Indicate a Maintenance Management Plan which reviews the activities to be undertaken, frequency and inspections
- Actions required in the case of a network blockage or pollution incident.

The following provides an indication of the intentions for adoption and maintenance for the drainage as detailed on drawing 21-023-002 entitled Drainage Strategy.

There are three main SuDS components associated with the surface water drainage strategy on this scheme:

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Attenuation Pond

Located and aimed to function as part of the public open space, a detention pond is proposed to treat and attenuate flows above the 1 in 30 year event. Storm water is temporarily stored in the pond during the 1:100 year peak surface flow events (with climate change allowance) prior to discharging into the downstream network.

Attenuation Modular Storage Tanks

An offline attenuation storage tank has been specified within the scheme. Storm water is temporarily stored in the attenuation crates during the 1:100 year peak surface flow events (with climate change allowance) prior to controlled release into the downstream drainage system

Porous Pavements

Type C permeable pavements (no infiltration) are located within private driveways and the shared access. These areas allow surface water to drain through a stone sub-base, slowing, collecting and filtering surface water flows.

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.

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.

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

Adoption

It is proposed that surface water drainage including the attenuation pond, geo-cellular storage tank and porous pavements are to be the responsibility of the developer and / or a management company. All surface water drainage on the development is to remain private.

Access

Access to SuDS elements is provided by the main access and parking areas which are under the control of the developer.

3.0 INDICATIVE MAINTENANCE MANAGEMENT PLAN

The information below is reproduced from Table 32.1 of CIRIA C753 The SuDS Manual and is used to indicate the maintenance and operation activities that each authority or management company is to apply –

Operation and maintenance activity	SuDS Component		
	Ponds	Modular Storage	Pervious Pavement
Regular Maintenance			
Inspection	■	●	■
Litter & Debris removal	■	□	■
Grass Cutting	■	□	□
Weed and Invasive plant control	□		□
Shrub Management (including Pruning)	□		□
Shoreline vegetation management	□		
Aquatic vegetation management	□		
Occasional Maintenance			
Sediment Management	●	■	●
Vegetation Replacement	□		
Vacuum sweeping and brushing			●
Remedial Maintenance			
Structure rehabilitation / repair	□	□	□
Infiltration surface reconditioning		□	□

Key

■ will be required

□ may be required

Extracts from Table 32.1 CIRIA C753 The SuDS Manual

Ponds

Ponds are basins that have a permanent pool of water. They can be created by using an existing natural depression, by excavating a new depression or by constructing embankments.

Each time it rains, the runoff entering the pond is detained and treated by setting out sediments and biological uptake until it is displaced by runoff from the next storm.

All ponds require a sediment forebay or other form of pre-treatment system (in this case a swale). This is to remove the majority of incoming sediment from the runoff before it is more widely dispersed within the larger permanent pool.

Outlets are usually built into an embankment with easy access for maintenance.

Many of the specific maintenance activities for the pond will be undertaken as part of a general landscaping contract. Maintenance responsibility will be placed with the developers appointed management company. All maintenance should be carried out in accordance with CDM regulations (2015) and CIRIA C753

The table below gives a summary of the operation and maintenance requirements for a pond:

Maintenance schedule	Required Action	Frequency
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass (public areas)	Monthly (during the growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season and autumn)
	Inspect marginal bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect waterbody for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay, treatment areas and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build up has occurred, to inform management disposal options.	Half Yearly
	Check hydrobrakes	Half Yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1m 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 or treatment area	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 (e.g. 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

	Re-align rip-rap (geomembrane) or repair other damage.	As required
	Repair / rehabilitate inlets and outlets	As required

Modular Storage

Regular inspection and maintenance are required to ensure the effective long-term operation of below ground modular storage systems.

Catchpits are installed at the inlet to the tanks to allow for removal of silt / debris as required. The tanks are utilised for the 1:100 year storm event and as such are envisaged to have minimal levels of silt due to the use of trapped gullies within the system.

Inspection and maintenance of the tank will be dependent upon the manufacturers recommendations and installation as per manufacturers details.

The table below gives a summary of the operation and maintenance requirements for modular storage –

MODULAR STORAGE	
Regular Maintenance	Frequency
Inspect and identify any areas that are not operating correctly	Monthly for 3 months after installation / regular usage
Debris and silt removal from catchment areas	Monthly
Removal of sediment from pre-treatment structures	Annually or as required
Remedial Works	Frequency
Repair / rehabilitation of inlets, outlets, overflows and vents	As required
Monitoring	Frequency
Inspect / check all inlets, inspection wells, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually and after large storms
Inspection of surface above units for sag points or depressions which may indicate structural failure.	Annually
Survey inside of the tank for sediment build-up and removal as required	Every 5 years or as required

Permeable Surfaces

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.

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.

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

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.

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

The table below gives a summary of the operation and maintenance requirements for permeable paving –

PERMEABLE AND POROUS SURFACES	
Regular Maintenance	Frequency
Brush regularly and remove sweepings from all hard surfaces	Three times a year at end of winter, mid-summer and after autumnal leaf fall, or as required based upon site specific observations or as per manufacturers recommendations
Occasional Tasks	Frequency
Removal of weeds	As required
Stabilise and mow contributing and adjacent areas	As required
Remedial Works	Frequency
Remediate any landscaping which, through vegetation maintenance or soil slip has encroached upon the permeable surface	As required
Remedial work to any depressions, rutting, cracked or broken blocks considered to be detrimental to the structure or that pose a hazard to users	As required
Rehabilitation of surface and upper substructure by sweeping	As required if infiltration performance is reduced
Monitoring	Frequency
Initial Inspection	Monthly for 3 months after installation / regular usage
Inspection for evidence of poor operation and / or weed growth	3 monthly & 48 hours after large storms
Inspection of silt accumulation	Annually
Monitoring of inspection chambers	Annually
Inspection for depressions, ponding or rutting	Annually

Flow Control Chambers

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.

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

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

5.0 BLOCKAGES AND SPILLAGES

Blockage

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.

If the blockage occurs at the flow control chamber, the bypass door can be operated to drain down the network such that works can be undertaken to remove the blockage.

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

Spillages

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

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.

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.

Appendix K

Exceedance Flows

