



Flood Risk Assessment

Proposed Residential Development

Durban Road/ Ash Grove, Bognor Regis PO22 9J T

October 2021

ENVIRONMENTAL AND
SUSTAINABILITY CONSULTANTS

Date of first Issue	Revision	Date of Revision	Issued By	Checked by
29 October 2021			MF	MB

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Hydrogeology

- 2.04 BGS 1:625,000 scale mapping shows a highly productive Principal bedrock aquifer associated with the White Chalk Subgroup, summarised as a yielding 50-100l/s from large diameter boreholes and up to 300l/s from adited systems: .
- 2.05 The Aquifer Designation Map for England shows the site to be within the area of a Principal bedrock aquifer and a Secondary A superficial drift aquifer. The site lies within an area mapped as Medium Groundwater Vulnerability with a soluble rock risk associated with the underlying chalk bedrock. The site lies outside of any Source Protection Zones.
- 2.06 The Cranfield Soil and Agrifood Institute Soilsapes map indicates that the site is within Soilscape 21, described as loamy and clayey soils of coastal flats with naturally high groundwater: . It is also suggested that surface water run-off drains to local groundwater.

Environmental Sensitivity

- 2.06 The site lies within SSSI Impact Risk Zones associated with the Felpham SSSI and Bognor Reef SSSI located just over 2km to the southeast and south of the site, respectively. Both SSSI sites are in favourable conditions. The site is also within 500m of The Brooks Local Nature Reserve.

4.04 According to the long term flood risk mapping service provided by the EA (Figure 3), the site is in an area with a very low to low risk of flooding from rivers (fluvial) and the sea (tidal). Very low risk means that the area has an annual chance of flooding of less than 0.1% Low risk means that the area has an annual chance of flooding of between 0.1% and 1% The probability of flooding takes into account the effect of flood defences in the area.

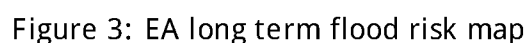
October 2021
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Figure 4: Pumping station and sea wall defence at Elmer

- 4.06 A culverted watercourse is present to the north of the site, which outfalls to a tributary of Aldingbourne Rife approximately 140m east of the site. The tributary also benefits from raised ground on either side of the channel.
- 4.07 In channel stop logs are located within Aldingbourne Rife, approximately 950m southeast of the site at the confluence with Lidsey Rife. The stop logs are presumed to provide a defence against tidal surges or pumping station failure.
- 4.08 A tidal flood defence, in the form of an embankment and sea wall (maintained by the EA), is present along the south coast at the location of the Aldingbourne Rife pumping station at Elmer (Figure 4) and extending to Gloucester Road to the west and Canning Road to the east. The Beachy Head to Selsey Bill Shoreline Management Plan indicates that the strategy for the Bognor Regis to Elmer tidal defences is to 'hold the line', meaning to maintain or upgrade the level of protection provided by defences. Due to the tidal defences and the pumping station, Aldingbourne Rife is considered to not be influenced by tidal action under normal operating circumstances.
- 4.09 Site-specific hydraulic data has been provided by the EA, in response to a Freedom of Information request, to inform this FRA (as contained in Appendix C). The fluvial hydraulic data is taken from the Aldingbourne Flood Risk Mapping Study, completed in 2015 by J BA Consulting (Defended only), plus climate change allowances (2016).

The tidal hydraulic data is taken from the River Arun to East Head Study, completed in 2016 by J BA Consulting. Modelled flood levels and depths are provided at four node points within the site boundary.

- 4.10 Fluvial hydraulic data has been provided for annual exceedance probabilities of: 5% 1% 1%+ climate change allowances of 35% 45%and 105% and 0.1% Climate change allowances were updated on 27th July 2021 and no longer reflect the same climate change allowance scenarios provided from the 2016 studies. The latest climate change predictions for peak river flow in the Arun and Western Streams Catchment are as indicated in Figure 5 below. For more vulnerable: development within Flood Zone 3a, it is recommended to use the central allowance to assess peak river flow. As such, climate change allowance for peak river flow should be a minimum of 25%

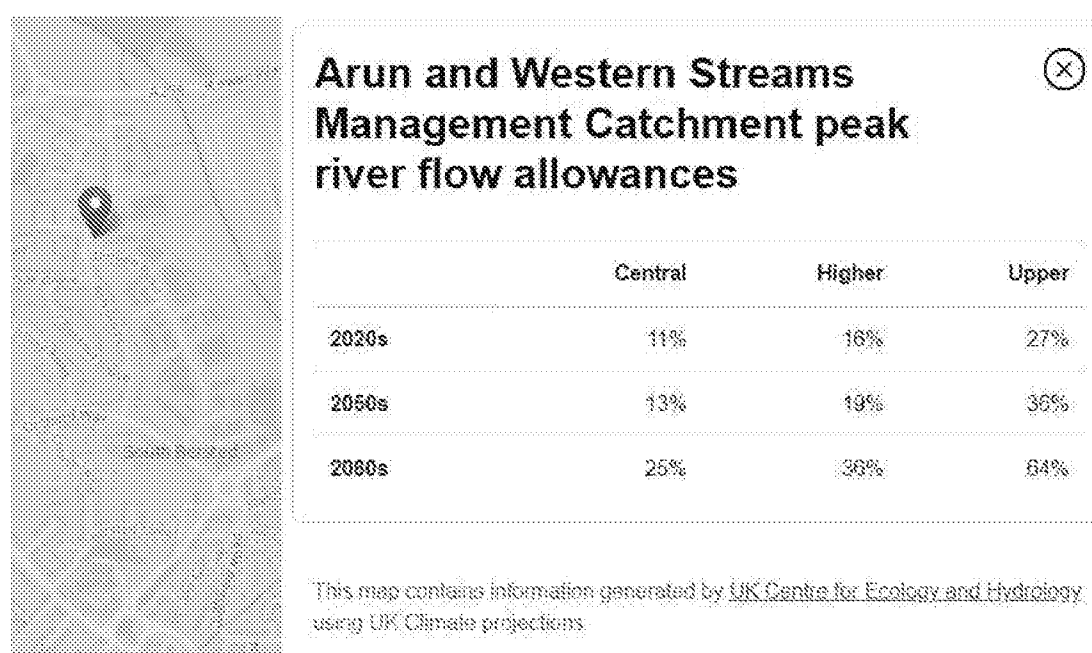


Figure 5: Peak river flow allowances (taken from <https://environment.data.gov.uk/hydrology/climate-change-allowances>)

- 4.11 In order to ensure that the development and users will be safe for its lifetime, the finished ground floor level should be set above the 1% AEP flood level with an allowance for climate change. The closest climate change allowance to this updated value within the 2016 study is 35% therefore the 35% climate change allowance will be used in lieu of additional hydraulic modelling. The hydraulic data provided indicates that the site would not experience fluvial flooding during a 1% AEP + 35% CCA fluvial flood event in both the defended and undefended scenarios. The modelling data, however, indicates that the site would experience flooding during a 1% AEP + 105% CCA fluvial flood event with a flood level of 2.27m AOD.
- 4.12 Given that the ground floor flats are not proposed to have direct access to a higher floor level without leaving the building, it is prudent to take a conservative approach

4.13 Tidal hydraulic data has been provided for 0.5% AEP flood events for the present, in 2070 and in 2115 (which take into account sea level rise) as well as 0.1% AEP flood events. The modelling data indicates that the site would not experience tidal flooding in the defended scenario under any of the above modelled flood events. Breach scenarios have not been supplied within the data provided, however flood levels for the undefended scenario suggest a maximum flood level of 3.60m AOD for a 0.5% AEP flood event in 2115. Considering that the strategy for the tidal defences along this stretch of coastline is to 'hold the line', tidal flooding as a result of an undefended scenario is not representative of the current or future situation. Despite this, there is a residual risk of pump failure or tidal defence breach, which could result in a depth of water of over 1m above the finished ground floor level. As such, a flood warning and evacuation plan should be provided to ensure that users of the development can escape or seek refuge in these very unlikely events.

4.14 Flood warnings are provided by the EA for areas at risk of flooding. The site is located in the flood warning area for Bognor, which covers the coastal areas of Bognor, including Felpham, South Bersted, North Bersted and Shrimpeny. Flood warnings can be received by signing up to the Flood Warning Service or by phoning the 24-hour Floodline service, details of which are provided at <https://www.gov.uk/sign-up-for-flood-warnings>. The Bognor flood warning area covers warnings for tidal flooding only. Flood warnings for flooding associated with Aldingbourne Rife are not available for the site.

4.15 There are four levels of flood warning as detailed in Figure 6, below. In the event of a flood warning or severe flood warning, users of the ground floor flats should move to a safe place at a higher elevation, either into the communal area of the building or to a lower residual tidal flood risk area. The nearest area of lower residual tidal flood risk is approximately 100m south of the site along Ash Grove.

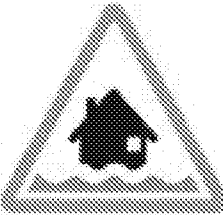
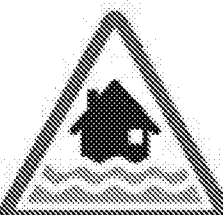
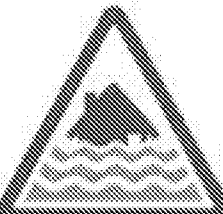
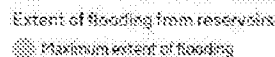
Flood Warning Symbol	What it means	What to do
	Flood Alerts are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advance notice of the possibility of flooding, but before we are fully confident that flooding in Flood Warning Areas is expected.	✓ Be prepared to act on your flood plan ✓ Prepare a flood kit of essential items ✓ Monitor local water levels and the flood forecast on the Environment Agency website ✓ Stay tuned to local radio or TV ✓ Alert your neighbours ✓ Check pets and livestock ✓ Reconsider travel plans
	Flood Warnings warn people of expected flooding and encourage them to take action to protect themselves and their property.	✓ Move family, pets and valuables to a safe place ✓ Turn off gas, electricity and water supplies if safe to do so ✓ Seal up ventilation system if safe to do so ✓ Put flood protection equipment in place ✓ Be ready should you need to evacuate from your home ✓ 'Go In, Stay In, Tune In'
	Severe Flood Warnings warn people of expected severe flooding where there is a significant threat to life.	✓ Stay in a safe place with a means of escape ✓ Co-operate with the emergency services and local authorities ✓ Call 999 if you are in immediate danger
Warnings no longer in force	Informs people that river or sea conditions begin to return to normal and no further flooding is expected in the area. People should remain careful as flood water may still be around for several days.	✓ Be careful. Flood water may still be around for several days ✓ If you've been flooded, ring your insurance company as soon as possible

Figure 6: EA flood warnings

- 4.16 Compensatory floodplain storage would normally be required within Flood Zone 3 where development would result in the raising of ground levels and the displacement of flood water from a 1% AEP + CCA design flood. However, as it has been demonstrated from the EA fluvial hydraulic data that the design flood would not result in flooding on the site, there would be no loss of floodplain storage. As such, compensatory floodplain storage is not considered necessary.

Groundwater Flooding

- 4.17 Groundwater flooding can occur due to prolonged rainfall in low-lying areas where highly permeable strata are present at shallow depth below ground. This type of flooding is associated with the water table rising above ground level, leading to more persistent inundation. Groundwater flooding can also occur due to ceasing of groundwater abstractions, resulting in groundwater rebound.



Sewer Flooding

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Surface Water Flooding

- 4.27 Surface water flooding can occur when drainage systems become overwhelmed by intense or prolonged rainfall, with the result that runoff accumulates in low-lying areas. As shown by Figure 8, according to the Environment Agency updated Flood Map for Surface Water (uFMfSW), the site is shown to be at low risk from this type of flooding, with a 0.1%-1% annual probability of flooding on the site. The flood risk at this probability occurs to the lower lying land that surrounds the slightly raised concrete slab, which formed the ground floor of the previous development.



Figure 8: EA updated Flood Map for Surface Water (site indicated in red)

- 4.28 In general terms, the surface water flood map alone should not be used to assess flood risk at an individual site level. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can affect the probability and severity of flooding. When used to consider catchment-wide surface water flows, the maps are a useful tool in determining generalised flood risk to an area. As such, the map indicates that the closest preferential surface water flow path follows the low lying areas of the site prior to heading off site towards the east and away from the development proposals.
- 4.29 The proposal to raise ground levels on the site to enable a finished ground floor level of 2.57mAOD would result in a lower chance of flooding to the site from overland surface water flow paths. The finished ground floor level should be set above the surrounding ground level by at least 150mm to reduce the risk of any residual surface water flooding from entering the building. As such, there is a low risk of sewer flooding to the proposed development.

Overall Flood Risk

- 4.30 Overall flood risk from all sources is considered to be low with the exception being the higher risk from fluvial and tidal flooding. From a review and analysis of the SFRA and EA hydraulic data, the site can be demonstrated to be benefitting from flood defences associated with Aldingbourne Rife and the coastal sea wall. The site is predicted to not experience flooding from fluvial sources in a defended or undefended scenario during the 1%AEP + 35%CCA flood events. The site is at risk of tidal flooding as a result of a failure of the pumping station or breach of the flood defences at Elmer. In this scenario, the development would be at risk of flooding to a depth of over 1m and an outline flood warning and evacuation plan has been provided to ensure safety of users, particularly at ground floor level.
- 4.31 The development would benefit from having a finished ground floor level of at least 2.57mAOD and an external ground level of 150mm lower to mitigate against the residual effects of flooding from surface water, groundwater and sewers. Flood risk is considered to be reduced even further through the use of a SuDS based surface water management strategy.

5.01 Management of surface water run-off from the development will need to be provided to ensure that the development proposals do not increase (and ideally, reduce) the risk of flooding from surface water to the site and the wider catchment. In addition to providing flood risk reduction, the management of surface water run-off should follow the principals of SuDS (Sustainable Drainage Systems) and aim to provide multi-functional benefits, as follows:

- ## Existing Surface Water Drainage

- 225mm diameter surface water sewer running south to north along western boundary, within Ash Grove.
- 450mm diameter surface water sewer running west to east along southern boundary, within Durban Road.
- 525mm diameter surface water sewer running south to north along eastern site boundary, within adjacent commercial site.
- 900mm diameter surface water sewer (culverted watercourse) running west to east along northern site boundary from Ash Grove to an outfall into a tributary of Aldingbourne Rife, approximately 135m east of the site.

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Surface Water Disposal Options

- 5.04 In accordance with Building Regulations Approved Document H and DEFRA's Non Statutory Technical Standards for SuDS, disposal of curtilage surface water run-off should be directed to the following, in order of preference:
- ⌘ Infiltration to ground;
 - ⌘ Disposal to a watercourse;
 - ⌘ Disposal to a surface water sewer;
 - ⌘ Disposal to a combined sewer.
- 5.05 An intrusive geotechnical ground investigation was undertaken in March 2007. Borehole records from this investigation demonstrate silty/fine sandy clay to approximately 1.80m depth, becoming medium/ loose grey black silt to 2.80m depth and Lewes Chalk below this depth. One borehole record also suggests made ground to a depth of 1.10m at the far north of the site. The presence of cohesive deposits greatly reduces the efficacy of an infiltration based surface water drainage system. Also considering the naturally high groundwater table, an infiltration based surface water disposal is likely to pose a risk of surface water flooding to the development through the inability to effectively drain the site, particularly in wetter winter months. Additionally, as the site is in an area of soluble rock risk, infiltration of surface water could lead to dissolution of the underlying strata, thus comprising the structural integrity of the foundation solution. As such, infiltration of surface water is not recommended as a means of disposal.
- 5.06 The nearest open watercourse is the tributary of Aldingbourne Rife, approximately 135m east of the site. There is no known direct outfall to this watercourse and provision of a direct connection and outfall would result in having to access third party land in an urban setting for construction. As such, a direct connection to an open watercourse is not feasible as a means of disposal.
- 5.07 The surrounding public surface water sewer network provides an ideal destination for the disposal of surface water. Each of the surrounding sewers to the south, east and west connects to the 900mm diameter public surface water sewer to the north, which in turn conveys surface water to the tributary of Aldingbourne Rife. The Southern Water public sewer network, therefore, provides the most feasible and sustainable destination for the disposal of surface water. Prior to making a connection to the public surface water sewer, a S106 Connection Agreement with Southern Water will need to be approved.

5.11 The sustainable drainage system will also manage surface water flows to reduce the overall volume of discharge, compared to the pre-development conditions, for a 1 in 100 year, 6 hour storm event, as shown in Table 2 below.

Table 2: Pre- and post-development run-off volume

- | Return Period | Pre-development run-off
volume, 6-hour storm duration
(m ³) | Post-development run-off
volume, 6-hour storm duration
(m ³) |
|---------------|---|--|
| 1 in 100 year | 29 | 24.9 |

5.12 A sustainable drainage system meeting the above criteria is presented in Appendix E with supporting hydraulic calculations in Appendix F.

5.13 In the event of a drainage system blockage or a storm in excess of the design parameters, there may not be sufficient capacity within the drainage system to accommodate collected surface water run-off below ground level or within the site. Under these circumstances, minor flooding may be expected on site, which may lead to overland flows being directed off of the site. Finished ground levels should be designed to allow overland flows to be directed away from building thresholds and to follow the natural, pre-development, flow paths for surface water. Proposed exceedance flow routes are indicated on the drawings within Appendix E.

- ## Water Quality

- 5.16 Green roofs eliminate the pollution that would otherwise be mobilised through the use of more traditional roofing materials. In terms of pollution reduction from rainwater, green roofs can provide filtration of airborne pollutants entrained within rainwater and can provide an overall improvement to receiving watercourse and waterbodies.
- 5.17 Filter drains can assist in reducing pollutant levels in surface water run-off by filtering out fine sediments, metals and hydrocarbons, among other pollutants. They also encourage adsorption and biological degradation of organic pollutants.
- 5.18 Bioretention tree pits will assist in filtering out pollutants for surface water run-off, including heavy metals, hydrocarbons and excess nitrogen and phosphorous within soils. Phytoremediation characteristics of more mature trees allows the uptake of harmful chemicals, metals and hydrocarbons and the transformation into nutrients or for storage within roots, stems and leaves.
- 5.19 In order to quantitatively assess the contamination removal from surface water run-off through the use of SuDS components, the Simple Index Approach (as defined within the CIRIA SuDS Manual, 2015) has been applied as Table x below. The proposed SuDS components are demonstrated to mitigate the contamination from surface water run-off from the proposed site use.

- ## Biodiversity

- ## Maintenance

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5.30 Filter drains should be inspected and maintained regularly to ensure good treatment levels for surface water run-off and to prevent clogging of the surface by excessive vegetation growth, leaf matter and litter. Maintenance should be undertaken by an appropriate maintenance organisation and Appendix G provides typical operation and maintenance requirements for filter drains.

5.31 It is estimated that bioretention tree pits will require approximately 2.5 times greater maintenance than typical landscape designs (Dalrymple, 2013), however the improvements to water quality and enhanced amenity and biodiversity benefits outweigh the maintenance requirements. Clogging of the surface level is the most common failure mechanism of bioretention tree pits, however underdrain and filter media blockages are not as easy to detect but still require inspection and maintenance. Visual inspections and measurement of sediment deposition should be undertaken frequently during the first few months of operation to help inform a future maintenance schedule. Maintenance should be undertaken by an appropriate maintenance organisation and Appendix G provides typical operation and maintenance requirements for bioretention tree pits.

5.32 For the flow control device, which will be located within a surface water manhole, it is recommended that one month after construction the device should be inspected, preferably after a period of rainfall. This will involve removing the cover and secondary cover and checking that water flows through the device. A visual check should be carried out on the debris guard or trash screen, with any debris removed. Thereafter inspections should be carried out monthly for three months and then annually, with cleaning if required.

6.00 Foul Water Management

- 6.01 Foul water from the development should be disposed of to the existing Southern Water public foul water sewer system within Durban Road or to the north of the site.
- 6.02 Southern Water have provided foul water drainage records for the site and immediate surroundings. Foul water sewers are present to the north and south of the site:
 - ζ 300mm diameter foul water sewer running west to east along southern boundary, within Durban Road.
 - ζ 375mm diameter foul water sewer running west to east along northern site boundary.
- 6.03 There is likely to be existing private surface water drainage associated with the previous site use for commercial premises. A topographic survey highlights the presence of at least one chamber, which is assumed to be associated with a former linear drain to the south of the former building. All existing drainage infrastructure on the site, and connections to off-site sewers, should be located by means of radar survey and CCTV survey prior to construction.
- 6.04 Prior to making a connection to the public foul sewer, a S106 Connection Agreement with Southern Water will need to be approved.

APPENDIX A
TOPOGRAPHIC SURVEY

LEGEND

Survey Station

△

Slopes

top

bottom

Gate

⌞

Trees

⊙

Building

▭

Contours

-60.00-

Fence

Vegetation

~~~~~

Hedge, width to scale

=====

Kerb/Upstands

=====

Overhead Feature

=====

Safety Barrier

=====

Verge/Edge of Surface

=====

Water

=====

ABBREVIATIONS

AV

Air Valve

AB

Advertisement Board

B

Bollard

BB

Balustrade

BL

Bed Level

BLT

Basement Light

BS

Bus Stop

BT

British Telecom

CATV

Cable Television

CH

Chalk

CL

Cover Level

CT

Cabinet

DC

Drainage Channel

E

Electricity Cable Pit

EP

Electricity Pole

GR

Gravel Road

P/B

Flower Bed

PL

The Hydrant

FLT

Floor Level

FL

Flood Light

FP

Flag Pole

FW

Fall Water

G

Gully

GV

Gas Valve

H

Height

GP

Guide Post

IB

Illuminated Bollard

IC

Inspection Cover

L

Invert Level

NO

North Arrow

LB

Letter Box

LI

Liter Bin

LP

Lamp Post

M

Manhole

MW

Marker

OW

Overhead Wire

NB

Notice Board

NP

Name Plate

P

Post

PB

Post Box

PSU

Push Button Unit

PM

Parking Meter

R

Ridge Level

RE

Reading Eye

RFL

Roof Level

RS

Road Sign

R/W

Retaining Wall

RWP

Rainwater Pipe

SC

Stop Code

SFL

Surface Level

SV

Sluice Valve

SW

Surface Water

TB

Telephone Box

TSC

Traffic Signal Cover

TL

Threshold Level

TM

Top of Wall

TL

Traffic Light

TM

Traffic Machine

TP

Telegraph Pole

UC

Unknown Cover

UTL

Under To Lift

VP

Vent Pipe

WC

Water Control Pillar

WL

Water Level

WM

Water Meter

WO

Wash Out

SVP

Soil & Vent Pipe

FENCE DESCRIPTIONS

BWF

Barbed Wire Fence

CBF

Close Boarded Fence

CF

Corrugated Iron Fence

CLF

Chain Link Fence

CPF

Concrete Paving Fence

CSF

Concrete Slab Fence

GDF

Garden Fence

MRF

Metal Railings

INF

Interweave Fence

LLF

Larch Lap Fence

OSF

Open Board Fence

PAF

Paving Fence

PAF

Post & Rail Fence

PWF

Post & Wire Fence

WMF

Wire Mesh Fence

NOTES

Coordinates and Levels based on OS derived from GPS.

↑

North

Survey Date:

December 2020

Client:

PHPM Properties Ltd  
Hyman Hill  
10 Buckingham Rd  
Shoreham  
West Sussex  
BN43 5UA

enka  
surveys

e: enquiries@enkasurveys.co.uk

w: www.enkasurveys.co.uk

WOODVIEW, WESTERN ROAD, CROWBOROUGH, EAST SUSSEX, TN6 3EW  
t : 01892 660459  
m: 07768 980285

Job No:

2472

Job Name:

Durban Road  
Bognor Regis

Title:

Topographical Survey

Scale:

1:200@A1

Sheet:

1

ARUN DISTRICT COUNCIL BR267021PL

APPENDIX B  
PROPOSED SITE PLANS

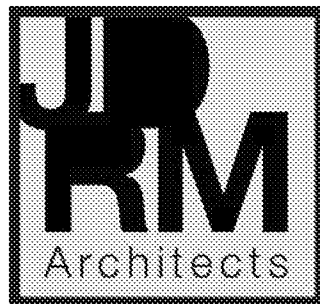
KEY:

- STUDIO UNIT
- 1B2P UNIT
- 1B3P UNIT
- 2B4P UNIT

17/09/2021 ISSUED FOR COMMENT RM GG

Rev: Date: Notes: Drawn: Checked:

Project:  
**DURBAN ROAD/ASH GROVE**  
BOGNOR REGIS  
PHPM PROPERTIES LTD



drawing number: rev: /

**2164(21)000**  
PROPOSED PLANS  
GROUND FLOOR

SCALE 1:100 @ A1

Issued For:  
**PRELIMINARY**  
Drawn by: RM  
Checked by: GG

STUDIO 8 | REACONSFIELD STUDIOS | 25 DITCHLING RISE | BRIGHTON | BN1 4QL  
www.jdrmarchitecture.com

1

**PROPOSED GROUND FLOOR PLAN**  
1:100

APPENDIX C  
ENVIRONMENT AGENCY HYDRAULIC DATA

Matt Freeman  
Encon Associates

**Our ref:** SSD230811  
**Date:** 01/09/2021

Dear Matt Freeman,

**Enquiry Regarding Product 4 for Flood Risk Assessment for Land At Durban Road And Ash Grove, Bognor Regis, PO22 9FD.**

Thank you for your enquiry which was received on 02 August 2021.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004. The information is attached.

The information on Flood Zones in the area relating to this address is as follows:

**The site is in an area located within Flood Zones 1, 2 & 3 as shown on our Flood Map for Planning (Rivers and Sea).**

*Note - This information relates to the area that the above named property is in and is not specific to the property itself as it is influenced by factors such as the height of door steps, air bricks or the height of surrounding walls. We do not have access to this information and is not currently used in our flood modelling.*

Flood Zone definitions can be found at [www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones](http://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones)

**Flood Defences**

There are no formal raised flood defences in the vicinity of the site.

**Model Information**

The Tidal model used was the River Arun To East Head Model which was completed by JBA Consulting in 2016.

The Fluvial model used was the Aldingbourne Modelling Study (Defended Only) which was completed by JBA Consulting in 2015, plus updated climate change allowances (2016).

**Flood History**

We hold no record of previous flooding events affecting this site.

Please note our records are not comprehensive and may not include all events. I recommend contacting the Lead Local Flood Authority, **West Sussex County Council** or the Local Authority, **Arun District Council** for a more comprehensive flood history check.

FRA advisory text

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name                                        | Product 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description                                 | Detailed Flood Risk Assessment Map for <b>Land At Durban Road And Ash Grove,, Bognor Regis, PO22 9FD.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Licence                                     | <u>Open Government Licence</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Information Warnings                        | <p>The flood risk data provided is based on existing EA hydraulic models with an allowance for climate change. Please note the climate change allowances provided are not up to date. These were updated on 27 July 2021.</p> <p>You should refer to '<a href="#">Flood risk assessments: climate change allowances</a>' for the most up to date allowances. You will need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.</p>                                                                                                  |
| Information Warning - OS background mapping | <i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.</i> |
| Attribution                                 | <p>Contains Environment Agency information © Environment Agency and/or database rights.</p> <p>Contains Ordnance Survey data © Crown copyright 2021 Ordnance Survey 100024198.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

## Data Available Online

Many of our flood datasets are available online:

- Flood Map For Planning ([Flood Zone 2](#), [Flood Zone 3](#), [Flood Storage Areas](#), [Flood Defences](#), [Areas Benefiting from Defences](#))
- [Risk of Flooding from Rivers and Sea](#)
- [Historic Flood Map](#)
- [Current Flood Warnings](#)

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

Yours sincerely,

**Edward Conway**  
**Partnership & Strategic Overview - West Sussex**  
**Environment Agency, Guildbourne House, Worthing, BN11 1LD**

## **Use of Environment Agency Information for Flood Risk Assessments**

### **Important**

The Environment Agency are keen to work with partners to enable development which is resilient to flooding for its lifetime and provides wider benefits to communities. If you have requested this information to help inform a development proposal, then we recommend engaging with us as early as possible by using the pre-application form available from our website:

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

We recognise the value of early engagement in development planning decisions. This allows complex issues to be discussed, innovative solutions to be developed that both enables new development and protects existing communities. Such engagement can often avoid delays in the planning process following planning application submission, by reaching agreements up-front. We offer a charged pre-application advice service for applicants who wish to discuss a development proposal.

We can also provide a preliminary opinion for free which will identify environmental constraints related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In preparing your planning application submission, you should refer to the Environment Agency's Flood Risk Standing Advice and the Planning Practice Guidance for information about what flood risk assessment is needed for new development in the different Flood Zones. This information can be accessed via:

<https://www.gov.uk/flood-risk-assessment-standing-advice>  
<http://planningguidance.planningportal.gov.uk/>

You should also consult the Strategic Flood Risk Assessment or other relevant materials produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk Assessment (FRA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or surface water runoff. Information produced by the local planning authority referred to above may assist here.
3. Where a planning application requires an FRA and this is not submitted or is deficient, the Environment Agency may raise an objection.

# Flood map for planning

Your reference  
**A5104**

Location (easting/northing)  
**493425/100896**

Created  
**20 Sep 2021 12:17**

**Your selected location is in flood zone 3, an area with a high probability of flooding.**

## This means:

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

## Notes

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

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

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

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

## Flood map for planning

Your reference

**A5104**

Location (easting/northing)

**493425/100896**

Scale

**1:2500**

Created

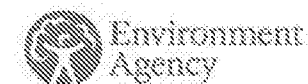
**20 Sep 2021 12:17**

-  Selected area
-  Flood zone 3
-  Flood zone 3: areas benefitting from flood defences
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Flood storage area

0 20 40 60m

Page 2 of 2

# Risk of flooding from Surface Water. Centred PO22 9FD. Created 01/09/2021.



1: 10,000

0 Metres 250



## Likelihood of flooding from Surface Water

- High ( $\geq 3.3\%$ )
- Medium ( $3.3\% - 1\%$ )
- Low ( $1\% - 0.1\%$ )
- Very Low
- Flood Extent 1 in 30
- Flood Extent 1 in 100
- Flood Extent 1 in 1000

## Likelihood of flooding from Surface Water

- High:** Greater than or equal to 3.3% (1 in 30) chance in any given year
- Medium:** Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year
- Low:** Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year
- Very Low:** Less than 0.1% (1 in 1,000) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on GOV.UK.

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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). E-mail: [enquires@environment-agency.gov.uk](mailto:enquires@environment-agency.gov.uk)

## Legend

Please see page 2 for asset  
symbology



## Structures

-  Control Gate
-  Draw Off Tower
-  Fish Pass
-  Hydrobrake
-  In Channel Stoplogs
-  Inspection Chamber
-  Jetty
-  Outfall
-  Screen
-  Spillway
-  Stilling Basin
-  Weir

## Beach Structures

-  Breakwater
-  Ramp
-  Slipway
-  Steps
-  Groyne

## Instruments

-  Active Monitoring
-  Passive Monitoring

## Channel Crossings

-  Bridge
-  Utility Services

## Aids to Navigation

-  Beacon
-  Buoy
-  Dolphin
-  Signage
-  Signal

## Building Assets

-  Pump House

## Major Civils

-  Abutment
-  Central Pier

## Defences

-  Embankment
-  Wall
-  Flood Gate
-  Demountable defence
-  Bridge abutment
-  High Ground
-  Beach
-  Barrier Beach
-  Promenade
-  Quay
-  Cliff
-  Dunes

## Channels

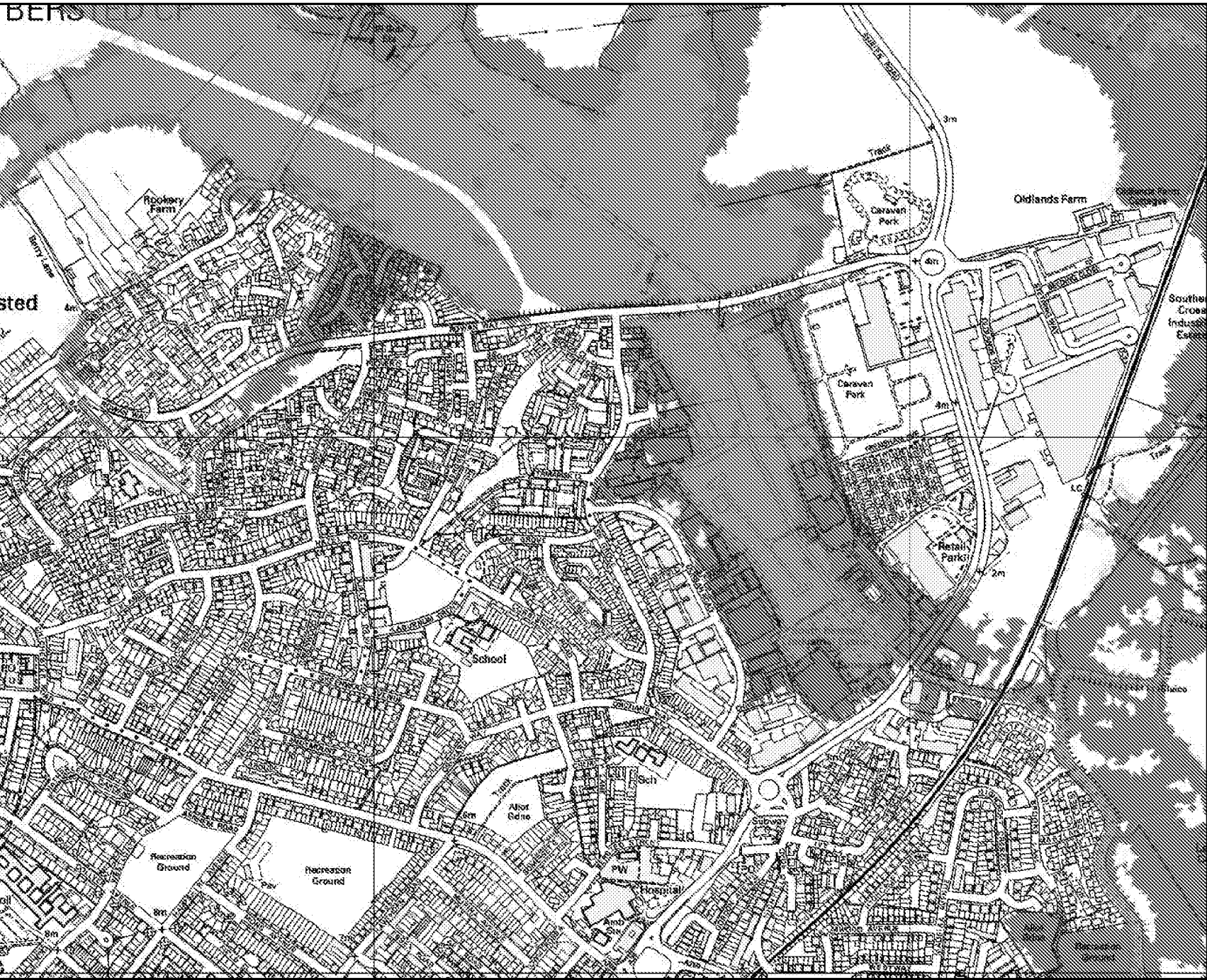
-  Open channel
-  Simple culvert
-  Complex culvert

## Land

-  Mudflats
-  Saltmarsh
-  Washland

## Sites

-  Amenity
-  Control Structure
-  Erosion Protection
-  General
-  Harbour
-  Monitoring
-  Navigation Lock
-  Pumping Station
-  Reservoir
-  Tidal Barrier

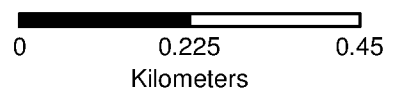


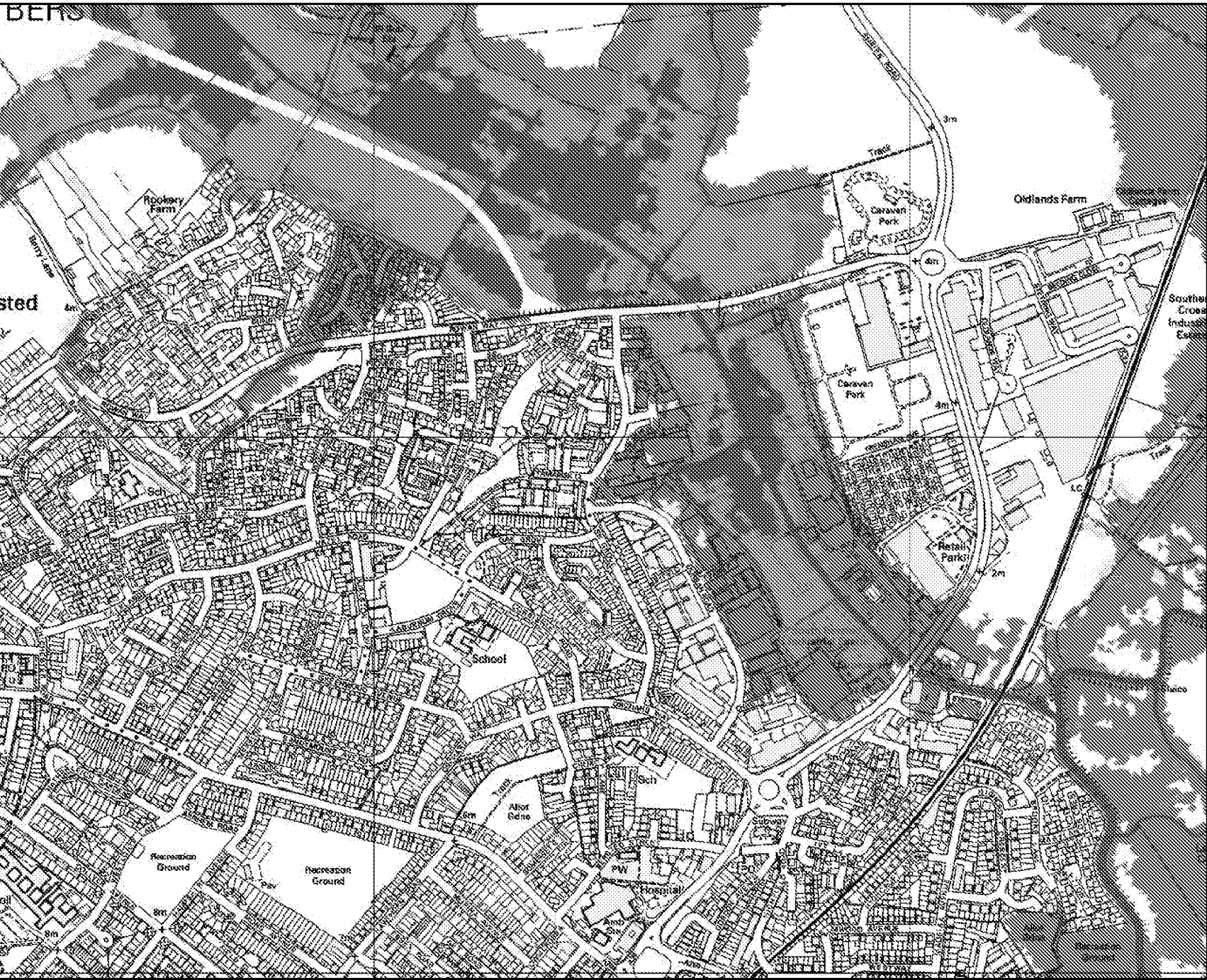
**Legend**

- Site Boundary
- 1% AEP (Un defended Fluvial)
- 0.1% AEP (Un defended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000







Environment  
Agency



N

### Legend

-  Site Boundary
-  5% AEP (Defended Fluvial)
-  1% AEP (Defended Fluvial)
-  0.1% AEP (Defended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



00.2250.45  
Kilometers



Environment  
Agency



N

**Legend**

-  Site Boundary
-  0.5% AEP (Un defended Tidal)
-  0.5% AEP (2070) NPPF (Un defended Tidal)
-  0.5% AEP (2115) NPPF (Un defended Tidal)
-  0.1% AEP (Un defended Tidal)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

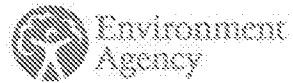
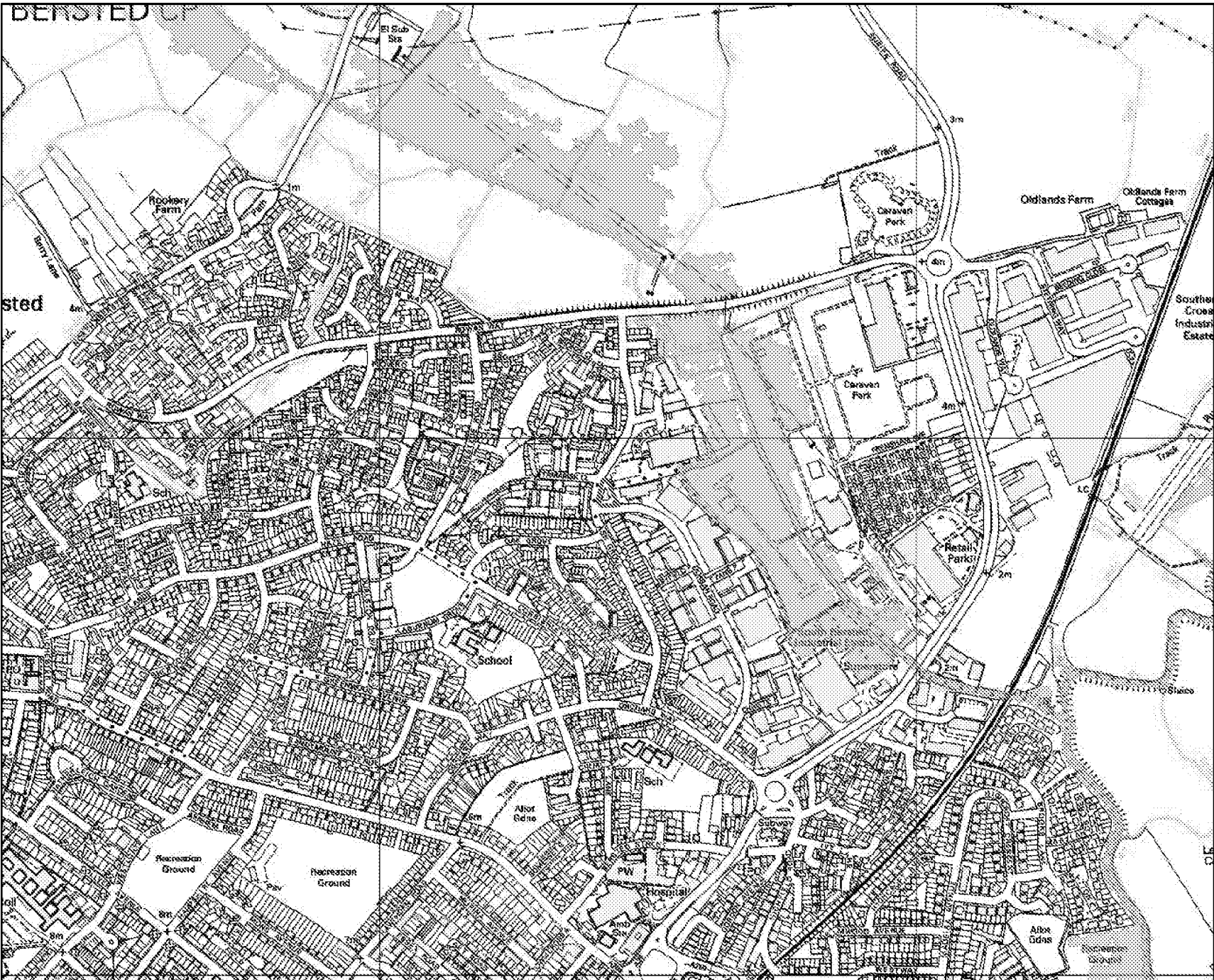
Scale: 1:10,000



00.2250.45

Kilometers



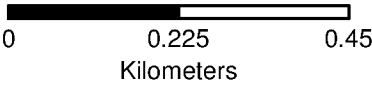


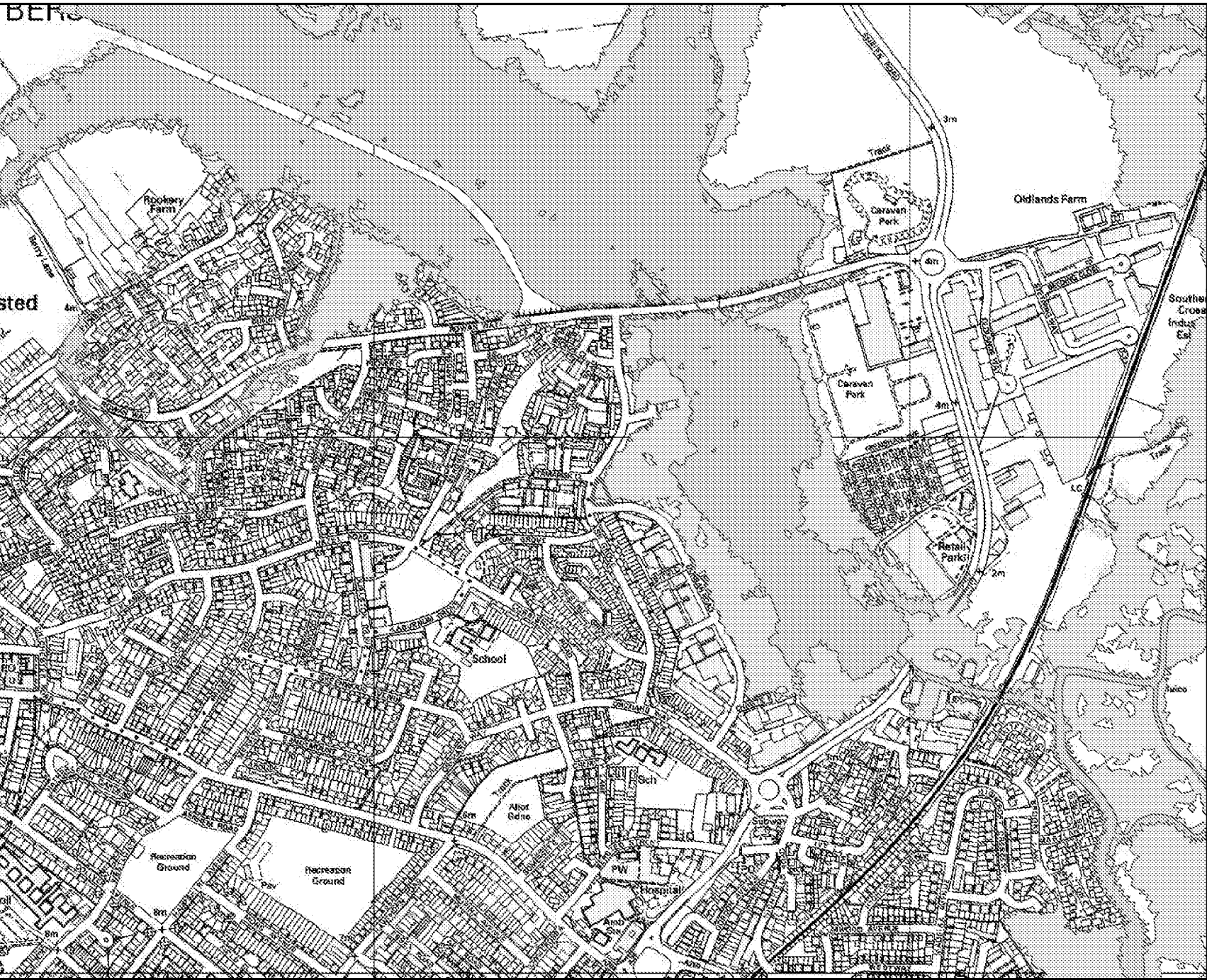
**Legend**

- Site Boundary
- 0.5% AEP (Defended Tidal)
- 0.5% AEP (2070) NPPF (Defended Tidal)
- 0.5% AEP (2115) NPPF (Defended Tidal)
- 0.1% AEP (Defended Tidal)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000







Environment  
Agency



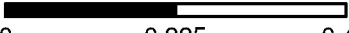
N

**Legend**

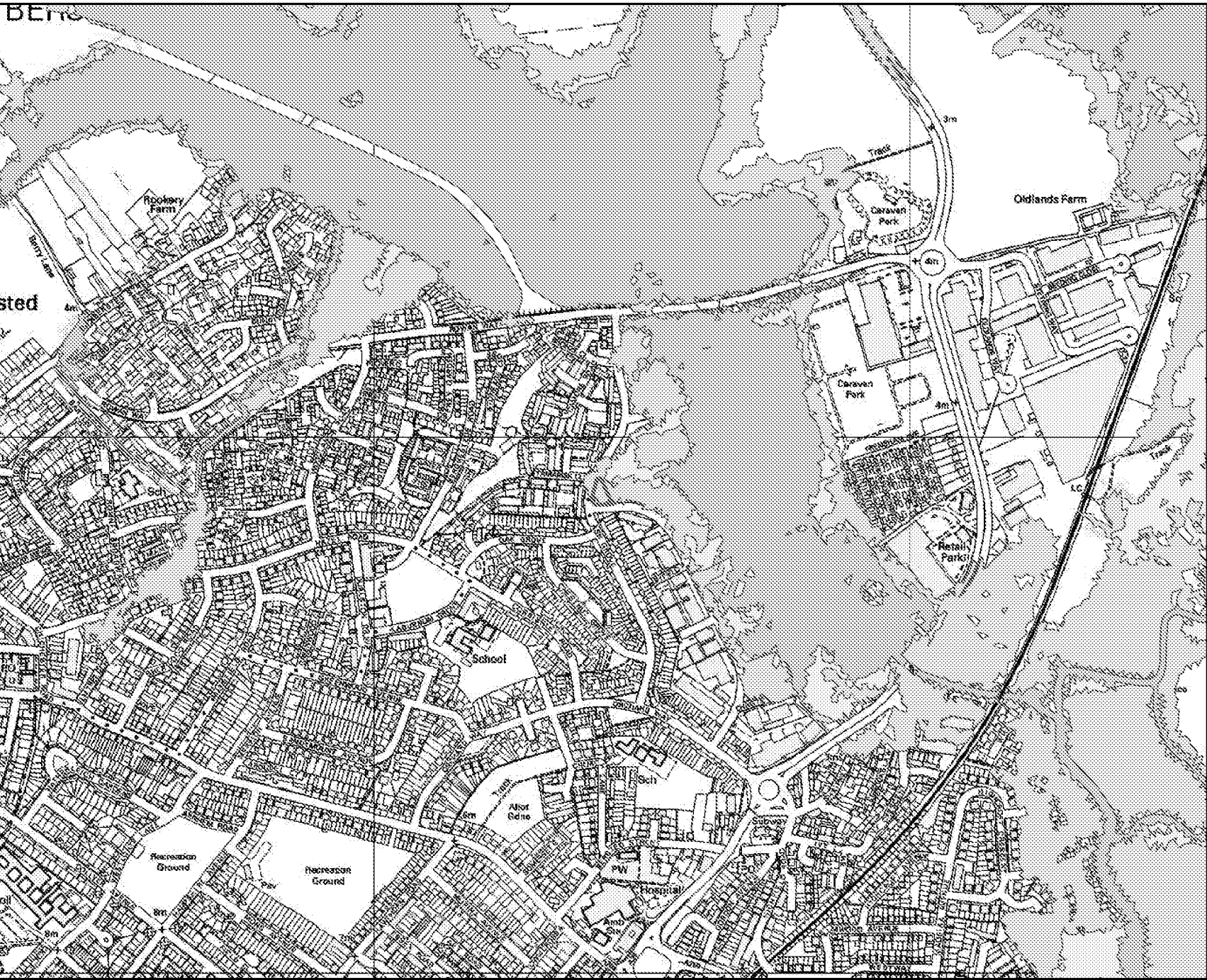
-  Site Boundary
-  1% AEP +35% (Defended Fluvial)
-  1% AEP +45% (Defended Fluvial)
-  1% AEP +105% (Defended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



00.2250.45  
Kilometers





Environment  
Agency

N  


**Legend**

-  Site Boundary
-  1% AEP +35% (Undefended Fluvial)
-  1% AEP +45% (Undefended Fluvial)
-  1% AEP +105% (Undefended Fluvial)

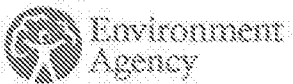
Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



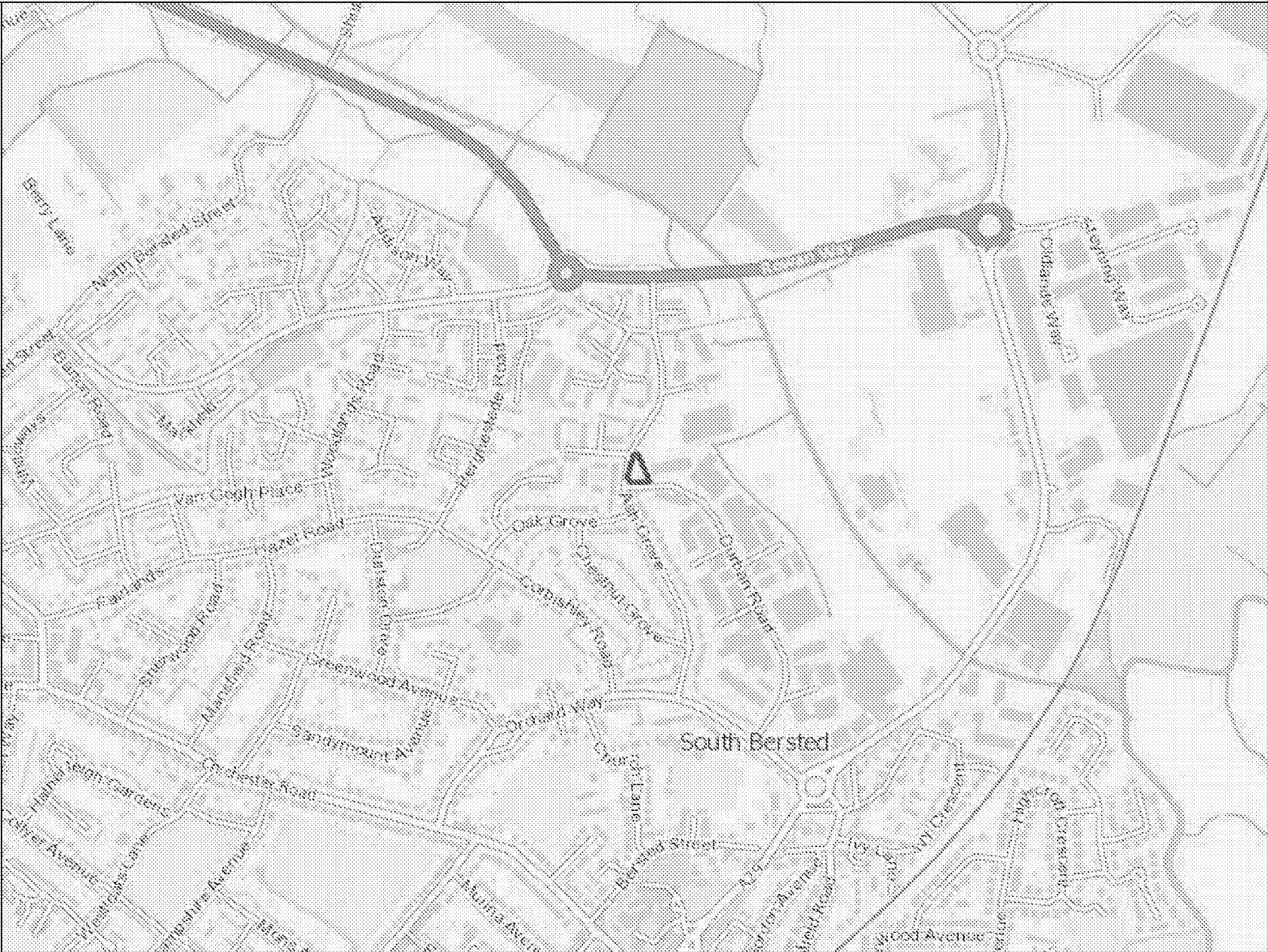
00.2250.45  
Kilometers

# Recorded Flood Outlines. Centred PO22 9FD. Created 01/09/2021.



## Legend

 All recorded flood outlines





Environment  
Agency



N

**Legend**

-  Site Nodes
-  Site Boundary

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

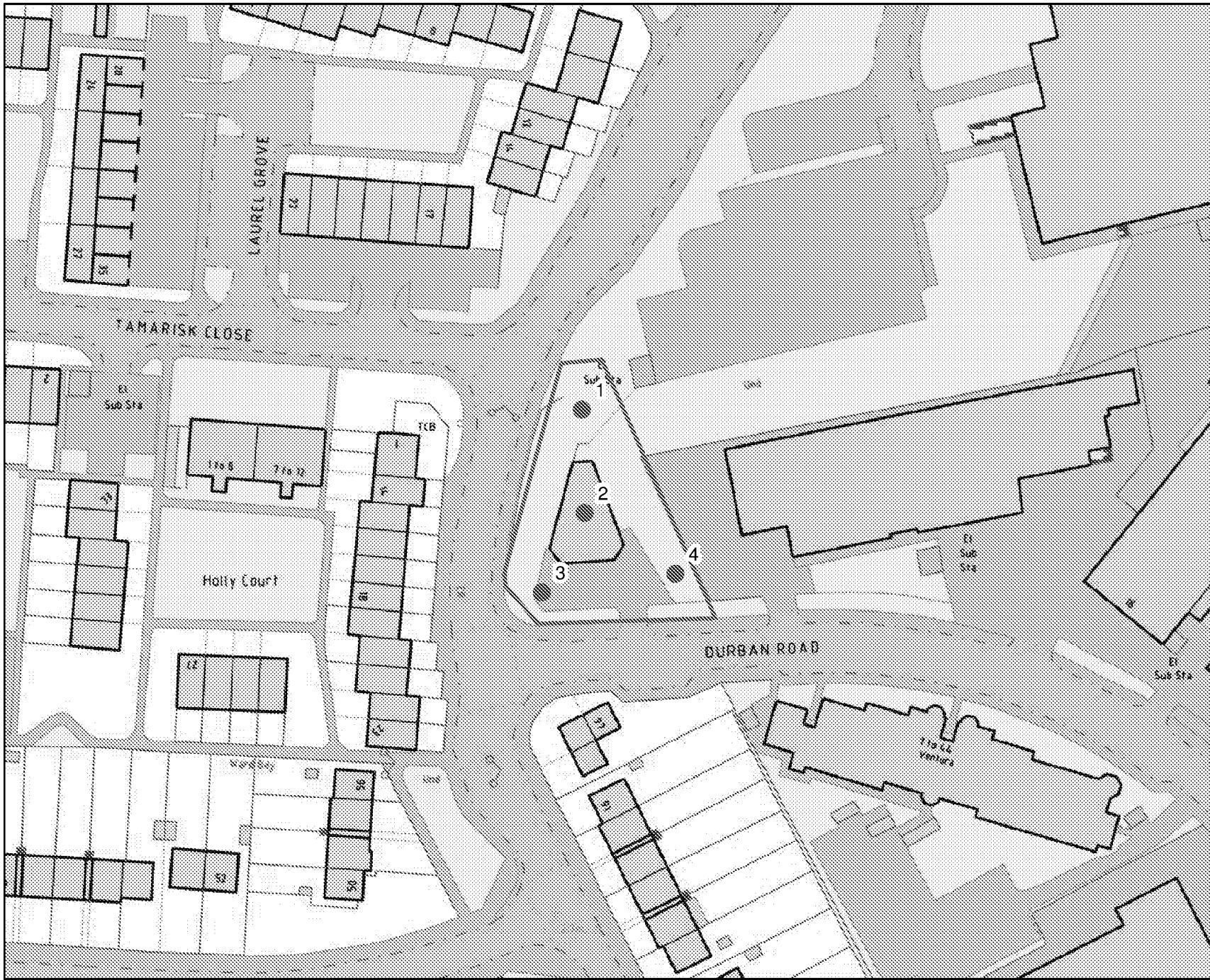
Scale: 1:1,000

0

0.0225

0.045

Kilometers



**Product 4 Flood Risk Data Requested by:** Encon Associates

**Site:** Land At Durban Road And Ash Grove, Bognor Regis, PO22 9FD

**Table 1: Water Levels: Fluvial Undefended**

| Node Ref | NGR      |           | Modelled Flood Levels in Metres AOD      |    |              |              |               |      |
|----------|----------|-----------|------------------------------------------|----|--------------|--------------|---------------|------|
|          | Eastings | Northings | Undefended Annual Exceedance Probability |    |              |              |               |      |
|          |          |           | 5%                                       | 1% | 1% +CC (35%) | 1% +CC (45%) | 1% +CC (105%) | 0.1% |
| 1        | 493419   | 100914    | -                                        | -  | -            | -            | 2.27          | -    |
| 2        | 493420   | 100894    | -                                        | -  | -            | -            | 2.27          | -    |
| 3        | 493412   | 100879    | -                                        | -  | -            | -            | 2.27          | -    |
| 4        | 493437   | 100883    | -                                        | -  | -            | -            | -             | -    |

**Table 2: Water Levels: Fluvial Defended**

| Node Ref | NGR      |           | Modelled Flood Levels in Metres AOD    |    |              |              |               |      |
|----------|----------|-----------|----------------------------------------|----|--------------|--------------|---------------|------|
|          | Eastings | Northings | Defended Annual Exceedance Probability |    |              |              |               |      |
|          |          |           | 5%                                     | 1% | 1% +CC (35%) | 1% +CC (45%) | 1% +CC (105%) | 0.1% |
| 1        | 493419   | 100914    | -                                      | -  | -            | -            | 2.27          | 2.10 |
| 2        | 493420   | 100894    | -                                      | -  | -            | -            | 2.27          | 2.13 |
| 3        | 493412   | 100879    | -                                      | -  | -            | -            | 2.27          | 2.11 |
| 4        | 493437   | 100883    | -                                      | -  | -            | -            | -             | -    |

**Table 3: Water Levels: Tidal Undefended**

| Node Ref | NGR      |           | Modelled Flood Levels in Metres AOD      |              |              |      |
|----------|----------|-----------|------------------------------------------|--------------|--------------|------|
|          | Eastings | Northings | Undefended Annual Exceedance Probability |              |              |      |
|          |          |           | 0.5%                                     | 0.5% (2070)* | 0.5% (2115)* | 0.1% |
| 1        | 493419   | 100914    | -                                        | 2.69         | 3.60         | 2.12 |
| 2        | 493420   | 100894    | -                                        | 2.69         | 3.60         | 2.12 |
| 3        | 493412   | 100879    | -                                        | 2.69         | 3.60         | 2.12 |
| 4        | 493437   | 100883    | -                                        | 2.69         | 3.60         | 2.12 |

**Table 4: Water Levels: Tidal Defended**

| Node Ref | NGR      |           | Modelled Flood Levels in Metres AOD    |              |              |      |
|----------|----------|-----------|----------------------------------------|--------------|--------------|------|
|          |          |           | Defended Annual Exceedance Probability |              |              |      |
|          | Eastings | Northings | 0.5%                                   | 0.5% (2070)* | 0.5% (2115)* | 0.1% |
| 1        | 493419   | 100914    | -                                      | -            | -            | -    |
| 2        | 493420   | 100894    | -                                      | -            | -            | -    |
| 3        | 493412   | 100879    | -                                      | -            | -            | -    |
| 4        | 493437   | 100883    | -                                      | -            | -            | -    |

**Table 5: Water Depths: Fluvial Undefended**

| Node Ref | NGR      |           | Modelled Flood Depths in Metres          |    |              |              |               |      |
|----------|----------|-----------|------------------------------------------|----|--------------|--------------|---------------|------|
|          |          |           | Undefended Annual Exceedance Probability |    |              |              |               |      |
|          | Eastings | Northings | 5%                                       | 1% | 1% +CC (35%) | 1% +CC (45%) | 1% +CC (105%) | 0.1% |
| 1        | 493419   | 100914    | -                                        | -  | -            | -            | 0.35          | -    |
| 2        | 493420   | 100894    | -                                        | -  | -            | -            | 0.38          | -    |
| 3        | 493412   | 100879    | -                                        | -  | -            | -            | 0.27          | -    |
| 4        | 493437   | 100883    | -                                        | -  | -            | -            | -             | -    |

**Table 6: Water Depths: Fluvial Defended**

| Node Ref | NGR      |           | Modelled Flood Depths in Metres        |    |              |              |               |      |
|----------|----------|-----------|----------------------------------------|----|--------------|--------------|---------------|------|
|          |          |           | Defended Annual Exceedance Probability |    |              |              |               |      |
|          | Eastings | Northings | 5%                                     | 1% | 1% +CC (35%) | 1% +CC (45%) | 1% +CC (105%) | 0.1% |
| 1        | 493419   | 100914    | -                                      | -  | -            | -            | 0.35          | 0.18 |
| 2        | 493420   | 100894    | -                                      | -  | -            | -            | 0.38          | 0.24 |
| 3        | 493412   | 100879    | -                                      | -  | -            | -            | 0.27          | 0.27 |
| 4        | 493437   | 100883    | -                                      | -  | -            | -            | -             | -    |

**Table 7: Water Depths: Tidal Undefended**

| Node Ref | NGR      |           | Modelled Flood Depths in Metres          |              |              |      |
|----------|----------|-----------|------------------------------------------|--------------|--------------|------|
|          |          |           | Undefended Annual Exceedance Probability |              |              |      |
|          | Eastings | Northings | 0.5%                                     | 0.5% (2070)* | 0.5% (2115)* | 0.1% |
| 1        | 493419   | 100914    | -                                        | 0.72         | 1.63         | 0.15 |
| 2        | 493420   | 100894    | -                                        | 0.84         | 1.74         | 0.27 |
| 3        | 493412   | 100879    | -                                        | 0.49         | 1.40         | 0.04 |
| 4        | 493437   | 100883    | -                                        | 0.66         | 1.57         | 0.14 |

**Table 8: Water Depths: Tidal Defended**

| Node Ref | NGR      |           | Modelled Flood Depths in Metres        |              |              |      |
|----------|----------|-----------|----------------------------------------|--------------|--------------|------|
|          | Eastings | Northings | Defended Annual Exceedance Probability |              |              |      |
|          |          |           | 0.5%                                   | 0.5% (2070)* | 0.5% (2115)* | 0.1% |
| 1        | 493419   | 100914    | -                                      | -            | -            | -    |
| 2        | 493420   | 100894    | -                                      | -            | -            | -    |
| 3        | 493412   | 100879    | -                                      | -            | -            | -    |
| 4        | 493437   | 100883    | -                                      | -            | -            | -    |

All levels taken from:

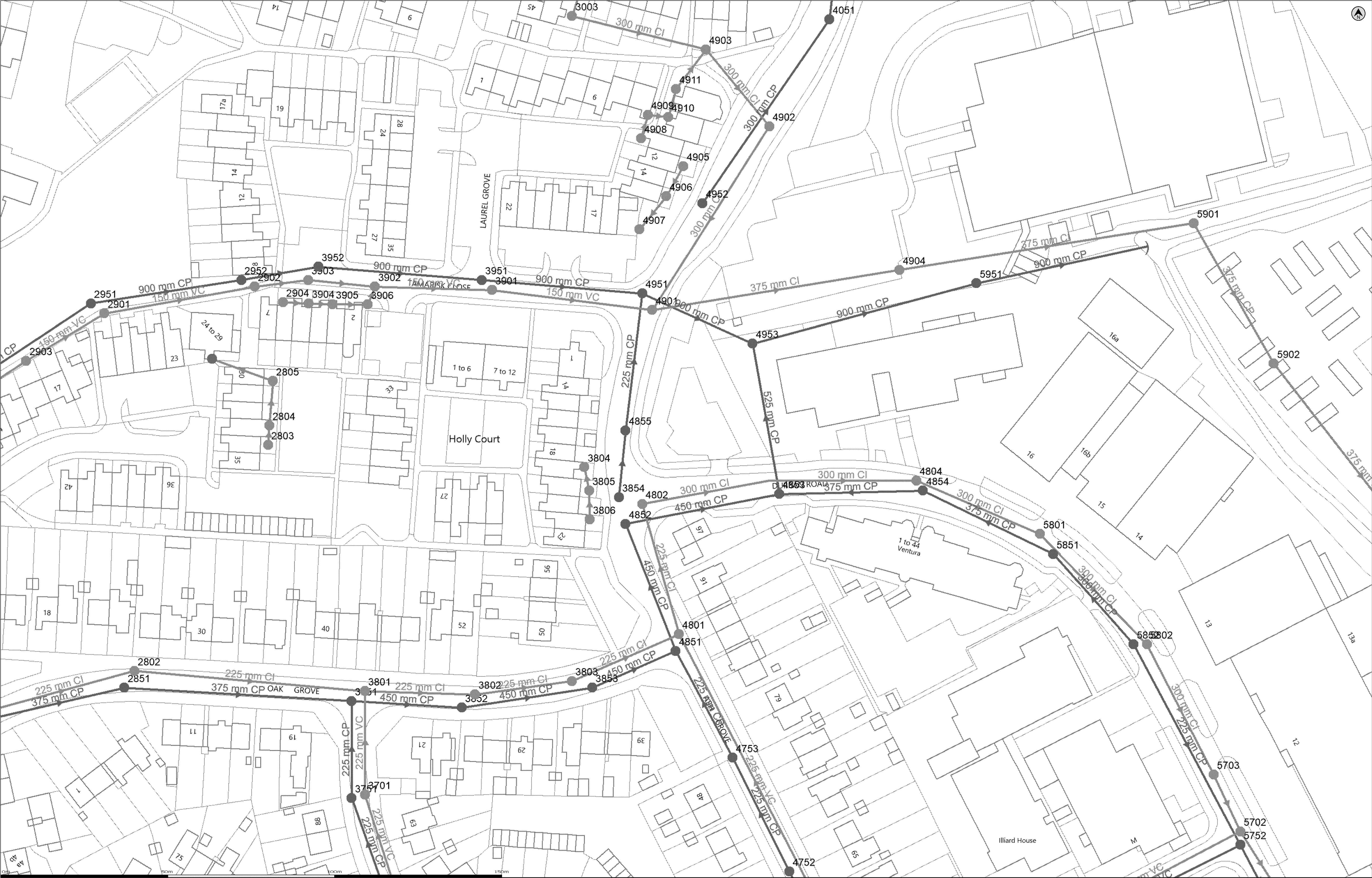
Fluvial: Aldingbourne Flood Risk Mapping Study, completed in 2015 by JBA Consulting (Defended only), plus climate change allowances (2016). Tidal: River Arun to East Head, completed in 2016 by JBA Consulting.

Produced on: 01/09/2021

**\*The flood risk data provided is based on existing EA hydraulic models with an allowance for climate change. Please note the climate change allowances provided are not up to date. These were updated on 27 July 2021.**  
**You should refer to 'Flood risk assessments: climate change allowances' for the most up to date allowances. You will need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.**

**There is no additional information or health warnings for these levels/depths or the model from which they have been produced.**

APPENDIX C  
SOUTHERN WATER PUBLIC SEWER RECORDS



(c) Crown copyright and database rights 2021 Ordnance Survey 100031673

Date: 02/09/21

Scale: 1:500

Map Centre: 493419,100882

Data updated: 16/08/21

Our Ref: 639218 - 1

Wastewater Plan A1

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2021 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

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

|  |  |  |  |  |  |
|--|--|--|--|--|--|
|  |  |  |  |  |  |
|  |  |  |  |  |  |
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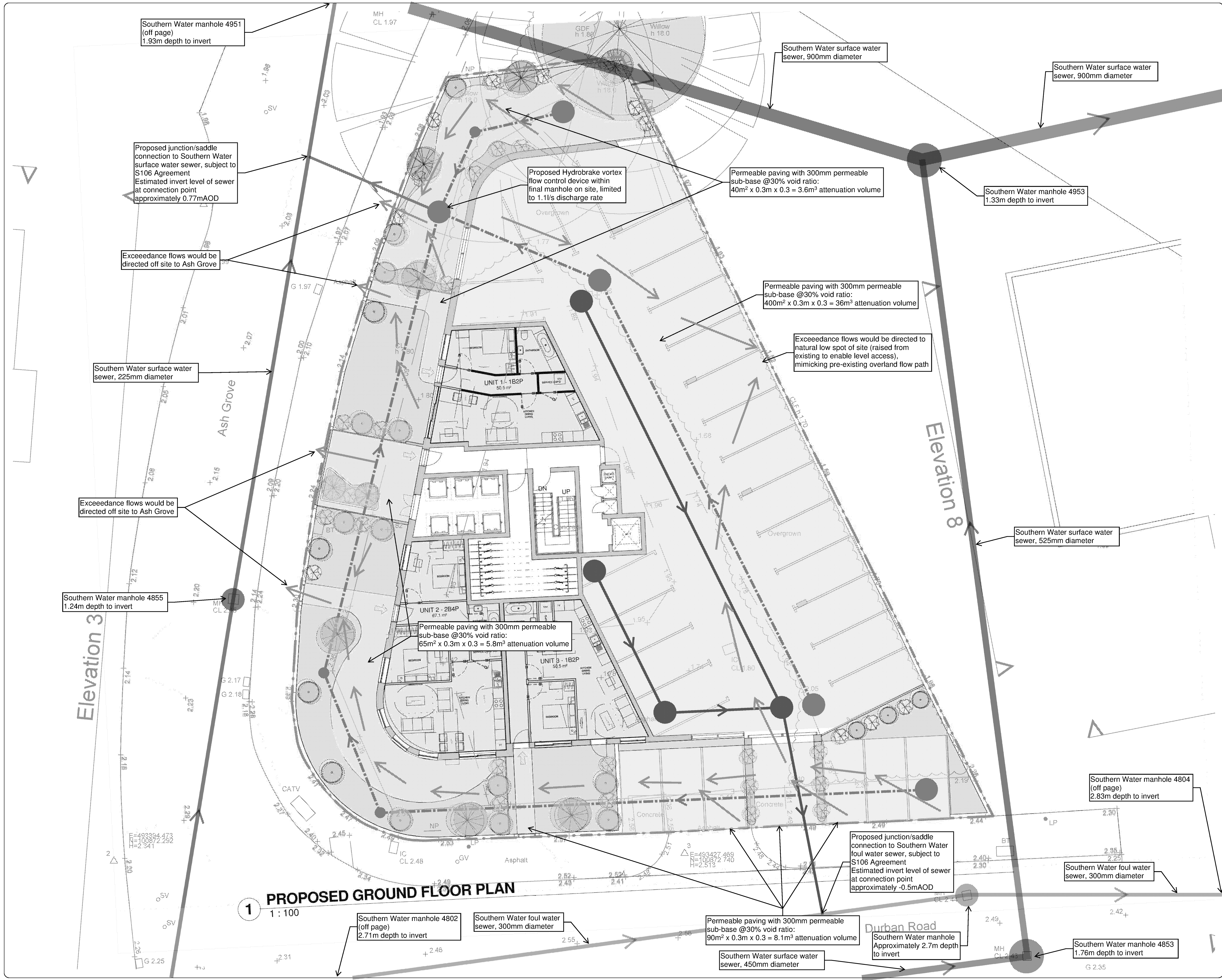
stuart.manning@aahplanning.com

A5104 Durban Road





APPENDIX C  
PROPOSED DRAINAGE STRATEGY



C. Encon Associates - DISCLAIMER:

This drawing is copyright and shall not be reproduced nor used for any other purpose without the written permission of Encon Associates. This drawing must be read in conjunction with all other related drawings and documentation. It is the contractors responsibility to ensure full compliance with the relevant Regulations. Until technical approval has been obtained from the relevant Authorities it should be understood that all drawings issued are PRELIMINARY and NOT for Construction. Should the contractor start site work prior to approval being given, it is entirely at his own risk. Do not scale from this drawing, use figured dimensions only. It is the contractors responsibility to check and verify all dimensions on site. Any discrepancies to be reported to Encon Associates immediately. All survey information is provided by the surveying company and Encon Associates cannot accept any liability for any discrepancies there in. All survey information to be verified on site by Contractor. For our Standard Terms and Conditions, please visit [www.enconassociates.co.uk/terms](http://www.enconassociates.co.uk/terms). Alternatively, a hard copy can be posted to you.

Notes:

- Proposed Surface Water Drainage with Perforated Pipe/ Filter Drain
- Proposed Surface Water Drainage with Solid Pipe
- Proposed Foul Water Drainage
- Existing Surface Water Sewer
- Existing Foul Water Sewer
- Proposed Permeable Paving
- Proposed Bioretention Tree Pit
- Proposed Exceedance Flow Route

| Rev | Date | Description | Drawn | Checked |
|-----|------|-------------|-------|---------|
|-----|------|-------------|-------|---------|

Client  
Pilot Developments Southern Ltd  
JDRM Architectural Design

Project  
Durban Road / Ash Grove  
Bognor Regis  
PO22 7JT

Title  
Drainage Strategy  
Surface Water Schematic Plan

Drawing Status  
Planning

| Drawn | MF | Checked | MF |
|-------|----|---------|----|
|-------|----|---------|----|

| Date | 29/10/21 | Scale (A1) | 1:100 |
|------|----------|------------|-------|
|------|----------|------------|-------|

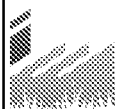
**encon**  
associates  
10 Chapel Lane  
Arnold  
Nottingham  
NG5 7DR  
T: 0115 987 55 99 E: [enquiries@enconassociates.co.uk](mailto:enquiries@enconassociates.co.uk) W: [www.enconassociates.co.uk](http://www.enconassociates.co.uk)

Sustainable Buildings Consultancy  
BRESAM - Landscape Architecture - Arboriculture - Ecology - Traffic & Transportation  
- Street Path Analysis - Energy Assessment - SAP - EPC - SBEM - Thermal Modelling - Daylighting

| Job Number | Drawing Number | Rev |
|------------|----------------|-----|
| A5104      | DR-D-001       | -   |

APPENDIX C

SURFACE WATER DRAINAGE HYDRAULIC CALCULATIONS



**encon**  
associates

Encon Associates  
10 Chapel Lane  
Arnold, Nottingham  
NG5 7DR

File: A5104-CA-D-001\_Durban  
Network: Storm Network  
Matthew Freeman  
29/10/2021

Page 1

### Design Settings

|                       |                   |                                      |               |
|-----------------------|-------------------|--------------------------------------|---------------|
| Rainfall Methodology  | FSR               | Maximum Time of Concentration (mins) | 30.00         |
| Return Period (years) | 100               | Maximum Rainfall (mm/hr)             | 50.0          |
| Additional Flow (%)   | 40                | Minimum Velocity (m/s)               | 1.00          |
| FSR Region            | England and Wales | Connection Type                      | Level Soffits |
| M5-60 (mm)            | 17.000            | Minimum Backdrop Height (m)          | 0.200         |
| Ratio-R               | 0.400             | Preferred Cover Depth (m)            | 0.600         |
| CV                    | 0.750             | Include Intermediate Ground          | ✓             |
| Time of Entry (mins)  | 5.00              | Enforce best practice design rules   | x             |

### Nodes

| Name  | Area<br>(ha) | T of E<br>(mins) | Cover<br>Level<br>(m) | Diameter<br>(mm) | Easting<br>(m) | Northing<br>(m) | Depth<br>(m) |
|-------|--------------|------------------|-----------------------|------------------|----------------|-----------------|--------------|
| 1     | 0.050        | 5.00             | 2.400                 | 1200             | 5.897          | 58.831          | 0.750        |
| 2     |              |                  | 2.400                 | 600              | -23.242        | 58.771          | 0.944        |
| 3     |              |                  | 2.400                 | 600              | -27.929        | 64.761          | 0.995        |
| 4     | 0.060        | 5.00             | 2.400                 | 1200             | -1.009         | 63.739          | 0.750        |
| 5     |              |                  | 2.400                 | 1200             | -11.998        | 88.793          | 1.050        |
| 6     | 0.010        | 5.00             | 2.400                 | 1200             | -13.095        | 98.372          | 0.700        |
| 7     |              |                  | 2.400                 | 600              | -17.816        | 97.811          | 0.780        |
| 8     |              |                  | 2.400                 | 1200             | -21.023        | 92.984          | 1.250        |
| 8_OUT |              |                  | 2.000                 |                  | -28.483        | 96.336          | 1.125        |

### Links (Input)

| Name  | US<br>Node | DS<br>Node | Length<br>(m) | ks (mm) /<br>n | US IL<br>(m) | DS IL<br>(m) | Fall<br>(m) | Slope<br>(1:X) | Dia<br>(mm) | T of C<br>(mins) | Rain<br>(mm/hr) |
|-------|------------|------------|---------------|----------------|--------------|--------------|-------------|----------------|-------------|------------------|-----------------|
| 1.000 | 1          | 2          | 29.139        | 0.600          | 1.650        | 1.456        | 0.194       | 150.0          | 150         | 5.59             | 50.0            |
| 1.001 | 2          | 3          | 7.606         | 0.600          | 1.456        | 1.405        | 0.051       | 150.0          | 150         | 5.75             | 50.0            |
| 1.002 | 3          | 8          | 29.056        | 0.600          | 1.405        | 1.211        | 0.194       | 150.0          | 150         | 6.34             | 50.0            |
| 2.000 | 4          | 5          | 27.358        | 0.600          | 1.650        | 1.350        | 0.300       | 91.2           | 150         | 5.43             | 50.0            |
| 2.001 | 5          | 8          | 9.951         | 0.600          | 1.350        | 1.211        | 0.139       | 71.6           | 150         | 5.57             | 50.0            |
| 3.000 | 6          | 7          | 4.754         | 0.600          | 1.700        | 1.620        | 0.080       | 59.4           | 100         | 5.08             | 50.0            |
| 3.001 | 7          | 8          | 5.795         | 0.600          | 1.620        | 1.522        | 0.098       | 59.1           | 100         | 5.18             | 50.0            |
| 1.003 | 8          | 8_OUT      | 8.178         | 0.600          | 1.150        | 0.875        | 0.275       | 29.7           | 150         | 6.41             | 50.0            |

### Simulation Settings

|                      |                   |                                         |        |
|----------------------|-------------------|-----------------------------------------|--------|
| Rainfall Methodology | FSR               | Analysis Speed                          | Normal |
| FSR Region           | England and Wales | Skip Steady State                       | x      |
| M5-60 (mm)           | 17.000            | Drain Down Time (mins)                  | 240    |
| Ratio-R              | 0.400             | Additional Storage (m <sup>3</sup> /ha) | 20.0   |
| Summer CV            | 0.750             | Check Discharge Rate(s)                 | x      |
| Winter CV            | 0.840             | Check Discharge Volume                  | x      |

### Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

| Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) |
|--------------------------|--------------------------|--------------------------|--------------------------|
| 1                        | 0                        | 0                        | 0                        |
| 30                       | 0                        | 0                        | 0                        |
| 100                      | 0                        | 0                        | 0                        |
| 100                      | 40                       | 0                        | 0                        |

#### Node 8 Online Hydro-Brake® Control

|                          |       |                         |                                |
|--------------------------|-------|-------------------------|--------------------------------|
| Flap Valve               | x     | Objective               | (HE) Minimise upstream storage |
| Downstream Link          | 1.003 | Sump Available          | ✓                              |
| Replaces Downstream Link | ✓     | Product Number          | CTL-SHE-0050-1100-0900-1100    |
| Invert Level (m)         | 1.150 | Min Outlet Diameter (m) | 0.075                          |
| Design Depth (m)         | 0.900 | Min Node Diameter (mm)  | 1200                           |
| Design Flow (l/s)        | 1.1   |                         |                                |

#### Node 1 Depth/Area Storage Structure

|                             |         |               |      |                           |       |
|-----------------------------|---------|---------------|------|---------------------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 1.800 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) |       |

| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 90.0                      | 0.0                           | 0.300        | 90.0                      | 0.0                           | 0.301        | 0.0                       | 0.0                           |

#### Node 3 Depth/Area Storage Structure

|                             |         |               |      |                           |       |
|-----------------------------|---------|---------------|------|---------------------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 1.800 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) |       |

| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 65.0                      | 0.0                           | 0.300        | 65.0                      | 0.0                           | 0.301        | 0.0                       | 0.0                           |

#### Node 7 Depth/Area Storage Structure

|                             |         |               |      |                           |       |
|-----------------------------|---------|---------------|------|---------------------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 1.800 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) |       |

| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 40.0                      | 0.0                           | 0.300        | 40.0                      | 0.0                           | 0.301        | 0.0                       | 0.0                           |

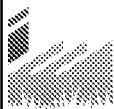
#### Node 4 Depth/Area Storage Structure

|                             |         |               |      |                           |       |
|-----------------------------|---------|---------------|------|---------------------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 1.800 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) |       |

| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 200.0                     | 0.0                           | 0.300        | 200.0                     | 0.0                           | 0.301        | 0.0                       | 0.0                           |

#### Node 5 Depth/Area Storage Structure

|                             |         |               |      |                           |       |
|-----------------------------|---------|---------------|------|---------------------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 1.800 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) |       |



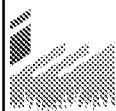
**encon**  
a s s o c i a t e s

Encon Associates  
10 Chapel Lane  
Arnold, Nottingham  
NG5 7DR

File: A5104-CA-D-001\_Durban  
Network: Storm Network  
Matthew Freeman  
29/10/2021

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| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 200.0                     | 0.0                           | 0.300        | 200.0                     | 0.0                           | 0.301        | 0.0                       | 0.0                           |



**Results for 1 year Critical Storm Duration. Lowest mass balance: 94.84%**

| Node Event       | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 60 minute winter | 1          | 58             | 1.812        | 0.162        | 3.1             | 0.7425           | 0.0000        | SURCHARGED |
| 60 minute winter | 2          | 59             | 1.812        | 0.356        | 2.9             | 0.1008           | 0.0000        | SURCHARGED |
| 60 minute winter | 3          | 60             | 1.812        | 0.407        | 2.4             | 0.3592           | 0.0000        | SURCHARGED |
| 60 minute winter | 4          | 59             | 1.812        | 0.162        | 3.7             | 1.1979           | 0.0000        | SURCHARGED |
| 60 minute winter | 5          | 60             | 1.812        | 0.462        | 3.5             | 1.2700           | 0.0000        | SURCHARGED |
| 60 minute winter | 6          | 60             | 1.812        | 0.112        | 0.9             | 0.1586           | 0.0000        | SURCHARGED |
| 60 minute winter | 7          | 60             | 1.812        | 0.192        | 1.2             | 0.2031           | 0.0000        | SURCHARGED |
| 60 minute winter | 8          | 60             | 1.812        | 0.662        | 3.2             | 0.7486           | 0.0000        | SURCHARGED |
| 15 minute summer | 8_OUT      | 1              | 0.875        | 0.000        | 1.0             | 0.0000           | 0.0000        | OK         |

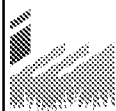
| Link Event<br>(Upstream Depth) | US<br>Node | Link         | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|------------|--------------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 60 minute winter               | 1          | 1.000        | 2          | 2.9              | 0.601             | 0.203    | 0.5130           |                       |
| 60 minute winter               | 2          | 1.001        | 3          | 2.1              | 0.535             | 0.148    | 0.1339           |                       |
| 60 minute winter               | 3          | 1.002        | 8          | -1.6             | 0.356             | -0.110   | 0.5115           |                       |
| 60 minute winter               | 4          | 2.000        | 5          | 3.5              | 0.670             | 0.191    | 0.4816           |                       |
| 60 minute winter               | 5          | 2.001        | 8          | 2.7              | 0.540             | 0.128    | 0.1752           |                       |
| 60 minute winter               | 6          | 3.000        | 7          | 0.8              | 0.574             | 0.101    | 0.0372           |                       |
| 60 minute winter               | 7          | 3.001        | 8          | -0.9             | 0.547             | -0.110   | 0.0453           |                       |
| 60 minute winter               | 8          | Hydro-Brake® | 8_OUT      | 1.0              |                   |          |                  | 10.9                  |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 94.84%**

| Node Event        | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|-------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 180 minute winter | 1          | 172            | 1.906        | 0.256        | 3.4             | 3.5084           | 0.0000        | SURCHARGED |
| 180 minute winter | 2          | 176            | 1.906        | 0.450        | 2.3             | 0.1273           | 0.0000        | SURCHARGED |
| 180 minute winter | 3          | 176            | 1.906        | 0.501        | 2.2             | 2.2158           | 0.0000        | SURCHARGED |
| 180 minute winter | 4          | 176            | 1.906        | 0.256        | 4.1             | 7.0938           | 0.0000        | SURCHARGED |
| 180 minute winter | 5          | 176            | 1.906        | 0.556        | 2.3             | 7.0081           | 0.0000        | SURCHARGED |
| 180 minute winter | 6          | 176            | 1.906        | 0.206        | 0.7             | 0.2916           | 0.0000        | SURCHARGED |
| 180 minute winter | 7          | 176            | 1.906        | 0.286        | 0.6             | 1.3557           | 0.0000        | SURCHARGED |
| 180 minute winter | 8          | 176            | 1.906        | 0.756        | 1.7             | 0.8547           | 0.0000        | SURCHARGED |
| 15 minute summer  | 8_OUT      | 1              | 0.875        | 0.000        | 1.0             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node | Link         | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|------------|--------------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 180 minute winter              | 1          | 1.000        | 2          | 2.3              | 0.468             | 0.157    | 0.5130           |                       |
| 180 minute winter              | 2          | 1.001        | 3          | 2.2              | 0.420             | 0.154    | 0.1339           |                       |
| 180 minute winter              | 3          | 1.002        | 8          | 1.5              | 0.350             | 0.102    | 0.5115           |                       |
| 180 minute winter              | 4          | 2.000        | 5          | 2.0              | 0.541             | 0.105    | 0.4816           |                       |
| 180 minute winter              | 5          | 2.001        | 8          | 1.3              | 0.508             | 0.060    | 0.1752           |                       |
| 180 minute winter              | 6          | 3.000        | 7          | 0.6              | 0.474             | 0.082    | 0.0372           |                       |
| 180 minute winter              | 7          | 3.001        | 8          | 0.6              | 0.423             | 0.072    | 0.0453           |                       |
| 180 minute winter              | 8          | Hydro-Brake® | 8_OUT      | 1.0              |                   |          |                  | 24.2                  |

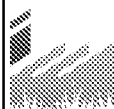


**Results for 100 year Critical Storm Duration. Lowest mass balance: 94.84%**

| Node Event        | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|-------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 180 minute winter | 1          | 176            | 1.965        | 0.315        | 4.5             | 5.2386           | 0.0000        | SURCHARGED |
| 180 minute winter | 2          | 176            | 1.965        | 0.509        | 2.9             | 0.1439           | 0.0000        | SURCHARGED |
| 180 minute winter | 3          | 180            | 1.964        | 0.559        | 2.9             | 3.3748           | 0.0000        | SURCHARGED |
| 180 minute winter | 4          | 180            | 1.965        | 0.315        | 5.4             | 10.7668          | 0.0000        | SURCHARGED |
| 180 minute winter | 5          | 180            | 1.965        | 0.615        | 3.2             | 10.5954          | 0.0000        | SURCHARGED |
| 180 minute winter | 6          | 180            | 1.964        | 0.264        | 0.9             | 0.3747           | 0.0000        | SURCHARGED |
| 180 minute winter | 7          | 180            | 1.964        | 0.344        | 0.8             | 2.0764           | 0.0000        | SURCHARGED |
| 180 minute winter | 8          | 180            | 1.964        | 0.814        | 2.1             | 0.9211           | 0.0000        | SURCHARGED |
| 15 minute summer  | 8_OUT      | 1              | 0.875        | 0.000        | 1.0             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node | Link         | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|------------|--------------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 180 minute winter              | 1          | 1.000        | 2          | 2.9              | 0.441             | 0.202    | 0.5130           |                       |
| 180 minute winter              | 2          | 1.001        | 3          | 2.9              | 0.436             | 0.198    | 0.1339           |                       |
| 180 minute winter              | 3          | 1.002        | 8          | 1.9              | 0.291             | 0.128    | 0.5115           |                       |
| 180 minute winter              | 4          | 2.000        | 5          | 2.2              | 0.579             | 0.118    | 0.4816           |                       |
| 180 minute winter              | 5          | 2.001        | 8          | 1.1              | 0.507             | 0.054    | 0.1752           |                       |
| 180 minute winter              | 6          | 3.000        | 7          | 0.8              | 0.474             | 0.106    | 0.0372           |                       |
| 180 minute winter              | 7          | 3.001        | 8          | -0.3             | 0.423             | -0.044   | 0.0453           |                       |
| 180 minute winter              | 8          | Hydro-Brake® | 8_OUT      | 1.1              |                   |          |                  | 24.9                  |

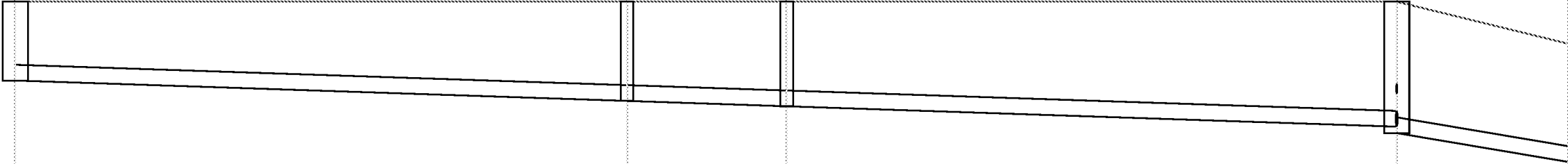


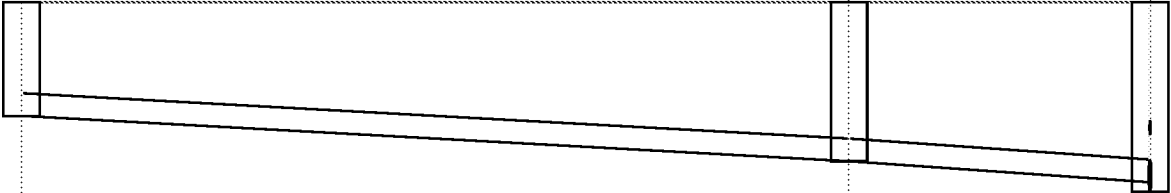
**Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 94.84%**

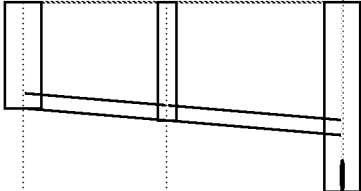
| Node Event        | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|-------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 240 minute winter | 1          | 236            | 2.067        | 0.417        | 5.1             | 8.2387           | 0.0000        | SURCHARGED |
| 240 minute winter | 2          | 236            | 2.066        | 0.610        | 3.3             | 0.1727           | 0.0000        | SURCHARGED |
| 240 minute winter | 3          | 236            | 2.066        | 0.661        | 3.2             | 5.3908           | 0.0000        | SURCHARGED |
| 240 minute winter | 4          | 236            | 2.066        | 0.416        | 6.1             | 17.1566          | 0.0000        | SURCHARGED |
| 240 minute winter | 5          | 236            | 2.066        | 0.716        | 3.6             | 16.8147          | 0.0000        | SURCHARGED |
| 240 minute winter | 6          | 236            | 2.066        | 0.366        | 1.0             | 0.5188           | 0.0000        | SURCHARGED |
| 240 minute winter | 7          | 236            | 2.066        | 0.446        | 0.9             | 3.3260           | 0.0000        | SURCHARGED |
| 240 minute winter | 8          | 236            | 2.066        | 0.916        | 2.3             | 1.0361           | 0.0000        | SURCHARGED |
| 15 minute summer  | 8_OUT      | 1              | 0.875        | 0.000        | 1.0             | 0.0000           | 0.0000        | OK         |

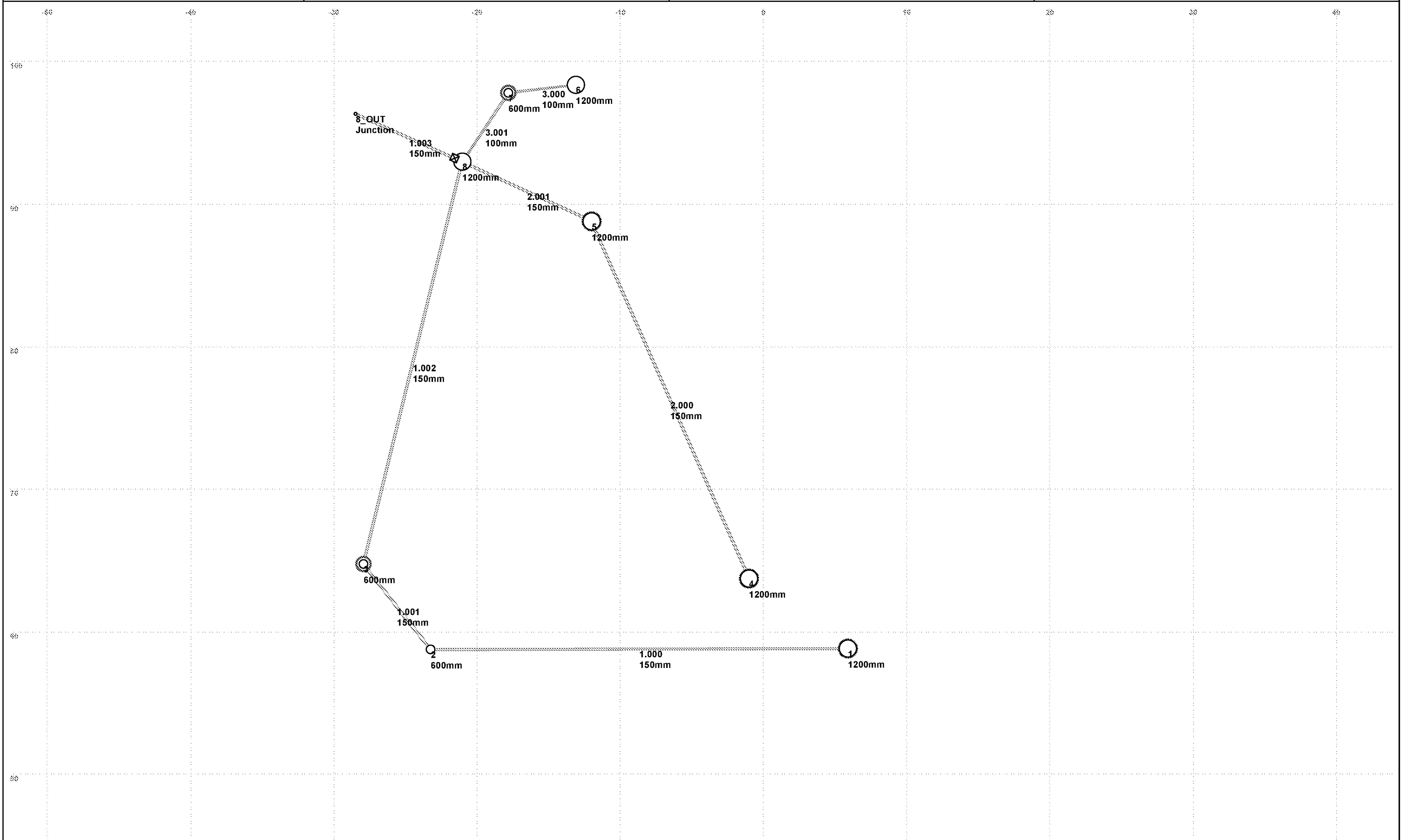
  

| Link Event<br>(Upstream Depth) | US<br>Node | Link         | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|------------|--------------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 240 minute winter              | 1          | 1.000        | 2          | 3.3              | 0.457             | 0.228    | 0.5130           |                       |
| 240 minute winter              | 2          | 1.001        | 3          | 3.2              | 0.451             | 0.224    | 0.1339           |                       |
| 240 minute winter              | 3          | 1.002        | 8          | 2.1              | 0.285             | 0.144    | 0.5115           |                       |
| 240 minute winter              | 4          | 2.000        | 5          | 2.4              | 0.581             | 0.129    | 0.4816           |                       |
| 240 minute winter              | 5          | 2.001        | 8          | -1.2             | 0.471             | -0.056   | 0.1752           |                       |
| 240 minute winter              | 6          | 3.000        | 7          | 0.9              | 0.422             | 0.117    | 0.0372           |                       |
| 240 minute winter              | 7          | 3.001        | 8          | -0.3             | 0.423             | -0.039   | 0.0453           |                       |
| 240 minute winter              | 8          | Hydro-Brake® | 8_OUT      | 1.1              |                   |          |                  | 29.7                  |

| Node Name                                                                                                                                                                                     | 1      | 2     | 3      | 8     | 8_OUT |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|--------|-------|-------|
| <div>  <div> A3 drawing<br/><br/> Hor Scale 250<br/> Ver Scale 50<br/><br/> Datum (m) -2.000 </div> </div> |        |       |        |       |       |
| Link Name                                                                                                                                                                                     | 1.000  | 1.001 | 1.002  | 1.003 |       |
| Section Type                                                                                                                                                                                  | 150mm  | 150mm | 150mm  | 150mm |       |
| Slope (1:X)                                                                                                                                                                                   | 150.0  | 150.0 | 150.0  | 29.7  |       |
| Cover Level (m)                                                                                                                                                                               | 2.400  | 2.400 | 2.400  | 2.400 | 2.000 |
| Invert Level (m)                                                                                                                                                                              | 1.650  | 1.456 | 1.405  | 1.211 | 0.875 |
| Length (m)                                                                                                                                                                                    | 29.139 | 7.606 | 29.056 | 8.178 |       |

| Node Name                                                                                                                                                                                                                      | 4      |  | 5              | 8     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--|----------------|-------|
| <div> <div>A3 drawing</div> <div> <div>Hor Scale 250</div> <div>Ver Scale 50</div> </div> <div>Datum (m) -2.000</div> </div> <div>  </div> |        |  |                |       |
| Link Name                                                                                                                                                                                                                      | 2.000  |  | 2.001          |       |
| Section Type                                                                                                                                                                                                                   | 150mm  |  | 150mm          |       |
| Slope (1:X)                                                                                                                                                                                                                    | 91.2   |  | 71.6           |       |
| Cover Level (m)                                                                                                                                                                                                                | 2.400  |  | 2.400          | 2.400 |
| Invert Level (m)                                                                                                                                                                                                               | 1.650  |  | 1.350<br>1.350 | 1.211 |
| Length (m)                                                                                                                                                                                                                     | 27.358 |  | 9.951          |       |

| Node Name                                                                                          | 6                                                                                    | 7     | 8     |
|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------|-------|
| <div>A3 drawing</div> <div>Hor Scale 250</div> <div>Ver Scale 50</div> <div>Datum (m) -2.000</div> |  |       |       |
| Link Name                                                                                          | 3.000                                                                                | 3.001 |       |
| Section Type                                                                                       | 100mm                                                                                | 100mm |       |
| Slope (1:X)                                                                                        | 59.4                                                                                 | 59.1  |       |
| Cover Level (m)                                                                                    | 2.400                                                                                | 2.400 | 2.400 |
| Invert Level (m)                                                                                   | 1.700<br>1.620                                                                       | 1.620 | 1.522 |
| Length (m)                                                                                         | 4.754                                                                                | 5.795 |       |



# Greenfield runoff rate estimation for sites

## Greenfield runoff tool

Calculated by: Matthew Freeman

Site name: Durban Road/Ash Grove

Site location: Bognor Regis

### Site Details

Latitude: 50.80000° N

Longitude: 0.67563° W

Reference: 2087361675

Date: Oct 27 2021 09:02

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach: IH124

### Site characteristics

Total site area (ha): 0.12

### Methodology

$Q_{BAR}$  estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

### Soil characteristics

|              | Default | Edited |
|--------------|---------|--------|
| SOIL type:   | 3       | 3      |
| HOST class:  | N/A     | N/A    |
| SPR/SPRHOST: | 0.37    | 0.37   |

### Hydrological characteristics

|                                | Default | Edited |
|--------------------------------|---------|--------|
| SAAR (mm):                     | 711     | 711    |
| Hydrological region:           | 7       | 7      |
| Growth curve factor 1 year:    | 0.85    | 0.85   |
| Growth curve factor 30 years:  | 2.3     | 2.3    |
| Growth curve factor 100 years: | 3.19    | 3.19   |
| Growth curve factor 200 years: | 3.74    | 3.74   |

### Notes

#### (1) Is $Q_{BAR} < 2.0$ l/s/ha?

When  $Q_{BAR}$  is  $< 2.0$  l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

#### (2) Are flow rates $< 5.0$ l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

#### (3) Is $SPR/SPRHOST \leq 0.3$ ?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

### Greenfield runoff rates

|                       | Default | Edited |
|-----------------------|---------|--------|
| $Q_{BAR}$ (l/s):      | 0.35    | 0.35   |
| 1 in 1 year (l/s):    | 0.3     | 0.3    |
| 1 in 30 years (l/s):  | 0.81    | 0.81   |
| 1 in 100 year (l/s):  | 1.12    | 1.12   |
| 1 in 200 years (l/s): | 1.31    | 1.31   |

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at [www.uksuds.com](http://www.uksuds.com). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [www.uksuds.com/terms-and-conditions.htm](http://www.uksuds.com/terms-and-conditions.htm). The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

APPENDIX C

TYPICAL OPERATION AND MAINTENANCE REQUIREMENTS

Table G 1: Permeable Paving Typical Operation and Maintenance Requirements

| Maintenance Schedule   | Required Action                                                                                                                                                                      | Typical frequency                                                                                                                                                                                                                                                                                                      |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Regular Maintenance    | Remove litter and debris                                                                                                                                                             | Monthly (or as required)                                                                                                                                                                                                                                                                                               |
|                        | Brushing and vacuuming (standard cosmetic sweep over whole surface)                                                                                                                  | Once a year after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this is most likely to collect the most sediment |
| Occasional Maintenance | Stabilise and mow contributing adjacent areas                                                                                                                                        | As required                                                                                                                                                                                                                                                                                                            |
|                        | Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying                                                                | As required, once per year on less frequently used pavements                                                                                                                                                                                                                                                           |
| Remedial Actions       | Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.                                             | As required                                                                                                                                                                                                                                                                                                            |
|                        | Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material | As required                                                                                                                                                                                                                                                                                                            |
|                        | Rehabilitation of surface and upper substructure by remedial sweeping                                                                                                                | Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)                                                                                                                                                                                                               |
| Monitoring             | Initial inspection                                                                                                                                                                   | Monthly for three months after installation                                                                                                                                                                                                                                                                            |
|                        | Inspect for evidence of poor operation and/or weed growth – if required, take remedial action                                                                                        | Three-monthly, 48 hours after large storms in first six months                                                                                                                                                                                                                                                         |
|                        | Inspect silt accumulation rates and establish appropriate brushing frequencies                                                                                                       | Annually                                                                                                                                                                                                                                                                                                               |
|                        | Monitor inspection chambers                                                                                                                                                          | Annually                                                                                                                                                                                                                                                                                                               |

Table G 2: Green Roof Typical Operation and Maintenance Requirements

| Maintenance Schedule | Required Action                                                                                                                                                                                                 | Typical frequency                                    |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Regular Inspections  | Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability | Annually and after severe storms                     |
|                      | Inspect soil substrate for evidence of erosion channels and identify any sediment sources                                                                                                                       | Annually and after severe storms                     |
|                      | Inspect drain outlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system                                                                                              | Annually and after severe storms                     |
|                      | Inspect underside of roof for evidence of leakage                                                                                                                                                               | Annually and after severe storms                     |
| Regular Maintenance  | Remove debris and litter to prevent clogging of inlet drains and interference with plant growth                                                                                                                 | Six monthly and annually or as required              |
|                      | During establishment (ie year one), replace dead plants as required                                                                                                                                             | Monthly (but usually responsibility of manufacturer) |
|                      | Post establishment, replace dead plants as required (where > 5% coverage)                                                                                                                                       | Annually (in autumn)                                 |
|                      | Remove fallen leaves and debris from deciduous plant foliage                                                                                                                                                    | Six monthly or as required                           |
|                      | Remove nuisance and invasive vegetation including weeds                                                                                                                                                         | Six monthly or as required                           |
|                      | Mow grasses, prune shrubs and manage other planting (if appropriate) as required ' clippings should be removed and not allowed to accumulate                                                                    | Six monthly or as required                           |
| Remedial Actions     | If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled                       | As required                                          |
|                      | If drain inlet has settled, crack or moved, investigate and repair as appropriate                                                                                                                               | As required                                          |

Table G 3: Filter Drains Typical Operation and Maintenance Requirements

| Maintenance Schedule   | Required Action                                                                                                                                   | Typical frequency           |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Regular Maintenance    | Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices                             | Monthly (or as required)    |
|                        | Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage             | Monthly                     |
|                        | Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation and establish appropriate silt removal frequencies            | Six monthly                 |
|                        | Remove sediment from pre-treatment devices                                                                                                        | Six monthly, or as required |
| Occasional Maintenance | Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJ UG, 2007 or BS 3998:2010) | As required                 |
|                        | At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium                        | Five yearly, or as required |
|                        | Clear perforated pipework of blockages                                                                                                            | As required                 |

Table G 4: Bioretention Tree Pits Typical Operation and Maintenance Requirements

| Maintenance Schedule   | Required Action                                                                                                                                                                                          | Typical frequency                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Regular Inspections    | Inspect infiltration surfaces for silting and ponding, record de-watering times of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary | Quarterly                                                        |
|                        | Check operation of underdrains by inspection of flows after rain                                                                                                                                         | Annually                                                         |
|                        | Assess plants for disease infection, poor growth, invasive species etc and replace as necessary                                                                                                          | Quarterly                                                        |
|                        | Inspect inlets and outlets for blockage                                                                                                                                                                  | Quarterly                                                        |
| Regular Maintenance    | Remove litter and surface debris and weeds                                                                                                                                                               | Quarterly (or more frequently for tidiness or aesthetic reasons) |
|                        | Replace any plants, to maintain planting density                                                                                                                                                         | As required                                                      |
|                        | Remove sediment, litter and debris build-up from around inlets or from forebays                                                                                                                          | Quarterly to biannually                                          |
| Occasional Maintenance | Infill any holes or scour in the filter medium, improve erosion protection if required                                                                                                                   | As required                                                      |
|                        | Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch                                                                                        | As required                                                      |
| Remedial Actions       | Remove and replace filter medium and vegetation above                                                                                                                                                    | As required but likely to be >20 years                           |