

Dunsbury Hill Farm

Surface Water Drainage and SuDS Strategy

On behalf of
Portsmouth City Council

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Appendix B	Access Road Surface Water Drainage Strategy Technical Note (Ref: TN001-PB2348-310055-Egha, dated 28th January 2015, Royal HaskoningDHV)
Appendix C	Proposed Surface Water Drainage Strategy and Storage Requirements (Ref: 30142/2001/001, May 2015)
Appendix D	MicroDrainage Modelling - 1 year, 30 year, 100 year and 100 year + 30% Climate Change

1 Introduction

1.1 Introduction

- 1.1.1 Peter Brett Associates LLP (PBA) has been commissioned by Portsmouth City Council (PCC) to prepare a document to aid the discharge of Planning Condition A2, Sustainable Drainage System (SuDS) Masterplan, Outline Planning Consent (APP/12/00338).
- 1.1.2 This document has been prepared in accordance with relevant national, regional and local planning policy and statutory guidance current as well as documents submitted as part of the outline application, including but not limited to:
- National Planning Policy Framework (NPPF), March 2012, and the accompanying Planning Practice Guidance,
 - The SuDS Manual, C697, CIRIA,
 - Rainfall Runoff Management for Developments, Ref: SC030219, October 2013, Environment Agency,
 - Dunsbury Hill Farm Environmental Statement, March 2012, Atkins,
 - Dunsbury Hill Farm Flood Risk Assessment, Ref:5099849/Rev 2.0, March 2012, Atkins,
 - Dunsbury Hill Farm Masterplan Option F, Ref: 4330/ARCH/1006/Rev B, 17th October 2014, BAM, and
 - Dunsbury Hill Farm Below Drainage Strategy, Ref: 4330/SERVE/5000/Rev P3, 10th October 2015, BAM.

2 Proposed Development Site

2.1 Site Location and Plan

- 2.1.1 The Dunsbury Hill Farm light industrial and retail development area is 33ha in size and lies between Waterlooville and Leigh Park (Havant) adjacent to the A3(M). The scheme received outline planning permission in February 2014 and works to construct the main access road through the development are due to start on site later this year. Currently the site comprises open fields and established hedgerows.

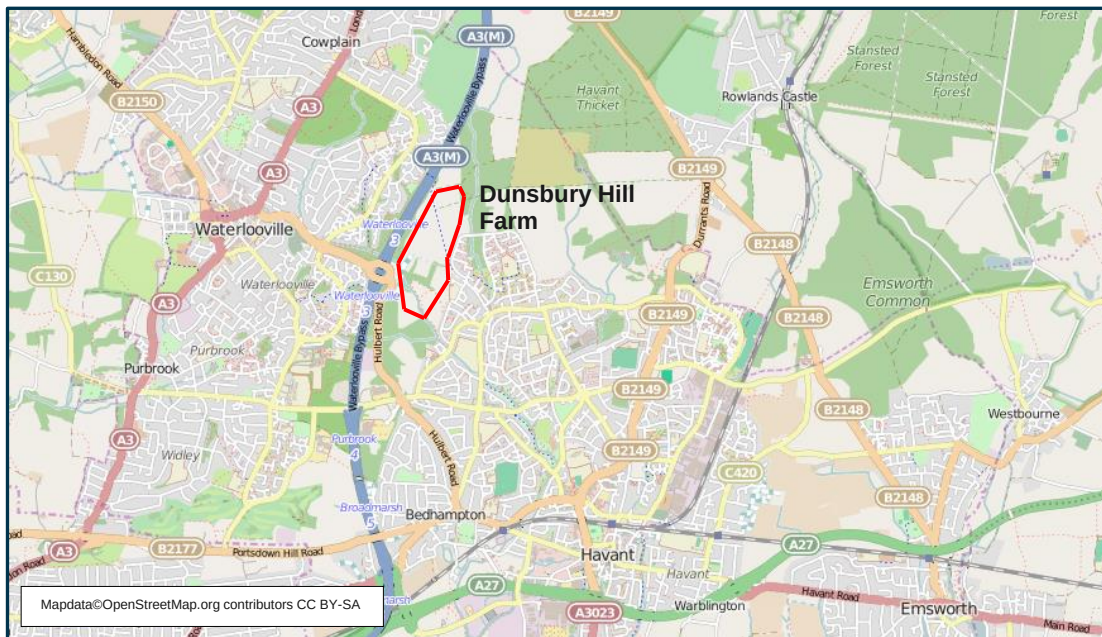


Figure 1: Site Location Plan

- 2.1.2 The Hermitage Stream runs through the southern part of the site while the Park Lane Stream is located to the north east.

2.2 Development Proposals

- 2.2.1 The proposed development will provide approximately 55,000m² of new employment space including a hotel and conference centre. The site will be accessed via a new road running west to east through the site from Junction 3 of the A3(M) to Woolstone Road, Leigh Park.
- 2.2.2 A copy of the proposed Dunbury Hill Farm Masterplan Option F (Ref: 4330/ARCH/1006/Rev B, 17th October 2014, BAM) is contained in **Appendix A**.

3 Surface Water Drainage and SuDS Strategy

3.1 Planning Condition A2

3.1.1 Further to submission of the Environmental Statement (March 2012, Atkins) and a site specific Flood Risk Assessment (Ref:5099849/Rev 2.0 March 2012, Atkins) outline planning permission (APP/12/00338) for the development was obtained in February 2014.

3.1.2 Under this Outline Permission condition A2 states:

'Unless otherwise approved in writing by the Local Planning Authority, no development shall take place until a Sustainable Drainage (SuDS) Masterplan and supporting technical information has been submitted to and approved in writing by the Local Planning Authority. This Masterplan and supporting information shall be in broad conformity with the Indicative Drainage Plan Figure 13.1, at Appendix A.1 of the Dunsbury Hill Farm Flood Risk Assessment dated March 2012 and shall include:

- a) measures to attenuate flows on the site so as not to exceed the greenfield run-off rate of 3.4 l/s/ha from the site, calculated in accordance with the relevant standard (currently Institute of Hydrology 124 with appropriate pro-rata adjustment to reflect the site area), and*
- b) proposals tested against 1, 30 and 100 year return periods, and*
- c) proposals tested for a 100 year + 30% climate, and*
- d) detention basins (where relevant) designed in accordance with the method prescribed in the Flood Risk and Drainage Assessment submitted with the outline application, and*
- e) design parameters of the SuDS masterplan which address its construction, use and maintenance in light of local hydrology, land use, the impact and use of physical site features, resulting benefits to the community & the environment, and future operation (both economic & maintenance),*
- f) An explanation of how sustainable drainage for the Access Link Road Corridor and Reserved Matters Areas are to be interconnected and designed not to exceed the greenfield run-off rate of 3.4 l/s/ha from the site.*
- g) Details of future SuDS management and maintenance arrangements including proof of adequate financial provision and a named body responsible for management plus production of a detailed management plan.*

The development shall only be carried out in accordance with this Masterplan and supporting technical information and all surface water SuDS drainage shall be permanently managed and maintained in accordance with the management and maintenance arrangements and provisions approved under part g of this condition.'

3.2 Flood Risk Assessment, March 2012

3.2.1 In accordance with current planning policy the site specific Flood Risk Assessment (Ref: 5099849/Rev 2.0, March 2012) (FRA, 2012), considers the local hydrology and the risk to the development from all sources of flooding, including the off-site impacts on the downstream flood risk to others.

Fluvial Flood Risk

- 3.2.2 With regards to fluvial flood risk the FRA, 2012, states that:

'Environment Agency mapping.....indicates that the business park site is located in Flood Zone 1 with an annual probability of fluvial flooding of less than 0.1%. Flood flows on the Hermitage Stream are currently contained within the river channel with no out-of-bank flow, as illustrated on the flood map. The proposed access road including the new bridge supports is therefore also located in Flood Zone 1 with a low probability of flooding.'

The site is at a low risk of flooding from the Hermitage Stream and Park Lane Stream and therefore all development is acceptable in line with the guidance in PPS25. Fluvial flood risk to the site will not be considered further as part of this FRA.'

Groundwater Flood Risk

- 3.2.3 With regards to the risk of flooding from groundwater the FRA, 2012, concludes that:

'Groundwater flood risk at the site is therefore assessed as being low. The development will not interfere with groundwater movement or storage and is unlikely to increase the risk of groundwater flooding in neighbouring areas. Any groundwater encountered during construction will be mitigated and further consultation/consent from the Environment Agency will be sought where necessary. For these reasons, the site is not considered to be at risk from groundwater flooding'

Surface Water Drainage Strategy and SuDS

- 3.2.4 The criteria for the proposed surface water drainage strategy for the development were set within the site specific FRA, 2012. This states that post development off-site discharge from the development up to and including the 1 in 100 year plus climate change rainfall event is to be restricted to the mean annual greenfield rate (Q_{bar}) calculated as 3.4 l/s/ha.

- 3.2.5 It also states that with regards to SuDS

'two levels of treatment should generally be sufficient except in areas of light industry, where three may be required. Localised treatment is preferred, requiring the sub-division of the site into smaller drainage catchments. The clayey soils preclude the use of infiltration methods.'

3.3 Environmental Statement, March 2012

- 3.3.1 In accordance with current planning policy the Water Resources and Flood Risk chapter of the Dunsbury Hill Farm Environmental Statement (March 2012, Atkins) (ES, 2012) assesses the likely significant effects of the Dunsbury Hill Farm development on the water environment through the developments construction and operational phases.

Surface Water Quality

- 3.3.2 The Water Resources and Flood Risk chapter of the ES, 2012, includes a review of the South East River Basin Management Plan. This identifies that the Hermitage Stream (ID Number: GB107042016370) is classified as a *'Heavily Modified'* waterbody under the Water Framework Directive, while the River Basin Management Plan classifies the overall potential of the river as *'moderate'*. The Hermitage Stream is therefore required to reach *'Good ecological Potential'* and *'Good Chemical Status'* by 2027.

3.3.3 The ES, 2012, concludes that:

'Assuming appropriate maintenance of SuDS installations, the effects relating to changes in the surface water quality and quantity on aquatic ecology and geomorphological quality of the Hermitage Stream including the proposed restored section and Park Lane Stream is assessed as permanent adverse of neutral significance.'

3.4 Proposed Surface Water and SuDS Strategy

3.4.1 The proposed surface water and SuDS strategy which has been developed based on the Dunbury Hill Farm Masterplan Option F (Ref: 4330/ARCH/1006/Rev B, 17th October 2014, BAM) and is divided into three parts; Access Road, Strategic Site Wide and On-Plot.

Access Road

3.4.2 The access road is served over four catchments by a standalone drainage system which restricts the off-site discharge rate to 3.4 l/s/ha and utilises SuDS to provide two levels of treatment to the runoff prior to discharge.

3.4.3 Further details of this strategy are provided within Surface Water Drainage Strategy Technical Note (Ref: TN001-PB2348-310055-Egha, 28th January 2015, Royal HaskoningDHV) contained in **Appendix B**.

Strategic Site Wide Strategy and Infrastructure

3.4.4 The Strategic Site Wide Strategy utilises pipes laid within the road network to convey flows from the development plot boundaries to the development's discharge point via a regional detention basin. The basin provides attenuation, and water quality and amenity benefits while restricting the final off-site discharge to the agreed discharge rate of Q_{bar} (3.4 l/s/ha).

3.4.5 In order to mitigate for the increase in volume of runoff generated by the development and the site geology's unsuitability for infiltration drainage techniques, a discharge rate of Q_{bar} has been selected in accordance with Rainfall Runoff Management for Developments (Ref: SC030219, October 2013, Environment Agency):

'Where compliance to the 100 year volumetric criterion is not provided.....the limiting discharge for any return period up to the 100 year event shall not be greater than the mean annual peak rate of runoff for the greenfield site (referred to as Q_{bar} in IoH report 124) or 2 l/s/ha, whichever is the greater.'

3.4.6 A copy of the proposed drainage strategy drawing 30142/2001/001 is contained in **Appendix C**.

3.4.7 The allowable discharge rate and estimated attenuation requirements for each development plot prior to discharge into the Strategic Site Wide infrastructure have been calculated based on the size of the plots, as shown on the Dunsbury Hill Farm Below Drainage Strategy (Ref: 4330/SERVE/5000/Rev P3, 10th October 2015, BAM) and an allowable discharge rate of 5 times Q_{bar} ($5 \times 3.4 \text{ l/s/ha} = 17.0 \text{ l/s/ha}$). The remaining attenuation requirements to meet the overall restricted site discharge (approximately 7300m³) is provided in the regional detention basin.

Plot	Impermeable Area (ha)	Allowable Discharge Rate (l/s)	Minimum Recommended On-Plot Storage
1	0.546	9.29	304
2	1.656	28.15	931
3	1.933	32.86	1,040
4	0.477	8.11	246
5	2.278	38.72	1,278
6	0.624	10.61	335
7	0.776	13.20	402
8	1.785	30.34	985
Total	10.075	N/A	5,521

Table 3.1: Plot Allowable Discharge Rates and Minimum Recommended On-Plot Storage Provision

- 3.4.8 As each plot is taken forward for development the developer will use the proposed drainage strategy drawing which includes a copy of Table 3.1 to determine the allowable discharge rate. Also provided on the drawing is an estimate of the quantum of on-plot storage required to meet the agreed design standards. To aid developers the indicative volume of on-plot attenuation required for each plot is also shown on proposed drainage strategy drawing 30142/2001/001 contained in **Appendix C**.
- 3.4.9 MicroDrainage modelling demonstrating that the on-plot discharge rates, minimum recommended on-plot storage volumes and regional detention basin can achieve the required discharge rate at the development boundary in the 1 year, 30 year, 100 year and 100 year + 30% climate change rainfall events ($10.075\text{ha} \times 3.4 \text{ l/s/ha} = 34.25 \text{ l/s}$) is contained in **Appendix D**. This modelling, when read in conjunction with the proposed drainage strategy drawing 30142/2001/001 contained in **Appendix C**, confirms that the proposed surface water drainage strategy is deliverable within the site boundary.
- 3.4.10 The detailed design of the regional detention basin taking into account the developments landscape proposals will be undertaken in accordance with The SuDS Manual (C697, CIRIA) at the detailed design stage. The construction phasing of the strategic site wide surface water drainage infrastructure will be specified at the detailed design stage and will follow the principles for protecting waterbodies and water quality as set out in the ES, 2012, and The SuDS Manual (C697, CIRIA).

On-Plot Strategy

- 3.4.11 In accordance with the site specific FRA, 2012, and The SuDS Manual (C697, CIRIA) the On-Plot strategy has been developed to provide source control measures which manage both the quantity and quality of surface water as close to the source as possible. Both these documents in conjunction with the ES, 2012, have been used to determine the number of surface water treatment stages required prior to discharge off-site into the Hermitage Stream.
- 3.4.12 Table 3.2 overleaf details the minimum number of treatment stages required for each type of land use currently proposed on the Dunsbury Hill Farm site.

Type of Development	Number of Treatment Stages Required	Treatment Stages Provided Within Strategic Off-Plot Infrastructure	Treatment Stages to be Provided On-Plot
Hotel, Conference Centre and Food Retail	2	1	1
B1	2	1	1
B2	3	1	2
B8	2	1	1

Table 3.2: Number of SuDS Treatment Stages required

- 3.4.13 The appropriate range of source control SuDS techniques will vary according to the proposed character and plot density of each proposed development parcel. The following techniques presented in Table 3.3 are examples of the SuDS techniques that could be implemented to restrict plot discharge rates and provide the number of treatment steps required by the type of development.

Type of Development	SuDS Techniques
Hotel, Conference Centre and Food Retail, B1, B2 and B8	Open surface water features such as ponds, wetlands, detention basins and swales, bioretention areas, filter drains / strips, green roofs, permeable pavements and cellular storage.

Table 3.3: SuDS Techniques

- 3.4.14 When selecting the type of SuDS for use plot developers should consider the type of pollutants likely to arise to ensure that the selected SuDS are capable of providing an improvement in water quality. Plot developers should also consider the ecological and amenity benefits of the selected SuDS in conjunction with the developments landscape strategy to ensure that a consistent approach is taken. Further details regarding the selection of SuDS is provided with the site specific FRA, 2012, and The SuDS Manual (C697, CIRIA).
- 3.4.15 As well as adhering to the design information provided on drawing 30142/2001/001 (**Appendix C**) and the suggested drainage techniques in Table 3.3, the on-plot drainage networks should be designed in accordance with legislation, planning policy, design standards and best practice current at the time of development.
- 3.4.16 The construction phasing of each plot and its associated surface water drainage infrastructure will be specified at the detailed design stage and will follow the principles for protecting waterbodies and water quality as set out in the ES, 2012, and The SuDS Manual (C697, CIRIA).

4 SuDS Management and Maintenance

4.1 Introduction

- 4.1.1 The Dunsbury Hill Farm development has the potential to incorporate a range of SuDS in the form of open surface water features such as ponds, wetlands, detention basins and swales, bioretention areas, filter drains / strips, green roofs, permeable pavements and cellular storage. As with any drainage system, SuDS require regular inspection and maintenance to ensure that they continue to operate as designed, both in terms of hydraulic capacity and potential pollutant removal.
- 4.1.2 This section sets out the inspection and maintenance requirements for long term management of the development's surface water drainage system in accordance with The SuDS Manual, CIRIA C697, and also identifies the various bodies responsible for ownership and maintenance of different elements of the system.

4.2 Health, Safety and Welfare

- 4.2.1 By their very nature SuDS minimise the need for deep excavations, and smooth transitions in depth are utilised to reduce turbulence in flows while reducing depth uncertainty for maintenance operatives. Along with shallow side slopes safety strips should be provided along the edges of the open surface water features in their design to increase the safety of the general public.
- 4.2.2 All those responsible for maintenance should take appropriate health, safety and welfare precautions for all activities including lone working, if relevant, and risk assessments should always be undertaken. The site's infrastructure Health and Safety File should be consulted before carrying out any works either inside or outside of the development's boundary and information regarding the location of existing utilities passed on to operatives.
- 4.2.3 The requirements of the Health and Safety at Work Act 1974 and The Construction (Design and Management) Regulations 2007 should be adhered to and any residual risks identified in the Health and Safety File should be managed and information passed on to maintenance operatives through task specific risk assessments.

4.3 Maintenance and Management Arrangements

- 4.3.1 The long term maintenance of the Dunsbury Hill Farm surface water drainage infrastructure and SuDS that are utilised within the surface water drainage and SuDS strategy is split between Hampshire County Council, as the Local Highway Authority, and Portsmouth City Council, as land owner.
- 4.3.2 Table 4.1 below details which bodies are responsible for different surface water drainage components. Records of inspections, their findings and maintenance undertaken should be retained by each of the maintenance bodies.

Maintenance Body	Piped Network		SuDS	
	In Adopted Highway	In Private Land	In Adopted Highway	In Private Land
Local Highway Authority (Hampshire County Council)	■			
Land Owner (Portsmouth City Council)		■	■ (under licence)	■

Table 4.1: Maintenance Bodies responsible for Surface Water Drainage Components

4.4 Operation and Maintenance

- 4.4.1 The SuDS Manual, CIRIA C697, states that there are three types of maintenance activities associated with SuDS:
- Regular Maintenance – *‘basic tasks undertaken on a frequent and predictable schedule’ including vegetation management, litter and debris removal, and inspections.’*
 - Occasional Maintenance – *‘tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example.’*
 - Remedial Maintenance – *‘intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.’*
- 4.4.2 In accordance with The SuDS Manual, CIRIA C697, specific maintenance needs should be monitored and maintenance schedules adjusted to suit a SuDS components particular requirements and location.
- 4.4.3 Table 4.2, overleaf, defines the type of maintenance required by each of the SuDS that could be potentially utilised as part of the Dunsbury Hill farm surface water drainage strategy. Further details regarding how often specific maintenance works should be undertaken are provided in Sections 4.5 – 4.13.

Operation and Maintenance Activity	SuDS Component							
	Piped Network	Pond	Wetland	Detention basin	Cellular / Modular Storage	Permeable Pavement	Swale / bioretention / Green Roofs	Filter Drains / Strips
Regular Maintenance								
Inspection	■	■	■	■	■	■	■	■
Litter / debris removal	■	■	■	■	□	■	■	■
Grass cutting		■	■	■	□	□	■	□
Weed / invasive plant control		□	□	□		□	□	□
Shrub management		□	□	□		□	□	□
Shoreline vegetation management		■	■	□				
Aquatic vegetation management		■	■	□				
Occasional maintenance								
Sediment management	■	■	■	■	■	■	■	■
Vegetation / plant replacement		□	□	□			□	□
Vacuum sweeping and brushing						■		
Remedial Maintenance								
Structure rehabilitation / repair	□	□	□	□	□	□	□	□
Infiltration surface conditioning						□	□	□
■ Will be required □ May be required								

Table 4.2: Extract from The SuDS Manual Table 22.1: Typical key SuDS components operation and maintenance activities.

4.5 Ponds

- 4.5.1 Ponds are basins that have a permanent pool of water and are designed to support emergent and submerged aquatic vegetation. Runoff from each rainfall event is detained and treated via sedimentation and biological uptake mechanisms to reduce nutrient concentrations.
- 4.5.2 Suitable maintenance access should be provided to the pond for appropriate equipment and vehicles. Temporary access routes for infrequent operations could be considered if access is tight. New ponds may become rapidly dominated by invasive native plants and it should be ensured that in the first five years, while vegetation is establishing that certain plant growth is controlled. After this period ponds can usually be allowed to develop naturally, with occasional maintenance require to the margins.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter removal.	As required
	Grass cutting – public areas	Monthly (during growing season)
	Grass cutting – meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect vegetation to wetland edge and remove nuisance plants (for first three years).	Monthly (at start, then as required)
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above wetland base; include max 25% of wetland surface). This activity may require a boot.	Annually
	Remove 25% of bank vegetation from waters edge to a minimum 1m above water level. This activity may require a boot.	Annually
	Tidy all dead growth before start of growing season.	Annually
	Remove sediment from forebay	One to five years, or as required
	Remove sediment from one quadrant of the main body of the wetland.	Two to five years
Occasional Maintenance	Removal sediment from the main body of the wetland when its volume is reduced by 20%.	>25 years (usually)
Remedial Maintenance	Repair of erosion or other damage.	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realignment of rip-rap or other damage	As required
	Repair / rehabilitation of inlets, outlets and overflows.	As required
Monitoring	Inspect structures for evidence of poor operation, Take remedial action if required.	Monthly / after large rainfall events
	Inspect banksides, structures, pipework etc. for evidence of physical damage.	Monthly (May to October)
	Inspect silt accumulation rates and establish appropriate removal frequencies.	Six monthly
	Check penstocks and other mechanical devices	Six monthly

Table 4.3: The SuDS Manual Table 17.4: ponds operation and maintenance requirements

4.6 Wetlands

- 4.6.1 Wetlands comprise shallow ponds and marshy areas covered almost entirely by aquatic vegetation. Though allowing sediments to settle and facilitating the adhesion of contaminants to vegetation and aerobic decomposition water quality is improved.
- 4.6.2 Maintenance requirements for wetlands tend to be higher than for ponds while vegetation becomes established, and effective monitoring during these first years is crucial to the success of the system. Key maintenance requirements include the removal of litter / debris and the management of vegetation in order to retain a high vegetation coverage to maximise the wetlands potential to remove pollutants, such as suspended matter and nutrients.
- 4.6.3 Inlet and outfall structures require checking for any erosion and to ensure that they don't become blocked either by litter or vegetation. Sediment removal and maintenance of any hydraulic controls should also be undertaken.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter, debris and surface scum removal.	Monthly
	Grass cutting – public areas	Monthly (during growing season)
	Grass cutting – meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect vegetation to wetland edge and remove nuisance plants (for first three years).	Monthly (at start, then as required)
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above wetland base; include max 25% of wetland surface). This activity may require a boot.	Annually or as required
	Remove 25% of bank vegetation from waters edge to a minimum 1m above water level. This activity may require a boot.	Annually or as required
	Tidy all dead growth before start of growing season.	Annually
	Remove sediment from upstream devices.	Annually or as required
	Remove sediment from one quadrant of the main body of the wetland.	Two to five years
Occasional Maintenance	Removal sediment from the main body of the wetland when its volume is reduced by 20%.	>25 years (usually)
Remedial Maintenance	Repair of erosion or other damage.	As required
	Repair / rehabilitation of inlets, outlets and overflows.	As required
	Supplement plants (to maintain at least 50% surface area coverage) if vegetation is not established after the second growing season.	One-off event
Monitoring	Inspect structures for evidence of poor operation, Take remedial action if required.	Monthly / after large rainfall events
	Inspect banksides, structures, pipework etc. for evidence of physical damage.	Monthly / after large rainfall events
	Inspect silt accumulation rates and establish appropriate removal frequencies.	Six monthly

Table 4.4: The SuDS Manual Table 18.2: Wetland operation and maintenance requirements.

4.7 Detention Basins

- 4.7.1 Detention basins are dry depressions that provide attenuation and water quality benefits through the settling of suspended materials. They can include small permanent wet pools, to prevent re-suspension of particles during high intensity rainfall events and/or sediment forebays to provide pre-treatment. In certain circumstances can also function as a recreational facility.
- 4.7.2 Regular mowing is required along maintenance access routes, amenity areas and main storage areas. The remaining areas can be managed as 'meadow'. Where a permanent wet pool is incorporated the submerged and emergent aquatic vegetation should be managed as per a pond or wetland.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter removal.	As required
	Grass cutting – public areas	Monthly (during growing season)
	Grass cutting – meadow grass	Half yearly (spring, before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Tidy all dead growth before start of growing season.	Annually
	Remove sediment from inlets, outlets and forebay	Annually, or as required
	Manage wetland plants in outlet pool – where provided	Annually
Occasional Maintenance	Re-seed area of poor vegetation growth	Annually, or as required
	Prune and trim trees and remove cuttings	Two years, or as required
	Remove sediment from forebay, when 50% full and from micropools if volume reduced by >25%	Three to ten years (or as required)
Remedial Maintenance	Repair of erosion or other damage by re-seeding or re-turfing	As required
	Realignment of rip-rap or other damage	As required
	Repair / rehabilitation of inlets, outlets and overflows.	As required
	Re-level uneven surfaces and reinstate design levels	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly / after large rainfall events
	Inspect banksides, structures, pipework etc. for evidence of physical damage.	Monthly / after large rainfall events
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Six monthly
	Check penstocks and other mechanical devices	Six monthly

Table 4.5: The SuDS Manual Table 16.2: Detention basin operation and maintenance requirements

4.8 Cellular / Modular Storage

- 4.8.1 Cellular storage systems are plastic high void ratio modular systems which can be used to control and manage runoff.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required take remedial action	Monthly for three months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually or as required
Remedial Maintenance	Repair / rehabilitation of inlets, outlets, overflows and vents	As required
Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storm events

Table 4.6: The SuDS Manual Table 13.2: Modular systems – operation and maintenance requirements

4.9 Permeable Pavements

- 4.9.1 Permeable pavements are a form of pavement construction which allows rainwater to permeate through the surface and into the underlying construction layers, where it is stored prior to infiltration into the ground or discharge into a wider drainage network. As water travels through the construction layers hydrocarbons and other organic materials are trapped and degraded by micro-organisms providing a water quality benefit.
- 4.9.2 The principal requirements related to permeable pavements involve surface cleaning at least three times a year. Additionally, litter and vegetation should be removed on a regular basis. Note that the use of grit and salt may adversely affect the treatment and drainage potential of permeable surfaces, and the use of weed killers can disrupt the biological breakdown of contaminants that would otherwise occur in the sub-base. An alternative de-icing agent such as wet gritting which does not contain the chlorides and contaminants found in road salt should be used.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Brushing and vacuuming. Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material if present. Any lost material should be replaced.	Three times / year – at end of winter, mid-summer after autumn leaf fall, or as required based on site-specific observations of clogging or manufacturers' recommendations
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weed.	As required
Remedial Maintenance	Remediate and landscaping which, through vegetation maintenance or soil strip, 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 structured performance or a hazard to users.	As required
	Rehabilitation of surface and upper structure.	As required (if infiltration and filtration performance is reduced as a result of 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, forty-eight hours after large rainfall events
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually
	Monitor inspection chambers.	Annually

Table 4.7: The SuDS Manual Table 12.12: Permeable pavement operation and maintenance requirements.

4.10 Swales

- 4.10.1 Swales are grassed or vegetated drainage features which can be used to store and convey runoff. Swales are usually designed as broad shallow channels and can replace pipework removing the need for gullies. Low flow velocities allow suspended material to settle out.
- 4.10.2 Regular inspection and maintenance is important for the effective operation of swales as designed. One of the most regular activities required is cutting (and removal) of the grass, and removal of any accumulated silt. Inlet and outfall structures require checking for any erosion and to ensure that they don't become blocked either by litter or vegetation. Sediment removal and maintenance of any hydraulic controls should also be undertaken. The use of fertiliser and/or weed killers can cause contamination of the runoff passing through the swale.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter and debris removal.	Monthly (or as required)
	Grass cutting – to retain grass height within specified design range.	Monthly (during growing season) or as required
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required)
Occasional Maintenance	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where possible.	Annually
	Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, if required.	Annually, or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Maintenance	Repair erosion or other damage by re-turfing or re-seeding.	As required
	Re-level uneven surfaces and reinstate design levels.	As required
	Scarify and spike topsoil layer to break up silt deposits and prevent compaction of the soil surface.	As required
	Remove build-up of sediment on upstream devices.	As required
	Remove and dispose of oils or petrol residues using safe standard practices.	Monthly
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly and after every rainfall event
	Inspect infiltration and filtration surfaces for ponding, compaction and silt accumulation. Record areas where water is ponding for >48hours.	Monthly, or when required
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly

Table 4.8: The SuDS Manual Table 10.3: Swales operation and maintenance requirements.

4.11 Bioretention Areas

- 4.11.1 Bioretention areas are landscaped depressions formed of structural soils and vegetation. Runoff enters via the surface and filters through the different layers towards a perforated pipe connected to the wider drainage network.
- 4.11.2 Adequate access must be provided for all bioretention areas for inspection and maintenance, including the appropriate equipment and vehicles. Sediments removed from devices that receive runoff from standard road and roof areas are generally not toxic or hazardous and can therefore be safely disposed of by either land application or landfilling. For industrial site runoff sediment testing is required to determine its classification and appropriate method of disposal.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter and debris removal.	Monthly (or as required)
	Mulching – remove and replace	Annually
	Pruning and trimming of trees – recycle back into mulch	2 yearly
	Spiking, scarifying and thatch removal	3 yearly (when mulching)
Occasional Maintenance	Watering of plants	As required
	Weeding	As required
Remedial Maintenance	Removal of damaged or slit covered vegetation to a depth 50mm below original design level	As required
	Treatment of diseased trees	As required
	Treatment and restoration of eroded areas	As required
	Re-turfing	As required
	Reinstatement of design levels, restoration or improvement of infiltration and silt removal	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly / after large storms
	Inspection infiltration surfaces for ponding. Record dewatering time of the facility to determine if maintenance is necessary	Monthly, or when required
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Half yearly
	Test planting soil for pH – if adjustment is necessary, amalgamate with appropriate substances	Annually

Table 4.9: The SuDS Manual Table 11.5: Bioretention areas operation and maintenance requirements

4.12 Green Roofs

- 4.12.1 Key to the successfulness of a green roof is regular irrigation during the establishment of vegetation and the inspection for, a replacement of, areas failing to establish.
- 4.12.2 Intensive green roofs require regular maintenance. Lawns will require mowing and plant bed will require weeding weekly or fortnightly during the growing season, and wildflower meadows may require annual mowing with the cuttings removed. Extensive green roofs should normally require bi-annual visits to remove litter, check fire breaks and drains.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter and debris removal.	Six Monthly / annually (or as required)
	During establishment (i.e. year one), replace dead plants as required	Monthly (but usually the responsibility of manufacturer)
	Post establishment, replace dead plants as required	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 (is appropriate) as required. Clippings must be removed and not allowed to accumulate	Six monthly or as required
Occasional Maintenance	-	-
Remedial Maintenance	If erosion channels are evident, these should be stabilised with additional soil substrate similar to the original material. Sources of erosion damage must be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and remove as appropriate	As required
Monitoring	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 / after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually / after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the roof from the drainage layer to the conveyance or roof drain system	Annually / after severe storms
	Inspect underside of roof for evidence of leakage	Annually / after severe storms

Table 4.10: The SuDS Manual Table 6.5:Green roof operation and maintenance requirements

4.13 Filter Drain / Strip

- 4.13.1 Filter drains comprise geotextile lined trenches filled with granular material and a perforated pipe at the base. Conveyance and storage of water is accommodated within the perforated pipe and voids between the granular material. Runoff is designed to flow across the surface of the filter drain filtering out sediments and organic materials.
- 4.13.2 The most significant maintenance activity is the removal of silt from the filter drain. The granular material should also be kept clear of litter and vegetation and will require replacing typically every 10-15 years due to clogging. Surrounding ground should be kept clear of silt to prevent it washing into the filter drain, and thus reduce the requirement for this work as much as possible.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter and debris removal from surface, access chambers and pre-treatment devices (e.g. gullies and rainwater downpipes).	Monthly (or as required)
	Removal and washing of exposed stones on the trench surface.	Annual (bi-annual the first year) or where silt is evident on the surface
	Trimming of any roots that may be causing blockages.	Annual (semi-annual the first year)
	Remove weeds on the trench surface.	Monthly (at start, then as required)
Occasional Maintenance	Removal of sediment from pre-treatment devices (e.g. gullies and rainwater downpipes).	Six monthly
	Remove tree roots or trees that grow close to the trench.	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash and replace filter media.	Five yearly
Remedial Maintenance	Clear perforated pipework of blockages.	As required
	Rehabilitate infiltration or filtration surfaces.	As required
	Replace geotextiles and clean and replace filter media if clogging occurs.	As required
	Excavate trench walls to expose clean soils if filtration performance reduces to unacceptable levels.	As required
	Inspection inlets, outlets and inspection points for blockages, clogging, standing water and structural damage.	Monthly
Monitoring	Inspect pre-treatment systems, inlets, trench surfaces and perforated pipework for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly

Table 4.11: The SuDS Manual Table 9.2: Trenches operation and maintenance requirements.

5 Summary

- 5.1.1 This report builds on the information contained within the the Dunsbury Hill Farm Environmental Statement (March 2012, Atkins) and the Dunsbury Hill Farm Flood Risk Assessment (Ref:5099849/Rev 2.0, March 2012, Atkins) and demonstrates that in accordance with Condition A2, SuDS Masterplan (Outline Planning Consent APP/12/00338), the measures proposed to treat and attenuate the surface water runoff generated by the development to the agreed rate (Q_{bar} , 3.4 l/s/ha up to and including the 1 in 100 year + 30% climate change rainfall event) can be accommodated by the proposed development.
- 5.1.2 The site's agreed discharge rate of Q_{bar} has been selected to mitigate for the increase the volume of runoff generated by the development in accordance with Rainfall Runoff Management for Developments (Ref: SC030219, October 2013, Environment Agency).
- 5.1.3 To ensure that each plot's proposed surface water and SuDS strategy (On-Plot) adheres to the site's strategy (Off-Plot) the allowable discharge rates and estimated on-plot attenuation requirements for each plot have been calculated based on its currently proposed impermeable area. The number of SuDS treatment stages required by each proposed plot usage have also been provided, along with recommended suitable SuDS techniques based on the sites geology.
- 5.1.4 As each plot is taken forward for development the developer will use this report in conjunction with proposed drainage strategy drawing to determine the allowable discharge rate and number of SuDS treatment stages required by their particular development.
- 5.1.5 To aid phasing the Access Road is served by a standalone network that restricts the off-site discharge rate to 3.4 l/s/ha and utilises SuDS to provide two levels of treatment.
- 5.1.6 The construction phasing of the strategic site wide surface water drainage infrastructure will be specified at the detailed design stage and will follow the principles for protecting waterbodies and water quality as set out in the ES, 2012, and The SuDS Manual (C697, CIRIA).
- 5.1.7 As required by Condition A2 the responsibilities of the maintaining bodies are set out along with the maintenance requirements of each SuDS recommended for use within the strategy.

Appendix A Dunbury Hill Farm Masterplan Option F (Ref: 4330/ARCH/1006/Rev B, 17th October 2014, BAM)

**Appendix B Access Road Surface Water Drainage
Strategy Technical Note (Ref: TN001-PB2348-
310055-Egha, dated 28th January 2015, Royal
HaskoningDHV)**

Appendix C Proposed Surface Water Drainage Strategy and Storage Requirements (Ref: 30142/2001/001, May 2015)

Appendix D MicroDrainage Modelling - 1 year, 30 year, 100 year and 100 year + 30% Climate Change

