

400 Longwater Avenue, Green Park

Surface Water Drainage Strategy

On behalf of **Green Park Reading No. 1 LLP**

Project Ref: 27159/2007 | Rev: 0 | Date: April 2016



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Contents

1	Introduction	1
1.1	Introduction	1
2	Site Information	2
2.1	Site Location and Plan	2
2.2	Proposals.....	3
3	Existing Surface Water Regime	4
3.1	Existing Surface Water Regime	4
4	Proposed Surface Water Drainage Strategy	5
4.1	Discharge Destination	5
4.2	Peak Flow Control – Defra Technical Standard S2.....	6
4.3	Volume Control – Defra Standard S6.....	7
4.4	Flood Risk within the development – Defra Technical Standards S7 to S9.....	8
4.5	SuDS Selection	8
4.6	Structural Integrity – Defra Technical Standards S10 & S11	9
5	Maintenance Strategy	10
5.1	Health, Safety and Welfare	10
5.2	Operation and Maintenance	10
5.3	Piped Network / Inspection Chambers / Catchpits.....	11
5.4	Swales	12
5.5	Filter Drain	13
5.6	Geocellular Storage.....	13
5.7	Permeable Pavements	14
6	Summary	16
6.1	Summary	16

Figures

Figure 2.1: Location of Green Park	2
Figure 2.2: Site Location within Green Park.....	2

Tables

Table 3.1: Greenfield Discharge Rates	4
Table 4.1: Extract from Updated Interpretive Report on Geotechnical and Geoenvironmental Investigation, dated December 2013.....	5
Table 4.2: Greenfield and Proposed Peak Discharge Rates	6
Table 4.3: Table 2 Peak Rainfall Intensity Allowance in Small and Urban Catchments (use 1961 to 1991 baseline)	6
Table 4.4: Greenfield and Proposed Discharge Rates – Northern Network	7

Table 4.5: Greenfield and Proposed Discharge Rates – Southern Network.....	7
Table 5.1: Extract Table 32.1 Typical Key SuDS Components operation and Maintenance Activities, The SuDS Manual C753, CIRIA 2015	11
Table 5.2: Operation and Maintenance for Piped Network / Inspection Chambers / Catchpits	11
Table 5.3: Operational and Maintenance Requirements for Swales	12
Table 5.4: Operation and Maintenance Requirements for Filter Drains.....	13
Table 5.5: Operation and Maintenance Requirements for Geocellular Storage	14
Table 5.6: Operation and Maintenance Requirements for Permeable Paving.....	15

Appendices

Appendix A	Topographical survey, Drawing Number 5904/01 Rev 0, dated 2008, Longdin and Browning
Appendix B	Proposed Site Layout, Drawing Number 15011_A_PL_003 Rev 01, dated 16 th March 2016, Robert Partington Architects
Appendix C	Greenfield Discharge Calculations
Appendix D	Proposed Surface Water Drainage Strategy, Drawing Number 27159/2007/001
Appendix E	Proposed MicroDrainage Calculations
Appendix F	Landscape GA Plan, Drawing Number 537_PL_001 Rev P00, dated March 2016, Place
Appendix G	Typical Construction Details, Drawing Number 27159/2007/002

1 Introduction

1.1 Introduction

- 1.1.1 Peter Brett Associates LLP (PBA) has been commissioned by Green Park Reading No. 1 LLP to prepare a Surface Water Drainage Strategy to support its planning application for 400 Longwater Avenue, Green Park.
- 1.1.2 This Strategy has been prepared in accordance with relevant national, regional and local planning policy guidance as follows:
- National policy regarding flood risk as contained within National Planning Policy Framework (NPPF), dated March 2012, and the accompanying National Planning Practice Guidance (NPPG), dated March 2015.
 - The Ministerial Statement HCWS161, dated 18th December 2014.
 - Non-statutory Technical Standards for Sustainable Drainage Systems, March 2015, Defra.
 - Flood Risk Assessments: Climate Change Allowances, 19th February 2016, Environment Agency (EA).
 - Reading Borough Council, Local Flood Risk Management Strategy, Rev 04 Draft, dated July 2015.
- 1.1.3 This Strategy should be read in conjunction with the 400 Longwater Avenue Green Park, Flood Risk Assessment (Ref: 27159/2007, dated March 2016, PBA) and supersedes any information provided therein with regards to surface water drainage.

2 Site Information

2.1 Site Location and Plan

- 2.1.1 400 Longwater Avenue is situated within Green Park which is a commercial business park located to the south of Reading; to the north of the M4 Motorway and west of the A33 Reading Relief Road. Refer to Figure 2.1 below.

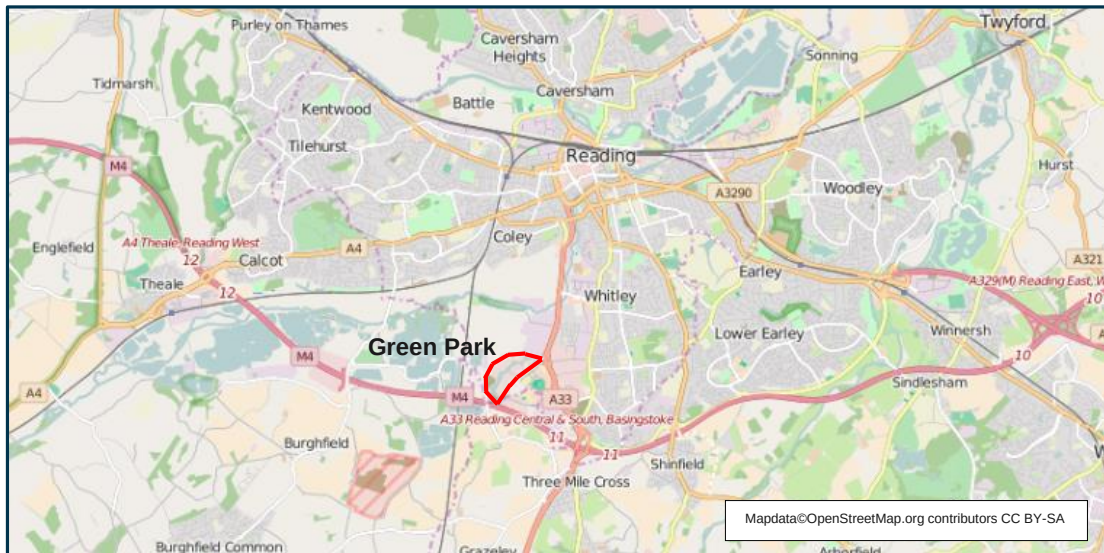


Figure 2.1: Location of Green Park

- 2.1.2 The 400 Longwater Avenue site is approximately 3ha in size and is bounded by Longwater Avenue to the west, existing commercial development to the north, Longwater Flood Relief Channel to the east and a future commercial development plot to the south. Refer to Figure 2.2 below.

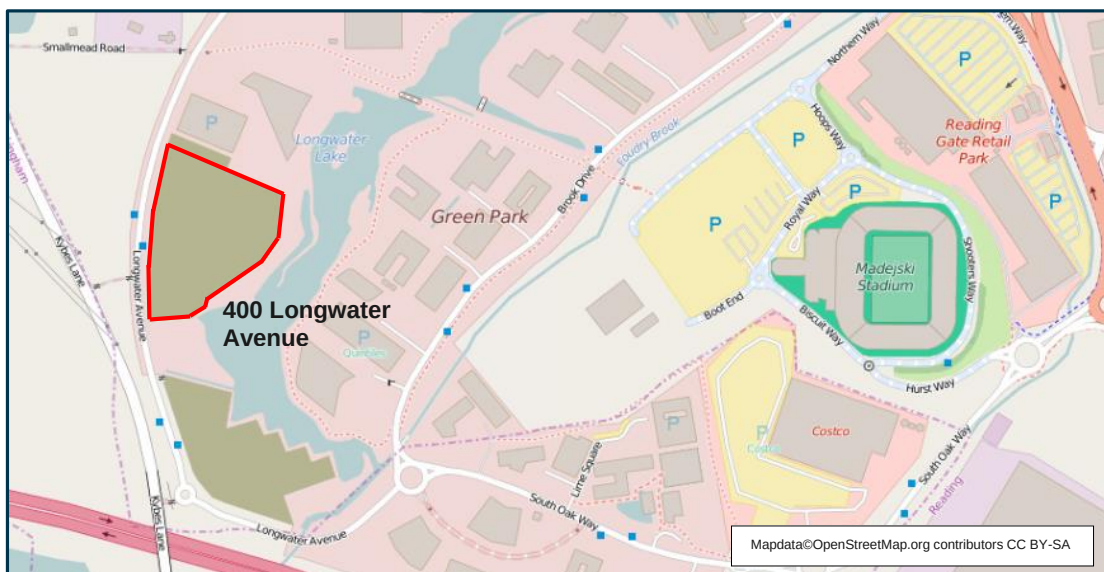


Figure 2.2: Site Location within Green Park

- 2.1.3 A copy of the topographical survey of the site undertaken by Longdin and Browning (Drawing Number 5904/01 Rev 0, dated 2008) is contained in **Appendix A**.

2.2 Proposals

- 2.2.1 The proposed development consists of two, five story offices with associated car parking, including two multi-level decked parking structures.
- 2.2.2 A copy of the proposed site layout (Drawing number 15011_A_PL_003 Rev 01, dated 16th March 2016, Robert Partington Architects) is contained in **Appendix B**.

3 Existing Surface Water Regime

3.1 Existing Surface Water Regime

- 3.1.1 The site is currently undeveloped and there are no formal drainage networks on the site. Surface water runoff generally flows overland from west to east towards the Longwater Flood Relief Channel and there are pockets of marshy / boggy land at localised low points.
- 3.1.2 There are ditches located to the north and south of the site which flow west to east into the Longwater Flood Relief Channel, however the topography of the site indicates that these are not utilised by the site itself, apart from a very small area (0.09ha) to the south of the site. The site generally falls from 39.5m AOD on the western boundary to approximately 38.9m AOD at the edge of the Longwater Flood Relief Channel.
- 3.1.3 A copy of the topographical survey of the site undertaken by Longdin and Browning (Drawing Number 5904/01 Rev 0, dated 2008) is contained in **Appendix A**.
- 3.1.4 Greenfield discharge calculations have been undertaken for the site in accordance with Rainfall Runoff Management for Developments (Report SC030219, October 2013, Defra/EA). In accordance with the Non-statutory Technical Standards for Sustainable Drainage Systems (March 2015, Defra) greenfield rates have been calculated for the 1 in 1 year and 1 in 100 year rainfall events. A copy of the calculations is contained in **Appendix C**. Table 3.1, provides a summary of the rates.

Return Period	Greenfield Discharge Rate
1 Year	1.48 l/s/ha
Q_{bar}	1.75 l/s/ha
100 Year	5.50 l/s/ha

Table 3.1: Greenfield Discharge Rates

4 Proposed Surface Water Drainage Strategy

4.1 Discharge Destination

- 4.1.1 In accordance with the discharge destination hierarchies of the Building Regulations H3 and the NPPG an assessment of the suitability of the site to utilise infiltration drainage techniques has been undertaken.

See the Planning Practice Guidance

This states:

"Generally the aim should be discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:

- 1. Into the ground (infiltration)*
- 2. To a surface water body;*
- 3. To a surface water sewer, highway drain or another drainage system;*
- 4. To a combined sewer."*

- 4.1.2 The Updated Interpretive Report on Ground Conditions (Contamination) – 2016 (27159/3504/CBH/RHT/CC Rev 01, dated March 2016, PBA) states that:

'In 2008 Engineered Fill was encountered in all the exploratory hole locations and generally comprised brown clayey gravelly sand or brown clayey sand and gravel. All of the exploratory holes reported gravel of flint, concrete and brick with occasional fragments of wood (BH103) within the upper 0.85m. The thickness of the engineered fill varied from 1.15m to 1.70m.'

- 4.1.3 Table 4.1 summarises the strata encountered and the depths of the stratum in the shallow exploratory holes drilled in 2008.

Strata	Depth to Top (mbgl)	Elevation (mAOD)	Thickness (m)
Engineered Fill	From Ground Level	39.35 – 39.90	1.15 – 1.70
Alluvium	1.15 – 1.70	38.20 – 37.85	0.15 – 0.85
River Terrace Deposits	1.40 – 2.40	37.95 – 37.15	1.80 – 3.30
Lambeth Group	4.0 – 6.0	35.75 – 33.90	Not Proven

Table 4.1: Extract from Updated Interpretive Report on Geotechnical and Geoenviromental Investigation, dated December 2013

- 4.1.4 The recorded groundwater level is approximately 37.8m AOD across Green Park with natural flow paths towards the Longwater Flood Relief Channel.
- 4.1.5 Review of the recorded groundwater level in conjunction with the ground conditions (engineering fill over alluvium), the existence of the neighbouring ditches and anecdotal evidence of marshy / boggy areas on site indicates that the site is not suitable for infiltration drainage techniques.
- 4.1.6 It is therefore proposed to mimic the existing drainage regime and discharge surface water runoff arising from the development into the Longwater Flood Relief Channel.

- 4.1.7 The Longwater Flood Relief Channel will be set above the Annual Average Flood Level of 37.80m AOD and be fitted with a non-return valve to ensure flood waters do not enter the on-plot system. Modelling of the rainfall events will include surcharging the outfall to a depth equivalent to the 1 in 20 year flood event level of 38.68m AOD. Refer to 400 Longwater Avenue Green Park, Flood Risk Assessment (Ref: 27159/2007, dated March 2016, PBA) for information regarding flood levels.

4.2 Peak Flow Control – Defra Technical Standard S2

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

- 4.2.1 The site is undeveloped, therefore the design peak flow rates will be calculated in accordance with the greenfield rates stated in Table 3.1. Two drainage networks are required to positively drain the development therefore, in accordance with Rainfall Runoff Management for Developments (Report SC030219, October 2013, Defra/EA) and best practice a minimum controlled discharge rate of 5 l/s, to reduce the risk of blockage, has been applied to each outfall.

Return Period	Existing Greenfield Discharge Rate		Proposed Discharge Rate	
	l/s/ha	l/s (based on 2.167ha impermeable area)	Northern Network l/s (based on 0.862ha)	Southern Network l/s (based on 1.305ha)
1 Year	1.48 l/s/ha	3.20 l/s	-	-
Q _{bar}	1.75 l/s/ha	3.79 l/s	-	-
100 Year	5.50 l/s/ha	11.91 l/s	-	-
100 Year + 30% climate change	-	-	5 l/s	5 l/s

Table 4.2: Greenfield and Proposed Peak Discharge Rates

- 4.2.2 As stated in Section 3.5 of the 400 Longwater Avenue Green Park, Flood Risk Assessment (Ref: 27159/2007, dated March 2016, PBA) and in accordance with Flood Risk Assessments: Climate Change (19th February 2016, EA) which supports the NPPF an allowance of 30% climate change has been added to the peak rainfall intensities in the 1 in 100 year rainfall event and provides a conservative approach to the proposed developments 'Less Vulnerable' classification (Table 2, NPPF Guidance) and 60 year life expectancy.

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115	Comment
Upper End	10%	20%	40%	30% allowance applied to provide conservative approach to 'less vulnerable' development with 60 year life expectancy.
Central	5%	10%	20%	

Table 4.3: Table 2 Peak Rainfall Intensity Allowance in Small and Urban Catchments (use 1961 to 1991 baseline)

- 4.2.3 A copy of the Proposed Surface Water Strategy drawing (27159/2007/001) and accompanying MicroDrainage calculations are contained within **Appendices D and E** respectively.

4.3 Volume Control – Defra Standard S6

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

- 4.3.1 The impermeable area of the application site will be increased as a result of the development and therefore the volume of run-off in the 100 year 6 hour storm event will be increased above the pre-development greenfield level. The management of the additional volume through infiltration or re-use is not considered reasonably practicable for the development and therefore the rate of run-off will be restricted to a reduced rate, for all storm events, in order to prevent an adverse effect on flood risk.
- 4.3.2 Typically the rate of run-off would be limited to the Q_{bar} rate for all storm events up to and including the 1 in 100 year event plus climate change allowance, however, due to the low flow rates arising from the application site area the practical minimum of 5 l/s will be utilised. Refer to Table 4.2 above and Tables 4.4 and 4.5 below.

Northern Network – 0.862ha Impermeable			
Return Period	Existing Greenfield Discharge Rate (l/s/ha)	Calculated Discharge Rate (l/s)	Proposed Discharge Rate (l/s)
1 Year	1.48 l/s/ha	1.27 l/s	-
Q_{bar}	1.75 l/s/ha	1.50 l/s	-
100 Year	5.50 l/s/ha	4.74 l/s	-
100 Year + 30% climate change allowance	-	-	5 l/s

Table 4.4: Greenfield and Proposed Discharge Rates – Northern Network

Southern Network – 1.305ha Impermeable			
Return Period	Existing Greenfield Discharge Rate (l/s/ha)	Calculated Discharge Rate (l/s)	Proposed Discharge Rate (l/s)
1 Year	1.48 l/s/ha	1.93 l/s	-
Q_{bar}	1.75 l/s/ha	2.28 l/s	-
100 Year	5.50 l/s/ha	7.17 l/s	-
100 Year + 30% climate change allowance	-	-	5 l/s

Table 4.5: Greenfield and Proposed Discharge Rates – Southern Network

4.4 Flood Risk within the development – Defra Technical Standards S7 to S9

S7. The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

S8. The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement) or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

- 4.4.1 The proposed surface water drainage network has been designed not to flood in a 1 in 30 year or a 1 in 100 year rainfall event, and hard standing areas adjacent to buildings have been designed to route surface water away from the buildings.
- 4.4.2 A copy of the Proposed Surface Water Drainage Strategy drawing (27159/2007/001) and accompanying MicroDrainage calculations are contained within **Appendices D and E** respectively.
- 4.4.3 A copy of the proposed site levels drawings (Landscape GA Plan, 537_PL_001 Rev P00, Place) are contained in **Appendix F**.

S9. The design of the site must ensure that so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

- 4.4.4 In the event of a rainfall event in excess of a 100 year + 30% climate change event surface water will flow overland eastwards following the topography of the site and the routing of the swales towards Longwater Flood Relief Channel mimicking the natural drainage flow paths.

4.5 SuDS Selection

- 4.5.1 The Ministerial Statement HCWS161, dated 18th December 2014 states that:

*'.....the Government's expectation is that sustainable drainage systems will be provided in new developments **wherever this is appropriate.**'*

- 4.5.2 The NPPG paragraph 051 describes SuDS as follows:

*'Sustainable drainage systems are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible. **They provide opportunities to:***

- *reduce the causes and impacts of flooding;*
- *remove pollutants from urban run-off at source;*
- *combine water management with green space with benefits for amenity, recreation and wildlife.'*

- 4.5.3 The current planning policy and guidance advises that SuDS in the form of open or near surface systems employing natural processes should be used where possible, not that they must be used. They can also provide opportunities to combine water management with amenity and wildlife, but only where appropriate.

- 4.5.4 The proposed drainage strategy for 400 Longwater Avenue, Green Park utilises SuDS in the form of swales, filter drains, permeable paving and geocellular crate storage. These features provide attenuation up to and including the 100 year + 30% climate change rainfall event below ground and provide water quality benefits through the biodegradation of hydrocarbons, the capture of nitrates and the removal of suspended debris.
- 4.5.5 As previously discussed (Section 4.1) the site is not considered suitable for infiltration techniques, therefore due to high groundwater levels and the proximity of the Longwater Flood Relief Channel all the proposed SuDS will be lined to prevent inundation by groundwater.
- 4.5.6 A copy of the Proposed Surface Water Drainage Strategy drawing (27159/2007/001) is contained in **Appendix D**.

4.6 Structural Integrity – Defra Technical Standards S10 & S11

S10. Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.

S11. The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.

- 4.6.1 The components that make up any drainage network have different life expectancies which can also be influenced by the effectiveness of their maintenance regime and upstream sediment capture / management.
- 4.6.2 The 400 Longwater Avenue, Green Park proposed drainage strategy comprises a piped network, inspection chambers / catchpits, swales, permeable paving, geocellular crate storage and hydraulic flow controls. As with any drainage system, this network requires regular inspection and maintenance to ensure that the individual components continue to operate as designed, both in terms of hydraulic capacity and potential pollutant removal. Further details regarding maintenance of the proposed system are contained in Section 5.
- 4.6.3 At the detailed design stage individual components will be specified that ensure that the structural integrity of all the components is suitable for their intended use, location and anticipated loading conditions.
- 4.6.4 Typical construction details for the drainage components are shown on drawing 27159/2007/002 Contained in **Appendix G**.

5 Maintenance Strategy

5.1 Health, Safety and Welfare

- 5.1.1 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.
- 5.1.2 The requirements of the Health and Safety at Work Act 1974 and The Construction (Design and Management) Regulations 2015 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.

5.2 Operation and Maintenance

- 5.2.1 There are three types of maintenance activities associated with surface water drainage systems. The SuDS Manual, CIRIA C753, defines these as:
- Regular Maintenance – *'basic tasks undertaken on a frequent and predictable schedule, including inspections / monitoring, silt or oil removal if required more frequently than once a year, vegetation management, sweeping of surfaces and litter and debris removal.'*
 - Occasional Maintenance – *'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the regular tasks (eg sediment removal or filter replacement).'*
 - 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, construction and regular maintenance activities. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and so timings are difficult to predict.'*
- 5.2.2 Specific maintenance needs should be monitored and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

Operation and Maintenance Activity	SuDS Components				
	Piped Network / Inspection Chambers / Catchpits	Swales	Filter Drain	Geocellular Storage	Permeable Pavements
Regular Maintenance					
Inspection	■	■	■	■	■
Litter and debris removal	■	■	■	□	■
Grass cutting		■	■	□	□
Weed and invasive plant control			□		□
Shrub management (including pruning)		□			□

Operation and Maintenance Activity	SuDS Components				
	Piped Network / Inspection Chambers / Catchpits	Swales	Filter Drain	Geocellular Storage	Permeable Pavements
Occasional Maintenance					
Sediment management ¹	■	■	■	■	■
Vegetation replacement					
Vacuum sweeping and brushing					■
Remedial Maintenance					
Structure rehabilitation / repair	□	□	□	□	□
Infiltration surface reconditioning		□	□		□
■ Will be required □ May be required ¹ Sediment should be collected and managed in pre-treatment systems, upstream of the main device					

Table 5.1: Extract Table 32.1 Typical Key SuDS Components operation and Maintenance Activities, The SuDS Manual C753, CIRIA 2015

5.3 Piped Network / Inspection Chambers / Catchpits

- 5.3.1 Piped network components require regular inspection and maintenance to ensure that the individual components continue to operate as designed, both in terms of hydraulic capacity and potential pollutant removal. All drainage inspection chambers and catchpits will therefore be inspected and cleaned regularly.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Inspect and identify any features that are not operating correctly. If required take remedial action	Monthly for three months, then six monthly
	Debris removal from catchment surface / gratings (where may cause risks to performance)	Monthly (and after large storms)
	Remove sediment from trapped sumps, manholes and catchpits.	Annually or as required
Remedial Maintenance	Repair / rehabilitation of gratings, inlets and outlets	As required
Monitoring	Inspect / check all gratings, trapped sumps, manholes and catchpits to ensure that they are in good condition and operating as designed	Annually and after large storm events
Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of features or pipework is required.	As required

Table 5.2: Operation and Maintenance for Piped Network / Inspection Chambers / Catchpits

5.4 Swales

- 5.4.1 Swales are flat bottomed, vegetated open channels designed to convey, treat and attenuate surface water runoff. They can enhance natural landscapes and provide aesthetic and biodiversity benefits. Swales can have a variety of profiles and can incorporate a range of different planting strategies.
- 5.4.2 Swales are vegetated, usually grassed, to slow the flow of water and facilitate sedimentation and filtration. Check dams / flow restrictors installed across the flow path can be used to temporarily pond surface water runoff to provide attenuation and increase pollutant retention.
- 5.4.3 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 vegetation, 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.
- 5.4.4 Regular mowing is required along maintenance strips and access routes. The use of fertiliser and / or weed killers can cause contamination of the runoff passing through the ditch.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter and debris removal.	Monthly (or as required)
	Cut grass – 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)
	Inspect inlets, outlets and overflows for blockages and clear if required.	Monthly
	Inspect vegetation coverage.	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies.	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.	As required
Remedial Maintenance	Repair erosion or other damage by re-profiling and or re-turfing / re-seeding.	As required
	Re-level uneven surfaces and reinstate design levels.	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 surfaces for ponding and silt accumulation. Record areas where water is ponding for >48hours.	Monthly, or when required

Table 5.3: Operational and Maintenance Requirements for Swales

5.5 Filter Drain

- 5.5.1 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. Filter drains can help reduce pollutant levels in surface water runoff by filtering out sediments, metals and hydrocarbons. They can also encourage adsorption and biodegradation.
- 5.5.2 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 and leaf litter 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 (including leaf litter) and debris removal from surface, access chambers and pre-treatment devices (e.g. gullies and rainwater downpipes).	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 NJUG, 2007 or BS 3998:2010).	As required
	At locations with high pollutant loads, remove surface geotextile and replace, and wash overlying filter medium.	Five yearly, or as required
	Clear perforated pipework of blockages.	As required

Table 5.4: Operation and Maintenance Requirements for Filter Drains

5.6 Geocellular Storage

- 5.6.1 Geocellular storage systems are high porosity modular plastic units that can be used to efficiently create a below ground structure for the temporary storage of surface water. Their inherent flexibility in size and shape means that they can be tailored to suit the specific characteristics and requirements of most sites. This is added by their ability to be located below public open space and trafficked areas.

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 annually
	Remove debris from the catchment surface (where may cause risks to performance).	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by silt, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually

Maintenance Schedule	Required Action	Frequency
	Remove sediment from pre-treatment structures and / or internal forebays.	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
	Survey inside the tank for sediment build-up and remove if necessary.	Every 5 year as required

Table 5.5: Operation and Maintenance Requirements for Geocellular Storage

5.7 Permeable Pavements

- 5.7.1 Permeable pavements have a surface that is formed of a material that is itself impervious to water, however the materials are laid to provide void space between the materials. These voids allow surface water to pass between the materials and through to the sub-base below where it can be temporarily stored.
- 5.7.2 Permeable pavements have been shown to reduce the concentrations of heavy metals, hydrocarbons, sediment and some nutrients. Treatment processes occurring within permeable pavements include:
- filtration of silt and the attached pollutants,
 - biodegradation of organic pollutants, such as petrol and diesel,
 - adsorption of pollutants, and the
 - settlement and retention of solids.
- 5.7.3 Permeable pavements can provide amenity and visual benefits as there are a wide range of surface materials which can be selected to meet overall planning, architectural or landscape design.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	One 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 these areas are likely to collect the most sedimentation.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weeds or management using glyphosate applied directly to 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

Maintenance Schedule	Required Action	Frequency
	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 surface 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, 48hr after large storm events in first 6 months
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually
	Monitor inspection chambers.	Annually

Table 5.6: Operation and Maintenance Requirements for Permeable Paving

6 Summary

6.1 Summary

- 6.1.1 This strategy has been developed in accordance with relevant national, regional and local planning policy guidance and should be read in conjunction with the 400 Longwater Avenue Green Park, Flood Risk Assessment (Ref: 27159/2007, dated March 2016, PBA) and supersedes any information provided therein with regards to surface water drainage.
- 6.1.2 Review of the recorded groundwater level in conjunction with the ground conditions (engineering fill over alluvium), the existence of the neighbouring ditches and anecdotal evidence of marshy / boggy areas on site indicates that the site is not suitable for infiltration drainage techniques. As such, the proposed surface water drainage strategy mimics the existing drainage regime and discharge of surface water arising on the site in to the Longwater Flood Relief Channel.
- 6.1.3 A minimum controlled discharge rate of 5 l/s per outfall has been applied to reduce the risk of blockage. This minimum controlled discharge rate has also been used to mitigate the increase in volume which occurs as a result of the increase in impermeable area.
- 6.1.4 In accordance with Flood Risk Assessments: Climate Change (19th February 2016, EA) which supports the NPPF an allowance of 30% climate change has been added to the peak rainfall intensities in the 1 in 100 year rainfall event and provides a conservative approach to the proposed developments 'Less Vulnerable' classification (Table 2, NPPF Guidance) and 60 year life expectancy.
- 6.1.5 The proposed drainage strategy utilises SuDS in the form of swales, filter drains, permeable paving and geocellular crate storage. These features provide attenuation up to and including the 100 year + 30% climate change rainfall event below ground and provide water quality benefits.
- 6.1.6 In the event of a rainfall event in excess of a 100 year + 30% climate change event surface water will flow overland eastwards following the topography of the site and the routing of the swales towards Longwater Flood Relief Channel mimicking the natural drainage flow paths.
- 6.1.7 As a result, the principles advocated by relevant national, regional and local planning policy guidance have been satisfactorily addressed.

Appendix A Topographical survey, Drawing Number 5904/01 Rev 0, dated 2008, Longdin and Browning

Appendix B Proposed Site Layout, Drawing Number 15011_A_PL_003 Rev 01, dated 16th March 2016, Robert Partington Architects

Appendix C Greenfield Discharge Calculations

Appendix D Proposed Surface Water Drainage Strategy, Drawing Number 27159/2007/001

Appendix E Proposed MicroDrainage Calculations

Appendix F Landscape GA Plan, Drawing Number 537_PL_001 Rev P00, dated March 2016, Place

Appendix G Typical Construction Details, Drawing Number 27159/2007/002