CAPITA

Former Nestle Factory, Hayes (Industrial Scheme)

Flood Risk Assessment and Drainage Strategy

Revision H | April 2017

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Job No	CS/075666		
Project	Former Nestlé Factory, Hayes Proposed Commercial Development		
Location	Hayes, London Borough of Hillingdon		
Title	Flood Risk Assessment and Drainage Strategy		
Client	SEGRO plc		
Document Ref	CS-075666-PE-16-121-R		
File Name	U:\CS-075666 - Project Lightning Hayes\Admin\Reports\FRA\CS-075666-PE-16-121-R_Rev H.docx		
Date	April 2017		
Prepared by	PWE	Signature (for file)	
Authorised by	NRB	Signature (for file)	

Revision Status / History

Rev	Date	Issue / Purpose / Comment	Prepared	Authorised
-	23/6/16	First Issue	PWE	NRB
A	17/1/17	Updated surface water drainage strategy	PWE	NRB
B	26/1/17	Updated drainage drawings	PWE	NRB
C	10/2/17	Planning consultant comments incorporated	PWE	NRB
D	10/2/17	Updated development description	PWE	NRB
E	3/3/17	Further updated drainage drawings and minor text amendments following client legal review	PWE	NRB
F	20/3/17	Amendments to surface water drainage strategy and drawings	PWE	NRB
G	20/4/17	Minor amendments to development description (para 1.2.1)	PWE	NRB
H	27/4/17	Amendment of report title per legal review comments. Deletion of word ‘jointly’ from para 1.2.1	PWE	NRB

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1. Introduction

1.1 Preamble

1.1.1 This report has been prepared by Capita Property and Infrastructure Limited on behalf of SEGRO plc in support of a planning application for the proposed redevelopment of the former Nestlé factory in Hayes, Middlesex (the Site).

1.2 Development Proposals

1.2.1 The Site is proposed to be redeveloped by SEGRO plc and Barratt London. This to comprise part-demolition of the existing factory buildings and associated structures, and redevelopment comprising 1,381 dwellings (Use Class C3), office, retail, community and leisure uses (Use Classes A1/A3/A4/B1/B8/D1/D2), 22,663 sqm (GEA) of commercial floorspace (Use Classes B1c/B2/B8 and Data Centre (sui generis)), amenity and playspace, allotments, landscaping, access, service yards, associated car parking and other engineering works.

1.2.2 A drawing illustrating the development proposals is provided in Appendix B.

1.3 Appointment and Context

1.3.1 Capita is retained as consultant engineer for SEGRO plc, and Hydrock Consultants Limited is retained as consultant engineer for Barratt London. In this regard a Flood Risk Assessment and Drainage Strategy has been prepared by each consultant covering their respective part of the development. Details regarding the Barratt scheme are described in the following Hydrock report:

- Flood Risk Assessment and Drainage Strategy, report ref. R/C151867/001.02

1.3.2 This Capita FRA is complementary to, and should be read in conjunction with, the Hydrock report.

1.4 Additional Reports

1.4.1 Capita has previously produced the following ground investigation reports in connection with the Site:

- Geo-environmental Investigation and Assessment, ref. CS-075666-PE-14-211-R Rev A dated 24 November 2014.
- Further Geo-environmental Investigation and Assessment, ref. CS-075666-PE-16-113-R Rev A, dated 6 June 2016.

2. Site Setting

2.1 Location and Description

2.1.1 The Site is located off North Hyde Gardens in Hayes, approximately centred on post code UB3 4RF and at Ordnance Survey National Grid Reference 510100, 179190 (see Appendix A).

2.1.2 The area covered by this report covers approximately 5.15 hectares in the eastern and northern part of the former Nestlé factory, which extends to over 12 hectares in total. The area was occupied by several buildings and areas of hardstanding (both macadam and concrete) and the main features were:

- The Green Bean Warehouse, previously used for the storage of coffee beans. Comprised a double bay, single storey warehouse with reinforced concrete frame, masonry panels and duo pitched roof.
- The Eden Building, used for packing and loading of finished products. Comprised a single storey warehouse with reinforced concrete frame, masonry panels and a flat roof. There was a canopy roof along the northern side of the building.
- The Lodge, a former residential property in the south-eastern corner of the Site. This was a two-storey (plus basement and attic) red brick building with mock timber framing.
- The Main Building, of varying construction types and modified / added to on a number of occasions. The building occupies land to be developed by both SEGRO and Barratt, with the SEGRO parts predominantly of reinforced concrete frame construction with masonry infill panels, and mostly 3 or 4 levels high. There is a large undercroft area, including support sleeper walls, below much of this building.
- The Gatehouse, located in the central eastern part of the Site.
- A macadam surfaced car park covering much of the southern end of the Site.

2.2 Boundaries and Surrounding Land Use

The Site is bounded by Nestles Avenue to the south, North Hyde Gardens to the east and the Grand Union Canal to the north. The western boundary is not defined by physical features as it comprises the remainder of the former Nestlé factory to be redeveloped separately.

2.3 Topography

2.3.1 The topography of the area is generally flat. Reference to an October 2014 topographical survey (see Appendix C) indicates the floor slab level of the Main Building to be about 31.3mAOD. The external areas are typically between about 29.8 and 30.55mAOD with an incline towards the north. The top of the canal wall along the north boundary is at a level of circa 30.4 to 30.5mAOD and the canal water level is around 29.45mAOD.

2.4 Previous Development History

2.4.1 Information on the Site's previous land use has been obtained from the 2013/14 Geosyntec reports and a Heritage Statement produced by CgMs in March 2016 (ref. HS/HB/21254).

2.4.2 The Site is indicated to have comprised agricultural land from at least the 1860s until the 1910s, and the earliest part of the Main Building was completed circa 1914 for a cocoa factory.

2.4.3 During the First World War much of the Site was commandeered for a munitions factory. The land surrounding the single factory building was occupied by numerous wooden huts used for shell manufacturing, with the huts linked to each other by raised walkways. Railway sidings connected the munitions works to the mainline to the north.

2.4.4 The munitions factory closed in 1919 and the Site reverted to cocoa, and later coffee, production. The Main Building was extended in the 1930s and further modified and added to in the 1960s. The factory complex continued to expand throughout the second half of the twentieth century and many of the larger warehouse-type buildings were constructed in the 1970s.

2.4.5 In 2012, Nestlé announced the planned closure of the factory and the transfer of the whole of its UK coffee operation, including manufacturing, filling and packing to Tutbury in Derbyshire. Manufacturing on the Nestlé Hayes Site finished in late 2014.

2.4.6 SEGRO purchased the Site from Nestlé in early 2015 and leased back the factory to Nestlé so that it could undertake decommissioning until October 2015. Following SEGRO's acquisition of the land, it sought a development partner (Barratt London) to deliver residential uses alongside its own commercial development.

2.5 Geology

2.5.1 British Geological Survey online mapping indicates the Site to be underlain by 'Worked Ground' over natural soils of the Lynch Hill Gravel Member. The Lynch Hill Gravel is part of the Maidenhead Formation and typically comprises river terrace sands and gravels. The underlying bedrock comprises the London Clay Formation (silty clay), which is expected to be circa 60m thick.

2.5.2 Previous Capita investigations recorded stratigraphy typically comprising:

Made Ground

Concrete or macadam hard surfacing (typically 0.3m thick) over 0.15 to 2.3m (average 0.85m) clayey gravel or gravelly clay with fragments of concrete, brick and stone. The coarse grained fraction also included chalk, charcoal, ash, slag and metal fragments.

Discontinuous Langley Silt Formation ('Brickearth')

Observed in most of the exploratory holes at an average thickness of 0.7m (ranging between 0.2 and 1.6m) and comprising firm gravelly and/or sandy silty clay.

Lynch Hill Gravel

Medium dense and dense orange-brown and dark brown sandy flint gravel, with occasional sand lenses, between 0.9 and 3.3m thick (average 2.3m).

London Clay

Reached at between 2.6 and 5.3mbgl and consisting of firm to stiff grey-brown silty clay.

2.6 Hydrogeology

2.6.1 The Lynch Hill Gravel is designated a Principal aquifer by the Environment Agency. The underlying London Clay Formation is categorised as an Unproductive stratum (i.e. a non aquifer).

2.6.2 The Site is not situated within an EA-designated Groundwater Source Protection Zone.

2.6.3 Resting groundwater depths were recorded on three occasions by Geosyntec between December 2013 and May 2014 and ranged between about 0.6 and 2.5m below ground level. Monitoring by Capita indicated depths of between about 0.9 and 1.5 mbgl within the Lynch Hill Gravel aquifer. Flow appeared to be generally directed towards the south-east at a gradient of approximately 1:150.

2.7 Hydrology

2.7.1 The nearest significant surface watercourse is the Grand Union Canal, which defines the Site's northern boundary.

2.7.2 The River Crane is situated about 175m east and flows in a southerly direction, discharging into the River Thames about 10km to the south.

3. Policy and Guidance

3.1 National Planning Policy Framework (March 2012)

3.1.1 In determining an approach for the assessment of flood risk for the development proposal there is a need to review the policy context. Government guidance requires that consideration be given to flood risk in the planning process. The National Planning Policy Framework (NPPF) was issued in March 2012 and outlines the national policy position on development and flood risk assessment.

3.1.2 The Framework states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk. Where development is necessary in flood risk areas, it can be permitted provided it is made safe without increasing flood risk elsewhere.

3.1.3 The essence of NPPF is that:

- Local Plans should be supported by Strategic Flood Risk Assessment and develop policies to manage flood risk from all sources, taking advice from the Environment Agency and other relevant flood risk management bodies, such as lead local flood authorities and internal drainage boards.
- Polices in development plans should outline the consideration, which will be given to flooding issues, recognising the uncertainties that are inherent in the prediction of flooding and that flood risk is expected to increase as a result of climate change.
- Planning authorities should apply the precautionary principle to the issue of flood risk, using a risk-based search sequence to avoid such risk where possible and managing it elsewhere;
- The vulnerability of a proposed land use should be considered when assessing flood risk;
- Opportunities offered by new developments should be used to reduce the causes and impacts of flooding;
- Planning authorities should recognise the importance of functional floodplains, where water flows or is held at times of flood, and avoid inappropriate development on undeveloped and undefended floodplains; and
- Development is based on the concept of Flood Risk Reduction, particularly in circumstances where development has been sanctioned on the basis of the “Exception Test”.

3.2 Planning Practice Guidance Flood Risk and Coastal Change (April 2015)

3.2.1 The accompanying practice guidance to the NPPF provides additional guidance to local planning authorities to ensure the effective implementation of the planning policy set out in the National Planning Policy Framework on development in areas at risk of flooding.

3.2.2 The practice guidance provides supporting information on:

- The application of the sequential approach and Sequential and Exception Tests;
- Measures to reduce flood risk to acceptable levels;
- How to manage residual risks; and
- Guidance on how to take climate change into account.

3.2.3 The April 2015 update to the practice guidance provides additional guidance on SuDS, including:

- The importance of SuDS;
- When SuDS should be considered;
- The SuDS discharge hierarchy;
- Factors a local authority will address when considering SuDS as part of a planning application;
- When SuDS are inappropriate and relevant flood risk consultees;
- Applicability of DEFRA's Non-statutory Technical Standards for Sustainable Drainage Systems;
- Design and construction cost considerations;
- Operation and maintenance considerations; and
- Where to go for further SuDS advice.

3.2.4 As part of the April 2015 update, the practice guidance provides details on the parties responsible for assessing the suitability of SuDS practices. As per paragraph 084 from the practice guidance:

> *The decision on whether a sustainable drainage system would be inappropriate in relation to a particular development proposal is a matter of judgement for the local planning authority. In making this judgement the local planning authority will seek advice from the relevant flood risk management bodies, principally the lead local flood authority, including on what sort of sustainable drainage system they would consider to be reasonably practicable.*

3.3 Flood and Water Management Act 2010

3.3.1 Combined with the Flood Risk Regulations 2009 ('the Regulations'), (which enact the EU Floods Directive in the England and Wales) the Flood and Water Management Act 2010 ('the Act') places significantly greater responsibility on Local Authorities to manage and lead on local flooding issues.

3.3.2 The Act and the Regulations together raise the requirements and targets Local Authorities need to meet, including:

- Playing an active role leading Flood Risk Management;
- Development of Local Flood Risk Management Strategies (LFRMS);
- Implementing requirements of Flood and Water Management legislation;
- Development and implementation of drainage and flooding management strategies;

3.3.3 The Flood and Water Management Act also clarifies three key areas that influence development:

1. ***Sustainable Drainage Systems (SuDS)*** - the Act makes provision for a national standard to be prepared on SuDS (The Non-statutory Technical Standards for Sustainable Drainage Systems, published March 2015). The suitability of SuDS will be assessed by the local authority, in consultation with other applicable flood risk management bodies, primarily the lead local flood authority.
2. ***Flood risk management structures*** - the Act enables the EA and local authorities to designate structures such as flood defences or embankments owned by third parties for protection if they affect flooding or coastal erosion. A developer or **l**andowner will not be able to alter, remove or replace a designated structure or feature without first obtaining consent from the relevant authority.
3. ***Permitted flooding of third party land -*** The EA and local authorities have the power to carry out work which may cause flooding to third party land where the works are deemed to be in the interest of nature conservation, the preservation of cultural heritage or people's enjoyment of the environment or of cultural heritage

3.4 The London Plan

3.4.1 The London Plan is the overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years. The London Plan was adopted in July 2011. Revised Early Minor Alterations to the London Plan were published in October 2013 and Minor Alterations in respect of housing and car parking standards were published in March 2016.

3.4.2 London Plan policies 2.18, 5.3, 5.9, 5.12, 5.13 and 5.15 (described below) require development to help reduce flood risk, including applying principles of sustainable urban drainage and not increasing hard-standing areas, in order to reduce run-off from sites.

Climate Change Adaptation

3.4.3 All developments should make the fullest contribution to London's adaptation to climate change and should be designed for the warmer, wetter winters and hotter, drier summers the city will experience over their lifetime, and to withstand possible natural hazards (such as heat waves, flooding and droughts) that may occur.

3.4.4 The following policies are supported by the London Climate Change Adaptation Strategy that contains further proposals to help London adapt to the major impacts of climate change, including:

- Minimising overheating and contribution to heat island effects (Policy 5.9);
- Minimising solar gain in summer (Policy 5.3);
- Contributing to reducing flood risk including applying principles of sustainable urban
- drainage (Policies 2.18 and 5.13);
- Minimising water use (Policy 5.15); and
- Protecting and enhancing green infrastructure.

Policy 5.12 Flood Risk Management

3.4.5 In line with the NPPF, boroughs should, when preparing Local Development Frameworks, utilise Strategic Flood Risk Appraisals to identify areas where particular flood risk issues exist. They should develop actions and policy approaches aimed at reducing these risks, particularly through redevelopment of sites at risk of flooding and identifying specific opportunities for flood risk management measures.

3.4.6 Where development in areas at risk from flooding is permitted, (taking into account the provisions of NPPF), the Mayor will, and boroughs and other agencies should, manage the existing risk of flooding, and the future increased risk and consequences of flooding as a result of climate change, by:

- Protecting the integrity of existing flood defences;
- Setting permanent built development back from existing flood defences to allow for the management, maintenance and upgrading of those defences to be undertaken in a sustainable and cost effective way;
- Incorporating flood resilient design; and
- Establishing flood warning and emergency procedures.

3.4.7 Opportunities should also be taken to identify and utilise areas for flood risk management, including the creation of new floodplain or the restoration of all or part of the natural floodplain to its original function, as well as using open space in the flood plain for the attenuation of flood water.

3.4.8 The Mayor will, and boroughs and other agencies should, take fully into account the emerging findings of the Thames Estuary 2100 Study, the Regional Flood Risk Appraisal and the Thames Catchment Flood Management Plan.

Policy 5.13 Sustainable Drainage

3.4.9 The Mayor will, and boroughs should, seek to ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1. Store rainwater for later use;
2. Use infiltration techniques, such as porous surfaces in non-clay areas;
3. Attenuate rainwater in ponds or open water features for gradual release to a watercourse;
4. Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse;
5. Discharge rainwater direct to a watercourse;
6. Discharge rainwater to a surface water drain; and
7. Discharge rainwater to the combined sewer.

3.4.10 The use of sustainable urban drainage systems should be promoted for development unless there are practical reasons for not doing so.

3.4.11 Such reasons may include the local ground conditions or density of development. In such cases, the developer should seek to manage as much run-off as possible on site and explore sustainable methods of managing the remainder as close as possible to the site.

3.4.12 The Mayor will encourage multi agency collaboration (GLA Group, Environment Agency, and Thames Water) to identify sustainable solutions to strategic surface water and combined sewer drainage flooding/overflows.

3.4.13 Developers should aim to achieve greenfield run off from their site through incorporating rainwater harvesting and sustainable drainage. Boroughs should encourage the retention of soft landscaping in front gardens and other means of reducing, or at least not increasing, the amount of hard standing associated with existing homes.

3.5 Strategic Flood Risk Assessment (SFRA, Level 1) 2008, updated in 2015 – London Borough of Hillingdon

3.5.1 The primary objective of the SFRA (which was drafted on behalf of the borough by Scott Wilson Ltd) is to inform the revision of flooding policies, including the allocation of land for future development, within the Local Development Framework (LDF). The SFRA has a broader purpose however, and in providing a robust depiction of flood risk across the borough it can:

- Inform the development/developer of Council policy that will underpin decision making within the Borough, particularly within the areas that are affected by (and/or may adversely impact upon) flooding;

- Assist the development control process by providing a more informed response to development proposals affected by flooding, influencing the design of future development within the Borough;
- Help to identify and implement strategic solutions to flood risk, providing the basis for possible future flood attenuation works;
- Support and inform the Council's emergency planning response to flooding;
- Identify what further investigations may be required in flood risk assessments for specific development proposals; and
- Provide flood information that supports sustainability appraisals of the local development framework.

3.5.2 The SFRA provides the following guidance on flood risk mitigation, which has been considered in preparing this flood risk assessment:

- Reduce the probability of flooding to a development and consequently reduce the associated hazard;
- Minimise the impact and damage that flood water may cause to a development and thus enable a faster recovery following a flood event;
- Ensure no adverse impacts resulting in increased flood risk to neighbouring sites;
- Wherever possible seek to provide an overall benefit to flood risk for neighbouring sites; and
- Be adaptable to future climate change scenarios.

3.6 London Borough of Hillingdon Surface Water Management Plan – Evidence Base (January 2013)

3.6.1 The Hillingdon Surface Water Management Plan (SWMP) Evidence Base sets out the data upon which the preferred surface water management strategy for the borough will be developed. This includes consideration of flooding from sewers, drains, groundwater and runoff from land, small watercourses and ditches. In particular the document identifies 17 Critical Drainage Areas (CDAs) where an elevated risk of surface water flooding exists. It also provides an options assessment for measures which may reduce the impact of flooding in the CDAs and across the wider borough.

3.7 Hillingdon Local Plan 1998 - Saved Policies (September 2007)

3.7.1 The LBH Local Plan was adopted in 1998 and a number of policies remain in place, including:

- Policy OE8: Planning permission will not be granted for new development or redevelopment of existing urban areas which would result in an increased flood risk due to additional surface water runoff, unless the proposed development includes appropriate attenuation measures to a standard satisfactory to the council, in consultation with the EA and, where appropriate, other drainage bodies.

- Policy OE9: Catchments which have the potential for sewerage flooding will not normally be granted planning permission for development which may precipitate such flooding or further flooding, until sufficient improvement has been implemented to alleviate the problem.
- Policy OE10: In areas of potential flooding or inadequate capacity of foul and surface water sewerage systems to receive the additional discharge from the development, a phased development may be required to match the provision of infrastructure so that the existing system is not overloaded to the detriment of the community as a whole.

3.8 Hillingdon Local Plan – Part 1 – 2012

3.8.1 The Hillingdon Local Plan is the key strategic planning document for the borough. Policy EM6 of the plan states that the Council will require new development to be directed away from Flood Zones 2 and 3 in accordance with the principles of the National Planning Policy Framework (NPPF). It also confirms that the Council will require all development across the borough to use sustainable urban drainage systems (SUDS) unless demonstrated that it is not viable.

3.9 Hillingdon Local Plan – Part 2 – 2015

3.9.1 Part 2 of the Local Plan sets out the Hillingdon's Development Management Policies. Policy DMEI 09 covers Management of Flood Risk. It states (inter alia):

- A) All development proposals in Flood Risk Zones 2 and 3a and 3b (medium and high probability risk) and areas identified as being at risk from artificial sources, sewer and surface water flooding and ordinary watercourses or historic flood events will be required to submit an appropriate level Flood Risk Assessment to demonstrate that the development is resistant and resilient to all relevant sources of flooding including surface water flooding. Critical Drainage Areas (CDAs) will be treated the same as flood zone 3.
- B) Development in Flood Zone 3b will be refused in principle unless identified as an appropriate development in Flood Risk Planning Policy Guidance.
- C) Developments may be required to make contributions (through legal agreements) to previously identified flood improvement works that will benefit the development site addressing surface water flood risk, where mitigation measures are required.
- D) Proposals that fail to make appropriate provision for flood risk mitigation, or which would increase the risk or consequences of flooding, will be refused.

4. Flood Probability and Hazard

4.1 Flood Zone

4.1.1 The Site is located within Flood Zone 1, based on current Environment Agency Flood Zone Maps. Land within this zone is defined as having a less than 1 in 1000 (<0.1%) annual probability of flooding from rivers or the sea.

4.1.2 A copy of the flood zone map covering the Site is provided in Appendix D.

4.2 Historic Flooding / Flooding from the Canal

4.2.1 The available London Borough of Hillingdon reference documents do not indicate historical flooding to have occurred at the Site.

4.2.2 In January 2015 Capita submitted an enquiry to the Canal and River Trust (CRT) to request any information held by them in relation to historical flooding from the Grand Union Canal. In its response (a copy of which is provided in Appendix F), CRT advised that it is not aware of any records of overtopping from, or breaches of, the waterway where the canal passes the Site.

4.3 Flooding From Land

4.3.1 Flooding from land occurs when intense, often short duration rainfall is unable to soak into the ground or enter drainage systems. The amount of runoff is a function of geology, topography, climate, rainfall, soil saturation, soil type and vegetation. It is noted that the natural surface geology comprises low permeability Alluvium, into which rainfall will not readily infiltrate.

4.3.2 As the Site is currently predominantly covered by buildings and hardstandings, there is not expected to be any significant infiltration into the ground at present.

4.3.3 The surface water drainage strategy for the proposed development will be designed to ensure rainfall run-off is adequately managed.

4.4 Sewer Flooding

4.4.1 Flooding from sewers occurs when rainfall exceeds the capacity of formal drainage networks or when there is an infrastructure failure. The impact is usually confined to relatively small localised areas however when it is associated with a blockage or failure of the sewer network, flooding can be rapid and unpredictable.

4.4.2 The 2013 Surface Water Management Strategy (SWMS) states that rainfall modelling has been undertaken across the Borough and the results used to identify Local Flood Risk Zones (LFRZs) where flooding affects houses, businesses and/or infrastructure. Those areas identified to be at more significant risk have been delineated into Critical Drainage Areas (CDAs) representing one or several LFRZs, as well as the contributing catchment area and features that influence the predicted flood extent.

4.4.3 17 CDAs have been identified in LB of Hillingdon, and with reference to Figure 1.2 of Appendix D in the SWMS it can be seen that the Site does not fall within any of these areas. The Site is therefore considered to be at low risk of flooding from sewer failure at present.

4.5 Flooding from Groundwater

4.5.1 Groundwater flooding is caused by subterranean water that flows back above ground from the underlying aquifer, occurring at the point where the water table meets the surface.

4.5.2 Recent investigations have recorded groundwater to be at depths of between about 0.9 and 1.5m below current ground level. As such the risk of flooding from groundwater is considered to be very low.

4.6 Climate Change

4.6.1 Projections of the likely impact of climate change indicate that more frequent short-duration, high intensity rainfall events can be expected in the UK, as well as more frequent prolonged periods of rainfall. The outline surface water drainage strategy for the proposed development, presented in Chapter 5, takes cognisance of this anticipated change.

5. Drainage Strategy and SuDS

5.1 Introduction

5.1.1 SuDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment.

5.1.2 Due to impermeable ground cover, a greater volume of runoff will be generated by a developed site compared to its undeveloped condition, regardless of the magnitude of any given storm event. This can lead to an increase in downstream flood risk so the Environment Agency generally requires runoff from new developments to be restricted as far as possible. Based on the proposed development layout and site constraints, the appropriateness of several Sustainable Drainage Systems (SuDS) has been assessed.

5.2 Green roofs

5.2.1 The Site is proposed to be developed for a new steel-framed industrial / commercial unit. By their nature such buildings span relatively wide areas and are of lightweight and economic construction. The adoption of green roofs would require significant and costly modifications to the structural design including significantly upgraded foundations and more extensive use of structural steelwork. It has consequently been determined that such an option is not compatible within the proposed development.

5.3 Basins and Ponds

5.3.1 The nature of the proposed development is such that almost the whole of the Site area will be occupied by either the new buildings or external hardstandings. The inclusion of basins or ponds within the scheme layout is not feasible and this option is therefore excluded.

5.4 Filter Strips and Swales

5.4.1 There is no viable location within the proposed development to accommodate filter strips or swales and they are not compatible with the scheme location and layout. These have therefore been discounted.

5.5 Infiltration devices

5.5.1 Capita has undertaken two detailed ground investigations at the Site, in November 2014 and more recently in May 2016. As discussed in Section 2 above, the Site is underlain by about 0.15 to 3m of variable Made Ground consisting of soft silt and clay with varying amounts of gravel and sand. This is underlain by Discontinuous Langley Silt Formation (‘Brickearth’). Such soils are not suitable for soakaway drainage due to very low infiltration coefficients and variable constituents.

5.5.2 The underlying Lynch Hill Gravel, whilst potentially permeable, was found to be fully saturated.

5.6 Soil infiltration rate testing was undertaken as part of Capita's 2016 investigation and the data indicated infiltration rates to be negligible, likely due to the relatively shallow groundwater table. It is therefore concluded that soakaway drainage would not be feasible for the proposed development.

5.7 Below Ground Storage

5.8 Underground storage of surface water run-off would be a suitable and beneficial SuDS option for the proposed development and would be compatible and appropriate within the scheme layout. The off-Site runoff is based on a maximum of 3 times the calculated greenfield runoff rate as specified in the London Plan (Supplementary Planning Guidance) and as a result below ground storage vessels, in the form of Tubosider storage pipes, have been proposed.

5.9 Surface Water Drainage Strategy

5.9.1 The surface water drainage strategy developed for the Site is proposed to comprise an attenuated below ground cellular storage system. Permeable paving is also to be utilised for the car parking areas, to improve the quality of the surface water runoff from these areas. The permeable paving will be Type C construction with no infiltration into the subsurface.

5.9.2 The overall system's storage capacity has been calculated based on a 1 in 100 year return period with an additional 20% allowance for climate change.

5.9.3 Full retention petrol interceptors will be positioned upstream of surface water entry to the attenuation pipework or tanks (other than from roof run-off) to remove hydrocarbons and sediments. In addition a bypass separator is to be positioned downstream of the tanks, upstream of the final manhole.

5.9.4 Full details of the strategy are provided in Appendix E, including drawings and supporting calculations which provide details of run-off and storage volumes. The calculations demonstrate that adequate below-ground storage has been provided for the 1 in 30 year storm and that above-ground ponding produced from storms of return period in excess of 1 in 30 years and up to 1 in 100 years plus 20% climate change allowance will remain within the Site boundaries.

6. Conclusions

6.1 This flood risk assessment has been prepared by Capita for SEGRO plc to support a planning application for the redevelopment of the former Nestlé factory in Hayes, Middlesex. It should be read in conjunction with, and is complementary to, an FRA produced by Hydrock Consultants Limited for Barratt London, also for the former Nestlé factory.

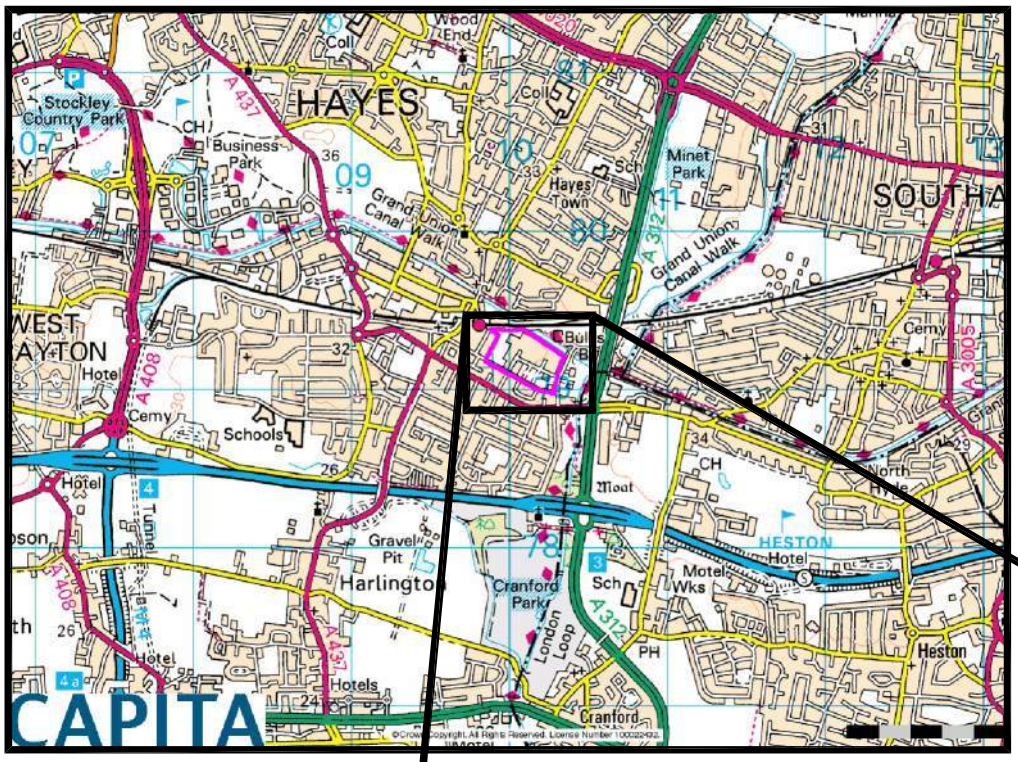
6.2 The Site is located in Flood Zone 1 and is at low probability of flooding from fluvial or tidal sources. Flood risk, both on and off-Site, from Site-generated runoff has been addressed via a surface water drainage strategy.

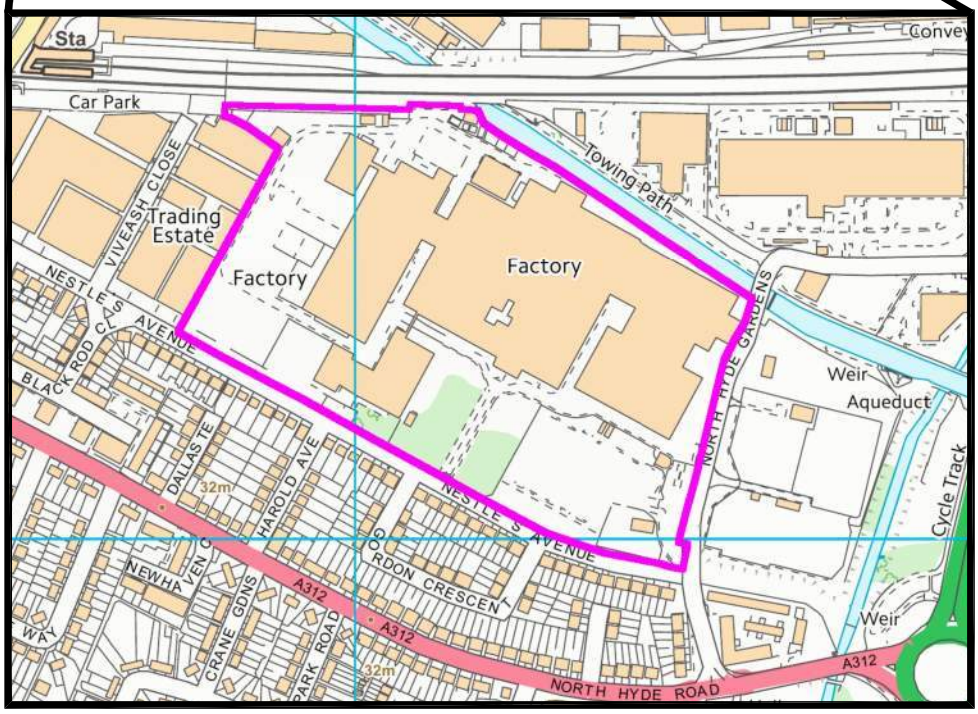
6.3 The strategy described in this report is proposed to comprise a system of attenuated below ground cellular storage and is based on a 1 in 100 year return period plus 20% for climate change. Off-Site discharge is to be restricted to 3 times the calculated greenfield runoff rate as specified in the London Plan.

6.4 All foul water flow from the proposed development is to be drained via a below ground gravity piped network and discharged into an existing Thames Water manhole on Nestles Avenue in the south-eastern corner of the Site.

6.5 The development is considered to be at low risk from flooding from all sources and is not considered to increase such risk to others.

Appendix A – Site Location Plan





Drawing status

PRELIMINARY

Client

SEGRO
WHERE BUSINESS WORKS

Project

FORMER NESTLE SITE, HAYES

Drawing

SITE LOCATION PLAN

Scale @ A4	Drawn	Checked
N.T.S.	WFJ	PWE
Project No.	**Date**	**Office**
CS/075666	21/11/14	WATFORD

Drawing Identifier — BS1192:2007 / Avanti Compliant

project	origin	zone	level	file type	role	number	revision
075666	- CA-	0 -	G00-	DSP-	SE-	502 -	P00

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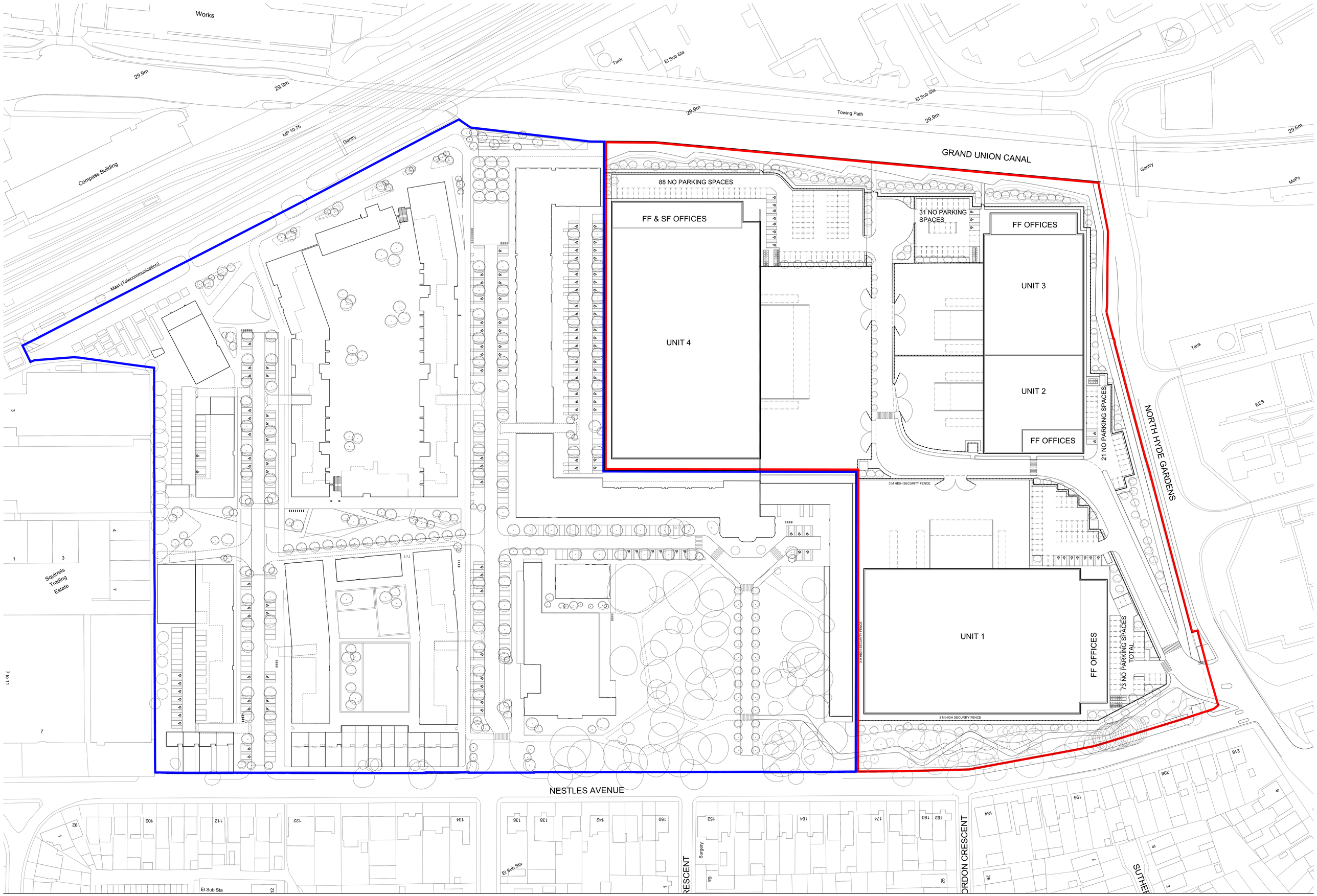
Reg. office 71 Victoria Street, Westminster, London SW1H 0XA • No: 2018542

Appendix B – Architect's Proposed Development Layout



BARRATT LONDON

SEGRO

MICHAEL SPARKS ASSOCIATES

11 Plato Place, St Dionis Road
London SW6 4TU

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info@michaelsparkfilarts.co.uk

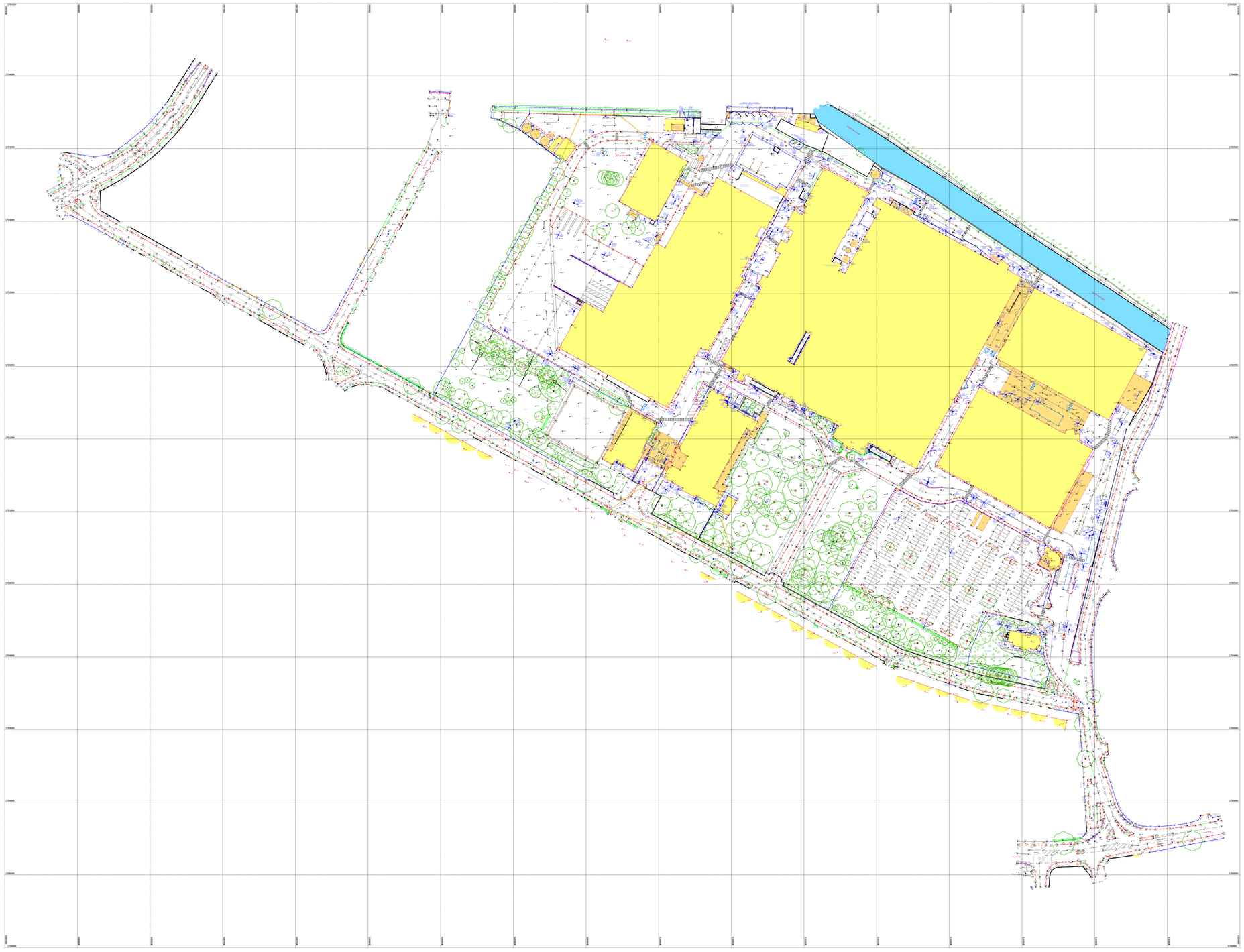
FORMER NESTLE FACTORY, HAYES

0 5 10 20 50m

SCALE 1:500@ A0

ISSUE D2

Appendix C – Topographical Survey



N

Station Information:

Station	Easting (m)	Northing (m)	Level (m)	Station	Easting (m)	Northing (m)	Level (m)
AR1	510776.675	179515.329	29.482	G47	509944.674	179103.631	30.808
AR2	510776.426	179471.706	29.390	G48	509944.900	179177.857	31.131
AR3	510777.725	179337.072	29.203	G49	509764.299	179214.691	31.288
AR4	510143.140	179065.874	28.842	G410	509889.263	179263.582	31.888
AR5	510290.029	179265.779	30.459	G411	509958.928	179263.851	31.251
AR6	510176.378	179317.488	30.396	G414	510300.293	179070.135	30.756
AR7	510112.135	179339.691	30.390	G416	510349.528	179208.947	31.218
AR8	509959.133	179391.871	31.265	L1	510127.369	179376.041	30.937
AR9	510087.025	179313.996	31.149	L2	510224.830	179197.069	30.262
AR10	509991.564	179359.043	31.475	L3	510075.751	179171.728	31.237
AR11	510028.595	179339.045	31.130	L4	510030.904	179140.130	31.208
G41	510008.708	179862.348	29.347	L5	509989.132	179132.707	31.257
G42	510304.906	179930.563	28.294	L6	510015.208	179103.402	31.320
G43	510297.832	179956.773	28.231	L8	510052.479	179242.062	31.176
G44	510199.971	179991.184	29.350	L9	509965.528	179217.265	31.147
G45	510129.795	179224.284	32.233	L10	509991.370	179270.540	31.144
G46	510040.407	179058.896	30.496	L11	509943.070	179306.613	31.269

OS Note:

Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.

OS Buildings *Surveyed Buildings*

This survey has been orientated to the Ordnance Survey (O.S) National Grid (OSGB36) via Global Navigational Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN02 & OSGM02 transformation models.
The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

Legend:

Buildings
Wall
Kerb line
Drop kerb
Centre line
Overhead Cable
Concrete edge
Hedge edge
Tarmac edge
Grass verge
Canopy/Overhang
Bridge
Station and Name
Station Level
100.000
Tree / Bush / Sapling
Area of Undergrowth
Woodland
Ridge Level
Eaves Level
Parapet Level
Gate
Fence types:
Hac
Hac
Iron Railings
Wire Mesh
Post & Rail
Post & Wire
Chain Link
Wooden Panels
Concrete Panels
Steel Palisade

IC	Inspection chamber	Bollard	Bollard
PInv	Pipe invert	IB	Illuminated bollard
Gy	Gully	Bin	Rubbish bin
Bg	Back gully	Vp	Vent pipe
Dp	Down pipe	Gl	Ground light
Pipe	Pipe above ground	Litter	Letter box
MH	Manhole	Ldr	Ladder
WL	Water level	Sly	Stile
Fl	Flood light	FL	Internal floor level
Lp	Lamp post	THL	Threshold level
Tp	Telegraph post	Sp	Sign post
Ep	Electricity post	Tm	Trafficm
Tl	Traffic light	BH	Borehole
Bus	Bus stop	ELE	Electric
Sv	Stop valve	BT	British Telecom
St	Stop tap	CSox	Control box
Er	Earth rod	TT	Tactile
Wm	Water meter	BP	Brick paved
Gas	Gas valve	CPS	Concrete paving slabs
Av	Air valve	CVR	Cover
ICU	Unidentified inspection	IC	Inspection chamber
Wo	Wash out	Rwall	Retaining wall
Re	Rodding eye	UTL	Unable to lift
BB	Belisha beacon	TCL	Tree canopy level
CTV	Cable tv	G	Girth
Mkr	Marker post	MG	Multi girth
Gmkr	Gas marker post	Stump	Tree Stump
Sc	Scrifb	CL	Cover level
		IL	Invert level

Rev	Date	Description	Drawn	Q. Ref

greenhatch group

- Topographical Surveys
- Site Engineering
- Utility / CCTV Surveys
- Measured Building Surveys
- 3D Laser Scanning
- Revit & BIM Models

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CLIENT
Segro

PROJECT
Project Lightning
Hayes

TITLE
Topographical Survey

SCALE	DATE
A0@ 1: 1000	Oct 2014
DRAWN	QUALITY REF
AR/LP	C1263

Level datum	See OS Note
Grid orientation	See OS Note
Job number	20897

Drawing No.	Rev.
20897_OGL	0

Comments
This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.

All dimensions should be checked on site prior to design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

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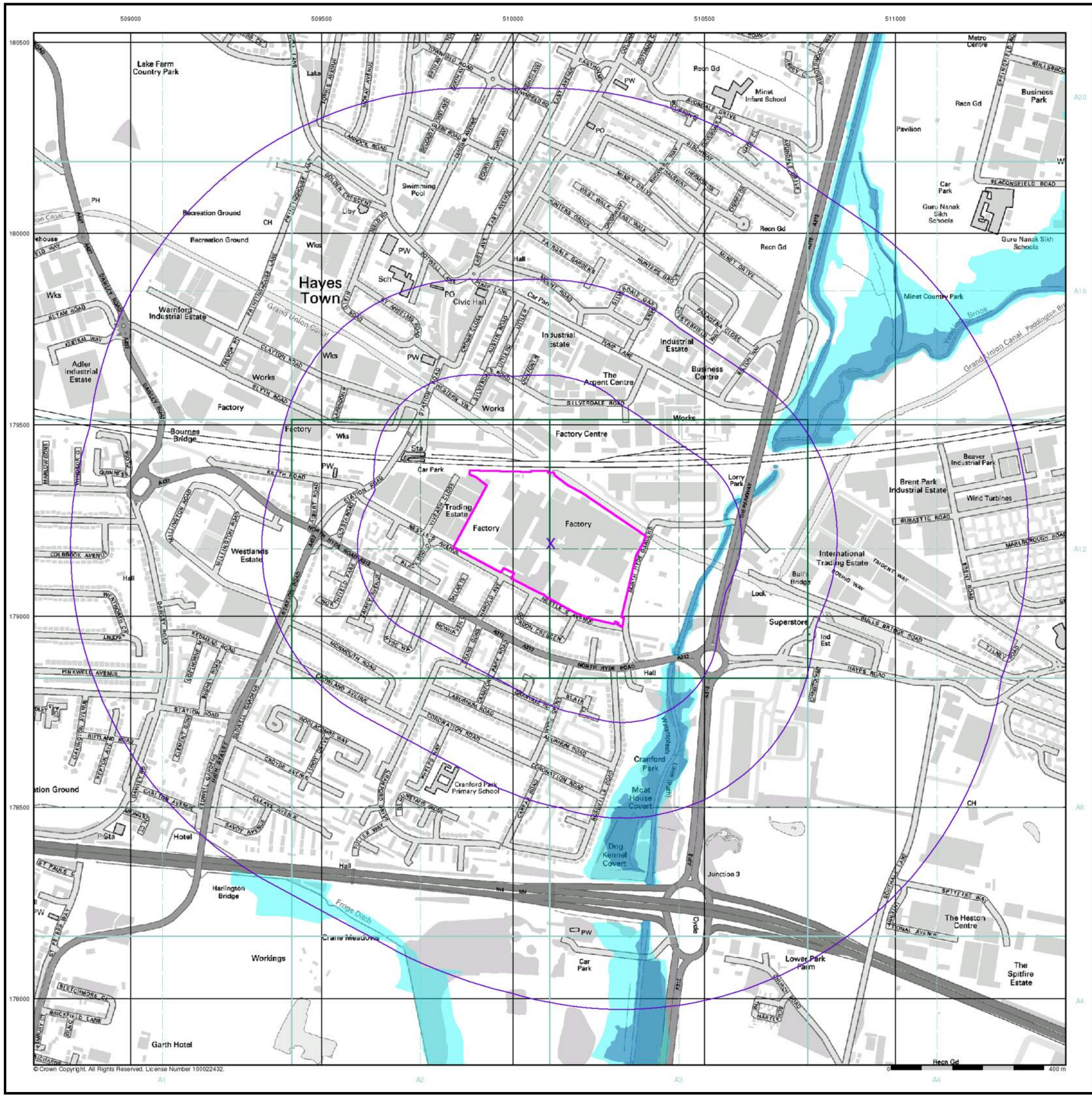
Appendix D – EA Flood Zone Plan



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environmental business solutions

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Delph New Road
Delph, Oldham
OL3 5DE
tel 0845 055 0575

www.fordconsulting.co.uk

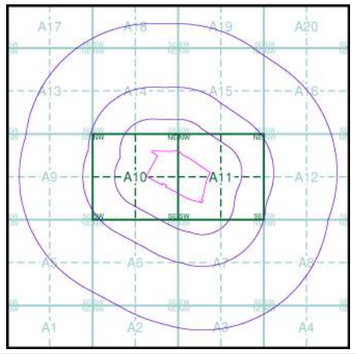
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A



N

Order Details

Order Number:	48644303_1_1
Customer Ref:	GCU0124020
National Grid Reference:	510100, 179190
Slice:	A
Site Area (Ha):	12.29
Search Buffer (m):	1000

Site Details

Nestle UK Ltd, Beverage Division, North Hyde Gardens, HAYES, Middlesex, UB3 4RF

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix E – Surface Water Drainage Strategy

CAPITA

Commercial in Confidence

Former Nestle Site, Hayes

Drainage Strategy - Revision C
20 March 2017

We | Listen Create Deliver

Contents

Pages

Drainage Strategy

Rural runoff calculations – 1 in 2 years, 1 in 30 years and 1 in 100 years

Assessment of pre and post development surface water runoff

Storm water storage calculations as follows;

1 in 2 years

Summary of results, inflow details, model details and schedules 1-28

1 in 30 years

Summary of results. 29-32

1 in 100 years +20%CC

Summary of results. 33-36

Preliminary assessment of foul flows

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web site: www.capita.co.uk

Drainage Strategy – Revision C

(by G. Males)

Surface water drainage strategy

References;

Capita drawings and calculations

075666-CA-0-GF-DR-S-010-P04 “Drainage layout and external levels Sheet 1 of 2”.

075666-CA-0-GF-DR-S-011-P04 “Drainage layout and external levels Sheet 2 of 2”.

Surface water drainage calculations.

Michael Sparks Associates drawing

MS101-Issue D2 “Former Nestle Factory, Hayes”.

Greenhatch Group drawing

20897-OGL- Rev 0 “Topographical Survey”.

In accordance with the requirements of NPPF (National Planning Policy Framework), and accompanying Planning Practice Guidance, a review of the development site was undertaken for the use of suitable SUD’s techniques. As a result below ground storage vessels, in the form of Tubosider storage pipes (Twinstore System) have been utilised along with a maximum off-site discharge of 50 l/sec for 1 in 2 years return period (9.66 l/sec/ha), 129.5 l/sec for 1 in 30 years return period (25.02 l/sec/ha) and 182.5 l/sec for 1 in 100 years return period (35.28 l/sec/ha) utilising complex flow controls. These figures are based on a maximum of three times the calculated greenfield runoff rate as specified in the London Plan (Supplementary Planning Guidance) for previously developed sites. As can be seen from the drainage calculations the final discharge from the site, for a 1 in 100 years return period +20%CC (110 l/sec), is well below the allowable figure above.

Ground investigations undertaken at the site identified a degree of variability in stratigraphy and, most notably, very shallow groundwater (between about 0.9 and 1.5m below current ground level). Soil infiltration rate testing was undertaken as part of these investigations to assess the viability of soakaway drainage. These tests recorded negligible infiltration rates and the use of soakaways within the new

development has therefore been discounted. Refer to Capita Property and Infrastructure 'Further Geo-environmental Assessment' dated 31 May 2016.

Notwithstanding the above the opportunity has been taken to include permeable paving for the car parking areas to improve the quality of the surface water runoff from these areas. These will be of Type C construction (no infiltration).

The surface water drainage network is a gravity system and has been designed in accordance with the requirements of BS EN 752:2008 namely no surcharging during a critical storm event of 1 in 2 years return period and no exceedance flooding during a critical storm event of 1 in 30 years return period.
In addition, in accordance with the Environment Agency's requirements, the flows and volumes produced from critical storm events in excess of 1 in 30 years up to 1 in 100 years return period, plus a 20% allowance for climate change, have been assessed.

Exceedance flooding, where possible, has been contained in the dock loading areas of each Unit. This is not possible for the main access road and therefore the storage pipe has been designed to cater for all flows up to 1 in 100 years + 20%CC as well as acting as a carrier pipe for the controlled discharges from each Unit.

The controlled surface water flow will discharge off-site via existing Thames Water manhole 2909 in Nestles Avenue subject to a Section 106 agreement with Thames Water.

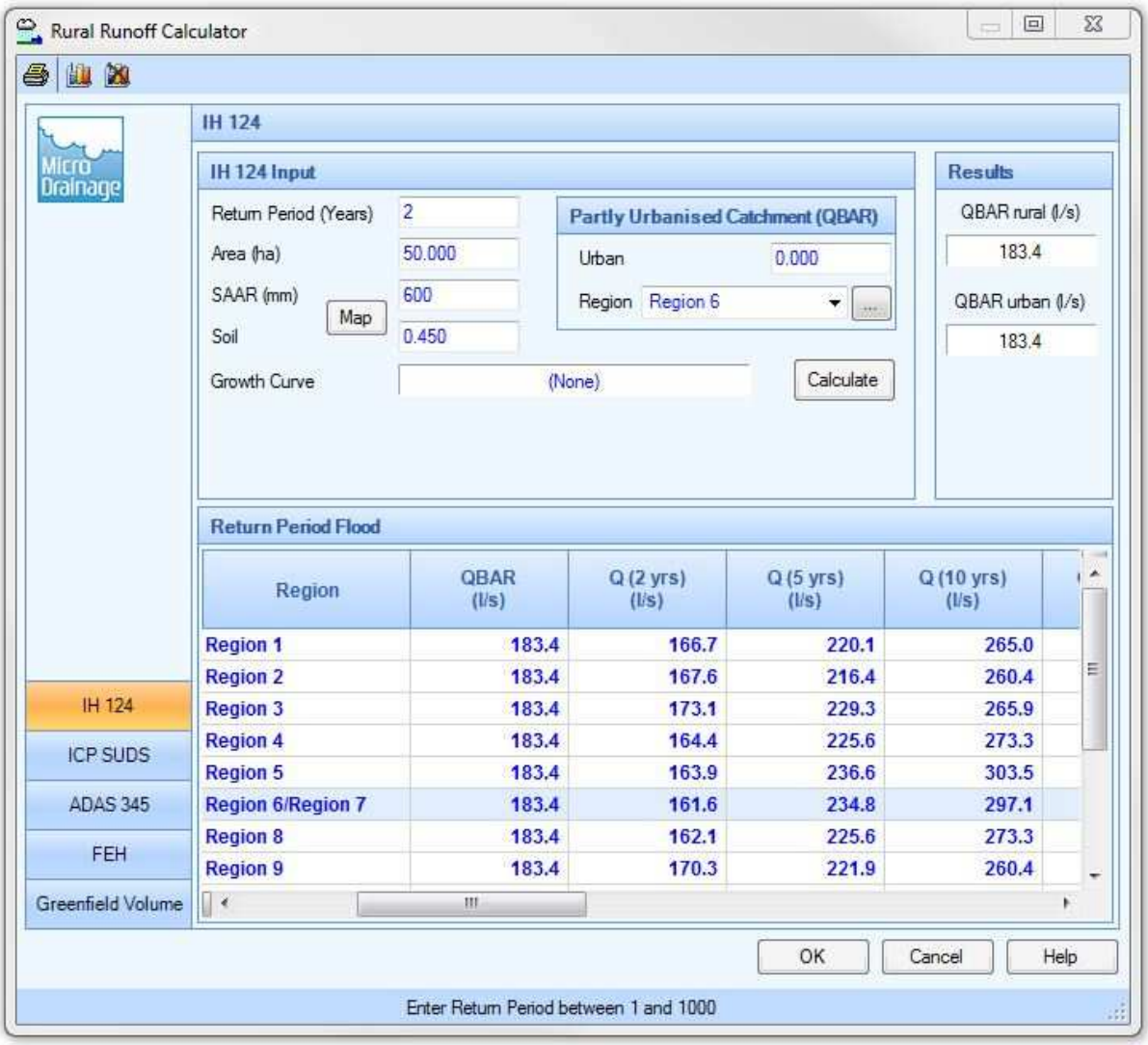
Pollution control to be provided by full retention separators in service yard areas. In addition a further bypass separator has been provided prior to final discharge from the site to cater for pollution that may arise from the main access road. All separators to be in accordance with BS EN 858-1.

Foul water drainage strategy

The foul water flows are collected by a gravity system and discharge off-site via existing Thames Water manhole 2908 in Nestles Avenue subject to a Section 106 Agreement (indirect connection) with Thames Water.

CS/075666 – Former Nestle site, Hayes

Rural runoff calculation – 1 in 2 year return period



Region	QBAR (l/s)	Q (2 yrs) (l/s)	Q (5 yrs) (l/s)	Q (10 yrs) (l/s)
Region 1	183.4	166.7	220.1	265.0
Region 2	183.4	167.6	216.4	260.4
Region 3	183.4	173.1	229.3	265.9
Region 4	183.4	164.4	225.6	273.3
Region 5	183.4	163.9	236.6	303.5
Region 6/Region 7	183.4	161.6	234.8	297.1
Region 8	183.4	162.1	225.6	273.3
Region 9	183.4	170.3	221.9	260.4

Site area = 5.175ha

Where the site is less than 50ha then the 50ha result for discharge is calculated and a pro-rata discharge linearly interpolated.

QBAR (1 in 2 years) = 161.6 l/sec for a 50ha site

5.175ha/50.000ha = 0.104

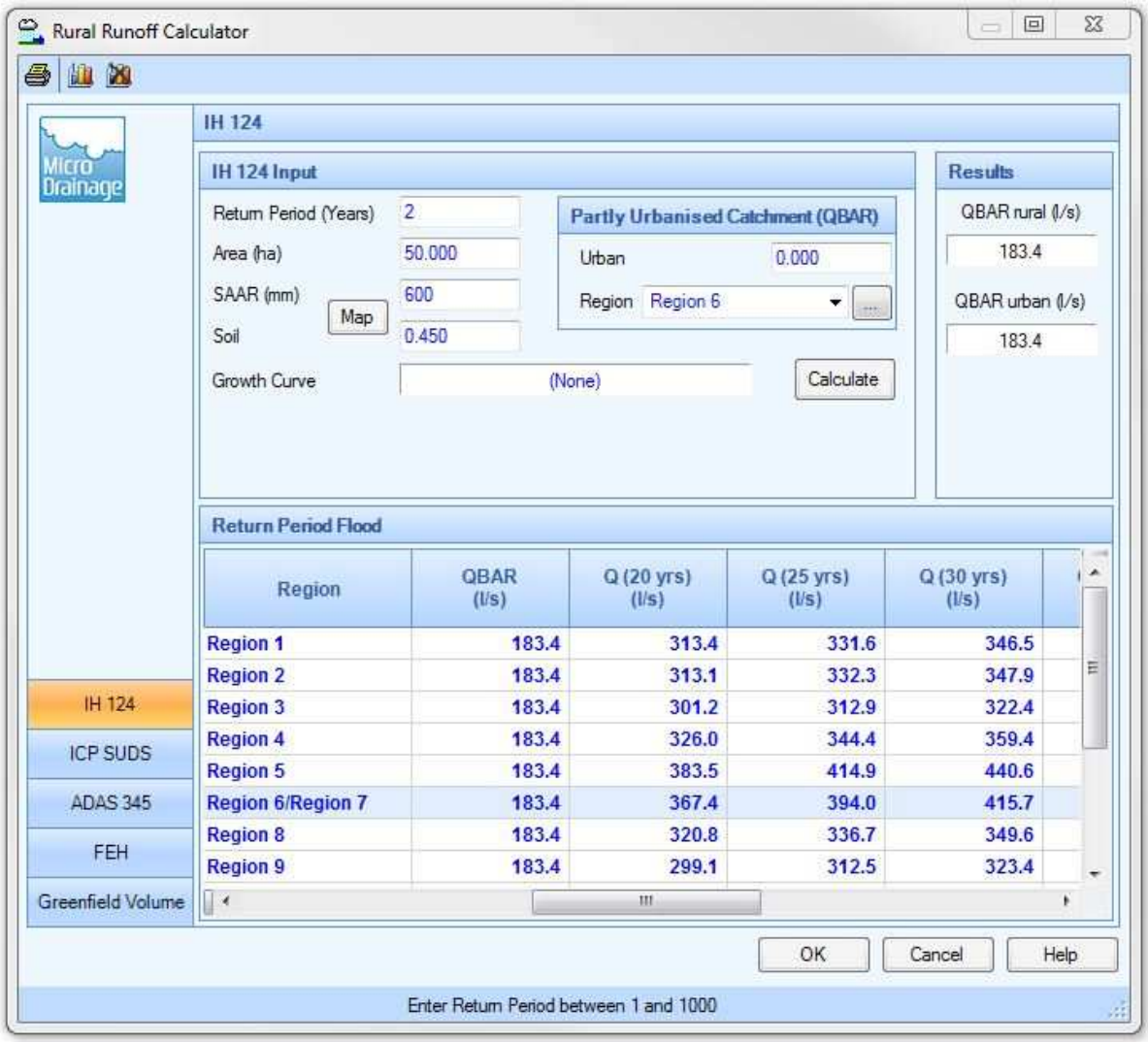
161.6 x 0.104 = 16.8 l/sec

16.8 l/sec/5.175ha = 3.25 l/sec/ha

Maximum site discharge = 3 x 16.8 = 50.4 say 50 l/sec or 9.66 l/sec/ha

CS/075666 – Former Nestle site, Hayes

Rural runoff calculation – 1 in 30 year return period



Region	QBAR (l/s)	Q (20 yrs) (l/s)	Q (25 yrs) (l/s)	Q (30 yrs) (l/s)
Region 1	183.4	313.4	331.6	346.5
Region 2	183.4	313.1	332.3	347.9
Region 3	183.4	301.2	312.9	322.4
Region 4	183.4	326.0	344.4	359.4
Region 5	183.4	383.5	414.9	440.6
Region 6/Region 7	183.4	367.4	394.0	415.7
Region 8	183.4	320.8	336.7	349.6
Region 9	183.4	299.1	312.5	323.4

Site area = 5.175ha

Where the site is less than 50ha then the 50ha result for discharge is calculated and a pro-rata discharge linearly interpolated.

QBAR (1 in 30 years) = 415.7 l/sec for a 50ha site

5.175ha/50.000ha = 0.104

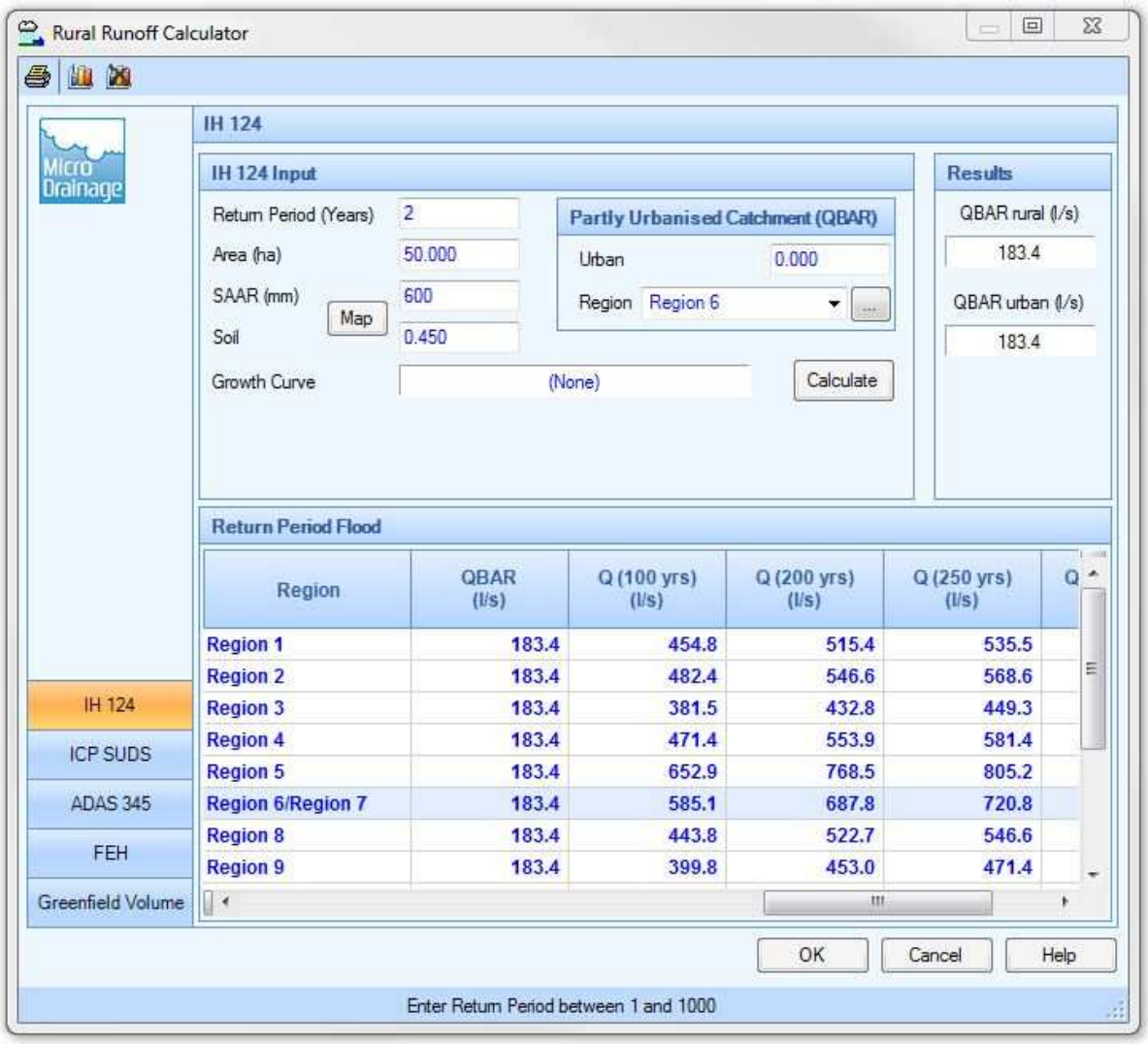
415.7 x 0.104 = 43.2 l/sec

43.2 l/sec/5.175ha = 8.35 l/sec/ha

Maximum site discharge = 3 x 43.2 = 129.6 say 129.5 l/sec or 25.02 l/sec/ha

CS/075666 – Former Nestle site, Hayes

Rural runoff calculation – 1 in 100 year return period



Region	QBAR (l/s)	Q (100 yrs) (l/s)	Q (200 yrs) (l/s)	Q (250 yrs) (l/s)
Region 1	183.4	454.8	515.4	535.5
Region 2	183.4	482.4	546.6	568.6
Region 3	183.4	381.5	432.8	449.3
Region 4	183.4	471.4	553.9	581.4
Region 5	183.4	652.9	768.5	805.2
Region 6/Region 7	183.4	585.1	687.8	720.8
Region 8	183.4	443.8	522.7	546.6
Region 9	183.4	399.8	453.0	471.4

Site area = 5.175ha

Where the site is less than 50ha then the 50ha result for discharge is calculated and a pro-rata discharge linearly interpolated.

QBAR (1 in 100 years) = 585.1 l/sec for a 50ha site

5.175ha/50.000ha = 0.104

585.1 x 0.104 = 60.85 l/sec

60.85 l/sec/5.175ha = 11.76 l/sec/ha

Maximum site discharge = 3 x 60.85 = 182.55 say 182.5 l/sec or 35.28 l/sec/ha

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web site: www.capita.co.uk

CS/075666 – Former Nestle Site, Hayes

Assessment of pre and post-development surface water runoff.

(by G. Males)

Total site area = approx. 5.175 ha or 51750m^2
(ref. MSA Architect's Site masterplan drawing 30680-FE-44 rev I)

From visual inspection of Greenhatch Group surveys drawing 20897-OGL-Rev 0 (dated October 2014) 95% of site is covered by hardstanding areas.

51750 x 95% = 49162m^2

Pre-development runoff

Ave. intensity for **1 in 1 year** return period (15min summer storm)
= 33.106 mm/hr

33.106 / 3600 = 0.0092 l/sec/m^2

0.0092 x 49162 = 452.290 say **452 l/sec**

Ave. intensity for **1 in 100 year +20%CC** return period (15min summer storm)
= 126.917 mm/hr

126.917 / 3600 = 0.0353 l/sec/m^2

0.0353 x 49162 = 1735.419 say **1735 l/sec**

Post-development runoff

In accordance with the London Plan (SPG part 3.4.10) runoff from previously developed sites should not be more than three times the calculated greenfield runoff (refer to separate sheets).

Allowable off-site discharge (1 in 2 years) = 5.175 ha x 9.66 l/sec/ha = 50 l/sec

Allowable off-site discharge (1 in 30 years) = 5.175 ha x 25.02 l/sec/ha = 129.5 l/sec

For hardstanding areas (1 in 2 years) 4.126 ha x 9.66 l/sec/ha = **40 l/sec**

For hardstanding areas (1 in 30 years) 4.126 ha x 25.02 l/sec/ha = **103 l/sec**

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For hardstanding areas (1 in 100 years) 4.126 ha x 35.28 l/sec/ha = **145 l/sec**

Attenuation

Maximimum flow off site = 110 l/sec (refer to separate calculations

110 / 1735 = 0.063

Therefore proposed surface water drainage strategy provides approximately **94% attenuation** for storms up to 1 in 100 year +20%%CC.

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.614	4-8	2.053	8-12	1.379	12-16	0.080

Total Area Contributing (ha) = 4.126

Total Pipe Volume (m^3) = 272.248

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	10.400	0.090	115.6	0.083	6.00	0.0	0.600	o	225
2.000	18.345	0.130	141.1	0.382	6.00	0.0	0.600	o	300
1.001	5.000	0.020	250.0	0.000	0.00	0.0	0.600	o	375
1.002	6.200	0.050	124.0	0.000	0.00	0.0	0.600	o	375
1.003	28.840	0.115	250.8	0.000	0.00	0.0	0.600	o	375
3.000	15.270	0.100	152.7	0.111	6.00	0.0	0.600	o	225
4.000	10.600	0.245	43.3	0.087	6.00	0.0	0.600	o	150
3.001	5.000	0.050	100.0	0.000	0.00	0.0	0.600	o	225
3.002	1.700	0.100	17.0	0.000	0.00	0.0	0.600	o	225
3.003	16.275	0.435	37.4	0.000	0.00	0.0	0.600	o	225
1.004	7.370	0.020	368.5	0.000	0.00	0.0	0.600	o	450
5.000	8.905	0.360	24.7	0.188	6.00	0.0	0.600	o	225
6.000	8.845	0.135	65.5	0.185	6.00	0.0	0.600	o	225

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	29.475	0.083	0.0	1.22	48.3
2.000	29.440	0.382	0.0	1.32	93.4
1.001	29.235	0.465	0.0	1.14	126.1
1.002	29.215	0.465	0.0	1.63	179.6
1.003	29.165	0.465	0.0	1.14	125.9
3.000	29.885	0.111	0.0	1.06	42.0
4.000	30.105	0.087	0.0	1.53	27.1
3.001	29.785	0.198	0.0	1.31	52.0
3.002	29.735	0.198	0.0	3.19	126.8
3.003	29.635	0.198	0.0	2.15	85.3
1.004	28.975	0.663	0.0	1.05	167.5
5.000	29.960	0.188	0.0	2.64	105.0
6.000	29.735	0.185	0.0	1.62	64.3

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.005	24.790	0.390	63.6	0.445	0.00	0.0	0.600	o	300
7.000	28.925	0.290	99.7	0.008	6.00	0.0	0.600	o	150
7.001	43.030	0.430	100.1	0.028	0.00	0.0	0.600	o	150
7.002	17.615	0.175	100.7	0.005	0.00	0.0	0.600	o	150
7.003	19.940	0.200	99.7	0.000	0.00	0.0	0.600	o	150
7.004	15.795	0.245	64.5	0.020	0.00	0.0	0.600	o	150
8.000	13.810	0.140	98.6	0.011	6.00	0.0	0.600	o	150
8.001	19.215	0.190	101.1	0.000	0.00	0.0	0.600	o	150
8.002	29.465	0.295	99.9	0.017	0.00	0.0	0.600	o	150
8.003	16.420	0.165	99.5	0.000	0.00	0.0	0.600	o	150
8.004	18.340	0.375	48.9	0.016	0.00	0.0	0.600	o	150
9.000	9.875	0.125	79.0	0.030	6.00	0.0	0.600	o	150
10.000	9.820	0.065	151.1	0.138	6.00	0.0	0.600	o	225
9.001	16.470	0.130	126.7	0.000	0.00	0.0	0.600	o	225
9.002	4.640	0.050	92.8	0.000	0.00	0.0	0.600	o	225
9.003	5.735	0.045	127.4	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.005	28.500	1.481	0.0	1.98	139.6
7.000	29.525	0.008	0.0	1.01	17.8
7.001	29.235	0.036	0.0	1.00	17.8
7.002	28.805	0.041	0.0	1.00	17.7
7.003	28.630	0.041	0.0	1.01	17.8
7.004	28.430	0.061	0.0	1.25	22.2
8.000	29.350	0.011	0.0	1.01	17.9
8.001	29.210	0.011	0.0	1.00	17.7
8.002	29.020	0.028	0.0	1.01	17.8
8.003	28.725	0.028	0.0	1.01	17.8
8.004	28.560	0.044	0.0	1.44	25.5
9.000	29.400	0.030	0.0	1.13	20.0
10.000	29.265	0.138	0.0	1.06	42.2
9.001	29.200	0.168	0.0	1.16	46.1
9.002	29.070	0.168	0.0	1.36	54.0
9.003	29.020	0.168	0.0	1.16	46.0

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
11.000	40.400	0.270	149.6	0.178	6.00	0.0	0.600	o	225
11.001	16.960	0.135	125.6	0.201	0.00	0.0	0.600	o	300
9.004	21.055	0.140	150.4	0.000	0.00	0.0	0.600	o	225
1.006	60.000	0.000	0.0	0.092	0.00	0.0	0.600	o	1000
1.007	61.925	0.000	0.0	0.044	0.00	0.0	0.600	o	1000
1.008	80.780	0.000	0.0	0.102	0.00	0.0	0.600	o	1000
1.009	25.540	0.000	0.0	0.000	0.00	0.0	0.600	o	1000
12.000	12.495	0.125	100.0	0.028	6.00	0.0	0.600	o	150
13.000	8.740	0.065	134.5	0.150	6.00	0.0	0.600	o	225
12.001	5.955	0.050	119.1	0.000	0.00	0.0	0.600	o	225
12.002	4.640	0.050	92.8	0.000	0.00	0.0	0.600	o	225
12.003	6.365	0.050	127.3	0.000	0.00	0.0	0.600	o	225
12.004	11.645	0.095	122.6	0.000	0.00	0.0	0.600	o	225
12.005	47.635	0.240	198.5	0.103	0.00	0.0	0.600	o	300
14.000	11.050	0.140	78.9	0.069	6.00	0.0	0.600	o	150
14.001	8.275	0.105	78.8	0.000	0.00	0.0	0.600	o	150

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
11.000	29.625	0.178	0.0	1.07	42.4
11.001	29.280	0.379	0.0	1.40	99.1
9.004	28.250	0.547	0.0	1.06	42.3
1.006	27.335	2.225	0.0	0.00	0.0
1.007	27.335	2.269	0.0	0.00	0.0
1.008	27.335	2.371	0.0	0.00	0.0
1.009	27.335	2.371	0.0	0.00	0.0
12.000	29.400	0.028	0.0	1.01	17.8
13.000	29.265	0.150	0.0	1.13	44.8
12.001	29.200	0.178	0.0	1.20	47.6
12.002	29.150	0.178	0.0	1.36	54.0
12.003	29.100	0.178	0.0	1.16	46.0
12.004	29.050	0.178	0.0	1.18	46.9
12.005	28.880	0.281	0.0	1.11	78.6
14.000	29.115	0.069	0.0	1.13	20.0
14.001	28.975	0.069	0.0	1.13	20.0

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
12.006	20.850	0.140	148.9	0.103	0.00	0.0	0.600	o	225
15.000	10.840	0.110	98.5	0.064	6.00	0.0	0.600	o	150
16.000	10.720	0.225	47.6	0.219	6.00	0.0	0.600	o	225
15.001	2.855	0.015	190.3	0.000	0.00	0.0	0.600	o	300
15.002	6.850	0.050	137.0	0.000	0.00	0.0	0.600	o	300
15.003	2.715	0.015	181.0	0.000	0.00	0.0	0.600	o	300
17.000	9.065	0.090	100.7	0.095	6.00	0.0	0.600	o	225
17.001	4.225	0.050	84.5	0.000	0.00	0.0	0.600	o	225
18.000	19.400	0.130	149.2	0.159	6.00	0.0	0.600	o	225
19.000	9.145	0.160	57.2	0.063	6.00	0.0	0.600	o	150
18.001	36.340	0.165	220.2	0.342	0.00	0.0	0.600	o	375
18.002	26.335	0.120	219.5	0.000	0.00	0.0	0.600	o	375
18.003	6.800	0.070	97.1	0.171	0.00	0.0	0.600	o	375

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
12.006	28.250	0.453	0.0	1.07	42.5
15.000	28.425	0.064	0.0	1.01	17.9
16.000	28.465	0.219	0.0	1.90	75.5
15.001	28.165	0.283	0.0	1.14	80.3
15.002	28.150	0.283	0.0	1.34	94.8
15.003	28.100	0.283	0.0	1.17	82.4
17.000	28.515	0.095	0.0	1.30	51.8
17.001	28.425	0.095	0.0	1.42	56.6
18.000	28.720	0.159	0.0	1.07	42.5
19.000	28.825	0.063	0.0	1.33	23.6
18.001	28.440	0.564	0.0	1.22	134.4
18.002	28.275	0.564	0.0	1.22	134.6
18.003	28.155	0.735	0.0	1.84	203.1

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
15.004	15.480	0.115	134.6	0.000	0.00	0.0	0.600	o	225
1.010	55.650	0.000	0.0	0.113	0.00	0.0	0.600	o	1000
1.011	28.380	0.055	516.0	0.076	0.00	0.0	0.600	o	600
1.012	7.045	0.015	469.7	0.000	0.00	0.0	0.600	o	450
1.013	5.250	0.100	52.5	0.000	0.00	0.0	0.600	o	450
1.014	7.105	0.015	473.7	0.000	0.00	0.0	0.600	o	450

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
15.004	27.450	1.113	0.0	1.13	44.7
1.010	27.335	4.050	0.0	0.00	0.0
1.011	27.335	4.126	0.0	1.07	301.2
1.012	27.280	4.126	0.0	0.93	148.1
1.013	27.265	4.126	0.0	2.81	447.1
1.014	27.165	4.126	0.0	0.93	147.5

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SP	29.925	0.450	Open Manhole	600 x 600	1.000	29.475	225				
SP	30.490	1.050	Open Manhole	600 x 600	2.000	29.440	300				
S46	31.075	1.840	Open Manhole	1500	1.001	29.235	375	1.000	29.385	225	
								2.000	29.310	300	
PI IN	31.075	1.860	Open Manhole	1500	1.002	29.215	375	1.001	29.215	375	
PI OUT	31.075	1.910	Open Manhole	1500	1.003	29.165	375	1.002	29.165	375	
SP	30.860	0.975	Open Manhole	600 x 600	3.000	29.885	225				
SP	31.005	0.900	Open Manhole	600 x 600	4.000	30.105	150				
S44	31.120	1.335	Open Manhole	1200	3.001	29.785	225	3.000	29.785	225	
								4.000	29.860	150	
PI IN	31.125	1.390	Open Manhole	1200	3.002	29.735	225	3.001	29.735	225	
PI OUT	31.125	1.490	Open Manhole	1200	3.003	29.635	225	3.002	29.635	225	
S45	31.145	2.170	Open Manhole	1500	1.004	28.975	450	1.003	29.050	375	
								3.003	29.200	225	
S43	31.185	1.225	Open Manhole	1200	5.000	29.960	225				
S41	30.960	1.225	Open Manhole	1200	6.000	29.735	225				
S42	30.980	2.480	Open Manhole	2100	1.005	28.500	300	1.004	28.955	450	605
								5.000	29.600	225	1025
								6.000	29.600	225	1025
S101	30.425	0.900	Open Manhole	600	7.000	29.525	150				
S102	30.410	1.175	Open Manhole	600	7.001	29.235	150	7.000	29.235	150	
S103	30.325	1.520	Open Manhole	600	7.002	28.805	150	7.001	28.805	150	
S104	30.350	1.720	Open Manhole	600	7.003	28.630	150	7.002	28.630	150	
S105	30.400	1.970	Open Manhole	600	7.004	28.430	150	7.003	28.430	150	
S106	30.250	0.900	Open Manhole	600	8.000	29.350	150				
S107	30.375	1.165	Open Manhole	600	8.001	29.210	150	8.000	29.210	150	
S108	30.375	1.355	Open Manhole	600	8.002	29.020	150	8.001	29.020	150	
S109	30.475	1.750	Open Manhole	600	8.003	28.725	150	8.002	28.725	150	
S110	30.485	1.925	Open Manhole	600	8.004	28.560	150	8.003	28.560	150	
SP	29.675	0.275	Open Manhole	600 x 600	9.000	29.400	150				
SP	30.240	0.975	Open Manhole	600 x 600	10.000	29.265	225				
S34	30.630	1.430	Open Manhole	1200	9.001	29.200	225	9.000	29.275	150	
								10.000	29.200	225	
PI IN	30.850	1.780	Open Manhole	1200	9.002	29.070	225	9.001	29.070	225	
PI OUT	30.850	1.830	Open Manhole	1200	9.003	29.020	225	9.002	29.020	225	
S31	30.850	1.225	Open Manhole	1200	11.000	29.625	225				
S32	30.850	1.570	Open Manhole	1500	11.001	29.280	300	11.000	29.355	225	
S33	30.990	2.740	Open Manhole	2100	9.004	28.250	225	9.003	28.975	225	725

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
								11.001	29.145	300	970
S1	30.945	3.610	Open Manhole	2100	1.006	27.335	1000	1.005	28.110	300	75
								7.004	28.185	150	
								8.004	28.185	150	
								9.004	28.110	225	
S2	30.820	3.485	Open Manhole	2100	1.007	27.335	1000	1.006	27.335	1000	
S3	30.280	2.945	Open Manhole	2100	1.008	27.335	1000	1.007	27.335	1000	
S4	30.090	2.755	Open Manhole	2100	1.009	27.335	1000	1.008	27.335	1000	
SP	29.675	0.275	Open Manhole	600 x 600	12.000	29.400	150				
SP	30.240	0.975	Open Manhole	600 x 600	13.000	29.265	225				
S23	30.505	1.305	Open Manhole	1200	12.001	29.200	225	12.000	29.275	150	
								13.000	29.200	225	
PI IN	30.700	1.550	Open Manhole	1200	12.002	29.150	225	12.001	29.150	225	
PI OUT	30.700	1.600	Open Manhole	1200	12.003	29.100	225	12.002	29.100	225	
S24	30.600	1.550	Open Manhole	1200	12.004	29.050	225	12.003	29.050	225	
S25	30.655	1.775	Open Manhole	1500	12.005	28.880	300	12.004	28.955	225	
SP	30.015	0.900	Open Manhole	600 x 600	14.000	29.115	150				
S21	30.330	1.355	Open Manhole	1200	14.001	28.975	150	14.000	28.975	150	
S22	30.595	2.345	Open Manhole	2100	12.006	28.250	225	12.005	28.640	300	465
								14.001	28.870	150	545
SP	28.875	0.450	Open Manhole	600 x 600	15.000	28.425	150				
SP	29.440	0.975	Open Manhole	600 x 600	16.000	28.465	225				
S17	29.830	1.665	Open Manhole	1500	15.001	28.165	300	15.000	28.315	150	
								16.000	28.240	225	
PI IN	29.830	1.680	Open Manhole	1500	15.002	28.150	300	15.001	28.150	300	
PI OUT	29.830	1.730	Open Manhole	1500	15.003	28.100	300	15.002	28.100	300	
SP	29.490	0.975	Open Manhole	600 x 600	17.000	28.515	225				
S16	29.770	1.345	Open Manhole	1200	17.001	28.425	225	17.000	28.425	225	
S11	29.945	1.225	Open Manhole	1200	18.000	28.720	225				
SP	29.725	0.900	Open Manhole	600 x 600	19.000	28.825	150				
S12	29.945	1.505	Open Manhole	1500	18.001	28.440	375	18.000	28.590	225	
								19.000	28.665	150	
S13	29.865	1.590	Open Manhole	1500	18.002	28.275	375	18.001	28.275	375	
S14	30.080	1.925	Open Manhole	1500	18.003	28.155	375	18.002	28.155	375	
S15	29.675	2.225	Open Manhole	2100	15.004	27.450	225	15.003	28.085	300	710
								17.001	28.375	225	925
								18.003	28.085	375	785
S5	29.940	2.605	Open Manhole	2100	1.010	27.335	1000	1.009	27.335	1000	

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
								12.006	28.110	225	
								15.004	27.335	225	
S6	29.045	1.710	Open Manhole	2100	1.011	27.335	600	1.010	27.335	1000	
S7	28.645	1.365	Open Manhole	1800	1.012	27.280	450	1.011	27.280	600	
PI IN	28.800	1.535	Open Manhole	1800	1.013	27.265	450	1.012	27.265	450	
PI OUT	28.800	1.635	Open Manhole	1800	1.014	27.165	450	1.013	27.165	450	
EX. SWMH	28.220	1.070	Open Manhole	1500		OUTFALL		1.014	27.150	450	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	SP	29.925	29.475	0.225	Open Manhole	600 x 600
2.000	o	300	SP	30.490	29.440	0.750	Open Manhole	600 x 600
1.001	o	375	S46	31.075	29.235	1.465	Open Manhole	1500
1.002	o	375	PI IN	31.075	29.215	1.485	Open Manhole	1500
1.003	o	375	PI OUT	31.075	29.165	1.535	Open Manhole	1500
3.000	o	225	SP	30.860	29.885	0.750	Open Manhole	600 x 600
4.000	o	150	SP	31.005	30.105	0.750	Open Manhole	600 x 600
3.001	o	225	S44	31.120	29.785	1.110	Open Manhole	1200
3.002	o	225	PI IN	31.125	29.735	1.165	Open Manhole	1200
3.003	o	225	PI OUT	31.125	29.635	1.265	Open Manhole	1200
1.004	o	450	S45	31.145	28.975	1.720	Open Manhole	1500
5.000	o	225	S43	31.185	29.960	1.000	Open Manhole	1200
6.000	o	225	S41	30.960	29.735	1.000	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	10.400	115.6	S46	31.075	29.385	1.465	Open Manhole	1500
2.000	18.345	141.1	S46	31.075	29.310	1.465	Open Manhole	1500
1.001	5.000	250.0	PI IN	31.075	29.215	1.485	Open Manhole	1500
1.002	6.200	124.0	PI OUT	31.075	29.165	1.535	Open Manhole	1500
1.003	28.840	250.8	S45	31.145	29.050	1.720	Open Manhole	1500
3.000	15.270	152.7	S44	31.120	29.785	1.110	Open Manhole	1200
4.000	10.600	43.3	S44	31.120	29.860	1.110	Open Manhole	1200
3.001	5.000	100.0	PI IN	31.125	29.735	1.165	Open Manhole	1200
3.002	1.700	17.0	PI OUT	31.125	29.635	1.265	Open Manhole	1200
3.003	16.275	37.4	S45	31.145	29.200	1.720	Open Manhole	1500
1.004	7.370	368.5	S42	30.980	28.955	1.575	Open Manhole	2100
5.000	8.905	24.7	S42	30.980	29.600	1.155	Open Manhole	2100
6.000	8.845	65.5	S42	30.980	29.600	1.155	Open Manhole	2100

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.005	o	300	S42	30.980	28.500	2.180	Open Manhole	2100
7.000	o	150	S101	30.425	29.525	0.750	Open Manhole	600
7.001	o	150	S102	30.410	29.235	1.025	Open Manhole	600
7.002	o	150	S103	30.325	28.805	1.370	Open Manhole	600
7.003	o	150	S104	30.350	28.630	1.570	Open Manhole	600
7.004	o	150	S105	30.400	28.430	1.820	Open Manhole	600
8.000	o	150	S106	30.250	29.350	0.750	Open Manhole	600
8.001	o	150	S107	30.375	29.210	1.015	Open Manhole	600
8.002	o	150	S108	30.375	29.020	1.205	Open Manhole	600
8.003	o	150	S109	30.475	28.725	1.600	Open Manhole	600
8.004	o	150	S110	30.485	28.560	1.775	Open Manhole	600
9.000	o	150	SP	29.675	29.400	0.125	Open Manhole	600 x 600
10.000	o	225	SP	30.240	29.265	0.750	Open Manhole	600 x 600
9.001	o	225	S34	30.630	29.200	1.205	Open Manhole	1200
9.002	o	225	PI IN	30.850	29.070	1.555	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.005	24.790	63.6	S1	30.945	28.110	2.535	Open Manhole	2100
7.000	28.925	99.7	S102	30.410	29.235	1.025	Open Manhole	600
7.001	43.030	100.1	S103	30.325	28.805	1.370	Open Manhole	600
7.002	17.615	100.7	S104	30.350	28.630	1.570	Open Manhole	600
7.003	19.940	99.7	S105	30.400	28.430	1.820	Open Manhole	600
7.004	15.795	64.5	S1	30.945	28.185	2.610	Open Manhole	2100
8.000	13.810	98.6	S107	30.375	29.210	1.015	Open Manhole	600
8.001	19.215	101.1	S108	30.375	29.020	1.205	Open Manhole	600
8.002	29.465	99.9	S109	30.475	28.725	1.600	Open Manhole	600
8.003	16.420	99.5	S110	30.485	28.560	1.775	Open Manhole	600
8.004	18.340	48.9	S1	30.945	28.185	2.610	Open Manhole	2100
9.000	9.875	79.0	S34	30.630	29.275	1.205	Open Manhole	1200
10.000	9.820	151.1	S34	30.630	29.200	1.205	Open Manhole	1200
9.001	16.470	126.7	PI IN	30.850	29.070	1.555	Open Manhole	1200
9.002	4.640	92.8	PI OUT	30.850	29.020	1.605	Open Manhole	1200

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.003	o	225	PI OUT	30.850	29.020	1.605	Open Manhole	1200
11.000	o	225	S31	30.850	29.625	1.000	Open Manhole	1200
11.001	o	300	S32	30.850	29.280	1.270	Open Manhole	1500
9.004	o	225	S33	30.990	28.250	2.515	Open Manhole	2100
1.006	o	1000	S1	30.945	27.335	2.610	Open Manhole	2100
1.007	o	1000	S2	30.820	27.335	2.485	Open Manhole	2100
1.008	o	1000	S3	30.280	27.335	1.945	Open Manhole	2100
1.009	o	1000	S4	30.090	27.335	1.755	Open Manhole	2100
12.000	o	150	SP	29.675	29.400	0.125	Open Manhole	600 x 600
13.000	o	225	SP	30.240	29.265	0.750	Open Manhole	600 x 600
12.001	o	225	S23	30.505	29.200	1.080	Open Manhole	1200
12.002	o	225	PI IN	30.700	29.150	1.325	Open Manhole	1200
12.003	o	225	PI OUT	30.700	29.100	1.375	Open Manhole	1200
12.004	o	225	S24	30.600	29.050	1.325	Open Manhole	1200
12.005	o	300	S25	30.655	28.880	1.475	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.003	5.735	127.4	S33	30.990	28.975	1.790	Open Manhole	2100
11.000	40.400	149.6	S32	30.850	29.355	1.270	Open Manhole	1500
11.001	16.960	125.6	S33	30.990	29.145	1.545	Open Manhole	2100
9.004	21.055	150.4	S1	30.945	28.110	2.610	Open Manhole	2100
1.006	60.000	0.0	S2	30.820	27.335	2.485	Open Manhole	2100
1.007	61.925	0.0	S3	30.280	27.335	1.945	Open Manhole	2100
1.008	80.780	0.0	S4	30.090	27.335	1.755	Open Manhole	2100
1.009	25.540	0.0	S5	29.940	27.335	1.605	Open Manhole	2100
12.000	12.495	100.0	S23	30.505	29.275	1.080	Open Manhole	1200
13.000	8.740	134.5	S23	30.505	29.200	1.080	Open Manhole	1200
12.001	5.955	119.1	PI IN	30.700	29.150	1.325	Open Manhole	1200
12.002	4.640	92.8	PI OUT	30.700	29.100	1.375	Open Manhole	1200
12.003	6.365	127.3	S24	30.600	29.050	1.325	Open Manhole	1200
12.004	11.645	122.6	S25	30.655	28.955	1.475	Open Manhole	1500
12.005	47.635	198.5	S22	30.595	28.640	1.655	Open Manhole	2100

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
14.000	o	150	SP	30.015	29.115	0.750	Open Manhole	600 x 600
14.001	o	150	S21	30.330	28.975	1.205	Open Manhole	1200
12.006	o	225	S22	30.595	28.250	2.120	Open Manhole	2100
15.000	o	150	SP	28.875	28.425	0.300	Open Manhole	600 x 600
16.000	o	225	SP	29.440	28.465	0.750	Open Manhole	600 x 600
15.001	o	300	S17	29.830	28.165	1.365	Open Manhole	1500
15.002	o	300	PI IN	29.830	28.150	1.380	Open Manhole	1500
15.003	o	300	PI OUT	29.830	28.100	1.430	Open Manhole	1500
17.000	o	225	SP	29.490	28.515	0.750	Open Manhole	600 x 600
17.001	o	225	S16	29.770	28.425	1.120	Open Manhole	1200
18.000	o	225	S11	29.945	28.720	1.000	Open Manhole	1200
19.000	o	150	SP	29.725	28.825	0.750	Open Manhole	600 x 600

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
14.000	11.050	78.9	S21	30.330	28.975	1.205	Open Manhole	1200
14.001	8.275	78.8	S22	30.595	28.870	1.575	Open Manhole	2100
12.006	20.850	148.9	S5	29.940	28.110	1.605	Open Manhole	2100
15.000	10.840	98.5	S17	29.830	28.315	1.365	Open Manhole	1500
16.000	10.720	47.6	S17	29.830	28.240	1.365	Open Manhole	1500
15.001	2.855	190.3	PI IN	29.830	28.150	1.380	Open Manhole	1500
15.002	6.850	137.0	PI OUT	29.830	28.100	1.430	Open Manhole	1500
15.003	2.715	181.0	S15	29.675	28.085	1.290	Open Manhole	2100
17.000	9.065	100.7	S16	29.770	28.425	1.120	Open Manhole	1200
17.001	4.225	84.5	S15	29.675	28.375	1.075	Open Manhole	2100
18.000	19.400	149.2	S12	29.945	28.590	1.130	Open Manhole	1500
19.000	9.145	57.2	S12	29.945	28.665	1.130	Open Manhole	1500

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
18.001	o	375	S12	29.945	28.440	1.130	Open Manhole	1500
18.002	o	375	S13	29.865	28.275	1.215	Open Manhole	1500
18.003	o	375	S14	30.080	28.155	1.550	Open Manhole	1500
15.004	o	225	S15	29.675	27.450	2.000	Open Manhole	2100
1.010	o	1000	S5	29.940	27.335	1.605	Open Manhole	2100
1.011	o	600	S6	29.045	27.335	1.110	Open Manhole	2100
1.012	o	450	S7	28.645	27.280	0.915	Open Manhole	1800
1.013	o	450	PI IN	28.800	27.265	1.085	Open Manhole	1800
1.014	o	450	PI OUT	28.800	27.165	1.185	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
18.001	36.340	220.2	S13	29.865	28.275	1.215	Open Manhole	1500
18.002	26.335	219.5	S14	30.080	28.155	1.550	Open Manhole	1500
18.003	6.800	97.1	S15	29.675	28.085	1.215	Open Manhole	2100
15.004	15.480	134.6	S5	29.940	27.335	2.380	Open Manhole	2100
1.010	55.650	0.0	S6	29.045	27.335	0.710	Open Manhole	2100
1.011	28.380	516.0	S7	28.645	27.280	0.765	Open Manhole	1800
1.012	7.045	469.7	PI IN	28.800	27.265	1.085	Open Manhole	1800
1.013	5.250	52.5	PI OUT	28.800	27.165	1.185	Open Manhole	1800
1.014	7.105	473.7	EX. SWMH	28.220	27.150	0.620	Open Manhole	1500

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.014	EX. SWMH	28.220	27.150	27.150	1500	0

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	3.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	5	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Storm Duration (mins)	30
Ratio R	0.438		

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Online Controls for Storm

Complex Manhole: S42, DS/PN: 1.005, Volume (m³): 10.1

Hydro-Brake Optimum®

Unit Reference	MD-SHE-0174-1450-0800-1450
Design Head (m)	0.800
Design Flow (l/s)	14.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	174
Invert Level (m)	28.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.800	14.4
Flush-Flo™	0.284	14.4
Kick-Flo®	0.586	12.4
Mean Flow over Head Range	-	12.0

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	6.2	1.200	17.4	3.000	27.0	7.000	40.6
0.200	14.1	1.400	18.7	3.500	29.1	7.500	42.0
0.300	14.3	1.600	20.0	4.000	31.0	8.000	43.4
0.400	14.1	1.800	21.1	4.500	32.8	8.500	44.5
0.500	13.6	2.000	22.2	5.000	34.5	9.000	45.8
0.600	12.5	2.200	23.3	5.500	36.2	9.500	47.0
0.800	14.4	2.400	24.3	6.000	37.7		
1.000	16.0	2.600	25.2	6.500	39.2		

Hydro-Brake Optimum®

Unit Reference	MD-SHE-0262-3700-0750-3700
Design Head (m)	0.750
Design Flow (l/s)	37.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	262
Invert Level (m)	29.300
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

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Hydro-Brake Optimum®

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.750	37.0
Flush-Flo™	0.378	36.9
Kick-Flo®	0.614	33.6
Mean Flow over Head Range	-	28.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.4	1.200	46.3	3.000	72.2	7.000	109.1
0.200	26.9	1.400	49.9	3.500	77.8	7.500	112.8
0.300	36.5	1.600	53.2	4.000	83.0	8.000	115.6
0.400	36.9	1.800	56.4	4.500	87.9	8.500	119.2
0.500	36.1	2.000	59.3	5.000	92.6	9.000	122.7
0.600	34.1	2.200	62.1	5.500	97.0	9.500	126.2
0.800	38.1	2.400	64.8	6.000	101.2		
1.000	42.4	2.600	67.4	6.500	105.2		

Complex Manhole: S33, DS/PN: 9.004, Volume (m³): 10.7

Hydro-Brake Optimum®

Unit Reference	MD-SHE-0113-5500-0800-5500
Design Head (m)	0.800
Design Flow (l/s)	5.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	113
Invert Level (m)	28.250
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	5.5
Flush-Flo™	0.240	5.4
Kick-Flo®	0.536	4.5
Mean Flow over Head Range	-	4.7

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

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Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.6	3.000	10.2	7.000	15.2
0.200	5.4	1.400	7.1	3.500	10.9	7.500	15.7
0.300	5.4	1.600	7.6	4.000	11.6	8.000	16.2
0.400	5.2	1.800	8.0	4.500	12.3	8.500	16.7
0.500	4.9	2.000	8.4	5.000	13.0	9.000	17.2
0.600	4.8	2.200	8.8	5.500	13.6	9.500	17.6
0.800	5.5	2.400	9.1	6.000	14.1		
1.000	6.1	2.600	9.5	6.500	14.7		

Hydro-Brake Optimum®

Unit Reference	MD-SHE-0169-1350-0750-1350
Design Head (m)	0.750
Design Flow (l/s)	13.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	169
Invert Level (m)	29.050
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.750	13.4
Flush-Flo™	0.274	13.4
Kick-Flo®	0.555	11.6
Mean Flow over Head Range	-	11.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.0	1.200	16.8	3.000	26.0	7.000	39.1
0.200	13.1	1.400	18.0	3.500	28.0	7.500	40.4
0.300	13.4	1.600	19.2	4.000	29.8	8.000	41.5
0.400	13.1	1.800	20.3	4.500	31.6	8.500	42.8
0.500	12.4	2.000	21.4	5.000	33.2	9.000	44.1
0.600	12.1	2.200	22.4	5.500	34.8	9.500	45.3
0.800	13.8	2.400	23.3	6.000	36.3		
1.000	15.4	2.600	24.2	6.500	37.7		

Complex Manhole: S22, DS/PN: 12.006, Volume (m^3): 11.5

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Hydro-Brake Optimum®

Unit Reference	MD-SHE-0103-4500-0800-4500
Design Head (m)	0.800
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	103
Invert Level (m)	28.250
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	4.5
Flush-Flo™	0.240	4.5
Kick-Flo®	0.530	3.7
Mean Flow over Head Range	-	3.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.5	1.200	5.4	3.000	8.3	7.000	12.4
0.200	4.4	1.400	5.8	3.500	8.9	7.500	12.8
0.300	4.4	1.600	6.2	4.000	9.5	8.000	13.2
0.400	4.3	1.800	6.5	4.500	10.1	8.500	13.6
0.500	3.9	2.000	6.9	5.000	10.6	9.000	14.0
0.600	3.9	2.200	7.2	5.500	11.1	9.500	14.4
0.800	4.5	2.400	7.5	6.000	11.5		
1.000	5.0	2.600	7.8	6.500	12.0		

Hydro-Brake Optimum®

Unit Reference	MD-SHE-0158-1150-0750-1150
Design Head (m)	0.750
Design Flow (l/s)	11.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	158
Invert Level (m)	29.050
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.750	11.4
Flush-Flo™	0.261	11.4
Kick-Flo®	0.547	9.9
Mean Flow over Head Range	-	9.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a

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Hydro-Brake Optimum®

Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.7	1.200	14.3	3.000	22.1	7.000	33.3
0.200	11.3	1.400	15.4	3.500	23.8	7.500	34.4
0.300	11.4	1.600	16.4	4.000	25.4	8.000	35.4
0.400	11.1	1.800	17.3	4.500	26.9	8.500	36.4
0.500	10.5	2.000	18.2	5.000	28.3	9.000	37.5
0.600	10.3	2.200	19.1	5.500	29.6	9.500	38.6
0.800	11.8	2.400	19.9	6.000	30.9		
1.000	13.1	2.600	20.7	6.500	32.1		

Complex Manhole: S15, DS/PN: 15.004, Volume (m³): 8.4

Hydro-Brake Optimum®

Unit Reference	MD-SHE-0155-1100-0800-1100
Design Head (m)	0.800
Design Flow (l/s)	11.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	155
Invert Level (m)	27.450
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	11.0
Flush-Flo™	0.266	10.9
Kick-Flo®	0.574	9.4
Mean Flow over Head Range	-	9.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	1.200	13.3	3.000	20.5	7.000	30.9
0.200	10.8	1.400	14.3	3.500	22.1	7.500	31.9
0.300	10.9	1.600	15.2	4.000	23.6	8.000	32.9
0.400	10.7	1.800	16.1	4.500	24.9	8.500	33.8
0.500	10.2	2.000	16.9	5.000	26.2	9.000	34.8
0.600	9.6	2.200	17.7	5.500	27.5	9.500	35.7
0.800	11.0	2.400	18.4	6.000	28.6		
1.000	12.2	2.600	19.2	6.500	29.8		

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Hydro-Brake Optimum®

Unit Reference	MD-SHE-0232-2800-0750-2800
Design Head (m)	0.750
Design Flow (l/s)	28.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	232
Invert Level (m)	28.250
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.750	27.8
Flush-Flo™	0.345	27.8
Kick-Flo®	0.595	24.9
Mean Flow over Head Range	-	22.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.7	1.200	34.8	3.000	54.2	7.000	81.9
0.200	23.3	1.400	37.5	3.500	58.4	7.500	84.7
0.300	27.7	1.600	40.0	4.000	62.3	8.000	86.8
0.400	27.6	1.800	42.4	4.500	66.0	8.500	89.5
0.500	26.8	2.000	44.6	5.000	69.5	9.000	92.2
0.600	25.0	2.200	46.7	5.500	72.8	9.500	94.7
0.800	28.7	2.400	48.7	6.000	75.9		
1.000	31.9	2.600	50.6	6.500	79.0		

Complex Manhole: S7, DS/PN: 1.012, Volume (m³): 10.9

Hydro-Brake Optimum®

Unit Reference	MD-SHE-0277-4100-0550-4100
Design Head (m)	0.550
Design Flow (l/s)	41.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	277
Invert Level (m)	27.280
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.550	40.9
Flush-Flo™	0.366	40.9

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Hydro-Brake Optimum®

Control Points	Head (m)	Flow (l/s)
Kick-Flo®	0.501	39.1
Mean Flow over Head Range	-	28.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.7	1.200	59.6	3.000	93.0	7.000	139.6
0.200	28.5	1.400	64.2	3.500	100.2	7.500	144.6
0.300	40.4	1.600	68.5	4.000	107.0	8.000	149.5
0.400	40.8	1.800	72.5	4.500	113.3	8.500	154.2
0.500	39.1	2.000	76.3	5.000	119.3	9.000	158.7
0.600	42.7	2.200	79.9	5.500	125.0	9.500	163.1
0.800	49.0	2.400	83.4	6.000	129.1		
1.000	54.6	2.600	86.7	6.500	134.5		

Orifice

Diameter (m) 0.287 Discharge Coefficient 0.600 Invert Level (m) 27.830

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Storage Structures for Storm

Cellular Storage Manhole: S42, DS/PN: 1.005

Invert Level (m) 28.500 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.68
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	563.2	563.2	1.300	563.2	686.6
0.100	563.2	572.7	1.400	563.2	696.1
0.200	563.2	582.2	1.500	563.2	705.6
0.300	563.2	591.7	1.550	563.2	710.3
0.400	563.2	601.2	1.551	0.0	710.4
0.500	563.2	610.7	1.800	0.0	710.4
0.600	563.2	620.2	1.900	0.0	710.4
0.700	563.2	629.6	2.000	0.0	710.4
0.800	563.2	639.1	2.100	0.0	710.4
0.900	563.2	648.6	2.200	0.0	710.4
1.000	563.2	658.1	2.300	0.0	710.4
1.100	563.2	667.6	2.400	0.0	710.4
1.200	563.2	677.1	2.500	0.0	710.4

Cellular Storage Manhole: S33, DS/PN: 9.004

Invert Level (m) 28.250 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.69
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	210.8	210.8	1.300	210.8	286.3
0.100	210.8	216.6	1.400	210.8	292.1
0.200	210.8	222.4	1.500	210.8	297.9
0.300	210.8	228.2	1.550	210.8	300.8
0.400	210.8	234.0	1.551	0.0	300.8
0.500	210.8	239.8	1.800	0.0	300.8
0.600	210.8	245.6	1.900	0.0	300.8
0.700	210.8	251.5	2.000	0.0	300.8
0.800	210.8	257.3	2.100	0.0	300.8
0.900	210.8	263.1	2.200	0.0	300.8
1.000	210.8	268.9	2.300	0.0	300.8
1.100	210.8	274.7	2.400	0.0	300.8
1.200	210.8	280.5	2.500	0.0	300.8

Cellular Storage Manhole: S22, DS/PN: 12.006

Invert Level (m) 28.250 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.68
Infiltration Coefficient Side (m/hr) 0.00000

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Cellular Storage Manhole: S22, DS/PN: 12.006

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	166.4	166.4	1.300	166.4	233.5
0.100	166.4	171.6	1.400	166.4	238.6
0.200	166.4	176.7	1.500	166.4	243.8
0.300	166.4	181.9	1.550	166.4	246.4
0.400	166.4	187.0	1.551	0.0	246.4
0.500	166.4	192.2	1.800	0.0	246.4
0.600	166.4	197.4	1.900	0.0	246.4
0.700	166.4	202.5	2.000	0.0	246.4
0.800	166.4	207.7	2.100	0.0	246.4
0.900	166.4	212.8	2.200	0.0	246.4
1.000	166.4	218.0	2.300	0.0	246.4
1.100	166.4	223.2	2.400	0.0	246.4
1.200	166.4	228.3	2.500	0.0	246.4

Cellular Storage Manhole: S15, DS/PN: 15.004

Invert Level (m) 27.450 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.69
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	393.6	393.6	1.300	393.6	496.8
0.100	393.6	401.5	1.400	393.6	504.7
0.200	393.6	409.5	1.500	393.6	512.6
0.300	393.6	417.4	1.550	393.6	516.6
0.400	393.6	425.3	1.551	0.0	516.6
0.500	393.6	433.3	1.800	0.0	516.6
0.600	393.6	441.2	1.900	0.0	516.6
0.700	393.6	449.2	2.000	0.0	516.6
0.800	393.6	457.1	2.100	0.0	516.6
0.900	393.6	465.0	2.200	0.0	516.6
1.000	393.6	473.0	2.300	0.0	516.6
1.100	393.6	480.9	2.400	0.0	516.6
1.200	393.6	488.8	2.500	0.0	516.6

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 3.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 4
Number of Online Controls 5 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.438
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 75.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SP	15 Winter	2	+0%	30/15 Summer	30/15 Winter		
2.000	SP	15 Winter	2	+0%	30/15 Summer	100/15 Summer		
1.001	S46	15 Winter	2	+0%	30/15 Summer			
1.002	PI IN	15 Winter	2	+0%	30/15 Summer			
1.003	PI OUT	15 Winter	2	+0%	30/15 Summer			
3.000	SP	15 Winter	2	+0%	30/15 Summer			
4.000	SP	15 Winter	2	+0%	30/15 Summer	100/15 Summer		
3.001	S44	15 Winter	2	+0%	2/15 Winter			
3.002	PI IN	15 Winter	2	+0%	30/15 Summer			
3.003	PI OUT	15 Winter	2	+0%	100/15 Summer			
1.004	S45	15 Winter	2	+0%	30/15 Summer			
5.000	S43	15 Winter	2	+0%	100/15 Summer			
6.000	S41	15 Winter	2	+0%	30/15 Summer			
1.005	S42	120 Winter	2	+0%	2/15 Winter			
7.000	S101	15 Winter	2	+0%				
7.001	S102	15 Winter	2	+0%	100/15 Summer			
7.002	S103	15 Winter	2	+0%	100/15 Summer			

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SP	29.592	-0.108	0.000	0.34		13.8	OK	10
2.000	SP	29.654	-0.086	0.000	0.83		67.2	OK	3
1.001	S46	29.571	-0.039	0.000	1.00		76.8	OK	
1.002	PI IN	29.511	-0.079	0.000	0.71		76.4	OK	
1.003	PI OUT	29.490	-0.050	0.000	0.67		74.1	OK	
3.000	SP	30.059	-0.051	0.000	0.49		18.1	OK	
4.000	SP	30.192	-0.063	0.000	0.64		15.5	OK	2
3.001	S44	30.026	0.016	0.000	1.00		31.5	SURCHARGED	
3.002	PI IN	29.875	-0.085	0.000	0.71		31.5	OK	
3.003	PI OUT	29.736	-0.124	0.000	0.42		31.5	OK	
1.004	S45	29.424	-0.001	0.000	1.06		102.5	OK	
5.000	S43	30.058	-0.127	0.000	0.40		33.4	OK	
6.000	S41	29.866	-0.094	0.000	0.64		32.9	OK	
1.005	S42	28.974	0.174	0.000	0.11		14.1	SURCHARGED	
7.000	S101	29.554	-0.121	0.000	0.08		1.4	OK	
7.001	S102	29.296	-0.089	0.000	0.34		5.8	OK	
7.002	S103	28.871	-0.084	0.000	0.40		6.5	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
7.003	S104	15 Winter	2	+0%	100/15 Summer			
7.004	S105	15 Winter	2	+0%	30/15 Winter			
8.000	S106	15 Winter	2	+0%				
8.001	S107	15 Winter	2	+0%				
8.002	S108	15 Winter	2	+0%				
8.003	S109	15 Winter	2	+0%				
8.004	S110	15 Winter	2	+0%				
9.000	SP	15 Winter	2	+0%	30/15 Summer	100/15 Summer		
10.000	SP	15 Winter	2	+0%	30/15 Summer			
9.001	S34	15 Winter	2	+0%	30/15 Summer			
9.002	PI IN	15 Winter	2	+0%	30/15 Summer			
9.003	PI OUT	15 Winter	2	+0%	30/15 Summer			
11.000	S31	15 Winter	2	+0%	30/15 Summer	100/15 Summer		
11.001	S32	15 Winter	2	+0%	30/15 Summer			
9.004	S33	120 Winter	2	+0%	2/15 Summer			
1.006	S1	240 Winter	2	+0%	100/30 Summer			
1.007	S2	240 Winter	2	+0%	100/30 Winter			
1.008	S3	240 Winter	2	+0%	100/30 Winter			
1.009	S4	240 Winter	2	+0%	100/30 Winter			
12.000	SP	15 Winter	2	+0%	30/15 Summer	100/15 Summer		
13.000	SP	15 Winter	2	+0%	30/15 Summer			
12.001	S23	15 Winter	2	+0%	30/15 Summer			
12.002	PI IN	15 Winter	2	+0%	30/15 Summer			
12.003	PI OUT	15 Winter	2	+0%	30/15 Summer			
12.004	S24	15 Winter	2	+0%	30/15 Summer			
12.005	S25	15 Winter	2	+0%	100/15 Summer			
14.000	SP	15 Winter	2	+0%	30/15 Summer			
14.001	S21	15 Winter	2	+0%	30/15 Summer			
12.006	S22	120 Winter	2	+0%	2/15 Summer			
15.000	SP	15 Winter	2	+0%	30/15 Summer	100/15 Summer		
16.000	SP	15 Winter	2	+0%	30/15 Summer			
15.001	S17	15 Winter	2	+0%	30/15 Summer			
15.002	PI IN	15 Winter	2	+0%	30/15 Summer			
15.003	PI OUT	15 Winter	2	+0%	30/15 Summer			
17.000	SP	15 Winter	2	+0%	100/15 Summer			
17.001	S16	15 Winter	2	+0%	100/15 Summer			
18.000	S11	15 Winter	2	+0%	30/15 Summer	100/15 Summer		
19.000	SP	15 Winter	2	+0%	30/15 Summer	100/15 Summer		
18.001	S12	15 Winter	2	+0%	30/15 Summer			
18.002	S13	15 Winter	2	+0%	30/15 Summer			
18.003	S14	15 Winter	2	+0%	30/15 Summer			
15.004	S15	180 Winter	2	+0%	2/15 Summer			
1.010	S5	240 Winter	2	+0%	100/60 Summer			
1.011	S6	240 Winter	2	+0%	30/120 Winter			
1.012	S7	240 Winter	2	+0%	30/30 Winter			
1.013	PI IN	240 Winter	2	+0%	100/120 Winter			
1.014	PI OUT	240 Winter	2	+0%				

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.003	S104	28.695	-0.085	0.000	0.39		6.6	OK	
7.004	S105	28.503	-0.077	0.000	0.46		9.5	OK	
8.000	S106	29.384	-0.116	0.000	0.12		2.0	OK	
8.001	S107	29.244	-0.116	0.000	0.12		1.9	OK	
8.002	S108	29.074	-0.096	0.000	0.27		4.6	OK	
8.003	S109	28.779	-0.096	0.000	0.28		4.6	OK	
8.004	S110	28.616	-0.094	0.000	0.30		7.1	OK	
9.000	SP	29.456	-0.094	0.000	0.30		5.3	OK	4
10.000	SP	29.404	-0.086	0.000	0.70		24.5	OK	
9.001	S34	29.343	-0.082	0.000	0.72		29.7	OK	
9.002	PI IN	29.243	-0.052	0.000	0.94		29.7	OK	
9.003	PI OUT	29.199	-0.046	0.000	1.00		29.7	OK	
11.000	S31	29.776	-0.074	0.000	0.76		30.8	OK	2
11.001	S32	29.474	-0.106	0.000	0.74		62.5	OK	
9.004	S33	28.705	0.230	0.000	0.14		5.4	SURCHARGED	
1.006	S1	27.795	-0.540	0.000	0.04		25.2	OK	
1.007	S2	27.778	-0.557	0.000	0.03		23.7	OK	
1.008	S3	27.760	-0.575	0.000	0.03		24.6	OK	
1.009	S4	27.739	-0.596	0.000	0.06		22.8	OK	
12.000	SP	29.457	-0.093	0.000	0.31		5.0	OK	4
13.000	SP	29.414	-0.076	0.000	0.73		26.3	OK	
12.001	S23	29.380	-0.045	0.000	0.99		31.0	OK	
12.002	PI IN	29.329	-0.046	0.000	0.99		31.3	OK	
12.003	PI OUT	29.279	-0.046	0.000	0.99		31.3	OK	
12.004	S24	29.201	-0.074	0.000	0.78		31.2	OK	
12.005	S25	29.053	-0.127	0.000	0.62		45.9	OK	
14.000	SP	29.206	-0.059	0.000	0.68		12.3	OK	
14.001	S21	29.068	-0.057	0.000	0.70		12.3	OK	
12.006	S22	28.721	0.246	0.000	0.11		4.4	SURCHARGED	
15.000	SP	28.518	-0.057	0.000	0.70		11.3	OK	21
16.000	SP	28.593	-0.097	0.000	0.61		38.9	OK	
15.001	S17	28.401	-0.064	0.000	0.97		49.9	OK	
15.002	PI IN	28.361	-0.089	0.000	0.81		49.9	OK	
15.003	PI OUT	28.334	-0.066	0.000	0.96		50.1	OK	
17.000	SP	28.614	-0.126	0.000	0.40		16.9	OK	
17.001	S16	28.543	-0.107	0.000	0.54		16.9	OK	
18.000	S11	28.864	-0.081	0.000	0.73		28.1	OK	4
19.000	SP	28.904	-0.071	0.000	0.54		11.2	OK	4
18.001	S12	28.689	-0.126	0.000	0.76		92.4	OK	
18.002	S13	28.562	-0.088	0.000	0.74		87.0	OK	
18.003	S14	28.502	-0.028	0.000	1.00		107.2	OK	
15.004	S15	27.980	0.305	0.000	0.28		10.9	SURCHARGED	
1.010	S5	27.734	-0.601	0.000	0.06		39.4	OK	
1.011	S6	27.713	-0.222	0.000	0.16		40.0	OK	
1.012	S7	27.682	-0.048	0.000	0.40		39.9	OK	
1.013	PI IN	27.409	-0.306	0.000	0.22		39.9	OK	
1.014	PI OUT	27.363	-0.252	0.000	0.40		39.9	OK	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 3.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 4
Number of Online Controls 5 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.438
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 75.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SP	15 Winter	30	+0%	30/15 Summer	30/15 Winter		
2.000	SP	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
1.001	S46	15 Winter	30	+0%	30/15 Summer			
1.002	PI IN	15 Winter	30	+0%	30/15 Summer			
1.003	PI OUT	15 Winter	30	+0%	30/15 Summer			
3.000	SP	15 Winter	30	+0%	30/15 Summer			
4.000	SP	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
3.001	S44	15 Winter	30	+0%	2/15 Winter			
3.002	PI IN	15 Winter	30	+0%	30/15 Summer			
3.003	PI OUT	15 Winter	30	+0%	100/15 Summer			
1.004	S45	15 Winter	30	+0%	30/15 Summer			
5.000	S43	15 Winter	30	+0%	100/15 Summer			
6.000	S41	15 Winter	30	+0%	30/15 Summer			
1.005	S42	180 Winter	30	+0%	2/15 Winter			
7.000	S101	15 Winter	30	+0%				
7.001	S102	15 Winter	30	+0%	100/15 Summer			
7.002	S103	15 Winter	30	+0%	100/15 Summer			

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SP	29.925	0.225	0.092	0.62		24.9	FLOOD	10
2.000	SP	30.114	0.374	0.000	1.38		111.3	SURCHARGED	3
1.001	S46	29.869	0.259	0.000	1.68		129.4	SURCHARGED	
1.002	PI IN	29.759	0.169	0.000	1.20		129.1	SURCHARGED	
1.003	PI OUT	29.650	0.110	0.000	1.16		128.2	SURCHARGED	
3.000	SP	30.297	0.187	0.000	0.91		33.8	SURCHARGED	
4.000	SP	30.494	0.239	0.000	1.07		26.0	SURCHARGED	2
3.001	S44	30.209	0.199	0.000	1.88		59.3	SURCHARGED	
3.002	PI IN	30.027	0.067	0.000	1.33		59.1	SURCHARGED	
3.003	PI OUT	29.786	-0.074	0.000	0.79		59.4	OK	
1.004	S45	29.494	0.069	0.000	1.94		187.3	SURCHARGED	
5.000	S43	30.106	-0.079	0.000	0.75		63.5	OK	
6.000	S41	30.011	0.051	0.000	1.19		61.7	SURCHARGED	
1.005	S42	29.429	0.629	0.000	0.23		28.7	SURCHARGED	
7.000	S101	29.565	-0.110	0.000	0.16		2.7	OK	
7.001	S102	29.336	-0.049	0.000	0.75		12.9	OK	
7.002	S103	28.917	-0.038	0.000	0.90		14.8	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
7.003	S104	15 Winter	30	+0%	100/15 Summer			
7.004	S105	15 Winter	30	+0%	30/15 Winter			
8.000	S106	15 Winter	30	+0%				
8.001	S107	15 Winter	30	+0%				
8.002	S108	15 Winter	30	+0%				
8.003	S109	15 Winter	30	+0%				
8.004	S110	15 Winter	30	+0%				
9.000	SP	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
10.000	SP	15 Winter	30	+0%	30/15 Summer			
9.001	S34	15 Winter	30	+0%	30/15 Summer			
9.002	PI IN	15 Winter	30	+0%	30/15 Summer			
9.003	PI OUT	15 Winter	30	+0%	30/15 Summer			
11.000	S31	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
11.001	S32	15 Winter	30	+0%	30/15 Summer			
9.004	S33	180 Winter	30	+0%	2/15 Summer			
1.006	S1	180 Winter	30	+0%	100/30 Summer			
1.007	S2	180 Winter	30	+0%	100/30 Winter			
1.008	S3	180 Winter	30	+0%	100/30 Winter			
1.009	S4	180 Winter	30	+0%	100/30 Winter			
12.000	SP	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
13.000	SP	15 Winter	30	+0%	30/15 Summer			
12.001	S23	15 Winter	30	+0%	30/15 Summer			
12.002	PI IN	15 Winter	30	+0%	30/15 Summer			
12.003	PI OUT	15 Winter	30	+0%	30/15 Summer			
12.004	S24	15 Winter	30	+0%	30/15 Summer			
12.005	S25	15 Winter	30	+0%	100/15 Summer			
14.000	SP	15 Winter	30	+0%	30/15 Summer			
14.001	S21	15 Winter	30	+0%	30/15 Summer			
12.006	S22	180 Winter	30	+0%	2/15 Summer			
15.000	SP	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
16.000	SP	15 Winter	30	+0%	30/15 Summer			
15.001	S17	15 Winter	30	+0%	30/15 Summer			
15.002	PI IN	15 Winter	30	+0%	30/15 Summer			
15.003	PI OUT	180 Winter	30	+0%	30/15 Summer			
17.000	SP	15 Winter	30	+0%	100/15 Summer			
17.001	S16	15 Winter	30	+0%	100/15 Summer			
18.000	S11	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
19.000	SP	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
18.001	S12	15 Winter	30	+0%	30/15 Summer			
18.002	S13	15 Winter	30	+0%	30/15 Summer			
18.003	S14	15 Winter	30	+0%	30/15 Summer			
15.004	S15	180 Winter	30	+0%	2/15 Summer			
1.010	S5	180 Winter	30	+0%	100/60 Summer			
1.011	S6	180 Winter	30	+0%	30/120 Winter			
1.012	S7	180 Winter	30	+0%	30/30 Winter			
1.013	PI IN	180 Winter	30	+0%	100/120 Winter			
1.014	PI OUT	180 Winter	30	+0%				

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.003	S104	28.739	-0.041	0.000	0.88		14.6	OK	
7.004	S105	28.588	0.008	0.000	1.01		20.7	SURCHARGED	
8.000	S106	29.398	-0.102	0.000	0.23		3.7	OK	
8.001	S107	29.258	-0.102	0.000	0.22		3.7	OK	
8.002	S108	29.104	-0.066	0.000	0.58		9.8	OK	
8.003	S109	28.810	-0.065	0.000	0.60		9.9	OK	
8.004	S110	28.651	-0.059	0.000	0.65		15.5	OK	
9.000	SP	29.639	0.089	0.000	0.58		10.4	FLOOD RISK	4
10.000	SP	29.698	0.208	0.000	1.18		41.5	SURCHARGED	
9.001	S34	29.610	0.185	0.000	1.17		47.9	SURCHARGED	
9.002	PI IN	29.425	0.130	0.000	1.53		48.2	SURCHARGED	
9.003	PI OUT	29.306	0.061	0.000	1.61		48.3	SURCHARGED	
11.000	S31	30.191	0.341	0.000	1.39		56.0	SURCHARGED	2
11.001	S32	29.711	0.131	0.000	1.41		119.2	SURCHARGED	
9.004	S33	29.151	0.676	0.000	0.30		11.4	SURCHARGED	
1.006	S1	28.335	0.000	0.000	0.06		43.4	OK	
1.007	S2	28.305	-0.030	0.000	0.06		38.7	OK	
1.008	S3	28.204	-0.131	0.000	0.05		34.9	OK	
1.009	S4	28.129	-0.206	0.000	0.08		30.8	OK	
12.000	SP	29.671	0.121	0.000	0.82		13.3	FLOOD RISK	4
13.000	SP	29.770	0.280	0.000	1.25		44.8	SURCHARGED	
12.001	S23	29.662	0.237	0.000	1.53		48.2	SURCHARGED	
12.002	PI IN	29.545	0.170	0.000	1.52		47.9	SURCHARGED	
12.003	PI OUT	29.429	0.104	0.000	1.53		48.2	SURCHARGED	
12.004	S24	29.312	0.037	0.000	1.21		48.4	SURCHARGED	
12.005	S25	29.180	0.000	0.000	1.00		74.0	OK	
14.000	SP	29.384	0.119	0.000	1.21		21.8	SURCHARGED	
14.001	S21	29.176	0.051	0.000	1.24		21.6	SURCHARGED	
12.006	S22	29.142	0.667	0.000	0.25		9.6	SURCHARGED	
15.000	SP	28.828	0.253	0.000	1.12		18.0	FLOOD RISK	21
16.000	SP	28.937	0.247	0.000	1.03		65.8	SURCHARGED	
15.001	S17	28.696	0.231	0.000	1.59		82.0	SURCHARGED	
15.002	PI IN	28.587	0.137	0.000	1.34		82.3	SURCHARGED	
15.003	PI OUT	28.538	0.138	0.000	0.44		23.0	SURCHARGED	
17.000	SP	28.668	-0.072	0.000	0.75		31.8	OK	
17.001	S16	28.617	-0.033	0.000	1.00		31.5	OK	
18.000	S11	29.469	0.524	0.000	1.36		52.3	SURCHARGED	4
19.000	SP	29.408	0.433	0.000	1.05		21.8	SURCHARGED	4
18.001	S12	29.279	0.464	0.000	1.34		162.7	SURCHARGED	
18.002	S13	28.971	0.321	0.000	1.38		162.1	SURCHARGED	
18.003	S14	28.742	0.212	0.000	1.94		208.2	SURCHARGED	
15.004	S15	28.537	0.862	0.000	0.28		10.9	SURCHARGED	
1.010	S5	28.117	-0.218	0.000	0.07		48.8	OK	
1.011	S6	28.068	0.133	0.000	0.20		47.9	SURCHARGED	
1.012	S7	28.064	0.334	0.000	0.48		48.1	SURCHARGED	
1.013	PI IN	27.425	-0.290	0.000	0.27		48.0	OK	
1.014	PI OUT	27.388	-0.227	0.000	0.48		48.0	OK	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 3.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 4
Number of Online Controls 5 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.438
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 75.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SP	15 Winter	100	+20%	30/15 Summer	30/15 Winter		
2.000	SP	15 Winter	100	+20%	30/15 Summer	100/15 Summer		
1.001	S46	15 Winter	100	+20%	30/15 Summer			
1.002	PI IN	120 Winter	100	+20%	30/15 Summer			
1.003	PI OUT	120 Winter	100	+20%	30/15 Summer			
3.000	SP	15 Winter	100	+20%	30/15 Summer			
4.000	SP	15 Winter	100	+20%	30/15 Summer	100/15 Summer		
3.001	S44	15 Winter	100	+20%	2/15 Winter			
3.002	PI IN	15 Winter	100	+20%	30/15 Summer			
3.003	PI OUT	15 Winter	100	+20%	100/15 Summer			
1.004	S45	120 Winter	100	+20%	30/15 Summer			
5.000	S43	15 Winter	100	+20%	100/15 Summer			
6.000	S41	15 Winter	100	+20%	30/15 Summer			
1.005	S42	120 Winter	100	+20%	2/15 Winter			
7.000	S101	15 Winter	100	+20%				
7.001	S102	15 Winter	100	+20%	100/15 Summer			
7.002	S103	15 Winter	100	+20%	100/15 Summer			

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SP	29.943	0.243	17.757	1.19		48.1	FLOOD	10
2.000	SP	30.495	0.755	4.780	1.98		159.4	FLOOD	3
1.001	S46	29.988	0.378	0.000	1.86		142.9	SURCHARGED	
1.002	PI IN	29.942	0.352	0.000	0.72		76.8	SURCHARGED	
1.003	PI OUT	29.866	0.326	0.000	0.69		76.8	SURCHARGED	
3.000	SP	30.830	0.720	0.000	1.33		49.2	FLOOD RISK	
4.000	SP	31.006	0.751	1.429	1.45		35.2	FLOOD	2
3.001	S44	30.643	0.633	0.000	2.51		79.1	SURCHARGED	
3.002	PI IN	30.325	0.365	0.000	1.77		79.1	SURCHARGED	
3.003	PI OUT	30.011	0.151	0.000	1.04		79.0	SURCHARGED	
1.004	S45	29.830	0.405	0.000	1.15		111.6	SURCHARGED	
5.000	S43	30.297	0.112	0.000	1.14		96.2	SURCHARGED	
6.000	S41	30.284	0.324	0.000	1.83		94.8	SURCHARGED	
1.005	S42	29.824	1.024	0.000	0.44		54.4	SURCHARGED	
7.000	S101	29.587	-0.088	0.000	0.24		4.2	OK	
7.001	S102	29.566	0.181	0.000	0.98		16.9	SURCHARGED	
7.002	S103	29.168	0.213	0.000	1.11		18.4	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
7.003	S104	15 Winter	100	+20%	100/15 Summer			
7.004	S105	15 Winter	100	+20%	30/15 Winter			
8.000	S106	15 Winter	100	+20%				
8.001	S107	15 Winter	100	+20%				
8.002	S108	15 Winter	100	+20%				
8.003	S109	15 Winter	100	+20%				
8.004	S110	15 Winter	100	+20%				
9.000	SP	15 Winter	100	+20%	30/15 Summer	100/15 Summer		
10.000	SP	15 Winter	100	+20%	30/15 Summer			
9.001	S34	15 Winter	100	+20%	30/15 Summer			
9.002	PI IN	180 Winter	100	+20%	30/15 Summer			
9.003	PI OUT	180 Winter	100	+20%	30/15 Summer			
11.000	S31	15 Winter	100	+20%	30/15 Summer	100/15 Summer		
11.001	S32	15 Winter	100	+20%	30/15 Summer			
9.004	S33	180 Winter	100	+20%	2/15 Summer			
1.006	S1	180 Winter	100	+20%	100/30 Summer			
1.007	S2	180 Winter	100	+20%	100/30 Winter			
1.008	S3	180 Winter	100	+20%	100/30 Winter			
1.009	S4	180 Winter	100	+20%	100/30 Winter			
12.000	SP	15 Winter	100	+20%	30/15 Summer	100/15 Summer		
13.000	SP	15 Winter	100	+20%	30/15 Summer			
12.001	S23	15 Winter	100	+20%	30/15 Summer			
12.002	PI IN	15 Winter	100	+20%	30/15 Summer			
12.003	PI OUT	15 Winter	100	+20%	30/15 Summer			
12.004	S24	120 Winter	100	+20%	30/15 Summer			
12.005	S25	120 Winter	100	+20%	100/15 Summer			
14.000	SP	15 Winter	100	+20%	30/15 Summer			
14.001	S21	180 Winter	100	+20%	30/15 Summer			
12.006	S22	180 Winter	100	+20%	2/15 Summer			
15.000	SP	360 Winter	100	+20%	30/15 Summer	100/15 Summer		
16.000	SP	15 Winter	100	+20%	30/15 Summer			
15.001	S17	240 Winter	100	+20%	30/15 Summer			
15.002	PI IN	240 Winter	100	+20%	30/15 Summer			
15.003	PI OUT	240 Winter	100	+20%	30/15 Summer			
17.000	SP	240 Winter	100	+20%	100/15 Summer			
17.001	S16	240 Winter	100	+20%	100/15 Summer			
18.000	S11	15 Winter	100	+20%	30/15 Summer	100/15 Summer		
19.000	SP	15 Winter	100	+20%	30/15 Summer	100/15 Summer		
18.001	S12	15 Winter	100	+20%	30/15 Summer			
18.002	S13	15 Winter	100	+20%	30/15 Summer			
18.003	S14	240 Winter	100	+20%	30/15 Summer			
15.004	S15	240 Winter	100	+20%	2/15 Summer			
1.010	S5	180 Winter	100	+20%	100/60 Summer			
1.011	S6	180 Winter	100	+20%	30/120 Winter			
1.012	S7	180 Winter	100	+20%	30/30 Winter			
1.013	PI IN	180 Winter	100	+20%	100/120 Winter			
1.014	PI OUT	180 Winter	100	+20%				

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.003	S104	28.959	0.179	0.000	1.13		18.9	SURCHARGED	
7.004	S105	28.744	0.164	0.000	1.28		26.3	SURCHARGED	
8.000	S106	29.411	-0.089	0.000	0.35		5.8	OK	
8.001	S107	29.271	-0.089	0.000	0.35		5.8	OK	
8.002	S108	29.135	-0.035	0.000	0.90		15.3	OK	
8.003	S109	28.840	-0.035	0.000	0.93		15.4	OK	
8.004	S110	28.698	-0.012	0.000	1.00		23.8	OK	
9.000	SP	29.682	0.132	6.543	1.42		25.2	FLOOD	4
10.000	SP	30.037	0.547	0.000	1.98		69.3	SURCHARGED	
9.001	S34	29.773	0.348	0.000	1.40		57.2	SURCHARGED	
9.002	PI IN	29.568	0.273	0.000	0.68		21.4	SURCHARGED	
9.003	PI OUT	29.565	0.320	0.000	0.72		21.4	SURCHARGED	
11.000	S31	30.852	1.002	1.748	2.00		80.7	FLOOD	2
11.001	S32	30.036	0.456	0.000	2.08		175.4	SURCHARGED	
9.004	S33	29.561	1.086	0.000	0.51		19.7	SURCHARGED	
1.006	S1	28.642	0.307	0.000	0.14		92.5	SURCHARGED	
1.007	S2	28.636	0.301	0.000	0.14		94.4	SURCHARGED	
1.008	S3	28.630	0.295	0.000	0.14		98.3	SURCHARGED	
1.009	S4	28.623	0.288	0.000	0.24		96.9	SURCHARGED	
12.000	SP	29.685	0.135	9.990	1.39		22.5	FLOOD	4
13.000	SP	30.183	0.693	0.000	2.04		73.2	FLOOD RISK	
12.001	S23	29.905	0.480	0.000	1.66		52.1	SURCHARGED	
12.002	PI IN	29.772	0.397	0.000	1.69		53.2	SURCHARGED	
12.003	PI OUT	29.644	0.319	0.000	1.72		54.1	SURCHARGED	
12.004	S24	29.590	0.315	0.000	0.76		30.5	SURCHARGED	
12.005	S25	29.564	0.384	0.000	0.62		45.9	SURCHARGED	
14.000	SP	29.829	0.564	0.000	1.79		32.3	SURCHARGED	
14.001	S21	29.548	0.423	0.000	0.49		8.6	SURCHARGED	
12.006	S22	29.541	1.066	0.000	0.43		16.6	SURCHARGED	
15.000	SP	28.955	0.380	80.131	0.62		10.0	FLOOD	21
16.000	SP	29.436	0.746	0.000	1.58		100.5	FLOOD RISK	
15.001	S17	29.115	0.650	0.000	0.53		27.2	SURCHARGED	
15.002	PI IN	29.131	0.681	0.000	0.43		26.6	SURCHARGED	
15.003	PI OUT	29.152	0.752	0.000	0.50		26.1	SURCHARGED	
17.000	SP	29.173	0.433	0.000	0.23		9.6	SURCHARGED	
17.001	S16	29.170	0.520	0.000	0.31		9.6	SURCHARGED	
18.000	S11	29.952	1.007	7.067	2.13		81.5	FLOOD	4
19.000	SP	29.733	0.758	7.889	2.18		45.2	FLOOD	4
18.001	S12	29.899	1.084	0.000	1.71		207.2	FLOOD RISK	
18.002	S13	29.395	0.745	0.000	1.75		205.0	SURCHARGED	
18.003	S14	29.227	0.697	0.000	0.68		72.6	SURCHARGED	
15.004	S15	29.168	1.493	0.000	0.34		13.3	SURCHARGED	
1.010	S5	28.617	0.282	0.000	0.18		119.9	SURCHARGED	
1.011	S6	28.609	0.674	0.000	0.45		110.4	SURCHARGED	
1.012	S7	28.585	0.855	0.000	1.11		110.4	FLOOD RISK	
1.013	PI IN	27.724	0.009	0.000	0.62		110.5	SURCHARGED	
1.014	PI OUT	27.615	0.000	0.000	1.11		110.4	OK	

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CAPITA

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CS/075666 – Former Nestle Site, Hayes

Preliminary assessment of foul flows (by G. Males)

Estimate of proposed peak foul flow

Total floor area of warehouse = 19249m2

Total area of offices = 2284m2
21533m2

From Employment Densities Guide 2nd Edition 2010;

Warehouse = 1 person per 40m2 (assuming B1c/B2?)

19249m2 / 40 = 481 persons

Offices = 1 person per 12m2 (General office)

2284m2 / 12 = 190 persons

Total number of persons on site = 481 + 190 = **671 persons**

From British Water – Flows and Loads 2;

flow loading per person per day = 50 litres (office/factory without canteen)

671 x 50 l/p/day = 33550 litres

DWF = 33550 / 12 x 60 x 60 = 0.777 say **0.8 l/sec**

Peak flow = 4 x DWF = 4 x 0.8 = **3.2 l/sec**

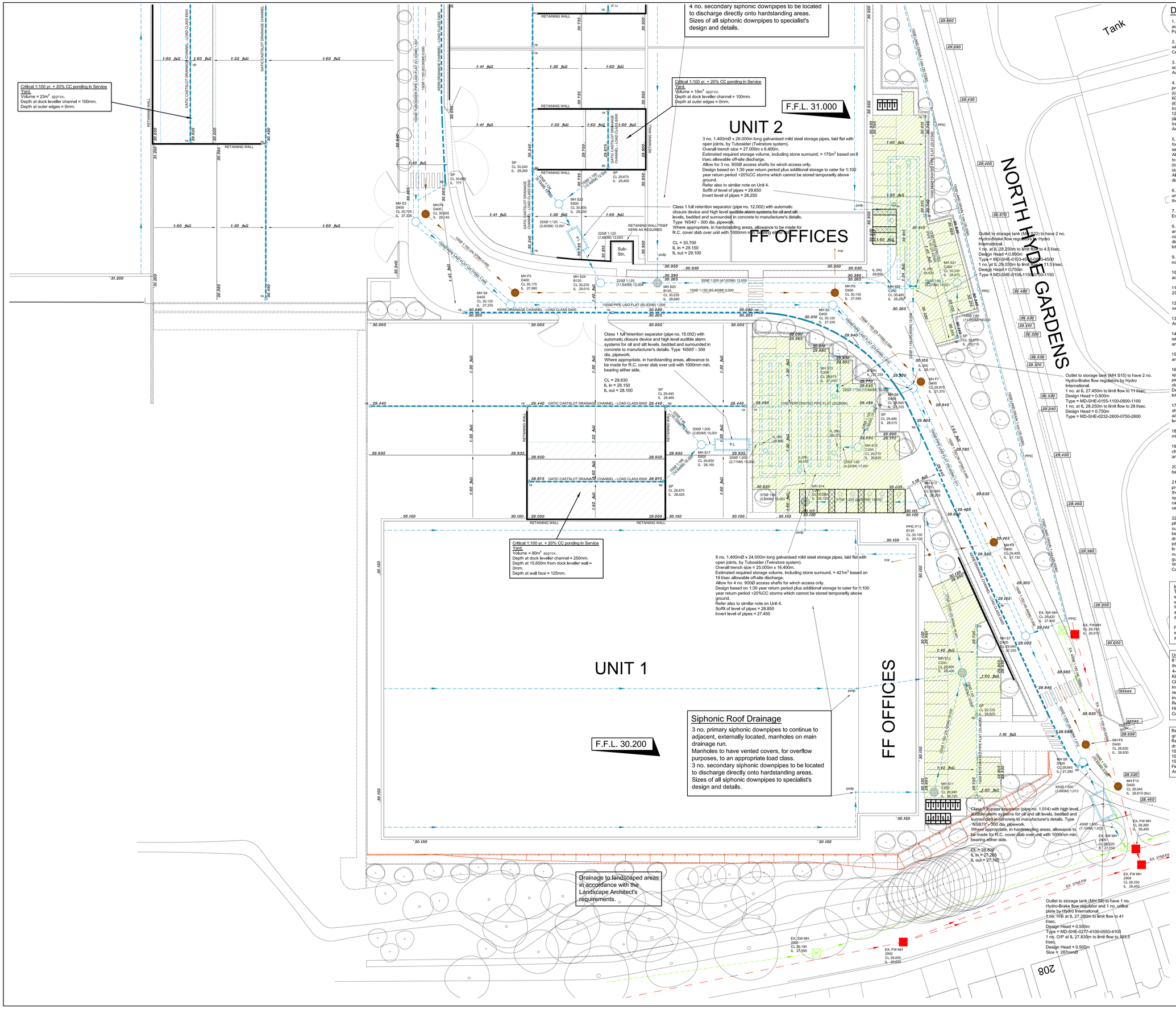
Estimate of proposed existing flow

(Refer to Thames Water Trade Effluent Discharge consent).

90m3/hr at point D (Garage)

90 x 1000 = 90,000 litres / hour

90000 / 3600 = **25 l/sec**



Drainage Notes

1. All private drainage works are to be carried out in accordance with BS EN 752:2008 and Building Regulations Part H.

2. All drainage works within adoptable areas are to comply with the requirements of the Water UK/Water Research Centre publication `Sewers for Adoption' (current edition).

3. All connections to existing public sewers to be in accordance with and to the satisfaction of the Local Authority.

4. Concrete protection (bedding class `Z') to pipework to be provided as follows;
(i) all pipework within soft areas with a cover of less than 600mm.
(ii) all pipework beneath roads, car parks and all other trafficked hardstanding areas with a cover less than 1200mm.
(iii) all pipework adjacent to existing and proposed trees/dense vegetation in landscaped areas.
An expansion joint shall be provided at all joint locations.

5. All below ground foul drainage from within building footprint to be 100mm dia. unless stated otherwise. Refer to separate note for recommended minimum gradients.
All below ground surface water drainage from RWP locations to main carrier drains to match the diameter of the downpipe (to Architect's and specialist contractor's details) unless stated otherwise.
All below ground drainage from road gullies to be 150mm dia. unless stated otherwise.

6. All pipework in manholes are to be laid soffit to soffit unless noted otherwise. All chamber invert levels, shown on the drawing, are for the outgoing pipe.

7. All internal drainage to be to the Architect's and M & E Engineer's drawings and details.

8. The position and invert levels of all existing drains, sewers and manholes to be confirmed by the contractor prior to the commencement of the proposed works and any discrepancies reported immediately to Capita Property and Infrastructure Ltd.

9. All pipes are to have a class `S' bed and surround unless noted otherwise (see note 4 above).

10. All concrete pipes are to be high strength and to be in accordance with BS EN 1916 and BS 5911.

11. All vitrified clay pipes are to be in accordance with BS EN 295.

12. Refer to drawing nos. xxxxxx-CA-0-GF-DR-S-xxx and xxx for drainage construction details.

13. For setting out of foul and rainwater outlets refer to the Architect's drawings.

14. This drawing to be read in conjunction with all other relevant Engineer's and Architect's drawings, specifications and documentation.

15. The contractor is to allow for grease traps in the kitchen and other appropriate areas.

16. Drainage channels and silt pits to be designed by a specialist manufacturer for critical storms of 1:5 year return period, to suit site conditions and in accordance with load class requirements as shown on the plan.
Design to be submitted for comment to Capita Property and Infrastructure Ltd. prior to ordering.

17. All external finished levels and manhole cover levels shown on this drawing are indicative and subject to adjustment on site to suit the finished ground levels. For final levels refer to the Architect's drawings.

18. All levels are in metres and all dimensions are in millimetres unless noted otherwise.

19. Any coordinates provided for manholes or inspection chambers are relevant to the main drainage run intersection and not the centre of the manhole.

20. Chalk and limestone are not to be used as bedding or backfilling material in soils with a pH value less than 7.

21. A CCTV drainage survey is to be carried out both at the pre-commencement of construction and at the completion of the contract to prove the integrity of the as-built drainage systems. At the completion of the contract this is to be carried out prior to the issue of the practical completion certificate.

22. Sewers, manholes, gullies, drainage channels and silt pits should be inspected at 6 monthly intervals and cleaned out at 12 monthly intervals. A full CCTV survey should also be carried out at 10 yearly intervals. Refer also to specialist drainage channel and petrol interceptor manufacturer's information and maintenance requirements.
In all instances, inspection and cleaning should be carried out only by a specialist contractor and in accordance with the guidelines given in `Safe Working in Sewers and at Sewage Works' published by National Joint Health and Safety Committee for the Water Services.

Important Note:
The Contractor is to exercise extreme care when excavating for drainage pipes and manholes and not to undermine existing or new column bases and/or strip footings already cast. Refer also to note 4 on this drawing and `concreting of drains laid near foundations' detail on drawing xxxxxx-CA-0-GF-DR-S-xxx.

For new construction, column foundations/strip footings must be taken down to below invert level of any nearby, adjacent services (drainage, gas, water, etc.)

Use of Thermoplastic Pipes
If thermoplastic pipes are to be used they are to be of the structured wall type and shall comply with WIS 4-35-01 and BS EN 13476 and must be BSI Kitemarked (e.g. Polysewer/Ridgisewer by Polypipe Civils, UltraRib by Wavin or similar). Pipes are to be installed strictly in accordance with the manufacturer's requirements and recommendations. Note: all installation must be in accordance with Building Regulations Part: H, BS EN 752:2008, Specification for Highway Works and all relevant British and European Codes of Practice.

Refer to the Architect's details for the internal, above ground, drainage layout.
Recommended minimum gradients for below ground foul drainage connections:
100 dia. at 1:40;
100 dia. at 1:80 with min 1 no. wc connection,
150 dia. at 1:150 with min 5 no. wc connections.
Final foul drainage connections to be coordinated with the Architect's internal drainage layout plans.

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DO NOT SCALE this drawing (printed or electronic versions). Contractors must check all dimensions from site.

All other design team elements, where indicated, have been imported from the consultant's drawings and reference should be made to the individual consultant's drawings for exact setting out, size and type of component.

Discrepancies and / or ambiguities within this drawing, between it and information given elsewhere, must be reported immediately to the architect for clarification before proceeding.

All works are to be carried out in accordance with the latest British Standards and Codes of Practice unless specifically directed otherwise in the specification.

All setting out to be in accordance with the Architect's details, (the Architect's drawings to take precedence over any setting out shown on this drawing).

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
Refer to the relevant Construction (Design and Management) documentation where applicable.

It is assumed that all works on this drawing will be carried out by a competent contractor, working where appropriate to an approved method statement.

LEGEND

	existing foul water drain with manhole
	existing surface water drain with manhole
	new foul water drain with manhole
	new surface water drain with manhole
	new surface water manhole with vented cover
	linear drainage channel
	permeable paving
	flow regulator
162.095	spot level
162.095	existing spot level
	concrete protection to pipework adjacent to tree roots
CL	Cover Level
IL	Invert level
SL	Sump level
S/A	Soakaway
RAI	Reverse Action Interceptor
bd	backdrop
re	rodding eye
svp	soil & vent pipe (rodable)
wvp	waste and vent pipe (rodable)
ss	stub stack (rodable)
sg	shower gully (rodable)
sp	silt pit (rodable)
ra	rodding access
rg	450Ø x 900 deep precast concrete trapped, rodable, road gully with grating area greater than 900cm²
fg	floor gully (rodable)
rwp	rainwater downpipe (rodable)
psdp	primary siphonic downpipe
ssdp	secondary siphonic downpipe
vp	vent pipe (oil separator)
aav	air admittance valve
TOB	Top of base level
CI	Cast Iron
VC	Vitrified Clay
R	Flexible `Rocker' joint
PPIC	Polypropylene inspection chamber

Note: Final setting out of all drainage points at ground level to the Architect's and M and E Engineer's details.

Rev	Date	By	Description	Rev/ check
P04	20.03.17	GM	Site layout updated in accordance with the Architect's latest requirements (MSA model MS101-02-Site Layout Plan dated 10.03.2017) and drainage layout and external levels updated to suit. All car parking areas now permeable paving in accordance with the Architect's latest requirements. By-pass separator removed from Unit 4 car park.	WFG
P03	23.02.17	GM	Site layout updated in accordance with the Architect's latest requirements (MSA model MS101-Site Layout Plan dated 20.02.2017) and drainage layout and external levels updated to suit. Vented manhole covers indicated.	WFG
P02	24.01.17	GM	Pipe 1.005 (Unit 4) increased from 225Ø to 300Ø. Surface water storage tank for Unit 1 Increased in length by 1,000m. Details of surface water flow controls updated in line with Planning requirements.	WFG
P01	21.06.16	GM	Pipe design numbers added. Ponding volumes updated following further design.	WFG

Drawing status
PRELIMINARY

Client
SEGRO
WHERE BUSINESS WORKS

Project
FORMER NESTLE SITE
HAYES

Drawing
DRAINAGE LAYOUT
AND EXTERNAL LEVELS

SHEET 1 OF 2

Scale @ A0	Drawn	Checked
1:250	G. Males	NRB
Project No.	**Date**	**Office**
CS/075666	Apr 2016	WATFORD

Drawing Identifier — BS1192:2007 / Avanti Compliant

project	origin	zone	level	file type	role	number	revision
075666	-CA-	0 -	GF -	DR -	S -	010 -	P04

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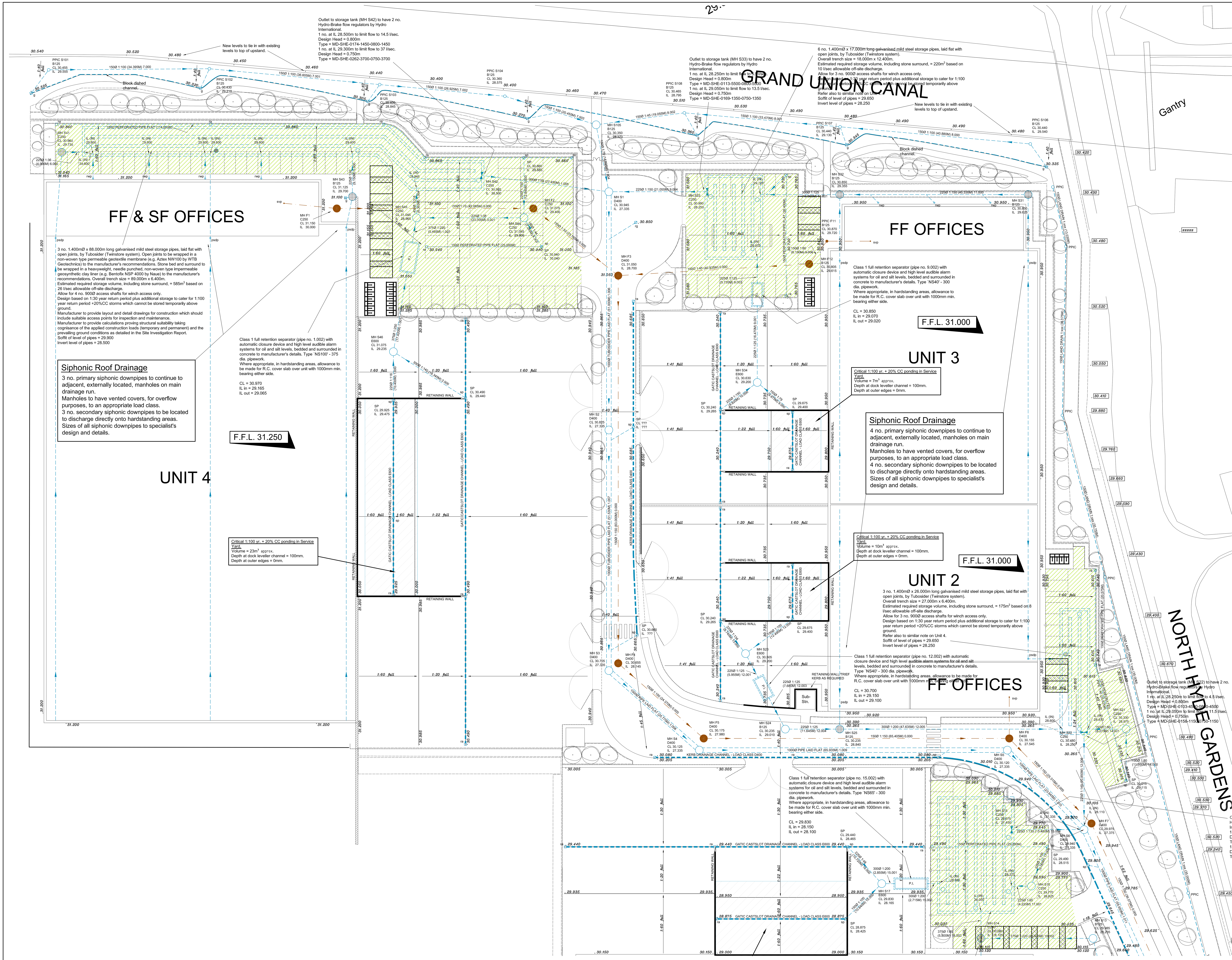
Capita Property and Infrastructure Ltd. www.capita.co.uk/property
Reg. office 71 Victoria Street, Westminster, London SW1H 0AX • No.2915642



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TOB	Top of base level
CI	Cast Iron
VC	Vitrified Clay
R	Flexible `Rocker' joint
PPIC	Polypropylene inspection chamber

Note: Final setting out of all drainage points at ground level to the Architect's and M and E Engineer's details.

Rev	Date	By	Description	Rev' check
P04	20.03.17	GM	Site layout updated in accordance with the Architect's latest requirements (MSA model MS101-D2-Site Layout Plan dated 10.03.2017) and drainage layout and external levels updated to suit. All car parking areas now permeable paving in accordance with the Architect's latest requirements. By-pass separator removed from Unit 4 car park.	WFG
P03	23.02.17	GM	Site layout updated in accordance with the Architect's latest requirements (MSA model MS101-Site Layout Plan dated 20.02.2017) and drainage layout and external levels updated to suit. Vented manhole covers indicated.	WFG
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Drawing status

PRELIMINARY

Client

SEGRO
WHERE BUSINESS WORKS

Project

FORMER NESTLE SITE HAYES

Drawing

DRAINAGE LAYOUT AND EXTERNAL LEVELS

SHEET 2 OF 2

Scale @ A0	Drawn	Checked
1:250	G. Males	NRB

Project No.	Date	Office
CS/075666	Apr 2016	WATFORD

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Appendix F – Correspondence from Canal & River Trust

Canal & River Trust

Keeping people, nature & history connected

28th January 2015

Paul Edwards
Geo-environmental Engineer
Property and infrastructure
Capita
Oak House
Reeds Crescent
Watford
WD24 4QP

Our Ref GU-212 / MW 28/01/15
Your Ref

Dear Paul

RE: FLOOD RISK ASSESSMENTS, GU-212, NESTLE HAYES

Further to your e-mail dated 27th January I have checked our records and spoken to the Supervisor responsible for this stretch of waterway and I can confirm the following:

- The Canal & River Trust is not aware of any records of overtopping from, or breaches of the waterway where the canal passes this site.
- This canal adjacent to this site is a 43 km long pound bounded by the canal locks Cowley Lock upstream **(E 505141, N 182210)**, and Norwood Top Lock **(E 513690, N 179359)** and Hampstead Road Locks **(E 528685, N 184088)** downstream. The control weir for the pound is Bulls Weir, located at coordinates **E 510473, N 179146**.
- The height of the controlling weir in this pound is **29.258m AOD**. The normal operating range of the water level in the pound is between +50mm over weir and -150mm under weir; i.e., **29.108m AOD to 29.308m AOD**. There are other flood weirs at different points and at different heights in the pound.

For further advice on flood risk assessments I have included some generic guidance (see appendix A).

Please note that the Canal & River Trust is unable to comment on the flood risk to individual properties or developments and interpretation of the information provided in this letter is your responsibility.

London Waterways
Canal & River Trust Docklands 420 Manchester Road London E14 9ST
T 0303 040 4040 **E** enquiries.london@canalrivertrust.org.uk www.canalrivertrust.org.uk
Patron: H.R.H. The Prince of Wales. Canal & River Trust, a charitable company limited by guarantee registered in England and Wales with company number 7807276 and registered charity number 1146792, registered office address First Floor North, Station House, 500 Elder Gate, Milton Keynes MK9 1BB

I trust this is satisfactory, however if you do require any further information please do not hesitate to contact me.

Yours sincerely

Mr Michael Wheeler B.Eng(Hons) I.Eng ACIWEM
Water Engineer (South)

Appendix A - **Guidance Note for Flood Risk Assessments**

The main incidents of uncontrolled loss of water from our waterways are overtopping and breaching as a result of inundation from adjacent water courses, vandalism or structural failure.

Canal & River Trust maintains water levels using reservoirs, feeders and boreholes, and thereafter manages the water by transferring it within the canal system. The level of the water in canals is normally determined predominantly by the level and size of weirs. Water levels in river navigations are affected by the flow in the river and will fluctuate more widely than canals.

When surface water enters our waterways, the level of the water rises. Eventually the water level will reach a point where it discharges from our waterways through control structures. Where the capacity of these control structures is exceeded, overtopping may result.

Breaches which may lead to flooding can occur on our waterways. There can be a number of causes for these including: culvert collapse, animal burrowing and overtopping. Canal & River Trust operates a comprehensive asset management system which enables us to manage the risks of such events occurring.

Breaches occur on average at a rate of three per year over the whole of the Canal & River Trust owned canal network (that's over 2,000 miles of canal).

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