Below Ground Drainage

Initial design Concept

To support

Planning Application

For

Plot 4a

Unit 5

At

Dunsbury Park.

Havant.

Hampshire.

November 2020.

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BAM Design Technical Report.

SUBJECT

Below Ground Drainage, Initial Design Concept.

CLIENT: BAM Construction South East.

PROJECT: Plot 4a, Unit 5. Dunsbury Park.

Contract no: TBA
Prepared by: S Bliss.

Job no: 4330 Z4A-U
Checked by: SGB.

Date: November 2020.

Document Ref: DHF-BMD-Z4A- XX-RP-P-58701.

Status of drawings / specifications: For Information / Approval.

AMENDMENTS				
ref.	date	amendment	amended by	checked by
In0	Nov 2020.	Issued to Support Planning Application.	SB	SB
P 01	25 May 2021	Updates to include pollution mitigation indices, storm drainage calculations and overland exceedance routes.	SB	SB

Contents

1.0 Introduction.

2.0 Plot 4a.

3.0 Drainage General.

4.0 Storm Water Drainage.

5.0 Water Quality Management.

6.0 Foul Water Drainage.

7.0 Conclusion.

Appendix A. Dunsbury Park, Site Boundary, Red Line.

Appendix B. Aerial Photograph, Plot B shaded.

Appendix C. Site Wide Drainage indicating attenuation ponds.

Appendix D. Plot 4a Drainage Proposal with 1 in 100 year Exceedance Flow Routes.

Appendix E. Surface Water Drainage Calculations & Simulation, 1, 30 & 100 year + 30% Storm Events.

Below ground drainage Initial Concept Design.

1.0 Introduction.

The Dunsbury Park site is located to the West of Leigh Park and to the East of Waterlooville. It is immediately east of the A3(M) at Junction 3. The motorway forming the western boundary of the site. The previous greenfield site has had a spine road (Fitzwygram Way) constructed, this links the A3(M) motorway Junction 3 slip road to Callshot Road on the Leigh Park residential area.

Despite this road being constructed to adoptable standards it is intended to remain as a private estate access road in Portsmouth City Council ownership.

The total Dunsbury Farm site has an area of 33 hectares, 20.2 hectares of which has been allocated for development.
The ground slopes in a southerly direction from a maximum elevation of approximately 55m above ordnance datum (AOD) to a minimum elevation of 15m AOD at the Hermitage Stream.

A Flood Risk Assessment was produced by Atkins Limited in March 2012 for an outline planning submission covering for the whole development at that time.

Plot 2 was the first plot to be developed with the construction of a warehouse / distribution centre. The below ground drainage design consisted separate foul and storm water systems. Storm water included a SUDS drainage system with porous car park surfaces, and on-site below ground storm water attenuation tanks.

During the development of plot 2, it was considered that site wide storm water attenuation would be a preferable option in comparison to provision of storm attenuation on an individual plot basis. Large ponds would provide a valuable asset for local residents whilst also increasing the areas Biodiversity. Both wet and slightly “marshy” storm water attenuation lakes were constructed 2017 to both attenuate and improve water quality prior to discharge into the Hermitage Stream.

This updated site wide drainage strategy was submitted for planning approval at the time and approved by Hampshire County Council.

2.0 Plot 4a.

Plot 4a is the third plot to be developed on this new Business Park. The plot is approximately half of the total area allocated for plot 4.

The plot is fronted by Fitzygram Way to the south and Aylwin Avenue to the east
Both roads are designated as private estate roads and form part of the overall development which remain within Portsmouth City Council ownership.

The Building area is 10,133m² and comprises, Clean Room environment for manufacturing medical equipment, warehouse materials storage, Goods in / Goods out loading bay, Administration offices and staff welfare facilities including showers, toilets, canteen, picnic area, etc. The building will contain approximately 250 personnel at any one time.

Staff and visitor vehicle Access is from Fitzwygram Way. An on-site one way vehicle management system directs vehicles towards a separate exit back onto Fitzwygram Way.

Heavy Goods Vehicle access to the buildings loading bay from Alywin Avenue on the eastern boundary.

The total plot 4a drained area is just under 1.9 hectares, of which approximately 10,000m² of this area is the building roof as previously mentioned.

Overhead power cables are present in the South East corner of the site. These will restrict working practices and have led to design decisions whereby the drainage in this area has been designed to promote hand dig where possible.

3.0 Drainage General.

The new below ground drainage installation will comprise completely separate foul and storm water drainage systems.

The systems will be designed in accordance with BS EN 752, The Building Regulations section H and Environment agency Planning Policy Statement PPS25. Foul water flows will be calculated in accordance with BS EN 12056 part 2.

In accordance with Environment Agency requirements the storm water drainage system from the new works will be designed to prevent surface flooding from a 1 in 30 year storm event.

The previously constructed attenuation ponds and wetland were designed to store storm water run-off from Plots 1 – 5 inclusive of the Dunsbury Park development. These have been sized to store water for a 1 in 100 year storm event + 30% for future climate change.

The proposed new building will have 243 vehicle parking spaces. These are spread over a large area to the west, south and east elevations of the building.

We have made effort to provide further SUDS treatment trains in addition to the previously installed SUDS attenuation ponds. A series of gravel filled trenches which receive water from car park drainage gullies have been introduced.

These trenches will have a perforated pipes within the base which conveys the water towards the on-site storm water network and ultimately the storm water attenuation ponds.

The complete granular fill and all perforated inlet / outlet pipes will be wrapped with Inbitex Geotextile fabric. This is a polypropylene and polyethelene non-woven fabric. During the manufacturing process, small dishes are created on the surface of the hairs from which the Geotextile is manufactured. This allows an early establishment of a microbial biomass which is responsible eating and degrading oils suspended in the water. It is also important during dry periods that the microbial population can retreat into the dishes where moisture can still be found. Thus when it rains again the microbial biomass is quickly re-established. This negates the need for traditional petrol interceptors.
Silt removal is performed as the water travels through the gravel from both surface levels and piped car park gullies. This provides two trains of improvement in water quality prior to discharge to the on-site network and attenuation ponds.

All drainage calculations will be produced using the industry accepted Micro Drainage software suite.

Once the drainage design has been completed, Section 106 applications will be made to Southern Water the new foul water discharges. The storm water discharges from the attenuation ponds into the Hermitage stream have been previously agreed.

4.0 Storm Water Drainage.

The Requirement H3 of the Building Regulations 2000 has been considered for this project. This establishes a preferred hierarchy for surface water disposal. Consideration should firstly be given to discharge to a soakaway infiltration system and secondly, to a watercourse, then thirdly to a public sewer, in that priority order.

Soil infiltration tests have previously been performed for this proposed development. The clay soils preclude the use of conventional soakaways.

Discharge to a water course is the second preferred storm water discharge method within the drainage hierarchy, this method has been adopted with a storm water connection into the Hermitage stream.

Rainwater from building roof, will be provided with a siphonic rainwater installation. This was selected to reduce the extent of below ground drainage which will minimise the depth of excavations.

The infrequently used access road to the rear of the building has been provided with a porous surface over a granular sub base. As with the gravel filled drainage filter trenches a geotextile wrapped perforated pipe will convey water to the main drainage system. Porous surfaces are another accepted drainage method for the entrapment of silts and are an accepted SUDS technique.

Porous surfaces are not robust enough for the heavily used loading bay area. This area will have concrete finishes which will fall to traditional drainage gullies and channels. A bypass type traditional petrol interceptor will be provided prior to connection the storm water drainage network.

SUDS storm water drainage systems which mimic the natural environment as far as practically possible. They are a very important aspect of managing storm water run-off and reducing both on-site and off-site flooding. The ongoing maintenance of the drainage system is recognised as a very important element of these objectives.

A drainage maintenance strategy will be issued to the building owner and occupying tenant upon completion of works. Emphasis will be made that continued maintenance of the drainage installation is a legal requirement.

SUDS Drainage techniques considered for this development are discussed below:

SUDS Drainage Technique Considered	Adopted (Y/N)	Reason	Benefit to Development.
Rainwater harvesting system	No	It is difficult to harvest water from a high velocity siphonic rainwater installation. It has therefore been rejected.	
Green roofs	No	The building frame is a lightweight structure and not designed for the additional weight imposed by green roofs.	
Infiltration systems	No	Soil infiltration tests in accordance with BRE Digest 365 have determined that the underlying soils are not suitable for infiltration drainage.	
Porous surface over granular sub-base	Yes	The infrequently access road to the rear of the building has been provided with porous surface over a granular sub base reservoir.	Removal of silts at surface level. Shallow drainage which will reduce excavation. Level surface with on falls to gullies.
Swales, ponds and detention basins	Yes	Storm water attenuation ponds have been provided as part of the Dunsbury Park site development.	Water stored without losing plot area. Reduced risk off-site flooding. Improved biodiversity.
Attenuation storage tanks	No	The Proposed use of ponds and other SUDS techniques removes the need for below ground attenuation tanks.	
Pervious surfaces	Yes	Overland surface water flow to pervious filter trenches.	Reduced hard drainage. Reduced excavation. Improved silt entrapment.
Filter Trenches.	Yes	Car park drainage gullies will discharge into gravel filled filter trenches. Perforated pipes in the base will be geotextile wrapped.	Filter trenches provide excellent Silt removal qualities which will protect the on-site drainage network and attenuation ponds.
Silt Trap Manholes.	Yes	Siphonic Rainwater pipes will discharge to silt trap manholes.	Further protection of on-site network and ponds.

5.0 Water Quality Management.

As previously described the new drained areas comprise:

- Main warehouse roof.
- Staff Car parking.
- HGV Delivery Loading Bay.

Table 4.3 below has been extracted from the SUDS Manual. This provides Pollution Hazard Levels for differing drained surfaces.

TABLE 4.3 Minimum water quality management requirements for discharges to receiving surface waters and groundwater

Land use	Pollution hazard level	Requirements for discharge to surface waters, including coasts and estuaries[2]	Requirements for discharge to groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (eg cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (eg schools, offices)	Low	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources[1]*	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources[1]*	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources1* In England and Wales, Risk Screening[4] must be undertaken first to determine whether consultation with the environmental regulator is required. In Northern Ireland, the need for risk screening should be agreed with the environmental regulator.
Trunk roads and motorways	High	Follow the guidance and risk assessment process set out in HA (2009)	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured, industrial sites	High	Discharges may require an environmental licence or permit[3]. Obtain pre-permitting advice from the environmental regulator. Risk assessment is likely to be required[5].	

From the above table, the pollution hazard levels for each of the new drained areas are as listed.

Proposed Drained Area	Pollution Hazard Level	Requirement for discharge to Surface Water
Warehouse Roof	Low	Simple Index Approach
Staff Car Parking < 300	Low	Simple Index Approach
Commercial Delivery	Medium	Simple Index Approach

SUDS Manual Table 26.2 provides pollution hazard indices for various drained area usages.

The new building roof will be a warm roof construction with waterproof rubber membrane, we there consider the pollution indices for heavy metals from this area to be very low at 0.2.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Table 26.3, provides mitigation indices that is provided by differing SUDS components.

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Low pollution hazard run-off from the building roof will only require total suspended solids to be considered. The ponds and wetlands serving the Dunsbury Hill Farm development have adequate mitigation indices to protect the Hermitage Stream.

The staff car parking also has low hazard level. The indices which can be mitigated by the ponds and wetlands. Porous parking bays and gravel filled filter trenches provide further mitigation by entrapment of silts etc. on site. This will further enhance the ability and of the ponds and reduce their maintenance requirement.

The loading bay area is considered a medium pollution hazard level. Again, whilst the pond and wetlands mitigation indices are adequate, a petrol interceptor has been further added to this area.

We therefore consider that all proposed new storm water discharges are provided with adequate pollution protection prior to discharge off site.

6.0 Foul Water Drainage.

A Section 106 consent for the new foul water discharge to the Southern Water sewer will be made once the design has been completed.

The new building will be provided with a completely separate gravity foul water drainage system.

Foul water flows will be calculated using the discharge unit method as detailed within BS EN 12056 part 2.

Duel flush 6 / 4.5 litre W.C' cisterns will be specified as will flow limiters on showers and wash basin taps. To further reduce foul water flows and save water, wash basin taps will be push button self closing operation.

Access Chambers and rodding points will be provided to allow future maintenance of the system. Adequate ventilation pipes and trapped gullies will be provided to prevent the build-up of foul smells in or around the building.

The bin store area will be provided with a foul water wash down gully. This will assist keeping the attenuation ponds free of pollution and encourage biodiversity.

7.0 Conclusion.

Storm water discharges to the Hermitage Stream. The run-off rates have been restricted to green field rates as previously agreed with the relevant authorities. The site wide drainage system including plot 4a therefore reflects the pre development scenario.

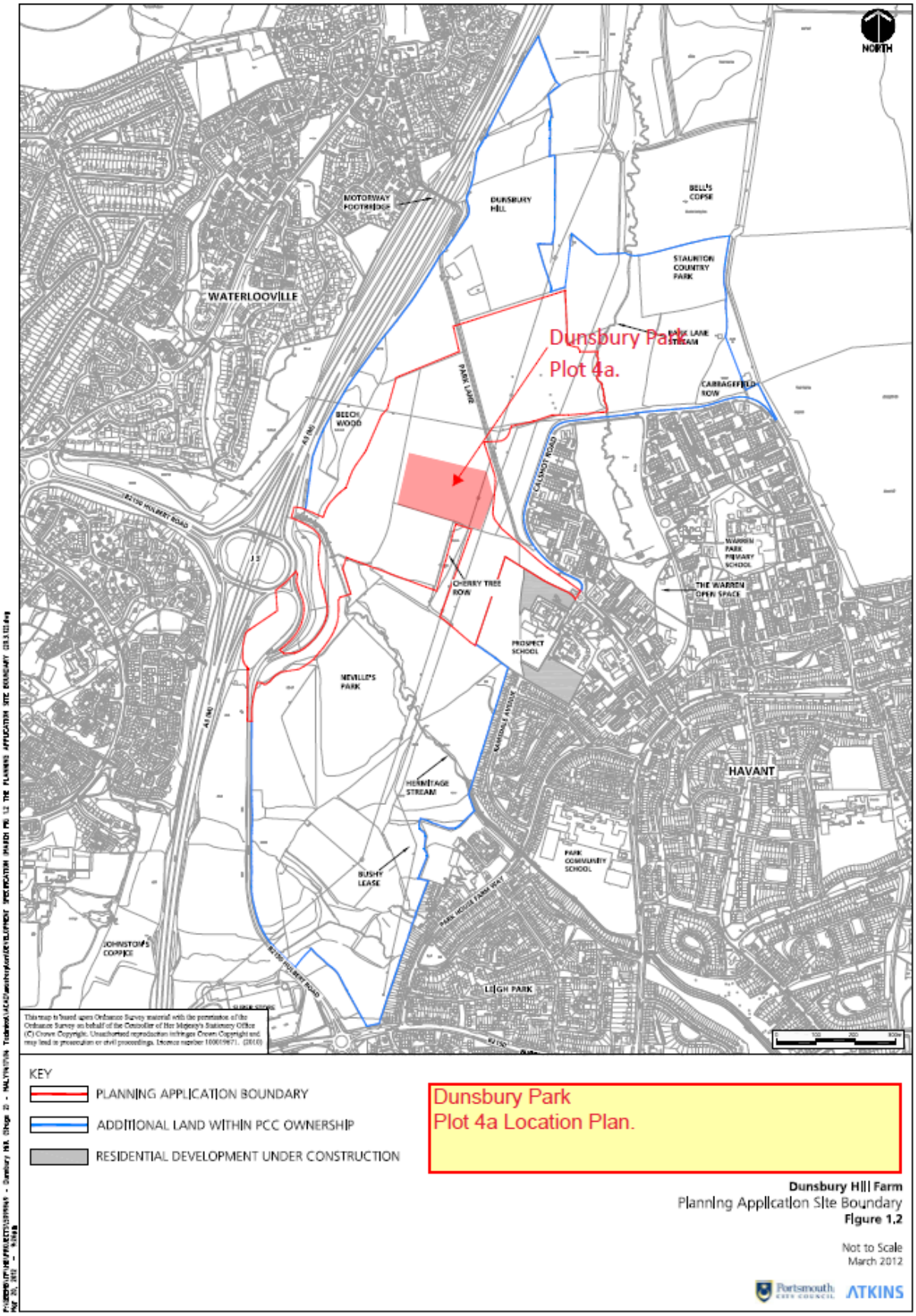
The previous installation of attenuation ponds has increased the developments bio diversity.

The inclusion of additional onsite SUDS techniques and increased treatment trains offers further benefit to the previously approved Dunsbury Park drainage strategy.

No on-plot surface flooding occurs for a 1 in 30 year storm event. The 1 in 100 year + 30% storm event does see surface level flooding in the loading bay area. This is generated from a siphonic rainwater pipe at the head of the system. Drainage channels within this area will convey the water further downstream.

Upon completion of works, a drainage maintenance strategy will be issued to the building owner and occupying tenant. Emphasis will be made that continued maintenance of the drainage installation is a legal requirement under planning law.

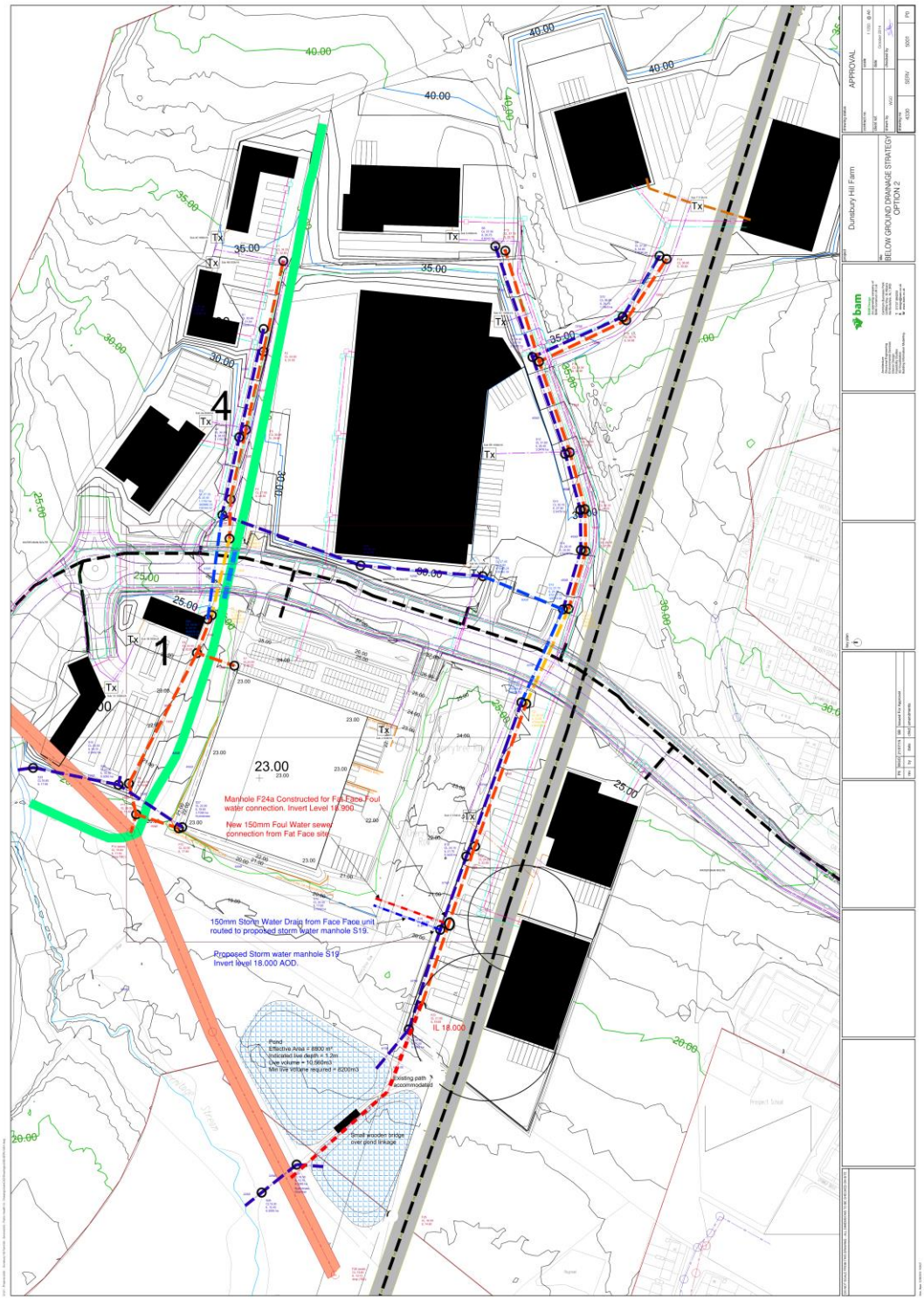
Appendix A. Dunsbury Park, Site Boundary Red Line.



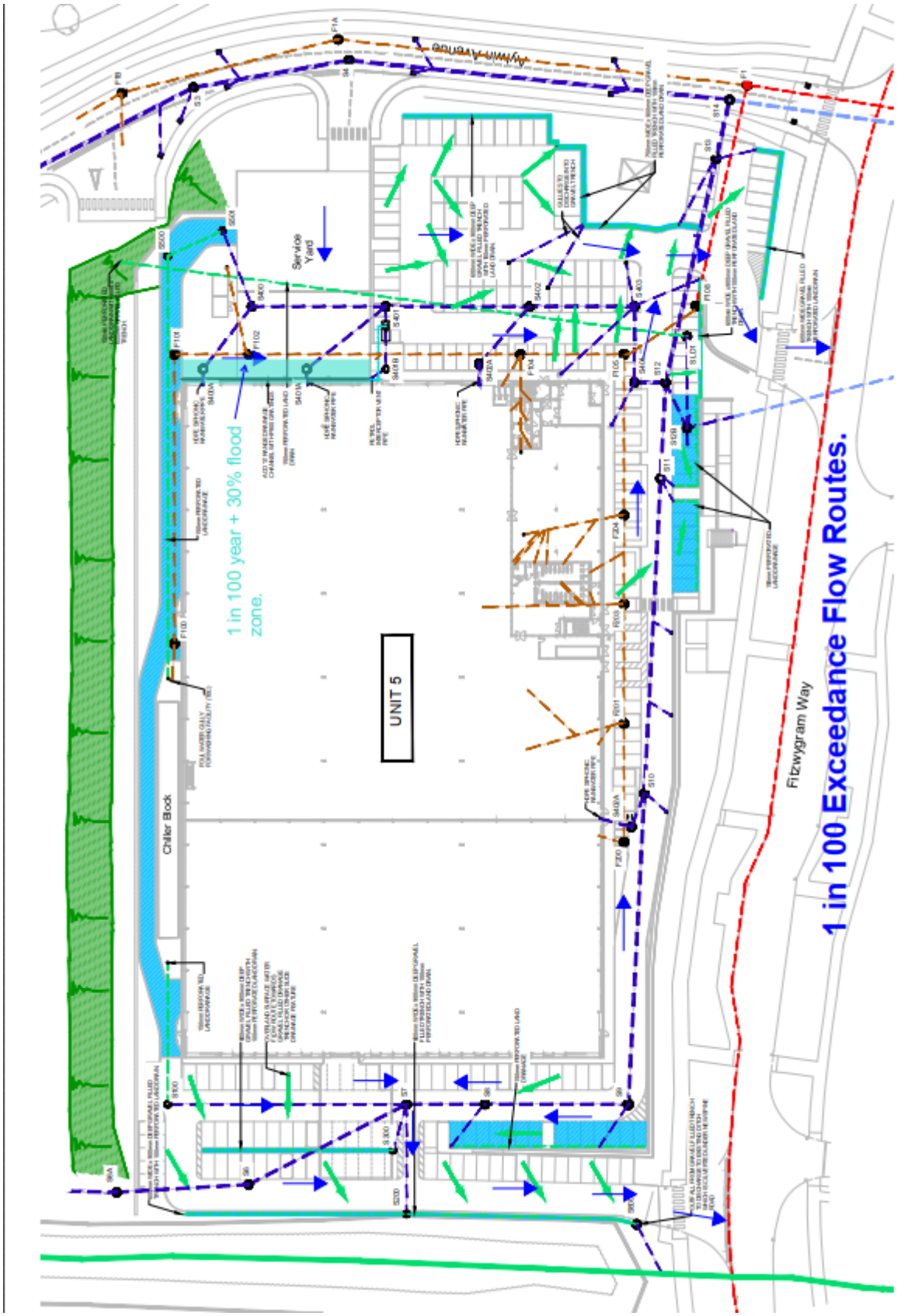
Appendix B. Arial Photograph. Plot 4a shaded.

Dunsbury Park, Plot 4a. Aerial Image.

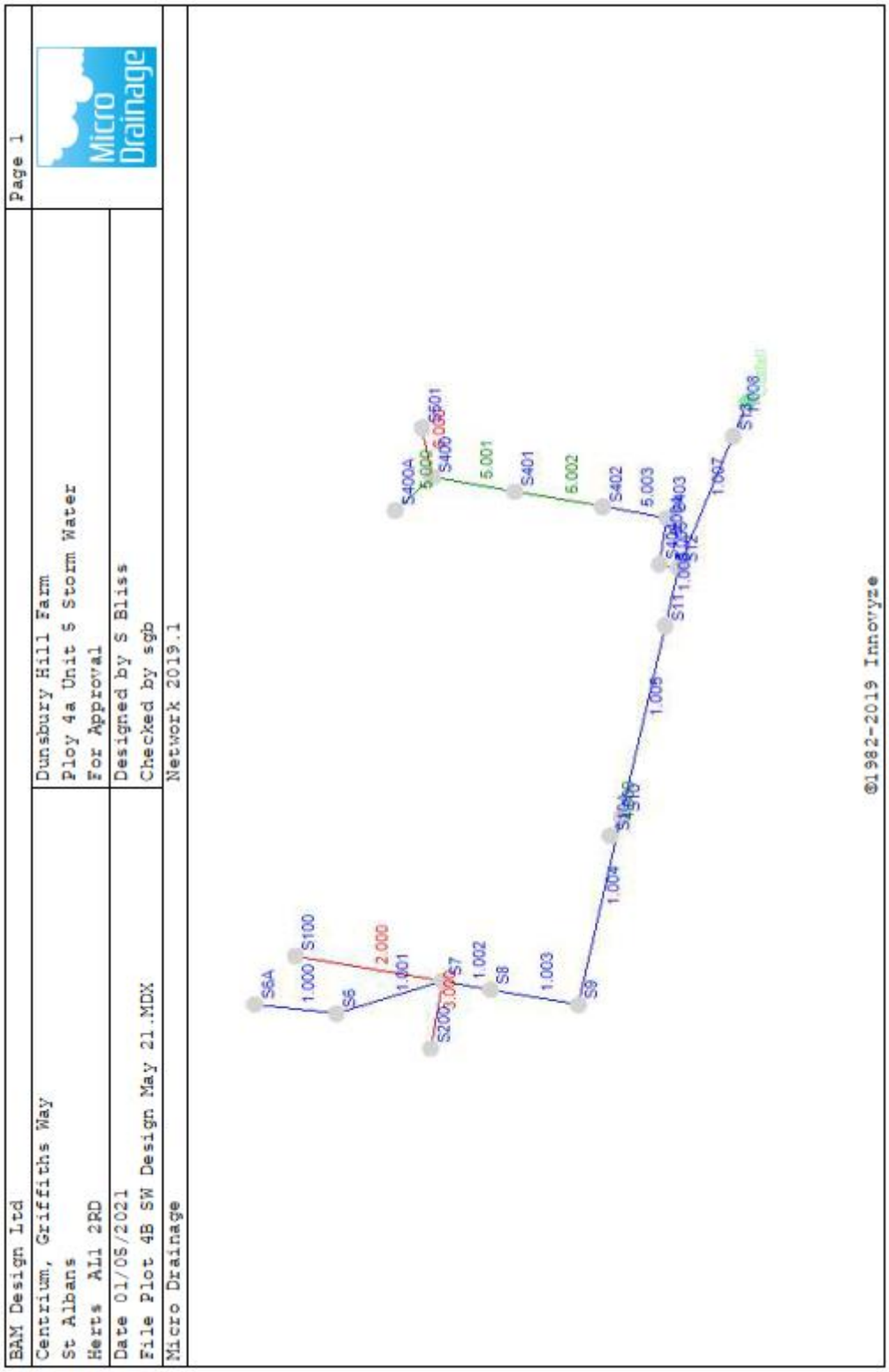
Appendix C. Site Wide Drainage indicating attenuation ponds.



Appendix D. Plot 3 Drainage Proposal with 1 in 100 year + 30% Exceedance flow routes.



Appendix E Storm Water Drainage calculations and simulation 1, 30 & 100 year + 30% storm events.



100 year return period Critical Summary of Results by Maximum Level (Rank 1)

Pipe Number	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow (l/s)	Infiltration Flow (l/s)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
1.000	S6A	15 minute 100 year Winte	31.000	28.086	-0.314	0.000			0.116	26.6	OK
1.001	S6	15 minute 100 year Winte	29.750	27.880	-0.110	0.000			1.124	26.3	OK
2.000	S100	15 minute 100 year Winte	29.970	28.902	0.052	0.000			0.223	15.3	SURCHARGED
3.000	S200	15 minute 100 year Winte	29.000	28.261	0.036	0.000			0.290	26.3	SURCHARGED
1.002	S7	15 minute 100 year Winte	29.650	27.863	0.003	0.000			4.428	103.5	SURCHARGED
1.003	S8	15 minute 100 year Winte	29.650	27.777	0.027	0.000			1.956	116.1	SURCHARGED
1.004	S9	15 minute 100 year Winte	29.820	27.679	0.079	0.000			3.648	144.2	SURCHARGED
4.000	S10A	15 minute 100 year Winte	29.750	28.887	0.087	0.000			0.433	79.4	SURCHARGED
1.005	S10	15 minute 100 year Winte	29.650	27.211	0.061	0.000			1.692	216.8	SURCHARGED
1.006	S11	15 minute 100 year Winte	29.500	26.894	0.394	0.000			9.558	235.0	SURCHARGED
5.000	S400A	15 minute 100 year Winte	30.000	30.018	0.918	17.855			19.178	132.9	FLOOD
6.000	S501	15 minute 100 year Winte	30.450	30.450	0.300	0.133			0.636	23.6	FLOOD
5.001	S400	15 minute 100 year Winte	30.180	30.079	1.279	0.000			2.924	175.4	FLOOD RISK
5.002	S401	15 minute 100 year Winte	30.200	29.503	0.828	0.000			3.435	310.6	SURCHARGED
5.003	S402	15 minute 100 year Winte	29.480	28.666	0.316	0.000			3.934	303.6	SURCHARGED
5.004	S403	15 minute 100 year Winte	29.000	28.370	0.420	0.000			4.210	321.5	SURCHARGED
5.005	S404	15 minute 100 year Winte	29.700	28.048	0.148	0.000			3.264	320.6	SURCHARGED
1.007	S12	15 minute 100 year Winte	29.420	26.742	0.357	0.000			4.238	526.2	SURCHARGED
1.008	S13	15 minute 100 year Winte	27.720	26.081	0.556	0.000			9.988	583.4	SURCHARGED

BAM Design Ltd		Page 1
Centrium, Griffiths Way St Albans Herts AL1 2RD	Dunsbury Plot 4A Storm Water For Approval	Micro Drainage
Date 24/05/2021 File Plot 4B SW Design May 2...	Designed by S Bliss Checked by sgb	
Micro Drainage	Network 2019.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.400	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	2.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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Micro Drainage	Network 2019.1	

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)
S6A	31.000	3.000	Open Manhole	1350	1.000	28.000	400				
S6	29.750	2.160	Open Manhole	1350	1.001	27.590	400	1.000	27.590	400	
S100	29.970	1.270	Open Manhole	1200	2.000	28.700	150				
S200	29.000	1.000	Open Manhole	1200	3.000	28.000	225				
S7	29.650	2.273	Open Manhole	1350	1.002	27.460	400	1.001	27.377	400	
								2.000	28.400	150	690
								3.000	27.977	225	342
S8	29.650	2.300	Open Manhole	1350	1.003	27.350	400	1.002	27.433	400	83
S9	29.820	2.670	Open Manhole	1350	1.004	27.150	450	1.003	27.292	400	92
S10A	29.750	1.250	Open Manhole	1200	4.000	28.500	300				
S10	29.650	2.950	Open Manhole	1350	1.005	26.700	450	1.004	27.092	450	392
								4.000	28.498	300	1648
S11	29.500	3.450	Open Manhole	1350	1.006	26.050	450	1.005	26.050	450	
S400A	30.000	1.200	Open Manhole	1200	5.000	28.800	300				
S501	30.450	0.450	Open Manhole	1200	6.000	30.000	150				
S400	30.180	1.680	Open Manhole	1200	5.001	28.500	300	5.000	28.500	300	
								6.000	29.977	150	1327
S401	30.200	1.900	Open Manhole	1350	5.002	28.300	375	5.001	28.375	300	
S402	29.480	1.580	Open Manhole	1350	5.003	27.900	450	5.002	28.175	375	200
S403	29.000	1.500	Open Manhole	1350	5.004	27.500	450	5.003	27.650	450	150
S404	29.700	2.325	Open Manhole	1500	5.005	27.375	525	5.004	27.450	450	
S12	29.420	3.560	Open Manhole	1500	1.007	25.860	525	1.006	25.860	450	
								5.005	27.370	525	1510
S13	27.720	2.720	Open Manhole	1500	1.008	25.000	525	1.007	25.075	525	75
Outfall	27.670	2.684	Open Manhole	1500		OUTFALL		1.008	24.986	525	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S6A	469929.521	109263.852	469929.521	109263.852	Required	
S6	469926.699	109238.775	469926.699	109238.775	Required	
S100	469944.432	109251.387	469944.432	109251.387	Required	

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BAM Design Ltd		Page 3
Centrium, Griffiths Way St Albans Herts AL1 2RD	Dunsbury Plot 4A Storm Water For Approval	Micro Drainage
Date 24/05/2021 File Plot 4B SW Design May 2...	Designed by S Bliss Checked by sgb	
Micro Drainage	Network 2019.1	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S200	469915.982	109209.978	469915.982	109209.978	Required	
S7	469936.654	109206.404	469936.654	109206.404	Required	
S8	469934.101	109191.639	469934.101	109191.639	Required	
S9	469929.433	109164.640	469929.433	109164.640	Required	
S10A	469981.568	109155.008	469981.568	109155.008	Required	
S10	469987.435	109151.507	469987.435	109151.507	Required	
S11	470046.256	109138.188	470046.256	109138.188	Required	
S400A	470081.740	109220.787	470081.740	109220.787	Required	
S501	470107.179	109212.561	470107.179	109212.561	Required	
S400	470091.940	109209.549	470091.940	109209.549	Required	
S401	470087.577	109184.316	470087.577	109184.316	Required	
S402	470082.899	109157.263	470082.899	109157.263	Required	
S403	470079.479	109137.484	470079.479	109137.484	Required	
S404	470065.161	109139.959	470065.161	109139.959	Required	
S12	470064.123	109134.142	470064.123	109134.142	Required	

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BAM Design Ltd		Page 4
Centrium, Griffiths Way St Albans Herts AL1 2RD	Dunsbury Plot 4A Storm Water For Approval	Micro Drainage
Date 24/05/2021 File Plot 4B SW Design May 2...	Designed by S Bliss Checked by sgb	
Micro Drainage	Network 2019.1	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S13	470104.627	109117.311	470104.627	109117.311	Required	
Outfall	470115.289	109112.881			No Entry	

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BAM Design Ltd		Page 5
Centrium, Griffiths Way St Albans Herts AL1 2RD	Dunsbury Plot 4A Storm Water For Approval	Micro Drainage
Date 24/05/2021 File Plot 4B SW Design May 2...	Designed by S Bliss Checked by sgb	
Micro Drainage	Network 2019.1	

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	400	S6A	31.000	28.000	2.600	Open Manhole	1350
1.001	o	400	S6	29.750	27.590	1.760	Open Manhole	1350
2.000	o	150	S100	29.970	28.700	1.120	Open Manhole	1200
3.000	o	225	S200	29.000	28.000	0.775	Open Manhole	1200
1.002	o	400	S7	29.650	27.460	1.790	Open Manhole	1350
1.003	o	400	S8	29.650	27.350	1.900	Open Manhole	1350
1.004	o	450	S9	29.820	27.150	2.220	Open Manhole	1350
4.000	o	300	S10A	29.750	28.500	0.950	Open Manhole	1200
1.005	o	450	S10	29.650	26.700	2.500	Open Manhole	1350
1.006	o	450	S11	29.500	26.050	3.000	Open Manhole	1350
5.000	o	300	S400A	30.000	28.800	0.900	Open Manhole	1200
6.000	o	150	S501	30.450	30.000	0.300	Open Manhole	1200
5.001	o	300	S400	30.180	28.500	1.380	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	25.235	61.5	S6	29.750	27.590	1.760	Open Manhole	1350
1.001	33.867	159.0	S7	29.650	27.377	1.873	Open Manhole	1350
2.000	45.650	152.2	S7	29.650	28.400	1.100	Open Manhole	1350
3.000	20.979	912.1	S7	29.650	27.977	1.448	Open Manhole	1350
1.002	14.984	555.0	S8	29.650	27.433	1.817	Open Manhole	1350
1.003	27.400	472.4	S9	29.820	27.292	2.128	Open Manhole	1350
1.004	59.470	1025.3	S10	29.650	27.092	2.108	Open Manhole	1350
4.000	6.832	3416.0	S10	29.650	28.498	0.852	Open Manhole	1350
1.005	60.310	92.8	S11	29.500	26.050	3.000	Open Manhole	1350
1.006	18.319	96.4	S12	29.420	25.860	3.110	Open Manhole	1500
5.000	15.000	50.0	S400	30.180	28.500	1.380	Open Manhole	1200
6.000	15.534	675.4	S400	30.180	29.977	0.053	Open Manhole	1200
5.001	25.607	204.9	S401	30.200	28.375	1.525	Open Manhole	1350

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BAM Design Ltd		Page 6
Centrium, Griffiths Way St Albans Herts AL1 2RD	Dunsbury Plot 4A Storm Water For Approval	Micro Drainage
Date 24/05/2021 File Plot 4B SW Design May 2...	Designed by S Bliss Checked by sgb	
Micro Drainage	Network 2019.1	

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)
5.002	o	375	S401	30.200	28.300	1.525	Open Manhole	1350
5.003	o	450	S402	29.480	27.900	1.130	Open Manhole	1350
5.004	o	450	S403	29.000	27.500	1.050	Open Manhole	1350
5.005	o	525	S404	29.700	27.375	1.800	Open Manhole	1500
1.007	o	525	S12	29.420	25.860	3.035	Open Manhole	1500
1.008	o	525	S13	27.720	25.000	2.195	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)
5.002	27.454	219.6	S402	29.480	28.175	0.930	Open Manhole	1350
5.003	20.072	80.3	S403	29.000	27.650	0.900	Open Manhole	1350
5.004	14.530	290.6	S404	29.700	27.450	1.800	Open Manhole	1500
5.005	5.909	1227.8	S12	29.420	27.370	1.525	Open Manhole	1500
1.007	43.862	55.9	S13	27.720	25.075	2.120	Open Manhole	1500
1.008	11.546	824.7	Outfall	27.670	24.986	2.159	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)
1.008	Outfall	27.670	24.986	0.000	1500	0

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	2.000
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	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Region	England and Wales
Return Period (years)	30	M5-60 (mm)	19.400

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BAM Design Ltd		Page 7
Centrium, Griffiths Way St Albans Herts AL1 2RD	Dunsbury Plot 4A Storm Water For Approval	Micro Drainage
Date 24/05/2021 File Plot 4B SW Design May 2...	Designed by S Bliss Checked by sgb	
Micro Drainage	Network 2019.1	

Synthetic Rainfall Details

Ratio R	0.350	Cv (Winter)	0.840
Profile Type	Summer	Storm Duration (mins)	30
Cv (Summer)	0.750		

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BAM Design Ltd		Page 8
Centrium, Griffiths Way St Albans Herts AL1 2RD	Dunsbury Plot 4A Storm Water For Approval	Micro Drainage
Date 24/05/2021 File Plot 4B SW Design May 2...	Designed by S Bliss Checked by sgb	
Micro Drainage	Network 2019.1	

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 2.000
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 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS 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) 1, 30, 100
Climate Change (%) 0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S6A	15 Winter	100	+30%				
1.001	S6	15 Winter	100	+30%				
2.000	S100	15 Winter	100	+30%	100/15 Summer			
3.000	S200	15 Winter	100	+30%	30/15 Winter			
1.002	S7	15 Winter	100	+30%	100/15 Summer			
1.003	S8	15 Winter	100	+30%	100/15 Summer			
1.004	S9	15 Winter	100	+30%	100/15 Summer			
4.000	S10A	15 Winter	100	+30%	30/15 Summer			
1.005	S10	15 Winter	100	+30%	100/15 Winter			
1.006	S11	15 Winter	100	+30%	100/15 Summer			
5.000	S400A	15 Winter	100	+30%	30/15 Summer	100/15 Summer		
6.000	S501	15 Winter	100	+30%	30/15 Summer	100/15 Winter		
5.001	S400	15 Winter	100	+30%	30/15 Summer			
5.002	S401	15 Winter	100	+30%	30/15 Summer			
5.003	S402	15 Winter	100	+30%	100/15 Summer			
5.004	S403	15 Winter	100	+30%	30/15 Summer			
5.005	S404	15 Winter	100	+30%	30/15 Summer			
1.007	S12	15 Winter	100	+30%	100/15 Summer			
1.008	S13	15 Winter	100	+30%	30/15 Summer			

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BAM Design Ltd		Page 9
Centrium, Griffiths Way St Albans Herts AL1 2RD	Dunsbury Plot 4A Storm Water For Approval	Micro Drainage
Date 24/05/2021 File Plot 4B SW Design May 2...	Designed by S Bliss Checked by sgb	
Micro Drainage	Network 2019.1	

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	S6A	28.086	-0.314	0.000	0.10		26.6	OK	
1.001	S6	27.880	-0.110	0.000	0.16		26.3	OK	
2.000	S100	28.902	0.052	0.000	1.09		15.3	SURCHARGED	
3.000	S200	28.261	0.036	0.000	2.45		26.3	SURCHARGED	
1.002	S7	27.863	0.003	0.000	1.79		103.5	SURCHARGED	
1.003	S8	27.777	0.027	0.000	1.24		116.1	SURCHARGED	
1.004	S9	27.679	0.079	0.000	1.55		144.2	SURCHARGED	
4.000	S10A	28.887	0.087	0.000	1.97		79.4	SURCHARGED	
1.005	S10	27.211	0.061	0.000	0.70		216.8	SURCHARGED	
1.006	S11	26.894	0.394	0.000	0.96		235.0	SURCHARGED	
5.000	S400A	30.018	0.918	17.855	1.01		132.9	FLOOD	4
6.000	S501	30.450	0.300	0.133	4.42		23.6	FLOOD	1
5.001	S400	30.079	1.279	0.000	2.53		175.4	FLOOD RISK	
5.002	S401	29.503	0.828	0.000	2.64		310.6	SURCHARGED	
5.003	S402	28.666	0.316	0.000	1.08		303.6	SURCHARGED	
5.004	S403	28.370	0.420	0.000	2.24		321.5	SURCHARGED	
5.005	S404	28.048	0.148	0.000	2.04		320.6	SURCHARGED	
1.007	S12	26.742	0.357	0.000	0.92		526.2	SURCHARGED	
1.008	S13	26.081	0.556	0.000	5.88		583.4	SURCHARGED	

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