Land at Melbourn, Royston

DATE	**15 March 2019**	**CONFIDENTIALITY**	**Public**
SUBJECT	**Outline Flood Risk and Surface Water Drainage Review**		
PROJECT: Land at Melbourn	**AUTHOR MR**	**CHECKED JWB**	
Project no. 70028034			

INTRODUCTION

1. APPOINTMENT AND BRIEF

1.1. WSP have been appointed to undertake an Outline Flood Risk and Surface Water Drainage Review to support the local plan representation for a proposed development on Land at Melbourn. A Site Masterplan is provided in **Appendix A.**

2. REPORT SCOPE AND LIMITATION

2.1. This report provides a preliminary risk based assessment of potential flooding from possible sources, including fluvial, tidal, groundwater, and surface water run-off. It also identifies and examines the residual flood risk to the proposed development and third-party land.

2.2. This report is based on the interpretation and assessment of data provided by third parties. WSP cannot be held responsible for the accuracy of the third-party data and the conclusions and findings of this report may change if the data is amended or updated after the date of consultation.

EXISTING STE

3. SITE LOCATION

3.1. The Site is located on Land at Melbourn. An approximate postcode for the site is SG8 6DG and approximate OS coordinates are 537290, 243955. The Site Masterplan is provided in **Appendix A**.

3.2. The site consists of two distinct parcels; the western parcel is identified as an employment park and roadside services, and the eastern parcel as a care village.

3.3. The existing site consists of undeveloped farmland.

Table 1 – Characteristics of the Site

Characteristics of the Site		Description
Area		EMPLOYMENT PARK - 12.4ha CARE VILLAGE - 5.1ha
General Topography		EMPLOYMENT PARK: The high point of the site is located in the southernmost corner with a level of 32.53mAOD and the low point of the site is located along the northern boundary with a level of 26.43mAOD. The Site tends to fall towards the northern boundary at an approximate gradient of 1 in 110. CARE VILLAGE: The high point of the site is located in the southeast corner with a level of 31.23mAOD and the low point of the site is located in the northeast corner with a level of 25.63mAOD. The Site tends to fall towards the northern boundary at an approximate gradient of 1 in 50.
Boundaries	**North**	Bury Lane Farm Shop
	South	Unnamed Road
	East	Royston Road
	West	Railway
Access		Vehicular access to the site is available via A10.

Figure 1 – Existing site

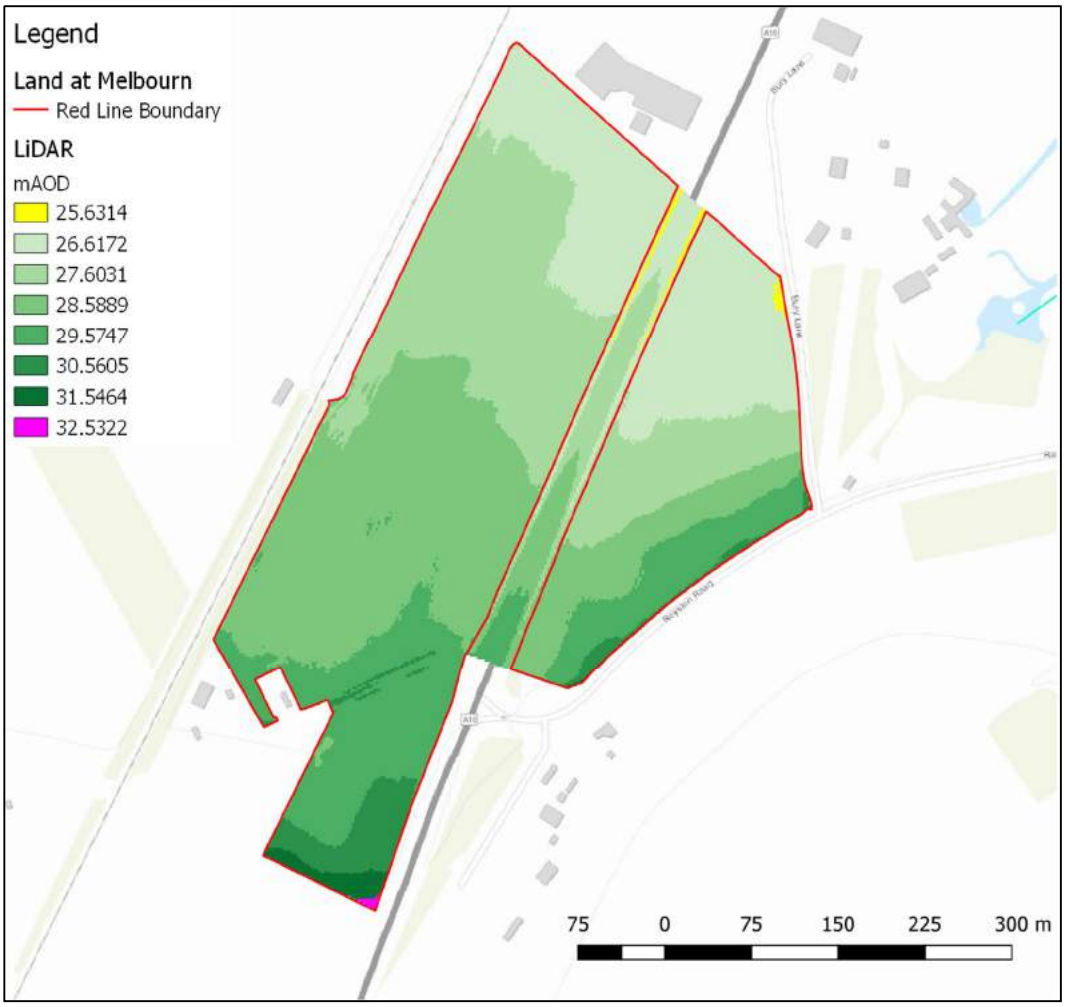
4. EXISTING TOPOGRAPHY

4.1. The existing topography has been derived from LiDAR data which is publicly available from the Environment Agency's website.

4.2. For the employment park parcel, the high point of the site is located in the southernmost corner with a level of 32.53mAOD and the low point of the site is located along the northern boundary with a level of 26.43mAOD. The Site tends to fall towards the northern boundary at an approximate gradient of 1 in 110. For the care village parcel, the high point of the site is located in the southeast corner with a level of 31.23mAOD and the low point of the site is located in the northeast corner with a level of 25.63mAOD. The Site tends to fall towards the northern boundary at an approximate gradient of 1 in 50.

4.3. In **Figure 2** below, the highest part of the parcel is coloured purple and lowest areas are coloured yellow.

Figure 2 - Existing Topography



5. EXISTING WATERBODIES

5.1. No watercourses have been identified on the site. The nearest watercourse to the site is the River Mel which is located approximately 200m northeast of the site. The River Mel is not considered to be a Main River by the EA.

6. GEOLOGY AND HYDROGEOLOGY

6.1. The British Geological Survey (BGS) online Geology of Britain Viewer indicates the site is entirely underlain by Zig Zag Chalk Formation (Chalk). The superficial deposits consist of Chalk and Flint Gravels.

6.2. The BGS map is supported by historic borehole log data obtained from the BGS website for locations between the two parcels and 167m south of the site. These borehole logs have confirmed the presence the chalk down to depths of approximately 29.90mBGL. A groundwater level of 15.24mBGL was recorded in the southern borehole which indicates that groundwater is unlikely to have an impact on the proposed drainage strategy for the site, but monitoring through a winter period is recommended.

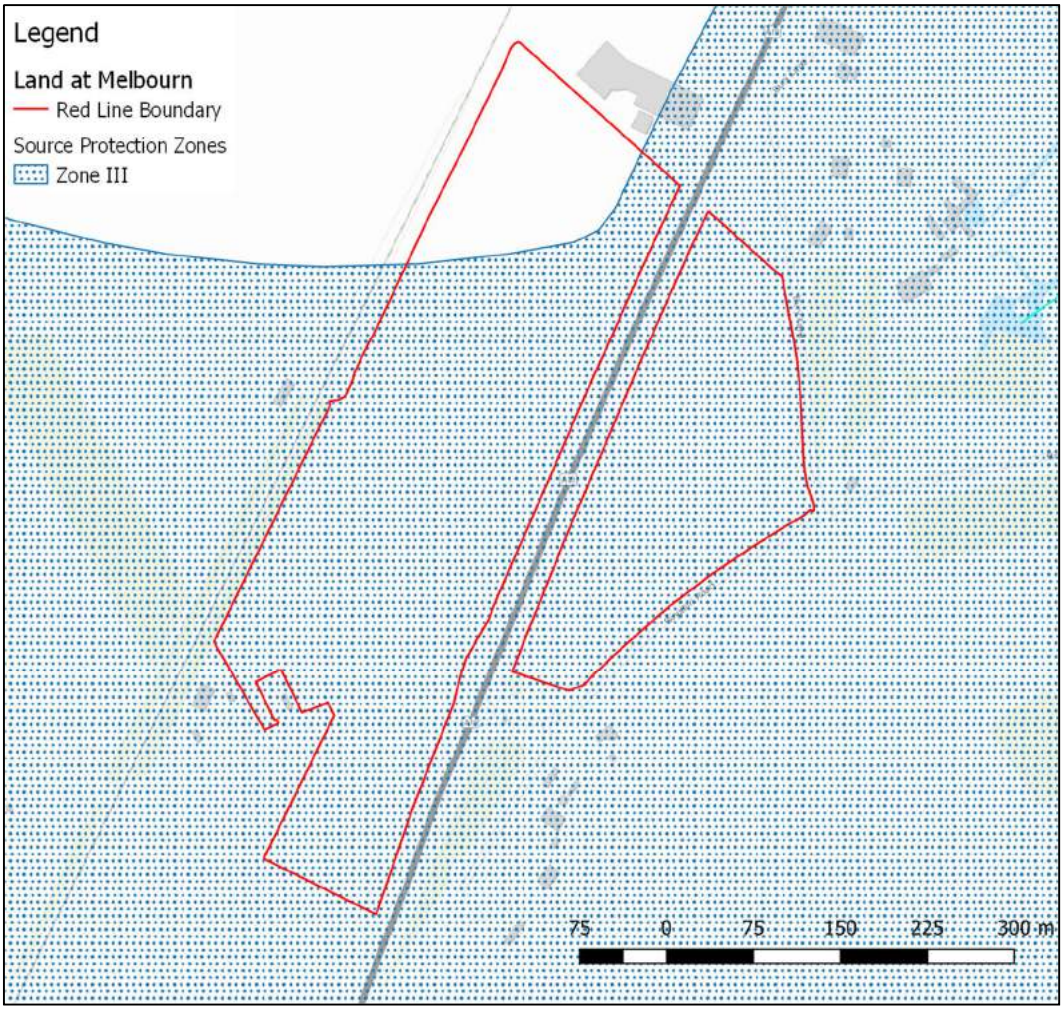
Table 2 – BGS Borehole Log TL34SE12– 167m South of the Site (537100, 243400)

Depth (m)	Stratum Description and Observations
Ground Level – 0.3	Topsoil
0.3 – 13.71	Top Chalk
13.71 – 14.63	Melbourne Rock
14.63 – 25.90	Lower Chalk
End of Borehole at 25.90mBGL (Ground water encountered at 15.24)	

7. GROUNDWATER PROTECTION ZONES

7.1. The majority of the site falls within Groundwater Source Protection Zone 3. See **Figure 3** for the Source Protection Zone Map of the site

Figure 3 – Groundwater Protection Zones



SOURCES OF FLOOD RISK

8. FLOOD RISK SUMMARY

8.1. This chapter assesses the risk of flooding to the site from all current and future potential sources of flooding.

8.2. **Table 3** summarises the findings of the assessment. A more detailed explanation of the flood risk issues on the site and determination of flood risk ratings are presented in sections below.

Table 3 - Degree of risk from each source of Flooding Source Risk

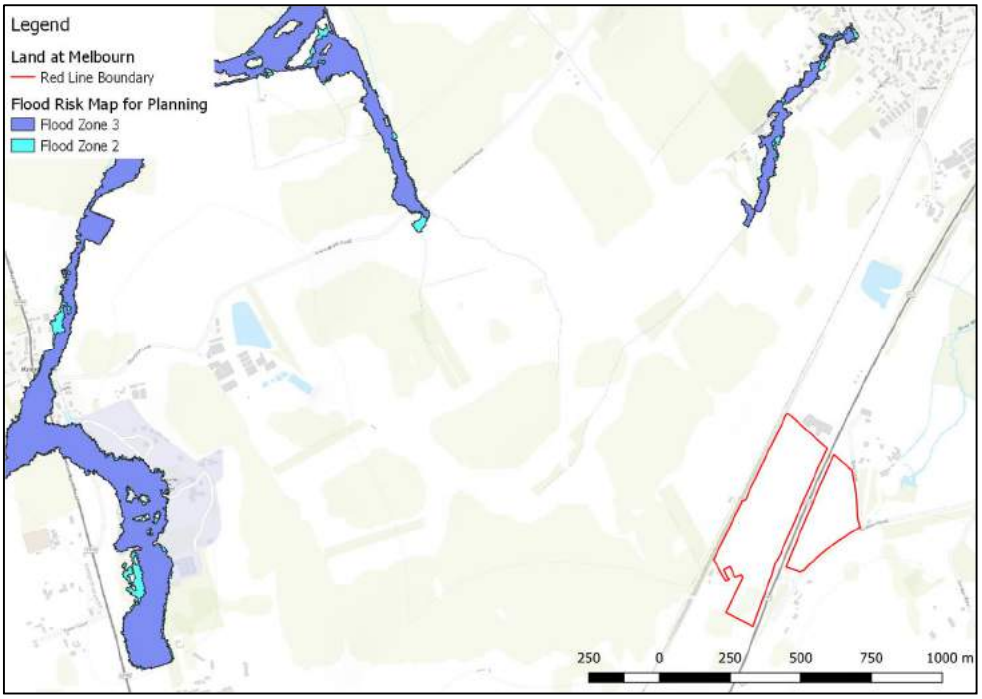
Source	Risk
Fluvial	Low
Surface Water	Low
Ground Water	Low
Sewer	Low
Other – Reservoir	Negligible
Other – Canals	Negligible
Other – Culverts	Negligible

9. FLUVIAL FLOOD RISK

9.1. The Environment Agency's (EA) Flood Map for Planning indicates that the site is located entirely within Flood Zone 1 (low probability); see **Figure 4** below. This means the site is assessed as having less than a 1 in 1,000 annual probability of river or sea flooding (<0.1%).

9.2. Based on the available information, the risk of fluvial flooding is considered to be low for the proposed site.

Figure 4 – Flood Map for Planning



10. SURFACE WATER FLOODING

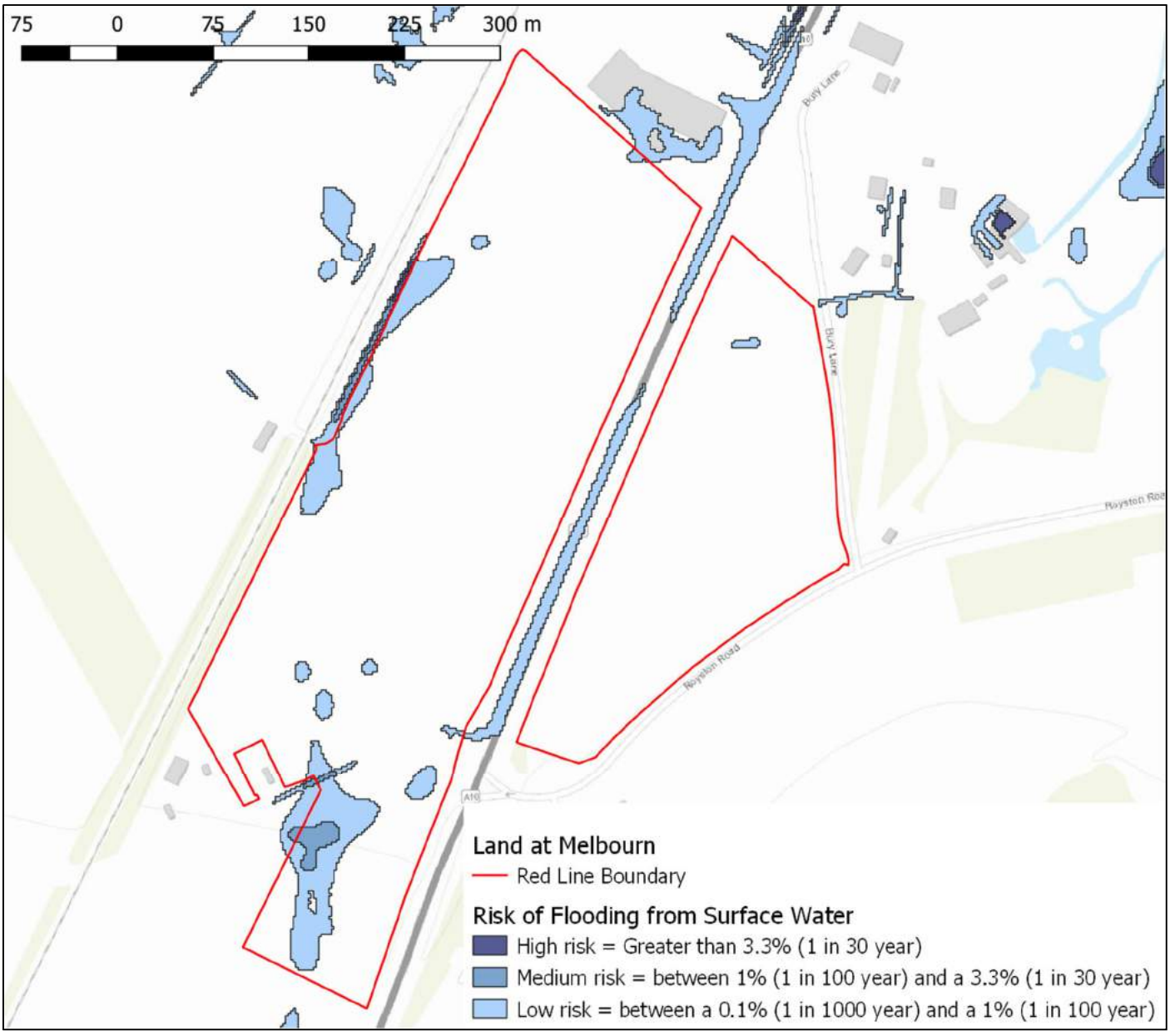
10.1. The surface water flooding was modelled by the EA, identifying areas that may experience ponding during each of a 1 in 30 year, 1 in 100 year and 1 in 1000 year return period storm. The Environment Agency's Risk of Flooding from Surface Water Map (refer to **Figure 5**) indicates that a very small area of land is at up to a medium risk of surface water flooding.

10.2. Based upon a review of the Site LiDAR data, no notable overland flow path have been identified therefore the risk post-development is likely to be mitigated following the implementation of a suitably designed surface water drainage strategy.

10.3. The vast majority of the site is shown to be at a very low risk of surface water flooding.

10.4. Based on the available information, the flood risk from surface water is considered to be low for the proposed site.

Figure 5 – Risk of Flooding from Surface Water



11. GROUND WATER FLOODING

11.1. The water level recorded in BGS Borehole TL34SE12 (see **Section 6** for further details) of 15.24mBGL was recorded 160m south of the site. Based upon the assumption that ground water will not vary considerably within the chalks, ground water is considered unlikely to pose a significant risk of flooding to the site.

11.2. Based on the available information, the risk of groundwater flooding is considered to be low for the proposed site.

12. OTHER SOURCES FLOOD RISK

12.1. Non-natural or artificial sources of flooding can include reservoirs, lakes, canals, culverts etc. The potential effects of flood risk management infrastructure and other structures also needs to be considered.

12.2. Environment Agency Reservoir Flood Mapping shows no risk of flooding from reservoir failure to the site area.

12.3. No canals, ordinary watercourses or canals have been identified in the vicinity of the site that could pose a risk. This analysis is subject to site visit and topographical survey.

13. HISTORICAL FLOOD RECORDS

13.1. From EA Online map of Recorded Flood Outlines, the closest event happened in March 1947 approximately 2.85km to the north.

FLOOD RISK MANAGEMENT AND DRAINAGE STRATEGY

14. SUSTAINABLE DRAINAGE SYSTEMS (SUDS)

14.1. A Sustainable Drainage Systems (SuDS) hierarchy should be followed in applying the use of sustainable drainage techniques to the proposed development. This has been set out in Table 14 below with justifications provided where particular techniques are deemed feasible.

Table 4 – SuDS Feasibility

SuDS Technique	Can they be feasibly incorporated into the site?	Reason
Green Roofs	X /✓	Green roofs may be viable on buildings with flat roofs (subject to structural loadings).
Basins and Ponds	✓	Infiltration basins will be used in both catchments which will provide attenuation, water quality and biodiversity enhancement. Basins are to be sized to provide (in conjunction with other SuDS) adequate attenuation for the 1 in 100 year storm + 40% climate change prior to discharge via infiltration.
Filter Strips and Swales	X /✓	Swales may be utilised within the site to provide treatment, conveyance and attenuation.
Permeable Surfaces and Filter Drains	✓	Permeable surfacing is proposed in communal and parking areas (which are not trafficked by HGVs), this is to provide an element of upstream storage and pre-treatment.
Rainwater Harvesting	X /✓	Rainwater harvesting could be utilised on site, but has not been allowed for within the attenuation calculations as it could be full during the critical event.
Tanked Systems	✓	Offline tank systems are proposed within Employment Park scheme to provide adequate attenuation for the extreme event.

14.2. Planning guidance requires drainage to discharge surface water in line with the following hierarchy:

1. Infiltration
2. Existing Watercourse
3. Existing sewer

14.3. No surface water sewers or watercourses have been identified within the vicinity of the site that would be suitable for the discharge of surface water. Based upon the existing ground conditions, discharge via infiltration should be viable.

14.4. Planning application S/2791/14/OL, on the South Cambridgeshire Planning Portal, for Land to the East of New Road, Melbourn, Cambridgeshire (1.3km to the east of the site) states that "soakaway testing was undertaken in six of the trial pits (TP1, TP7 & TP15 – TP18) in accordance with the methods described in BRE Digest 365 'Soakaway Design' (2007). Each of the six trial pits was filled with clean water from a water bowser on three occasions, with the fall in water level being monitored at regular intervals. An infiltration rate was then calculated for the soils encountered."

14.5. An infiltration rate of 0.105m/hr has been utilised in for this drainage strategy which was the lowest infiltrate rate from the 6 testing locations undertaken at the nearby site as described above.

15. SURFACE WATER DRAINAGE STRATEGY

15.1. As there will be an increase in impermeable area across the site, there will be an increase in the likelihood and magnitude of standing water and surface water runoff occurring. The surface water strategy below has been devised to mitigate this. Refer to drawing 8034-D-01 in **Appendix B** for more details.

15.2. SuDS should be implemented within this development scheme. The conceptual SuDS strategy for the proposed development has been derived using the principles outlined within the CIRIA C753 SuDS Design Manual along with BS 8582:2013 – Code of Practise for Surface Water Management for Development Sites.

15.3. The proposed piped drainage system should be designed such that there is no surcharging in the 1 in 2 year probability event, and no flooding in the 1 in 30 year probability event as per Sewers for Adoption criteria. The piped system should be designed to adoptable standards.

15.4. In order to protect SuDS devices, catchpit manholes will be required prior to the SuDS structures.

15.5. To ensure the effectiveness of the proposed drainage network a robust maintenance regime, in accordance with CIRIA C753, will be implemented to ensure future performance of all SuDS and drainage components. This will include regular cleaning of SuDS devices located on communal areas. It will also be necessary to implement treatment devices such as trapped gullies and catch pit manholes to prevent any contamination and silt ingress into the drainage system.

15.6. The proposed drainage network for both parcels is designed not to exacerbate any existing flood risk associated with properties situated upstream, or downstream, in accordance with principles set out within the NPPF.

15.7. As the expected traffic movements will be in excess of 300 vehicular movements per day for both parcels and as they each lie within Source Protection Zone 3 it is proposed that a minimum of three levels of treatment of surface water are required prior to discharge.

15.8. Due to the nature of the site, the drainage strategy has been detailed in two separate sections. These sections will detail the drainage strategy for the employment park (West) and care village (East).

EMPLOYMENT PARK DRAINAGE STARTEGY

15.9. Source control in the form of green roofs, permeable paving and bioretention areas should be integrated into the masterplan where viable. Exceedance flows from these will be conveyed via an oil separator to the strategic attenuation within the north of the site.

15.10. Prior to discharge to the proposed infiltration basin a sediment forebay is proposed to provide an additional level of treatment. The proposed infiltration basin has been sized to attenuate the development surface water run-off for all events up to 1 in 30 year without overflowing into the proposed cellular storage tank. The MicroDrainage modelling is set out in **Appendix C** and summarised in the tables below.

15.11. During the extreme event, the infiltration basin will overflow via high level pipes to an offline cellular storage tank. This attenuation has been sized to attenuate the development surface water run-off in conjunction with the basin for all events up to the critical 1 in 100 year + 40% climate change below the freeboard. A non-return valve should be fitted on the outlet from the tank to restrict its use for lower return period events.

Table 5 – Employment Park Infiltration Basin

Structure	Contributing Impermeable Area (ha)	Anticipated Infiltration Rate (m/hr)	Structure Depth (m)	Invert Level (mAOD)	Volume Provided (m^3)
Infiltration Basin	12.4	0.105	2.0 + 0.3 Freeboard	24.4	6,610

Table 6 – Employment Park Cell Storage Tank

Structure	Contributing Impermeable Area (ha)	Invert Level (mAOD)	Structure Depth (m)	Structure 2D Area (ha)	Volume Provided (m^3)
Cellular Storage tank	12.4	25.0	0.8	0.541	4,120

CARE VILLAGE DRAINAGE

15.12. The surface water drainage strategy for this parcel consists drainage networks that will be supplemented, where appropriate, with SuDS devices to provide source control, water quality treatment and bio diversity enhancement prior to discharging surface water via infiltration basins in the north of the parcel.

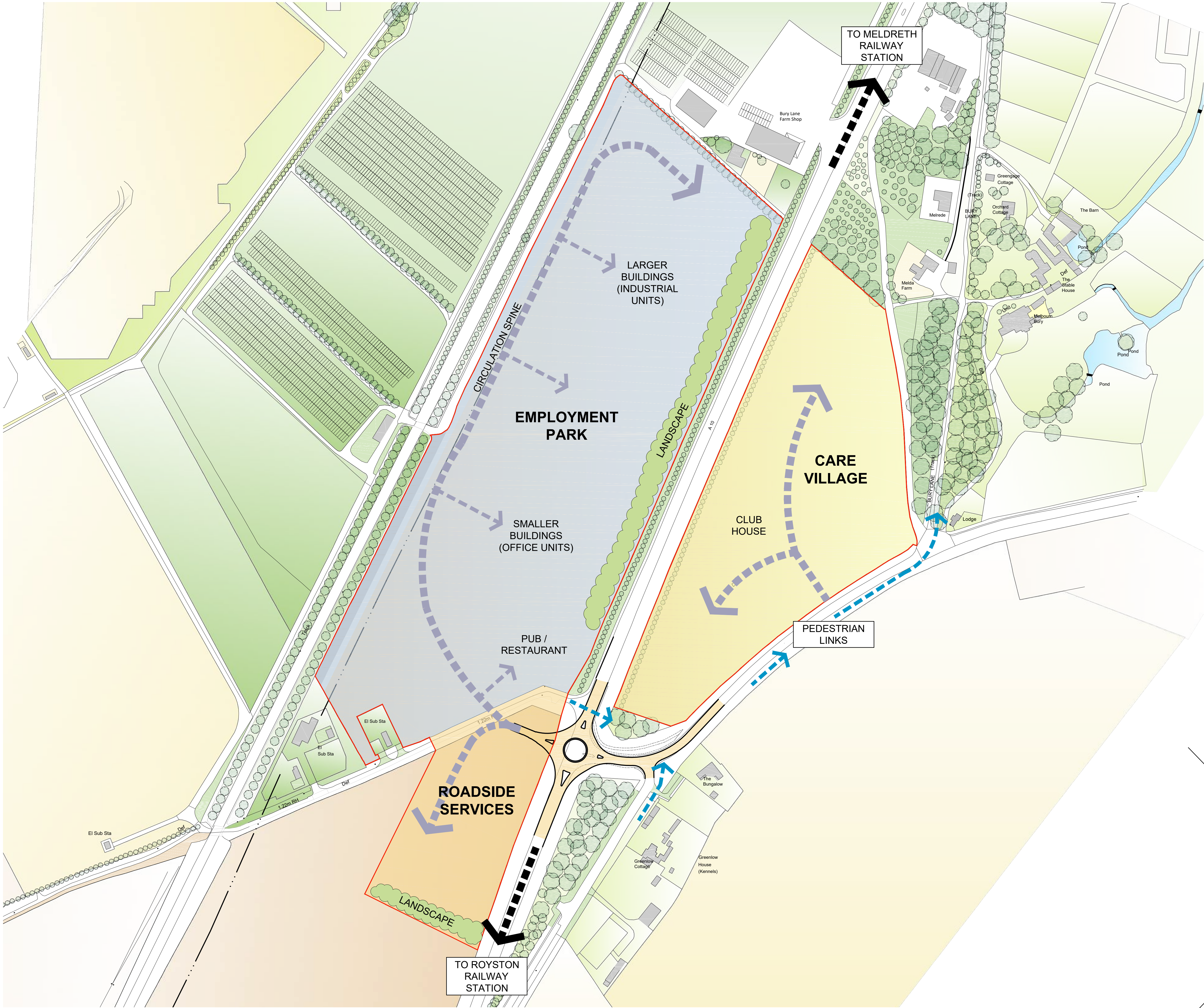
15.13. The proposed infiltration basin has been sized to attenuate the development surface water run-off for all events up to the critical 1 in 100 year + 40% climate change. A sediment forebay Is proposed at the inlet.

15.14. MicroDrainage modelling (set out in **Appendix C**) has been undertaken and the proposed attenuation volume is set out in Table 7.

Table 7 – Care Village Infiltration Basin

Structure	Contributing Impermeable Area (ha)	Anticipated Infiltration Rate (m/hr)	Structure Depth (m)	Invert Level (mAOD)	Volume Provided (m^3)
Infiltration Basin	5.1	0.105	2.0 + 0.3 Freeboard	23.8	3,280

APPENDIX A – SITE MASTERPLAN



Revisions:

ROADSIDE SERVICES

EMPLOYMENT PARK

CARE VILLAGE

VEHICULAR CIRCULATION

PEDESTRIAN LINKS

TRANSPORT LINKS

NOTE: THIS SKETCH LAYOUT IS PRELIMINARY AND IS SUBJECT TO TOPO SURVEYS, SERVICES, AND OTHER CONSULTANT INFORMATION.

WORK IN PROGRESS
BCRI ARCHITECTS
13 MARCH 2019

Purpose of Issue
PRELIMINARY

Project Title
MASTERPLAN
MELBOURN LAND NEAR A10

Drawing Title
SITE PLAN - OPTION 5
CALL FOR SITES

Project Ref	: 1764			
Scale @ A1	: 1:1500	Scale @ A3	:	1:3000
Created By	: KO	Checked By	:	-
Date	: 13.03.2019			
CAD Ref	: 1764 Masterplan Opt5			
Drawing No	: 1764-L1000 CALL	Rev	:	5

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APPENDIX B – SURFACE WATER DRAINAGE STRATEGY

INFILTRATION/ATTENUATION BASIN: BASINS WILL PROVIDE ATTENUATION AND TREATMENT OF STORMWATER AS WELL AS AMENITY AND BIODIVERSITY SPACE.

CELLULAR STORAGE TANKS: CELLULAR STORAGE TANKS PROVIDE AN EFFICIENT MEANS OF SURFACE WATER ATTENUATION AND ARE TYPICALLY LOCATED BENEATH LARGER PAVED AREAS. TANKS DO NOT PROVIDE A LEVEL OF TREATMENT.

PERMEABLE PAVING: PERMEABLE PAVING ALLOWS RAINWATER TO INFILTRATE THROUGH THE SURFACE INTO THE UNDERLYING LAYERS. TREATMENT PROCESS OCCURS WITHIN THE SURFACE STRUCTURE, SUBSURFACE MATRIX AND GEOTEXTILE LAYERS.

BIO RETENTION AREAS: BIO RETENTION PROVIDES A SMALL AMOUNT OF UPSTREAM STORAGE AS WELL AS AN ADDITIONAL SURFACE WATER TREATMENT STAGE PRIOR TO DISCHARGE.

DO NOT SCALE

NOTES

1. ALL LEVELS ARE IN METRES AOD UNLESS OTHERWISE SPECIFIED.
2. FOR PURPOSES OF CALCULATING THE ATTENUATION VOLUME, THE PROPOSED DEVELOPMENT AREAS AS LAID OUT WITHIN DRAWING '1764 MELBOURN MASTERPLAN OPT5 WIP 190313 (002)' RECEIVED FROM PEGASUS ON 13/03/2019 HAVE BEEN ASSUMED AS 100% IMPERMEABLE WITH A RUNOFF COEFFICIENT (Cv) OF 0.95 USED.
3. BASED UPON A REVIEW OF BGS MAPPING IT IS ASSUMED THAT INFILTRATION IS LIKELY TO BE VIABLE WITHIN BOTH PARCELS. AS INFILTRATION TESTING HAS NOT YET BEEN UNDERTAKEN, AN ASSUMED INFILTRATION RATE OF 0.105m/HR HAS BEEN USED. THIS VALUE WAS TAKEN FROM A NEARBY SITE LOCATED 1.3km EAST OF THE PROPOSED DEVELOPMENT SITE THAT FALLS WITHIN A SIMILAR SOIL STRATUM. FURTHER DETAILS OF THIS SITE CAN BE FOUND ON THE SOUTH CAMBRIDGESHIRE PLANNING PORTAL WITH REFERENCE NUMBER S/2791/14/OL.
4. TOPOGRAPHICAL DATA PRODUCED USING LIDAR DATA WHICH IS PUBLICLY AVAILABLE FROM THE ENVIRONMENT AGENCY WEBSITE – https://environment.data.gov.uk/ds/survey/index.jsp#/survey.
5. BASINS ARE TO BE PRIVATELY MAINTAINED.

KEY

- SITE BOUNDARY
- PROPOSED BASIN
- 3m BASIN ACCESS/MAINTENANCE TRACK
- BASIN EARTHWORKS
- PROPOSED CELLULAR STORAGE TANK
- PROPOSED HIGH LEVEL OVERFLOW PIPE
- PROPOSED SEDIMENT FOREBAY AT BASIN INLETS

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	15/03/2019	JAF	FIRST ISSUE	JWB	JWB

DRAWING STATUS: S0 - WORK IN PROGRESS

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CLIENT:

ARCHITECT: PEGASUS GROUP

SITE/PROJECT: LAND AT MELBOURN

TITLE: INDICATIVE SURFACE WATER DRAINAGE STRATEGY

SCALE @ A1:	CHECKED:	APPROVED:
1:2000	JWB	JWB

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
70028034	JAF	JAF	March 19

DRAWING No: 8034-D-01 REV: P01

APPENDIX C – MICRODRAINAGE CALCULATIONS

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Employment Land

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	10	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.450	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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.	0.950	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Employment Land

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	4.891	4-8	6.851	8-12	0.654

Total Area Contributing (ha) = 12.396

Total Pipe Volume (m³) = 637.308

Network Design Table for Employment Land

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	90.000	1.000	90.0	0.805	5.00	0.0	0.600	o	750	Pipe/Conduit	
1.001	90.000	0.430	209.3	0.871	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.002	90.000	0.460	195.7	0.913	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.003	90.000	0.770	116.9	0.829	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.004	90.000	0.390	230.8	0.815	0.00	0.0	0.600	o	975	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.51	28.310	0.805	0.0	0.0	0.0	2.95	1303.6	138.1
1.001	50.00	6.29	27.310	1.676	0.0	0.0	0.0	1.93	852.9	287.5
1.002	50.00	6.96	26.730	2.590	0.0	0.0	0.0	2.24	1422.9	444.2
1.003	50.00	7.47	26.270	3.419	0.0	0.0	0.0	2.90	1843.3	586.4
1.004	50.00	8.17	25.425	4.234	0.0	0.0	0.0	2.16	1614.9	726.2

Network Design Table for Employment Land

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.005	90.000	0.335	268.7	0.820	0.00	0.0	0.600	o	975	Pipe/Conduit	
2.000	90.000	0.184	489.1	1.082	5.00	0.0	0.600	o	825	Pipe/Conduit	
2.001	90.000	0.180	500.0	1.068	0.00	0.0	0.600	o	900	Pipe/Conduit	
2.002	90.000	0.646	139.3	0.909	0.00	0.0	0.600	o	900	Pipe/Conduit	
2.003	90.000	0.290	310.3	0.926	0.00	0.0	0.600	o	975	Pipe/Conduit	
2.004	90.000	0.465	193.5	1.035	0.00	0.0	0.600	o	975	Pipe/Conduit	
3.000	24.672	0.422	58.5	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.001	28.553	0.300	95.2	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.006	77.754	1.329	58.5	2.321	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	50.00	8.92	25.035	5.054	0.0	0.0	0.0	2.00	1496.0	866.9
2.000	50.00	6.12	26.615	1.082	0.0	0.0	0.0	1.34	714.0	185.6
2.001	50.00	7.20	26.356	2.150	0.0	0.0	0.0	1.39	887.1	368.7
2.002	50.00	7.76	26.176	3.059	0.0	0.0	0.0	2.65	1687.7	524.7
2.003	50.00	8.57	25.455	3.986	0.0	0.0	0.0	1.86	1391.3	683.6
2.004	50.00	9.20	25.165	5.020	0.0	0.0	0.0	2.36	1764.3	861.1
3.000	50.00	5.41	25.697	0.000	0.0	0.0	0.0	1.01	7.9	0.0
3.001	50.00	5.61	24.850	0.000	0.0	0.0	0.0	2.30	497.1	0.0
1.006	50.00	9.83	24.400	12.396	0.0	0.0	0.0	2.06	145.6«	2126.2

Manhole Schedules for Employment Land

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)
1	30.260	1.950	Open Manhole	1800	1.000	28.310	750				
2	29.260	1.950	Open Manhole	1800	1.001	27.310	750	1.000	27.310	750	
3	28.830	2.100	Open Manhole	1800	1.002	26.730	900	1.001	26.880	750	
4	28.370	2.100	Open Manhole	1800	1.003	26.270	900	1.002	26.270	900	
5	27.600	2.175	Open Manhole	1875	1.004	25.425	975	1.003	25.500	900	
6	27.210	2.175	Open Manhole	1875	1.005	25.035	975	1.004	25.035	975	
8	28.640	2.025	Open Manhole	1800	2.000	26.615	825				
9	28.980	2.624	Open Manhole	1800	2.001	26.356	900	2.000	26.431	825	
10	28.580	2.404	Open Manhole	1800	2.002	26.176	900	2.001	26.176	900	
11	27.630	2.175	Open Manhole	1875	2.003	25.455	975	2.002	25.530	900	
12	27.340	2.175	Open Manhole	1875	2.004	25.165	975	2.003	25.165	975	
12	28.000	2.303	Open Manhole	1200	3.000	25.697	100				
7	27.200	2.350	Open Manhole	1500	3.001	24.850	525	3.000	25.275	100	
7	26.700	2.300	Open Manhole	1875	1.006	24.400	300	1.005	24.700	975	975
								2.004	24.700	975	975
								3.001	24.550	525	375
	26.700	3.629	Open Manhole	0		OUTFALL		1.006	23.071	300	

PIPELINE SCHEDULES for Employment Land

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	750	1	30.260	28.310	1.200	Open Manhole	1800
1.001	o	750	2	29.260	27.310	1.200	Open Manhole	1800
1.002	o	900	3	28.830	26.730	1.200	Open Manhole	1800
1.003	o	900	4	28.370	26.270	1.200	Open Manhole	1800
1.004	o	975	5	27.600	25.425	1.200	Open Manhole	1875
1.005	o	975	6	27.210	25.035	1.200	Open Manhole	1875
2.000	o	825	8	28.640	26.615	1.200	Open Manhole	1800
2.001	o	900	9	28.980	26.356	1.724	Open Manhole	1800
2.002	o	900	10	28.580	26.176	1.504	Open Manhole	1800
2.003	o	975	11	27.630	25.455	1.200	Open Manhole	1875
2.004	o	975	12	27.340	25.165	1.200	Open Manhole	1875
3.000	o	100	12	28.000	25.697	2.203	Open Manhole	1200
3.001	o	525	7	27.200	24.850	1.825	Open Manhole	1500
1.006	o	300	7	26.700	24.400	2.000	Open Manhole	1875

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	90.000	90.0	2	29.260	27.310	1.200	Open Manhole	1800
1.001	90.000	209.3	3	28.830	26.880	1.200	Open Manhole	1800
1.002	90.000	195.7	4	28.370	26.270	1.200	Open Manhole	1800
1.003	90.000	116.9	5	27.600	25.500	1.200	Open Manhole	1875
1.004	90.000	230.8	6	27.210	25.035	1.200	Open Manhole	1875
1.005	90.000	268.7	7	26.700	24.700	1.025	Open Manhole	1875
2.000	90.000	489.1	9	28.980	26.431	1.724	Open Manhole	1800
2.001	90.000	500.0	10	28.580	26.176	1.504	Open Manhole	1800
2.002	90.000	139.3	11	27.630	25.530	1.200	Open Manhole	1875
2.003	90.000	310.3	12	27.340	25.165	1.200	Open Manhole	1875
2.004	90.000	193.5	7	26.700	24.700	1.025	Open Manhole	1875
3.000	24.672	58.5	7	27.200	25.275	1.825	Open Manhole	1500
3.001	28.553	95.2	7	26.700	24.550	1.625	Open Manhole	1875
1.006	77.754	58.5		26.700	23.071	3.329	Open Manhole	0

Area Summary for Employment Land

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.805	0.805	0.805
1.001	User	-	100	0.871	0.871	0.871
1.002	User	-	100	0.913	0.913	0.913
1.003	User	-	100	0.829	0.829	0.829
1.004	User	-	100	0.815	0.815	0.815
1.005	User	-	100	0.820	0.820	0.820
2.000	User	-	100	1.082	1.082	1.082
2.001	User	-	100	1.068	1.068	1.068
2.002	User	-	100	0.909	0.909	0.909
2.003	User	-	100	0.926	0.926	0.926
2.004	User	-	100	1.035	1.035	1.035
3.000	-	-	100	0.000	0.000	0.000
3.001	-	-	100	0.000	0.000	0.000
1.006	User	-	100	2.321	2.321	2.321
				Total	Total	Total
				12.396	12.396	12.396

Free Flowing Outfall Details for Employment Land

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.006		26.700	23.071	0.000	0	0

Simulation Criteria for Employment Land

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	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	10	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

Online Controls for Employment Land

Non Return Valve Manhole: 7, DS/PN: 3.001, Volume (m³): 4.3

Pump Manhole: 7, DS/PN: 1.006, Volume (m³): 143.8

Invert Level (m) 24.400

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0000	0.900	0.0000	1.700	0.0000	2.500	0.0000
0.200	0.0000	1.000	0.0000	1.800	0.0000	2.600	0.0000
0.300	0.0000	1.100	0.0000	1.900	0.0000	2.700	0.0000
0.400	0.0000	1.200	0.0000	2.000	0.0000	2.800	0.0000
0.500	0.0000	1.300	0.0000	2.100	0.0000	2.900	0.0000
0.600	0.0000	1.400	0.0000	2.200	0.0000	3.000	0.0000
0.700	0.0000	1.500	0.0000	2.300	0.0000		
0.800	0.0000	1.600	0.0000	2.400	0.0000		

Offline Controls for Employment Land

Pipe Manhole: 7, DS/PN: 1.006, Loop to PN: 3.001

Diameter (m)	-1	Roughness k (mm)	0.600
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	26.150

Storage Structures for Employment Land

Cellular Storage Manhole: 7, DS/PN: 3.001

Invert Level (m) 25.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	5410.0	0.0	0.801	0.0	0.0
0.800	5410.0	0.0			

Infiltration Basin Manhole: 7, DS/PN: 1.006

Invert Level (m) 24.400 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.10500 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.10500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2365.2	2.000	3994.8	2.300	4275.8

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Employment Land

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	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.450
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.950

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	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, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	15 Winter	1	+0%	100/15 Winter			
1.001	2	15 Winter	1	+0%	100/15 Winter			
1.002	3	15 Winter	1	+0%	100/15 Winter			
1.003	4	15 Winter	1	+0%	100/15 Winter			
1.004	5	15 Winter	1	+0%	100/15 Winter			
1.005	6	15 Winter	1	+0%	30/15 Winter			
2.000	8	15 Winter	1	+0%	100/15 Winter			
2.001	9	15 Winter	1	+0%	100/15 Winter			
2.002	10	15 Winter	1	+0%	100/15 Winter			
2.003	11	15 Winter	1	+0%	100/15 Winter			
2.004	12	15 Winter	1	+0%	100/15 Winter			
3.000	12	2160 Winter	1	+0%	100/720 Winter			
3.001	7	2160 Winter	1	+0%	100/180 Winter			
1.006	7	720 Winter	1	+0%	1/15 Winter		100/60 Winter	17

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Employment Land

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	1	28.477	-0.583	0.000	0.11		129.2	OK	
1.001	2	27.596	-0.464	0.000	0.30		235.2	OK	
1.002	3	27.053	-0.577	0.000	0.28		347.3	OK	
1.003	4	26.590	-0.580	0.000	0.27		444.2	OK	
1.004	5	25.845	-0.555	0.000	0.38		536.5	OK	
1.005	6	25.510	-0.500	0.000	0.48		621.9	OK	
2.000	8	26.912	-0.528	0.000	0.26		163.8	OK	
2.001	9	26.737	-0.519	0.000	0.36		281.7	OK	
2.002	10	26.489	-0.587	0.000	0.26		386.9	OK	
2.003	11	25.885	-0.545	0.000	0.40		481.5	OK	
2.004	12	25.581	-0.559	0.000	0.38		583.0	OK	
3.000	12	25.697	-0.100	0.000	0.00		0.0	OK	
3.001	7	24.850	-0.525	0.000	0.00		0.0	OK	
1.006	7	25.191	0.491	0.000	0.00	0.0	0.0	SURCHARGED	

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

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	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.450
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.950

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	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, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	15 Winter	30	+0%	100/15 Winter			
1.001	2	15 Winter	30	+0%	100/15 Winter			
1.002	3	15 Winter	30	+0%	100/15 Winter			
1.003	4	15 Winter	30	+0%	100/15 Winter			
1.004	5	15 Winter	30	+0%	100/15 Winter			
1.005	6	960 Winter	30	+0%	30/15 Winter			
2.000	8	15 Winter	30	+0%	100/15 Winter			
2.001	9	15 Winter	30	+0%	100/15 Winter			
2.002	10	15 Winter	30	+0%	100/15 Winter			
2.003	11	15 Winter	30	+0%	100/15 Winter			
2.004	12	960 Winter	30	+0%	100/15 Winter			
3.000	12	2160 Winter	30	+0%	100/720 Winter			
3.001	7	2160 Winter	30	+0%	100/180 Winter			
1.006	7	960 Winter	30	+0%	1/15 Winter		100/60 Winter	17

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

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	1	28.578	-0.482	0.000	0.27		317.0	OK	
1.001	2	27.818	-0.242	0.000	0.77		591.5	OK	
1.002	3	27.290	-0.340	0.000	0.69		864.1	OK	
1.003	4	26.817	-0.353	0.000	0.67		1099.0	OK	
1.004	5	26.306	-0.094	0.000	0.86		1220.0	OK	
1.005	6	26.055	0.045	0.000	0.09		111.8	SURCHARGED	
2.000	8	27.172	-0.268	0.000	0.62		398.6	OK	
2.001	9	27.040	-0.216	0.000	0.89		696.0	OK	
2.002	10	26.698	-0.378	0.000	0.62		931.1	OK	
2.003	11	26.214	-0.216	0.000	0.94		1147.0	OK	
2.004	12	26.056	-0.084	0.000	0.07		112.6	OK	
3.000	12	25.697	-0.100	0.000	0.00		0.0	OK	
3.001	7	24.850	-0.525	0.000	0.00		0.0	OK	
1.006	7	26.055	1.355	0.000	0.00	0.0	0.0	SURCHARGED	

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

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	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.450
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.950

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	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, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	15 Winter	100	+40%	100/15 Winter			
1.001	2	15 Winter	100	+40%	100/15 Winter			
1.002	3	15 Winter	100	+40%	100/15 Winter			
1.003	4	15 Winter	100	+40%	100/15 Winter			
1.004	5	15 Winter	100	+40%	100/15 Winter			
1.005	6	15 Winter	100	+40%	30/15 Winter			
2.000	8	15 Winter	100	+40%	100/15 Winter			
2.001	9	15 Winter	100	+40%	100/15 Winter			
2.002	10	15 Winter	100	+40%	100/15 Winter			
2.003	11	15 Winter	100	+40%	100/15 Winter			
2.004	12	15 Winter	100	+40%	100/15 Winter			
3.000	12	1440 Winter	100	+40%	100/720 Winter			
3.001	7	2160 Winter	100	+40%	100/180 Winter			
1.006	7	240 Winter	100	+40%	1/15 Winter		100/60 Winter	17

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

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	1	29.112	0.052	0.000	0.49		573.9	SURCHARGED	
1.001	2	29.031	0.971	0.000	1.22		940.9	FLOOD RISK	
1.002	3	28.615	0.985	0.000	0.98		1231.6	FLOOD RISK	
1.003	4	28.190	1.020	0.000	0.98		1597.5	FLOOD RISK	
1.004	5	27.441	1.041	0.000	1.38		1944.5	FLOOD RISK	
1.005	6	26.673	0.663	0.000	1.72		2250.6	SURCHARGED	
2.000	8	28.625	1.185	0.000	1.07		681.2	FLOOD RISK	
2.001	9	28.492	1.236	0.000	1.46		1141.9	SURCHARGED	
2.002	10	28.180	1.104	0.000	1.04		1545.7	SURCHARGED	
2.003	11	27.507	1.077	0.000	1.58		1925.2	FLOOD RISK	
2.004	12	26.746	0.606	0.000	1.51		2331.5	SURCHARGED	
3.000	12	26.243	0.446	0.000	-0.05		-0.4	SURCHARGED	
3.001	7	26.411	1.036	0.000	0.27		109.8	SURCHARGED	
1.006	7	26.444	1.744	0.000	0.00	519.1	0.0	FLOOD RISK	