TECHNICAL NOTE

Job Name: Green Park Interchange

Job No: 36382/2011

Note No: 36382/2011/TN001 **Rev C**

Date: 22nd December 2017 – **Rev C 21st February 2020**

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Checked By: C Brown

Approved By: S Earl

Subject: **Flood Risk and Proposed Surface Water Drainage – Station Building, Eastern Platform and Interchange**

1. Introduction

Stantec have been commissioned by Reading Borough Council (RBC) to complete a detailed design of the surface water drainage for Green Park Transport Interchange, including an allowance for surface water discharge from the proposed station building and eastern platform (station surface water to be designed by others). To gain planning permission, a Flood Risk Assessment (FRA) (reference 28791/4001; date Oct 2014) was submitted to RBC outlining the requirements for flood risk and the proposed surface water drainage strategy. There are three RBC planning conditions relating to surface water drainage and flood risk; these are:

- RBC Planning condition 30 – Design of the Surface Water Drainage
- RBC Planning Condition 29 – Compliance with Flood Risk Assessment
- RBC Planning condition 27 –Avoidance of construction of soakaways in contaminated land
-

These planning conditions can be found in **Appendix A**

This Technical Note outlines the proposed surface water drainage design to be constructed, and addresses the planning conditions listed above, as well as the following conditions associated with the station building.

19/01468/FUL

- WBC planning condition 7 – SuDS
- WBC planning condition 8 – Soakaways

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- RBC planning condition 8 – Design of Drainage

2. Proposed Surface Water Drainage Strategy

Discharge Destination

In accordance with the discharge destination hierarchies of the National Planning Practice Guidance, an assessment of the suitability of the site to utilise infiltration drainage techniques has been undertaken.

See the Planning Practice Guidance

This states:

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

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

Geo-environmental Report on Ground Conditions (Document reference 11321 / 4004 Rev 01; dated Oct 2010) and Geoenvironmental Data (technical note No. TN02/GEO; dated 24th October 2014 – submitted as part of the Interchange planning application – See Appendix E) outlines that the site was formerly used as a waste transfer site and that the composition of the made ground under the site has the potential to impact water quality.

The mitigation measures outlined in these geoenvironmental reports include a lined drainage system and measures to ensure no uncontrolled discharges, including run-off.

As such the proposed surface water strategy will discharge into the existing surface water body via a lined surface water drainage system. The proposed surface water network will discharge via a proposed headwall into the surface water lake along the eastern edge of the site.

The proposed outfall invert level will be set at 38.866m which is the modelled flood level for 1 in 100 year flood event. This outfall level has been set to allow cover of around 800mm to the surface water drainage pipe work under the proposed interchange carriageway in the north western edge of the site. The proposed pipe will be concrete encased for additional protection.

To mimic the effect of climate change, the surface water network was modelled to have a surcharged outfall to the 1 in 100 year flood event plus 20% climate change flood level (39.10m) to meet the Interchange planning condition.

This has also been checked against the 1 in 100 flood event plus 40% climate change flood level for the station building planning application.

Peak Flow Control – Defra Technical Standard S2

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

In accordance with best practice the proposed surface water drainage strategy seeks to reduce the peak discharge rate from the site to '*should never exceed greenfield runoff rate*'.

In addition, RBC planning condition 30 states that 'run off rates will be limited to greenfield rates and the discharge volumes will be limited either by using infiltration drainage or where this is not practical the run-off rate will be limited to Qbar of 2l/s/ha and additional attenuation provided to ensure no increase of flood risk downstream.'

As infiltration techniques will not be used, the proposed drainage scheme will provide attenuation to reduce the total peak discharge rate from the 0.9ha site to 5 l/s, which is the practical minimum to avoid blockage.

Table 1 below shows the Calculated Greenfield Runoff Rates as outlined in the Flood Risk Assessment for the site.

Rainfall Event	Greenfield Runoff Rate (l/s/ha)	Greenfield Runoff Rate (l/s) (Site Area 0.9ha)	Designed Rate from Microdrainage model (l/s)
1 in 1 year	3.16	2.84	5.0
1 in 30 year	8.32	7.49	5.0
1 in 100 year	11.85	10.67	5.0
1 in 100 year + 20% CC	-	-	5.0
1 in 100 year + 40% CC	-	-	5.0

Table 1: Calculated Greenfield Runoff Rates

This represents a reduction of greater than 50% on the existing greenfield run-off rate in the 1 in 100 year rainfall event.

The EA's *Flood Risk Assessments: Climate Change Allowances* guidance, which supports the NPPF, provides contingency allowances for potential increases in sea level, peak river flow and rainfall intensity.

In accordance with this guidance, the potential for increased pluvial (rainfall) flood probability as the result of possible climate change has been taken into account, over the lifetime of the development, through a +20% allowance for increases in peak rainfall intensity within the surface water drainage design. This represents the central limit for the climate change period up to 2115. This has also been checked against the upper end limit for the climate change period up to 2115 (40% allowance).

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115	Comment
Upper End	10%	20%	40%	**20% allowance applied** for 'more vulnerable' development in Flood Zone 1, not within a known flood risk area with a 100 year life expectancy (checked against 40%)
Central	5%	10%	20%	

Table 2: Flood Risk Assessments: Climate Change Allowances Table 2 Peak Rainfall Intensity Allowance in Small and Urban Catchments (use 1961 to 1991 baseline)

In order to demonstrate that the proposed peak discharge rates are deliverable within the development layout the surface water drainage network has been modelled. A copy of the Proposed Surface Water Drainage drawing (36382/2002/SK114) and accompanying MicroDrainage calculations are contained within **Appendices B and C** respectively.

S4 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

The development proposals will increase the existing level of impermeability across the site and as such the volumetric run-off will be increased. However, the proposed drainage scheme will introduce attenuation and reduce the peak rate of run-off to the practical minimum. Therefore, the volumetric run-off will be reduced in any given storm duration compared to the existing unrestricted greenfield run-off rate.

Flood Risk within the Development – Defra Technical Standards S7 to S9

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

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

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

The proposed outline surface water drainage network has been designed to demonstrate that the peak discharge rate can be achieved with no flooding in a 1 in 30 year or a 1 in 100 year rainfall event.

SuDS Selection

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

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

The NPPG paragraph 051 describes SuDS as follows:

> *'Sustainable drainage systems are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible.* ***They provide opportunities to:***
>
> - *reduce the causes and impacts of flooding;*
> - *remove pollutants from urban run-off at source;*
> - *combine water management with green space with benefits for amenity, recreation and wildlife.'*

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

For the Green Park Interchange development it is considered that open surface SuDS are not appropriate due to the density of the development. Therefore, a system which utilises cellular attenuation tanks is proposed.

Cellular crate storage will provide the primary attenuation required for management of the 100 year + 40% storm event.

The proposed system follows the principles of the NPPG SuDS requirements by reducing flood risk and removal of pollutants / contaminants through the use of trapped gullies, catchpits / silt traps and an oil interceptor.

Structural Integrity – Defra Technical Standards S10 & S11

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

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

The components that make up any drainage network have different life expectances which can be greatly affected by the effectiveness of their maintenance regime and upstream sediment capture/management.

Green Park Interchange drainage network comprises a piped network, inspection chambers / catchpits, cellular crate storage and hydraulic flow controls. As with any drainage system, this network requires regular inspection and maintenance to ensure that the individual components continue to operate as designed, both in terms of hydraulic capacity and potential pollutant removal.

All the drainage manholes, catchpits and gullies will therefore be inspected and cleaned regularly by a Reading Borough Council within the Interchange. The drainage located in Network Rail land will be maintained and inspected by Network Rail. Refer to Appendix F for the proposed drainage for the Station itself.

3. Maintenance Strategy

This section sets out the inspection and maintenance requirements for long term management of the development's surface water drainage system. These works within the Interchange is to be undertaken by Reading Borough Council.

Health, Safety and Welfare

All those responsible for maintenance should take appropriate health, safety and welfare precautions for all activities, including lone working if relevant, and risk assessments should always be undertaken. The site's infrastructure Health and Safety File should be consulted before carrying out any works either inside or outside of the development's boundary and information regarding the location of existing utilities passed on to operatives.

The requirements of the Health and Safety at Work Act 1974 and The Construction (Design and Management) Regulations 2015 should be adhered to and any residual risks identified in the Health and Safety File should be managed and information passed on to maintenance operatives through task specific risk assessments.

Operation and Maintenance

There are three types of maintenance activities associated with surface water drainage systems. The SuDS Manual, CIRIA C753, defines these as:

- Regular Maintenance – '*basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections*.'
- Occasional Maintenance – *'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example.'*
- Remedial Maintenance – *'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.*'

Specific maintenance needs should be monitored and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

Operation and Maintenance Activity	SuDS Component		
	Piped Network / Inspection Chambers	Cellular / Modular Storage	Oil Interceptor
Regular Maintenance			
Inspection	■	■	■
Litter and debris removal	■	□	□
Grass cutting			
Weed and invasive plant control			
Occasional Maintenance			
Sediment management[1]	■	■	■
Vacuum sweeping and brushing			
Remedial Maintenance			
Structure rehabilitation / repair	□	□	□
■ Will be required □ May be required [1] Sediment should be collected and managed in pre-treatment systems, upstream of the main device.			

Table 3: Extract from The SuDS Manual

Piped Network / Inspection Chambers

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

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

Table 4: Piped Network / Inspection Chambers operation and maintenance

Cellular / Modular Storage

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

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required take remedial action	Monthly for three months, then annually
	Remove debris from catchment surface (where may cause risks to performance)	Monthly
	Remove sediment from pre-treatment structures and / or catchpits	Annually, or as required
Remedial Maintenance	Repair / rehabilitate inlets, outlets, overflows and vents	As required
Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually, and after large rainfall events
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required
Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of storage units is required.	As required

Table 5: The SuDS Manual Table 21.3: Operation and maintenance requirements for attenuation storage tanks

4. Fill Material

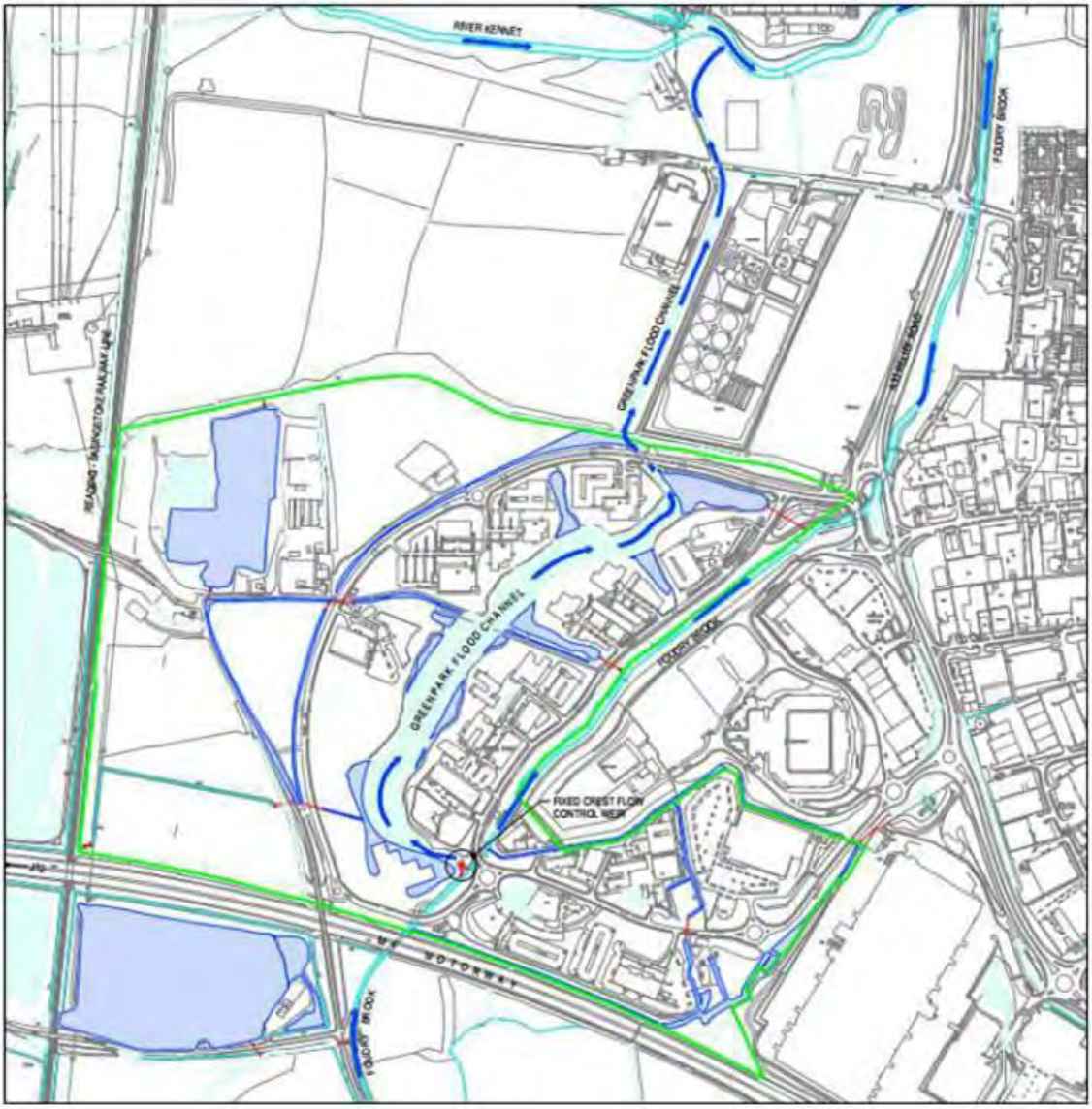
Within the FRA (reference 28791/4001; date Oct 2014), there is a requirement that the fill material is to have an infiltration rate of 1x10-5 m/s to allow for soakaways. Due to the potential for contaminated land and potential to contaminate the ground water it is not appropriate to use infiltration drainage. In addition there are higher costs associated to fill material with a material with an infiltration rate of 1x10-5 m/s, therefore a cohesive Class 2 material will be used with a lower infiltration rate.

5. Flood Compensation

The site lies within the area of land designated as part of the 'Green Park Flood Management Scheme' (GPFMS), a floodplain management scheme devised in the 1980s in order to facilitate the development of all the Green Park phases and alleviate an existing flooding problem in South

Reading. The RBC SFRA provides details of this scheme in Section 7.2 and states that "the scheme is designed to reduce the flood risk associated with the Foudry Brook whilst at the same time allowing further land raising to facilitate the entire Green Park development. The majority of the scheme has now been implemented. The original scheme requires that any losses in flood storage within boundary ditches will need to be compensated for on an area for area basis at the 37.8m contour". See SFRA Figure 7.2 below (extent of GPFMS shown by green outline with designated flood storage areas in blue)

Figure 7.2: Overview of Green Park Floodplain Management Strategy



This Strategy was developed in order to facilitate the development of all the phases of Green Park and alleviate the flooding problems in the South Reading area. The GPFMS determined that 16ha of flood storage area has been dedicated to serve the Green Park development and enable development of the site. The proposed railway station building lies on land above the designated contour level of 37.8m AOD, and therefore floodplain compensation is not required for this element.

As a consequence of this, there would not be any requirement to provide floodplain compensation for the ground raising associated with the development – effectively, this compensatory flood storage was already provided as part of the original Strategy and the site lies within the extent of permissible

development based on the Strategy (for reference, the site is on a consented development platform of between 41.0 and 41.5m AOD, well above the modelled 1 in 100 annual probability +70% allowance for climate change flood level in any case (39.4m AOD)).

This approach was reconfirmed and accepted by the EA during the consultation period of the original Green Park Station scheme.

The FRA (reference 28791/4001; date Oct 2014), recommends flood compensation is provided however it was subsequently agreed in April 2015 with the Environment Agency (reference WA/2015/119569/02-L01) that flood compensation is not required as the area was included in the wider Floodplain Management Strategy. See **Appendix D** for details.

6. Construction Programme

Construction of the adjacent Transport Interchange (covered by RBC planning application 141944, approved on 8th May 2015) commenced in March 2019. Piling works for the station platforms are currently due to commence in Summer 2020.

Construction of the station building is currently programmed for completion in Spring 2021, and the currently project completion date is Spring 2021.

The key dates on the latest construction programme (January 2020) are shown below.

Access Date: Spring 2019

Start on Site (Interchange and enabling works): April 2019

Platform works commence: Summer 2020

Station Building works commence: Summer 2020

Completion Date: Spring 2021

7. Conclusion

Technical Note No TN02/GEO (See Appendix E) submitted as part of the Interchange planning application outlines that for the protection of the controlled waters the proposed surface water drainage system is to be lined and therefore, the site will not use infiltrating drainage techniques. As such the proposed surface water strategy will discharge into the existing surface water lake at the eastern edge of the site.

The proposed drainage scheme will provide attenuation to reduce the total peak discharge rate to 5 l/s in both the 1 in 100 year + 20% Climate Change (CC) and 1 in 100 year + 40% Climate Change events, which represents a reduction greater than 50% on the existing greenfield run-off rate.

In accordance with Table 2 of the EA's Flood Risk Assessments: Climate Change Allowances guidance, an allowance of 20% has been added to the peak rainfall intensities in the 1 in 100 year design storm event to account for the potential effects of climate change (and checked for an allowance of 40%).

The proposed surface water system utilises cellular crate storage to provide attenuation and water quality improvements in the management of run-off. The proposed system follows the principles of the NPPG SuDS requirements by reducing flood risk and removal of pollutants / contaminants through the use of trapped gullies, catchpits / silt traps and an oil interceptor.

As the landowner of the Interchange, Reading Borough Council will be responsible for the long term maintenance of the proposed system and will undertake inspection and maintenance in accordance with this Strategy.

As a result, the principles advocated by relevant national, regional and local planning policy guidance have been satisfactorily addressed.

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Manager)
36382-2011-TN001	-	22.12.17	GR/AM/RT	CB	CB	SE
36382-2011-TN001	B	13.12.19	GR	RT	GR	GR
36382-2011-TN001	C	21.02.20	RT	GR	GR	GR

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Appendix A

Planning Conditions relating to surface water drainage and flood risk.

RBC Planning condition 27 states the following:
The development hereby permitted shall not be commenced until such time as a scheme to dispose of surface water that ensures that no soakaways are constructed in contaminated ground, has been submitted to, and approved in writing by the Local Planning Authority. The scheme shall be implemented as approved.
Core Strategy Policy CS34: Pollution and Water Resources

RBC Planning Condition 29 states the following:
The development hereby permitted shall only be carried out in accordance with approved Flood Risk Assessment (FRA) ref: 28791/4001 undertaken by Peter Brett Associates, dated October 2014.
Reason: To reduce the risk of flooding. This condition is imposed in accordance with the National Planning Policy Framework (March 2012), and Policy CS16 of the West Berkshire Core Strategy (2006-2026).

RBC Planning condition 30 states the following:
No development shall commence on the railway station hereby approved until a surface water drainage scheme has been submitted to and approved in writing by the Local Planning Authority. Before these details are submitted an assessment shall be carried out of the potential for disposing of surface water by means of a sustainable drainage systems March 2015, and the results of the assessment provided to the local planning authority. Where a sustainable drainage scheme is to be provided, the submitted details shall:
i. provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of the receiving groundwater and/or surface waters;
ii. Include a timetable for its implementation; and
iii. provide a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime. Run off rates will be limited to greenfield rates and the discharge volumes will be limited either by using infiltration drainage or where this is not practical the run-off rate will be limited to Qbar of 2l/s/ha and additional attenuation provided to ensure no increase of flood risk downstream.
iv. Thereafter, the railway station shall not be brought into use until the surface water drainage scheme has been implemented in accordance with the requirements pf part ii) of this condition. Thereafter the approved surface waste drainage scheme shall be maintained and operated in accordance with the approved details.
Reason: To prevent the increased risk of flooding, to improve and protect water quality, improve habitat and amenity, and ensure future maintenance of the surface water drainage system. This condition is imposed in accordance with the National Planning Policy Framework (March 2012), Policy CS16 of the West Berkshire Core Strategy (2006-2026), and Supplementary Planning Document Quality Design (June 2006).

Appendix B

Drawing Numbers:

- 36382/2002/SK114
- 36382/2011/SD03
- 36382/2011/SD04

GULLY SCHEDULE (CENTRE POINTS)

ITEM	EASTING	NORTHING
G1	469550.990	170181.814
G2	469552.652	170196.000
G3	469554.560	170212.211
G4	469555.714	170218.904
G5	469561.990	170222.301
G6	469567.423	170216.867
G7	469567.463	170216.339
G8	469565.698	170200.619
G9	469563.004	170177.871
G10	469554.476	170162.497
G11	469549.987	170166.099

GULLY SCHEDULE (CENTRE POINTS)

ITEM	EASTING	NORTHING
G12	469598.315	170196.557
G13	469597.735	170190.781
G14	469597.813	170187.946
G15	469598.983	170186.944
G16	469593.456	170177.975
G17	469596.711	170173.558
G18	469594.713	170156.580
G19	469587.200	170140.449
G20	469577.157	170148.009
G21	469560.940	170154.867
G22	469560.493	170154.711

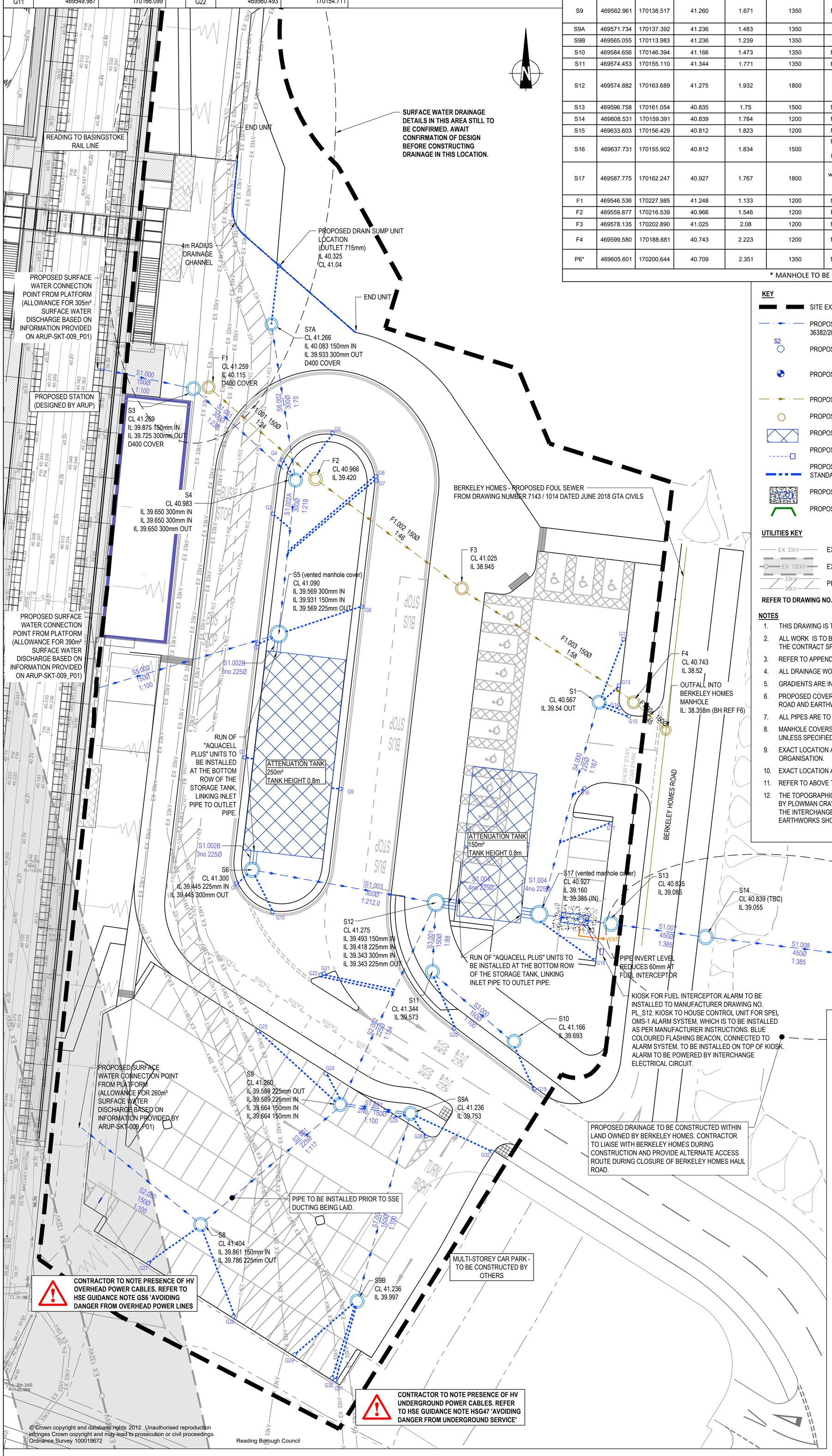
GULLY SCHEDULE (CENTRE POINTS)

ITEM	EASTING	NORTHING
G23	469552.693	170147.673
G24	469561.157	170142.353
G25	469569.585	170137.080
G26	469573.667	170134.534
G27	469539.039	170118.729
G28	469549.626	170112.083
G29	469557.283	170107.325
G30	469561.926	170104.394
G31	469562.330	170104.109
G32	469581.914	170132.628

Manhole Schedule

US/MH Name	Easting (m)	Northing (m)	Cover Level (m)	Manhole depth (m)	Manhole Diam.,L*W (mm)	Manhole Type	Incoming pipe No.	Incoming invert (m)	Incoming diameter (mm)	Outgoing pipe No.	Outgoing invert (m)	Outgoing diameter (mm)
S1	469595.252	170188.686	40.567	1.027	1350	MH TYPE 2				S4.000	39.540	225
S2												
S3	469544.642	170227.790	41.269	1.544	1350	MH TYPE 2	S1.000	39.875 39.875	150 100	S1.001	39.725	300
S4	469557.369	170216.381	40.983	1.333	1350	CP TYPE 1	S1.001 S6.002	39.650 39.650	300 300	S1.002A	39.650	300
S5	469555.275	170197.194	41.090	1.521	1500	CP TYPE 1 with vent from cellular storage	S1.002A S5.000	39.569 39.931	300 150	S1.002B	39.569	225 (3No)
S6	469551.947	170167.785	41.300	1.855	1500	CP TYPE 1	S1.002B	39.445	225 (3no)	S1.003	39.445	300
S7												
S7A	469554.370	170235.843	41.266	1.333	1350	CP TYPE 1	S6.001	39.993	300	S6.002	39.933	300
S8	469545.520	170123.549	41.404	1.618	1350	MH TYPE 2	S2.000	39.861	150	S2.001	39.786	225
S9	469562.961	170138.517	41.260	1.671	1350	MH TYPE 2	S2.001 S7.001	39.589 39.664	225 150 (2No.)	S2.002	39.589	225
S9A	469571.734	170137.392	41.236	1.483	1350	CP TYPE 1	S7.000	40.295	150	S7.001	39.753	150 (2No.)
S9B	469565.055	170113.983	41.236	1.239	1350	CP TYPE 1				S7.000	39.997	150
S10	469584.656	170146.394	41.166	1.473	1350	MH TYPE 2				S3.000	39.693	150
S11	469574.453	170155.110	41.344	1.771	1350	MH TYPE 2	S3.000	39.573	150	S3.001	39.573	150
S12	469574.882	170163.689	41.275	1.932	1800	CP TYPE 1	S1.003 S2.002 S3.001	39.343 39.418 39.493	300 225 150	S1.004	39.343	225 (4no)
S13	469596.758	170161.054	40.835	1.75	1500	MH TYPE 2	S1.006	39.085	450	S1.007	39.085	450
S14	469608.531	170159.391	40.839	1.784	1200	MH TYPE 2	S1.007	39.055	450	S1.008	39.055	450
S15	469633.603	170156.429	40.812	1.823	1200	MH TYPE 2	S1.008	38.989	450	S1.009	38.989	450
S16	469637.731	170155.902	40.812	1.834	1500	MH TYPE 3 with Hydrobrake	S1.009	38.978	450	S1.010	38.978	150
S17	469587.775	170162.247	40.927	1.767	1800	CP TYPE 1 with vent from cellular storage	S1.004 S4.000	39.160 39.160	225 (4 no) 225	S1.005	39.160	450
F1	469546.536	170227.985	41.248	1.133	1200	MH TYPE 2				F1.001	40.115	150
F2	469559.877	170216.539	40.966	1.546	1200	MH TYPE 2	F1.001	39.420	150	F1.002	39.420	150
F3	469578.135	170202.890	41.025	2.08	1200	MH TYPE 2	F1.002	38.945	150	F1.003	38.945	150
F4	469599.580	170188.681	40.743	2.223	1200	MH TYPE 2	F1.003	38.52	150	F1.004	38.52	150
P6*	469605.601	170200.644	40.709	2.351	1350	MH TYPE 2	F1.002	38.358	150	BH SEWER	38.358	225

* MANHOLE TO BE CONSTRUCTED BY BERKELEY HOMES



KEY

- SITE EXTENTS
- PROPOSED SURFACE WATER HIGHWAY DRAIN (GRADIENT AND PIPE SIZE). SEE STANDARD DETAIL 36382/2011/SD06 FOR BEDDING DETAIL
- S2 — PROPOSED SURFACE WATER MANHOLE REFER TO MANHOLE SCHEDULE
- PROPOSED SURFACE WATER FLOW CONTROL MANHOLE.
- PROPOSED FOUL WATER SEWER
- PROPOSED FOUL WATER MANHOLE
- PROPOSED LINED CELLULAR STORAGE TANK SEE STANDARD DETAIL 36382/2011/SD04
- PROPOSED TRAPPED GULLY AND CONNECTION. REFER TO STANDARD DETAIL 36382/2011/SD06
- PROPOSED CHANNEL DRAIN (ACO M150D CONSTANT OVERALL DEPTH 210mm OR EQUIVALENT APPROVED). SEE STANDARD DETAIL 36382/2011/SD03
- PROPOSED FUEL INTERCEPTOR REFER TO DRAWING NO. 36382/2011/SD13 FOR DETAILS.
- PROPOSED HEADWALL

UTILITIES KEY

- EX 33kV — EXISTING ELECTRICITY - 33KV UNDERGROUND TO BE DIVERTED
- EX 132kV — EXISTING ELECTRICITY - 132 KV OVERHEAD AND SAFETY CLEARANCE ZONE
- 33kV / 33kV — PROPOSED 33Kv ELECTRICITY UNDERGROUND CABLE CORRIDOR

REFER TO DRAWING NO. 36382/2001/SK060 & SK072 FOR DETAILS

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER CONTRACT DOCUMENTS AND DRAWINGS.
2. ALL WORK IS TO BE IN ACCORDANCE WITH THE HIGHWAYS AGENCY SPECIFICATION FOR HIGHWAYS WORK VOLUME 1 AND THE CONTRACT SPECIFIC NUMBERED APPENDICES.
3. REFER TO APPENDIX 5/1 OF THE SPECIFICATION FOR DETAILS.
4. ALL DRAINAGE WORKS ARE TO COMMENCE AT THE OUTFALL AND WORK UPSTREAM.
5. GRADIENTS ARE INDICATED FOR HYDRAULIC PURPOSES ONLY AND SHOULD NOT BE USED FOR SETTING OUT.
6. PROPOSED COVER LEVELS SHOWN ARE INDICATIVE FOR DRAINAGE PURPOSES AND ARE TO BE CHECKED AGAINST FINISHED ROAD AND EARTHWORK LEVELS.
7. ALL PIPES ARE TO BE CONNECTED WITH LEVEL SOFFITS UNLESS OTHERWISE STATED.
8. MANHOLE COVERS IN CARRIAGEWAY AND PARKING AREAS TO BE D400. B125 IN FOOTWAYS, VERGES AND PEDESTRIAN AREAS UNLESS SPECIFIED OTHERWISE.
9. EXACT LOCATION AND SETTING OUT OF PROPOSED GULLY LOCATIONS TO BE AGREED ON-SITE WITH THE OVERSEEING ORGANISATION.
10. EXACT LOCATION AND SETTING OUT OF MANHOLE COVERS TO BE AGREED ON-SITE WITH THE OVERSEEING ORGANISATION.
11. REFER TO ABOVE TABLES FOR SETTING OUT INFORMATION, DO NOT USE MICRO-DRAINAGE OUTPUT FOR CONSTRUCTION.
12. THE TOPOGRAPHICAL SURVEY FOR THE RAILTRACK IS TAKEN FROM THE SURVEY ORIGINALLY COMPLETED IN JANUARY 2017 BY PLOWMAN CRAVEN AND VERIFIED IN AUGUST 2018 BY PLOWMAN CRAVEN. REFER TO DIRECTLY TO SURVEY FOR DETAILS. THE INTERCHANGE AREA HAS BEEN FILLED BY BERKELEY HOMES TO 40.2M AND HAS NOT BEEN SURVEYED, AS SUCH THE EARTHWORKS SHOWN UNDER THE INTERCHANGE ARE INDICATIVE

Mark	Revision	Date	Drawn	Chkd	Appd

SCALING NOTE: Do not scale this drawing - any errors or omissions shall be reported to Stantec without delay.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Drawing Issue Status

FOR PLANNING

GREEN PARK STATION PROPOSED INTERCHANGE DRAINAGE LAYOUT

Client

Reading Borough Council — Working better with you

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READING
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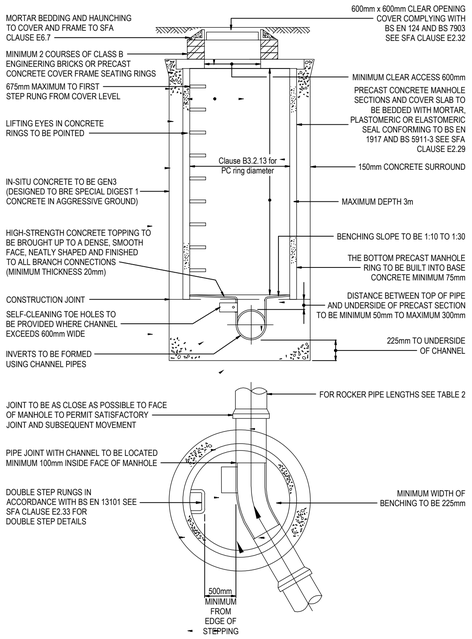
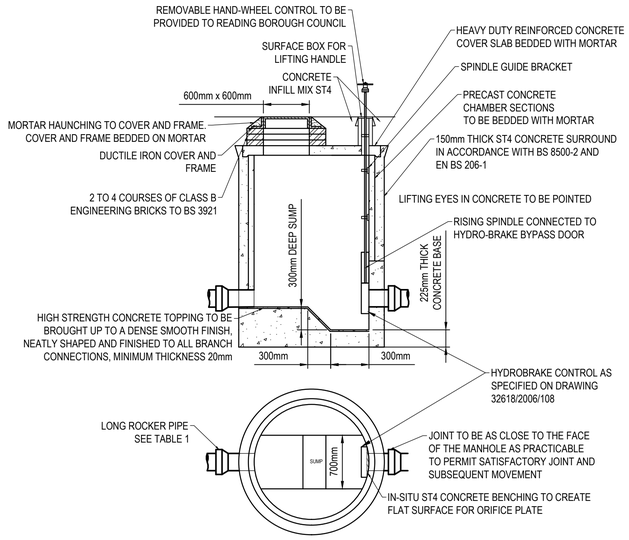
Date of 1st Issue	Designed	Drawn
20.02.20	RT	SF
A1 Scale	**Checked**	**Approved**
1:250	GR	-

Drawing Number: 36382/2002/SK123

Revision: -



MANHOLE TYPE 2 DETAILS



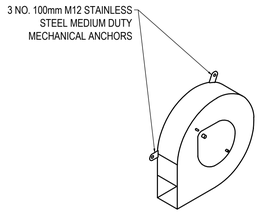
TYPE 3 FLOW CONTROL MANHOLE

MANHOLE AND INSPECTION CHAMBER NOTES

1. CONSTRUCTION SHALL COMPLY WITH THE REQUIREMENTS AND SPECIFICATION OF MCHW AND THOSE SPECIFIC REQUIREMENTS OF THE ADOPTING STATUTORY UNDERTAKER.
2. ALL PIPES TO BE EITHER VITRIFIED CLAY OR CONCRETE AS PER THE MCHW.
3. RISING SPINDLE AND GUIDE BRACKETS TO BE STAINLESS STEEL A131 316L TO BS EN 10088.
4. HYDROBRAKE TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURES INSTRUCTIONS.

Table 1

Pipe Dia.	Rocker Length
150 - 600	0.600
601 - 750	1.000
750 +	1.250



NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS AND DOCUMENTS.
2. ALL WORKS IS TO BE DONE IN ACCORDANCE WITH THE HIGHWAY AGENCY SPECIFICATION FOR HIGHWAY WORKS VOLUME 1 AND CONTRACT SPECIFIC APPENDICES.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

GULLY DETAILS-

4. GRATINGS AND FRAMES SHALL BE IN ACCORDANCE WITH THE FOLLOWING:
   - BS EN124:1994 CLASS D400 FOR USE IN CARRIAGEWAYS AND BUS BAYS ETC.
   - MIN C250 FOR USE IN FOOTWAYS
5. BRICKWORK SHALL BE CLASS B ENGINEERING TO BS 3921 LAID IN MORTAR TO DESIGNATION (1). IN ENGLISH BOND.
6. GULLY POTS SHALL NORMALLY BE:
   - CONCRETE TO BS 5911 PART 230
   - VITRIFIED CLAY TO BS 65 AND BS EN 295
   - POTS SHALL BE 450Ø x 900 DEEP IN CARRIAGEWAYS AND 375Ø x 750 DEEP IN FOOTWAYS
7. SLOTS IN GRATINGS SHALL NOT BE PARALLEL TO THE DIRECTION OF THE TRAFFIC.
8. HINGED CAPTIVE GRATINGS MUST BE USED. END HINGED GRATINGS MUST BE SET WITH HINGE TOWARDS APPROACHING TRAFFIC.
9. BRICK GULLIES AND CAST - IN SITU CONCRETE GULLIES MAY ONLY BE USED WITH THE APPROVAL OF THE ENGINEER WHERE SPACE IS LIMITED.
10. CONNECTIONS TO CARRIER DRAINS SHALL BE BY MEANS OF 'Y' JUNCTIONS OR SADDLES AS APPROPRIATE.
11. PERMITTED MATERIALS TO BE AGREED WITH ENGINEER. MINIMUM PIPE STRENGTH TO BE 20kN/m (PROOF). ALL PIPES TO BE IMPERVIOUS.
12. ALL WORK TO BE IN ACCORDANCE WITH THE HIGHWAYS AGENCY SPECIFICATION FOR HIGHWAYS WORKS VOLUME 1 AND THE CONTRACT SPECIFIC NUMBERED APPENDICES.
13. ALL ADOPTABLE WORKS TO BE CARRIED OUT IN ACCORDANCE WITH SEWERS FOR ADOPTION 7TH EDITION.

CHANNEL DRAIN DETAIL-

14. RODDABLE TRAPPED SUMP UNITS TO BE POSITIONED AT CONNECTION TO DRAIN. SEE LAYOUTS.
15. LOADINGS TO BS EN 124:1994.
16. FOR SURFACING DETAILS REFER TO LANDSCAPE ARCHITECTS DRAWINGS.
17. IF PAVIOURS ARE TO BE LOCATED DIRECTLY ADJACENT TO SLOT THESE AREA TO BE BEDDED USING A POLYMER MODIFIED MORTAR (BY CRETEPLUS OR SIMILAR APPROVED).

CATCHPIT DETAILS-

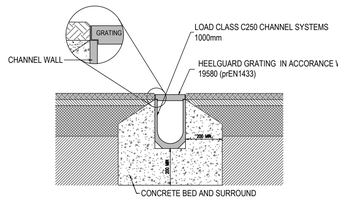
18. REFER TO DRAWINGS 36234/2002/1a/13 & 14 AND APPENDIX 5/1 OF THE SPECIFICATION LOCATIONS AND TYPES OF SPECIFIC CATCH PITS. THE FINAL POSITION OF CHAMBERS AND DUCTS TO BE AGREED WITH THE OVERSEEING ORGANISATION ON SITE. ALL CHAMBERS TO BE LOCATED IN FOOTWAY OR VERGE.
19. CHAMBERS SHALL BE CONCRETE STAKKA BOX JOINT BOX SYSTEM SUPPORTED BY NAL LTD. OR BRICKWORK (OR ALTERNATIVE APPROVED).
20. CHAMBER TYPE AND NUMBER OF STACKING SECTIONS WILL DEPEND ON PIPE INVERT LEVELS. CONTRACTOR TO INVESTIGATE ALL EXISTING DRAINAGE AS AN EARLY ACTIVITY AND REPORT FINDINGS TO THE ENGINEER A MINIMUM OF 2 WEEKS PRIOR TO COMMENCING DRAINAGE WORKS.
21. CHAMBER COVERS AND FRAMES TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATION AND RECOMMENDATIONS.
22. IDS BLACK ANTI-SLIP COMPOSITE COVER OR EQUIVALENT APPROVED, WITH AN UNLOCK AND LIFT DEVICE.

MANHOLE DETAILS -

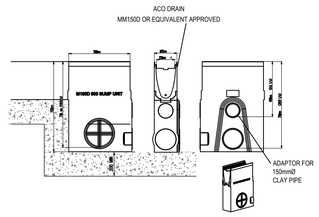
23. FOR DATED REFERENCES, SUBSEQUENT AMENDMENTS TO, OR REVISIONS OF, ANY OF THESE PUBLICATION DO NOT APPLY. FOR UNDATED REFERENCES, THE LATEST EDITION OF THE PUBLICATION REFERRED TO APPLIES.
24. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND THE SPECIFICATION.
25. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY. ALL DIMENSIONS ARE IN MILLIMETRES.
26. MANHOLE COVERS AND FRAMES - SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 124. THEY SHALL BE OF A NON-ROCKING DESIGN WHICH DOES NOT RELY ON THE USE OF CUSHION INSERTS. CLASS D400 COVERS SHALL BE USED IN CARRIAGEWAYS OF ROADS (INCLUDING PEDESTRIAN STREETS), HARD SHOULDERS AND PARKING AREAS USED BY ALL TYPES OF ROAD VEHICLE. CLASS B125 SHALL BE USED IN FOOTWAYS, PEDESTRIAN AREAS AND COMPARABLE LOCATIONS. MINIMUM FRAME DEPTHS FOR NRSWA ROAD CATEGORIES 1 TO IV SHALL BE 150mm (EXCEPT RESIDENTIAL CUL-DE-SACS WHERE THE MINIMUM FRAME DEPTH SHALL BE 100mm). ALL MANHOLES COVERS SHALL BE THE NON-VENTILATING TYPE AND HAVE CLOSED KEYWAYS. IN VERGES COVERS SHALL BE POSITIONED ON THE SIDE FURTHEST FROM THE CARRIAGEWAY.
27. BRICKS - SHALL BE CLASS B ENGINEERING COMPLYING WITH THE RELEVANT PROVISIONS OF BS 3921. ALL BRICKS SHALL BE FROST RESISTANT CATEGORY F. BRICKS SHALL BE LAID IN ENGLISH BOND.
28. MORTAR - SHALL BE MIXED ONLY AS AND WHEN REQUIRED, IN THE PROPORTION 1:3 CEMENT:SAND BY VOLUME. ALL MORTAR SHALL BE CONVEYED FRESH TO THE WORKS AS REQUIRED FOR USE. MORTAR WHICH HAS BEGUN TO SET OR WHICH HAS BEEN MIXED FOR A PERIOD OF MORE THAN 1 HOUR SHALL NOT BE USED.
29. SANDS FOR MORTAR - SHALL BE WASHED SAND, COMPLYING WITH BS 1200 AND GRADED IN ACCORDANCE WITH TABLE 1 OF THAT STANDARD.
30. CEMENT (FOR INSITU CONCRETE AND MORTAR) - SHALL BE SULPHATE RESISTING PORTLAND CEMENT (SRPC) COMPLYING WITH BS 4027.
31. CEMENT (FOR PRECAST CONCRETE PIPES OR MANHOLES) - SHALL BE A COMBINATION OF CEMENT CONFORMING TO BS 12 AND g.g.b.s OR p.f.a. OR CEMENT CONFORMING TO BS 4027 ALONE TO MEET UP TO AND INCLUDING DESIGN SULPHATE CLASS DS-3 AS DEFINED IN BRE SPECIAL DIGEST 1, 2001.
32. WATER FOR USE WITH CEMENT - SHALL BE OF POTABLE QUALITY.
33. PRECAST CONCRETE MANHOLE COMPONENTS - SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS 5911-200. UNITS WHICH BED INTO BASES SHALL BE MANUFACTURED SO THAT IMPOSED VERTICAL LOADS ARE TRANSMITTED DIRECTLY VIA THE FULL WALL THICKNESS OF THE UNIT. FOR JOINTS BETWEEN UNITS AND THE UNDERSIDE OF SLABS, JOINT PROFILES SHALL BE CAPABLE OF WITHSTANDING APPLIED LOADINGS FROM SUCH SLABS, AND SPIGOT-ENDED SECTIONS SHALL ONLY BE USED WHERE THE SOFFIT OF THE SLAB IS RECESSED TO RECEIVED THEM.
34. IN SITU CONCRETE - STANDARDISED PRESCRIBED CONCRETE MIX ST4 (UNREINFORCED) IN ACCORDANCE WITH BS 8500-2 AND BS EN 206-1 SHALL BE USED WITH A 20mm NOMINAL MAXIMUM SIZE OF AGGREGATE AND A CLASS S2 (75mm) SLUMP. ADMIXTURES (INCLUDING CALCIUM CHLORIDE AND PIGMENTS) SHALL NOT BE USED IN THE PRODUCTION OF CONCRETE. COMPRESSIVE STRENGTH TESTING SHALL NOT BE USED TO JUDGE THE COMPLIANCE OF A CONCRETE, BUT WHERE REQUIRED BY THE ADOPTING AUTHORITY, THE CONTRACTOR SHALL PROVIDE EVIDENCE OF THE BATCH MASSES USED TO PRODUCE ANY CONCRETE.

    NB STANDARDISED PRESCRIBED CONCRETE PRODUCED USING SULFATE-RESISTING PORTLAND CEMENT IS NOT INTENDED TO PRODUCE SULFATE-RESISTING CONCRETE. WHERE THE DESIGN SULPHATE CLASS IS HIGHER THAN DESIGN CHEMICAL CLASS DS-2, IN-SITU (AND PRECAST CONCRETE, WHERE APPLICABLE) SHALL BE AS DESIGNATED ON THE CONTRACT SPECIFIC DRAINAGE LAYOUT DRAWING, MANHOLE SCHEDULE OR SPECIFICATION.
35. AGGREGATES FOR CONCRETE - SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS 882*.
36. HIGH STRENGTH CONCRETE TOPPING - SHALL BE PRODUCED, LAID AND FINISHED IN ACCORDANCE WITH THE RELEVANT PROVISIONS OF BS 8204: PART 2 AND THE FOLLOWING APPROXIMATE MIX PROPORTIONS BY WEIGHT SHALL BE USED: 1 PART CEMENT, 1 PART NATURAL SAND AND 2 PARTS SINGLE SIZED COARSE AGGREGATE.
37. AGGREGATE FOR HIGH STRENGTH CONCRETE TOPPING - SHALL COMPLY WITH BS 882* AND BE 10mm NOMINAL SIZE, GRADED IN ACCORDANCE WITH TABLE 6 OF THAT STANDARD.

    *WHEN THIS STANDARD IS SUPERSEDED BY EN 12620, THE AGGREGATES SHALL FOLLOW THE RECOMMENDATIONS IN THE UK NATIONAL GUIDANCE TO EN 12620.
38. ALL ADOPTABLE WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH SEWERS FOR ADOPTION 6th EDITION.
39. ALL THE ABOVE REQUIREMENTS SHALL APPLY UNLESS OTHERWISE STATED IN THE DRAINAGE LAYOUT DRAWING, MANHOLE SCHEDULE OR SPECIFICATION. IN THE EVENT OF A CONTRADICTION THE CONTRACT SPECIFIC DOCUMENTS SHALL BE DEEMED TO PREVAIL.
40. CONSTRUCTION SHALL COMPLY WITH THE REQUIREMENTS AND SPECIFICATION OF SEWERS FOR ADOPTION (SFA) 6th EDITION AND THOSE SPECIFIC REQUIREMENTS OF THE ADOPTING STATUTORY UNDERTAKER.
41. TYPE 2 MANHOLE MAXIMUM DEPTH FROM COVER LEVEL TO SOFFIT OF PIPE TO BE 3.0m.
42. ALL PIPES TO BE EITHER VITRIFIED CLAY OR CONCRETE AS PER THE SFA SPECIFICATION. ALL JOINTS AND MATERIALS SHALL BE RESISTANT TO CORROSION AND THE PARTICULAR NATURE OF THE CONTAMINANTS FOUND ON THE SITE AS DETAILED IN THE PROJECT GROUND INVESTIGATION.
43. RISING SPINDLE AND GUIDE BRACKETS TO BE STAINLESS STEEL A131 316L TO BS EN 10088.
44. HYDROBRAKE TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURES INSTRUCTIONS.

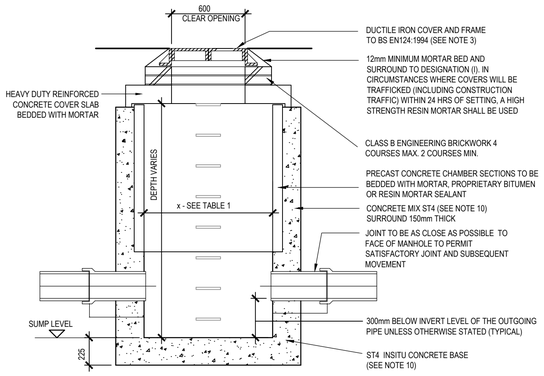


SECTION



SUMP UNIT

CHANNEL DRAIN DETAIL



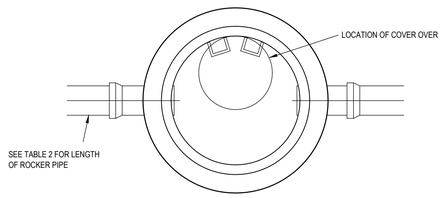
PIPE DIAMETER	DIAMETER OF CHAMBER
LESS THAN 375	1200*
375 - 450	1350
500 - 700	1500
750 - 900	1800

* IN AREAS CONSTRAINED BY UTILITIES, 1200mm Ø CHAMBERS HAVE BEEN REPLACED WITH RECTANGULAR 600x750mm PRECAST CONCRETE CHAMBERS.

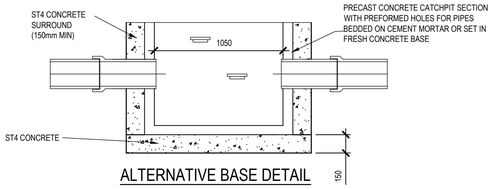
TABLE 1

PIPE DIAMETER	ROCKER PIPE LENGTH
150 - 600	0.6
601 - 750	1.0
750 & OVER	1.25

TABLE 2

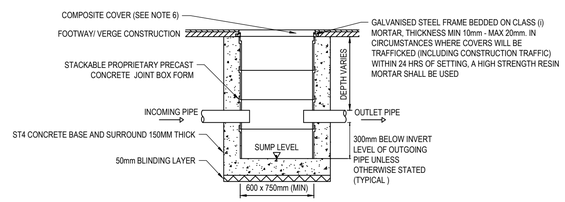


TYPICAL PLAN



ALTERNATIVE BASE DETAIL

CATCHPIT DETAIL TYPE 1 (1.5 - 3.0m DEEP)



CATCHPIT DETAIL TYPE 2 (TO 1.5m DEEP)

Mark	Revision	Date	Drawn	Chkd	Appd
C3	ACO drain update	12.03.19	SF	GR	MF

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.
UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status
FOR CONSTRUCTION

GREEN PARK STATION
PROPOSED INTERCHANGE LAYOUT
DRAINAGE CONSTRUCTION DETAILS

Client
Reading Borough Council
Working better with you

Date of 1st Issue	Designed	Drawn
09.03.18	RT	SF
A1 Scale	Checked	Approved
NTS	RT	MF

Drawing Number: 36382/2011/SD03
Revision: C3

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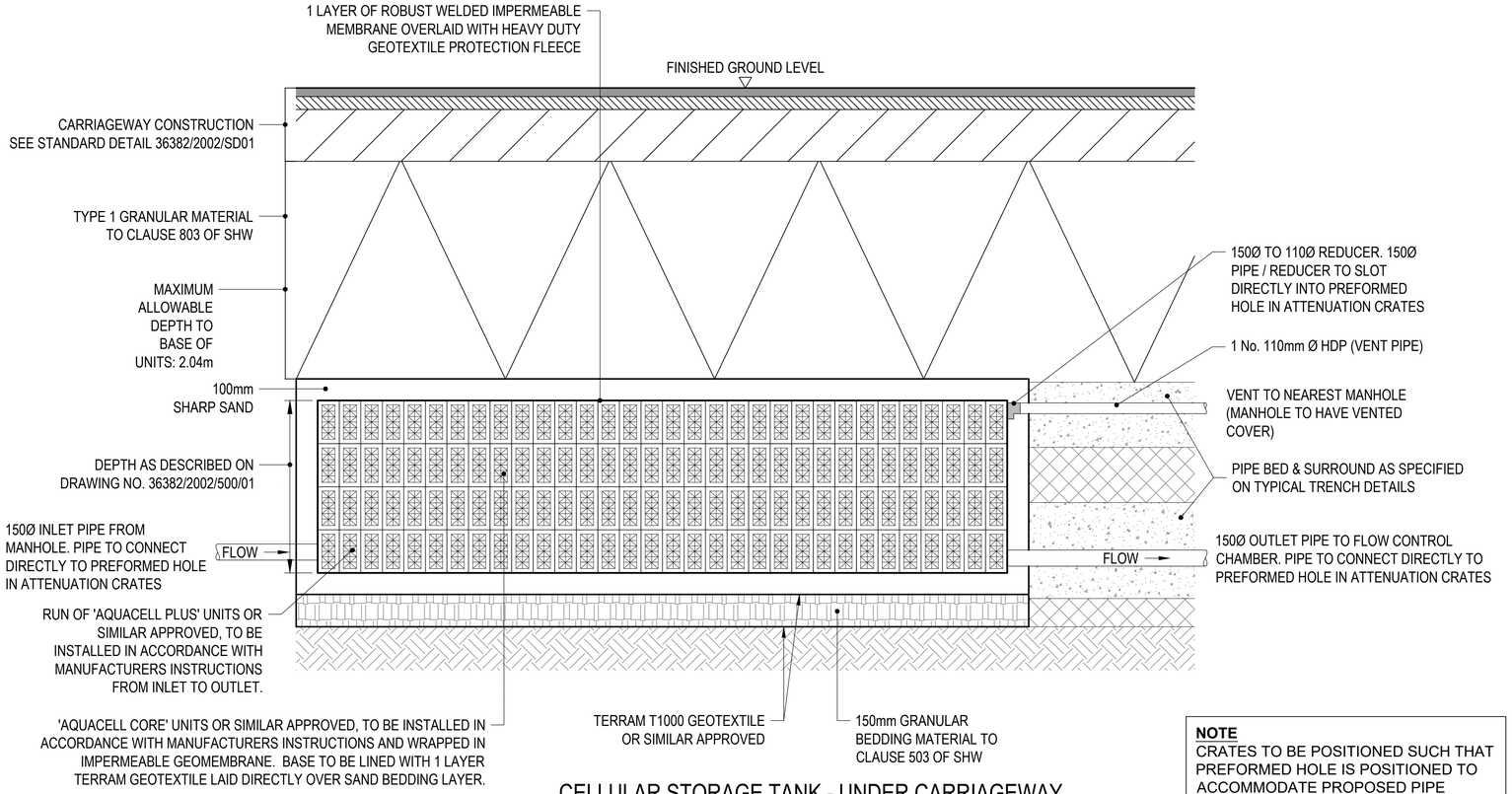
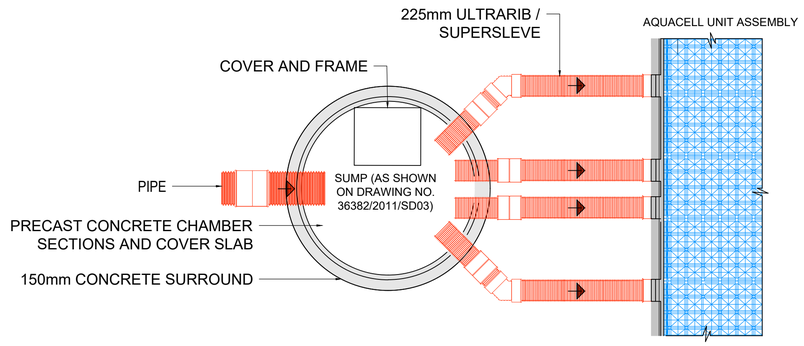


CELLULAR STORAGE TANK - UNDER CARRIAGEWAY

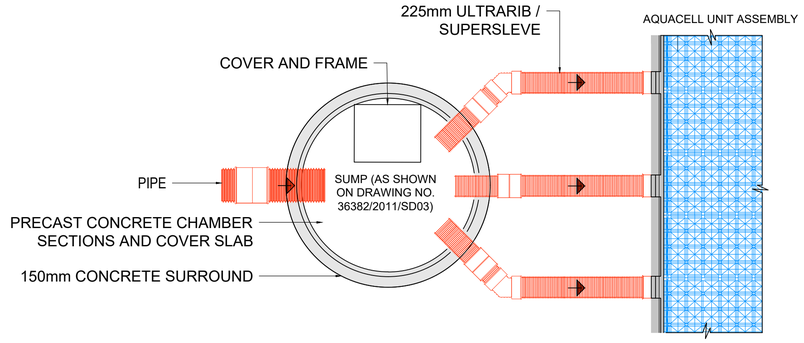
NTS

NOTE
CRATES TO BE POSITIONED SUCH THAT PREFORMED HOLE IS POSITIONED TO ACCOMMODATE PROPOSED PIPE CONNECTION LOCATION



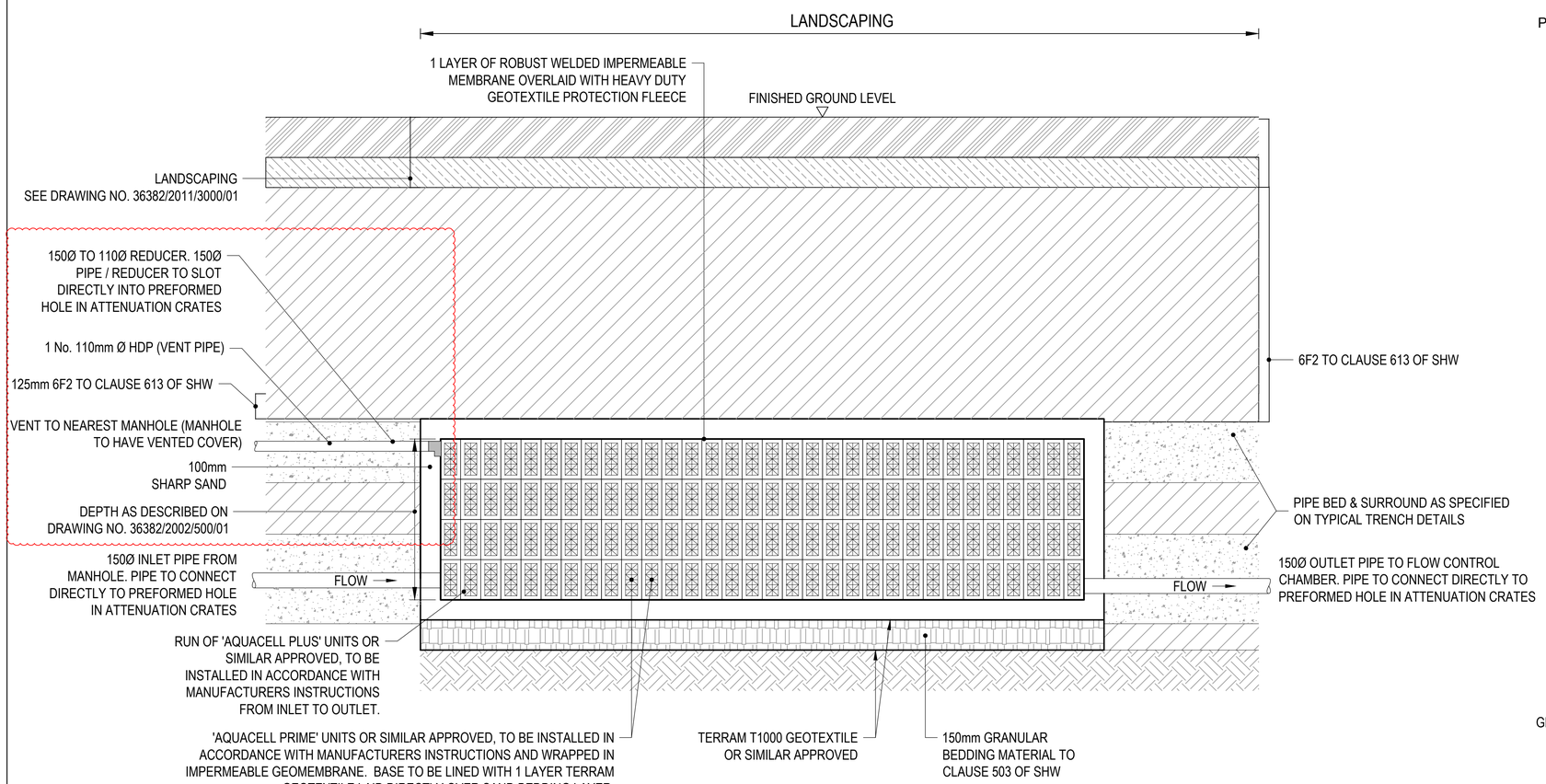
MANIFOLD CONNECTION UNDER CARRIAGEWAY

NTS



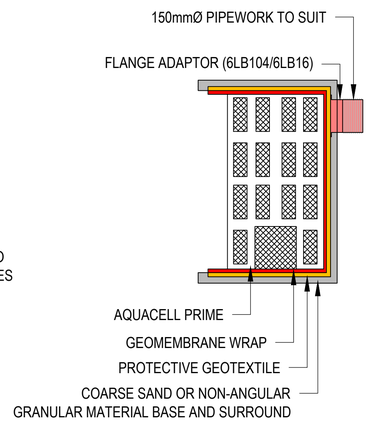
MANIFOLD CONNECTION UNDER LANDSCAPING / VERGE

NTS



CELLULAR STORAGE TANK - UNDER LANDSCAPING / VERGE

NTS



GULLY CONNECTIONS TO CELLULAR STORAGE

Mark	Revision	Date	Drawn	Chkd	Appd
C8	VENT LOCATION AMENDED	12.11.19	CD	TY	GR
C7	AMENDMENTS TO IMPROVE BUILDABILTY	17.09.19	SF	GR	MF
C6	"AQUACELL PLUS" UNITS ADDEDTO EACH AREA	21.05.19	RT	GR	MF
C5	INFLOW DETAILS UPDATED	12.03.19	SF	GR	MF
C4	PIPE DIMENSIONS UPDATED	30.08.18	RT	GR	MF
C3	CONNECTION CONFIGURATIONS ADDED	26.07.18	SF	GR	MF
C2	CELLULAR STORAGE SPEC UPDATED	31.05.18	RT	GR	SE

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.
UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status
FOR CONSTRUCTION

GREEN PARK STATION
PROPOSED INTERCHANGE
CELLULAR STORAGE TANK
CONSTRUCTION DETAILS

Client
Reading Borough Council
Working better with you

Date of 1st Issue	Designed	Drawn
09.03.18	RT	SF
A1 Scale	**Checked**	**Approved**
NTS	RT	MF

Drawing Number	Revision
36382/2011/SD04	C8

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TECHNICAL NOTE

Appendix C

MicroDrainage calculations

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	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	0.700
M5-60 (mm)	18.800	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.400	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	100	Add Flow / Climate Change (%)	30	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.337	4-8	0.317

Total Area Contributing (ha) = 0.654

Total Pipe Volume (m³) = 24.205

Network Design Table for Storm

« - Indicates pipe capacity < flow

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Network Design Table 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)	Section Type	Auto Design
S1.000	5.596	0.056	99.9	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	5.596	0.056	99.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	14.183	0.170	83.4	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	18.445	0.184	100.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	17.840	0.075	237.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	17.383	0.073	238.1	0.038	5.00	0.0	0.600	o	150	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)
S1.000	65.53	5.09	39.987	0.030	0.0	0.0	1.6	1.01	17.8	6.9
S1.001	65.02	5.19	39.931	0.030	0.0	0.0	1.6	1.01	17.8	6.9
S2.000	64.87	5.21	40.200	0.000	0.0	0.0	0.0	1.10	19.5	0.0
S2.001	63.28	5.52	40.030	0.000	0.0	0.0	0.0	1.00	17.7	0.0
S1.002	61.83	5.81	39.725	0.030	0.0	0.0	1.6	1.02	71.8	6.9
S3.000	63.65	5.45	40.006	0.038	0.0	0.0	2.0	0.65	11.4	8.5

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Network Design Table 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)	Section Type	Auto Design
S3.001	19.791	0.283	69.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	24.411	0.103	237.0	0.038	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.000	21.572	0.216	99.9	0.039	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	24.918	0.103	241.9	0.115	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	22.747	0.102	223.0	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.000	25.275	0.241	104.9	0.000	5.00	0.0	0.600	o	100	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)
S3.001	62.76	5.62	39.933	0.038	0.0	0.0	2.0	1.88	133.1	8.5
S1.003	59.98	6.21	39.650	0.106	0.0	0.0	5.2	1.02	71.9	22.4
S4.000	64.11	5.36	39.900	0.039	0.0	0.0	2.0	1.01	17.8	8.8
S1.004	58.20	6.63	39.534	0.260	0.0	0.0	12.3	1.01	71.1	53.3
S1.005	56.74	6.99	39.445	0.289	0.0	0.0	13.3	1.05	74.1	57.7
S5.000	63.07	5.56	40.219	0.000	0.0	0.0	0.0	0.75	5.9	0.0

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Network Design Table 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)	Section Type	Auto Design
S5.001	19.787	0.198	99.9	0.026	0.00	0.0	0.600	o	150	Pipe/Conduit	
S5.002	23.059	0.197	117.1	0.034	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.000	24.391	0.244	100.0	0.034	5.00	0.0	0.600	o	150	Pipe/Conduit	
S6.001	8.947	0.089	100.5	0.039	0.00	0.0	0.600	oo	150	Double Pipe	
S5.003	28.974	0.171	169.4	0.037	0.00	0.0	0.600	o	225	Pipe/Conduit	
S7.000	13.382	0.134	99.9	0.044	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.001	9.767	0.098	99.7	0.005	0.00	0.0	0.600	o	150	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)
S5.001	61.47	5.89	39.984	0.026	0.0	0.0	1.3	1.01	17.8	5.6
S5.002	60.01	6.21	39.786	0.060	0.0	0.0	2.9	1.21	48.0	12.7
S6.000	63.87	5.40	39.997	0.034	0.0	0.0	1.8	1.01	17.8	7.6
S6.001	63.11	5.55	39.753	0.073	0.0	0.0	3.7	1.00	35.4	16.2
S5.003	57.94	6.69	39.589	0.170	0.0	0.0	8.0	1.00	39.8	34.7
S7.000	64.83	5.22	39.693	0.044	0.0	0.0	2.3	1.01	17.8	10.0
S7.001	63.98	5.38	39.573	0.049	0.0	0.0	2.5	1.01	17.8	11.0

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Network Design Table 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)	Section Type	Auto Design
S1.006	12.927	0.033	391.7	0.027	0.00	0.0	0.600	o	450	Pipe/Conduit	
S8.000	27.439	0.163	168.3	0.082	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	9.337	0.024	387.0	0.037	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.008	11.614	0.030	387.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.009	25.246	0.066	382.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.010	4.162	0.011	378.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.011	1.461	0.009	162.3	0.000	0.00	0.0	0.600	o	225	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)
S1.006	55.92	7.20	39.193	0.535	0.0	0.0	24.3	1.02	162.4	105.3
S8.000	63.61	5.46	39.540	0.082	0.0	0.0	4.2	1.00	40.0	18.4
S1.007	55.36	7.35	39.109	0.654	0.0	0.0	29.4	1.03	163.4	127.5
S1.008	54.67	7.54	39.085	0.654	0.0	0.0	29.4	1.03	163.4	127.5
S1.009	53.24	7.95	39.055	0.654	0.0	0.0	29.4	1.03	164.4	127.5
S1.010	53.02	8.01	38.989	0.654	0.0	0.0	29.4	1.04	165.3	127.5
S1.011	52.94	8.04	38.978	0.654	0.0	0.0	29.4	1.02	40.7«	127.5

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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)
SSTATION 2	41.200	1.213	Open Manhole	1350	S1.000	39.987	150				
S2	41.200	1.269	Open Manhole	1200	S1.001	39.931	150	S1.000	39.931	150	
SSTATION 19	41.250	1.050	Open Manhole	1200	S2.000	40.200	150				
SSTATION 20	41.195	1.165	Open Manhole	1200	S2.001	40.030	150	S2.000	40.030	150	
S3	41.100	1.375	Sealed Manhole	1350	S1.002	39.725	300	S1.001	39.875	150	
								S2.001	39.846	150	
S7	41.106	1.100	Open Manhole	1350	S3.000	40.006	150				
S7a	41.250	1.317	Open Manhole	1350	S3.001	39.933	300	S3.000	39.933	150	
S4	41.000	1.350	Sealed Manhole	1350	S1.003	39.650	300	S1.002	39.650	300	
								S3.001	39.650	300	
SSTATION 7	41.100	1.200	Open Manhole	1350	S4.000	39.900	150				
S5	41.100	1.566	Open Manhole	1350	S1.004	39.534	300	S1.003	39.547	300	13
								S4.000	39.684	150	
S6	41.300	1.869	Open Manhole	1500	S1.005	39.445	300	S1.004	39.431	300	
SSTATION 21	41.325	1.106	Open Manhole	1200	S5.000	40.219	100				
SSTATION 22	41.000	1.022	Open Manhole	1350	S5.001	39.984	150	S5.000	39.978	100	
S8	41.322	1.536	Open Manhole	1350	S5.002	39.786	225	S5.001	39.786	150	
S9b	41.236	1.239	Open Manhole	1500	S6.000	39.997	150				
S9a	41.250	1.497	Open Manhole	1500	S6.001	39.753	150	S6.000	39.753	150	

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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)
S9	41.233	1.644	Open Manhole	1350	S5.003	39.589	225	S5.002	39.589	225	
								S6.001	39.664	150	
S10	41.225	1.532	Open Manhole	1350	S7.000	39.693	150				
S11	41.325	1.766	Open Manhole	1350	S7.001	39.573	150	S7.000	39.559	150	
S12	41.300	2.107	Open Manhole	1800	S1.006	39.193	450	S1.005	39.343	300	
								S5.003	39.418	225	
								S7.001	39.475	150	
S1	41.000	1.460	Open Manhole	1350	S8.000	39.540	225				
S17	40.894	1.785	Open Manhole	1800	S1.007	39.109	450	S1.006	39.160	450	51
								S8.000	39.377	225	43
S13	40.867	1.782	Open Manhole	1500	S1.008	39.085	450	S1.007	39.085	450	
S14	40.839	1.784	Open Manhole	1200	S1.009	39.055	450	S1.008	39.055	450	
S15	40.839	1.850	Open Manhole	1200	S1.010	38.989	450	S1.009	38.989	450	
S16	40.839	1.861	Open Manhole	1500	S1.011	38.978	225	S1.010	38.978	450	
S17	40.250	1.281	Open Manhole	0		OUTFALL		S1.011	38.969	225	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SSTATION 2	469532.665	170230.347	469532.665	170230.347	Required	
S2	469538.194	170229.482	469538.194	170229.482	Required	
SSTATION 19	469543.713	170261.225	469543.713	170261.225	Required	
SSTATION 20	469543.146	170247.053	469543.146	170247.053	Required	
S3	469543.723	170228.617			No Entry	
S7	469553.067	170253.366	469553.067	170253.366	Required	
S7a	469554.325	170236.029	469554.325	170236.029	Required	
S4	469556.704	170216.381			No Entry	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SSTATION 7	469532.439	170190.647	469532.439	170190.647	Required	
S5	469553.960	170192.125	469553.960	170192.125	Required	
S6	469552.491	170167.250	469552.491	170167.250	Required	
SSTATION 21	469532.680	170161.201	469532.680	170161.201	Required	
SSTATION 22	469530.119	170136.055	469530.119	170136.055	Required	
S8	469545.437	170123.531	469545.437	170123.531	Required	
S9b	469565.044	170114.115	469565.044	170114.115	Required	
S9a	469571.854	170137.536	469571.854	170137.536	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S9	469562.961	170138.517	469562.961	170138.517	Required	
S10	469584.585	170146.387	469584.585	170146.387	Required	
S11	469574.412	170155.081	469574.412	170155.081	Required	
S12	469575.108	170164.823	469575.108	170164.823	Required	
S1	469595.154	170188.676	469595.154	170188.676	Required	
S17	469587.775	170162.247	469587.775	170162.247	Required	
S13	469597.029	170161.009	469597.029	170161.009	Required	
S14	469608.531	170159.391	469608.531	170159.391	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S15	469633.603	170156.429	469633.603	170156.429	Required	
S16	469637.731	170155.902	469637.731	170155.902	Required	
S17	469639.182	170155.739			No Entry	

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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)
S1.000	o	150	SSTATION 2	41.200	39.987	1.063	Open Manhole	1350
S1.001	o	150	S2	41.200	39.931	1.119	Open Manhole	1200
S2.000	o	150	SSTATION 19	41.250	40.200	0.900	Open Manhole	1200
S2.001	o	150	SSTATION 20	41.195	40.030	1.015	Open Manhole	1200
S1.002	o	300	S3	41.100	39.725	1.075	Sealed Manhole	1350
S3.000	o	150	S7	41.106	40.006	0.950	Open Manhole	1350

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)
S1.000	5.596	99.9	S2	41.200	39.931	1.119	Open Manhole	1200
S1.001	5.596	99.9	S3	41.100	39.875	1.075	Sealed Manhole	1350
S2.000	14.183	83.4	SSTATION 20	41.195	40.030	1.015	Open Manhole	1200
S2.001	18.445	100.2	S3	41.100	39.846	1.104	Sealed Manhole	1350
S1.002	17.840	237.9	S4	41.000	39.650	1.050	Sealed Manhole	1350
S3.000	17.383	238.1	S7a	41.250	39.933	1.167	Open Manhole	1350

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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)
S3.001	o	300	S7a	41.250	39.933	1.017	Open Manhole	1350
S1.003	o	300	S4	41.000	39.650	1.050	Sealed Manhole	1350
S4.000	o	150	SSTATION 7	41.100	39.900	1.050	Open Manhole	1350
S1.004	o	300	S5	41.100	39.534	1.266	Open Manhole	1350
S1.005	o	300	S6	41.300	39.445	1.555	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)
S3.001	19.791	69.9	S4	41.000	39.650	1.050	Sealed Manhole	1350
S1.003	24.411	237.0	S5	41.100	39.547	1.253	Open Manhole	1350
S4.000	21.572	99.9	S5	41.100	39.684	1.266	Open Manhole	1350
S1.004	24.918	241.9	S6	41.300	39.431	1.569	Open Manhole	1500
S1.005	22.747	223.0	S12	41.300	39.343	1.657	Open Manhole	1800

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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)
S5.000	o	100	SSTATION 21	41.325	40.219	1.006	Open Manhole	1200
S5.001	o	150	SSTATION 22	41.000	39.984	0.866	Open Manhole	1350
S5.002	o	225	S8	41.322	39.786	1.311	Open Manhole	1350
S6.000	o	150	S9b	41.236	39.997	1.089	Open Manhole	1500
S6.001	oo	150	S9a	41.250	39.753	1.347	Open Manhole	1500
S5.003	o	225	S9	41.233	39.589	1.419	Open Manhole	1350

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)
S5.000	25.275	104.9	SSTATION 22	41.000	39.978	0.922	Open Manhole	1350
S5.001	19.787	99.9	S8	41.322	39.786	1.386	Open Manhole	1350
S5.002	23.059	117.1	S9	41.233	39.589	1.419	Open Manhole	1350
S6.000	24.391	100.0	S9a	41.250	39.753	1.347	Open Manhole	1500
S6.001	8.947	100.5	S9	41.233	39.664	1.419	Open Manhole	1350
S5.003	28.974	169.4	S12	41.300	39.418	1.657	Open Manhole	1800

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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)
S7.000	o	150	S10	41.225	39.693	1.382	Open Manhole	1350
S7.001	o	150	S11	41.325	39.573	1.602	Open Manhole	1350
S1.006	o	450	S12	41.300	39.193	1.657	Open Manhole	1800
S8.000	o	225	S1	41.000	39.540	1.235	Open Manhole	1350
S1.007	o	450	S17	40.894	39.109	1.335	Open Manhole	1800
S1.008	o	450	S13	40.867	39.085	1.332	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)
S7.000	13.382	99.9	S11	41.325	39.559	1.616	Open Manhole	1350
S7.001	9.767	99.7	S12	41.300	39.475	1.675	Open Manhole	1800
S1.006	12.927	391.7	S17	40.894	39.160	1.284	Open Manhole	1800
S8.000	27.439	168.3	S17	40.894	39.377	1.292	Open Manhole	1800
S1.007	9.337	387.0	S13	40.867	39.085	1.332	Open Manhole	1500
S1.008	11.614	387.1	S14	40.839	39.055	1.334	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)
S1.009	o	450	S14	40.839	39.055	1.334	Open Manhole	1200
S1.010	o	450	S15	40.839	38.989	1.400	Open Manhole	1200
S1.011	o	225	S16	40.839	38.978	1.636	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)
S1.009	25.246	382.5	S15	40.839	38.989	1.400	Open Manhole	1200
S1.010	4.162	378.4	S16	40.839	38.978	1.411	Open Manhole	1500
S1.011	1.461	162.3	S17	40.250	38.969	1.056	Open Manhole	0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.030	0.030	0.030
1.001	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.000	0.000	0.000
2.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.038	0.038	0.038
3.001	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.038	0.038	0.038
4.000	-	-	100	0.039	0.039	0.039
1.004	-	-	100	0.115	0.115	0.115
1.005	-	-	100	0.029	0.029	0.029
5.000	-	-	100	0.000	0.000	0.000
5.001	-	-	100	0.026	0.026	0.026
5.002	-	-	100	0.034	0.034	0.034
6.000	-	-	100	0.034	0.034	0.034
6.001	-	-	100	0.039	0.039	0.039
5.003	-	-	100	0.037	0.037	0.037
7.000	-	-	100	0.044	0.044	0.044
7.001	-	-	100	0.005	0.005	0.005
1.006	-	-	100	0.027	0.027	0.027
8.000	-	-	100	0.082	0.082	0.082
1.007	-	-	100	0.037	0.037	0.037
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
				0.654	0.654	0.654

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.011	S17	40.250	38.969	0.000	0	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	39.100	10	39.100	19	39.100	28	39.100	37	39.100	46	39.100	55	39.100	64	39.100	73	39.100
2	39.100	11	39.100	20	39.100	29	39.100	38	39.100	47	39.100	56	39.100	65	39.100	74	39.100
3	39.100	12	39.100	21	39.100	30	39.100	39	39.100	48	39.100	57	39.100	66	39.100	75	39.100
4	39.100	13	39.100	22	39.100	31	39.100	40	39.100	49	39.100	58	39.100	67	39.100	76	39.100
5	39.100	14	39.100	23	39.100	32	39.100	41	39.100	50	39.100	59	39.100	68	39.100	77	39.100
6	39.100	15	39.100	24	39.100	33	39.100	42	39.100	51	39.100	60	39.100	69	39.100	78	39.100
7	39.100	16	39.100	25	39.100	34	39.100	43	39.100	52	39.100	61	39.100	70	39.100	79	39.100
8	39.100	17	39.100	26	39.100	35	39.100	44	39.100	53	39.100	62	39.100	71	39.100	80	39.100
9	39.100	18	39.100	27	39.100	36	39.100	45	39.100	54	39.100	63	39.100	72	39.100	81	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
82	39.100	108	39.100	134	39.100	160	39.100	186	39.100	212	39.100	238	39.100	264	39.100	290	39.100
83	39.100	109	39.100	135	39.100	161	39.100	187	39.100	213	39.100	239	39.100	265	39.100	291	39.100
84	39.100	110	39.100	136	39.100	162	39.100	188	39.100	214	39.100	240	39.100	266	39.100	292	39.100
85	39.100	111	39.100	137	39.100	163	39.100	189	39.100	215	39.100	241	39.100	267	39.100	293	39.100
86	39.100	112	39.100	138	39.100	164	39.100	190	39.100	216	39.100	242	39.100	268	39.100	294	39.100
87	39.100	113	39.100	139	39.100	165	39.100	191	39.100	217	39.100	243	39.100	269	39.100	295	39.100
88	39.100	114	39.100	140	39.100	166	39.100	192	39.100	218	39.100	244	39.100	270	39.100	296	39.100
89	39.100	115	39.100	141	39.100	167	39.100	193	39.100	219	39.100	245	39.100	271	39.100	297	39.100
90	39.100	116	39.100	142	39.100	168	39.100	194	39.100	220	39.100	246	39.100	272	39.100	298	39.100
91	39.100	117	39.100	143	39.100	169	39.100	195	39.100	221	39.100	247	39.100	273	39.100	299	39.100
92	39.100	118	39.100	144	39.100	170	39.100	196	39.100	222	39.100	248	39.100	274	39.100	300	39.100
93	39.100	119	39.100	145	39.100	171	39.100	197	39.100	223	39.100	249	39.100	275	39.100	301	39.100
94	39.100	120	39.100	146	39.100	172	39.100	198	39.100	224	39.100	250	39.100	276	39.100	302	39.100
95	39.100	121	39.100	147	39.100	173	39.100	199	39.100	225	39.100	251	39.100	277	39.100	303	39.100
96	39.100	122	39.100	148	39.100	174	39.100	200	39.100	226	39.100	252	39.100	278	39.100	304	39.100
97	39.100	123	39.100	149	39.100	175	39.100	201	39.100	227	39.100	253	39.100	279	39.100	305	39.100
98	39.100	124	39.100	150	39.100	176	39.100	202	39.100	228	39.100	254	39.100	280	39.100	306	39.100
99	39.100	125	39.100	151	39.100	177	39.100	203	39.100	229	39.100	255	39.100	281	39.100	307	39.100
100	39.100	126	39.100	152	39.100	178	39.100	204	39.100	230	39.100	256	39.100	282	39.100	308	39.100
101	39.100	127	39.100	153	39.100	179	39.100	205	39.100	231	39.100	257	39.100	283	39.100	309	39.100
102	39.100	128	39.100	154	39.100	180	39.100	206	39.100	232	39.100	258	39.100	284	39.100	310	39.100
103	39.100	129	39.100	155	39.100	181	39.100	207	39.100	233	39.100	259	39.100	285	39.100	311	39.100
104	39.100	130	39.100	156	39.100	182	39.100	208	39.100	234	39.100	260	39.100	286	39.100	312	39.100
105	39.100	131	39.100	157	39.100	183	39.100	209	39.100	235	39.100	261	39.100	287	39.100	313	39.100
106	39.100	132	39.100	158	39.100	184	39.100	210	39.100	236	39.100	262	39.100	288	39.100	314	39.100
107	39.100	133	39.100	159	39.100	185	39.100	211	39.100	237	39.100	263	39.100	289	39.100	315	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
316	39.100	342	39.100	368	39.100	394	39.100	420	39.100	446	39.100	472	39.100	498	39.100	524	39.100
317	39.100	343	39.100	369	39.100	395	39.100	421	39.100	447	39.100	473	39.100	499	39.100	525	39.100
318	39.100	344	39.100	370	39.100	396	39.100	422	39.100	448	39.100	474	39.100	500	39.100	526	39.100
319	39.100	345	39.100	371	39.100	397	39.100	423	39.100	449	39.100	475	39.100	501	39.100	527	39.100
320	39.100	346	39.100	372	39.100	398	39.100	424	39.100	450	39.100	476	39.100	502	39.100	528	39.100
321	39.100	347	39.100	373	39.100	399	39.100	425	39.100	451	39.100	477	39.100	503	39.100	529	39.100
322	39.100	348	39.100	374	39.100	400	39.100	426	39.100	452	39.100	478	39.100	504	39.100	530	39.100
323	39.100	349	39.100	375	39.100	401	39.100	427	39.100	453	39.100	479	39.100	505	39.100	531	39.100
324	39.100	350	39.100	376	39.100	402	39.100	428	39.100	454	39.100	480	39.100	506	39.100	532	39.100
325	39.100	351	39.100	377	39.100	403	39.100	429	39.100	455	39.100	481	39.100	507	39.100	533	39.100
326	39.100	352	39.100	378	39.100	404	39.100	430	39.100	456	39.100	482	39.100	508	39.100	534	39.100
327	39.100	353	39.100	379	39.100	405	39.100	431	39.100	457	39.100	483	39.100	509	39.100	535	39.100
328	39.100	354	39.100	380	39.100	406	39.100	432	39.100	458	39.100	484	39.100	510	39.100	536	39.100
329	39.100	355	39.100	381	39.100	407	39.100	433	39.100	459	39.100	485	39.100	511	39.100	537	39.100
330	39.100	356	39.100	382	39.100	408	39.100	434	39.100	460	39.100	486	39.100	512	39.100	538	39.100
331	39.100	357	39.100	383	39.100	409	39.100	435	39.100	461	39.100	487	39.100	513	39.100	539	39.100
332	39.100	358	39.100	384	39.100	410	39.100	436	39.100	462	39.100	488	39.100	514	39.100	540	39.100
333	39.100	359	39.100	385	39.100	411	39.100	437	39.100	463	39.100	489	39.100	515	39.100	541	39.100
334	39.100	360	39.100	386	39.100	412	39.100	438	39.100	464	39.100	490	39.100	516	39.100	542	39.100
335	39.100	361	39.100	387	39.100	413	39.100	439	39.100	465	39.100	491	39.100	517	39.100	543	39.100
336	39.100	362	39.100	388	39.100	414	39.100	440	39.100	466	39.100	492	39.100	518	39.100	544	39.100
337	39.100	363	39.100	389	39.100	415	39.100	441	39.100	467	39.100	493	39.100	519	39.100	545	39.100
338	39.100	364	39.100	390	39.100	416	39.100	442	39.100	468	39.100	494	39.100	520	39.100	546	39.100
339	39.100	365	39.100	391	39.100	417	39.100	443	39.100	469	39.100	495	39.100	521	39.100	547	39.100
340	39.100	366	39.100	392	39.100	418	39.100	444	39.100	470	39.100	496	39.100	522	39.100	548	39.100
341	39.100	367	39.100	393	39.100	419	39.100	445	39.100	471	39.100	497	39.100	523	39.100	549	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
550	39.100	576	39.100	602	39.100	628	39.100	654	39.100	680	39.100	706	39.100	732	39.100	758	39.100
551	39.100	577	39.100	603	39.100	629	39.100	655	39.100	681	39.100	707	39.100	733	39.100	759	39.100
552	39.100	578	39.100	604	39.100	630	39.100	656	39.100	682	39.100	708	39.100	734	39.100	760	39.100
553	39.100	579	39.100	605	39.100	631	39.100	657	39.100	683	39.100	709	39.100	735	39.100	761	39.100
554	39.100	580	39.100	606	39.100	632	39.100	658	39.100	684	39.100	710	39.100	736	39.100	762	39.100
555	39.100	581	39.100	607	39.100	633	39.100	659	39.100	685	39.100	711	39.100	737	39.100	763	39.100
556	39.100	582	39.100	608	39.100	634	39.100	660	39.100	686	39.100	712	39.100	738	39.100	764	39.100
557	39.100	583	39.100	609	39.100	635	39.100	661	39.100	687	39.100	713	39.100	739	39.100	765	39.100
558	39.100	584	39.100	610	39.100	636	39.100	662	39.100	688	39.100	714	39.100	740	39.100	766	39.100
559	39.100	585	39.100	611	39.100	637	39.100	663	39.100	689	39.100	715	39.100	741	39.100	767	39.100
560	39.100	586	39.100	612	39.100	638	39.100	664	39.100	690	39.100	716	39.100	742	39.100	768	39.100
561	39.100	587	39.100	613	39.100	639	39.100	665	39.100	691	39.100	717	39.100	743	39.100	769	39.100
562	39.100	588	39.100	614	39.100	640	39.100	666	39.100	692	39.100	718	39.100	744	39.100	770	39.100
563	39.100	589	39.100	615	39.100	641	39.100	667	39.100	693	39.100	719	39.100	745	39.100	771	39.100
564	39.100	590	39.100	616	39.100	642	39.100	668	39.100	694	39.100	720	39.100	746	39.100	772	39.100
565	39.100	591	39.100	617	39.100	643	39.100	669	39.100	695	39.100	721	39.100	747	39.100	773	39.100
566	39.100	592	39.100	618	39.100	644	39.100	670	39.100	696	39.100	722	39.100	748	39.100	774	39.100
567	39.100	593	39.100	619	39.100	645	39.100	671	39.100	697	39.100	723	39.100	749	39.100	775	39.100
568	39.100	594	39.100	620	39.100	646	39.100	672	39.100	698	39.100	724	39.100	750	39.100	776	39.100
569	39.100	595	39.100	621	39.100	647	39.100	673	39.100	699	39.100	725	39.100	751	39.100	777	39.100
570	39.100	596	39.100	622	39.100	648	39.100	674	39.100	700	39.100	726	39.100	752	39.100	778	39.100
571	39.100	597	39.100	623	39.100	649	39.100	675	39.100	701	39.100	727	39.100	753	39.100	779	39.100
572	39.100	598	39.100	624	39.100	650	39.100	676	39.100	702	39.100	728	39.100	754	39.100	780	39.100
573	39.100	599	39.100	625	39.100	651	39.100	677	39.100	703	39.100	729	39.100	755	39.100	781	39.100
574	39.100	600	39.100	626	39.100	652	39.100	678	39.100	704	39.100	730	39.100	756	39.100	782	39.100
575	39.100	601	39.100	627	39.100	653	39.100	679	39.100	705	39.100	731	39.100	757	39.100	783	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
784	39.100	810	39.100	836	39.100	862	39.100	888	39.100	914	39.100	940	39.100	966	39.100	992	39.100
785	39.100	811	39.100	837	39.100	863	39.100	889	39.100	915	39.100	941	39.100	967	39.100	993	39.100
786	39.100	812	39.100	838	39.100	864	39.100	890	39.100	916	39.100	942	39.100	968	39.100	994	39.100
787	39.100	813	39.100	839	39.100	865	39.100	891	39.100	917	39.100	943	39.100	969	39.100	995	39.100
788	39.100	814	39.100	840	39.100	866	39.100	892	39.100	918	39.100	944	39.100	970	39.100	996	39.100
789	39.100	815	39.100	841	39.100	867	39.100	893	39.100	919	39.100	945	39.100	971	39.100	997	39.100
790	39.100	816	39.100	842	39.100	868	39.100	894	39.100	920	39.100	946	39.100	972	39.100	998	39.100
791	39.100	817	39.100	843	39.100	869	39.100	895	39.100	921	39.100	947	39.100	973	39.100	999	39.100
792	39.100	818	39.100	844	39.100	870	39.100	896	39.100	922	39.100	948	39.100	974	39.100	1000	39.100
793	39.100	819	39.100	845	39.100	871	39.100	897	39.100	923	39.100	949	39.100	975	39.100	1001	39.100
794	39.100	820	39.100	846	39.100	872	39.100	898	39.100	924	39.100	950	39.100	976	39.100	1002	39.100
795	39.100	821	39.100	847	39.100	873	39.100	899	39.100	925	39.100	951	39.100	977	39.100	1003	39.100
796	39.100	822	39.100	848	39.100	874	39.100	900	39.100	926	39.100	952	39.100	978	39.100	1004	39.100
797	39.100	823	39.100	849	39.100	875	39.100	901	39.100	927	39.100	953	39.100	979	39.100	1005	39.100
798	39.100	824	39.100	850	39.100	876	39.100	902	39.100	928	39.100	954	39.100	980	39.100	1006	39.100
799	39.100	825	39.100	851	39.100	877	39.100	903	39.100	929	39.100	955	39.100	981	39.100	1007	39.100
800	39.100	826	39.100	852	39.100	878	39.100	904	39.100	930	39.100	956	39.100	982	39.100	1008	39.100
801	39.100	827	39.100	853	39.100	879	39.100	905	39.100	931	39.100	957	39.100	983	39.100	1009	39.100
802	39.100	828	39.100	854	39.100	880	39.100	906	39.100	932	39.100	958	39.100	984	39.100	1010	39.100
803	39.100	829	39.100	855	39.100	881	39.100	907	39.100	933	39.100	959	39.100	985	39.100	1011	39.100
804	39.100	830	39.100	856	39.100	882	39.100	908	39.100	934	39.100	960	39.100	986	39.100	1012	39.100
805	39.100	831	39.100	857	39.100	883	39.100	909	39.100	935	39.100	961	39.100	987	39.100	1013	39.100
806	39.100	832	39.100	858	39.100	884	39.100	910	39.100	936	39.100	962	39.100	988	39.100	1014	39.100
807	39.100	833	39.100	859	39.100	885	39.100	911	39.100	937	39.100	963	39.100	989	39.100	1015	39.100
808	39.100	834	39.100	860	39.100	886	39.100	912	39.100	938	39.100	964	39.100	990	39.100	1016	39.100
809	39.100	835	39.100	861	39.100	887	39.100	913	39.100	939	39.100	965	39.100	991	39.100	1017	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1018	39.100	1039	39.100	1060	39.100	1081	39.100	1102	39.100	1123	39.100	1144	39.100	1165	39.100	1186	39.100
1019	39.100	1040	39.100	1061	39.100	1082	39.100	1103	39.100	1124	39.100	1145	39.100	1166	39.100	1187	39.100
1020	39.100	1041	39.100	1062	39.100	1083	39.100	1104	39.100	1125	39.100	1146	39.100	1167	39.100	1188	39.100
1021	39.100	1042	39.100	1063	39.100	1084	39.100	1105	39.100	1126	39.100	1147	39.100	1168	39.100	1189	39.100
1022	39.100	1043	39.100	1064	39.100	1085	39.100	1106	39.100	1127	39.100	1148	39.100	1169	39.100	1190	39.100
1023	39.100	1044	39.100	1065	39.100	1086	39.100	1107	39.100	1128	39.100	1149	39.100	1170	39.100	1191	39.100
1024	39.100	1045	39.100	1066	39.100	1087	39.100	1108	39.100	1129	39.100	1150	39.100	1171	39.100	1192	39.100
1025	39.100	1046	39.100	1067	39.100	1088	39.100	1109	39.100	1130	39.100	1151	39.100	1172	39.100	1193	39.100
1026	39.100	1047	39.100	1068	39.100	1089	39.100	1110	39.100	1131	39.100	1152	39.100	1173	39.100	1194	39.100
1027	39.100	1048	39.100	1069	39.100	1090	39.100	1111	39.100	1132	39.100	1153	39.100	1174	39.100	1195	39.100
1028	39.100	1049	39.100	1070	39.100	1091	39.100	1112	39.100	1133	39.100	1154	39.100	1175	39.100	1196	39.100
1029	39.100	1050	39.100	1071	39.100	1092	39.100	1113	39.100	1134	39.100	1155	39.100	1176	39.100	1197	39.100
1030	39.100	1051	39.100	1072	39.100	1093	39.100	1114	39.100	1135	39.100	1156	39.100	1177	39.100	1198	39.100
1031	39.100	1052	39.100	1073	39.100	1094	39.100	1115	39.100	1136	39.100	1157	39.100	1178	39.100	1199	39.100
1032	39.100	1053	39.100	1074	39.100	1095	39.100	1116	39.100	1137	39.100	1158	39.100	1179	39.100	1200	39.100
1033	39.100	1054	39.100	1075	39.100	1096	39.100	1117	39.100	1138	39.100	1159	39.100	1180	39.100		
1034	39.100	1055	39.100	1076	39.100	1097	39.100	1118	39.100	1139	39.100	1160	39.100	1181	39.100		
1035	39.100	1056	39.100	1077	39.100	1098	39.100	1119	39.100	1140	39.100	1161	39.100	1182	39.100		
1036	39.100	1057	39.100	1078	39.100	1099	39.100	1120	39.100	1141	39.100	1162	39.100	1183	39.100		
1037	39.100	1058	39.100	1079	39.100	1100	39.100	1121	39.100	1142	39.100	1163	39.100	1184	39.100		
1038	39.100	1059	39.100	1080	39.100	1101	39.100	1122	39.100	1143	39.100	1164	39.100	1185	39.100		

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.500
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	2	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	18.800	Cv (Summer)	0.750
Return Period (years)	100	Ratio R	0.400	Cv (Winter)	0.840
Region	England and Wales	Profile Type	Summer	Storm Duration (mins)	30

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S15, DS/PN: S1.010, Volume (m³): 5.9

Unit Reference	MD-SHE-0098-5000-1500-5000	Sump Available	Yes
Design Head (m)	1.500	Diameter (mm)	98
Design Flow (l/s)	5.0	Invert Level (m)	38.989
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	Mean Flow over Head Range	-	4.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	0.600	4.8	1.600	5.1	2.600	6.5	5.000	8.8	7.500	10.7
0.200	4.4	0.800	4.3	1.800	5.4	3.000	6.9	5.500	9.2	8.000	11.0
0.300	4.8	1.000	4.1	2.000	5.7	3.500	7.4	6.000	9.6	8.500	11.3
0.400	4.9	1.200	4.5	2.200	6.0	4.000	7.9	6.500	10.0	9.000	11.6
0.500	4.9	1.400	4.8	2.400	6.2	4.500	8.4	7.000	10.3	9.500	11.9

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Non Return Valve Manhole: S16, DS/PN: S1.011, Volume (m³): 3.7

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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: S1.005

Invert Level (m) 39.445 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	250.0	0.0	0.800	250.0	0.0	0.801	0.0	0.0

Cellular Storage Manhole: S17, DS/PN: S1.007

Invert Level (m) 39.110 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	150.0	0.0	0.800	150.0	0.0	0.801	0.0	0.0

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.500
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status OFF Inertia Status OFF
Analysis Timestep Fine DVD 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) 100
Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
S1.000	SSTATION 2	15 Winter	100	+20%	100/15 Summer				40.466	0.329	0.000	1.28		11.9
S1.001	S2	15 Winter	100	+20%	100/15 Summer				40.370	0.289	0.000	1.36		12.6

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
S1.000	SSTATION 2	SURCHARGED	
S1.001	S2	SURCHARGED	

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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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
S2.000	SSTATION 19	15 Winter	100	+20%					40.261	-0.089	0.000	0.03		0.5
S2.001	SSTATION 20	15 Winter	100	+20%	100/15 Summer				40.275	0.095	0.000	0.16		2.7
S1.002	S3	15 Winter	100	+20%	100/15 Summer				40.292	0.267	0.000	0.34		14.5
S3.000	S7	15 Winter	100	+20%	100/15 Summer				40.477	0.321	0.000	1.44		15.2
S3.001	S7a	15 Winter	100	+20%	100/15 Summer				40.319	0.086	0.000	0.19		16.0
S1.003	S4	15 Winter	100	+20%	100/15 Summer				40.284	0.334	0.000	0.79		39.7
S4.000	SSTATION 7	15 Winter	100	+20%	100/15 Summer				40.339	0.289	0.000	1.04		17.5
S1.004	S5	15 Winter	100	+20%	100/15 Summer				40.113	0.279	0.000	1.89		95.2
S1.005	S6	360 Winter	100	+20%	100/30 Winter				40.101	0.356	0.000	0.18		9.1
S5.000	SSTATION 21	15 Winter	100	+20%	100/15 Summer				40.401	0.082	0.000	0.29		1.6
S5.001	SSTATION 22	15 Winter	100	+20%	100/15 Summer				40.438	0.304	0.000	0.64		10.7
S5.002	S8	15 Winter	100	+20%	100/15 Summer				40.387	0.376	0.000	0.57		22.5
S6.000	S9b	15 Winter	100	+20%	100/15 Summer				40.518	0.371	0.000	0.84		14.2
S6.001	S9a	15 Winter	100	+20%	100/15 Summer				40.360	0.457	0.000	1.20		28.1
S5.003	S9	15 Winter	100	+20%	100/15 Summer				40.205	0.391	0.000	1.79		65.3
S7.000	S10	15 Winter	100	+20%	100/15 Summer				40.169	0.326	0.000	1.34		19.2
S7.001	S11	480 Winter	100	+20%	100/15 Summer				40.139	0.416	0.000	0.21		2.6
S1.006	S12	480 Winter	100	+20%	100/15 Summer				40.162	0.519	0.000	0.15		16.1
S8.000	S1	480 Winter	100	+20%	100/15 Summer				40.168	0.403	0.000	0.12		4.4
S1.007	S17	480 Winter	100	+20%	100/15 Summer				40.180	0.621	0.000	0.12		11.6
S1.008	S13	1440 Winter	100	+20%	100/15 Summer				40.310	0.775	0.000	0.07		7.6
S1.009	S14	1440 Summer	100	+20%	100/15 Summer				40.415	0.910	0.000	0.06		6.6
S1.010	S15	1440 Summer	100	+20%	100/15 Summer				40.435	0.996	0.000	0.05		4.8
S1.011	S16	480 Winter	100	+20%					39.102	-0.101	0.000	0.26		4.9

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
S2.000	SSTATION 19	OK	
S2.001	SSTATION 20	SURCHARGED	
S1.002	S3	SURCHARGED*	
S3.000	S7	SURCHARGED	
S3.001	S7a	SURCHARGED	
S1.003	S4	SURCHARGED*	
S4.000	SSTATION 7	SURCHARGED	
S1.004	S5	SURCHARGED	
S1.005	S6	SURCHARGED	
S5.000	SSTATION 21	SURCHARGED	
S5.001	SSTATION 22	SURCHARGED	
S5.002	S8	SURCHARGED	
S6.000	S9b	SURCHARGED	
S6.001	S9a	SURCHARGED	
S5.003	S9	SURCHARGED	
S7.000	S10	SURCHARGED	
S7.001	S11	SURCHARGED	
S1.006	S12	SURCHARGED	
S8.000	S1	SURCHARGED	
S1.007	S17	SURCHARGED	
S1.008	S13	SURCHARGED	
S1.009	S14	SURCHARGED	
S1.010	S15	SURCHARGED	
S1.011	S16	OK	

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S1.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S1.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S2.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S2.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S1.002 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S3.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S3.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S1.003 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S4.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S1.004 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 360 minute 100 year Winter I+20% for Pipe S1.005 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
6	0.843	48	5.281	90	6.991	132	16.880	174	28.973	216	22.719	258	10.128	300	5.363	342	4.439
12	2.422	54	5.270	96	7.918	138	18.735	180	29.810	222	20.619	264	8.940	306	5.282	348	3.582
18	3.582	60	5.282	102	8.940	144	20.619	186	29.810	228	18.735	270	7.918	312	5.270	354	2.422
24	4.439	66	5.363	108	10.128	150	22.719	192	28.973	234	16.880	276	6.991	318	5.281	360	0.842
30	4.894	72	5.535	114	11.672	156	24.507	198	27.812	240	14.878	282	6.360	324	5.267		
36	5.153	78	5.885	120	13.213	162	26.174	204	26.174	246	13.213	288	5.885	330	5.153		
42	5.267	84	6.360	126	14.878	168	27.812	210	24.507	252	11.672	294	5.535	336	4.894		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S5.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S5.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S5.002 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S6.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S6.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S5.003 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 15 minute 100 year Winter I+20% for Pipe S7.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	26.342	3	50.066	5	102.587	7	236.235	9	236.235	11	102.587	13	50.066	15	26.342
2	48.070	4	63.378	6	165.979	8	274.405	10	165.979	12	63.378	14	48.070		

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Rainfall Hyetograph for 480 minute 100 year Winter I+20% for Pipe S7.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.672	64	4.211	120	5.574	176	13.458	232	23.100	288	18.114	344	8.075	400	4.276	456	3.539
16	1.931	72	4.202	128	6.313	184	14.938	240	23.768	296	16.440	352	7.128	408	4.212	464	2.856
24	2.856	80	4.212	136	7.128	192	16.440	248	23.768	304	14.938	360	6.313	416	4.202	472	1.931
32	3.539	88	4.276	144	8.075	200	18.114	256	23.100	312	13.458	368	5.574	424	4.211	480	0.672
40	3.902	96	4.413	152	9.306	208	19.540	264	22.174	320	11.862	376	5.071	432	4.200		
48	4.108	104	4.692	160	10.535	216	20.869	272	20.869	328	10.535	384	4.692	440	4.108		
56	4.200	112	5.071	168	11.862	224	22.174	280	19.540	336	9.306	392	4.413	448	3.902		

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Rainfall Hyetograph for 480 minute 100 year Winter I+20% for Pipe S1.006 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.672	64	4.211	120	5.574	176	13.458	232	23.100	288	18.114	344	8.075	400	4.276	456	3.539
16	1.931	72	4.202	128	6.313	184	14.938	240	23.768	296	16.440	352	7.128	408	4.212	464	2.856
24	2.856	80	4.212	136	7.128	192	16.440	248	23.768	304	14.938	360	6.313	416	4.202	472	1.931
32	3.539	88	4.276	144	8.075	200	18.114	256	23.100	312	13.458	368	5.574	424	4.211	480	0.672
40	3.902	96	4.413	152	9.306	208	19.540	264	22.174	320	11.862	376	5.071	432	4.200		
48	4.108	104	4.692	160	10.535	216	20.869	272	20.869	328	10.535	384	4.692	440	4.108		
56	4.200	112	5.071	168	11.862	224	22.174	280	19.540	336	9.306	392	4.413	448	3.902		

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Rainfall Hyetograph for 480 minute 100 year Winter I+20% for Pipe S8.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.672	64	4.211	120	5.574	176	13.458	232	23.100	288	18.114	344	8.075	400	4.276	456	3.539
16	1.931	72	4.202	128	6.313	184	14.938	240	23.768	296	16.440	352	7.128	408	4.212	464	2.856
24	2.856	80	4.212	136	7.128	192	16.440	248	23.768	304	14.938	360	6.313	416	4.202	472	1.931
32	3.539	88	4.276	144	8.075	200	18.114	256	23.100	312	13.458	368	5.574	424	4.211	480	0.672
40	3.902	96	4.413	152	9.306	208	19.540	264	22.174	320	11.862	376	5.071	432	4.200		
48	4.108	104	4.692	160	10.535	216	20.869	272	20.869	328	10.535	384	4.692	440	4.108		
56	4.200	112	5.071	168	11.862	224	22.174	280	19.540	336	9.306	392	4.413	448	3.902		

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Rainfall Hyetograph for 480 minute 100 year Winter I+20% for Pipe S1.007 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.672	64	4.211	120	5.574	176	13.458	232	23.100	288	18.114	344	8.075	400	4.276	456	3.539
16	1.931	72	4.202	128	6.313	184	14.938	240	23.768	296	16.440	352	7.128	408	4.212	464	2.856
24	2.856	80	4.212	136	7.128	192	16.440	248	23.768	304	14.938	360	6.313	416	4.202	472	1.931
32	3.539	88	4.276	144	8.075	200	18.114	256	23.100	312	13.458	368	5.574	424	4.211	480	0.672
40	3.902	96	4.413	152	9.306	208	19.540	264	22.174	320	11.862	376	5.071	432	4.200		
48	4.108	104	4.692	160	10.535	216	20.869	272	20.869	328	10.535	384	4.692	440	4.108		
56	4.200	112	5.071	168	11.862	224	22.174	280	19.540	336	9.306	392	4.413	448	3.902		

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Rainfall Hyetograph for 1440 minute 100 year Winter I+20% for Pipe S1.008 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
24	0.280	192	1.757	360	2.326	528	5.616	696	9.639	864	7.558	1032	3.369	1200	1.784	1368	1.477
48	0.806	216	1.753	384	2.634	552	6.233	720	9.918	888	6.860	1056	2.974	1224	1.757	1392	1.192
72	1.192	240	1.757	408	2.974	576	6.860	744	9.918	912	6.233	1080	2.634	1248	1.753	1416	0.806
96	1.477	264	1.784	432	3.369	600	7.558	768	9.639	936	5.616	1104	2.326	1272	1.757	1440	0.280
120	1.628	288	1.841	456	3.883	624	8.153	792	9.253	960	4.950	1128	2.116	1296	1.752		
144	1.714	312	1.958	480	4.396	648	8.708	816	8.708	984	4.396	1152	1.958	1320	1.714		
168	1.752	336	2.116	504	4.950	672	9.253	840	8.153	1008	3.883	1176	1.841	1344	1.628		

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Rainfall Hyetograph for 1440 minute 100 year Summer I+20% for Pipe S1.009 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
24	1.277	192	1.506	360	2.035	528	4.077	696	12.948	864	6.987	1032	2.476	1200	1.695	1368	1.380
48	1.309	216	1.561	384	2.161	552	4.850	720	14.920	888	5.741	1056	2.295	1224	1.632	1392	1.341
72	1.341	240	1.632	408	2.295	576	5.741	744	14.920	912	4.850	1080	2.161	1248	1.561	1416	1.309
96	1.380	264	1.695	432	2.476	600	6.987	768	12.948	936	4.077	1104	2.035	1272	1.506	1440	1.277
120	1.412	288	1.759	456	2.744	624	8.201	792	11.214	960	3.478	1128	1.940	1296	1.475		
144	1.443	312	1.845	480	3.075	648	9.510	816	9.510	984	3.075	1152	1.845	1320	1.443		
168	1.475	336	1.940	504	3.478	672	11.214	840	8.201	1008	2.744	1176	1.759	1344	1.412		

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Rainfall Hyetograph for 1440 minute 100 year Summer I+20% for Pipe S1.010 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
24	1.277	192	1.506	360	2.035	528	4.077	696	12.948	864	6.987	1032	2.476	1200	1.695	1368	1.380
48	1.309	216	1.561	384	2.161	552	4.850	720	14.920	888	5.741	1056	2.295	1224	1.632	1392	1.341
72	1.341	240	1.632	408	2.295	576	5.741	744	14.920	912	4.850	1080	2.161	1248	1.561	1416	1.309
96	1.380	264	1.695	432	2.476	600	6.987	768	12.948	936	4.077	1104	2.035	1272	1.506	1440	1.277
120	1.412	288	1.759	456	2.744	624	8.201	792	11.214	960	3.478	1128	1.940	1296	1.475		
144	1.443	312	1.845	480	3.075	648	9.510	816	9.510	984	3.075	1152	1.845	1320	1.443		
168	1.475	336	1.940	504	3.478	672	11.214	840	8.201	1008	2.744	1176	1.759	1344	1.412		

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Rainfall Hyetograph for 480 minute 100 year Winter I+20% for Pipe S1.011 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.672	64	4.211	120	5.574	176	13.458	232	23.100	288	18.114	344	8.075	400	4.276	456	3.539
16	1.931	72	4.202	128	6.313	184	14.938	240	23.768	296	16.440	352	7.128	408	4.212	464	2.856
24	2.856	80	4.212	136	7.128	192	16.440	248	23.768	304	14.938	360	6.313	416	4.202	472	1.931
32	3.539	88	4.276	144	8.075	200	18.114	256	23.100	312	13.458	368	5.574	424	4.211	480	0.672
40	3.902	96	4.413	152	9.306	208	19.540	264	22.174	320	11.862	376	5.071	432	4.200		
48	4.108	104	4.692	160	10.535	216	20.869	272	20.869	328	10.535	384	4.692	440	4.108		
56	4.200	112	5.071	168	11.862	224	22.174	280	19.540	336	9.306	392	4.413	448	3.902		

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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	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	0.700
M5-60 (mm)	18.800	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.400	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	100	Add Flow / Climate Change (%)	30	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.337	4-8	0.317

Total Area Contributing (ha) = 0.654

Total Pipe Volume (m³) = 24.205

Network Design Table for Storm

« - Indicates pipe capacity < flow

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Network Design Table 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)	Section Type	Auto Design
S1.000	5.596	0.056	99.9	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	5.596	0.056	99.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	14.183	0.170	83.4	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	18.445	0.184	100.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	17.840	0.075	237.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	17.383	0.073	238.1	0.038	5.00	0.0	0.600	o	150	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)
S1.000	65.53	5.09	39.987	0.030	0.0	0.0	1.6	1.01	17.8	6.9
S1.001	65.02	5.19	39.931	0.030	0.0	0.0	1.6	1.01	17.8	6.9
S2.000	64.87	5.21	40.200	0.000	0.0	0.0	0.0	1.10	19.5	0.0
S2.001	63.28	5.52	40.030	0.000	0.0	0.0	0.0	1.00	17.7	0.0
S1.002	61.83	5.81	39.725	0.030	0.0	0.0	1.6	1.02	71.8	6.9
S3.000	63.65	5.45	40.006	0.038	0.0	0.0	2.0	0.65	11.4	8.5

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Network Design Table 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)	Section Type	Auto Design
S3.001	19.791	0.283	69.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	24.411	0.103	237.0	0.038	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.000	21.572	0.216	99.9	0.039	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	24.918	0.103	241.9	0.115	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	22.747	0.102	223.0	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.000	25.275	0.241	104.9	0.000	5.00	0.0	0.600	o	100	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)
S3.001	62.76	5.62	39.933	0.038	0.0	0.0	2.0	1.88	133.1	8.5
S1.003	59.98	6.21	39.650	0.106	0.0	0.0	5.2	1.02	71.9	22.4
S4.000	64.11	5.36	39.900	0.039	0.0	0.0	2.0	1.01	17.8	8.8
S1.004	58.20	6.63	39.534	0.260	0.0	0.0	12.3	1.01	71.1	53.3
S1.005	56.74	6.99	39.445	0.289	0.0	0.0	13.3	1.05	74.1	57.7
S5.000	63.07	5.56	40.219	0.000	0.0	0.0	0.0	0.75	5.9	0.0

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Network Design Table 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)	Section Type	Auto Design
S5.001	19.787	0.198	99.9	0.026	0.00	0.0	0.600	o	150	Pipe/Conduit	
S5.002	23.059	0.197	117.1	0.034	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.000	24.391	0.244	100.0	0.034	5.00	0.0	0.600	o	150	Pipe/Conduit	
S6.001	8.947	0.089	100.5	0.039	0.00	0.0	0.600	oo	150	Double Pipe	
S5.003	28.974	0.171	169.4	0.037	0.00	0.0	0.600	o	225	Pipe/Conduit	
S7.000	13.382	0.134	99.9	0.044	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.001	9.767	0.098	99.7	0.005	0.00	0.0	0.600	o	150	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)
S5.001	61.47	5.89	39.984	0.026	0.0	0.0	1.3	1.01	17.8	5.6
S5.002	60.01	6.21	39.786	0.060	0.0	0.0	2.9	1.21	48.0	12.7
S6.000	63.87	5.40	39.997	0.034	0.0	0.0	1.8	1.01	17.8	7.6
S6.001	63.11	5.55	39.753	0.073	0.0	0.0	3.7	1.00	35.4	16.2
S5.003	57.94	6.69	39.589	0.170	0.0	0.0	8.0	1.00	39.8	34.7
S7.000	64.83	5.22	39.693	0.044	0.0	0.0	2.3	1.01	17.8	10.0
S7.001	63.98	5.38	39.573	0.049	0.0	0.0	2.5	1.01	17.8	11.0

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Network Design Table 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)	Section Type	Auto Design
S1.006	12.927	0.033	391.7	0.027	0.00	0.0	0.600	o	450	Pipe/Conduit	
S8.000	27.439	0.163	168.3	0.082	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	9.337	0.024	387.0	0.037	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.008	11.614	0.030	387.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.009	25.246	0.066	382.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.010	4.162	0.011	378.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.011	1.461	0.009	162.3	0.000	0.00	0.0	0.600	o	225	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)
S1.006	55.92	7.20	39.193	0.535	0.0	0.0	24.3	1.02	162.4	105.3
S8.000	63.61	5.46	39.540	0.082	0.0	0.0	4.2	1.00	40.0	18.4
S1.007	55.36	7.35	39.109	0.654	0.0	0.0	29.4	1.03	163.4	127.5
S1.008	54.67	7.54	39.085	0.654	0.0	0.0	29.4	1.03	163.4	127.5
S1.009	53.24	7.95	39.055	0.654	0.0	0.0	29.4	1.03	164.4	127.5
S1.010	53.02	8.01	38.989	0.654	0.0	0.0	29.4	1.04	165.3	127.5
S1.011	52.94	8.04	38.978	0.654	0.0	0.0	29.4	1.02	40.7«	127.5

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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)
SSTATION 2	41.200	1.213	Open Manhole	1350	S1.000	39.987	150				
S2	41.200	1.269	Open Manhole	1200	S1.001	39.931	150	S1.000	39.931	150	
SSTATION 19	41.250	1.050	Open Manhole	1200	S2.000	40.200	150				
SSTATION 20	41.195	1.165	Open Manhole	1200	S2.001	40.030	150	S2.000	40.030	150	
S3	41.100	1.375	Sealed Manhole	1350	S1.002	39.725	300	S1.001	39.875	150	
								S2.001	39.846	150	
S7	41.106	1.100	Open Manhole	1350	S3.000	40.006	150				
S7a	41.250	1.317	Open Manhole	1350	S3.001	39.933	300	S3.000	39.933	150	
S4	41.000	1.350	Sealed Manhole	1350	S1.003	39.650	300	S1.002	39.650	300	
								S3.001	39.650	300	
SSTATION 7	41.100	1.200	Open Manhole	1350	S4.000	39.900	150				
S5	41.100	1.566	Open Manhole	1350	S1.004	39.534	300	S1.003	39.547	300	13
								S4.000	39.684	150	
S6	41.300	1.869	Open Manhole	1500	S1.005	39.445	300	S1.004	39.431	300	
SSTATION 21	41.325	1.106	Open Manhole	1200	S5.000	40.219	100				
SSTATION 22	41.000	1.022	Open Manhole	1350	S5.001	39.984	150	S5.000	39.978	100	
S8	41.322	1.536	Open Manhole	1350	S5.002	39.786	225	S5.001	39.786	150	
S9b	41.236	1.239	Open Manhole	1500	S6.000	39.997	150				
S9a	41.250	1.497	Open Manhole	1500	S6.001	39.753	150	S6.000	39.753	150	

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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)
S9	41.233	1.644	Open Manhole	1350	S5.003	39.589	225	S5.002	39.589	225	
								S6.001	39.664	150	
S10	41.225	1.532	Open Manhole	1350	S7.000	39.693	150				
S11	41.325	1.766	Open Manhole	1350	S7.001	39.573	150	S7.000	39.559	150	
S12	41.300	2.107	Open Manhole	1800	S1.006	39.193	450	S1.005	39.343	300	
								S5.003	39.418	225	
								S7.001	39.475	150	
S1	41.000	1.460	Open Manhole	1350	S8.000	39.540	225				
S17	40.894	1.785	Open Manhole	1800	S1.007	39.109	450	S1.006	39.160	450	51
								S8.000	39.377	225	43
S13	40.867	1.782	Open Manhole	1500	S1.008	39.085	450	S1.007	39.085	450	
S14	40.839	1.784	Open Manhole	1200	S1.009	39.055	450	S1.008	39.055	450	
S15	40.839	1.850	Open Manhole	1200	S1.010	38.989	450	S1.009	38.989	450	
S16	40.839	1.861	Open Manhole	1500	S1.011	38.978	225	S1.010	38.978	450	
S17	40.250	1.281	Open Manhole	0		OUTFALL		S1.011	38.969	225	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SSTATION 2	469532.665	170230.347	469532.665	170230.347	Required	
S2	469538.194	170229.482	469538.194	170229.482	Required	
SSTATION 19	469543.713	170261.225	469543.713	170261.225	Required	
SSTATION 20	469543.146	170247.053	469543.146	170247.053	Required	
S3	469543.723	170228.617			No Entry	
S7	469553.067	170253.366	469553.067	170253.366	Required	
S7a	469554.325	170236.029	469554.325	170236.029	Required	
S4	469556.704	170216.381			No Entry	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SSTATION 7	469532.439	170190.647	469532.439	170190.647	Required	
S5	469553.960	170192.125	469553.960	170192.125	Required	
S6	469552.491	170167.250	469552.491	170167.250	Required	
SSTATION 21	469532.680	170161.201	469532.680	170161.201	Required	
SSTATION 22	469530.119	170136.055	469530.119	170136.055	Required	
S8	469545.437	170123.531	469545.437	170123.531	Required	
S9b	469565.044	170114.115	469565.044	170114.115	Required	
S9a	469571.854	170137.536	469571.854	170137.536	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S9	469562.961	170138.517	469562.961	170138.517	Required	
S10	469584.585	170146.387	469584.585	170146.387	Required	
S11	469574.412	170155.081	469574.412	170155.081	Required	
S12	469575.108	170164.823	469575.108	170164.823	Required	
S1	469595.154	170188.676	469595.154	170188.676	Required	
S17	469587.775	170162.247	469587.775	170162.247	Required	
S13	469597.029	170161.009	469597.029	170161.009	Required	
S14	469608.531	170159.391	469608.531	170159.391	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S15	469633.603	170156.429	469633.603	170156.429	Required	
S16	469637.731	170155.902	469637.731	170155.902	Required	
S17	469639.182	170155.739			No Entry	

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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)
S1.000	o	150	SSTATION 2	41.200	39.987	1.063	Open Manhole	1350
S1.001	o	150	S2	41.200	39.931	1.119	Open Manhole	1200
S2.000	o	150	SSTATION 19	41.250	40.200	0.900	Open Manhole	1200
S2.001	o	150	SSTATION 20	41.195	40.030	1.015	Open Manhole	1200
S1.002	o	300	S3	41.100	39.725	1.075	Sealed Manhole	1350
S3.000	o	150	S7	41.106	40.006	0.950	Open Manhole	1350

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)
S1.000	5.596	99.9	S2	41.200	39.931	1.119	Open Manhole	1200
S1.001	5.596	99.9	S3	41.100	39.875	1.075	Sealed Manhole	1350
S2.000	14.183	83.4	SSTATION 20	41.195	40.030	1.015	Open Manhole	1200
S2.001	18.445	100.2	S3	41.100	39.846	1.104	Sealed Manhole	1350
S1.002	17.840	237.9	S4	41.000	39.650	1.050	Sealed Manhole	1350
S3.000	17.383	238.1	S7a	41.250	39.933	1.167	Open Manhole	1350

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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)
S3.001	o	300	S7a	41.250	39.933	1.017	Open Manhole	1350
S1.003	o	300	S4	41.000	39.650	1.050	Sealed Manhole	1350
S4.000	o	150	SSTATION 7	41.100	39.900	1.050	Open Manhole	1350
S1.004	o	300	S5	41.100	39.534	1.266	Open Manhole	1350
S1.005	o	300	S6	41.300	39.445	1.555	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)
S3.001	19.791	69.9	S4	41.000	39.650	1.050	Sealed Manhole	1350
S1.003	24.411	237.0	S5	41.100	39.547	1.253	Open Manhole	1350
S4.000	21.572	99.9	S5	41.100	39.684	1.266	Open Manhole	1350
S1.004	24.918	241.9	S6	41.300	39.431	1.569	Open Manhole	1500
S1.005	22.747	223.0	S12	41.300	39.343	1.657	Open Manhole	1800

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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)
S5.000	o	100	SSTATION 21	41.325	40.219	1.006	Open Manhole	1200
S5.001	o	150	SSTATION 22	41.000	39.984	0.866	Open Manhole	1350
S5.002	o	225	S8	41.322	39.786	1.311	Open Manhole	1350
S6.000	o	150	S9b	41.236	39.997	1.089	Open Manhole	1500
S6.001	oo	150	S9a	41.250	39.753	1.347	Open Manhole	1500
S5.003	o	225	S9	41.233	39.589	1.419	Open Manhole	1350

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)
S5.000	25.275	104.9	SSTATION 22	41.000	39.978	0.922	Open Manhole	1350
S5.001	19.787	99.9	S8	41.322	39.786	1.386	Open Manhole	1350
S5.002	23.059	117.1	S9	41.233	39.589	1.419	Open Manhole	1350
S6.000	24.391	100.0	S9a	41.250	39.753	1.347	Open Manhole	1500
S6.001	8.947	100.5	S9	41.233	39.664	1.419	Open Manhole	1350
S5.003	28.974	169.4	S12	41.300	39.418	1.657	Open Manhole	1800

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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)
S7.000	o	150	S10	41.225	39.693	1.382	Open Manhole	1350
S7.001	o	150	S11	41.325	39.573	1.602	Open Manhole	1350
S1.006	o	450	S12	41.300	39.193	1.657	Open Manhole	1800
S8.000	o	225	S1	41.000	39.540	1.235	Open Manhole	1350
S1.007	o	450	S17	40.894	39.109	1.335	Open Manhole	1800
S1.008	o	450	S13	40.867	39.085	1.332	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)
S7.000	13.382	99.9	S11	41.325	39.559	1.616	Open Manhole	1350
S7.001	9.767	99.7	S12	41.300	39.475	1.675	Open Manhole	1800
S1.006	12.927	391.7	S17	40.894	39.160	1.284	Open Manhole	1800
S8.000	27.439	168.3	S17	40.894	39.377	1.292	Open Manhole	1800
S1.007	9.337	387.0	S13	40.867	39.085	1.332	Open Manhole	1500
S1.008	11.614	387.1	S14	40.839	39.055	1.334	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)
S1.009	o	450	S14	40.839	39.055	1.334	Open Manhole	1200
S1.010	o	450	S15	40.839	38.989	1.400	Open Manhole	1200
S1.011	o	225	S16	40.839	38.978	1.636	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)
S1.009	25.246	382.5	S15	40.839	38.989	1.400	Open Manhole	1200
S1.010	4.162	378.4	S16	40.839	38.978	1.411	Open Manhole	1500
S1.011	1.461	162.3	S17	40.250	38.969	1.056	Open Manhole	0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.030	0.030	0.030
1.001	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.000	0.000	0.000
2.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.038	0.038	0.038
3.001	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.038	0.038	0.038
4.000	-	-	100	0.039	0.039	0.039
1.004	-	-	100	0.115	0.115	0.115
1.005	-	-	100	0.029	0.029	0.029
5.000	-	-	100	0.000	0.000	0.000
5.001	-	-	100	0.026	0.026	0.026
5.002	-	-	100	0.034	0.034	0.034
6.000	-	-	100	0.034	0.034	0.034
6.001	-	-	100	0.039	0.039	0.039
5.003	-	-	100	0.037	0.037	0.037
7.000	-	-	100	0.044	0.044	0.044
7.001	-	-	100	0.005	0.005	0.005
1.006	-	-	100	0.027	0.027	0.027
8.000	-	-	100	0.082	0.082	0.082
1.007	-	-	100	0.037	0.037	0.037
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
				0.654	0.654	0.654

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.011	S17	40.250	38.969	0.000	0	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	39.100	10	39.100	19	39.100	28	39.100	37	39.100	46	39.100	55	39.100	64	39.100	73	39.100
2	39.100	11	39.100	20	39.100	29	39.100	38	39.100	47	39.100	56	39.100	65	39.100	74	39.100
3	39.100	12	39.100	21	39.100	30	39.100	39	39.100	48	39.100	57	39.100	66	39.100	75	39.100
4	39.100	13	39.100	22	39.100	31	39.100	40	39.100	49	39.100	58	39.100	67	39.100	76	39.100
5	39.100	14	39.100	23	39.100	32	39.100	41	39.100	50	39.100	59	39.100	68	39.100	77	39.100
6	39.100	15	39.100	24	39.100	33	39.100	42	39.100	51	39.100	60	39.100	69	39.100	78	39.100
7	39.100	16	39.100	25	39.100	34	39.100	43	39.100	52	39.100	61	39.100	70	39.100	79	39.100
8	39.100	17	39.100	26	39.100	35	39.100	44	39.100	53	39.100	62	39.100	71	39.100	80	39.100
9	39.100	18	39.100	27	39.100	36	39.100	45	39.100	54	39.100	63	39.100	72	39.100	81	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
82	39.100	108	39.100	134	39.100	160	39.100	186	39.100	212	39.100	238	39.100	264	39.100	290	39.100
83	39.100	109	39.100	135	39.100	161	39.100	187	39.100	213	39.100	239	39.100	265	39.100	291	39.100
84	39.100	110	39.100	136	39.100	162	39.100	188	39.100	214	39.100	240	39.100	266	39.100	292	39.100
85	39.100	111	39.100	137	39.100	163	39.100	189	39.100	215	39.100	241	39.100	267	39.100	293	39.100
86	39.100	112	39.100	138	39.100	164	39.100	190	39.100	216	39.100	242	39.100	268	39.100	294	39.100
87	39.100	113	39.100	139	39.100	165	39.100	191	39.100	217	39.100	243	39.100	269	39.100	295	39.100
88	39.100	114	39.100	140	39.100	166	39.100	192	39.100	218	39.100	244	39.100	270	39.100	296	39.100
89	39.100	115	39.100	141	39.100	167	39.100	193	39.100	219	39.100	245	39.100	271	39.100	297	39.100
90	39.100	116	39.100	142	39.100	168	39.100	194	39.100	220	39.100	246	39.100	272	39.100	298	39.100
91	39.100	117	39.100	143	39.100	169	39.100	195	39.100	221	39.100	247	39.100	273	39.100	299	39.100
92	39.100	118	39.100	144	39.100	170	39.100	196	39.100	222	39.100	248	39.100	274	39.100	300	39.100
93	39.100	119	39.100	145	39.100	171	39.100	197	39.100	223	39.100	249	39.100	275	39.100	301	39.100
94	39.100	120	39.100	146	39.100	172	39.100	198	39.100	224	39.100	250	39.100	276	39.100	302	39.100
95	39.100	121	39.100	147	39.100	173	39.100	199	39.100	225	39.100	251	39.100	277	39.100	303	39.100
96	39.100	122	39.100	148	39.100	174	39.100	200	39.100	226	39.100	252	39.100	278	39.100	304	39.100
97	39.100	123	39.100	149	39.100	175	39.100	201	39.100	227	39.100	253	39.100	279	39.100	305	39.100
98	39.100	124	39.100	150	39.100	176	39.100	202	39.100	228	39.100	254	39.100	280	39.100	306	39.100
99	39.100	125	39.100	151	39.100	177	39.100	203	39.100	229	39.100	255	39.100	281	39.100	307	39.100
100	39.100	126	39.100	152	39.100	178	39.100	204	39.100	230	39.100	256	39.100	282	39.100	308	39.100
101	39.100	127	39.100	153	39.100	179	39.100	205	39.100	231	39.100	257	39.100	283	39.100	309	39.100
102	39.100	128	39.100	154	39.100	180	39.100	206	39.100	232	39.100	258	39.100	284	39.100	310	39.100
103	39.100	129	39.100	155	39.100	181	39.100	207	39.100	233	39.100	259	39.100	285	39.100	311	39.100
104	39.100	130	39.100	156	39.100	182	39.100	208	39.100	234	39.100	260	39.100	286	39.100	312	39.100
105	39.100	131	39.100	157	39.100	183	39.100	209	39.100	235	39.100	261	39.100	287	39.100	313	39.100
106	39.100	132	39.100	158	39.100	184	39.100	210	39.100	236	39.100	262	39.100	288	39.100	314	39.100
107	39.100	133	39.100	159	39.100	185	39.100	211	39.100	237	39.100	263	39.100	289	39.100	315	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
316	39.100	342	39.100	368	39.100	394	39.100	420	39.100	446	39.100	472	39.100	498	39.100	524	39.100
317	39.100	343	39.100	369	39.100	395	39.100	421	39.100	447	39.100	473	39.100	499	39.100	525	39.100
318	39.100	344	39.100	370	39.100	396	39.100	422	39.100	448	39.100	474	39.100	500	39.100	526	39.100
319	39.100	345	39.100	371	39.100	397	39.100	423	39.100	449	39.100	475	39.100	501	39.100	527	39.100
320	39.100	346	39.100	372	39.100	398	39.100	424	39.100	450	39.100	476	39.100	502	39.100	528	39.100
321	39.100	347	39.100	373	39.100	399	39.100	425	39.100	451	39.100	477	39.100	503	39.100	529	39.100
322	39.100	348	39.100	374	39.100	400	39.100	426	39.100	452	39.100	478	39.100	504	39.100	530	39.100
323	39.100	349	39.100	375	39.100	401	39.100	427	39.100	453	39.100	479	39.100	505	39.100	531	39.100
324	39.100	350	39.100	376	39.100	402	39.100	428	39.100	454	39.100	480	39.100	506	39.100	532	39.100
325	39.100	351	39.100	377	39.100	403	39.100	429	39.100	455	39.100	481	39.100	507	39.100	533	39.100
326	39.100	352	39.100	378	39.100	404	39.100	430	39.100	456	39.100	482	39.100	508	39.100	534	39.100
327	39.100	353	39.100	379	39.100	405	39.100	431	39.100	457	39.100	483	39.100	509	39.100	535	39.100
328	39.100	354	39.100	380	39.100	406	39.100	432	39.100	458	39.100	484	39.100	510	39.100	536	39.100
329	39.100	355	39.100	381	39.100	407	39.100	433	39.100	459	39.100	485	39.100	511	39.100	537	39.100
330	39.100	356	39.100	382	39.100	408	39.100	434	39.100	460	39.100	486	39.100	512	39.100	538	39.100
331	39.100	357	39.100	383	39.100	409	39.100	435	39.100	461	39.100	487	39.100	513	39.100	539	39.100
332	39.100	358	39.100	384	39.100	410	39.100	436	39.100	462	39.100	488	39.100	514	39.100	540	39.100
333	39.100	359	39.100	385	39.100	411	39.100	437	39.100	463	39.100	489	39.100	515	39.100	541	39.100
334	39.100	360	39.100	386	39.100	412	39.100	438	39.100	464	39.100	490	39.100	516	39.100	542	39.100
335	39.100	361	39.100	387	39.100	413	39.100	439	39.100	465	39.100	491	39.100	517	39.100	543	39.100
336	39.100	362	39.100	388	39.100	414	39.100	440	39.100	466	39.100	492	39.100	518	39.100	544	39.100
337	39.100	363	39.100	389	39.100	415	39.100	441	39.100	467	39.100	493	39.100	519	39.100	545	39.100
338	39.100	364	39.100	390	39.100	416	39.100	442	39.100	468	39.100	494	39.100	520	39.100	546	39.100
339	39.100	365	39.100	391	39.100	417	39.100	443	39.100	469	39.100	495	39.100	521	39.100	547	39.100
340	39.100	366	39.100	392	39.100	418	39.100	444	39.100	470	39.100	496	39.100	522	39.100	548	39.100
341	39.100	367	39.100	393	39.100	419	39.100	445	39.100	471	39.100	497	39.100	523	39.100	549	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
550	39.100	576	39.100	602	39.100	628	39.100	654	39.100	680	39.100	706	39.100	732	39.100	758	39.100
551	39.100	577	39.100	603	39.100	629	39.100	655	39.100	681	39.100	707	39.100	733	39.100	759	39.100
552	39.100	578	39.100	604	39.100	630	39.100	656	39.100	682	39.100	708	39.100	734	39.100	760	39.100
553	39.100	579	39.100	605	39.100	631	39.100	657	39.100	683	39.100	709	39.100	735	39.100	761	39.100
554	39.100	580	39.100	606	39.100	632	39.100	658	39.100	684	39.100	710	39.100	736	39.100	762	39.100
555	39.100	581	39.100	607	39.100	633	39.100	659	39.100	685	39.100	711	39.100	737	39.100	763	39.100
556	39.100	582	39.100	608	39.100	634	39.100	660	39.100	686	39.100	712	39.100	738	39.100	764	39.100
557	39.100	583	39.100	609	39.100	635	39.100	661	39.100	687	39.100	713	39.100	739	39.100	765	39.100
558	39.100	584	39.100	610	39.100	636	39.100	662	39.100	688	39.100	714	39.100	740	39.100	766	39.100
559	39.100	585	39.100	611	39.100	637	39.100	663	39.100	689	39.100	715	39.100	741	39.100	767	39.100
560	39.100	586	39.100	612	39.100	638	39.100	664	39.100	690	39.100	716	39.100	742	39.100	768	39.100
561	39.100	587	39.100	613	39.100	639	39.100	665	39.100	691	39.100	717	39.100	743	39.100	769	39.100
562	39.100	588	39.100	614	39.100	640	39.100	666	39.100	692	39.100	718	39.100	744	39.100	770	39.100
563	39.100	589	39.100	615	39.100	641	39.100	667	39.100	693	39.100	719	39.100	745	39.100	771	39.100
564	39.100	590	39.100	616	39.100	642	39.100	668	39.100	694	39.100	720	39.100	746	39.100	772	39.100
565	39.100	591	39.100	617	39.100	643	39.100	669	39.100	695	39.100	721	39.100	747	39.100	773	39.100
566	39.100	592	39.100	618	39.100	644	39.100	670	39.100	696	39.100	722	39.100	748	39.100	774	39.100
567	39.100	593	39.100	619	39.100	645	39.100	671	39.100	697	39.100	723	39.100	749	39.100	775	39.100
568	39.100	594	39.100	620	39.100	646	39.100	672	39.100	698	39.100	724	39.100	750	39.100	776	39.100
569	39.100	595	39.100	621	39.100	647	39.100	673	39.100	699	39.100	725	39.100	751	39.100	777	39.100
570	39.100	596	39.100	622	39.100	648	39.100	674	39.100	700	39.100	726	39.100	752	39.100	778	39.100
571	39.100	597	39.100	623	39.100	649	39.100	675	39.100	701	39.100	727	39.100	753	39.100	779	39.100
572	39.100	598	39.100	624	39.100	650	39.100	676	39.100	702	39.100	728	39.100	754	39.100	780	39.100
573	39.100	599	39.100	625	39.100	651	39.100	677	39.100	703	39.100	729	39.100	755	39.100	781	39.100
574	39.100	600	39.100	626	39.100	652	39.100	678	39.100	704	39.100	730	39.100	756	39.100	782	39.100
575	39.100	601	39.100	627	39.100	653	39.100	679	39.100	705	39.100	731	39.100	757	39.100	783	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
784	39.100	810	39.100	836	39.100	862	39.100	888	39.100	914	39.100	940	39.100	966	39.100	992	39.100
785	39.100	811	39.100	837	39.100	863	39.100	889	39.100	915	39.100	941	39.100	967	39.100	993	39.100
786	39.100	812	39.100	838	39.100	864	39.100	890	39.100	916	39.100	942	39.100	968	39.100	994	39.100
787	39.100	813	39.100	839	39.100	865	39.100	891	39.100	917	39.100	943	39.100	969	39.100	995	39.100
788	39.100	814	39.100	840	39.100	866	39.100	892	39.100	918	39.100	944	39.100	970	39.100	996	39.100
789	39.100	815	39.100	841	39.100	867	39.100	893	39.100	919	39.100	945	39.100	971	39.100	997	39.100
790	39.100	816	39.100	842	39.100	868	39.100	894	39.100	920	39.100	946	39.100	972	39.100	998	39.100
791	39.100	817	39.100	843	39.100	869	39.100	895	39.100	921	39.100	947	39.100	973	39.100	999	39.100
792	39.100	818	39.100	844	39.100	870	39.100	896	39.100	922	39.100	948	39.100	974	39.100	1000	39.100
793	39.100	819	39.100	845	39.100	871	39.100	897	39.100	923	39.100	949	39.100	975	39.100	1001	39.100
794	39.100	820	39.100	846	39.100	872	39.100	898	39.100	924	39.100	950	39.100	976	39.100	1002	39.100
795	39.100	821	39.100	847	39.100	873	39.100	899	39.100	925	39.100	951	39.100	977	39.100	1003	39.100
796	39.100	822	39.100	848	39.100	874	39.100	900	39.100	926	39.100	952	39.100	978	39.100	1004	39.100
797	39.100	823	39.100	849	39.100	875	39.100	901	39.100	927	39.100	953	39.100	979	39.100	1005	39.100
798	39.100	824	39.100	850	39.100	876	39.100	902	39.100	928	39.100	954	39.100	980	39.100	1006	39.100
799	39.100	825	39.100	851	39.100	877	39.100	903	39.100	929	39.100	955	39.100	981	39.100	1007	39.100
800	39.100	826	39.100	852	39.100	878	39.100	904	39.100	930	39.100	956	39.100	982	39.100	1008	39.100
801	39.100	827	39.100	853	39.100	879	39.100	905	39.100	931	39.100	957	39.100	983	39.100	1009	39.100
802	39.100	828	39.100	854	39.100	880	39.100	906	39.100	932	39.100	958	39.100	984	39.100	1010	39.100
803	39.100	829	39.100	855	39.100	881	39.100	907	39.100	933	39.100	959	39.100	985	39.100	1011	39.100
804	39.100	830	39.100	856	39.100	882	39.100	908	39.100	934	39.100	960	39.100	986	39.100	1012	39.100
805	39.100	831	39.100	857	39.100	883	39.100	909	39.100	935	39.100	961	39.100	987	39.100	1013	39.100
806	39.100	832	39.100	858	39.100	884	39.100	910	39.100	936	39.100	962	39.100	988	39.100	1014	39.100
807	39.100	833	39.100	859	39.100	885	39.100	911	39.100	937	39.100	963	39.100	989	39.100	1015	39.100
808	39.100	834	39.100	860	39.100	886	39.100	912	39.100	938	39.100	964	39.100	990	39.100	1016	39.100
809	39.100	835	39.100	861	39.100	887	39.100	913	39.100	939	39.100	965	39.100	991	39.100	1017	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1018	39.100	1039	39.100	1060	39.100	1081	39.100	1102	39.100	1123	39.100	1144	39.100	1165	39.100	1186	39.100
1019	39.100	1040	39.100	1061	39.100	1082	39.100	1103	39.100	1124	39.100	1145	39.100	1166	39.100	1187	39.100
1020	39.100	1041	39.100	1062	39.100	1083	39.100	1104	39.100	1125	39.100	1146	39.100	1167	39.100	1188	39.100
1021	39.100	1042	39.100	1063	39.100	1084	39.100	1105	39.100	1126	39.100	1147	39.100	1168	39.100	1189	39.100
1022	39.100	1043	39.100	1064	39.100	1085	39.100	1106	39.100	1127	39.100	1148	39.100	1169	39.100	1190	39.100
1023	39.100	1044	39.100	1065	39.100	1086	39.100	1107	39.100	1128	39.100	1149	39.100	1170	39.100	1191	39.100
1024	39.100	1045	39.100	1066	39.100	1087	39.100	1108	39.100	1129	39.100	1150	39.100	1171	39.100	1192	39.100
1025	39.100	1046	39.100	1067	39.100	1088	39.100	1109	39.100	1130	39.100	1151	39.100	1172	39.100	1193	39.100
1026	39.100	1047	39.100	1068	39.100	1089	39.100	1110	39.100	1131	39.100	1152	39.100	1173	39.100	1194	39.100
1027	39.100	1048	39.100	1069	39.100	1090	39.100	1111	39.100	1132	39.100	1153	39.100	1174	39.100	1195	39.100
1028	39.100	1049	39.100	1070	39.100	1091	39.100	1112	39.100	1133	39.100	1154	39.100	1175	39.100	1196	39.100
1029	39.100	1050	39.100	1071	39.100	1092	39.100	1113	39.100	1134	39.100	1155	39.100	1176	39.100	1197	39.100
1030	39.100	1051	39.100	1072	39.100	1093	39.100	1114	39.100	1135	39.100	1156	39.100	1177	39.100	1198	39.100
1031	39.100	1052	39.100	1073	39.100	1094	39.100	1115	39.100	1136	39.100	1157	39.100	1178	39.100	1199	39.100
1032	39.100	1053	39.100	1074	39.100	1095	39.100	1116	39.100	1137	39.100	1158	39.100	1179	39.100	1200	39.100
1033	39.100	1054	39.100	1075	39.100	1096	39.100	1117	39.100	1138	39.100	1159	39.100	1180	39.100		
1034	39.100	1055	39.100	1076	39.100	1097	39.100	1118	39.100	1139	39.100	1160	39.100	1181	39.100		
1035	39.100	1056	39.100	1077	39.100	1098	39.100	1119	39.100	1140	39.100	1161	39.100	1182	39.100		
1036	39.100	1057	39.100	1078	39.100	1099	39.100	1120	39.100	1141	39.100	1162	39.100	1183	39.100		
1037	39.100	1058	39.100	1079	39.100	1100	39.100	1121	39.100	1142	39.100	1163	39.100	1184	39.100		
1038	39.100	1059	39.100	1080	39.100	1101	39.100	1122	39.100	1143	39.100	1164	39.100	1185	39.100		

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.500
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	2	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	18.800	Cv (Summer)	0.750
Return Period (years)	100	Ratio R	0.400	Cv (Winter)	0.840
Region	England and Wales	Profile Type	Summer	Storm Duration (mins)	30

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S15, DS/PN: S1.010, Volume (m³): 5.9

Unit Reference	MD-SHE-0098-5000-1500-5000	Sump Available	Yes
Design Head (m)	1.500	Diameter (mm)	98
Design Flow (l/s)	5.0	Invert Level (m)	38.989
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	Mean Flow over Head Range	-	4.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	0.600	4.8	1.600	5.1	2.600	6.5	5.000	8.8	7.500	10.7
0.200	4.4	0.800	4.3	1.800	5.4	3.000	6.9	5.500	9.2	8.000	11.0
0.300	4.8	1.000	4.1	2.000	5.7	3.500	7.4	6.000	9.6	8.500	11.3
0.400	4.9	1.200	4.5	2.200	6.0	4.000	7.9	6.500	10.0	9.000	11.6
0.500	4.9	1.400	4.8	2.400	6.2	4.500	8.4	7.000	10.3	9.500	11.9

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Non Return Valve Manhole: S16, DS/PN: S1.011, Volume (m³): 3.7

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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: S1.005

Invert Level (m) 39.445 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	250.0	0.0	0.800	250.0	0.0	0.801	0.0	0.0

Cellular Storage Manhole: S17, DS/PN: S1.007

Invert Level (m) 39.110 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	150.0	0.0	0.800	150.0	0.0	0.801	0.0	0.0

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.500
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status OFF Inertia Status OFF
Analysis Timestep Fine DVD 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) 100
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
S1.000	SSTATION 2	15 Winter	100	+40%	100/15 Summer				40.647	0.510	0.000	1.49		13.8
S1.001	S2	480 Winter	100	+40%	100/15 Summer				40.643	0.562	0.000	0.21		1.9

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
S1.000	SSTATION 2	SURCHARGED	
S1.001	S2	SURCHARGED	

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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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
S2.000	SSTATION 19	480 Winter	100	+40%	100/15 Winter				40.630	0.280	0.000	0.01		0.2
S2.001	SSTATION 20	480 Winter	100	+40%	100/15 Summer				40.639	0.459	0.000	0.02		0.3
S1.002	S3	480 Winter	100	+40%	100/15 Summer				40.658	0.633	0.000	0.04		1.8
S3.000	S7	15 Winter	100	+40%	100/15 Summer				40.682	0.526	0.000	1.65		17.4
S3.001	S7a	480 Winter	100	+40%	100/15 Summer				40.659	0.426	0.000	0.03		2.5
S1.003	S4	480 Winter	100	+40%	100/15 Summer				40.667	0.717	0.000	0.12		6.2
S4.000	SSTATION 7	480 Winter	100	+40%	100/15 Summer				40.651	0.601	0.000	0.15		2.5
S1.004	S5	480 Winter	100	+40%	100/15 Summer				40.679	0.845	0.000	0.30		15.0
S1.005	S6	480 Winter	100	+40%	100/15 Winter				40.692	0.947	0.000	0.15		7.4
S5.000	SSTATION 21	480 Winter	100	+40%	100/15 Summer				40.611	0.292	0.000	0.03		0.2
S5.001	SSTATION 22	480 Winter	100	+40%	100/15 Summer				40.632	0.498	0.000	0.10		1.7
S5.002	S8	480 Winter	100	+40%	100/15 Summer				40.655	0.644	0.000	0.10		3.8
S6.000	S9b	15 Winter	100	+40%	100/15 Summer				40.731	0.584	0.000	0.97		16.3
S6.001	S9a	480 Winter	100	+40%	100/15 Summer				40.651	0.748	0.000	0.20		4.6
S5.003	S9	480 Winter	100	+40%	100/15 Summer				40.671	0.857	0.000	0.28		10.3
S7.000	S10	480 Winter	100	+40%	100/15 Summer				40.642	0.799	0.000	0.19		2.7
S7.001	S11	480 Winter	100	+40%	100/15 Summer				40.665	0.942	0.000	0.24		2.9
S1.006	S12	480 Winter	100	+40%	100/15 Summer				40.696	1.053	0.000	0.15		16.1
S8.000	S1	480 Winter	100	+40%	100/15 Summer				40.689	0.924	0.000	0.15		5.2
S1.007	S17	480 Winter	100	+40%	100/15 Summer				40.704	1.145	0.000	0.11		10.3
S1.008	S13	480 Winter	100	+40%	100/15 Summer				40.714	1.179	0.000	0.09		9.5
S1.009	S14	480 Winter	100	+40%	100/15 Summer				40.718	1.213	0.000	0.07		7.6
S1.010	S15	480 Winter	100	+40%	100/15 Summer				40.718	1.279	0.000	0.05		5.0
S1.011	S16	480 Winter	100	+40%					39.102	-0.101	0.000	0.27		5.0

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
S2.000	SSTATION 19	SURCHARGED	
S2.001	SSTATION 20	SURCHARGED	
S1.002	S3	SURCHARGED*	
S3.000	S7	SURCHARGED	
S3.001	S7a	SURCHARGED	
S1.003	S4	SURCHARGED*	
S4.000	SSTATION 7	SURCHARGED	
S1.004	S5	SURCHARGED	
S1.005	S6	SURCHARGED	
S5.000	SSTATION 21	SURCHARGED	
S5.001	SSTATION 22	SURCHARGED	
S5.002	S8	SURCHARGED	
S6.000	S9b	SURCHARGED	
S6.001	S9a	SURCHARGED	
S5.003	S9	SURCHARGED	
S7.000	S10	SURCHARGED	
S7.001	S11	SURCHARGED	
S1.006	S12	SURCHARGED	
S8.000	S1	SURCHARGED	
S1.007	S17	FLOOD RISK	
S1.008	S13	FLOOD RISK	
S1.009	S14	FLOOD RISK	
S1.010	S15	FLOOD RISK	
S1.011	S16	OK	

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Rainfall Hyetograph for 15 minute 100 year Winter I+40% for Pipe S1.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	30.733	3	58.411	5	119.684	7	275.607	9	275.607	11	119.684	13	58.411	15	30.732
2	56.082	4	73.941	6	193.642	8	320.139	10	193.642	12	73.941	14	56.082		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S2.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S2.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.002 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 15 minute 100 year Winter I+40% for Pipe S3.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	30.733	3	58.411	5	119.684	7	275.607	9	275.607	11	119.684	13	58.411	15	30.732
2	56.082	4	73.941	6	193.642	8	320.139	10	193.642	12	73.941	14	56.082		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S3.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.003 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S4.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.004 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.005 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S5.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S5.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S5.002 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 15 minute 100 year Winter I+40% for Pipe S6.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	30.733	3	58.411	5	119.684	7	275.607	9	275.607	11	119.684	13	58.411	15	30.732
2	56.082	4	73.941	6	193.642	8	320.139	10	193.642	12	73.941	14	56.082		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S6.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S5.003 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S7.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S7.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.006 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S8.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.007 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
24	3.332	80	4.914	136	8.315	192	19.180	248	27.729	304	17.428	360	7.365	416	4.902	472	2.253
32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.008 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
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32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.009 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
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32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
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56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.010 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
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32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Rainfall Hyetograph for 480 minute 100 year Winter I+40% for Pipe S1.011 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
8	0.784	64	4.913	120	6.503	176	15.701	232	26.950	288	21.133	344	9.421	400	4.988	456	4.129
16	2.253	72	4.902	128	7.365	184	17.428	240	27.729	296	19.180	352	8.315	408	4.914	464	3.332
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32	4.129	88	4.988	144	9.421	200	21.133	256	26.950	312	15.701	368	6.503	424	4.913	480	0.784
40	4.552	96	5.149	152	10.857	208	22.796	264	25.870	320	13.839	376	5.916	432	4.900		
48	4.793	104	5.474	160	12.291	216	24.347	272	24.347	328	12.291	384	5.474	440	4.793		
56	4.900	112	5.916	168	13.839	224	25.870	280	22.796	336	10.857	392	5.149	448	4.552		

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Appendix D

Environment Agency response

creating a better place

Environment Agency

Our ref:	WA/2015/119569/02-L01
Your ref:	141944/REG3
Date:	28 April 2015

Reading Borough Council
Development Control
PO Box 17
Reading
Berkshire
RG1 7TD

Dear Ms A Amoah

Construction of a new railway station, bus interchange, multi-storey car park (park and rise facility), short stay car park, taxi drop-off, disable parking facility, station access road from Longwater Avenue, landscaping and associated works. Land West Of Longwater Avenue, Reading, RG2 6GP.

I refer to the email dated 27 March 2015 from Peter Brett Associates (PBA) regarding the above site.

The email includes:

-27159_001_020 - Green Park Scheme Overview
-28791_002_402 - Flood compensation scheme
-28791 - Green Park Flood Management Strategy_TN01_March15
-LFP_Axiom4_Foudry Brook Flood Storage Proposals
-PBA Foudry Brook Report - Proposed New Channel Tech Report B&W

Environment Agency position

We have reviewed the submitted information and we are able to **withdraw our objections** on flood risk grounds subject to the following conditions being imposed on any planning permission granted:

1) Condition: Development shall not begin until a surface water drainage scheme for this phase of work, based on the agreed Flood Risk Assessment has been submitted to and approved in writing by the local planning authority. The scheme shall subsequently be implemented in accordance with the approved details before the scheme is completed.
The scheme should allow for:

- The drainage design will be designed in accordance with the new Defra technical guidance for sustainable drainage systems.
- Run off rates will be limited to Greenfield rates and the discharges volumes will be

Cont/d..

limited by either utilising infiltration drainage or where this is not practical the runoff rate will be limited to Qbar of 2l/s/ha and additional attenuation provided to ensure no increase in flood risk downstream.

Reason: To prevent the increased risk of flooding, to improve and protect water quality, improve habitat and amenity, and ensure future maintenance of the surface water drainage system.

2) Condition: Prior to occupation of any part of the permitted development, a verification report demonstrating completion of the works set out in the approved remediation strategy and the effectiveness of the remediation shall be submitted to and approved, in writing, by the local planning authority. The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan to demonstrate that the site remediation criteria have been met. It shall also include any plan (a “long-term monitoring and maintenance plan”) for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action, as identified in the verification plan, and for the reporting of this to the local planning authority.

Reasons: This site is located over Beenham Grange Gravel Member (River Terrace Deposits) over Lambeth Group (both Secondary A Aquifers) and the Newhaven and Seaford Chalk (Principal Aquifer) and we need to protect these aquifers fro contamination that potentially could be mobilised during development.

3) Condition: If, during development, contamination not previously identified is found to be present at the site then no further development (unless otherwise agreed in writing with the Local Planning Authority) shall be carried out until the developer has submitted, and obtained written approval from the Local Planning Authority for, an amendment to the remediation strategy detailing how this unsuspected contamination shall be dealt with.

Reason: Part of this site was historically a waste transfer station and infilling has been undertaken along the perimeter of the Trout Lakes, therefore there is the potential for unsuspected contamination to be encountered during development. Any visual or olfactory contamination encountered should be dealt with in an appropriate manner in order to protect the aquifers below the site (Secondary A Aquifers in the River Terrace Deposits and Lambeth Group and the Principal Aquifer in the Chalk).

4) Condition: The development hereby permitted shall not be commenced until such time as a scheme to dispose of surface water (that should ensure that no soakaways are constructed in contaminated land) has been submitted to, and approved in writing by, the local planning authority. The scheme shall be implemented as approved.

Reason: There is a know hotspot of soils contamination in the made ground on this site and infiltration drainage methods would increase the mobilisation of contamination into the aquifers below the site.

5) Condition: Piling or any other foundation designs using penetrative methods shall not be permitted other than with the express written consent of the Local Planning Authority, which may be given for those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to groundwater.

Reasons: The conclusions of the PBA Technical Note dated 24 October 2014 considers protection of controlled waters and states that adoption of an appropriate piling technique will minimise creation of preferential pathways. We need assurance that

piles will terminate at the previously agreed level of 6 m above the surface of the Chalk.

Advice to LPA and applicant about flood risk

Surface water control measures

PBA has confirmed the drainage design will be designed in accordance with the new Defra technical guidance for sustainable drainage systems. PBA have confirmed commitment to provide a drainage system meeting these requirements.

Loss of flood plain storage

The site lies within Flood Zone 3a/2 defined by the Planning Practice Guidance as having a high / medium probability of flooding. PBA has provided additional information confirming the background history about this development and design strategies being used. With this information we are prepared to remove this objection.

Explanation

The documentation provided has confirmed that flood risk has been assessed for the site and flood mitigation by way of 'level for level' compensation has been provided in line with earlier agreements.

PBA have clarified there will be limited impact on flood risk in flood zone 3a with this phase of the construction of Green Park. This phase of work has already been accounted for in the mitigation. This phase of work is also providing additional flood compensation with the work on the lake providing flood storage.

It has been noted that this compensation for loss of flood plain storage is based on the best information available at the time which dates back several years and is based on studies from 1985. We would highlight the following points following this review:

· The Environment Agency has not reviewed the model produced by PBA in 2007. We cannot comment on any assumptions made, accuracy of the results and benefits this scheme provides.
· Encroachment of the flood plain by the access road and car parks is relatively small. PBA confirmed this has been identified and allowed for during the initial design of the flood compensation area.
· There have been various developments outside this site boundary which may affect flood risk on watercourses'. These watercourses may influence flood risk on this development.
· Due to changes in flood risk strategies and modelling techniques, more up to date modelling may be required to ensure the model is still valid.
· Future development on this site may require an up to date model. This should confirm the existing flood risk, the compensation provides the benefits suggested and account for other development in the area that would affect flood risk.

Low hazard access and egress

The FRA sets out that the route of access from the development is a very low hazard in accordance with FD2320 (Flood Risk Assessment Guidance for New Developments). The access and egress extends to an area outside of the 1 in 100 year with an allowance for climate change floodplain.

Please note, whilst the applicant has demonstrated the access is a very low hazard during the design flood level (the 1 in 100 plus climate change), during more extreme events the access route may have a greater hazard.

Given the nature of this development, we would recommend the applicant/ local authority may wish to develop a flood plan for emergency situations. Issues to cover may include the availability of flood warnings, duration of flooding, depth of flooding and the length of the evacuation route. It is not our role to review and assess evacuation plans or flood management plans, therefore the applicability and requirements of any site specific flood plan should be discussed with the Local Authority.

Advice for condition 2 – Verification Report

We have reviewed the PBA Technical Note dated 24 October 2014, which summarises the investigations carried out on this site. We agree with the conclusions of this Technical Note that "hot spot" remediation of ground in the vicinity of WS8 is required and that site wide mitigation measures should be incorporated in to the development design.

Advice to applicant - Foul drainage

All sewage or trade effluent should be discharged to the foul sewer if available subject to the approval of Thames Water Utilities or its sewerage agent.

The developer should ensure early negotiations are made with the local sewerage provider to ensure that there are no capacity issues generated by this development's connection to the local foul sewer.

Advice to applicant - Waste

The Environmental Protection (Duty of Care) Regulations 1991 for dealing with waste materials are applicable for any off-site movements of wastes. The developer as waste producer therefore has a duty of care to ensure all materials removed go to an appropriate permitted facility and all relevant documentation is completed and kept in line with regulations.

If any waste is to be used onsite, the applicant will be required to obtain the appropriate waste exemption or permit from us. We are unable to specify what exactly would be required if anything, due to the limited amount of information provided.

The developer must apply the waste hierarchy in a priority order of prevention, re-use, recycling before considering other recovery or disposal options.

Advice to applicant- Pollution prevention

It is suggested that larger areas of hard standing e.g. walkways/car-parking are constructed following the recommendations set out in Sustainable Urban Drainage Systems guidance. This can be continued with designs for open space and landscaping within the area. The use of SUDS can attenuate the disposal of water and reduce the impact of pollutants to nearby watercourses.

We advise you to consult Pollution Prevention Guidance 6 relating to the use of oil interceptors for discharges from car parking areas. Clean roof water should not pass through the oil separator. Where soakaways are used it should preferably not discharge

to soakaways used to drain road and vehicle parking areas. Roof water downpipes should be connected to the drainage system either directly, or by means of back inlet gullies provided with sealing plates instead of open gratings.

Following the good practice described does not remove your obligation to comply with relevant legislation and to prevent pollution from your site. Pollution of the environment is a criminal offence and compliance with one or more Guidance Note is not a defence to such offences.

Yours sincerely

Ms Michelle Kidd
Planning Advisor

Direct dial 01491 828455
Direct e-mail planning-wallingford@environment-agency.gov.uk

cc Peter Brett Associates

End

Geoenvironmental Technical Note

TECHNICAL NOTE

Job Name: Green Park Station

Job No: 28791

Note No: TN02/GEO

Date: 24 October 2014

Prepared By: Claire Walton / Catherine Copping

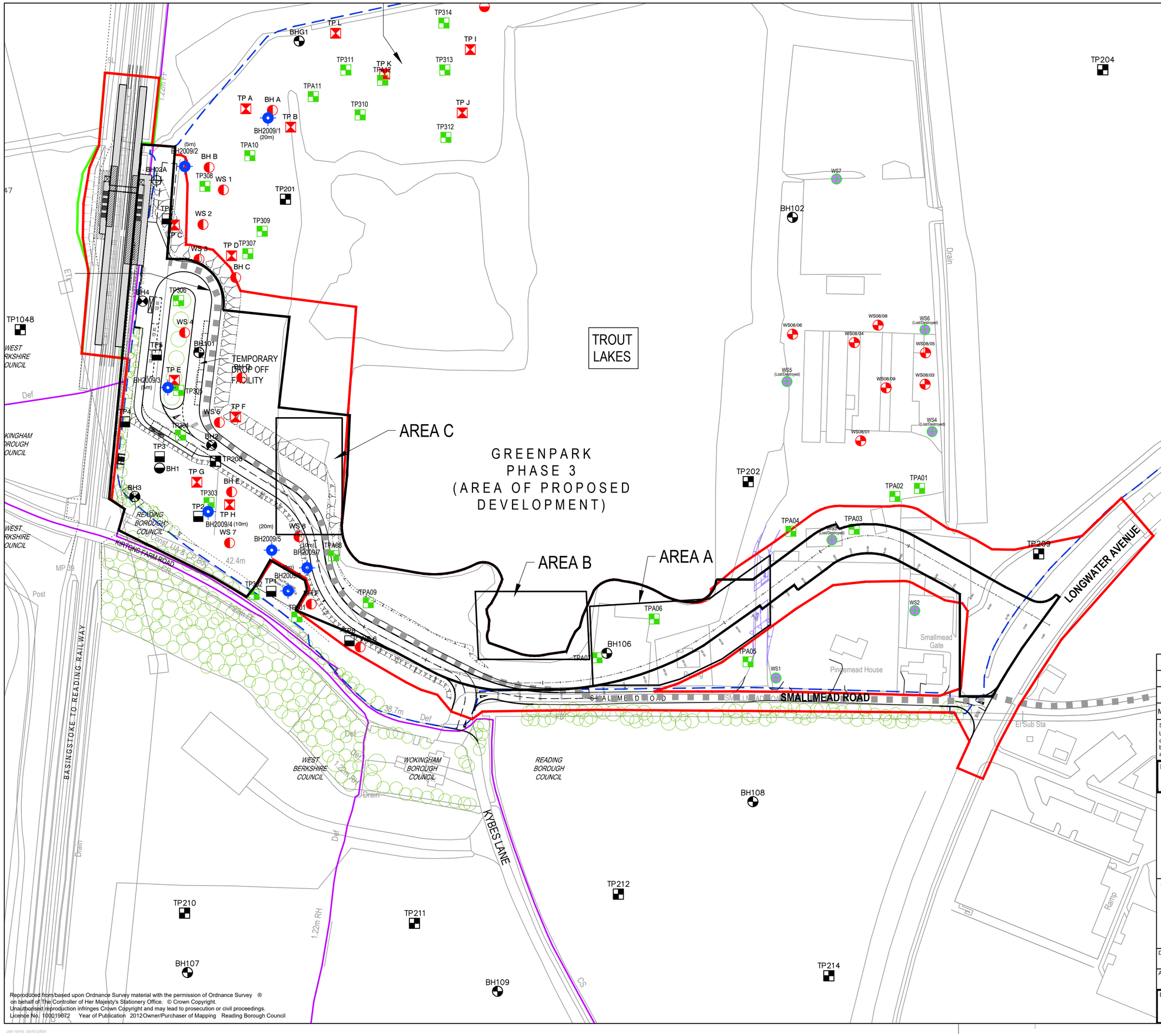
Subject: **Geoenvironmental Data**

Item	Subject
1.	**Introduction** Planning consent for the permanent Reading Green Park Railway Station (RGPRS) development (Approved Scheme) was achieved in 2007, (Reading Borough Council reference 07/01108/FUL, and West Berkshire Council Reference 07/02570/COMIND). Planning permission ref: 07/01108/FUL (now superseded by planning permission ref: 019/01494/VARAT) included conditions in respect of the management of potential land contamination at the site. Significant progress has been made towards the discharge of these conditions under Consent 09/01494/VARIAT. A synopsis report was prepared (PBA 2010) to present a single report summarising the work carried out in the various separate reports would allow the situation regarding ground characterisation and risk management to be formally presented. PBA have prepared a number of ground condition reports (refer to Section 1.5 for details) in relation to the station development and on adjacent land (Green Park Village and Temporary Access Works). The ground condition characterisation progressed to the point where a detailed remedial strategy has been prepared (PBA 2009D) and agreed with the regulators. Documentation relating to these agreements in principle is presented in Appendix 1 of the Synopsis Report. The reports utilised are listed below:- • **PBA 1998**: This scoping study comprised a desk based investigation which gathered geoenvironmental and geotechnical information on the site and other land owned by Bucknell Holdings nearby. An intrusive investigation was not undertaken as part of this study. • **PBA 2001**: This report presents the findings of ground investigation along the route of a proposed electric cable on land adjacent to the railway line. The investigation involved the excavation of nine trial pits, two boreholes and five window sample boreholes. Soil and groundwater testing was carried out on a number of samples. • **PBA 2002**: This investigation involved the excavation of 18 trial pits and the drilling of 19 boreholes and seven window sample locations. The investigation targeted the wider Phase III area of Green Park and included soil and groundwater chemical testing along with ground gas monitoring. A geoenvironmental risk assessment and geotechnical assessment was also carried out. • **PBA 2007A**: This report presents the findings of a gas and groundwater/surface water quality monitoring programme to assess whether lateral migration of potential pollutants is taking place from the landfill present to the north of Green Park Phase III land. • **PBA 2007B**: This investigation involved the excavation of twelve trial pits and the drilling of six boreholes and eight window sample locations within the area used by Clembins as Waste Transfer Station and included soil and groundwater chemical testing along with ground gas monitoring. • **PBA 2008A**: This report presents a hydrogeological risk assessment associated

Item	Subject
	with the proposed dewatering of the Trout Lakes (to the east of the proposed RGPRS). • **PBA 2009A**: This investigation involved the excavation of twelve trial pits along the course of a proposed temporary access road and car park to be developed as part of the RGPRS but the subject of a separate planning application. • **PBA 2009B**: This supplementary investigation comprised the excavation of fourteen trial pits and the drilling of seven boreholes in conjunction with groundwater and ground gas monitoring. This investigation targeted potential data gaps around the proposed RGPRS. • **PBA 2009C**: This investigation comprised the excavation of 11 trial pits and groundwater monitoring undertaken to assess two potential hot-spots (WS8 and BHC) in order to finalise the outline remedial strategy for the proposed RGPRS. • **PBA 2009D**: Report presenting a detailed remedial strategy for the RGPRS. • **PBA 2010**: Synopsis Report on Ground Conditions for Green Park Village
2.	**Red Line Boundary** Figure 1 (attached) shows the red boundary for the previous application and the red boundary for the current application. Whilst there are changes in the land under application it is considered that these will not alter the ground condition assessment.
3.	**Land Use** A PBA representative attended site on 30 September 2014 and it is considered that there is no visible evidence that the current land use has altered since the previous application. The topographic survey dated 2008 has been compared to the survey completed by Longdin & Browning in 2014 (dwg no 28791/002/009 dated 3 September 2014). The majority of the site remains largely unchanged apart from some minor variances of under approximately 20mm. The following differences are noted:- A. The area directly to the east of the Trout Lakes and north of Smallmead Road shows cuts of up to 600mm and fills of up to 560mm. B. The southern boundary of the Trout Lakes has been infilled with up to 1m of fill. C. Directly to the west of the Trout Lakes approximately 1.5-2m of fill has been placed. The three areas identified above are presented on the attached drawing – Figure 1. Whilst it is acknowleged that there are some areas of land use change as a result of importation of materials it is considered unlikely that this will alter the findings presented previously. If additional investigation were to be required this could be secured through conditions.
4.	**Criteria Used for Assessing Potential to Impact Human Health** The assessment criteria used to assess soil concentrations and the need to protect human health in the Synopsis 2010 report are the same as those currently used. It is therefore considered that the data does not need to be reviewed and the assessment and conclusions remain valid. However, the report only presents data for the western portion of the Site. Data is available for the eastern section and this has been extracted from the previous reports and assessed. None of the soil concentrations exceed the selected generic assessment criteria for commercial/ industrial end use. A summary table is attached.

Item	Subject
	It is therefore considered that the conclusions regarding potential to impact human health remain valid for the current application.
5.	**Criteria Used for Assessing Potential to Impact Controlled Waters** The assessment criteria used in the Synopsis Report were derived under the requirements of the Dangerous Substances Directive which presented a classification system for chemical substances (classified substances as List I and List II). In 2010 Directions were issued to the Environment Agency in connection with the implementation of the following EU Directives:- (a) Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy – referred to as the EU Water Framework Directive (WFD); and (b) Directive 2008/105/EC of the European Parliament and of the Council on environmental quality standards in the field of water policy. This Directive lays down environmental quality standards (EQS) for priority substances and certain other pollutants as provided for in Article 16 the WFD. The Directions cited as The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010 came into force on 4 August 2010. All the groundwater testing has been reassessed against the criteria presented in the Directions and a summary table is attached. The Test 2 criteria are for assessing groundwater impacts on surface water and the Test 2 minimum is the lowest criterion set in any of the 16 River Basin Management Plans and the Test 2 maximum is the highest criterion in any of the 16 River Basin Management Plans. Due to changes in the criteria used the following analytes exceed the standards: • Cadmium – the criterion has changed from 5 to 0.2µg/l. All of the data now exceeds the Test 2 lower criterion, however, all the results are reported as the limit of detection level (LOD) (which varies depending on when the testing was undertaken) and this may not reflect the true concentration which could be much lower. • Chromium – the criterion has changed from 50 to 5 µg/l. The samples that exceed the Test 2 lower are all from wells installed in the Made Ground present across the former waste transfer station. One result from BHD also exceeds the Test 2 maximum. • Copper – the criterion has changed from 28 to 10.1 µg/l. One result from BH3 exceeds the Test 2 lower criterion which is from a well located in the Made Ground. • Total Phenol – the criterion has changed from 30 to 15.2 µg/l. One result from BH3 now exceeds this criterion and also exceeds the Test 2 maximum. This result was identified previously. **Criteria Used for Assessing Potential to Impact Drinking Water** • PAH's – the criterion has changed from 0.2 to 0.1 µg/l. • Benzene – the minimum detection level is 10ug/l and the criterion is 1ug/l. Two additional samples have been highlighted using this criterion. Whilst there are changes to the assessment criteria and these have resulted in some additional samples being identified this is not considered to alter the previous assessment conclusions regarding groundwater quality. Where there are new parameters highlighted these were not considered previously and additional assessment is provided here. ➢ Cadmium – all the data is highlighted which if this where a potential hazard would indicate a wider background of impact. ➢ Chromium – the samples that exceed the criterion are from the Made Ground. The data for the down hydraulic gradient wells in the Lambeth Group does not show any

Item	Subject
	exceedances. ➢ Copper – only one sample exceeds the criterion and there is no data to suggest that the underlying aquifer has been impacted. It is considered that the conclusions regarding potential to impact controlled waters remain valid for the current application.
6.	**Conclusions** The conclusions from the Synopsis Report are reiterated below:- *Protection of Human Health* • Soil remediation for the protection of end user human health is not considered necessary. In addition, the raising of ground levels by 1m for flood alleviation using clean inert fill will remove direct contact pathways. • Gas mitigation measures are considered necessary. The design of the development will adopt measures commensurate with Characteristic Situation CS3. • The design of protected water supply pipes will be considered subject to discussions with the water utility provider. *Protection of Controlled Waters* • It is considered that site wide remediation is not required but that “hot spot” remediation of ground in the vicinity of WS8 and site wide mitigation measures should be incorporated in to the development design. • The mitigation measures comprise lined drainage systems, a protocol setting out the management of unforeseen ground conditions and measures to ensure no uncontrolled discharges including run off, adoption of an appropriate piling technique to minimise creation of preferential pathways. The above conclusions are considered valid for the current application, noting that the proposal to raise ground levels across the site is no longer necessary and therefore it may be necessary to design a clean cover system should any landscaping be proposed incorporated into the design in the western section of the site (former waste transfer station). It is proposed that the earthworks will utilise materials arising from any cut areas of fill areas such as the raising of the eastern end of the access road. It is proposed to utilise the CL:AIRE Development Industries Code of Practise (COP) which enables the legitimate re-use of materials on site as an alternative to Environmental Permits or Waste Exemptions. Provided that acceptance from the local authority can be obtained, it is likely that soils containing asbestos can be reused on site i.e. by engineering in beneath hard standing, roads, etc. Incorporation of asbestos containing soils into future engineering will include relevant precautions (indicator layers, minimum placement depth, etc.) and clear records indicating where the materials have been placed to protect future developers/end users.



Mark	Revision	Drawn	Date	Chkd

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status

GREEN PARK STATION
PROPOSED INTERCHANGE LAYOUT
PLANNING APPLICATION BOUNDARY

Client

Reading Borough Council
Working better with you

Date of 1st Issue 21.10.2014	Drawn by davco
A2 Scale 1:1250	Checked by CW
Drawing Number Figure 1	Revision

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READING
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GREEN PARK STATION, READING
TABLE SUMMARISING SOIL RESULTS AND HIGHLIGHTING EXCEEDANCES ABOVE HUMAN HEALTH ASSESSMENT CRITERIA

		Assessment Criteria										TPA07	TPA06	TPA05	TPA03	TPA01	TP209	WS3	WS3	WS2	WS2	WS1
Analyte	**Units**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**0.0-0.5**	**0.25-0.6**	**0.0-0.6**	**0.0-0.3**	**0.0-0.6**	**0.3**	**0.2**	**1.1**	**0.2**	**1**	**0.3-0.5**
Stones BG 2.6/3.0	%											3	9.9	19	13	32		2.2	1.5	8.6	23	6.1
Moisture content at 30 C	%											23	32	20	32	20		19	30	16	17	13
Arsenic as As, dry weight	mg/kg	43	32	640									6	11	3	7	11		2.9		3.6	6.6
Beryllium as BE, dry weight	mg/kg				55	51	420							0.5	0.6							0.62
Boron as B, hot water sol dw	mg/kg				45	291	192000															
Cadmium as Cd, dry weight	mg/kg	1.8	10	230									0.4	0.4	0.3	0.7	0.5		0.5		0.5	0.5
Chromium as Cr, dry weight	mg/kg	34600	3000	30400									32	20	20	20	15		22		20	19
Copper as Cu, dry weight	mg/kg				524	2330	71700							14	14		22					20
Lead as Pb, dry weight	mg/kg	450*	450*	750*									59	61	41	210	16		20		37	29
Mercury as Hg, dry weight	mg/kg	80	170	3600									0.4	0.4	0.4	0.4	0.3		0.25		0.25	0.25
Nickel as Ni, dry weight	mg/kg	230	130	1800									25	8	15	16	13		25		24	38
Selenium as Se, dry weight	mg/kg	120	350	13000									3	3	3	3	0.5		0.93		0.84	0.3
Vanadium as Vn, dry weight	mg/kg				18	75	3160							34	26							23
Zinc as Zn, dry weight	mg/kg				618	3750	665000							100	75		43					40
Cyanide (Total)	mg/kg																2.5					
Organic matter	%													4.4	6.7							3.3
Phenol, Total	mg/kg			3200				66	184					0.15	0.15		0.01					0.72
Sulphate (Total) as SO4	%																0.032					0.24
pH	pH Units													7.7	6.99		6.81				8.4	9
Benzene								0.02	0.08	28												
Toluene								22	120	870												
Ethylbenzene								16	65	520												
Xylene								28	42	475												
>C5 to C6 Aliphatic	mg/kg				740	30	3400													0.12		
>C6 to C8 Aliphatic	mg/kg				2300	73	8300													0.19		
>C8 to C10 Aliphatic	mg/kg				320	19	2100													0.73		
>C10 to C12 Aliphatic	mg/kg				2200	93	10000													10		
>C12 to C16 Aliphatic	mg/kg				11000	740	61000													9.4		
>C16 to C35 Aliphatic	mg/kg				260000	45000	2E+06													130		
>C35 to C44 Aliphatic	mg/kg				260000	45000	2E+06													64		
Total Aliphatic	mg/kg																			210		
>C5 to C7 Aromatic	mg/kg				13	65	28000													0.012		
>C7 to C8 Aromatic	mg/kg				22	120	59000													0.012		
>C8 to C10 Aromatic	mg/kg				8.6	27	3700													0.12		
>C10 to C12 Aromatic	mg/kg				13	69	17000													7.3		
>C12 to C16 Aromatic	mg/kg				23	140	36000													11		
>C16 to C21 Aromatic	mg/kg				46	250	28000													25		
>C21 TO C35 Aromatic	mg/kg				370	890	28000													110		
>C35 to C44 Aromatic	mg/kg				370	890	28000													69		
Total Aromatic	mg/kg																			210		
Total EPH Aliphatic/Aromatic	mg/kg										1000	110			130			830		440		
TPH by GC (>C6-C10)	mg/kg																			60		
TPH by GC (>C10 - C20)	mg/kg																			150		
TPH by GC (>C20-C40)	mg/kg																			860		
TPH by GC (>C6 - C40)	mg/kg																			1000		
TPH (Chromatogram)	TEXT																					
naphthalene	mg/kg				4.1	1.5	200					0.016			0.017							
acenaphthylene	mg/kg				28	170	84000					0.017			0.032							
acenaphthene	mg/kg				34	210	85000					0.008			0.008							
fluorene	mg/kg				27	160	64000					0.01			0.01							
phenanthrene	mg/kg				16	92	22000					0.13			0.18							
anthracene	mg/kg				380	2300	530000					0.026			0.054							
fluoranthene	mg/kg				52	260	23000					0.2			0.52							
pyrene	mg/kg				110	560	54000					0.17			0.48							
benzo(a)anthracene	mg/kg				2.5	3.1	90					0.085			0.25							
chrysene	mg/kg				2.6	6	140					0.12			0.24							
benzo(b)fluoranthene	mg/kg				3.5	5.6	100					0.12			0.28							
benzo(k)fluoranthene	mg/kg				6.8	8.5	140					0.056			0.14							
benzo(a)pyrene	mg/kg				0.6	0.83	14					0.082			0.29							
indeno(123cd)pyrene	mg/kg				1.8	3.2	60					0.059			0.17							
dibenzo(ah)anthracene	mg/kg				0.76	0.76	13					0.023			0.053							
benzo(ghi)perylene	mg/kg				70	44	650					0.085			0.24							
PAH (Total)	mg/kg											1.2			2.9							
PCB (as Aroclors)	mg/kg																					
1,2-dichloroethane	mg/kg				0.0046	0.0054	0.71															
1,1,1 Trichloroethane (TCA)	mg/kg				48	6.2	700															
1,1,1,2 Tetrachloroethane	mg/kg				0.79	0.9	120															
1,1,2,2 Tetrachloroethane	mg/kg				0.41	1.4	290															
Tetrachloroethene (PCE)	mg/kg				1.6	0.94	130															
Tetrachloromethane					0.16	0.018	3															
Tetrachloroethene (TCE)	mg/kg				0.43	0.11	12															
Trichlormethane (Chloroform)	mg/kg				0.36	0.75	110															
Vinyl Chloride (Chloroethene)	mg/kg				0.0006	0.0005	0.063															
Asbestos	TEXT																					
Floride	mg/kg																					
Molybdenum	mg/kg																					

Assessment Criteria

A - Soil Guideline Value (SGV) for Allotments
B - SGV for Residential with Plant Uptake
C - SGV for Commercial/Industrial
D - LQM Generic Assessment Criteria (GAC) for Allotments
E - LQM GAC for Residential with Plant Uptake
F - LQM GAC for Commercial/Industrial
G - Contaminated Land Working Group (CLWG) GAC for Allotments
H - CLWG GAC for Residential with Plant Uptake
I - CLWG GAC for Commercial/Industrial
J - PBA Internal Screening Value

*Lead - Soil Guideline Value 2002

GREEN PARK STATION, READING
HIGHLIGHTED TABLE - WATERS

					RTD (UG)	RTD (UG)	RTD (UG)	RTD (UG)	RTD (UG)	RTD (UG)	RTD (UG)	MG (MG)	MG (UG)	MG (UG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)
		Protection of Controlled Waters		Protection of Human Health	BH2009/03	BH2009/03	BH2009/03	BH2009/06	BH2009/06	BH2009/06	BH2009/06	BH3	BHF	BHF	BHD	BHD	BHE	BHE	BHE	BHE	WS8	WS8	WS8
Analyte	**Units**	**Test 2 Lowest**	**Test 2 Highest**	**WSWQ**	27/03/2009	07/04/2009	05/05/2009	27/03/2009	07/04/2009	05/05/2009	18/08/2009	17/05/2001	27/06/2007	11/07/2007	27/06/2007	11/07/2007	27/06/2007	11/07/2007	13/01/2009	28/01/2009	13/01/2009	28/01/2009	18/08/2009
Antimony		-	-	5	1.5	0.75	0.75	0.75	0.75	0.75	0.75		1	1	1.2	1.2			0.75	2	0.75	1	15
Arsenic	µg/l	51.6	199	10	1.4	1	1.3	1.9	2.5	0.8	2.2	12	3.2	9.4	3	7.8	1	1.4	0.75	5	7.5	7	5.4
Boron	µg/l	-	-	1000	20	20	20	48	20	22		188	390	190	480	530			79	160	270	330	
Cadmium	µg/l	0.2	1.1	5	0.22	0.22	0.22	0.22	0.22	0.22	0.22	1	0.5	0.5	0.5	0.5	0.5	0.5	0.22	1	0.22	1	0.88
Chromium	µg/l	5	27.6	50	3	1	2	4	1	3	1	20	12	21	24	66	14	10	3	4.95	17	12	3
Copper	µg/l	10.1	57.8	2000	2	1.6	1.6	3.7	1.7	1.6	5.5	20	5	5	5	5			7.8	5	7.5	5	3.8
Iron	µg/l	-	-	200	50	50	50	59	57	50	150	16145	2	2	11000	950			710	80	37000	38000	5000
Lead	µg/l	7.3	39.8	10	0.6	0.4	0.4	0.7	0.5	0.4	0.5	20	2.8	1	3.8	1	2.3	1	2.5	5	2.4	5	1.6
Managnese	µg/l	-	-	50	250	250	250	730	710	730	520	1754	900	1	2900	1		1	690	440	4000	3300	1800
Mercury	µg/l	-	-	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.01	0.05	0.01	0.05	0.01
Nickel	µg/l	20.2	116	20	3.3	3.4	1.5	3.8	4.6	2.7	4.2	20	11	4.5	30	20	10	2	2.8	5	15	43	11
Selenium	µg/l	-	-	10	1	1	1	3	2	1	2	10	2	2.5	12	17	1.8	1.9	1	5	13	11	5
Vanadium	µg/l	-	-	-	2	2	1	4	4	3	5		10	10	10	10			1	5	5	5	4
Zinc	µg/l	75.8	414	-	8	5	5	12	12	5	9	39	11	5	29	24	7.8	5	11	9	24	13	6
Ammonium NH4	mg/l	-	-	0.5	0.8	0.7	0.7	3.2	3	2.9	2.7	3.65	3	3.4	0.4	11	1.7	2	1.5	0.66	19	18	19
Ammonia NH3	mg/l	0.3	1.73	-																			
Chloride	mg/l	-	-	250	29	30	33	38	38	36	35	80	33	44	39	130	33	37	32	22	84	71	36
Cyanide	mg/l	-	-	50																			
Electrical Conductivity	mS/cm	-	-	2500	460	470	450	820	860	850	630	1393	860	740	1500	1900	530	630	630	1090	2800	2710	2000
pH	pH	-	-	6.5 to 10	8.3	8.36	7.75	8.63	8.28	7.58	8.63	7.3	6.8	6.9	6.7	6.8	7	6.9	7.17	7.3	7.02	6.8	7.76
Nitrate	mg/l	-	-	50																			
Sulphate	mg/l	-	-	250	27	25	11	120	130	130	20	137	480	130	40	630	65	66	73	420	99	120	560
Anthracene	µg/l	0.1	0.55	-																			
Benzene	µg/l	10.1	55.2	1	10	10	10	10	10	10	10		1	1	1	1				5	10	5	10
Benzo(a)pyrene	µg/l	-	-	0.01	0.009	0.01	0.009	0.009	0.48	0.009	0.009		0.0095		0.0095			0.0095	0.009	0.1	0.009	0.1	0.08
Chloroform	µg/l	2.53	13.8	100									1	1	1	1							
1.2-Dichloroethane	µg/l	-	-	3									1	1	1	1							
1,1,1-Trichloroethane	µg/l	-	-	-									1	1	1	1							
Flouranthene	µg/l	0.1	0.6	-																			
Naphthalene	µg/l	2.4	13.2	-	0.1	0.1	0.1	0.1	0.1	0.1			0.11		0.062			0.094	0.1	0.1	0.75	0.1	
Hexochlorobenzene	µg/l	-	-	-									1		1			1					
Hexachlorobutadine	µg/l	-	-	-									1	1	1	1							
Phenol	µg/l	-	-	-									1.2		1			1					
Total Phenol	µg/l	15.2	82.8	0.5	0.01	0.01	0.01	0.01	0.01	0.01		696	1.2	3	5.6	4.7	1.2	3.3	0.01	0.01	0.01	0.01	
PAHs	µg/l	-	-	0.1	0.14	0.1	0.1	0.21	0.63	0.1	0.1		0.26	0.32	0.12	0.2	0.27	0.3	0.095	0.095	3.5	2.9	0.031
Toluene	µg/l	50.5	276	-	10	10	10	10	10		10		1	1	1	1				5	10	5	31
Trichloroethene TCE	µg/l	10.1	55.2	10									1.8	1	1.9	1							
1,1,2-Trichloroethane	µg/l	-	-	-									1	1	1	1							
Tetrachloroethene PCE	µg/l	10.1	57.8	10									1	1	1	1							
Styrene	µg/l	-	-	-									1	1	1	1							
Vinyl Chloride	µg/l	-	-	0.5									1	1	1	1							
Xylene	µg/l	30.3	166	-	10	10	10	10	10	10	10		3	3	3	3				5	10	5	10
TPH	µg/l	10[a]			9.95	9.95	9.95	9.95	9.95	9.95	9.95	1100	9.95	80	9.95	120	9.95	100	9.5	9.5	33	100	31
BOD	mg/l	-	-	-	1	1	1	1	2	1	1		10	7.5	11	18			5	3	17	4.7	77

KEY
Test 2 - Groundwater Impacts on Surface Water
Test 5 - General Quality of a Groundwater Body
WSWQ - Water supply (Water Quality) Regulations 2000
10a TPH from Water Supply Regs 1991
MG - Made Ground
RTD - River Terrace Deposits
LMB - Lambeth Group
CHK - Upper Cretaceous Chalk
UG - Up Gradient
MG - Mid Gradient
DG - Down Gradient

GREEN PARK STATION, READING
HIGHLIGHTED TABLE - WATERS

		Protection of Controlled Waters		Protection of Human Health	LMB (MG)	LMB (MG)	LMB (MG)	LMB (DG)	LMB (DG)	LMB (DG)	CHK (DG)	CHK (DG)	CHK (DG)	Surface	Surface	Surface	Surface
					BH2009/04	BH2009/04	BH2009/04	BH2009/07	BH2009/07	BH2009/07	BH2009/05	BH2009/05	BH2009/05	DITCH 1	LAKE 01	LAKE	DITCH
Analyte	**Units**	**Test 2 Lowest**	**Test 2 Highest**	**WSWQ**	27/03/2009	07/04/2009	05/05/2009	27/03/2009	07/04/2009	05/05/2009	27/03/2009	07/04/2009	05/05/2009	13/01/2009	13/01/2009	28/01/2009	28/01/2009
Antimony		-	-	5	1	6.5	0.75	9.4	0.75	0.75	1.4	5.3	0.8	0.75	0.75	1	1
Arsenic	µg/l	51.6	199	10	0.75	0.78	0.75	0.87	0.75	0.75	3.1	0.75	0.75	1.7	1.1	5	5
Boron	µg/l	-	-	1000	20	20	20	20	20	20	130	140	150	48	57	60	58
Cadmium	µg/l	0.2	1.1	5	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	1	1
Chromium	µg/l	5	27.6	50	3	1	2	3	1	2	2	1	1	1	1	4.95	4.95
Copper	µg/l	10.1	57.8	2000	1.6	1.6	1.6	9.7	1.6	1.6	3.3	1.6	1.6	7	6.7	5	5
Iron	µg/l	-	-	200	50	3900	1700	5500	6600	50	50	50	50	93	50	25	25
Lead	µg/l	7.3	39.8	10	0.6	0.4	0.4	0.8	0.4	0.4	0.8	0.4	0.4	2.4	2.7	5	5
Managnese	µg/l	-	-	50	360	390	390	710	510	430	34	28	40	71	56	43	42
Mercury	µg/l	-	-	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05
Nickel	µg/l	20.2	116	20	3.4	2.7	2.2	11	2.5	1.5	4.8	1.8	1.5	1.6	3.3	5	5
Selenium	µg/l	-	-	10	1	1	1	6	1	1	22	1	1	2	1	5	5
Vanadium	µg/l	-	-	-	1	1	1	1	2	1	2	3	1	1	1	5	5
Zinc	µg/l	75.8	414	-	19	8	5	56	12	5	10	5	5	6	8	5	7
Ammonium NH4	mg/l	-	-	0.5	0.4	0.5	0.4	1.1	0.7	1.4	1	0.6	0.6	0.4	0.4	0.07	0.07
Ammonia NH3	mg/l	0.3	1.73	-													
Chloride	mg/l	-	-	250	70	73	75	120	58	54	270	60	54	32	34	33	32
Cyanide	mg/l	-	-	50													
Electrical Conductivity	mS/cm	-	-	2500	720	750	790	1000	710	690	1700	720	710	390	430	469	443
pH	pH	-	-	6.5 to 10	8.27	8.26	7.42	8.09	8.35	7.37	8.26	8.58	8.02	7.82	7.99	8.1	7.8
Nitrate	mg/l	-	-	50													
Sulphate	mg/l	-	-	250	63	67	67	160	65	76	350	77	58	16	25	49	31
Anthracene	µg/l	0.1	0.55	-													
Benzene	µg/l	10.1	55.2	1	10	10	10	10	10	10	10	10	10			5	5
Benzo(a)pyrene	µg/l	-	-	0.01	0.009	0.009	0.009	0.015	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.1	0.1
Chloroform	µg/l	2.53	13.8	100													
1.2-Dichloroethane	µg/l	-	-	3													
1,1,1-Trichloroethane	µg/l	-	-	-													
Flouranthene	µg/l	0.1	0.6	-													
Naphthalene	µg/l	2.4	13.2	-	0.1	0.1	0.1	0.96	0.33	0.1	0.19	0.1	0.1	1	1	0.1	0.1
Hexochlorobenzene	µg/l	-	-	-													
Hexachlorobutadine	µg/l	-	-	-													
Phenol	µg/l	-	-	-													
Total Phenol	µg/l	15.2	82.8	0.5	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PAHs	µg/l	-	-	0.1	0.1	0.1	0.1	4.9	2.9	0.99	0.22	0.1	0.1	1	1		
Toluene	µg/l	50.5	276	-	10	10	10	10	10	10	10	10	10			5	5
Trichloroethene TCE	µg/l	10.1	55.2	10													
1,1,2-Trichloroethane	µg/l	-	-	-													
Tetrachloroethene PCE	µg/l	10.1	57.8	10													
Styrene	µg/l	-	-	-													
Vinyl Chloride	µg/l	-	-	0.5													
Xylene	µg/l	30.3	166	-	10	10	10	10	10	10	10	10	10			5	5
TPH	µg/l	10[a]			9.95	9.95	9.95	9.95	9.95	9.95	9.95	9.95	9.95	9.5	9.5	9.5	9.5
BOD	mg/l	-	-	-	1	2	1	1	1	1	88	13	12	5	3	3.2	5

KEY
Test 2 - Groundwater Impacts on Surface Water
Test 5 - General Quality of a Groundwater Body
WSWQ - Water supply (Water Quality) Regulations 2000
10a TPH from Water Supply Regs 1991
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LMB - Lambeth Group
CHK - Upper Cretaceous Chalk
UG - Up Gradient
MG - Mid Gradient
DG - Down Gradient

Appendix F

Station Drainage Design Information

Balfour Beatty

Reading Green Park Station

Drainage Strategy

139787-ARP-RG-ST-RP-D-000001

A02 | 9 August 2019

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 260708-00

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ARUP

Document Verification

ARUP

Job title		Reading Green Park Station		**Job number** 260708-00
Document title		Drainage Strategy		**File reference**
Document ref		139787-ARP-RG-ST-RP-D-000001		
Revision	**Date**	**Filename**	139787-ARP-RG-ST-RP-D-000001.docx	
A01	9 Aug 2019	**Description**	Issued for planning condition discharge	
			Prepared by	Checked by	Approved by
		Name	Charles Bennett	Matthew Colman	Chris Woodman
		Signature			
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			Prepared by	Checked by	Approved by
		Name	Charles Bennett	Matthew Colman	Chris Woodman
		Signature	P.P.		
		Filename			
		Description			
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		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

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Appendices

Appendix A

Green Park Interchange Drainage Strategy

Appendix B

Calculations

Appendix C

Ordinary Watercourse Consent

Appendix D

Drainage Strategy Drawing

1 Introduction

This document sets out the Drainage Strategy for the elements of the proposed Reading Green Park Station under Arup design. It sets out the key principles for foul and surface water drainage for the development and the proposed approach for maintenance and operation.

This document covers the elements of the Station designed by Arup, which primarily comprises the platform and land to the west of the railway line. Reference should be made to Peter Brett Associates (PBA) information for details of the Green Park Interchange to the east of the Station.

This report should be read in accordance with the PBA Surface Water Technical Note (Reference 36382/2012/TN001) included in Appendix A.

The site lies in two planning areas, West Berkshire Council (WBC) and Wokingham Borough Council:

- Works to approximately the southern third of the platform length are in the Wokingham Borough Council planning area and have been approved subject to conditions (Wokingham BC planning reference 181514)
- Works to approximately the northern two thirds of the platform length are in the West Berkshire Council planning area and have been approved subject to conditions. (West Berkshire Council planning reference 18/01451/COMIND.

Table 1 lists the planning conditions relating to drainage. This report has been prepared to meet the requirements identified in these conditions, as they apply to the elements of the development within Arup's design.

Table 1 – Drainage related planning conditions

Condition	Details
West Berkshire 18/01451/COMIND Condition 7	No development shall take place until details of sustainable drainage measures to manage surface water within the site have been submitted to and approved in writing by the Local Planning Authority. These details shall: a) Incorporate the implementation of Sustainable Drainage methods (SuDS) in accordance with the Non-Statutory Technical Standards for SuDS (March 2015), the SuDS Manual C753 (2015) and West Berkshire Council local standards, particularly the WBC SuDS Supplementary Planning Document December 2018; b) Include details of how the existing flood plain will be sustained or mitigated (any measures for loss of flood plain shall not increase flood risk elsewhere) during both the construction and operational phases, in accordance with Environment Agency requirements (Ref. A/2018/125383/01-L01); r) Include an approved application for an Ordinary Watercourse Consent in the case of diversion of a watercourse / ditch. The above sustainable drainage measures shall be implemented in accordance with the approved details in accordance with a timetable to be submitted and agreed in writing with the Local Planning Authority as part of the details submitted for this condition. The sustainable drainage measures shall be maintained and managed in accordance with the approved details thereafter.
West Berkshire 18/01451/COMIND Condition 8	No infiltration of surface water drainage into the ground at Land East of Cottage Lane, Reading is permitted except where details of such surface water drainage and any required mitigation measures, including a schedule of implementation to address any identified water pollution have been submitted and approved under a formal discharge of conditions application. The development shall be carried out in accordance with the approved details and the schedule of implementation of mitigation measures.
West Berkshire 18/01451/COMIND Condition 15	No development shall commence until a detailed method statement for the proposed ditch diversion has been submitted to and approved in writing by the Local Planning Authority. The method statement shall include, amongst other information, proposed time of implementation, details of the hydraulic capacity of the existing and diverted watercourse and detailed landscaping proposals. Thereafter, the station platforms shall not be brought into use until the approved scheme has been implemented in full.
Wokingham 181514 Condition 3	Development should not begin until the drainage strategy drawing and storage calculations for the western platform have been submitted to and approved by the LPA. The calculations should demonstrate how the 1 in 100 year flood event with a 40% allowance for climate change have been considered for the western platform impermeable area.
Wokingham 181514 Condition 4	Prior to the commencement of the development, details of the compensatory flood plain storage shall be submitted to and approved in writing by the Local Planning authority. The scheme shall be implemented and thereafter managed and maintained in accordance with the approved details.

2 Existing Site and Proposed Development

2.1 Existing site

Reading Green Park is a planned railway station in Reading, Berkshire located on the Reading to Basingstoke Line, south of Southcote Junction, centred at National Grid Reference (NGR) SU695702.

The site is currently greenfield, with a railway track running through the centre of it. An existing ditch runs alongside the western side of the railway which can provide an outfall for surface water from the platform and roof areas. There is currently no track drainage and the railway embankment is free draining.

Figure 1 – Site Location

2.2 Proposed development

The station is intended to serve the proposed Green Park Village residential development, the existing Green Park Business Park and the Madejski Stadium. New infrastructure required on the site includes:

- Station Building;
- 2 No. New platforms, each 150m long;
- Footbridge, staircase and lift for access to both lines;

The Green Park Transport Interchange is being developed under a separate application and is not considered in this report.

Figure 2 - Development proposals

The proposed station development comprises the following impermeable areas:

Location	Increase of impermeable area (m^2)	Increase of impermeable area (m^2)
Western Platform	853	0.085
Eastern Platform	809	0.081
Bridge	30	0.003
Total	1692	0.169

(Note these areas exclude the Green Park Transport Interchange). .

3 Standards & Guidance

The drainage strategy has been prepared in accordance with the following design standards and guidance documents:

- Building Regulations Approved Document H – Drainage and Waste Disposal;
- Sewers for Adoption 7th Edition;
- NR-L3-CIV-005 - Railway drainage systems manual;
- Rainfall runoff management for developments (DEFRA / EA Report SC030219);
- BS EN 752 - Drain and sewer systems outside buildings;
- BS EN 12056 - Gravity drainage systems inside buildings;
- BS 8582 - Code of practice for surface water management for development sites;
- Ciria C635 - Designing for Exceedance in Urban Drainage;
- Ciria C753 – The SuDS Manual.

3.1 Planning

The site lies at the intersection of three LPAs: Reading Borough Council, West Berkshire Council and Wokingham Borough Council. The station lies within the West Berkshire Council and Wokingham Borough Council boundaries. The Green Park Transport Interchange is within the Reading Borough Council boundary.

Full planning consent for the proposed station works was awarded by Reading Borough Council (Ref. 141944) and West Berkshire Council (Ref. 14/03289/COMIND) in spring 2015.

The design of the station has subsequently changed, meaning a new planning application was required. This was submitted in 2018 (West Berkshire Council planning reference 18/01451/COMIND, Wokingham Council planning reference 181514).

Planning conditions relating to drainage identified under the new planning consent are provided in Section 1.

The Green Park Transport Interchange is approved under a separate consent with Reading Borough Council.

Policy CS16 of the WBC Core Strategy identifies that '*On all development sites, surface water will be managed in a sustainable manner through the implementation of Sustainable Drainage Methods (SuDS) in accordance with best practice…and to provide attenuation to greenfield run-off rates and volumes, for all new development and redevelopment'*

WBC adopted a 'Sustainable Drainage Systems' Supplementary Planning Document in December 2018.

4 Site Constraints & Opportunities

4.1 Existing drainage

There is currently no public sewerage in the area. The site consists of an existing railway surrounded by open greenfield land. Currently surface water drains via natural infiltration into the ground or will enter the existing watercourse (ditch) on the west side of the platform, or to the minor tributary to the north of the site. The local sewerage authority is Thames Water. There is no track drainage present along this stretch of railway.

4.2 Hydrology

Important hydrological features can be seen in Figure 3. The site is in the catchment of River Kennet, which runs approximately 1km to the north of the site.

Figure 3 - Aerial view showing the River Kennet 1km north of the site, Foudry Brook to the east, and the tributary of the Foudry Brook along the north of the site

A minor unnamed watercourse which is a tributary of the Foudry Brook runs to the north of the site.

On the west side of the proposed railway ditch is a small drainage ditch. A minor diversion of this ditch is proposed. This ditch flows into the tributary of the Foudry Brook, which in turn flows into the River Kennett near to Fobney Lock.

To the west of the site are several man-made lakes, formed from following gravel extraction in the 20th century. There is also a large manmade lake to the east of the proposed development.

4.3 Geology & hydrogeology

Initial ground investigations were undertaken by Aspin Foundations Ltd in April 2017. Details of this investigation can be found in the 'Interpretive ground Investigation Report' by Aspin Foundations Ltd in 2018.

According to the online British Geology Society (BGS) map, the bedrock underlying the site is 'Lambeth Group - Clay, Silt and Sand'. The superficial deposits of the site are 'Beenham Grange Gravel Member- Sand and Gravel' according to the online map. This can be seen in Figure 4.

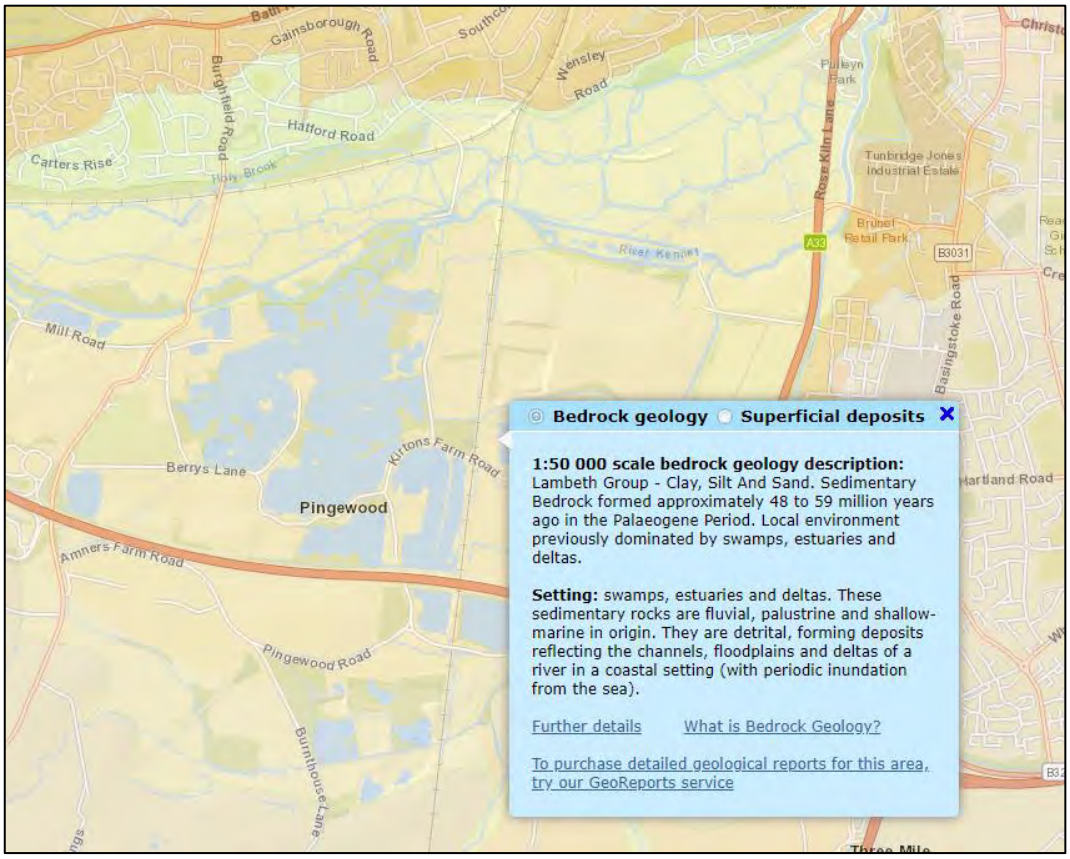

Figure 4 - Image from the BGS online map

The Cranfield Soil and Agrifood Institute Soilscapes Website describes the site as "Loamy and Clayey floodplain soils with naturally high groundwater".

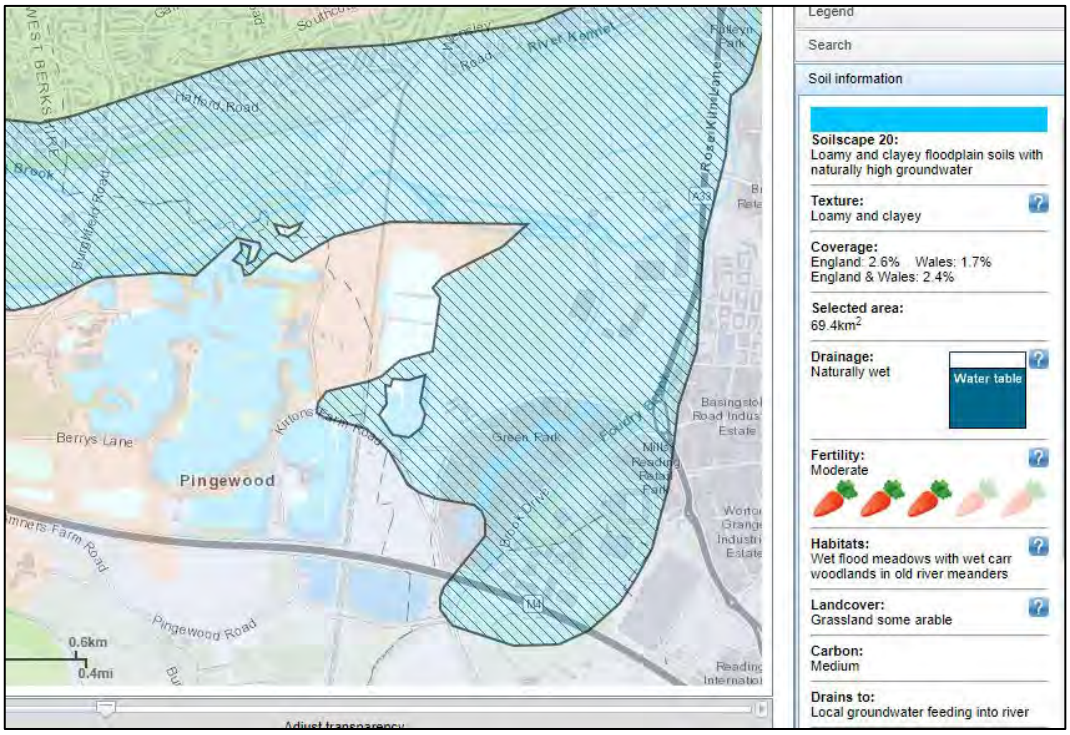

Figure 5 - Image from the Cranfield Soil and Agrifood Institute Soilscapes map indicating that the top soil of the site is generally loamy and clayey, with naturally high groundwater.

4.3.1 Infiltration

The underlying geology and soil mapping indicate that there is naturally high groundwater on the site, and therefore drainage via infiltration is likely to be not achievable.

4.3.2 Contamination

According to the Geo-Environmental Report on Ground Conditions (Document reference 11321 / 4004 Rev 01; dated Oct 2010), the area to the west of the railway tracks was previously used as a landfill and filled with inert industrial waste during the 1970s and 1980s. As a result, the ground underlying the site has potential to impact water quality.

The ditch realignment will be constructed from the existing ground material. As noted in section 4.3.1, infiltration is not achievable due to the naturally high ground water level and, as such, it is considered that there is a minimal risk of any additional contamination seepage from the proposed ditch works. All below ground pipework and materials are to be resistant to both corrosion and to the contaminants found in the ground investigation.

4.4 Space requirements

The Great Western mainline railway runs through the site. No structure is to obstruct the tracks. The site is bordered to the south by Kirtons Farm Road, by the Green Park Interchange to the east, by the existing ditch to the west and by an existing culvert to the north. This is shown clearly in Figure 6. Burghfield substation is situated to the north-west of the site, with overhead cables from this substation running over the tracks in the location of the site. There is an existing pylon to the west of the site. This is shown in Figure 7.

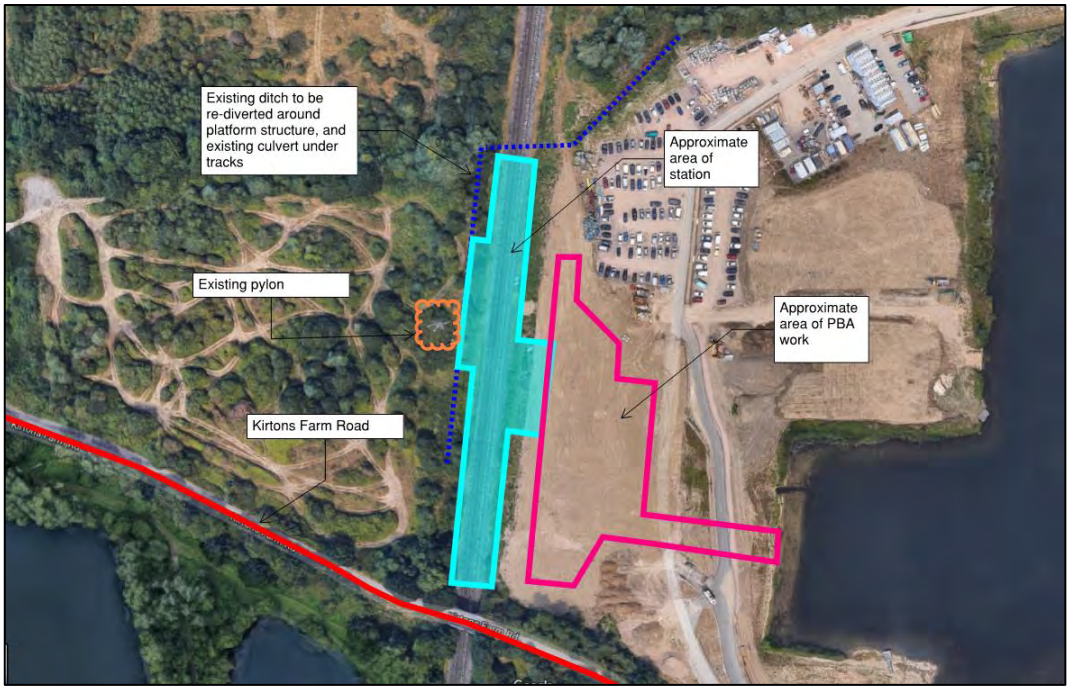

Figure 6 - Site location and boundaries

Figure 7 - Site location, showing Burghfield Substation to the north and Kirtons Farm Road to the south

5 Site drainage area and runoff

5.1 Existing discharge rates

The site consists of an existing railway surrounded by open greenfield land. Estimated greenfield discharge rates from the site are summarised below and shown in Table 3 of PBA's Surface Water Drainage Technical Note in Appendix A.

Table 2 – Estimated greenfield flow rates

Return Period (Years)	Greenfield Flow (l/s/ha)
1	3.16
30	8.32
100	11.85

5.2 Proposed discharge rates

West of mainline

To the west of the mainline the new platform will discharge directly to the re-aligned ditch. Due to the limited available space it has not been possible to attenuate or restrict the discharge from this part of the site.

The contributing area discharging to the ditch is estimated to be 880m2 (0.088 Ha). The peak flow resulting from this contributing area has been assessed as shown in Table 4.

Table 3 – Peak flow into watercourse

Return Period (Years)	Peak Flow (l/s)
1	6.0
30	15.9
100	20.9
100 including 40% increase in rainfall intensity to allow for potential climate change impacts	29.3

The ditch will provide some attenuation and slowing of the flow, so the flow rate from the ditch to the downstream watercourse is likely to be less than the above. This impact has not been quantified.

East of mainline

To the east of the mainline, the new platform and station building will discharge into the Green Park Interchange surface water drainage system designed by PBA at an unrestricted rate.

The Green Park Interchange system is designed to discharge to the downstream watercourse at an agreed rate of 5 l/s. This is considered to be as close as possible to the existing greenfield flow rate without introducing too great a risk of blockage.

The Green Park Interchange system will discharge to Foudry Brook further downstream.

5.3 Attenuation volume

Due to the restricted available space it has not been possible to incorporate attenuation in the drainage network for the western platform,

The PBA design incorporates 308m³ of surface water attenuation storage to the eastern side of the site, with a vortex flow control downstream of the storage system restricting the flow to the identified peak rate.

5.4 Discharge hierarchy

The drainage strategy has been developed in accordance with the hierarchy of drainage options as defined in the NPPF:

Table 4 – Proposed discharge strategy

Approach	Details	Yes/No
1. Infiltration into the ground	Infiltration on the site is low, and the ground has a naturally high water table.	✗
2. Discharge to a surface water body	There are multiple natural lakes in the area, so discharge to a surface water body is possible. Permission to discharge into the ditch had been granted. PBA design involves outfalling to an existing surface water lake.	✓
3. Discharge to a surface water sewer	On the western side, remoteness of location and the availability of soft ground and surface water bodies renders discharge to a surface water sewer unnecessary.	✗
4. Discharge to a combined/foul sewer	Unfeasible due to distance from combined sewer.	✗

5.5 Water Quality

Impermeable areas on site include roofs of the station building and bridge over the tracks, and surface water from the platforms. There are no high-risk activities on site which could lead to pollutants entering the surface water system.

The ditch which the surface water on the western platform will outfall to acts as a swale, which eventually discharges to the River Kennet. Vegetation can remove coarse to medium sediments in the surface water through filtration.

6 Surface Water Drainage Design

The surface water drainage is divided into two separate systems: to the west of the mainline the drainage is to connect into an existing small ditch; to the east of the mainline the drainage is to connect into the wider PBA drainage system.

6.1 West of mainline

The works to the west of the mainline are limited to the construction of the new platform, including stairs and lift to the platform bridge. No facilities are provided on the western platform.

The working space is very limited to the west of the mainline. As such, the proposed design is for surface water from the platform, footbridge stairs and lift to discharge directly to the ditch to the west of the platform.

As there is no space for surface water storage, the discharge into the watercourse will be unrestricted. Peak flow rates are identified in Section 5.2.

6.2 East of mainline

The works to the east of the mainline comprise the construction of the new platform, including stairs and lift to the platform bridge. A new station building is proposed, which includes the ticket desk, toilet facilities, retail and staff rest areas.

The wider Green Park Interchange development (not within the Arup scope, and covered in a separate planning application) includes new car parking and road improvements. Refer to PBA information for details of the drainage strategy for these areas.

Surface water drainage from the new platform and station building will discharge to the car park drainage designed by PBA. The discharge from the car park drainage system is limited to 5 l/s, with 308m^3 of attenuation storage proposed to avoid surface water flooding.

6.3 SuDS measures

Several different SuDS measures were considered and are shown in Table 5. SuDS options for the site are heavily constrained by the lack of open space at ground level and the ground conditions which prevent the use of infiltration methods.

Table 5 - SuDS features

SuDS Measure	Appropriate for the development?	
Swales/ filter strips	✓	There is an existing ditch alongside the West platform which SW can outfall to. The ditch is being diverted and improved as part of the works.
Soakaways	✗	The ground conditions are not suitable for infiltration due to low permeability and risk of contamination from the existing ground.
Detention / Infiltration basins	✗	Due to the ground conditions, detention/infiltration basins are not feasible due to low permeability and risk of contamination from the existing ground.
Permeable paving	✗	Due to the ground conditions, permeable paving is not feasible. There are no paving areas within Arup's site.
Blue/Green Roofs	✗	Roof areas small and building structure is too light for blue/greens roofs to be a viable option.
Geocellular storage systems	✓	Geocellular attenuation proposed by PBA as part of their car park drainage strategy. There is insufficient space for geocellular storage as part of Arup's drainage works.
Tree pits	✗	Lack of space renders tree pits unfeasible.
Rainwater Harvesting	✗	Building structure not tall enough, no room for collection tank.

7 Watercourse diversion

The existing small watercourse / ditch to the west of the Station is required to be diverted to allow construction of the western platform. The proposed diversion is shown on drawing 158989-ARP-RG-ST-DR-D-000001.

These works are in the West Berkshire Council boundary and the approach has been agreed with their drainage officer, Stuart Clark.

An Ordinary Watercourse Consent for these works is required under the Land Drainage Act 1991 and the Flood and Water Management Act 2010. This has been approved (subject to payment), with the completed application form and relevant correspondence included in Appendix C.

8 Foul drainage

New gravity foul drainage is proposed to serve the new station facilities on the eastern platform. No foul drainage is proposed for the western platform.

The foul drainage on the eastern platform will pick up above ground connections from the new toilets, staff areas and retail units in the new station building. The peak flow has been estimated to be 3.6 l/s.

The new foul drainage will connect to the foul drainage system serving the new Green Park Interchange, refer to PBA information for further details.

9 Proposed Maintenance Strategy

Maintenance of the station platform drainage is to be carried out by the station operator.

Maintenance of the downstream drainage network in the Green Park Interchange will be the responsibility of Reading Borough Council.

Table 6 – Maintenance requirements

Element	Maintenance/Inspection Elements	Maintenance Action	Frequency
All drainage	Regular Cleaning	General de-silting, de-weeding, cleaning, litter picking, debris clearance of all visible above ground features. Additional inspections should be carried out in late autumn/early winter following trees shedding their leaves or after heavy storm events which are likely to lead to a high rate of debris being built up in the system.	Monthly; plus additional cleaning late autumn/early winter and after significant storms.
	Blockage/ siltation	Visual inspections should record locations where siltation is prevalent and additional care and removal should be undertaken as required at these locations.	Quarterly and after significant storms.
	Remedial Maintenance	Whilst structural failure of components is not anticipated within the design life, inspections should look for signs of structural damage. This requirement becomes more prevalent as the age of the structures increase.	Yearly and make repairs as required.
Ditch	Regular Maintenance	Remove litter and debris Manage vegetation and remove nuisance plants Inspect inlets, outlets and overflows for blockages, clear if required	3-monthly, or as required
		Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
		Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly

General maintenance requirements are noted below:

- Inspections to enable general de-silting and cleaning should be undertaken especially in late autumn/early winter following trees shedding their leaves.
- Inspections should be undertaken after heavy storm events which are likely to lead to a high rate of debris being built up in the system.
- Disposal of sediment from silt traps and drainage features etc. should be in accordance with waste management regulations.
- The visual inspections and cleaning operations should comply with BS EN 752:2008 and the project Health and Safety file.
- Whilst structural failure of components is not anticipated within the design life, inspections should look for signs of structural damage. This requirement becomes more prevalent as the age of the structures increase.
- In the event of any spillage or contaminates entering the drainage system Thames Water and the Environment Agency should be notified.

For further information see BS EN 752:2008

10 Summary

This document provides a summary of the proposed drainage design for Reading Green Park Station. The site comprises approximately 0.17 ha of greenfield land, adjacent to the existing Great Western mainline.

The development proposals comprise 2 No. new 150m long platforms, a new station building, a footbridge, staircase and lift for access to both lines. Multi-modal interchanges, access road improvements and car parking areas also form part of the overall development (designed by others).

The existing peak discharge rates from the greenfield site have been estimated by PBA. This can be seen in Appendix A.

The proposed drainage design consists of realigning an existing ditch to fit around the proposed western platform. Runoff from the western platform and western station structure will outfall to this ditch. The ditch will act to slow the runoff and provide some attenuation.

Several different SuDS strategies were considered to appropriately manage surface water on the site. Due to the low permeability and high-water table and contamination risks, infiltration is not possible. Limited space within the boundary renders some options such as open water bodies and geocellular crates as unfeasible.

Drainage channels span the length of both east and west platforms. On the eastern platform, the drainage from these channels and downpipes from the station structures are to connect into the drainage designed by PBA. This interchange drainage outfalls to an existing lake to the east of the site after passing through an attenuation system and hydrobrake which limits flow to 5l/s.

On the western platform, the collected rainwater from linear channels and from downpipes from the station structures are to outfall to an existing ditch adjacent to the western platform. Ordinary Watercourse Consent has been granted for outfall of surface water drainage from the western platform to the ditch.

A new gravity foul drainage network will collect flows from the station building and connect to the new foul drainage network serving the Green Park Interchange.

Condition	Details	Arup Response
West Berkshire 18/01451/COMIND Condition 7	No development shall take place until details of sustainable drainage measures to manage surface water within the site have been submitted to and approved in writing by the Local Planning Authority. These details shall:	
	a) Incorporate the implementation of Sustainable Drainage methods (SuDS) in accordance with the Non-Statutory Technical Standards for SuDS (March 2015), the SuDS Manual C753 (2015) and West Berkshire Council local standards, particularly the WBC SuDS Supplementary Planning Document December 2018;	The surface water drainage design has been undertaken to maximise the use of Sustainable Drainage methods (SuDS).
	b) Include details of how the existing flood plain will be sustained or mitigated (any measures for loss of flood plain shall not increase flood risk elsewhere) during both the construction and operational phases, in accordance with Environment Agency requirements (Ref. A/2018/125383/01-L01);	Refer to PBA Flood Risk Assessment for information on flood risk management.
	r) Include an approved application for an Ordinary Watercourse Consent in the case of diversion of a watercourse / ditch.	Application for Ordinary Watercourse Consent is included in Appendix C.
	The above sustainable drainage measures shall be implemented in accordance with the approved details in accordance with a timetable to be submitted and agreed in writing with the Local Planning Authority as part of the details submitted for this condition. The sustainable drainage measures shall be maintained and managed in accordance with the approved details thereafter.	The latest programme for the works is included in Appendix C. Maintenance requirements are identified in Section 8
West Berkshire18/01451/COMIND Condition 8	No infiltration of surface water drainage into the ground at Land East of Cottage Lane, Reading is permitted except where details of such surface water drainage and any required mitigation measures, including a schedule of implementation to address any identified water pollution have been submitted and approved under a formal discharge of conditions application. The development shall be carried out in accordance with the approved details and the schedule of implementation of mitigation measures.	No infiltration of surface water is proposed.

Condition	Details	Arup Response
West Berkshire 18/01451/COMIND Condition 15	No development shall commence until a detailed method statement for the proposed ditch diversion has been submitted to and approved in writing by the Local Planning Authority. The method statement shall include, amongst other information, proposed time of implementation, details of the hydraulic capacity of the existing and diverted watercourse and detailed landscaping proposals. Thereafter, the station platforms shall not be brought into use until the approved scheme has been implemented in full.	Method statement is included in Appendix C.

Condition	Details	Arup Response
Wokingham 181514 Condition 3	Development should not begin until the drainage strategy drawing and storage calculations for the western platform have been submitted to and approved by the LPA. The calculations should demonstrate how the 1 in 100 year flood event with a 40% allowance for climate change have been considered for the western platform impermeable area.	Drainage strategy drawing included in Appendix D. Drainage calculations for the Western Platform are included in Appendix C.
Wokingham 181514 Condition 4	Prior to the commencement of the development, details of the compensatory flood plain storage shall be submitted to and approved in writing by the Local Planning authority. The scheme shall be implemented and thereafter managed and maintained in accordance with the approved details.	Refer to PBA Flood Risk Assessment for information on flood risk management (included in Appendix A).

Appendix A

Green Park Interchange
Drainage Strategy

Appendix E Surface Water Drainage

PBA Technical Note ‘Proposed Surface Water Drainage’

TECHNICAL NOTE

Job Name: Green Park Platform Extension

Job No: 36382/2012

Note No: 36382/2012/TN001 A

Date: 09th February 2018

Prepared By: R Tew

Checked By: E Edney

Approved By: R Fisher

Subject: **Green Park Station Proposed Surface Water Drainage**

1. Introduction

The proposed development of Green Park Railway Station, together with a transport Interchange, multi-storey car park, surface car park and access road, was granted full planning permission by Reading Borough Council (Ref. 141944) and West Berkshire Council (Ref. 14/03289/COMIND) in spring 2015.

As a result of subsequent detailed design work and engineering constraints (such as the existing Foudry Brook culvert and high voltage cables), it is necessary for the approved platforms to be relocated further south and for the platforms to be extended to 165m to accommodate 6 carriage trains. This, in turn, requires relocation of the approved footbridge and a change to the location of the approved ditch diversion.

The proposed amendments fall within land located outside of but adjacent to the previously approved application boundary. As a result, a new full planning application is being submitted seeking approval for the proposed amendments on the adjacent land.

To gain planning permission for the original station design, a Flood Risk Assessment (FRA) (reference 28791/4001; date Oct 2014) was submitted to RBC and West Berkshire Council outlining the requirements for flood risk and the proposed surface water drainage strategy. These requirements have been adopted for the proposed works to the west of the station.

There are three RBC planning conditions relating to surface water drainage and flood risk as follows:

- RBC Planning condition 30 – Design of the Surface Water Drainage
- RBC Planning Condition 29 – compliance with Flood Risk Assessment
- RBC Planning condition 27 –Avoidance of construction of soakaways in contaminated land.

The requirements of these planning conditions can be found in **Appendix A** and were discharged by RBC on the 10th April 2018 with regard to the Interchange. This Technical Note outlines the design methodology of the proposed surface water drainage scheme for this planning application

2. Impermeable Areas

The proposed development comprises the following impermeable areas as outlined in **Table 1**.

Location	Increase of Impermeable Area (m^2)
Western Platform	853
Eastern Platform	809
Bridge	30

Table 1: Impermeable Areas

The surface water from the eastern platform will drain to the Interchange surface water drainage network, which limits discharge to 5l/s and discharges to the existing surface water body to the east of the site. This was in accordance with the previous planning permission and the associated planning conditions listed in **Appendix A**. The drainage layout for the Eastern Platform is provided in **Appendix C** and the approved Eastern Platform surface water drainage strategy is provided in **Appendix D**. This leaves an impermeable area of approximately 0.088ha to drain to the brook to the north of the site. This technical note discusses the drainage strategy for the western platforms.

3. Proposed Surface Water Drainage Strategy

Discharge Destination

In accordance with the discharge destination hierarchies of the National Planning Practice Guidance an assessment of the suitability of the site to utilise infiltration drainage techniques has been undertaken.

See the Planning Practice Guidance

This states:

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

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

The Geo-environmental Report on Ground Conditions (Document reference 11321 / 4004 Rev 01; dated Oct 2010) outlines that the site to the west of the railway tracks is a historic landfill, which was unlicensed and filled with inert and industrial waste in the 1970s and 1980s, and therefore that the composition of the ground under the site has the potential to impact water quality.

The mitigation measures outlined in these geo-environmental reports include a lined drainage system and measures to ensure no uncontrolled discharges, including run off.

As such the proposed surface water strategy will discharge into the existing Foudry Brook surface water stream via a lined surface water drainage system.

The proposed outfall invert level will be set based on the Environment Agency Modelled Flood Levels, shown in **Table 2**. This outfall level will also take into consideration the required pipe gradients and cover levels in the network.

Flood Event (Annual Probability)	Modelled Flood Level (m AOD)
1 in 20 year (5%)	39.56
1 in 100 year (1%)	39.75
1 in 100 year + 40% CC	39.89

Table 2: EA Modelled Flood Levels

To mimic the effect of climate change, the surface water network will be modelled to have a surcharged outfall to the 1 in 100 year flood event plus 40% climate change flood level (39.89m).

Peak Flow Control – Defra Technical Standard S2

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

In accordance with best practice the proposed surface water drainage strategy seeks to reduce the peak discharge rate from the site to '*should never exceed greenfield runoff rate*'.

In addition, RBC planning condition 30 states that 'run off rates will be limited to greenfield rates and the discharge volumes will be limited either by using infiltration drainage or where this is not practical the run-off rate will be limited to Qbar of 2l/s/ha and additional attenuation provided to ensure no increase of flood risk downstream.'

As infiltration techniques will not be used, the proposed drainage scheme will provide attenuation to reduce the total peak discharge rate from the 0.088ha to the lowest practical runoff rate to prevent blockage of the drainage network. As stated in the Environment Agency's 'Rainfall runoff management for developments' report, the lowest practical discharge rate from attenuation storage to avoid blockages is 5l/s.

Table 3 shows the Calculated Greenfield Runoff Rates as outlined in the Flood Risk Assessment for the site.

Rainfall Event	Greenfield Runoff Rate (l/s/ha)	Greenfield Runoff Rate (l/s) (Impermeable Area 0.088ha)	Lowest Practical Runoff Rate (l/s)
1 in 1 year	3.16	0.28	5 l/s
1 in 30 year	8.32	0.73	5 l/s
1 in 100 year	11.85	1.04	5 l/s
1 in 100 year + 40% CC	-	-	-

Table 3: Calculated Greenfield Runoff Rates

The EA's Flood Risk Assessments: Climate Change Allowances guidance which supports the NPPF provides contingency allowances for potential increases in sea level rise, peak river flow and rainfall intensity.

In accordance with this guidance, the potential for increased pluvial (rainfall) flood probability as the result of possible climate change has been taken into account, over the lifetime of the development, through a +40% allowance for increases in peak rainfall intensity within the surface water drainage design. This represents the upper end limit for the climate change period up to 2115 and has been utilised for design purposes as a conservative approach at this stage (see **Table 4**).

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper End	10%	20%	40%
Central	5%	10%	20%

Table 4: Flood Risk Assessments: Climate Change Allowances

In order to demonstrate that the proposed peak discharge rates are deliverable within the development layout the surface water drainage network will be modelled as part of the detailed design..

Volume Control - Defra Technical Standard S4

S4. Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

The development proposals will increase the existing level of impermeability across the site and as such the volumetric run-off will be increased. However, the proposed drainage scheme will introduce attenuation and reduce the peak rate of run-off to the practical minimum.

Flood Risk within the Development – Defra Technical Standards S7 to S9

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

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

The proposed outline surface water drainage network has been designed to demonstrate that the peak discharge rate can be achieved with no flooding of the station platform in a 1 in 30 year or a 1 in 100 year rainfall event.

SuDS Selection

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

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

The NPPG paragraph 051 describes SuDS as follows:

> *'Sustainable drainage systems are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible.* ***They provide opportunities to:***
>
> - *reduce the causes and impacts of flooding;*
> - *remove pollutants from urban run-off at source;*
> - *combine water management with green space with benefits for amenity, recreation and wildlife.'*

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

For the Green Park Station scheme it is considered that infiltration SuDS are not appropriate due to the risk of contamination from the below ground.

Storage will be provided for the primary attenuation required for management of the 100 year + 40% storm event. Initial analysis of the proposed impermeable area associated with the western platform indicates that attenuation may be required for the 100 year + 40% storm if the outflow is limited to 5l/s. If this is the case, an attenuation system will be included as part of the detailed design process. Attenuation will be provided under the Interchange as part of the Interchange surface water drainage network for the eastern platform.

Structural Integrity – Defra Technical Standards S10 & S11

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

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

The components that make up any drainage network have different life expectancies which can be greatly affected by the effectiveness of their maintenance regime and upstream sediment capture/management. This will be taken into consideration when undertaking the detailed design of the drainage system at the site.

4. Maintenance Strategy

This section sets out the inspection and maintenance requirements for long term management of the development's surface water drainage system. Long term maintenance work to the station platform drainage system is to be undertaken by Reading Borough Council.

Health, Safety and Welfare

All those responsible for maintenance should take appropriate health, safety and welfare precautions for all activities including lone working, if relevant, and risk assessments should always be undertaken. The site's infrastructure Health and Safety File should be consulted before carrying out any works either inside or outside of the development's boundary and information regarding the location of existing utilities passed on to operatives.

The requirements of the Health and Safety at Work Act 1974 and The Construction (Design and Management) Regulations 2015 should be adhered to and any residual risks identified in the Health and Safety File should be managed and information passed on to maintenance operatives through task specific risk assessments.

Operation and Maintenance

There are three types of maintenance activities associated with surface water drainage systems. The SuDS Manual, CIRIA C753, defines these as:

- Regular Maintenance – '*basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections*.'
- Occasional Maintenance – *'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example.'*
- Remedial Maintenance – *'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.*'

Specific maintenance needs should be monitored and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

5. Conclusion

Technical Note No TN02/GEO outlines that for the protection of the controlled waters the proposed surface water drainage system is to be lined and therefore, the site will not use infiltrating drainage techniques. As such the surface water for the proposed western platform will discharge into the existing surface water brook to the north of the site. The eastern platform will discharge via the Interchange drainage network which will ultimately discharge into the surface water body to the east of the site.

In accordance with Table 3, the EA's "Flood Risk Assessments: Climate Change Allowances" guidance, an allowance of 40% has been added to the peak rainfall intensities in the 1 in 100 year design storm event to account for the potential effects of climate change.

The proposed drainage scheme will provide attenuation to reduce the total peak discharge rate to the lowest practical minimum for the 1 in 100 year + 40% climate change event..

The proposed surface water system will utilise appropriate attenuation measures to manage runoff. The system will follow the principles of the NPPG SuDS requirements by reducing flood risk and incorporating measures for the removal of pollutants.

As the landowner for the Interchange, Reading Borough Council will be responsible for the long-term maintenance of the proposed Interchange drainage network and will undertake inspection and maintenance in accordance with this Strategy. As the landowner for the Station, Network Rail will be responsible for the long term maintenance of the proposed station drainage network and will undertake inspection and maintenance in accordance with this Strategy.

As a result, the principles advocated by relevant national, regional and local planning policy guidance will be satisfactorily addressed.

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Manager)
36382-2011-TN001	-	09.02.18	RT	EE	RF	RF
36382-2011-TN001_A	A	14.05.18	JP	EE	GR	RF

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Appendix A

Planning Conditions relating to surface water drainage and flood risk.

RBC Planning condition 27 states the following:
The development hereby permitted shall not be commenced until such time as a scheme to dispose of surface water that ensures that no soakaways are constructed in contaminated ground, has been submitted to, and approved in writing by the Local Planning Authority. The scheme shall be implemented as approved.

Core Strategy Policy CS34: Pollution and Water Resources

RBC Planning Condition 29 states the following:
The development hereby permitted shall only be carried out in accordance with approved Flood Risk Assessment (FRA) ref: 28791/4001 undertaken by Peter Brett Associates, dated October 2014.

Reason: To reduce the risk of flooding. This condition is imposed in accordance with the National Planning Policy Framework (March 2012), and Policy CS16 of the West Berkshire Core Strategy (2006-2026).

RBC Planning condition 30 states the following:
No development shall commence on the railway station hereby approved until a surface water drainage scheme has been submitted to and approved in writing by the Local Planning Authority. Before these details are submitted an assessment shall be carried out of the potential for disposing of surface water by means of a sustainable drainage systems March 2015, and the results of the assessment provided to the local planning authority. Where a sustainable drainage scheme is to be provided, the submitted details shall:

i. provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of the receiving groundwater and/or surface waters;
ii. Include a timetable for its implementation; and
iii. provide a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime. Run off rates will be limited to greenfield rates and the discharge volumes will be limited either by using infiltration drainage or where this is not practical the run-off rate will be limited to Qbar of 2l/s/ha and additional attenuation provided to ensure no increase of flood risk downstream.
iv. Thereafter, the railway station shall not be brought into use until the surface water drainage scheme has been implemented in accordance with the requirements pf part ii) of this condition. Thereafter the approved surface waste drainage scheme shall be maintained and operated in accordance with the approved details.

Reason: To prevent the increased risk of flooding, to improve and protect water quality, improve habitat and amenity, and ensure future maintenance of the surface water drainage system. This condition is imposed in accordance with the National Planning Policy Framework (March 2012), Policy CS16 of the West Berkshire Core Strategy (2006-2026), and Supplementary Planning Document Quality Design (June 2006).

TECHNICAL NOTE

Appendix B

Environment Agency response

creating a better place

Environment Agency

Our ref:	WA/2015/119569/02-L01
Your ref:	141944/REG3
Date:	28 April 2015

Reading Borough Council
Development Control
PO Box 17
Reading
Berkshire
RG1 7TD

Dear Ms A Amoah

Construction of a new railway station, bus interchange, multi-storey car park (park and rise facility), short stay car park, taxi drop-off, disable parking facility, station access road from Longwater Avenue, landscaping and associated works. Land West Of Longwater Avenue, Reading, RG2 6GP.

I refer to the email dated 27 March 2015 from Peter Brett Associates (PBA) regarding the above site.

The email includes:

-27159_001_020 - Green Park Scheme Overview
-28791_002_402 - Flood compensation scheme
-28791 - Green Park Flood Management Strategy_TN01_March15
-LFP_Axiom4_Foudry Brook Flood Storage Proposals
-PBA Foudry Brook Report - Proposed New Channel Tech Report B&W

Environment Agency position

We have reviewed the submitted information and we are able to **withdraw our objections** on flood risk grounds subject to the following conditions being imposed on any planning permission granted:

1) Condition: Development shall not begin until a surface water drainage scheme for this phase of work, based on the agreed Flood Risk Assessment has been submitted to and approved in writing by the local planning authority. The scheme shall subsequently be implemented in accordance with the approved details before the scheme is completed.
The scheme should allow for:

- The drainage design will be designed in accordance with the new Defra technical guidance for sustainable drainage systems.
- Run off rates will be limited to Greenfield rates and the discharges volumes will be

Cont/d..

limited by either utilising infiltration drainage or where this is not practical the runoff rate will be limited to Qbar of 2l/s/ha and additional attenuation provided to ensure no increase in flood risk downstream.

Reason: To prevent the increased risk of flooding, to improve and protect water quality, improve habitat and amenity, and ensure future maintenance of the surface water drainage system.

2) Condition: Prior to occupation of any part of the permitted development, a verification report demonstrating completion of the works set out in the approved remediation strategy and the effectiveness of the remediation shall be submitted to and approved, in writing, by the local planning authority. The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan to demonstrate that the site remediation criteria have been met. It shall also include any plan (a “long-term monitoring and maintenance plan”) for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action, as identified in the verification plan, and for the reporting of this to the local planning authority.

Reasons: This site is located over Beenham Grange Gravel Member (River Terrace Deposits) over Lambeth Group (both Secondary A Aquifers) and the Newhaven and Seaford Chalk (Principal Aquifer) and we need to protect these aquifers fro contamination that potentially could be mobilised during development.

3) Condition: If, during development, contamination not previously identified is found to be present at the site then no further development (unless otherwise agreed in writing with the Local Planning Authority) shall be carried out until the developer has submitted, and obtained written approval from the Local Planning Authority for, an amendment to the remediation strategy detailing how this unsuspected contamination shall be dealt with.

Reason: Part of this site was historically a waste transfer station and infilling has been undertaken along the perimeter of the Trout Lakes, therefore there is the potential for unsuspected contamination to be encountered during development. Any visual or olfactory contamination encountered should be dealt with in an appropriate manner in order to protect the aquifers below the site (Secondary A Aquifers in the River Terrace Deposits and Lambeth Group and the Principal Aquifer in the Chalk).

4) Condition: The development hereby permitted shall not be commenced until such time as a scheme to dispose of surface water (that should ensure that no soakaways are constructed in contaminated land) has been submitted to, and approved in writing by, the local planning authority. The scheme shall be implemented as approved.

Reason: There is a know hotspot of soils contamination in the made ground on this site and infiltration drainage methods would increase the mobilisation of contamination into the aquifers below the site.

5) Condition: Piling or any other foundation designs using penetrative methods shall not be permitted other than with the express written consent of the Local Planning Authority, which may be given for those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to groundwater.

Reasons: The conclusions of the PBA Technical Note dated 24 October 2014 considers protection of controlled waters and states that adoption of an appropriate piling technique will minimise creation of preferential pathways. We need assurance that

piles will terminate at the previously agreed level of 6 m above the surface of the Chalk.

Advice to LPA and applicant about flood risk

Surface water control measures

PBA has confirmed the drainage design will be designed in accordance with the new Defra technical guidance for sustainable drainage systems. PBA have confirmed commitment to provide a drainage system meeting these requirements.

Loss of flood plain storage

The site lies within Flood Zone 3a/2 defined by the Planning Practice Guidance as having a high / medium probability of flooding. PBA has provided additional information confirming the background history about this development and design strategies being used. With this information we are prepared to remove this objection.

Explanation

The documentation provided has confirmed that flood risk has been assessed for the site and flood mitigation by way of 'level for level' compensation has been provided in line with earlier agreements.

PBA have clarified there will be limited impact on flood risk in flood zone 3a with this phase of the construction of Green Park. This phase of work has already been accounted for in the mitigation. This phase of work is also providing additional flood compensation with the work on the lake providing flood storage.

It has been noted that this compensation for loss of flood plain storage is based on the best information available at the time which dates back several years and is based on studies from 1985. We would highlight the following points following this review:

· The Environment Agency has not reviewed the model produced by PBA in 2007. We cannot comment on any assumptions made, accuracy of the results and benefits this scheme provides.
· Encroachment of the flood plain by the access road and car parks is relatively small. PBA confirmed this has been identified and allowed for during the initial design of the flood compensation area.
· There have been various developments outside this site boundary which may affect flood risk on watercourses'. These watercourses may influence flood risk on this development.
· Due to changes in flood risk strategies and modelling techniques, more up to date modelling may be required to ensure the model is still valid.
· Future development on this site may require an up to date model. This should confirm the existing flood risk, the compensation provides the benefits suggested and account for other development in the area that would affect flood risk.

Low hazard access and egress

The FRA sets out that the route of access from the development is a very low hazard in accordance with FD2320 (Flood Risk Assessment Guidance for New Developments). The access and egress extends to an area outside of the 1 in 100 year with an allowance for climate change floodplain.

Please note, whilst the applicant has demonstrated the access is a very low hazard during the design flood level (the 1 in 100 plus climate change), during more extreme events the access route may have a greater hazard.

Given the nature of this development, we would recommend the applicant/ local authority may wish to develop a flood plan for emergency situations. Issues to cover may include the availability of flood warnings, duration of flooding, depth of flooding and the length of the evacuation route. It is not our role to review and assess evacuation plans or flood management plans, therefore the applicability and requirements of any site specific flood plan should be discussed with the Local Authority.

Advice for condition 2 – Verification Report

We have reviewed the PBA Technical Note dated 24 October 2014, which summarises the investigations carried out on this site. We agree with the conclusions of this Technical Note that "hot spot" remediation of ground in the vicinity of WS8 is required and that site wide mitigation measures should be incorporated in to the development design.

Advice to applicant - Foul drainage

All sewage or trade effluent should be discharged to the foul sewer if available subject to the approval of Thames Water Utilities or its sewerage agent.

The developer should ensure early negotiations are made with the local sewerage provider to ensure that there are no capacity issues generated by this development's connection to the local foul sewer.

Advice to applicant - Waste

The Environmental Protection (Duty of Care) Regulations 1991 for dealing with waste materials are applicable for any off-site movements of wastes. The developer as waste producer therefore has a duty of care to ensure all materials removed go to an appropriate permitted facility and all relevant documentation is completed and kept in line with regulations.

If any waste is to be used onsite, the applicant will be required to obtain the appropriate waste exemption or permit from us. We are unable to specify what exactly would be required if anything, due to the limited amount of information provided.

The developer must apply the waste hierarchy in a priority order of prevention, re-use, recycling before considering other recovery or disposal options.

Advice to applicant- Pollution prevention

It is suggested that larger areas of hard standing e.g. walkways/car-parking are constructed following the recommendations set out in Sustainable Urban Drainage Systems guidance. This can be continued with designs for open space and landscaping within the area. The use of SUDS can attenuate the disposal of water and reduce the impact of pollutants to nearby watercourses.

We advise you to consult Pollution Prevention Guidance 6 relating to the use of oil interceptors for discharges from car parking areas. Clean roof water should not pass through the oil separator. Where soakaways are used it should preferably not discharge

to soakaways used to drain road and vehicle parking areas. Roof water downpipes should be connected to the drainage system either directly, or by means of back inlet gullies provided with sealing plates instead of open gratings.

Following the good practice described does not remove your obligation to comply with relevant legislation and to prevent pollution from your site. Pollution of the environment is a criminal offence and compliance with one or more Guidance Note is not a defence to such offences.

Yours sincerely

Ms Michelle Kidd
Planning Advisor

Direct dial 01491 828455
Direct e-mail planning-wallingford@environment-agency.gov.uk

cc Peter Brett Associates

End

TECHNICAL NOTE

Appendix C

Station Interchange Drainage Strategy

TECHNICAL NOTE

Job Name: Green Park Interchange

Job No: 36382/2011

Note No: 36382/2011/TN001

Date: 22nd December 2017

Prepared By: G Roseff/A Mulholland/R Tew

Checked By: C Brown

Approved By: S Earl

Subject: **Flood Risk and Proposed Surface Water Drainage**

1. Introduction

Peter Brett Associates have been commissioned by Reading Borough Council (RBC) to complete a detailed design of the surface water drainage for Green Park Transport Interchange (station surface water to be designed by others). To gain planning permission, a Flood Risk Assessment (FRA) (reference 28791/4001; date Oct 2014) was submitted to RBC outlining the requirements for flood risk and the proposed surface water drainage strategy. There are three RBC planning conditions relating to surface water drainage and flood risk; these are:

- RBC Planning condition 30 – Design of the Surface Water Drainage
- RBC Planning Condition 29 – compliance with Flood Risk Assessment
- RBC Planning condition 27 –Avoidance of construction of soakaways in contaminated land

These planning conditions can be found in **Appendix A**

This Technical Note outlines the proposed surface water drainage design to be constructed, and addresses the planning conditions listed above.

2. Proposed Surface Water Drainage Strategy

Discharge Destination

In accordance with the discharge destination hierarchies of the National Planning Practice Guidance an assessment of the suitability of the site to utilise infiltration drainage techniques has been undertaken.

See the Planning Practice Guidance

This states:

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

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

Geo-environmental Report on Ground Conditions (Document reference 11321 / 4004 Rev 01; dated Oct 2010) and Geoenvironmental Data (technical note No. TN02/GEO; dated 24th October 2014 – submitted

as part of the planning application) outline that the site used to be used as a waste transfer site and that composition of the made ground under the site has the potential to impact water quality.

The mitigation measures outlined in these geo environmental reports include a lined drainage system and measures to ensure no uncontrolled discharges, including run off.

As such the proposed surface water strategy will discharge into the existing surface water body via a lined surface water drainage system. The proposed surface water network will discharge via a proposed headwall into the surface water lake along the eastern edge of the site.

The proposed outfall invert level will be set at 38.866m which is the modelled flood level for 1 in 100 year flood event. This outfall level has been set to allow cover of around 800mm to the surface water drainage pipe work under the proposed interchange carriageway in the north western edge of the site. The proposed pipe will be concrete encased for additional protection.

To mimic the effect of climate change, the surface water network was modelled to have a surcharged outfall to the 1 in 100 year flood event plus 20% climate change flood level (39.10m).

Peak Flow Control – Defra Technical Standard S2

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

In accordance with best practice the proposed surface water drainage strategy seeks to reduce the peak discharge rate from the site to '*should never exceed greenfield runoff rate'*.

In addition, RBC planning condition 30 states that 'run off rates will be limited to greenfield rates and the discharge volumes will be limited either by using infiltration drainage or where this is not practical the run-off rate will be limited to Qbar of 2l/s/ha and additional attenuation provided to ensure no increase of flood risk downstream.'

As infiltration techniques will not be used, the proposed drainage scheme will provide attenuation to reduce the total peak discharge rate from the 0.9ha site to 5 l/s, which is the practical minimum to avoid blockage.

Table 1 below shows the Calculated Greenfield Runoff Rates as outlined in the Flood Risk Assessment for the site.

Rainfall Event	Greenfield Runoff Rate (l/s/ha)	Greenfield Runoff Rate (l/s) (Site Area 0.9ha)	Designed Rate from Microdrainage model (l/s)
1 in 1 year	3.16	2.84	5.0
1 in 30 year	8.32	7.49	5.0
1 in 100 year	11.85	10.67	5.0
1 in 100 year + 20% CC	-	-	5.0

Table 1: Calculated Greenfield Runoff Rates

This represents a reduction of greater than 50% on the existing greenfield run-off rate in the 1 in 100 year rainfall event.

The EA's Flood Risk Assessments: Climate Change Allowances guidance which supports the NPPF provides contingency allowances for potential increases in sea level rise, peak river flow and rainfall intensity.

In accordance with this guidance, the potential for increased pluvial (rainfall) flood probability as the result of possible climate change has been taken into account, over the lifetime of the development, through a +20% allowance for increases in peak rainfall intensity within the surface water drainage design. This represents the central limit for the climate change period up to 2115.

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115	Comment
Upper End	10%	20%	40%	**20% allowance applied** for 'more vulnerable' development in Flood Zone 1, not within a known flood risk area with a 100 year life expectancy
Central	5%	10%	20%	

Table 2: Flood Risk Assessments: Climate Change Allowances Table 2 Peak Rainfall Intensity Allowance in Small and Urban Catchments (use 1961 to 1991 baseline)

In order to demonstrate that the proposed peak discharge rates are deliverable within the development layout the surface water drainage network has been modelled. A copy of the Proposed Surface Water Drainage drawing (36382/2011/500/01) and accompanying MicroDrainage calculations are contained within **Appendices B and C** respectively.

Volume Control - Defra Technical Standard S4

> **S4.** Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

The development proposals will increase the existing level of impermeability across the site and as such the volumetric run-off will be increased. However, the proposed drainage scheme will introduce

attenuation and reduce the peak rate of run-off to the practical minimum. Therefore, the volumetric run-off will be reduced in any given storm duration compared to the existing unrestricted greenfield run-off rate.

Flood Risk within the Development – Defra Technical Standards S7 to S9

> **S7.** The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.
>
> **S8.** The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement) or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

The proposed outline surface water drainage network has been designed to demonstrate that the peak discharge rate can be achieved with no flooding in a 1 in 30 year or a 1 in 100 year rainfall event.

SuDS Selection

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

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

The NPPG paragraph 051 describes SuDS as follows:

> *'Sustainable drainage systems are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible.* ***They provide opportunities to:***
>
> - *reduce the causes and impacts of flooding;*
> - *remove pollutants from urban run-off at source;*
> - *combine water management with green space with benefits for amenity, recreation and wildlife.'*

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

For the Green Park Interchange development it is considered that open surface SuDS are not appropriate due to the density of the development. Therefore, a system which utilises cellular attenuation tanks is proposed.

Cellular crate storage will provide the primary attenuation required for management of the 100 year + 20% storm event.

The proposed system follows the principles of the NPPG SuDS requirements by reducing flood risk and removal of pollutants / contaminants through the use of trapped gullies, catchpits / silt traps and an oil interceptor.

> **S10.** Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.
>
> **S11.** The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.

The components that make up any drainage network have different life expectances which can be greatly affected by the effectiveness of their maintenance regime and upstream sediment capture/management.

Green Park Interchange drainage network comprises a piped network, inspection chambers / catchpits, cellular crate storage and hydraulic flow controls. As with any drainage system, this network requires regular inspection and maintenance to ensure that the individual components continue to operate as designed, both in terms of hydraulic capacity and potential pollutant removal.

All the drainage manholes, catchpits and gullies will therefore be inspected and cleaned regularly by a Reading Borough Council.

3. Maintenance Strategy

This section sets out the inspection and maintenance requirements for long term management of the development's surface water drainage system. This work is to be undertaken by Reading Borough Council.

Health, Safety and Welfare

All those responsible for maintenance should take appropriate health, safety and welfare precautions for all activities including lone working, if relevant, and risk assessments should always be undertaken. The site's infrastructure Health and Safety File should be consulted before carrying out any works either inside or outside of the development's boundary and information regarding the location of existing utilities passed on to operatives.

The requirements of the Health and Safety at Work Act 1974 and The Construction (Design and Management) Regulations 2015 should be adhered to and any residual risks identified in the Health and Safety File should be managed and information passed on to maintenance operatives through task specific risk assessments.

Operation and Maintenance

There are three types of maintenance activities associated with surface water drainage systems. The SuDS Manual, CIRIA C753, defines these as:

- Regular Maintenance – '*basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections*.'
- Occasional Maintenance – *'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example.'*
- Remedial Maintenance – *'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where*

remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.'

Specific maintenance needs should be monitored and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

Operation and Maintenance Activity	SuDS Component		
	Piped Network / Inspection Chambers	Cellular / Modular Storage	Oil Interceptor
Regular Maintenance			
Inspection	■	■	■
Litter and debris removal	■	□	□
Grass cutting		□	
Weed and invasive plant control			
Occasional Maintenance			
Sediment management[1]	■	■	■
Vacuum sweeping and brushing			
Remedial Maintenance			
Structure rehabilitation / repair	□	□	□
■ Will be required □ May be required [1] Sediment should be collected and managed in pre-treatment systems, upstream of the main device.			

Table 3: Extract from The SuDS Manual

Piped Network / Inspection Chambers

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

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

Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of features or pipework is required.	As required

Table 4: Piped Network / Inspection Chambers operation and maintenance

Cellular / Modular Storage

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

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required take remedial action	Monthly for three months, then annually
	Remove debris from catchment surface (where may cause risks to performance)	Monthly
	Remove sediment from pre-treatment structures and / or catchpits	Annually, or as required
Remedial Maintenance	Repair / rehabilitate inlets, outlets, overflows and vents	As required
Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually, and after large rainfall events
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required
Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of storage units is required.	As required

Table 5: The SuDS Manual Table 21.3: Operation and maintenance requirements for attenuation storage tanks

4. Fill Material

Within the FRA (reference 28791/4001; date Oct 2014), there is a requirement that the fill material is to have an infiltration rate of 1x10-5 m/s to allow for soakaways. Due to the potential for contaminated land and potential to contaminate the ground water it is not appropriate to use infiltration drainage. In addition there are higher costs associated to fill material with a material with an infiltration rate of 1x10-5 m/s, therefore a cohesive Class 2 material will be used with a lower infiltration rate.

5. Flood Compensation

The FRA (reference 28791/4001; date Oct 2014), recommends flood compensation is provided however it was subsequently agreed in April 2015 with the Environment Agency (reference WA/2015/119569/02-L01) that flood compensation is not required as the area was included in the wider Floodplain Management Strategy. See **Appendix D** for details.

6. Conclusion

Technical Note No TN02/GEO submitted as part of the planning application outlines that for the protection of the controlled waters the proposed surface water drainage system is to be lined and therefore, the site will not use infiltrating drainage techniques. As such the proposed surface water strategy will discharge into the existing surface water lake at the eastern edge of the site.

The proposed drainage scheme will provide attenuation to reduce the total peak discharge rate to 5 l/s for the 1 in 100 year + 20% Climate Change (CC) event, which represents a reduction greater than 50% on the existing greenfield run-off rate.

In accordance with Table 2 of the EA's Flood Risk Assessments: Climate Change Allowances guidance, an allowance of 20% has been added to the peak rainfall intensities in the 1 in 100 year design storm event to account for the potential effects of climate change.

The proposed surface water system utilises cellular crate storage to provide attenuation and water quality improvements in the management of run-off. The proposed system follows the principles of the NPPG SuDS requirements by reducing flood risk and removal of pollutants / contaminants through the use of trapped gullies, catchpits / silt traps and an oil interceptor.

As the landowner, Reading Borough Council will be responsible for the long term maintenance of the proposed system and will undertake inspection and maintenance in accordance with this Strategy.

As a result, the principles advocated by relevant national, regional and local planning policy guidance have been satisfactorily addressed.

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Manager)
36382-2011-TN001	-	22.12.17	GR/AM/RT	CB	CB	SE

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Appendix A

Planning Conditions relating to surface water drainage and flood risk.

RBC Planning condition 27 states the following:
The development hereby permitted shall not be commenced until such time as a scheme to dispose of surface water that ensures that no soakaways are constructed in contaminated ground, has been submitted to, and approved in writing by the Local Planning Authority. The scheme shall be implemented as approved.
Core Strategy Policy CS34: Pollution and Water Resources

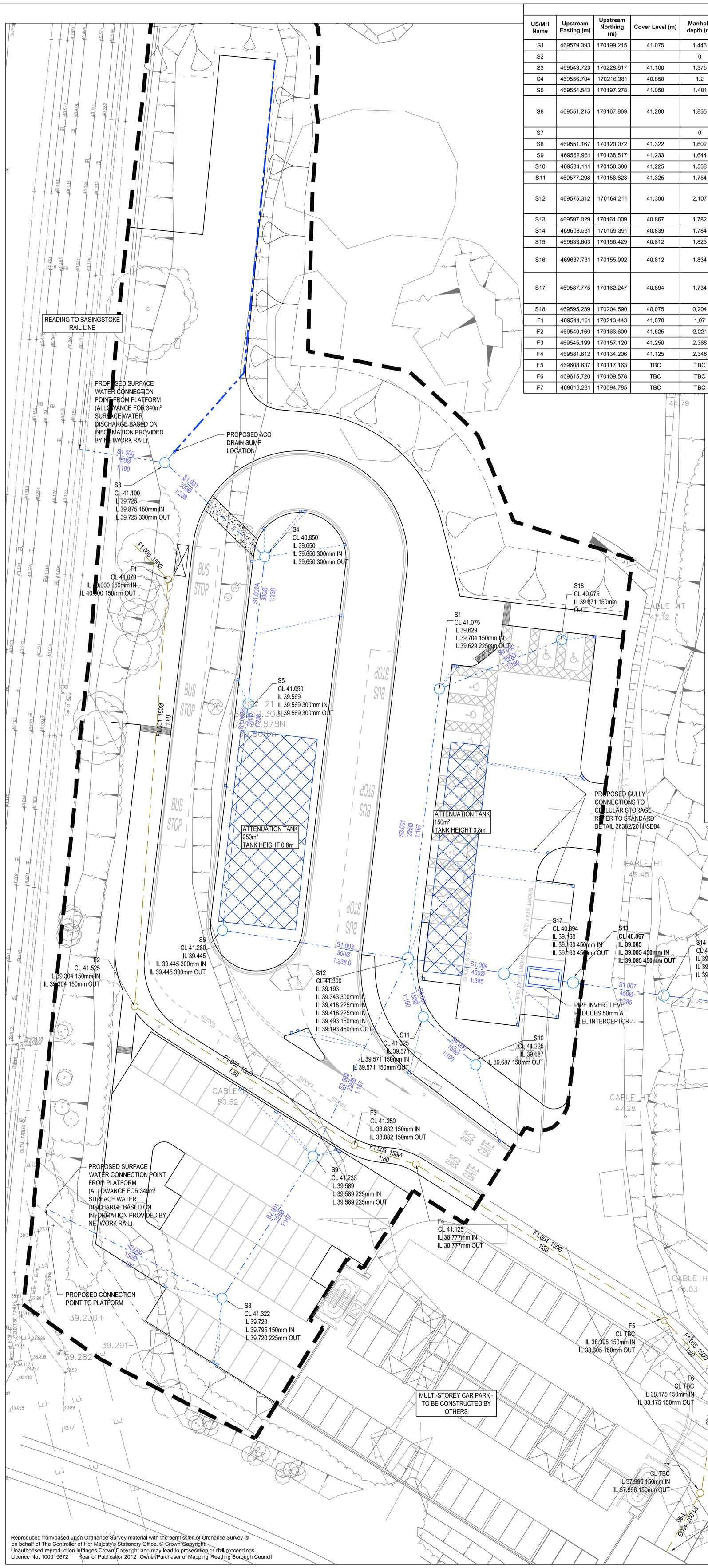
RBC Planning Condition 29 states the following:
The development hereby permitted shall only be carried out in accordance with approved Flood Risk Assessment (FRA) ref: 28791/4001 undertaken by Peter Brett Associates, dated October 2014.
Reason: To reduce the risk of flooding. This condition is imposed in accordance with the National Planning Policy Framework (March 2012), and Policy CS16 of the West Berkshire Core Strategy (2006-2026).

RBC Planning condition 30 states the following:
No development shall commence on the railway station hereby approved until a surface water drainage scheme has been submitted to and approved in writing by the Local Planning Authority. Before these details are submitted an assessment shall be carried out of the potential for disposing of surface water by means of a sustainable drainage systems March 2015, and the results of the assessment provided to the local planning authority. Where a sustainable drainage scheme is to be provided, the submitted details shall:
i. provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of the receiving groundwater and/or surface waters;
ii. Include a timetable for its implementation; and
iii. provide a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime. Run off rates will be limited to greenfield rates and the discharge volumes will be limited either by using infiltration drainage or where this is not practical the run-off rate will be limited to Qbar of 2l/s/ha and additional attenuation provided to ensure no increase of flood risk downstream.
iv. Thereafter, the railway station shall not be brought into use until the surface water drainage scheme has been implemented in accordance with the requirements pf part ii) of this condition. Thereafter the approved surface waste drainage scheme shall be maintained and operated in accordance with the approved details.
Reason: To prevent the increased risk of flooding, to improve and protect water quality, improve habitat and amenity, and ensure future maintenance of the surface water drainage system. This condition is imposed in accordance with the National Planning Policy Framework (March 2012), Policy CS16 of the West Berkshire Core Strategy (2006-2026), and Supplementary Planning Document Quality Design (June 2006).

Appendix B

Drawing Numbers:

- 36382/2011/500/01
- 36382/2011/SD03
- 36382/2011/SD04



Manhole Schedule

US/MH Name	Upstream Easting (m)	Upstream Northing (m)	Cover Level (m)	Manhole depth (m)	Manhole Diam.,L*W (mm)	Manhole Type	Incoming pipe No.	Incoming invert (m)	Incoming diameter (mm)	Outgoing pipe No.	Outgoing invert (m)	Outgoing diameter (mm)
S1	469579.393	170199.215	41.075	1.446	1350	MH TYPE 2	S3.000	39.704	150	S3.001	39.629	225
S2				0								
S3	469543.723	170228.617	41.100	1.375	1200	MH TYPE 2	S1.000	39.875	150	S1.001	39.725	300
S4	469556.704	170216.381	40.850	1.2	1500	MH TYPE 2	S1.001	39.650	300	S1.002A	39.650	300
S5	469554.543	170197.278	41.050	1.481	1500	CP TYPE 2	S1.002A	39.569	300	S1.002B	39.569	300
S6	469551.215	170167.869	41.280	1.835	1500	MH TYPE 2 with vent from cellular storage	S1.002B	39.445	300	S1.003	39.445	300
S7				0								
S8	469551.167	170120.072	41.322	1.602	1350	MH TYPE 2	S2.000	39.795	150	S2.001	39.720	225
S9	469562.961	170138.517	41.233	1.644	1500	MH TYPE 2	S2.001	39.589	225	S2.002	39.589	225
S10	469584.111	170150.380	41.225	1.538	1200	MH TYPE 2				S4.000	39.687	150
S11	469577.298	170156.623	41.325	1.754	1200	MH TYPE 2	S4.000	39.571	150	S4.001	39.571	150
S12	469575.312	170164.211	41.300	2.107	1500	CP TYPE 1	S1.003 S2.002 S3.001 S4.001	39.343 39.418 39.418 39.493	300 225 225 150	S1.004	39.193	450
S13	469597.029	170161.009	40.867	1.782	1500	MH TYPE 2	S1.006	39.085	450	S1.007	39.085	450
S14	469608.531	170159.391	40.839	1.784	1200	MH TYPE 2	S1.007	39.055	450	S1.008	39.055	450
S15	469633.603	170156.429	40.812	1.823	1200	MH TYPE 2	S1.008	38.989	450	S1.009	38.989	450
S16	469637.731	170155.902	40.812	1.834	1500	MH TYPE 3 with Hydrobrake	S1.009	38.978	450	S1.010	38.978	450
S17	469587.775	170162.247	40.894	1.734	1500	MH TYPE 2 with vent from cellular storage	S1.004	39.160	450	S1.005	39.160	450
S18	469595.239	170204.590	40.075	0.204	1200	MH TYPE 2				S3.000	39.871	150
F1	469544.161	170213.443	41.070	1.07	1200		F1.000	40.000	150	F1.001	40.000	150
F2	469540.160	170163.609	41.525	2.221	1200		F1.001	39.304	150	F1.002	39.304	150
F3	469545.199	170157.120	41.250	2.368	1200		F1.002	38.882	150	F1.003	38.882	150
F4	469581.612	170134.206	41.125	2.348	1200		F1.003	38.777	150	F1.004	38.777	150
F5	469608.637	170117.163	TBC	TBC	1200		F1.004	38.305	150	F1.005	38.305	150
F6	469615.720	170109.578	TBC	TBC	1200		F1.005	38.175	150	F1.006	38.175	150
F7	469613.281	170094.785	TBC	TBC	1200		F1.006	37.988	150	F1.007	37.988	150

SITE EXTENTS

PROPOSED SURFACE WATER HIGHWAY DRAIN (GRADIENT AND PIPE SIZE). SEE STANDARD DETAIL 36382/2011/SD06 FOR BEDDING DETAIL

S2 PROPOSED SURFACE WATER MANHOLE REFER TO MANHOLE SCHEDULE

PROPOSED SURFACE WATER FLOW CONTROL MANHOLE.

PROPOSED FOUL WATER SEWER

PROPOSED FOUL WATER MANHOLE

PROPOSED LINED CELLULAR STORAGE TANK SEE STANDARD DETAIL 36382/2011/SD04

PROPOSED TRAPPED GULLY AND CONNECTION. REFER TO STANDARD DETAIL 36382/2011/SD06

SEWER TO BE ENCASED IN ST4 CONCRETE. REFER TO STANDARD DETAIL 36382/2011/SD06

PROPOSED CHANNEL DRAIN (ACO M150D CONSTANT OVERALL DEPTH 210mm OR EQUIVALENT APPROVED). SEE STANDARD DETAIL 36382/2011/SD03

PROPOSED BYPASS FUEL INTERCEPTOR SEE APPENDIX 5/1 IN SPECIFICATION FOR DETAILS.

PROPOSED HEADWALL

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER CONTRACT DOCUMENTS AND DRAWINGS.
2. ALL WORK IS TO BE IN ACCORDANCE WITH THE HIGHWAYS AGENCY SPECIFICATION FOR HIGHWAYS WORK VOLUME 1 AND THE CONTRACT SPECIFIC NUMBERED APPENDICES.
3. REFER TO APPENDIX 5/1 OF THE SPECIFICATION FOR DETAILS.
4. ALL DRAINAGE WORKS ARE TO COMMENCE AT THE OUTFALL AND WORK UPSTREAM.
5. GRADIENTS ARE INDICATED FOR HYDRAULIC PURPOSES ONLY AND SHOULD NOT BE USED FOR SETTING OUT.
6. PROPOSED COVER LEVELS SHOWN ARE INDICATIVE FOR DRAINAGE PURPOSES AND ARE TO BE CHECKED AGAINST FINISHED ROAD AND EARTHWORK LEVELS.
7. ALL PIPES ARE TO BE CONNECTED WITH LEVEL SOFFITS UNLESS OTHERWISE STATED.
8. MANHOLE COVERS IN CARRIAGEWAY AND PARKING AREAS TO BE D400. B125 IN FOOTWAYS, VERGES AND PEDESTRIAN AREAS.
9. EXACT LOCATION AND SETTING OUT OF PROPOSED GULLY LOCATIONS TO BE AGREED ON-SITE WITH THE OVERSEEING ORGANISATION.

Mark	Revision	Date	Drawn	Chkd	Appd

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status

FOR APPROVAL

GREEN PARK STATION PROPOSED INTERCHANGE DRAINAGE LAYOUT

Client

Reading Borough Council
Working better with you

Date of 1st Issue	Designed	Drawn
04.01.18	RT	SF
A1 Scale	**Checked**	**Approved**
1:250	CB	SE

Drawing Number	Revision
36382/2011/500/01	-

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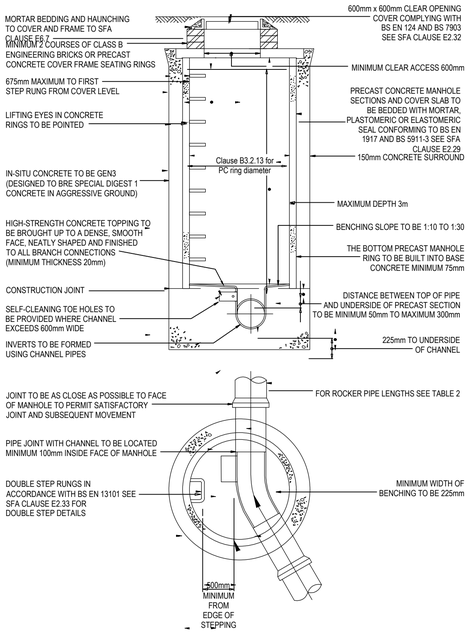
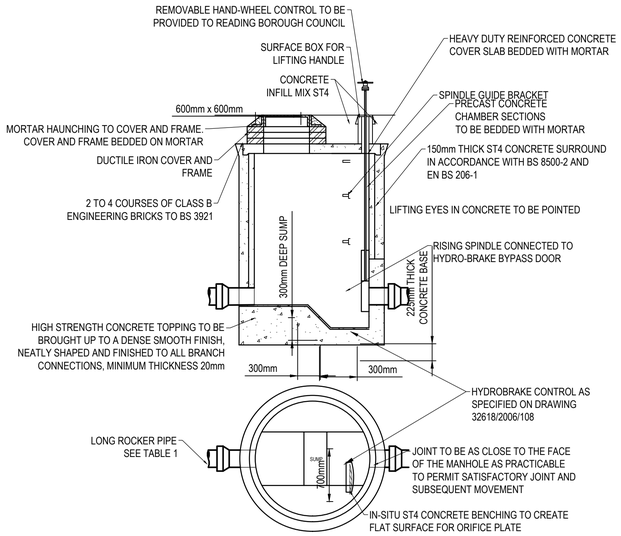


MANHOLE TYPE 2 DETAILS

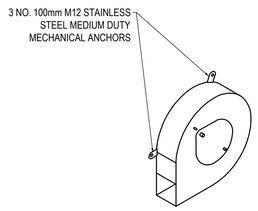


TYPE 3 FLOW CONTROL MANHOLE

MANHOLE AND INSPECTION CHAMBER NOTES

1. CONSTRUCTION SHALL COMPLY WITH THE REQUIREMENTS AND SPECIFICATION OF MCHW AND THOSE SPECIFIC REQUIREMENTS OF THE ADOPTING STATUTORY UNDERTAKER.
2. ALL PIPES TO BE EITHER VITRIFIED CLAY OR CONCRETE AS PER THE MCHW.
3. RISING SPINDLE AND GUIDE BRACKETS TO BE STAINLESS STEEL A131 316L TO BS EN 10088.
4. HYDROBRAKE TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURES INSTRUCTIONS.

Table 1	
Pipe Dia.	Rocker Length
150 - 600	0.600
601 - 750	1.000
750 +	1.250



NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS AND DOCUMENTS.
2. ALL WORKS IS TO BE DONE IN ACCORDANCE WITH THE HIGHWAY AGENCY SPECIFICATION FOR HIGHWAY WORKS VOLUME 1 AND CONTRACT SPECIFIC APPENDICES.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

GULLY DETAILS-

4. GRATINGS AND FRAMES SHALL BE IN ACCORDANCE WITH THE FOLLOWING:
   - BS EN124:1994 CLASS D400 FOR USE IN CARRIAGEWAYS AND BUS BAYS ETC,
   - MIN C250 FOR USE IN FOOTWAYS
5. BRICKWORK SHALL BE CLASS B ENGINEERING TO BS 3921 LAID IN MORTAR TO DESIGNATION (1), IN ENGLISH BOND.
6. GULLY POTS SHALL NORMALLY BE:
   - CONCRETE TO BS 5911 PART 230
   - VITRIFIED CLAY TO BS 65 AND BS EN 295
   - POTS SHALL BE 450Ø x 900 DEEP IN CARRIAGEWAYS AND 375Ø x 750 DEEP IN FOOTWAYS
7. SLOTS IN GRATINGS SHALL NOT BE PARALLEL TO THE DIRECTION OF THE TRAFFIC.
8. HINGED CAPTIVE GRATINGS MUST BE USED. END HINGED GRATINGS MUST BE SET WITH HINGE TOWARDS APPROACHING TRAFFIC.
9. BRICK GULLIES AND CAST - IN SITU CONCRETE GULLIES MAY ONLY BE USED WITH THE APPROVAL OF THE ENGINEER WHERE SPACE IS LIMITED.
10. CONNECTIONS TO CARRIER DRAINS SHALL BE BY MEANS OF 'Y' JUNCTIONS OR SADDLES AS APPROPRIATE.
11. PERMITTED MATERIALS TO BE AGREED WITH ENGINEER. MINIMUM PIPE STRENGTH TO BE 20kN/m (PROOF). ALL PIPES TO BE IMPERVIOUS.
12. ALL WORK TO BE IN ACCORDANCE WITH THE HIGHWAYS AGENCY SPECIFICATION FOR HIGHWAYS WORKS VOLUME 1 AND THE CONTRACT SPECIFIC NUMBERED APPENDICES.
13. ALL ADOPTABLE WORKS TO BE CARRIED OUT IN ACCORDANCE WITH SEWERS FOR ADOPTION 7TH EDITION.

CHANNEL DRAIN DETAIL-

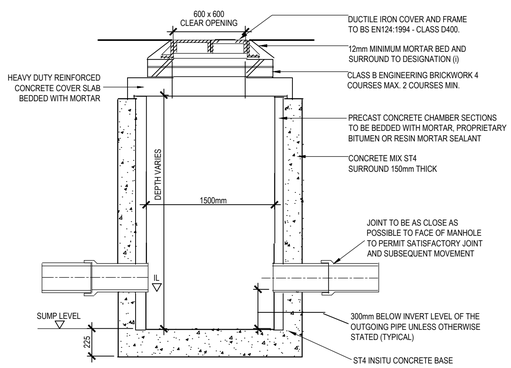
14. RODDABLE TRAPPED SUMP UNITS TO BE POSITIONED AT CONNECTION TO DRAIN. SEE LAYOUTS.
15. LOADINGS TO BS EN 124:1994.
16. FOR SURFACING DETAILS REFER TO LANDSCAPE ARCHITECTS DRAWINGS.
17. IF PAVIOURS ARE TO BE LOCATED DIRECTLY ADJACENT TO SLOT THESE AREA TO BE BEDDED USING A POLYMER MODIFIED MORTAR (BY CRETEPLUS OR SIMILAR APPROVED).

MANHOLE DETAILS -

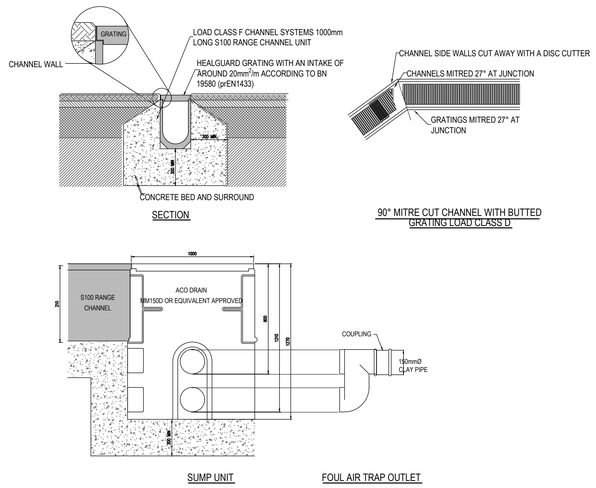
18. FOR DATED REFERENCES, SUBSEQUENT AMENDMENTS TO, OR REVISIONS OF, ANY OF THESE PUBLICATION DO NOT APPLY. FOR UNDATED REFERENCES, THE LATEST EDITION OF THE PUBLICATION REFERRED TO APPLIES.
19. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND THE SPECIFICATION.
20. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY. ALL DIMENSIONS ARE IN MILLIMETRES.
21. MANHOLE COVERS AND FRAMES - SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 124. THEY SHALL BE OF A NON-ROCKING DESIGN WHICH DOES NOT RELY ON THE USE OF CUSHION INSERTS. CLASS D400 COVERS SHALL BE USED IN CARRIAGEWAYS OF ROADS (INCLUDING PEDESTRIAN STREETS), HARD SHOULDERS AND PARKING AREAS USED BY ALL TYPES OF ROAD VEHICLE. CLASS B125 SHALL BE USED IN FOOTWAYS, PEDESTRIAN AREAS AND COMPARABLE LOCATIONS. MINIMUM FRAME DEPTHS FOR NRSWA ROAD CATEGORIES I TO IV SHALL BE 150mm (EXCEPT RESIDENTIAL CUL-DE-SACS WHERE THE MINIMUM FRAME DEPTH SHALL BE 100mm). ALL MANHOLES COVERS SHALL BE THE NON-VENTILATING TYPE AND HAVE CLOSED KEYWAYS. IN VERGES COVERS SHALL BE POSITIONED ON THE SIDE FURTHEST FROM THE CARRIAGEWAY.
22. BRICKS - SHALL BE CLASS B ENGINEERING COMPLYING WITH THE RELEVANT PROVISIONS OF BS 3921. ALL BRICKS SHALL BE FROST RESISTANT CATEGORY F. BRICKS SHALL BE LAID IN ENGLISH BOND.
23. MORTAR - SHALL BE MIXED ONLY AS AND WHEN REQUIRED, IN THE PROPORTION 1:3 CEMENT:SAND BY VOLUME. ALL MORTAR SHALL BE CONVEYED FRESH TO THE WORKS AS REQUIRED FOR USE. MORTAR WHICH HAS BEGUN TO SET OR WHICH HAS BEEN MIXED FOR A PERIOD OF MORE THAN 1 HOUR SHALL NOT BE USED.
24. SANDS FOR MORTAR - SHALL BE WASHED SAND, COMPLYING WITH BS 1200 AND GRADED IN ACCORDANCE WITH TABLE 1 OF THAT STANDARD.
25. CEMENT (FOR INSITU CONCRETE AND MORTAR) - SHALL BE SULPHATE RESISTING PORTLAND CEMENT (SRPC) COMPLYING WITH BS 4027.
26. CEMENT (FOR PRECAST CONCRETE PIPES OR MANHOLES) - SHALL BE A COMBINATION OF CEMENT CONFORMING TO BS 12 AND p.g.b.s OR p.f.a. OR CEMENT CONFORMING TO BS 4027 ALONE TO MEET UP TO AND INCLUDING DESIGN SULPHATE CLASS DS-3 AS DEFINED IN BRE SPECIAL DIGEST 1, 2001.
27. WATER FOR USE WITH CEMENT - SHALL BE OF POTABLE QUALITY.
28. PRECAST CONCRETE MANHOLE COMPONENTS - SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS 5911-200. UNITS WHICH BED INTO BASES SHALL BE MANUFACTURED SO THAT IMPOSED VERTICAL LOADS ARE TRANSMITTED DIRECTLY VIA THE FULL WALL THICKNESS OF THE UNIT. FOR JOINTS BETWEEN UNITS AND THE UNDERSIDE OF SLABS, JOINT PROFILES SHALL BE CAPABLE OF WITHSTANDING APPLIED LOADINGS FROM SUCH SLABS, AND SPIGOT-ENDED SECTIONS SHALL ONLY BE USED WHERE THE SOFFIT OF THE SLAB IS RECESSED TO RECEIVED THEM.
29. IN SITU CONCRETE - STANDARDISED PRESCRIBED CONCRETE MIX ST4 (UNREINFORCED) IN ACCORDANCE WITH BS 8500-2 AND BS EN 206-1 SHALL BE USED WITH A 20mm NOMINAL MAXIMUM SIZE OF AGGREGATE AND A CLASS S2 (75mm) SLUMP. ADMIXTURES (INCLUDING CALCIUM CHLORIDE AND PIGMENTS) SHALL NOT BE USED IN THE PRODUCTION OF CONCRETE. COMPRESSIVE STRENGTH TESTING SHALL NOT BE USED TO JUDGE THE COMPLIANCE OF A CONCRETE, BUT WHERE REQUIRED BY THE ADOPTING AUTHORITY, THE CONTRACTOR SHALL PROVIDE EVIDENCE OF THE BATCH MASSES USED TO PRODUCE ANY CONCRETE.

    NO STANDARDISED PRESCRIBED CONCRETE PRODUCED USING SULFATE-RESISTING PORTLAND CEMENT IS NOT INTENDED TO PRODUCE SULFATE-RESISTING CONCRETE. WHERE THE DESIGN SULPHATE CLASS IS HIGHER THAN DESIGN CHEMICAL CLASS DS-2, IN-SITU (AND PRECAST CONCRETE, WHERE APPLICABLE) SHALL BE AS DESIGNATED ON THE CONTRACT SPECIFIC DRAINAGE LAYOUT DRAWING, MANHOLE SCHEDULE OR SPECIFICATION.
30. AGGREGATES FOR CONCRETE - SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS 882*.
31. HIGH STRENGTH CONCRETE TOPPING - SHALL BE PRODUCED, LAID AND FINISHED IN ACCORDANCE WITH THE RELEVANT PROVISIONS OF BS 8204: PART 2 AND THE FOLLOWING APPROXIMATE MIX PROPORTIONS BY WEIGHT SHALL BE USED: 1 PART CEMENT, 1 PART NATURAL SAND AND 2 PARTS SINGLE SIZED COARSE AGGREGATE.
32. AGGREGATE FOR HIGH STRENGTH CONCRETE TOPPING - SHALL COMPLY WITH BS 882* AND BE 10mm NOMINAL SIZE, GRADED IN ACCORDANCE WITH TABLE 6 OF THAT STANDARD.

    *WHEN THIS STANDARD IS SUPERSEDED BY EN 12620, THE AGGREGATES SHALL FOLLOW THE RECOMMENDATIONS IN THE UK NATIONAL GUIDANCE TO EN 12620.
33. ALL ADOPTABLE WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH SEWERS FOR ADOPTION 6th EDITION.
34. ALL THE ABOVE REQUIREMENTS SHALL APPLY UNLESS OTHERWISE STATED IN THE DRAINAGE LAYOUT DRAWING, MANHOLE SCHEDULE OR SPECIFICATION. IN THE EVENT OF A CONTRADICTION THE CONTRACT SPECIFIC DOCUMENTS SHALL BE DEEMED TO PREVAIL.
35. CONSTRUCTION SHALL COMPLY WITH THE REQUIREMENTS AND SPECIFICATION OF SEWERS FOR ADOPTION (SFA) 6th EDITION AND THOSE SPECIFIC REQUIREMENTS OF THE ADOPTING STATUTORY UNDERTAKER.
36. TYPE 2 MANHOLE MAXIMUM DEPTH FROM COVER LEVEL TO SOFFIT OF PIPE TO BE 3.0m.
37. ALL PIPES TO BE EITHER VITRIFIED CLAY OR CONCRETE AS PER THE SFA SPECIFICATION. ALL JOINTS AND MATERIALS SHALL BE RESISTANT TO CORROSION AND THE PARTICULAR NATURE OF THE CONTAMINANTS FOUND ON THE SITE AS DETAILED IN THE PROJECT GROUND INVESTIGATION.
38. RISING SPINDLE AND GUIDE BRACKETS TO BE STAINLESS STEEL A131 316L TO BS EN 10088.
39. HYDROBRAKE TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURES INSTRUCTIONS.



CATCHPIT



CHANNEL DRAIN DETAIL

Mark	Revision	Date	Drawn	Chkd	Appd

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.
UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status
FOR APPROVAL

GREEN PARK STATION
PROPOSED INTERCHANGE LAYOUT
DRAINAGE CONSTRUCTION DETAILS

Client
Reading Borough Council
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Date of 1st Issue	Designed	Drawn
04.01.18	RT	SF
A1 Scale	Checked	Approved
NTS	CB	SE

Drawing Number: 36382/2011/SD03
Revision: -

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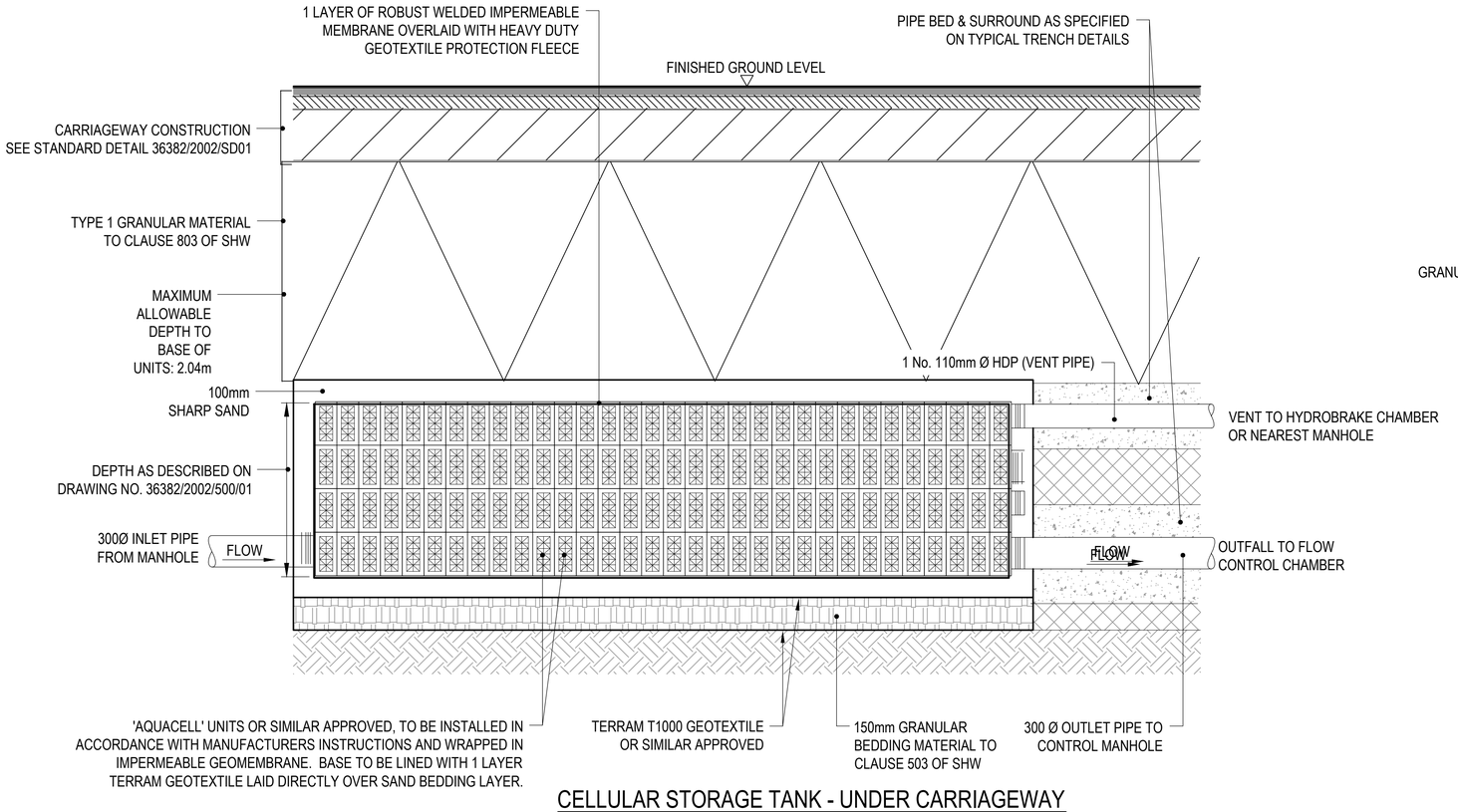
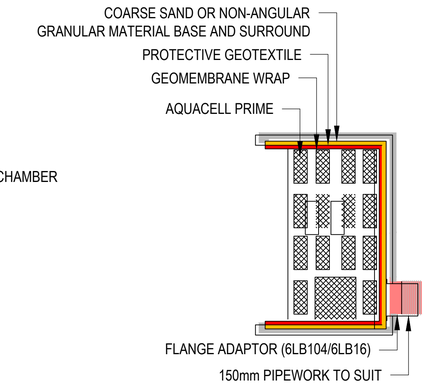
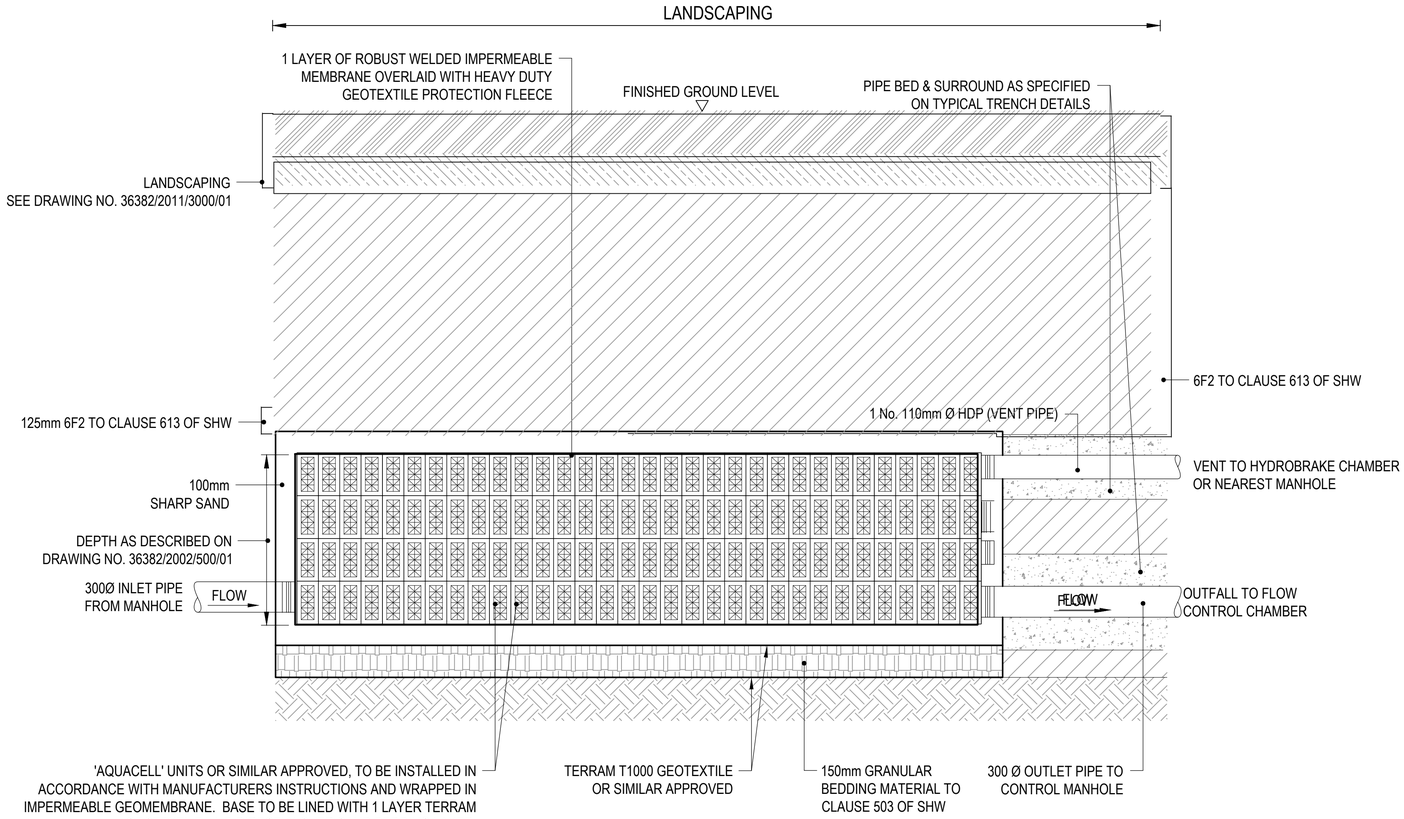


CELLULAR STORAGE TANK - UNDER CARRIAGEWAY

NTS



GULLY CONNECTIONS TO CELLULAR STORAGE



CELLULAR STORAGE TANK - UNDER LANDSCAPING / VERGE

NTS

Mark	Revision	Date	Drawn	Chkd	Appd

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Drawing Issue Status

FOR APPROVAL

GREEN PARK STATION
PROPOSED INTERCHANGE
CELLULAR STORAGE TANK
CONSTRUCTION DETAILS

Client

Reading Borough Council
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Date of 1st Issue	Designed	Drawn
04.01.18	RT	SF
A1 Scale	Checked	Approved
NTS	CB	SE

Drawing Number: 36382/2011/SD04

Revision: -

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TECHNICAL NOTE

Appendix C

MicroDrainage calculations

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	Foul Sewage (l/s/ha)	0.000	Min Design Depth for Optimisation (m)	1.200
M5-60 (mm)	18.800	Volumetric Runoff Coeff.	0.750	Min Vel for Auto Design only (m/s)	1.00
Ratio R	0.400	Add Flow / Climate Change (%)	30	Min Slope for Optimisation (1:X)	500
Maximum Rainfall (mm/hr)	100	Minimum Backdrop Height (m)	0.200		
Maximum Time of Concentration (mins)	30	Maximum Backdrop Height (m)	0.700		

Designed with Level Soffits

Network Design Table for Storm

« - 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)	Auto Design

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)

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Network Design Table 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)	Auto Design
S1.000	11.192	0.112	99.9	0.034	5.00	0.0	0.600	o	150	
S1.001	17.840	0.075	237.9	0.061	0.00	0.0	0.600	o	300	
S1.002	48.822	0.205	238.2	0.220	0.00	0.0	0.600	o	300	
S1.003	24.373	0.102	239.0	0.036	0.00	0.0	0.600	o	300	
S2.000	25.732	0.257	100.1	0.034	5.00	0.0	0.600	o	150	
S2.001	21.894	0.131	167.1	0.072	0.00	0.0	0.600	o	225	
S2.002	28.508	0.171	166.7	0.020	0.00	0.0	0.600	o	225	
S3.000	35.242	0.211	167.0	0.052	5.00	0.0	0.600	o	225	

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)
S1.000	65.02	5.19	39.987	0.034	0.0	0.0	1.8	1.01	17.8	7.8
S1.001	63.49	5.48	39.725	0.095	0.0	0.0	4.9	1.02	71.8	21.2
S1.002	59.69	6.28	39.650	0.314	0.0	0.0	15.2	1.01	71.7	66.1
S1.003	57.97	6.68	39.445	0.351	0.0	0.0	16.5	1.01	71.6«	71.6
S2.000	63.75	5.43	40.052	0.034	0.0	0.0	1.8	1.00	17.7	7.6
S2.001	61.95	5.79	39.720	0.106	0.0	0.0	5.3	1.01	40.1	23.1
S2.002	59.78	6.26	39.589	0.125	0.0	0.0	6.1	1.01	40.2	26.4
S3.000	62.97	5.58	39.629	0.052	0.0	0.0	2.7	1.01	40.1	11.6

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Network Design Table 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)	Auto Design
S4.000	9.240	0.116	79.7	0.027	5.00	0.0	0.600	o	150	
S4.001	7.844	0.078	100.6	0.030	0.00	0.0	0.600	o	150	
S1.004	12.617	0.033	382.3	0.115	0.00	0.0	0.600	o	450	
S1.005	5.238	0.014	385.0	0.000	0.00	0.0	0.600	o	450	
S1.006	4.099	0.011	372.6	0.005	0.00	0.0	0.600	o	450	
S1.007	11.614	0.030	385.0	0.000	0.00	0.0	0.600	o	450	
S1.008	25.246	0.066	385.0	0.000	0.00	0.0	0.600	o	450	
S1.009	4.162	0.011	385.0	0.000	0.00	0.0	0.600	o	450	

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)
S4.000	65.29	5.14	39.687	0.027	0.0	0.0	1.4	1.13	19.9	6.3
S4.001	64.59	5.27	39.571	0.057	0.0	0.0	3.0	1.00	17.7	13.0
S1.004	57.15	6.89	39.193	0.700	0.0	0.0	32.5	1.03	164.4	140.9
S1.005	56.81	6.97	39.110	0.700	0.0	0.0	32.5	1.03	163.8	140.9
S1.006	56.56	7.04	39.096	0.705	0.0	0.0	32.5	1.05	166.6	140.9
S1.007	55.83	7.22	39.085	0.705	0.0	0.0	32.5	1.03	163.8	140.9
S1.008	54.34	7.63	39.055	0.705	0.0	0.0	32.5	1.03	163.8	140.9
S1.009	54.10	7.70	38.989	0.705	0.0	0.0	32.5	1.03	163.8	140.9

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Network Design Table 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)	Auto Design
S1.010	1.461	0.004	385.0	0.000	0.00	0.0	0.600	o	450	

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)
S1.010	54.01	7.72	38.978	0.705	0.0	0.0	32.5	1.03	163.8	140.9

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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)
S2	41.200	1.213	Open Manhole	1200	S1.000	39.987	150				
S3	41.100	1.375	Sealed Manhole	1200	S1.001	39.725	300	S1.000	39.875	150	
S4	40.850	1.200	Sealed Manhole	1200	S1.002	39.650	300	S1.001	39.650	300	
S6	41.280	1.835	Open Manhole	1200	S1.003	39.445	300	S1.002	39.445	300	
S7	41.000	0.948	Open Manhole	1200	S2.000	40.052	150				
S8	41.322	1.602	Open Manhole	1200	S2.001	39.720	225	S2.000	39.795	150	
S9	41.233	1.644	Open Manhole	1200	S2.002	39.589	225	S2.001	39.589	225	
S1	41.075	1.446	Open Manhole	1200	S3.000	39.629	225				
S10	41.225	1.538	Open Manhole	1200	S4.000	39.687	150				
S11	41.325	1.754	Open Manhole	1200	S4.001	39.571	150	S4.000	39.571	150	
S12	41.300	2.107	Open Manhole	1350	S1.004	39.193	450	S1.003	39.343	300	
								S2.002	39.418	225	
								S3.000	39.418	225	
								S4.001	39.493	150	
S13	40.894	1.784	Open Manhole	1350	S1.005	39.110	450	S1.004	39.160	450	50
S13	40.880	1.784	Open Manhole	1350	S1.006	39.096	450	S1.005	39.096	450	
S13	40.867	1.782	Open Manhole	1350	S1.007	39.085	450	S1.006	39.085	450	
S14	40.839	1.784	Open Manhole	1350	S1.008	39.055	450	S1.007	39.055	450	
S15	40.812	1.823	Open Manhole	1350	S1.009	38.989	450	S1.008	38.989	450	

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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)
S16	40.812	1.834	Open Manhole	1350	S1.010	38.978	450	S1.009	38.978	450	
S17	40.250	1.276	Open Manhole	0		OUTFALL		S1.010	38.974	450	

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.034	0.034	0.034
1.001	User	-	100	0.061	0.061	0.061
1.002	User	-	100	0.021	0.021	0.021
	User	-	100	0.049	0.049	0.071
	User	-	100	0.022	0.022	0.092
	User	-	100	0.078	0.078	0.170
	User	-	100	0.035	0.035	0.205
	User	-	30	0.049	0.015	0.220
1.003	User	-	100	0.036	0.036	0.036
2.000	-	-	100	0.034	0.034	0.034
2.001	User	-	100	0.036	0.036	0.036
	User	-	100	0.036	0.036	0.072
2.002	User	-	100	0.008	0.008	0.008
	User	-	100	0.012	0.012	0.020
3.000	User	-	100	0.052	0.052	0.052
4.000	User	-	100	0.027	0.027	0.027
4.001	User	-	100	0.028	0.028	0.028
	User	-	100	0.002	0.002	0.030
1.004	User	-	100	0.019	0.019	0.019
	User	-	100	0.096	0.096	0.115
1.005	-	-	100	0.000	0.000	0.000
1.006	User	-	30	0.015	0.005	0.005
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
				0.750	0.705	0.705

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.010	S17	40.250	38.974	0.000	0	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	39.100	10	39.100	19	39.100	28	39.100	37	39.100	46	39.100	55	39.100	64	39.100	73	39.100
2	39.100	11	39.100	20	39.100	29	39.100	38	39.100	47	39.100	56	39.100	65	39.100	74	39.100
3	39.100	12	39.100	21	39.100	30	39.100	39	39.100	48	39.100	57	39.100	66	39.100	75	39.100
4	39.100	13	39.100	22	39.100	31	39.100	40	39.100	49	39.100	58	39.100	67	39.100	76	39.100
5	39.100	14	39.100	23	39.100	32	39.100	41	39.100	50	39.100	59	39.100	68	39.100	77	39.100
6	39.100	15	39.100	24	39.100	33	39.100	42	39.100	51	39.100	60	39.100	69	39.100	78	39.100
7	39.100	16	39.100	25	39.100	34	39.100	43	39.100	52	39.100	61	39.100	70	39.100	79	39.100
8	39.100	17	39.100	26	39.100	35	39.100	44	39.100	53	39.100	62	39.100	71	39.100	80	39.100
9	39.100	18	39.100	27	39.100	36	39.100	45	39.100	54	39.100	63	39.100	72	39.100	81	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
82	39.100	108	39.100	134	39.100	160	39.100	186	39.100	212	39.100	238	39.100	264	39.100	290	39.100
83	39.100	109	39.100	135	39.100	161	39.100	187	39.100	213	39.100	239	39.100	265	39.100	291	39.100
84	39.100	110	39.100	136	39.100	162	39.100	188	39.100	214	39.100	240	39.100	266	39.100	292	39.100
85	39.100	111	39.100	137	39.100	163	39.100	189	39.100	215	39.100	241	39.100	267	39.100	293	39.100
86	39.100	112	39.100	138	39.100	164	39.100	190	39.100	216	39.100	242	39.100	268	39.100	294	39.100
87	39.100	113	39.100	139	39.100	165	39.100	191	39.100	217	39.100	243	39.100	269	39.100	295	39.100
88	39.100	114	39.100	140	39.100	166	39.100	192	39.100	218	39.100	244	39.100	270	39.100	296	39.100
89	39.100	115	39.100	141	39.100	167	39.100	193	39.100	219	39.100	245	39.100	271	39.100	297	39.100
90	39.100	116	39.100	142	39.100	168	39.100	194	39.100	220	39.100	246	39.100	272	39.100	298	39.100
91	39.100	117	39.100	143	39.100	169	39.100	195	39.100	221	39.100	247	39.100	273	39.100	299	39.100
92	39.100	118	39.100	144	39.100	170	39.100	196	39.100	222	39.100	248	39.100	274	39.100	300	39.100
93	39.100	119	39.100	145	39.100	171	39.100	197	39.100	223	39.100	249	39.100	275	39.100	301	39.100
94	39.100	120	39.100	146	39.100	172	39.100	198	39.100	224	39.100	250	39.100	276	39.100	302	39.100
95	39.100	121	39.100	147	39.100	173	39.100	199	39.100	225	39.100	251	39.100	277	39.100	303	39.100
96	39.100	122	39.100	148	39.100	174	39.100	200	39.100	226	39.100	252	39.100	278	39.100	304	39.100
97	39.100	123	39.100	149	39.100	175	39.100	201	39.100	227	39.100	253	39.100	279	39.100	305	39.100
98	39.100	124	39.100	150	39.100	176	39.100	202	39.100	228	39.100	254	39.100	280	39.100	306	39.100
99	39.100	125	39.100	151	39.100	177	39.100	203	39.100	229	39.100	255	39.100	281	39.100	307	39.100
100	39.100	126	39.100	152	39.100	178	39.100	204	39.100	230	39.100	256	39.100	282	39.100	308	39.100
101	39.100	127	39.100	153	39.100	179	39.100	205	39.100	231	39.100	257	39.100	283	39.100	309	39.100
102	39.100	128	39.100	154	39.100	180	39.100	206	39.100	232	39.100	258	39.100	284	39.100	310	39.100
103	39.100	129	39.100	155	39.100	181	39.100	207	39.100	233	39.100	259	39.100	285	39.100	311	39.100
104	39.100	130	39.100	156	39.100	182	39.100	208	39.100	234	39.100	260	39.100	286	39.100	312	39.100
105	39.100	131	39.100	157	39.100	183	39.100	209	39.100	235	39.100	261	39.100	287	39.100	313	39.100
106	39.100	132	39.100	158	39.100	184	39.100	210	39.100	236	39.100	262	39.100	288	39.100	314	39.100
107	39.100	133	39.100	159	39.100	185	39.100	211	39.100	237	39.100	263	39.100	289	39.100	315	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
316	39.100	342	39.100	368	39.100	394	39.100	420	39.100	446	39.100	472	39.100	498	39.100	524	39.100
317	39.100	343	39.100	369	39.100	395	39.100	421	39.100	447	39.100	473	39.100	499	39.100	525	39.100
318	39.100	344	39.100	370	39.100	396	39.100	422	39.100	448	39.100	474	39.100	500	39.100	526	39.100
319	39.100	345	39.100	371	39.100	397	39.100	423	39.100	449	39.100	475	39.100	501	39.100	527	39.100
320	39.100	346	39.100	372	39.100	398	39.100	424	39.100	450	39.100	476	39.100	502	39.100	528	39.100
321	39.100	347	39.100	373	39.100	399	39.100	425	39.100	451	39.100	477	39.100	503	39.100	529	39.100
322	39.100	348	39.100	374	39.100	400	39.100	426	39.100	452	39.100	478	39.100	504	39.100	530	39.100
323	39.100	349	39.100	375	39.100	401	39.100	427	39.100	453	39.100	479	39.100	505	39.100	531	39.100
324	39.100	350	39.100	376	39.100	402	39.100	428	39.100	454	39.100	480	39.100	506	39.100	532	39.100
325	39.100	351	39.100	377	39.100	403	39.100	429	39.100	455	39.100	481	39.100	507	39.100	533	39.100
326	39.100	352	39.100	378	39.100	404	39.100	430	39.100	456	39.100	482	39.100	508	39.100	534	39.100
327	39.100	353	39.100	379	39.100	405	39.100	431	39.100	457	39.100	483	39.100	509	39.100	535	39.100
328	39.100	354	39.100	380	39.100	406	39.100	432	39.100	458	39.100	484	39.100	510	39.100	536	39.100
329	39.100	355	39.100	381	39.100	407	39.100	433	39.100	459	39.100	485	39.100	511	39.100	537	39.100
330	39.100	356	39.100	382	39.100	408	39.100	434	39.100	460	39.100	486	39.100	512	39.100	538	39.100
331	39.100	357	39.100	383	39.100	409	39.100	435	39.100	461	39.100	487	39.100	513	39.100	539	39.100
332	39.100	358	39.100	384	39.100	410	39.100	436	39.100	462	39.100	488	39.100	514	39.100	540	39.100
333	39.100	359	39.100	385	39.100	411	39.100	437	39.100	463	39.100	489	39.100	515	39.100	541	39.100
334	39.100	360	39.100	386	39.100	412	39.100	438	39.100	464	39.100	490	39.100	516	39.100	542	39.100
335	39.100	361	39.100	387	39.100	413	39.100	439	39.100	465	39.100	491	39.100	517	39.100	543	39.100
336	39.100	362	39.100	388	39.100	414	39.100	440	39.100	466	39.100	492	39.100	518	39.100	544	39.100
337	39.100	363	39.100	389	39.100	415	39.100	441	39.100	467	39.100	493	39.100	519	39.100	545	39.100
338	39.100	364	39.100	390	39.100	416	39.100	442	39.100	468	39.100	494	39.100	520	39.100	546	39.100
339	39.100	365	39.100	391	39.100	417	39.100	443	39.100	469	39.100	495	39.100	521	39.100	547	39.100
340	39.100	366	39.100	392	39.100	418	39.100	444	39.100	470	39.100	496	39.100	522	39.100	548	39.100
341	39.100	367	39.100	393	39.100	419	39.100	445	39.100	471	39.100	497	39.100	523	39.100	549	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
550	39.100	576	39.100	602	39.100	628	39.100	654	39.100	680	39.100	706	39.100	732	39.100	758	39.100
551	39.100	577	39.100	603	39.100	629	39.100	655	39.100	681	39.100	707	39.100	733	39.100	759	39.100
552	39.100	578	39.100	604	39.100	630	39.100	656	39.100	682	39.100	708	39.100	734	39.100	760	39.100
553	39.100	579	39.100	605	39.100	631	39.100	657	39.100	683	39.100	709	39.100	735	39.100	761	39.100
554	39.100	580	39.100	606	39.100	632	39.100	658	39.100	684	39.100	710	39.100	736	39.100	762	39.100
555	39.100	581	39.100	607	39.100	633	39.100	659	39.100	685	39.100	711	39.100	737	39.100	763	39.100
556	39.100	582	39.100	608	39.100	634	39.100	660	39.100	686	39.100	712	39.100	738	39.100	764	39.100
557	39.100	583	39.100	609	39.100	635	39.100	661	39.100	687	39.100	713	39.100	739	39.100	765	39.100
558	39.100	584	39.100	610	39.100	636	39.100	662	39.100	688	39.100	714	39.100	740	39.100	766	39.100
559	39.100	585	39.100	611	39.100	637	39.100	663	39.100	689	39.100	715	39.100	741	39.100	767	39.100
560	39.100	586	39.100	612	39.100	638	39.100	664	39.100	690	39.100	716	39.100	742	39.100	768	39.100
561	39.100	587	39.100	613	39.100	639	39.100	665	39.100	691	39.100	717	39.100	743	39.100	769	39.100
562	39.100	588	39.100	614	39.100	640	39.100	666	39.100	692	39.100	718	39.100	744	39.100	770	39.100
563	39.100	589	39.100	615	39.100	641	39.100	667	39.100	693	39.100	719	39.100	745	39.100	771	39.100
564	39.100	590	39.100	616	39.100	642	39.100	668	39.100	694	39.100	720	39.100	746	39.100	772	39.100
565	39.100	591	39.100	617	39.100	643	39.100	669	39.100	695	39.100	721	39.100	747	39.100	773	39.100
566	39.100	592	39.100	618	39.100	644	39.100	670	39.100	696	39.100	722	39.100	748	39.100	774	39.100
567	39.100	593	39.100	619	39.100	645	39.100	671	39.100	697	39.100	723	39.100	749	39.100	775	39.100
568	39.100	594	39.100	620	39.100	646	39.100	672	39.100	698	39.100	724	39.100	750	39.100	776	39.100
569	39.100	595	39.100	621	39.100	647	39.100	673	39.100	699	39.100	725	39.100	751	39.100	777	39.100
570	39.100	596	39.100	622	39.100	648	39.100	674	39.100	700	39.100	726	39.100	752	39.100	778	39.100
571	39.100	597	39.100	623	39.100	649	39.100	675	39.100	701	39.100	727	39.100	753	39.100	779	39.100
572	39.100	598	39.100	624	39.100	650	39.100	676	39.100	702	39.100	728	39.100	754	39.100	780	39.100
573	39.100	599	39.100	625	39.100	651	39.100	677	39.100	703	39.100	729	39.100	755	39.100	781	39.100
574	39.100	600	39.100	626	39.100	652	39.100	678	39.100	704	39.100	730	39.100	756	39.100	782	39.100
575	39.100	601	39.100	627	39.100	653	39.100	679	39.100	705	39.100	731	39.100	757	39.100	783	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
784	39.100	810	39.100	836	39.100	862	39.100	888	39.100	914	39.100	940	39.100	966	39.100	992	39.100
785	39.100	811	39.100	837	39.100	863	39.100	889	39.100	915	39.100	941	39.100	967	39.100	993	39.100
786	39.100	812	39.100	838	39.100	864	39.100	890	39.100	916	39.100	942	39.100	968	39.100	994	39.100
787	39.100	813	39.100	839	39.100	865	39.100	891	39.100	917	39.100	943	39.100	969	39.100	995	39.100
788	39.100	814	39.100	840	39.100	866	39.100	892	39.100	918	39.100	944	39.100	970	39.100	996	39.100
789	39.100	815	39.100	841	39.100	867	39.100	893	39.100	919	39.100	945	39.100	971	39.100	997	39.100
790	39.100	816	39.100	842	39.100	868	39.100	894	39.100	920	39.100	946	39.100	972	39.100	998	39.100
791	39.100	817	39.100	843	39.100	869	39.100	895	39.100	921	39.100	947	39.100	973	39.100	999	39.100
792	39.100	818	39.100	844	39.100	870	39.100	896	39.100	922	39.100	948	39.100	974	39.100	1000	39.100
793	39.100	819	39.100	845	39.100	871	39.100	897	39.100	923	39.100	949	39.100	975	39.100	1001	39.100
794	39.100	820	39.100	846	39.100	872	39.100	898	39.100	924	39.100	950	39.100	976	39.100	1002	39.100
795	39.100	821	39.100	847	39.100	873	39.100	899	39.100	925	39.100	951	39.100	977	39.100	1003	39.100
796	39.100	822	39.100	848	39.100	874	39.100	900	39.100	926	39.100	952	39.100	978	39.100	1004	39.100
797	39.100	823	39.100	849	39.100	875	39.100	901	39.100	927	39.100	953	39.100	979	39.100	1005	39.100
798	39.100	824	39.100	850	39.100	876	39.100	902	39.100	928	39.100	954	39.100	980	39.100	1006	39.100
799	39.100	825	39.100	851	39.100	877	39.100	903	39.100	929	39.100	955	39.100	981	39.100	1007	39.100
800	39.100	826	39.100	852	39.100	878	39.100	904	39.100	930	39.100	956	39.100	982	39.100	1008	39.100
801	39.100	827	39.100	853	39.100	879	39.100	905	39.100	931	39.100	957	39.100	983	39.100	1009	39.100
802	39.100	828	39.100	854	39.100	880	39.100	906	39.100	932	39.100	958	39.100	984	39.100	1010	39.100
803	39.100	829	39.100	855	39.100	881	39.100	907	39.100	933	39.100	959	39.100	985	39.100	1011	39.100
804	39.100	830	39.100	856	39.100	882	39.100	908	39.100	934	39.100	960	39.100	986	39.100	1012	39.100
805	39.100	831	39.100	857	39.100	883	39.100	909	39.100	935	39.100	961	39.100	987	39.100	1013	39.100
806	39.100	832	39.100	858	39.100	884	39.100	910	39.100	936	39.100	962	39.100	988	39.100	1014	39.100
807	39.100	833	39.100	859	39.100	885	39.100	911	39.100	937	39.100	963	39.100	989	39.100	1015	39.100
808	39.100	834	39.100	860	39.100	886	39.100	912	39.100	938	39.100	964	39.100	990	39.100	1016	39.100
809	39.100	835	39.100	861	39.100	887	39.100	913	39.100	939	39.100	965	39.100	991	39.100	1017	39.100

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1018	39.100	1039	39.100	1060	39.100	1081	39.100	1102	39.100	1123	39.100	1144	39.100	1165	39.100	1186	39.100
1019	39.100	1040	39.100	1061	39.100	1082	39.100	1103	39.100	1124	39.100	1145	39.100	1166	39.100	1187	39.100
1020	39.100	1041	39.100	1062	39.100	1083	39.100	1104	39.100	1125	39.100	1146	39.100	1167	39.100	1188	39.100
1021	39.100	1042	39.100	1063	39.100	1084	39.100	1105	39.100	1126	39.100	1147	39.100	1168	39.100	1189	39.100
1022	39.100	1043	39.100	1064	39.100	1085	39.100	1106	39.100	1127	39.100	1148	39.100	1169	39.100	1190	39.100
1023	39.100	1044	39.100	1065	39.100	1086	39.100	1107	39.100	1128	39.100	1149	39.100	1170	39.100	1191	39.100
1024	39.100	1045	39.100	1066	39.100	1087	39.100	1108	39.100	1129	39.100	1150	39.100	1171	39.100	1192	39.100
1025	39.100	1046	39.100	1067	39.100	1088	39.100	1109	39.100	1130	39.100	1151	39.100	1172	39.100	1193	39.100
1026	39.100	1047	39.100	1068	39.100	1089	39.100	1110	39.100	1131	39.100	1152	39.100	1173	39.100	1194	39.100
1027	39.100	1048	39.100	1069	39.100	1090	39.100	1111	39.100	1132	39.100	1153	39.100	1174	39.100	1195	39.100
1028	39.100	1049	39.100	1070	39.100	1091	39.100	1112	39.100	1133	39.100	1154	39.100	1175	39.100	1196	39.100
1029	39.100	1050	39.100	1071	39.100	1092	39.100	1113	39.100	1134	39.100	1155	39.100	1176	39.100	1197	39.100
1030	39.100	1051	39.100	1072	39.100	1093	39.100	1114	39.100	1135	39.100	1156	39.100	1177	39.100	1198	39.100
1031	39.100	1052	39.100	1073	39.100	1094	39.100	1115	39.100	1136	39.100	1157	39.100	1178	39.100	1199	39.100
1032	39.100	1053	39.100	1074	39.100	1095	39.100	1116	39.100	1137	39.100	1158	39.100	1179	39.100	1200	39.100
1033	39.100	1054	39.100	1075	39.100	1096	39.100	1117	39.100	1138	39.100	1159	39.100	1180	39.100		
1034	39.100	1055	39.100	1076	39.100	1097	39.100	1118	39.100	1139	39.100	1160	39.100	1181	39.100		
1035	39.100	1056	39.100	1077	39.100	1098	39.100	1119	39.100	1140	39.100	1161	39.100	1182	39.100		
1036	39.100	1057	39.100	1078	39.100	1099	39.100	1120	39.100	1141	39.100	1162	39.100	1183	39.100		
1037	39.100	1058	39.100	1079	39.100	1100	39.100	1121	39.100	1142	39.100	1163	39.100	1184	39.100		
1038	39.100	1059	39.100	1080	39.100	1101	39.100	1122	39.100	1143	39.100	1164	39.100	1185	39.100		

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.500
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	2	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	18.800	Cv (Summer)	0.750
Return Period (years)	100	Ratio R	0.400	Cv (Winter)	0.840
Region	England and Wales	Profile Type	Summer	Storm Duration (mins)	30

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Online Controls for Storm

Hydro-Brake Optimum® Manhole: S15, DS/PN: S1.009, Volume (m³): 6.4

Unit Reference	MD-SHE-0098-5000-1500-5000	Diameter (mm)	98
Design Head (m)	1.500	Invert Level (m)	38.989
Design Flow (l/s)	5.0	Minimum Outlet Pipe Diameter (mm)	150
Flush-Flo™	Calculated	Suggested Manhole Diameter (mm)	1200
Objective	Minimise upstream storage		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	Mean Flow over Head Range	-	4.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	0.600	4.8	1.600	5.1	2.600	6.5	5.000	8.8	7.500	10.7
0.200	4.4	0.800	4.3	1.800	5.4	3.000	6.9	5.500	9.2	8.000	11.0
0.300	4.8	1.000	4.1	2.000	5.7	3.500	7.4	6.000	9.6	8.500	11.3
0.400	4.9	1.200	4.5	2.200	6.0	4.000	7.9	6.500	10.0	9.000	11.6
0.500	4.9	1.400	4.8	2.400	6.2	4.500	8.4	7.000	10.3	9.500	11.9

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Non Return Valve Manhole: S16, DS/PN: S1.010, Volume (m^3): 3.1

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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: S1.003

Invert Level (m) 39.442 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	250.0	0.0	0.800	250.0	0.0	0.801	0.0	0.0

Cellular Storage Manhole: S13, DS/PN: S1.005

Invert Level (m) 39.155 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	150.0	0.0	0.800	150.0	0.0	0.801	0.0	0.0

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TECHNICAL NOTE

Appendix D

Environment Agency response

creating a better place

Environment Agency

Our ref:	WA/2015/119569/02-L01
Your ref:	141944/REG3
Date:	28 April 2015

Reading Borough Council
Development Control
PO Box 17
Reading
Berkshire
RG1 7TD

Dear Ms A Amoah

Construction of a new railway station, bus interchange, multi-storey car park (park and rise facility), short stay car park, taxi drop-off, disable parking facility, station access road from Longwater Avenue, landscaping and associated works. Land West Of Longwater Avenue, Reading, RG2 6GP.

I refer to the email dated 27 March 2015 from Peter Brett Associates (PBA) regarding the above site.

The email includes:

-27159_001_020 - Green Park Scheme Overview
-28791_002_402 - Flood compensation scheme
-28791 - Green Park Flood Management Strategy_TN01_March15
-LFP_Axiom4_Foudry Brook Flood Storage Proposals
-PBA Foudry Brook Report - Proposed New Channel Tech Report B&W

Environment Agency position

We have reviewed the submitted information and we are able to **withdraw our objections** on flood risk grounds subject to the following conditions being imposed on any planning permission granted:

1) Condition: Development shall not begin until a surface water drainage scheme for this phase of work, based on the agreed Flood Risk Assessment has been submitted to and approved in writing by the local planning authority. The scheme shall subsequently be implemented in accordance with the approved details before the scheme is completed.
The scheme should allow for:

- The drainage design will be designed in accordance with the new Defra technical guidance for sustainable drainage systems.
- Run off rates will be limited to Greenfield rates and the discharges volumes will be

Cont/d..

limited by either utilising infiltration drainage or where this is not practical the runoff rate will be limited to Qbar of 2l/s/ha and additional attenuation provided to ensure no increase in flood risk downstream.

Reason: To prevent the increased risk of flooding, to improve and protect water quality, improve habitat and amenity, and ensure future maintenance of the surface water drainage system.

2) Condition: Prior to occupation of any part of the permitted development, a verification report demonstrating completion of the works set out in the approved remediation strategy and the effectiveness of the remediation shall be submitted to and approved, in writing, by the local planning authority. The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan to demonstrate that the site remediation criteria have been met. It shall also include any plan (a “long-term monitoring and maintenance plan”) for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action, as identified in the verification plan, and for the reporting of this to the local planning authority.

Reasons: This site is located over Beenham Grange Gravel Member (River Terrace Deposits) over Lambeth Group (both Secondary A Aquifers) and the Newhaven and Seaford Chalk (Principal Aquifer) and we need to protect these aquifers fro contamination that potentially could be mobilised during development.

3) Condition: If, during development, contamination not previously identified is found to be present at the site then no further development (unless otherwise agreed in writing with the Local Planning Authority) shall be carried out until the developer has submitted, and obtained written approval from the Local Planning Authority for, an amendment to the remediation strategy detailing how this unsuspected contamination shall be dealt with.

Reason: Part of this site was historically a waste transfer station and infilling has been undertaken along the perimeter of the Trout Lakes, therefore there is the potential for unsuspected contamination to be encountered during development. Any visual or olfactory contamination encountered should be dealt with in an appropriate manner in order to protect the aquifers below the site (Secondary A Aquifers in the River Terrace Deposits and Lambeth Group and the Principal Aquifer in the Chalk).

4) Condition: The development hereby permitted shall not be commenced until such time as a scheme to dispose of surface water (that should ensure that no soakaways are constructed in contaminated land) has been submitted to, and approved in writing by, the local planning authority. The scheme shall be implemented as approved.

Reason: There is a know hotspot of soils contamination in the made ground on this site and infiltration drainage methods would increase the mobilisation of contamination into the aquifers below the site.

5) Condition: Piling or any other foundation designs using penetrative methods shall not be permitted other than with the express written consent of the Local Planning Authority, which may be given for those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to groundwater.

Reasons: The conclusions of the PBA Technical Note dated 24 October 2014 considers protection of controlled waters and states that adoption of an appropriate piling technique will minimise creation of preferential pathways. We need assurance that

piles will terminate at the previously agreed level of 6 m above the surface of the Chalk.

Advice to LPA and applicant about flood risk

Surface water control measures

PBA has confirmed the drainage design will be designed in accordance with the new Defra technical guidance for sustainable drainage systems. PBA have confirmed commitment to provide a drainage system meeting these requirements.

Loss of flood plain storage

The site lies within Flood Zone 3a/2 defined by the Planning Practice Guidance as having a high / medium probability of flooding. PBA has provided additional information confirming the background history about this development and design strategies being used. With this information we are prepared to remove this objection.

Explanation

The documentation provided has confirmed that flood risk has been assessed for the site and flood mitigation by way of 'level for level' compensation has been provided in line with earlier agreements.

PBA have clarified there will be limited impact on flood risk in flood zone 3a with this phase of the construction of Green Park. This phase of work has already been accounted for in the mitigation. This phase of work is also providing additional flood compensation with the work on the lake providing flood storage.

It has been noted that this compensation for loss of flood plain storage is based on the best information available at the time which dates back several years and is based on studies from 1985. We would highlight the following points following this review:

· The Environment Agency has not reviewed the model produced by PBA in 2007. We cannot comment on any assumptions made, accuracy of the results and benefits this scheme provides.
· Encroachment of the flood plain by the access road and car parks is relatively small. PBA confirmed this has been identified and allowed for during the initial design of the flood compensation area.
· There have been various developments outside this site boundary which may affect flood risk on watercourses'. These watercourses may influence flood risk on this development.
· Due to changes in flood risk strategies and modelling techniques, more up to date modelling may be required to ensure the model is still valid.
· Future development on this site may require an up to date model. This should confirm the existing flood risk, the compensation provides the benefits suggested and account for other development in the area that would affect flood risk.

Low hazard access and egress

The FRA sets out that the route of access from the development is a very low hazard in accordance with FD2320 (Flood Risk Assessment Guidance for New Developments). The access and egress extends to an area outside of the 1 in 100 year with an allowance for climate change floodplain.

Please note, whilst the applicant has demonstrated the access is a very low hazard during the design flood level (the 1 in 100 plus climate change), during more extreme events the access route may have a greater hazard.

Given the nature of this development, we would recommend the applicant/ local authority may wish to develop a flood plan for emergency situations. Issues to cover may include the availability of flood warnings, duration of flooding, depth of flooding and the length of the evacuation route. It is not our role to review and assess evacuation plans or flood management plans, therefore the applicability and requirements of any site specific flood plan should be discussed with the Local Authority.

Advice for condition 2 – Verification Report

We have reviewed the PBA Technical Note dated 24 October 2014, which summarises the investigations carried out on this site. We agree with the conclusions of this Technical Note that "hot spot" remediation of ground in the vicinity of WS8 is required and that site wide mitigation measures should be incorporated in to the development design.

Advice to applicant - Foul drainage

All sewage or trade effluent should be discharged to the foul sewer if available subject to the approval of Thames Water Utilities or its sewerage agent.

The developer should ensure early negotiations are made with the local sewerage provider to ensure that there are no capacity issues generated by this development's connection to the local foul sewer.

Advice to applicant - Waste

The Environmental Protection (Duty of Care) Regulations 1991 for dealing with waste materials are applicable for any off-site movements of wastes. The developer as waste producer therefore has a duty of care to ensure all materials removed go to an appropriate permitted facility and all relevant documentation is completed and kept in line with regulations.

If any waste is to be used onsite, the applicant will be required to obtain the appropriate waste exemption or permit from us. We are unable to specify what exactly would be required if anything, due to the limited amount of information provided.

The developer must apply the waste hierarchy in a priority order of prevention, re-use, recycling before considering other recovery or disposal options.

Advice to applicant- Pollution prevention

It is suggested that larger areas of hard standing e.g. walkways/car-parking are constructed following the recommendations set out in Sustainable Urban Drainage Systems guidance. This can be continued with designs for open space and landscaping within the area. The use of SUDS can attenuate the disposal of water and reduce the impact of pollutants to nearby watercourses.

We advise you to consult Pollution Prevention Guidance 6 relating to the use of oil interceptors for discharges from car parking areas. Clean roof water should not pass through the oil separator. Where soakaways are used it should preferably not discharge

to soakaways used to drain road and vehicle parking areas. Roof water downpipes should be connected to the drainage system either directly, or by means of back inlet gullies provided with sealing plates instead of open gratings.

Following the good practice described does not remove your obligation to comply with relevant legislation and to prevent pollution from your site. Pollution of the environment is a criminal offence and compliance with one or more Guidance Note is not a defence to such offences.

Yours sincerely

Ms Michelle Kidd
Planning Advisor

Direct dial 01491 828455
Direct e-mail planning-wallingford@environment-agency.gov.uk

cc Peter Brett Associates

End

Appendix B

Calculations

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	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	18.800	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.400	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table 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)	Section Type	Auto Design
S1.000	59.352	0.380	156.2	0.030	10.00	0.0	0.600	o	150	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)
S1.000	44.31	11.23	39.600	0.030	0.0	0.0	0.0	0.80	14.2	3.6

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Network Design Table 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)	Section Type	Auto Design
S1.001	11.769	0.950	12.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	9.771	0.049	200.0	0.008	0.00	0.0	0.600	|_|	300	Ditch	
S1.003	13.777	0.069	200.0	0.015	0.00	0.0	0.600	|_|	300	Ditch	
S1.004	24.623	0.123	200.0	0.011	0.00	0.0	0.600	|_|	300	Ditch	
S1.005	16.115	0.081	200.0	0.008	0.00	0.0	0.600	|_|	300	Ditch	
S1.006	40.786	0.204	199.9	0.000	0.00	0.0	0.600	|_|	300	Ditch	
S1.007	25.836	0.129	200.0	0.000	0.00	0.0	0.600	|_|	300	Ditch	
S1.008	66.691	0.333	200.0	0.000	0.00	0.0	0.600	|_|	300	Ditch	

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)
S1.001	44.16	11.30	39.220	0.030	0.0	0.0	0.0	2.88	50.9	3.6
S1.002	43.90	11.42	38.120	0.038	0.0	0.0	0.0	1.33	119.8	4.5
S1.003	43.54	11.60	38.071	0.053	0.0	0.0	0.0	1.33	119.8	6.2
S1.004	42.91	11.91	38.002	0.064	0.0	0.0	0.0	1.33	119.8	7.4
S1.005	42.51	12.11	37.879	0.072	0.0	0.0	0.0	1.33	119.8	8.3
S1.006	41.53	12.62	37.799	0.072	0.0	0.0	0.0	1.33	119.8	8.3
S1.007	40.94	12.94	37.595	0.072	0.0	0.0	0.0	1.33	119.8	8.3
S1.008	39.50	13.78	37.465	0.072	0.0	0.0	0.0	1.33	119.8	8.3

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.030	0.030	0.030
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.008	0.008	0.008
1.003	-	-	100	0.015	0.015	0.015
1.004	-	-	100	0.011	0.011	0.011
1.005	-	-	100	0.008	0.008	0.008
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.072	0.072	0.072

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)
S1.008	S	40.000	37.132	37.100	0	0

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	18.800	Cv (Summer)	0.750
Return Period (years)	2	Ratio R	0.400	Cv (Winter)	0.840
Region	England and Wales	Profile Type	Summer	Storm Duration (mins)	30

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

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100, 101
Climate Change (%) 0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S_CP1	30 Winter	1	+0%					39.643	-0.107	0.000	0.18		2.5	OK
S1.001	S_CP2	30 Winter	1	+0%					39.242	-0.128	0.000	0.05		2.5	OK
S1.002	SDI_2	30 Winter	1	+0%					38.137	-1.863	0.000	0.01		3.1	OK

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

PN	US/MH Name	Level Exceeded
S1.000	S_CP1	
S1.001	S_CP2	
S1.002	SDI_2	

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1 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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.003	SDI_3	30 Winter	1	+0%					38.092	-1.908	0.000	0.01		4.3	OK
S1.004	SDI_4	30 Winter	1	+0%					38.027	-1.973	0.000	0.01		5.3	OK
S1.005	SDI_5	30 Winter	1	+0%					37.907	-2.094	0.000	0.01		6.0	OK
S1.006	S6	30 Winter	1	+0%					37.825	-2.174	0.000	0.01		6.0	OK
S1.007	S7	30 Winter	1	+0%					37.620	-2.379	0.000	0.01		6.0	OK
S1.008	S8	30 Winter	1	+0%					37.499	-2.502	0.000	0.00		6.0	OK

PN	US/MH Name	Level Exceeded
S1.003	SDI_3	
S1.004	SDI_4	
S1.005	SDI_5	
S1.006	S6	
S1.007	S7	
S1.008	S8	

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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 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100, 101
Climate Change (%) 0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S_CP1	30 Winter	30	+0%					39.671	-0.079	0.000	0.45		6.2	OK
S1.001	S_CP2	30 Winter	30	+0%					39.256	-0.114	0.000	0.13		6.2	OK
S1.002	SDI_2	30 Winter	30	+0%					38.161	-1.839	0.000	0.01		7.5	OK

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

PN	US/MH Name	Level Exceeded
S1.000	S_CP1	
S1.001	S_CP2	
S1.002	SDI_2	

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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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.003	SDI_3	30 Summer	30	+0%					38.123	-1.877	0.000	0.02		11.0	OK
S1.004	SDI_4	30 Summer	30	+0%					38.063	-1.937	0.000	0.02		14.0	OK
S1.005	SDI_5	30 Summer	30	+0%					37.946	-2.054	0.000	0.02		16.2	OK
S1.006	S6	30 Summer	30	+0%					37.865	-2.134	0.000	0.02		16.1	OK
S1.007	S7	30 Summer	30	+0%					37.661	-2.338	0.000	0.02		16.2	OK
S1.008	S8	30 Summer	30	+0%					37.539	-2.462	0.000	0.01		15.9	OK

PN	US/MH Name	Level Exceeded
S1.003	SDI_3	
S1.004	SDI_4	
S1.005	SDI_5	
S1.006	S6	
S1.007	S7	
S1.008	S8	

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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 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100, 101
Climate Change (%) 0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S_CP1	30 Winter	100	+0%					39.683	-0.067	0.000	0.58		8.1	OK
S1.001	S_CP2	30 Winter	100	+0%					39.262	-0.108	0.000	0.18		8.1	OK
S1.002	SDI_2	30 Winter	100	+0%					38.172	-1.828	0.000	0.02		9.7	OK

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

PN	US/MH Name	Level Exceeded
S1.000	S_CP1	
S1.001	S_CP2	
S1.002	SDI_2	

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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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.003	SDI_3	30 Summer	100	+0%					38.134	-1.866	0.000	0.02		14.4	OK
S1.004	SDI_4	30 Summer	100	+0%					38.076	-1.925	0.000	0.02		18.3	OK
S1.005	SDI_5	30 Summer	100	+0%					37.960	-2.040	0.000	0.03		21.2	OK
S1.006	S6	30 Summer	100	+0%					37.879	-2.120	0.000	0.02		21.1	OK
S1.007	S7	30 Summer	100	+0%					37.675	-2.324	0.000	0.02		21.3	OK
S1.008	S8	30 Summer	100	+0%					37.551	-2.449	0.000	0.02		20.9	OK

PN	US/MH Name	Level Exceeded
S1.003	SDI_3	
S1.004	SDI_4	
S1.005	SDI_5	
S1.006	S6	
S1.007	S7	
S1.008	S8	

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

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100, 101
Climate Change (%) 0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S_CP1	30 Winter	101	+40%					39.705	-0.045	0.000	0.82		11.3	FLOOD RISK
S1.001	S_CP2	30 Winter	101	+40%					39.270	-0.100	0.000	0.25		11.3	OK
S1.002	SDI_2	30 Winter	101	+40%					38.187	-1.813	0.000	0.02		13.7	OK

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

PN	US/MH Name	Level Exceeded
S1.000	S_CP1	
S1.001	S_CP2	
S1.002	SDI_2	

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101 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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.003	SDI_3	30 Summer	101	+40%					38.151	-1.849	0.000	0.03		20.2	OK
S1.004	SDI_4	30 Summer	101	+40%					38.096	-1.905	0.000	0.03		25.8	OK
S1.005	SDI_5	30 Summer	101	+40%					37.982	-2.018	0.000	0.04		29.9	OK
S1.006	S6	30 Summer	101	+40%					37.901	-2.098	0.000	0.03		29.7	OK
S1.007	S7	30 Summer	101	+40%					37.698	-2.302	0.000	0.03		29.9	OK
S1.008	S8	30 Summer	101	+40%					37.571	-2.430	0.000	0.02		29.3	OK

PN	US/MH Name	Level Exceeded
S1.003	SDI_3	
S1.004	SDI_4	
S1.005	SDI_5	
S1.006	S6	
S1.007	S7	
S1.008	S8	

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Appendix C

Ordinary Watercourse Consent

LLFA Ordinary Watercourse Consent

Land Drainage Act 1991

Name

Derek Neupauer – West Berkshire Council

Consent applying to

Realignment and installation of 6 new outfalls into existing ditch

Consent Number

OWC/19/004

Effective from

24/07/2019

Introduction

This Note does not form part of the Certificate of Authorisation.

West Berkshire Council Land Drainage Consents are required by virtue of the Land Drainage Act 1991. The following activities on an Ordinary (non-main) Watercourse require Local Authority Consent:

under Section 23 of the Land Drainage Act 1991

- the erection or alteration of any mill dam, weir or other like obstruction to the flow of any watercourse
- the erection or alteration of any culvert that would be likely to affect the flow of any watercourse

under Sections 17 and 20(2) of the Land Drainage Act 1991

- Any drainage works carried out by a local authority against flooding in connection with any watercourse

under Section 61F Land Drainage Act 1991 (Inserted by Schedule 22 Environment Act 1995)

- the operation of any drainage works, under the control of any Internal Drainage Board or local authority, so as to manage the level of water in a watercourse for the purposes of facilitating spray irrigation.

Note: Consent under the above legislation is required irrespective of whether the works are permanent or temporary.

Contraventions

In relation to Ordinary Watercourses, the authority can under Section 24 of the Land Drainage Act 1991 serve a legal notice requiring the person to abate the nuisance within a specified time. Failure to abide by such a notice can result in West Berkshire Council carrying out the necessary remedial work and seeking to recover costs.

Land Drainage Act 1991

Land Drainage Consent

Control of works affecting watercourses and/or flood defences

Consent number **OWC/19/004**

To: **Charles Bennett**

The LLFA (West Berkshire Council), in exercise of its powers under **Section 23** of the Land Drainage Act 1991 and subject to the conditions attached, hereby grants its consent in relation to the works or operations described in this Consent.

Watercourse: **Un-named watercourse**

Location: **Green Park Station Reading**

Map reference: **469506 E** **170230 N**

Description of works: **New railway station - Reading Green Park. Drainage from the western platform is to discharge into the ditch.**

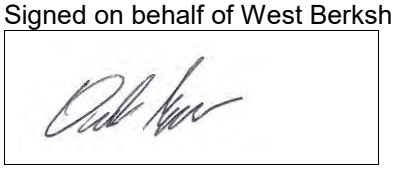
as detailed on plans and sections:

- Drg Ref **139787-ARP-RG-ST-DR-D-000001**

The ditch is also to be realigned to suit the platform location.
West Berkshire Council does not accept any responsibility for the design and construction of the works referred hereto and any liability for any loss or damage which may arise out of their design, construction, maintenance or use.
This Consent shall come into effect on

Date: 24/07/2019

Signed on behalf of West Berkshire Council



Derek Neupauer
Project Engineer

Date of signing

24/07/2019

Conditions

This consent is granted with the following conditions:

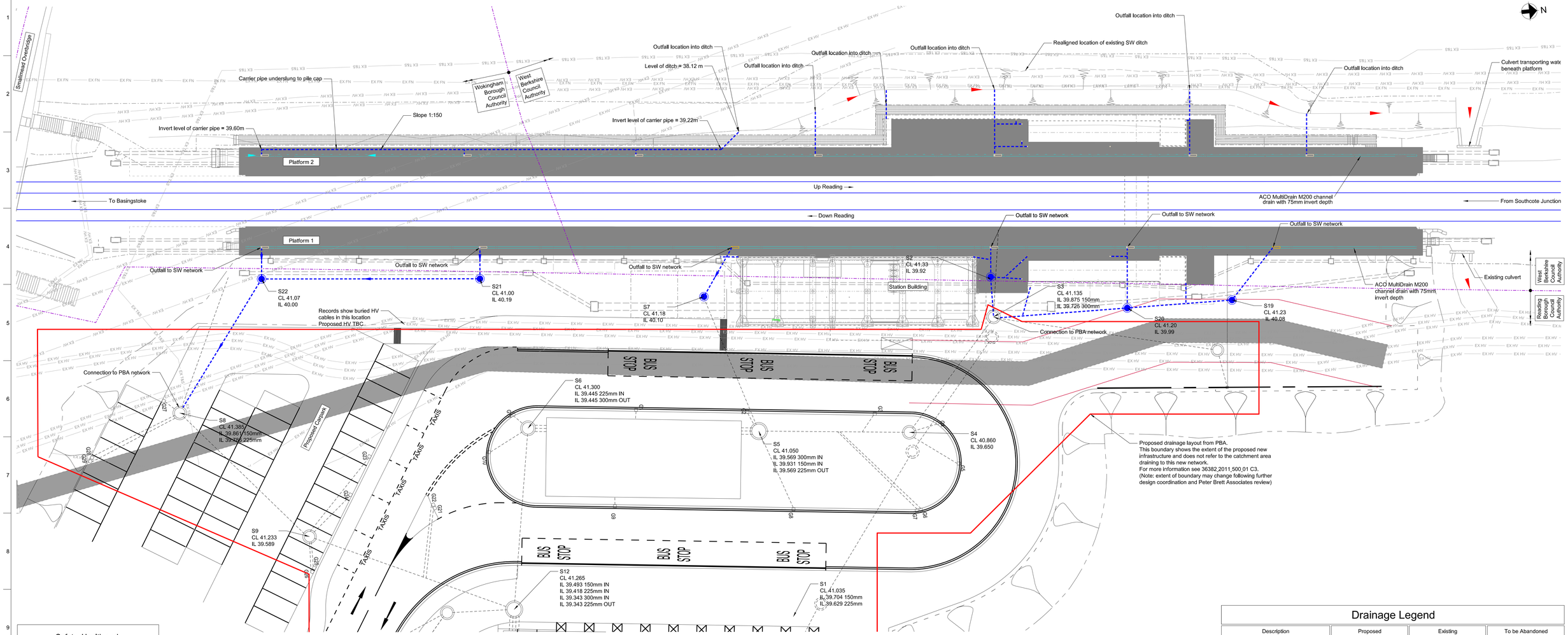
- *Works to take place in accordance with the approved drawings listed above.*

- *Ensure no pollution occurs to existing watercourse. Any incident of pollution shall be dealt with immediately and the appropriate Authority notified in accordance with current legislation*

Appendix D

Drainage Strategy Drawing

A1+1



Reading Green Park Proposed Station (ch. 62577.13m) - Drainage Layout

Scale 1:200

Safety, Health and Environmental Information

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, special attention should be given to:

Buried HV Electric Cables - Contractor to confirm location and depth with intrusive survey prior to construction. Contractor to identify appropriate safe methods of working.

Drainage Legend

Description	Proposed	Existing	To be Abandoned
Private Surface Water Sewer & Manhole	S1.1	S1.1(X) F1.1(X)	
Linear Drainage Channel			
Linear Drainage Outlet			
PBA Drainage Boundary			
Green Park Interchange Drainage			

Note: extent of boundary may change following further design coordination and Peter Brett Associates review

Notes:

01. This drawing is to be read in conjunction with all relevant Engineers drawings, reports and specifications.
02. Any discrepancies in the information provided should be immediately reported to the Engineer prior to the commencement of work.
03. All levels are shown in metres above Ordnance Datum (mAOD) unless noted otherwise.
04. All dimensions are in metres unless noted otherwise.
05. Do not scale from this drawing, only figured dimensions and levels to be used.
06. Chainage datum is 62764.4m at the 39m mile post. Chainage references presented on the layout are measured along the proposed Up Reading centreline in metres.
07. Green Park Interchange drainage shown for information only. Refer to PBA drawings for construction information.
08. All pipes where cover to soffit of pipe is less than 750mm are to be surrounded in concrete. Refer to Drainage Details drawings for requirements.
09. This schedule shows manhole to manhole connections only and does not include connections from gullys, linear drainage or building drainage. Please refer to the layout plans for these connections.
10. Refer to Drainage Details drawing for Manhole Types in accordance with Sewers for Adoption.
11. Cover Grade refers to BS EN 124:2015 Gully tops and manhole tops for vehicular and pedestrian areas.
12. Coordinates should be cross checked against the location shown on plan drawings. Any discrepancies should be clarified with the Engineer prior to construction.
13. Extent of SSE diversion ducting and easement based on information supplied by PBA on 17/07/2019 in drawing 36382/2002/SK079 Rev C. Contractor to ensure that they are working to the latest position of SSE duct route and observe any restrictions imposed by SSE.

General Legend:

- Local Authority Boundary
- Existing track to be modified. Refer to drawing 158989-ARP-RG-ST-DR-R-000001 for details
- S1 Survey Station
- SSE Restrictive Easement zone, refer to PBA drawing 36382_2002_SK079

Rev	Date	Description	By	Chkd	Appd	Auth
B01	08/08/19	Issued with drainage report	SJ	MC	MC	—

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Principal Contractor
Balfour Beatty

Project Title
READING GREEN PARK STATION

Drawing Title
Proposed Surface Water Drainage Layout

Scale at A1: N/A			Arup Job No: 260708-00
Role: Drainage, Highways Engineer			
Suitability: S2 - Suitable for Information			
Rev: B01	By: SJ	Chkd: MC	Appd: MC	Auth: —
	Date: 08/08/19	Date: 08/08/19	Date: 08/08/19	Date: —

Name: 158989 - ARP - RG - ST - DR - D - 000001
Project | Originator | Volume | Location | Type | Role | Number

Do not scale

© Arup

pw:\\MCCNTS\04.global.arup.com:PW_ARUP_UK_2\Documents\Reading Green Park Station\01 Arup\D - Drainage, Highway Engineer\DR - Drawings\158989-ARP-RG-ST-DR-D-000001