RIDGE

BICESTER HERITAGE
NEW TECHNICAL SITE

DRAINAGE DESIGN, MANAGEMENT AND MAINTENANCE REPORT

01 November 2019

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01 November 2019

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VERSION CONTROL

VERSION	DATE	DESCRIPTION	CREATED BY	REVIEWED BY
1.0	09/07/2019	Issue for Discharge of Planning Conditions 7 and 26	MG	SW
2.0	20/08/2019	Updated to reflect LLFA comments	MG	SW
3.0	03/09/2019	Microdrainage Network Drainage model revised to incorporate the attenuation basin	MG	SW
4.0	01/11/2019	Management and Maintenance plan updated to include maintenance of swales/ditches	MG	SW

CONTENTS

1. INTRODUTION 4
2. SURFACE WATER DRAINAGE (CONDITION 7) 6
2.1. SUDs Management and Maintenance plan 9
3. FOUL WATER DRAINAGE (CONDITION 26) 13
APPENDIX A – CIVIL ENGINEERING DRAWINGS 15
APPENDIX B – MICRODRAINAGE NETWORK CALCULATIONS 16
APPENDIX C – MICRODRAINAGE SOURCE CONTROL CALCULATIONS 17
APPENDIX D – GEO INTEGRITY SITE INVESTIGATION REPORT 18
APPENDIX E – GREENFIELD RUN-OFF RATES 19
APPENDIX F – GEO-INTEGRITY LETTER TO EA RE. GROUNDWATER TESTING 20
APPENDIX G – MICRODRAINAGE CASCADE MODEL – EXISTING POND 21
APPENDIX H – FOUL PUMPING CHAMBER SPECIALIST QUOTATION 22
APPENDIX I – COMMUNICATION WITH THAMES WATER 23

1. INTRODUTION

The Bicester Heritage New Technical Site development comprises of 8 new commercial units which are located in the south west corner of the former RAF Bicester airfield, Bicester, Oxfordshire. The new units are named the 'New Technical Site' and shall be the base for an extension to the existing engineering, sales, office and apprenticeship hub, providing much needed space for skilled businesses in the historic motoring arena.

The development has a resolution to grant planning. Planning ref: (18/01333/F). This report provides the additional information requested by the Lead Local Flood Authority, Oxfordshire County Council (Condition 7 Surface Water Management, refer to Section 2) and Thames Water (Condition 26 Waste Water Upgrades, refer to Section 3), for the discharge of the planning conditions.

Conditions 7 is a pre-commencement condition which relates to the management of surface water on the proposed development. The Condition is as follows:

> *"No development shall take place until a surface water drainage scheme for the site, based on sustainable drainage principles and an assessment of the hydrological and hydro-geological context of the development, 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 development is completed. The scheme shall include:*
>
> - *Infiltration to BRE 365 (Seasonal monitoring of groundwater levels at the site)*
> - *SUDS (Swale, Underground Geo-Cellular Soakaway, Permeable Paving)*
> - *Maintenance and management of SUDS features (To include provision of a SuDS Management and Maintenance Plan)*
> - *Detailed drainage layout with pipe numbers*
> - *Network drainage calculations*
> - *Flood Flow Routing in exceedance conditions*
> - *To prevent any potential contamination of groundwater, details of a scheme of soil/ leachate testing below and within the vicinity of any infiltration device*
> - *Details of any mitigation that is required to prevent contamination to ground-water below or surrounding any proposed infiltration device (after soil / leachate testing)*
>
> *Reason: To ensure that the development is served by sustainable arrangements for the disposal of surface water, to comply with Policy ESD6 of the Cherwell Local Plan 2011 – 2031 Part 1, Saved Policy ENV1 of the Cherwell Local Plan 1996 and Government advice in the National Planning Policy Framework. This information is required prior to commencement of the development as it is fundamental to the acceptability of the scheme."*

Condition 26 is a pre-occupation condition which relates to the wastewater flow rates from the development which has been stipulated due to the limited capacity in the Thames Water foul sewage network in Bicester. The condition is as follows:

> *"No buildings shall be bought into use until confirmation has been provided that either:- all wastewater network upgrades required to accommodate the additional flows from the development have been completed; or an infrastructure phasing plan has been agreed with Thames Water to allow additional business units to first be bought into use. Where an infrastructure phasing plan is agreed no use of the business units shall take place other than in accordance with the agreed infrastructure phasing plan.*

Reason - The development may lead to sewage flooding and network reinforcement works are anticipated to be necessary to ensure that sufficient capacity is made available to accommodate additional flows anticipated from the new development. Any necessary reinforcement works will be necessary in order to avoid sewer flooding and/or potential pollution incidents."

The following Civil Engineering drawings have been prepared to support this report and can be found in Appendix A:

- 5002855-RDG-XX-ST-PL-C-0501 Foul and Surface Water Drainage Layout Sheet 1 of 2
- 5002855-RDG-XX-ST-PL-C-0502 Foul and Surface Water Drainage Layout Sheet 2 of 2
- 5002855-RDG-XX-XX-SC-C-0503 Foul and Surface Water Drainage Schedules
- 5002855-RDG-XX-ST-PL-C-0504 Surface Water Exceedance Flood Flow Routing
- 5002855-RDG-XX-ST-PL-C-0505 Existing Surface run-off Catchment
- 5002855-RDG-XX-XX-DT-C-0510 Foul and Surface Water Drainage Construction Details Sheet 1 of 2
- 5002855-RDG-XX-XX-DT-C-0511 Foul and Surface Water Drainage Construction Details Sheet 2 of 2
- 5002855-RDG-XX-XX-DT-C-0512 Surface Water Attenuation Basin Layout
- 5002855-RDG-XX-ST-PL-C-0601 Site Levels Layout Sheet 1 of 2
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- 5002855-RDG-XX-XX-SE-C-0604 Road Alignment Long Sections
- 5002855-RDG-XX-XX-DT-C-0710 Surface Finishes Construction Details

2. SURFACE WATER DRAINAGE (CONDITION 7)

The surface water drainage strategy prepared by AKS Ward to support the planning application utilised multiple cellular soakaway structures combined with infiltration swales. Ridge were appointed to progress the drainage design for Tender issue.

A review of the AKS proposals found that the soakaway structures were not compliant with the 5 metre rule from Building regulations, the overarching strategy was complex and there were concerns that the depth of soakaway structures would be too close to the groundwater level.

It was felt that the design could be simplified by incorporating a single SUDs feature to the east of the development, the sites low point, to manage the surface water run-off. The simplified design was submitted as an addendum to the planning application.

The surface water drainage design taken forward for the discharge of planning conditions replicates the simplified strategy discussed above. The impermeable roofs, road and service areas all drain via a network of pipes to an attenuation basin to the east of the development which then discharges to the adjacent ditch to greenfield run-off rates.

The site is underlain by cornbrash formation which offers an acceptable infiltration rate. The infiltration rate on the site varies between 1.72x10-4m/s to 9.78x10-5m/s. Unfortunately, due to shallow groundwater the use of an infiltration basin was not considered appropriate. The groundwater level has been recorded as shallow as 1.52m below ground level. The results of the infiltration testing and groundwater monitoring are presented in the Geo-Integrity Site Investigation report in Appendix D.

Soil samples were taken from locations around the existing site and tested for the presence of contaminants. The conclusion of the Site Investigation report states that:

> *"no significant source-pathway-receptor linkage exists at the site and consequently no additional human health risk assessment is considered necessary at the site. Additionally, it is considered that there is no elevated risk of Controlled Waters pollution from development at this site".*

In addition to the soil samples being collected, subsequent ground water samples were taken from the site at the request of the EA. Geo integrity concluded that the controlled waters are not at any significant risk from development at the site, and that the previous uses of the site have not impacted upon groundwater quality. Refer to Appendix F for the Geo-integrity letter to the EA presenting the groundwater sample test results. Following the findings from the investigations above, it is believed that the requirement for a mitigation strategy to prevent contamination to the groundwater should not be required.

As infiltration is not appropriate, it is proposed to manage surface water run-off from the site using an attenuation basin with a restricted discharge to greenfield run-off rates. The greenfield run-off rate for the development is shown in Table 1 below (refer to Appendix E for the greenfield run-off rate calculation). QBar urban has been calculated based on approximately 25% of the existing site being previously developed/surfaced.

TABLE 1 – GREENFIELD RUN-OFF RATES	
	Greenfield Run-off Rate (l/s)
QBar (Rural)	0.6
QBar (Urban)	1.4
Q1	1.2
Q30	2.8
Q100	3.5

It is proposed to use a hydrobrake control chamber to restrict the run-off from the development which incorporates a complex discharge. This will enable an outflow from the basin to varying discharge rates depending on the storm event. Refer to Appendix C for source control calculations which detail the complex discharge. *The source control model of the attenuation basin presents the worst-case scenario when compared with the Microdrainage Network model. Therefore the complex discharge has been designed using the water levels as shown on the source control model.*

Up to the 1in30 year storm event, the control chamber will restrict the flows leaving the development to QBar urban. Between a 1in30 year and 1in100 year storm event the flow rate will be restricted to Q30. Between a 1in100 and 1in100 +40% climate change storm event the flow rate will be restricted to Q100. In an exceedance event, the weir built into the control chamber will be triggered and the flow will be unrestricted. Table 2 below presents the post development flow rates:

TABLE 2 – POST DEVELOPMENT RUN-OFF RATES	
Storm Event (up to and equal to)	Post-development run off restricted to (l/s)
1in1	1.2
1in30	1.4
1in100	2.8
1in100+40%	3.5

The Attenuation basin will have 1:3 gradient banks with an invert level of 77.100mAOD and top of bank level of 78.250mAOD. An existing 525mm drain that will cross the basin will be encased in concrete with a stone surround and will have lateral pipes below the drain invert to allow water flow within the basin. The basin will be topsoiled and landscaped. For details of the basin, refer to drawing 5002855-RDG-XX-XX-DT-C-0512 in Appendix A. An impermeable liner will not be installed on the footprint of the basin as it is proposed to allow infiltration alongside the controlled discharge. If the ground water rises and reduces the infiltration rate, the controlled discharge will be the sole outflow. For design purposes, infiltration has been excluded in the source control model.

The attenuation basin has a volume of 513m^3 (at water level 78.000mAOD) and the site has an overall attenuated volume of 854m^3 (at water level 78.250mAOD). The main basin will contain a 1in100 year storm event but in a 1in100+40% climate change storm event, the water level in the basin exceeds 78.000mAOD

and overflows the western bank which will flood a designated area within the proposed development. The water level for a 1in100+40% climate change storm event is 78.178mAOD. Refer to drawing 5002855-RDG-XX-ST-PL-C-0502 in Appendix A for the extents of the controlled flooding.

In an exceedance event, above 1in100+40%climate change, the weir in the control chamber will be triggered. If water levels continue to rise, the water level will rise to a maximum level of 78.250mAOD where the water will overflow the south east bank of the attenuation basin and will be conveyed away from the site by the existing ditches. Therefore the highest water level on the site will be 150mm below the lowest building FFL.

The surface water drainage pipe network is split in two, Network A, which is the main network through the road and Network B to the north. The surface water drainage networks have been designed so that the system does not surcharge for the 1 in 2 year return period and no flooding occurs up to the 1:100 year return period. Simulation of the 1in 100 year return period and 1 in 100 year return period plus 40% climate change confirms flooding in Network A whilst Network B does not flood. Refer to Appendix B for the Microdrainage Network Calculations.

The proposed site levels have been designed so that the impermeable surfaces fall towards the main road through the site which also falls from West to East towards the Attenuation Basin. Therefore, flooding which occurs during the 1in 100 year return period and 1 in 100 year return period plus 40% climate change will be conveyed overland to the infiltration basin where it will be stored and released to the adjacent ditch, restricted to Greenfield Run-off Rates. Refer to Drawing 5002855-RDG-XX-ST-PL-C-0504 in Appendix A for details of the overland flood flow routing.

Car parking bays located around the proposed development are mostly constructed out of a permeable grasscrete construction (44 out of 81 bays). The grasscrete construction incorporates two layers of filtration which will provide treatment to the car parking bay run-off before infiltrating into the ground. The construction detail for the grasscrete parking bays can be seen on 5002855-RDG-XX-XX-DT-C-0710 in Appendix A.

The existing site extents are flagged up by the EA flood maps as being at high risk of flooding from surface water flows. As the proposed site levels are being raised the risk of flooding to the development are low. The surface water flooding appears to be conveyed into the existing site from the North West (Caversfield). Refer to drawing 5002855-RDG-XX-ST-PL-C-0505 in Appendix A for details of the existing catchment.

To minimise the risk of these overland flows flooding the proposed development it is proposed to build a swale on the western boundary of the development which links the flows from the north west to the south of the development. As the existing Skimmingdish Lane carriageway and the proposed development are on an embankment, there will be a depression which is formed along the southern boundary of the site. To assist with conveying these flows to the east, which is the natural flow route, it is proposed to install a 300mm diameter culvert which crosses the existing access to the site between Building 140 and 145. Also a swale in the south east corner of the site will link the depression to the existing 225mm and 375mm dimeter culverts south of the existing pond. Refer to drawing 5002855-RDG-XX-ST-PL-C-0504 in Appendix A for the proposed swales and culverts proposed to manage the surface water flooding.

A review of the existing pond and its catchment was carried out to understand the impact to the proposed development. Drawing 5002855-RDG-XX-ST-PL-C-0505 in Appendix A shows the extent of the catchement to the pond. A Microdrainage source control cascade model has been created, as presented in Appendix G, to assess the existing site arrangement based on a pond outfalling into a ditch via 2 no. 100mm diameter outlets with a overflow straight into the ditch. The ditch then has a 225mm pipe outflow with a high level 375mm diameter drain. The model shows that the pond has a small amount of flooding although, any flooding from the pond will end up in the adjacent ditch. The model of the ditch shows that the existing setup can manage the flows generated by the existing catchment.

2.1. SUDs Management and Maintenance plan

Regular inspections and maintenance of the surface water drainage system is essential to ensure the effective operation of the drainage system.

As the surface water drainage system will remain in private ownership. The developer and site owner, Bicester Heritage will be responsible for maintaining the following SUDs features in perpetuity:

- Permeable Grasscrete paving
- Attenuation Basin
- Overland flow conveyance features
- Hydrobrake Control Chamber
- Catchpits/Manholes
- Linear Drainage Units
- Roof Gutters

Outlined below are details of the proposed maintenance regime, which is in accordance with the guidance provided in the SUDS manual, CIRIA publication C753.

2.1.1. Attenuation Basin

The proposed attenuation basin will be located in the south east corner of the site.

Regular ongoing maintenance of the basin is required to ensure continuing operation to design performance standards.

The basin should be inspected on a regular basis (typically monthly) and any build-up of litter (including leaf litter in the autumn), debris and trash should be removed as required.

Routine maintenance of the landscaped areas, including grass cutting and the aquatic vegetation will also be required on a regular basis particularly during the growing season. Slope areas that have become bare should be re-vegetated and any eroded areas should be regraded before replanting.

Silt removal should be undertaken, as required, to ensure the effective operation of the basin and to maintain aesthetic appearance of the site. Care should be taken to avoid disturbance to nesting birds during the breeding season and habitats of target species at critical times. The window for carrying out maintenance to achieve this is usually towards the end of the growing season (typically September/October). Invasive silt and vegetation removal should only be carried out to limited areas at a time (25/30% of the basin on one occasion each year) to minimise the impact on biodiversity.

A summary of the maintenance requirements are provided in the schedule below:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

2.1.2. Overland Flow Conveyance Features

Conveyance features installed within the site such as the Swales, depressions, culvert and the existing ditch will be maintained and managed in perpetuity by the site owner. These features are required to ensure overland flows from the north west of the site are conveyed around the development and away from the site in the south east corner.

Regular inspection and maintenance is required to ensure the conveyance features operate to their design performance standards.

Inspections will be required on a regular monthly basis which will require the removal of any litter or debris within the conveyance features. This shall include inspection to the culvert and any blockages or sediment removed.

The major maintenance requirement is to mow the grass of the conveyance features to achieve a grass length of between 75-150mm. This shall be carried out on a monthly basis through growing season. All grass clippings shall be removed from the extents of the swales.

Any sediment within the conveyance features shall be removed when it exceeds 25mm in depth.

A summary of the maintenance requirements are provided in the schedule below:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when 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
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

2.1.3. Flow Control Devices

It is proposed to use a Hydrobrake control chamber to control the rate of outflow from the attenuation basin to the existing drainage network. There are two hydrobrakes required to manage the surface water flows from the development. For details refer to drawing 5002855-RDG-XX-ST-PL-C-0502 and 5002855-RDG-XX-XX-DT-C-0510.

The flow control chambers should be inspected on a regular basis and any build-up of silt detritus should be removed, as required, to reduce the potential for blockages. For further details of the maintenance requirements refer to the manufactures guidelines.

2.1.4. Permeable Grasscrete Paving

The permeable grasscrete paving should be inspected regularly, preferably during and after heavy rainfall, to check for effective operation and identify any areas of surface ponding.

Permeable grasscrete paving should be regularly cleaned of silt and other sediment to preserve its infiltration capability.

Care should be taken to avoid stockpiling any materials, in particular granular material or soil, on the permeable grasscrete paving to avoid contaminating the underlying granular sub-base and laying course. In the event of a spillage, vacuum sweeping of the affected area should be undertaking immediately.

A summary of the maintenance requirements are provided in the schedule below:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

2.1.5. Catchpit and Manholes

Catchpits will be provided on the surface water drainage network to minimise the transfer or detritus and silts to the downstream SUDs features.

Catchpits and Manholes shall be inspected on a regular basis and any build-up of detritus or silt should be removed from the system.

2.1.6. Gutters

House gutters and downpipe filters should be cleaned on a regular basis to prevent leaves and other detritus from entering the drainage system. The use of leaf guards should be considered where the buildings are in close proximity of trees.

2.1.7. Linear Drainage Units

Linear Drainage Units installed with sumps on the outlet units to minimise the transfer or detritus and silts to the downstream SUDs features.

Linear Drainage units and outlets shall be inspected on a regular basis and any build-up of detritus or silt should be removed from the system.

3. FOUL WATER DRAINAGE (CONDITION 26)

The proposed development has a foul sewer which runs across the western side of the site. Due to level constraints, it is proposed that units 149, 148, 142 and half of unit 145 will drain to the Sewer by gravity whilst the remaining units will drain via a gravity network to a pump chamber where it is pumped up to the Sewer. It is proposed that the rising main will discharge in a private manhole upstream of the proposed sewer. Refer to drainage layouts in Appendix A for details.

Internal fit out of the 8 units is yet to be finalised so to determine the foul flow rate the Sewers for Adoption flow rates for industrial developments have been used which equate to 1.1l/s per Hectare. Refer to Table A below which presents the gravity flow rate from units 149, 148,142 and 145.

TABLE A – GRAVITY FOUL FLOW RATE TO SEWER

Unit	Ground Floor Area (m^2)	Mezzanine Area (m^2)	Foul Flow Rate (l/s/ha)	Total Design Flow (l/s)
142	550	320	1.1	0.0957
145	243	180	1.1	0.0465
148	570	325	1.1	0.0985
149	90	0	1.1	0.010
			Total Foul Flow by Gravity Connection	0.251

The foul pump chamber has been designed to accommodate 24 hour storage based on a 3.8l/s pump rate. The gravity foul flow rates used to calculate the 24 hour storage for the pump chamber has been calculated as presented in Table B below:

TABLE B – GRAVITY FOUL FLOW RATE TO PUMP CHAMBER

Unit	Ground Floor Area (m2)	Mezzanine Area (m2)	Foul Flow Rate (l/s/ha)	Total Design Flow (l/s)
138	570	250	1.1	0.0902
139	320	150	1.1	0.0517
140	710	240	1.1	0.105
141	990	600	1.1	0.1749
145	243	180	1.1	0.0465
			Total Foul Flow by Gravity Connection	0.468

For details of the proposed foul pumping chamber refer to Appendix H.

Thames Water raised concerns over the capacity of the sewage network in Bicester. They have plans to upgrade their network with a programme of 18 months duration which should have commenced November 2018 based on their Pre-planning Enquiry letter dated 28th November 2018.

Communication with Thames Water as per the email referenced in Appendix I confirms that upon submission of the drainage strategy detailing the foul drainage proposals and a construction programme, the Thames Water Asset Planning will review the information and recommend the discharge of condition 26. The key milestones from the construction programme are as follows:

- Start on Site – 05/08/2019
- Construction Completion – 16/03/2020
- Early Access (Building 145) – 18/02/2020
- Tenant Fit out (Approx 2 months) – April 2020.
- Earliest Tenant Occupation April 2020

APPENDIX A – CIVIL ENGINEERING DRAWINGS

- 5002855-RDG-XX-ST-PL-C-0501 Foul and Surface Water Drainage Layout Sheet 1 of 2
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APPENDIX B – MICRODRAINAGE NETWORK CALCULATIONS

APPENDIX C – MICRODRAINAGE SOURCE CONTROL CALCULATIONS

APPENDIX D – GEO INTEGRITY SITE INVESTIGATION REPORT

APPENDIX E – GREENFIELD RUN-OFF RATES

APPENDIX F – GEO-INTEGRITY LETTER TO EA RE. GROUNDWATER TESTING

APPENDIX G – MICRODRAINAGE CASCADE MODEL – EXISTING POND

APPENDIX H – FOUL PUMPING CHAMBER SPECIALIST QUOTATION

APPENDIX I – COMMUNICATION WITH THAMES WATER

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