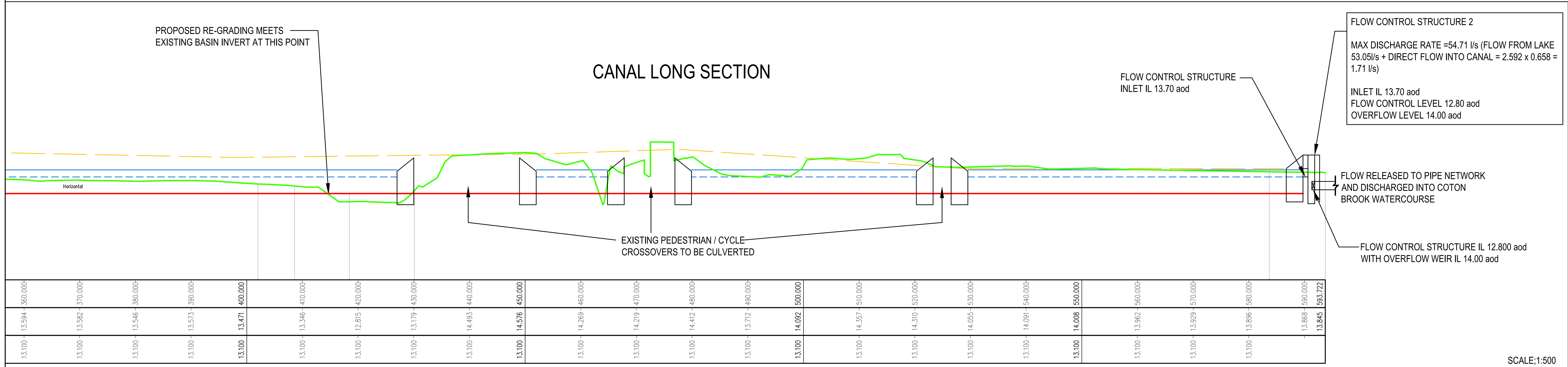
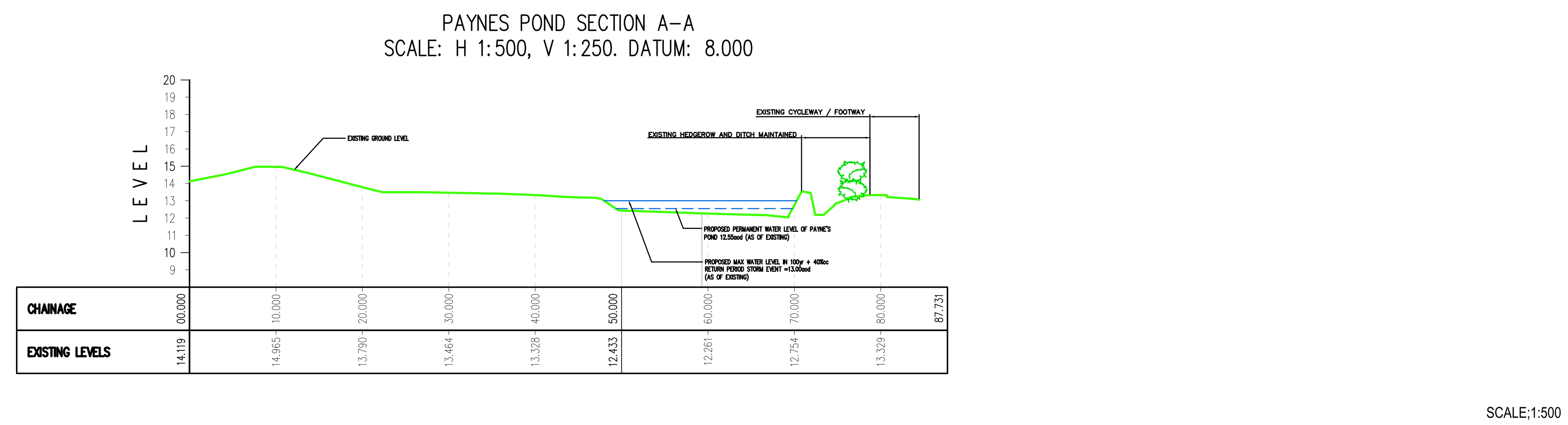
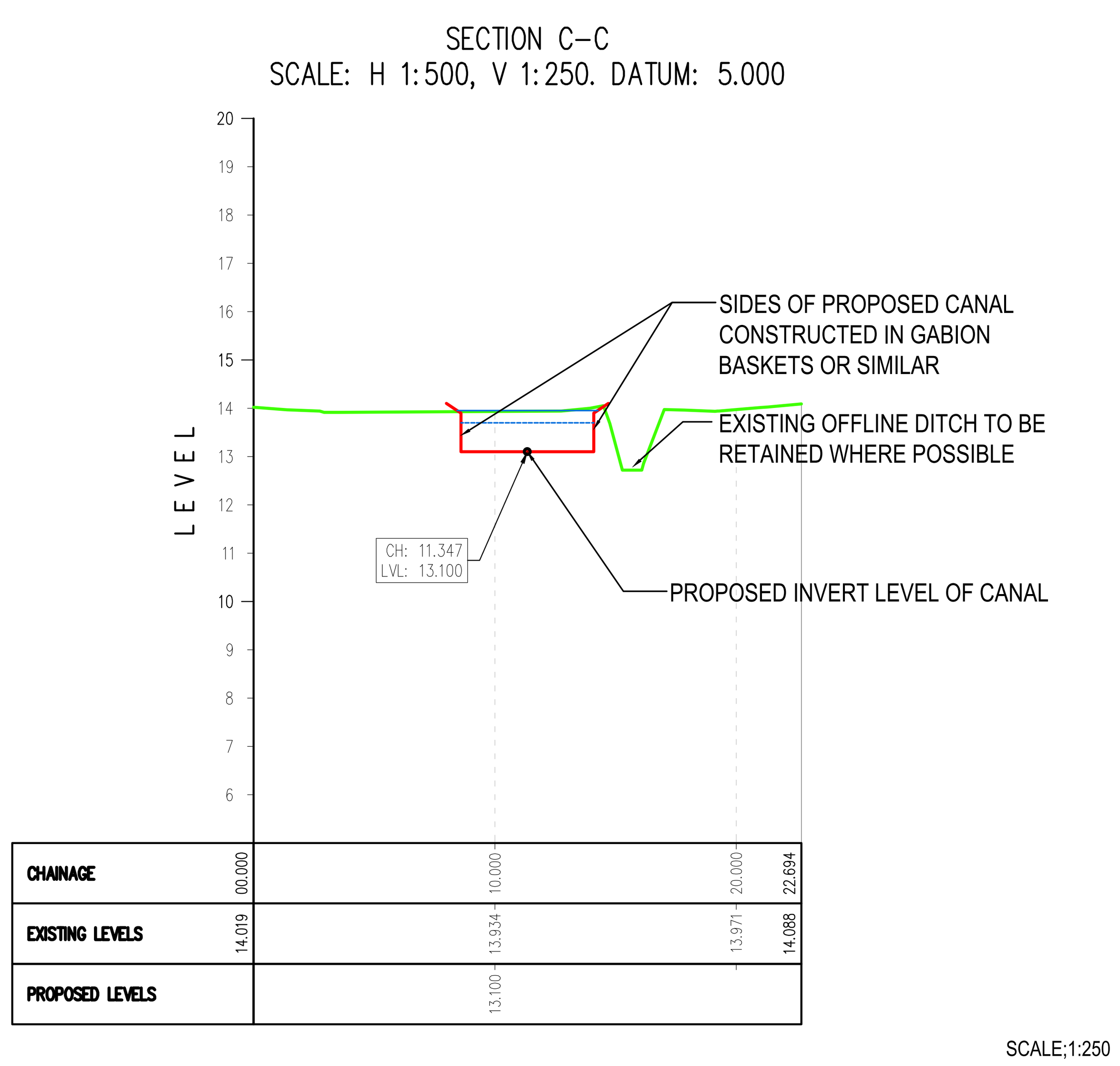
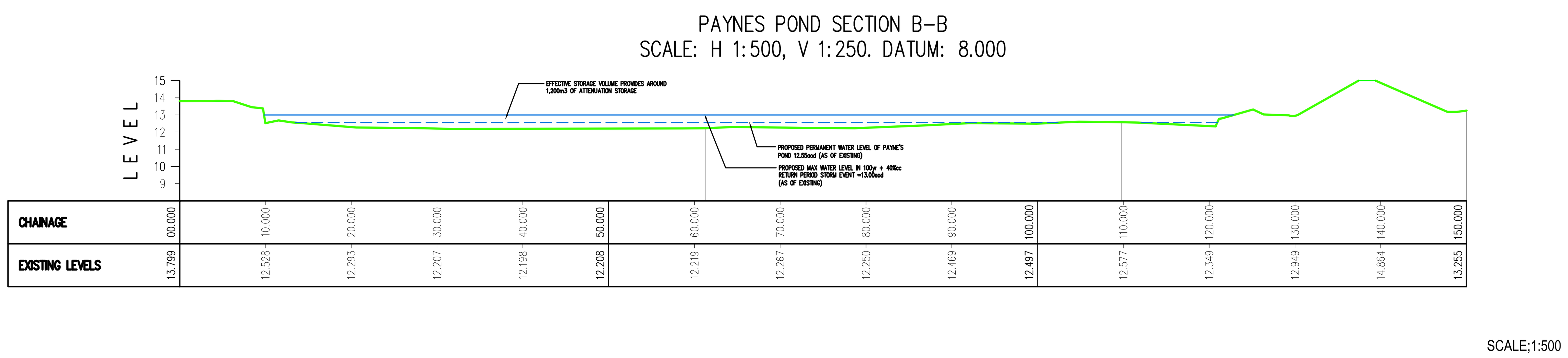


STORAGE FEATURE	EXISTING STORAGE VOLUME (m^3)	PROPOSED STORAGE VOLUME (m^3)
EASTERN LAKE	9,466m^3	18,334m^3
CANAL	UNKNOWN	554m^3
PAYNES POND	1,200m^3 APPROX	1,200m^3 APPROX (AS OF EXISTING)







NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM NEWLYN UNLESS NOTED OTHERWISE.
3. ALL COORDINATES ARE IN METRES RELATIVE TO ORDNANCE SURVEY NATIONAL GRID.
4. THE CONTRACTOR IS TO VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING WORK OR PREPARING SHOP DRAWINGS.
5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS AND ARCHITECTS DRAWINGS AND SPECIFICATIONS.
6. PROFILES OF EXISTING STORAGE FEATURES SHOWN ON THIS PLAN HAVE BEEN BASED OFF AS-BUILT INFORMATION AND VERIFIED VISUALLY FROM A SITE VISIT

Mark	Revision	Date	Drawn	Chkd	Appd
C	MASTERPLAN UPDATED	30.06.17	GC	ST	ST
B	NOTES AMENDED	12.12.16	GC	RC	ST
A	AMENDED FOLLOWING CPA COMMENTS	03.11.16	DRM	DRM	ST

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

PRELIMINARY

PROPOSED WORKS TO EXISTING DRAINAGE INFRASTRUCTURE WEST CAMBRIDGE DENSIFICATION (SHEET 3 OF 3)

Client

WEST CAMBRIDGE

Date of 1st Issue	Designed	Drawn
19.04.2016	DRM	DRM
A1 Scale	Checked	Approved
1:500	DRM	ST

Drawing Number: 31500/2006/118 — Revision: C

pba peterbrett
Offices throughout the UK and Europe
www.peterbrett.com
CAMBRIDGE
Tel: 01223 882000

Appendix Q Schedule of Restricted Plot Discharges (Surface and Foul Water)

West Cambridge Plot Drainage Summary Table - 28.06.2017								
Plot Number	**Total Plot Area (ha)**	**Imp Area Factor**	**Imp Area (ha)**	**Allowable discharge based on 1 in 1 year greenfield runoff rate (2.592 l/s/ha)**	**Allowable Foul Discharge Rate**	**SW Discharge Location**	**FW Discharge Location**	**Is plot Existing or Proposed?**
A01A	0.611	85%	0.519	1.35 l/s	3.42 l/s	onsite storage	proposed FW network	proposed
A02	1.679	85%	1.427	3.70 l/s	3.63 l/s	onsite storage	proposed FW network	proposed
A03	0.282	85%	0.24	freeflow discharge	As of existing (assumed peak of 1.30 l/s)	paynes pond	proposed FW network	existing
A04	0.364	85%	0.309	freeflow discharge	As of existing (assumed peak of 1.55 l/s)	paynes pond	proposed FW network	existing
A05A	1.038	85%	0.882	2.29 l/s	3.63 l/s	onsite storage	proposed FW network	proposed
A05B	0.546	85%	0.464	1.20 l/s	1.29 l/s	onsite storage	proposed FW network	proposed
A06								
A07	1.424	85%	1.21	3.14 l/s	5.99 l/s	onsite storage	proposed FW network	proposed
A08	0.08	85%	0.07	freeflow discharge	0.09 l/s	paynes pond	proposed FW network	proposed
A09A	0.636	85%	0.541	freeflow discharge	As of existing (assumed peak of 2.20 l/s)	paynes pond	proposed FW network	existing
A09B	0.156	85%	0.133	1.00 l/s	0.96 l/s	onsite storage	proposed FW network	proposed
A10	0.388	85%	0.33	1.00 l/s	1.24 l/s	onsite storage	proposed FW network	existing
A11	0.661	85%	0.615	1.46 l/s	1.38 l/s	onsite storage	proposed FW network	proposed
A12	0.561	85%	0.957	1.24 l/s	2.15 l/s	onsite storage	proposed FW network	proposed
A13	0.798	85%	0.678	1.76 l/s	1.69 l/s	onsite storage	proposed FW network	existing
A14	0.421	85%	0.358	1.00 l/s	2.14 l/s	onsite storage	proposed FW network	proposed
A15	0.476	85%	0.401	freeflow discharge	As of existing (assumed peak of 0.14 l/s)	west pond	proposed FW network	existing
A16	0.28	85%	0.238	1.00 l/s	1.50 l/s	onsite storage	proposed FW network	proposed
A17	2.261	85%	1.922	4.98 l/s	6.54	onsite storage	proposed FW network	proposed
A18	0.349	85%	0.297	1.00 l/s	1.24 l/s	onsite storage	proposed FW network	proposed
A19	0.273	85%	0.232	freeflow discharge	0.43 l/s	west pond	proposed FW network	proposed
A20	0.38	85%	0.323	freeflow discharge	0.99 l/s	west pond	proposed FW network	existing
A21	0.485	85%	0.412	freeflow discharge	2.32 l/s	west pond	proposed FW network	existing
A22	0.287	85%	0.244	freeflow discharge	1.65 l/s	west pond	proposed FW network	proposed
A23	0.56	85%	0.476	freeflow discharge	2.29 l/s	west pond	proposed FW network	existing
A24	0.234	85%	0.2	freeflow discharge	1.50 l/s	west pond	proposed FW network	proposed
A25	0.777	85%	0.66	freeflow discharge	1.30 l/s	west pond	proposed FW network	existing
A26	1.54	85%	1.309	freeflow discharge	0.87 l/s	west pond	proposed FW network	proposed
A27	0.435	85%	0.37	freeflow discharge	0.21 l/s	west pond	proposed FW network	proposed
B01	0.54	85%	0.459	1.19 l/s	2.35 l/s	onsite storage	proposed FW network	proposed
B02	0.73	85%	0.62	1.61 l/s	2.61 l/s	onsite storage	proposed FW network	proposed
B04	1.087	85%	0.924	freeflow discharge	6.73 l/s	west pond	proposed FW network	proposed
B05A	0.593	85%	0.504	freeflow discharge	As of existing (assumed peak of 0.62 l/s)	west pond	proposed FW network	existing
B05B	0.189	85%	0.161	freeflow discharge	0.38 l/s	west pond	proposed FW network	proposed
B06	1.548	85%	1.316	freeflow discharge	5.34 l/s	west pond	proposed FW network	proposed
B07	1.47	85%	1.25	3.24 l/s	3.85 l/s	onsite storage	proposed FW network	proposed
B09	0.97	85%	0.825	2.14 l/s	4.68 l/s	onsite storage	proposed FW network	proposed
B10	0.44	85%	0.374	1.00 l/s	1.75 l/s	onsite storage	proposed FW network	proposed
C01	3.315	85%	2.818	7.30 l/s	2.14 l/s	Madingley Road	proposed FW network	proposed
C02	0.746	85%	0.634	freeflow discharge	1.75 l/s	west pond	proposed FW network	proposed
C03	0.574	85%	0.488	freeflow discharge	1.97 l/s	west pond	proposed FW network	proposed
C04	0.476	85%	0.405	freeflow discharge	2.95 l/s	west pond	proposed FW network	proposed
C05	0.668	85%	0.568	freeflow discharge	3.49 l/s	west pond	proposed FW network	proposed
C06	0.608	85%	0.517	freeflow discharge	2.32 l/s	west pond	proposed FW network	proposed
C07a	0.51	85%	0.434	freeflow discharge	1.97 l/s	west pond	proposed FW network	proposed
C07b	1.145	85%	0.973	freeflow discharge	4.68 l/s	west pond	proposed FW network	proposed
C08	1.949	50%	0.975	freeflow discharge	2.13 l/s	west pond	proposed FW network	existing
D01	0.159	50%	0.135	1.00 l/s	As of existing (assumed peak of 0.19 l/s)	Madingley Road	Madingley Road	existing
D02	2.429	85%	2.065	5.35 l/s	As of existing (assumed peak of 2.89 l/s)	Madingley Road	Madingley Road	existing
D03	0.672	50%	0.336	freeflow discharge	N/A	west pond	N/A	existing
D04	0.725	85%	0.616	freeflow discharge	As of existing (assumed peak of 0.86 l/s)	west pond	Madingley Road	existing
D05	0.29	85%	0.247	freeflow discharge	2.67 l/s	west pond	proposed FW network	proposed
D06	0.216	85%	0.184	freeflow discharge	0.63 l/s	west pond	proposed FW network	proposed
D07A	0.693	85%	0.589	freeflow discharge	3.14 l/s	west pond	proposed FW network	proposed
D07B	0.23	85%	0.196	freeflow discharge	0.32 l/s	west pond	proposed FW network	proposed
D07C	0.325	85%	0.276	freeflow discharge	N/A	west pond	N/A	proposed
D08	0.571	50%	0.286	freeflow discharge	0.42 l/s	west pond	proposed FW network	existing
D09	0.505	35%	0.19	freeflow discharge	0.43	west pond	proposed FW network	proposed
A_PR02	0.791	35%	0.277	1.00 l/s	N/A	onsite storage	N/A	proposed
A_PR03	0.887	35%	0.31	1.00 l/s	N/A	onsite storage	N/A	proposed
A_PR04	0.189	35%	0.067	1.00 l/s	N/A	onsite storage	N/A	proposed
A_PR05a	0.11	35%	0.038	1.00 l/s	N/A	onsite storage	N/A	proposed
A_PR05b	0.235	35%	0.082	1.00 l/s	N/A	onsite storage	N/A	proposed
A_PR06	0.23	35%	0.081	freeflow discharge	N/A	paynes pond	N/A	proposed
A_PR07	1.458	35%	0.51	freeflow discharge	N/A	paynes pond	N/A	proposed
A_PR08	0.836	35%	0.293	1.00 l/s	N/A	onsite storage	N/A	proposed
A_PR09	0.527	35%	0.184	1.00 l/s	N/A	onsite storage	N/A	proposed
A_PR10	0.277	85%	0.235	1.00 l/s	N/A	onsite storage	N/A	proposed
A_PR11	0.214	35%	0.075	freeflow discharge	N/A	west pond	N/A	proposed
A_PR12	0.298	35%	0.104	1.00 l/s	N/A	onsite storage	N/A	proposed
A_PR13	0.08	35%	0.03	freeflow discharge	N/A	west pond	N/A	proposed
A_PR14	0.233	35%	0.082	freeflow discharge	N/A	west pond	N/A	proposed
A_PR15	1.048	50%	0.524	1.36 l/s	N/A	canal	N/A	proposed
A_PR16	1.568	50%	0.784	freeflow discharge	N/A	west pond	N/A	proposed
A_PR17	0.383	50%	0.134	1.00 l/s	N/A	canal	N/A	proposed
B_PR01a	0.311	35%	0.109	1.00 l/s	N/A	onsite storage	N/A	proposed
B_PR01b	0.473	35%	0.166	1.00 l/s	N/A	onsite storage	N/A	proposed
B_PR02	1.486	35%	0.52	freeflow discharge	N/A	west pond	N/A	proposed
B_PR03	0.228	85%	0.194	freeflow discharge	N/A	west pond	N/A	existing
B_PR04	1.137	35%	0.398	freeflow discharge	N/A	west pond	N/A	proposed
B_PR04a	0.12	35%	0.042	1.00 l/s	N/A	onsite storage	N/A	proposed
B_PR05a	0.317	35%	0.111	1.00 l/s	N/A	onsite storage	N/A	proposed
B_PR05b	0.521	35%	0.182	1.00 l/s	N/A	Madingley Road	N/A	proposed
B_PR05c	0.224	35%	0.078	1.00 l/s	N/A	Madingley Road	N/A	proposed
C_PR01	0.195	35%	0.068	1.00 l/s	N/A	Madingley Road	N/A	proposed
C_PR02	0.523	85%	0.445	1.15 l/s	N/A	Madingley Road	N/A	proposed
C_PR03	0.267	35%	0.09	freeflow discharge	N/A	west pond	N/A	proposed
C_PR04	0.07	35%	0.02	freeflow discharge	N/A	west pond	N/A	proposed
C_PR05	0.145	35%	0.051	freeflow discharge	N/A	west pond	N/A	proposed
C_PR06	0.221	35%	0.077	freeflow discharge	N/A	west pond	N/A	proposed
C_PR07	0.751	35%	0.263	freeflow discharge	N/A	west pond	N/A	proposed
C_PR08	0.356	35%	0.125	freeflow discharge	N/A	west pond	N/A	proposed
C_PR09	0.326	85%	0.28	freeflow discharge	N/A	west pond	N/A	proposed
C_PR10	2.625	50%	1.313	freeflow discharge	N/A	west pond	N/A	proposed
D_PR01a	1.145	35%	0.4	freeflow discharge	N/A	west pond	N/A	proposed
D_PR01b	0.904	35%	0.316	freeflow discharge	N/A	west pond	N/A	proposed
D_PR02	0.464	35%	0.162	freeflow discharge	N/A	west pond	N/A	proposed
D_PR03	0.286	35%	0.1	freeflow discharge	N/A	west pond	N/A	proposed

Appendix R Technical Note on Water Quality and Pollution Mitigation Measures

TECHNICAL NOTE

Job Name: West Cambridge

Job No: 31500

Note No: TN010

Date: 19/05/2017

Prepared By: Simon Tucker

Subject: **Supplementary Technical Note to West Cambridge (FRA), Water Quality – Mitigation Measures**

Item	Subject
1.	Introduction and Objective This Technical Note (TN) has been prepared to assess practical mitigation measures for the treatment of post development flows from the West Cambridge Site, in order to maintain the required levels of water quality to receiving bodies. It is intended to supplement the Flood Risk Assessment and Drainage Strategy prepared by Peter Brett (Reference 31500 FRA/Drainage Strategy) in support of the Outline Planning Application for the West Cambridge Site, (Ref: 16/1134/OUT). Post submission discussions with Cambridge City Council's Drainage and Flood Risk Officer, has identified concerns over the potential risk of pollution from post development surface water discharges. The objective of this TN is to set out the proposed measures based on current CIRIA practice, which if implemented, could mitigate pollution risk to receiving water bodies located down stream of re-development. The following sections set out the technical and environmental considerations and identify options for achieving required water quality targets.
2.	Development Proposals - Background Much of the water services infrastructure from the 1999 consented masterplan has been built. The site is serviced by a well-established surface water network, which in general follows the alignments of the roads. Many of the plots have been built out over the past 20 years. The construction of roads, development platforms and utility corridors, present both spatial and level constraints on new construction including water services infrastructure. Much of the original network was future proofed to accommodate later phases of development which have yet to be built. The drainage infrastructure was designed in accordance with best practice applicable at that time.

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
Job No/Brief/TN001	-	26.04.17	ST	DM	ST	SCD

Peter Brett Associates LLP Telford House Fulbourn Cambridge CB21 5HB
T: +44 (0)1223 882 000 E: cambridge@peterbrett.com

Item	Subject
	The Environment Agency were consulted on the principles of the original (1999) drainage strategy, and approved the Flood Risk Assessment. The proposed Drainage Strategy therefore focusses on re-using and adapting as much of the existing water services infrastructure as possible; whilst supplementing and improving existing SuDs features where feasible.
3.	<u>Existing Drainage Arrangements</u> The catchment topography is characterised by a Western/Eastern ridgeline which splits the site in two. Approximately one third of the site drains Northwards to Washpit Brook and the remainder South to Coton Brook. Pre-application consultation with the Local Lead Flood Authority and City Council, identified that both receiving bodies would be sensitive to any increase in flow or pollutant loads. Appendix 1 shows the existing surface water network and SuDs attenuation facilities which serve the site. Notable SuD's features across the site include: • The Western Lake • The Canal, including swales and ditches (located along the Southern boundary) • A number of ponds (North of Schlumberger and South of the Institute for Manufacturing), the most notable of which is Paynes Pond located to the South East of the site. • Geocellular storage, located within car parks located South of Charles Babbage Road, and East of JJ Thomson Avenue.
4.	<u>Proposed Flood Mitigation.</u> To mitigate potential flood risk to downstream development and address long term storage requirements discharges will be significantly restricted. The low discharge rates from the site, will lengthen retention times of run-off within attenuation facilities. It has been agreed with the LLFA and City Councils' Flood Risk and Drainage Officers, that the total post development surface water discharges from the site will be restricted by strategic flow controls to the 1 in 1 year Greenfield run-off rate. This greatly increases the amount of attenuation required on site, but does provide significant benefit by reducing downstream flood risk. In order to maximise the amount of storage that can be achieved from existing facilities, it is proposed to lower flow controls to the Western Lake and incorporate additional flow controls to the Southern swale and Paynes Pond. These measures will allow the majority of the Western and Central areas to drain freely to the Western Lake and swale without restriction, and convey flows through several strategic SuDs features. Due to level constraints associated with built development, the majority of the Eastern and some central areas will require on plot attenuation as flows from these areas can not drain to the Western Lake, or swale. Flows from these plots are restricted to the 1 in 1 year event, and will discharge off-site (as they currently do) via: - 1. Surface water sewers located in Clerk Maxwell Road 2. Paynes Pond, (which discharges to Coton Brook). Details of drainage proposals, including catchments are shown in Appendix 2.

Item	Subject
5.	<u>Water Quality Considerations</u> The mitigation measures set out in this TN aims to reduce pollutant levels to environmentally acceptable levels. The existing drainage infrastructure is relatively modern (less than 20 years old) and whilst it performs well, it is acknowledged that current design standards are more onerous than at the time the original development secured planning consent. Development will increase the quantum of impervious surfaces. Managing the quality of surface water runoff so that receiving surface waters are protected, is dependent upon water retention time within the SuDs network which is related to the method of flow control and type of conveyance and attenuation facilities used. Current best practice (CIRIA C753) encourages developments to use source control measures, to treat run-off before conveying flows to the next element of the SuDs train. The on plot SuDS should be designed to intercept runoff (and the associated pollutants) for most rainfall events up to approximately 5 mm in depth. This will require each plot development to incorporate innovative measures, such as green roofs, blue roofs and tanked permeable paving to car parking/access roads and hard standings. It is intended that each development plot will use source control techniques and design details will be set out in the Flood Risk Assessment and Drainage Strategy submitted in support of each individual Reserved Matters Application. The greatest risk to the receiving water courses is the run off generated from existing roads, proposed roads and car parking which has the potential to mobilise contaminants, and contribute to the total pollutant load. At present run-off from roads and car parking is collected via trapped gullies and catchpits. Although effective for trapping silt and sediment, these features are not particularly effective at removing hydrocarbons metals or suspended solids.They do however, provide a degree of pre-treatment. Typically, development activities could mobilise. • Total Suspended Solids (TSS) • Copper • Zinc • Cadmium In developing the site wide SuDs strategy, reference has been made to current industry guidance CIRIA C753 the SuDs Manual.
6.	<u>Catchments and Flow Conveyance</u> Much of the sites catchment drains to the Western Lake, with the central areas draining to the swale & Payne's Pond along the Southern boundary before out falling to Coton Brook. For details of the catchments refer to Appendix 2. The volume of retained water within the Western Lake contributes significantly to dilution of potential pollutants. The highway drainage system upstream of the Western Lake incorporates measures such as catchpits and gullies which all perform an important function in the removal of grit, silt and sediment. Outflows from the Western Lake undergo another stage of treatment as they flow along

Item	Subject
	the swale. The presence of reeds assist in the removal of other pollutants such as metals and hydro carbons. The length of swale (Western Lake to outfall) is 650m which provide a very effective treatment train, as hydraulic residence times are increased, which contributes greatly to removal of pollutants. Nutrient (total nitrogen and phosphorous) removal is important, and can be achieved by the use of the slow conveyance zone provided by the Southern swale. Street sweeping is also an effective pollution prevention measure for nutrient control through removal of nutrient sources. The majority of the Eastern areas discharge directly to the surface water sewers, located in Clerk Maxwell Road and which eventually flow into Coton Brook. Pre-treatment consists primarily of trapped gullies and catchpits. Existing car parks utilise By Pass Interceptors for the containment of hydrocarbons. A small proportion of the North-Western area of the site outfalls to Washpit Brook. The Schlumberger facility discharges flows to attenuation ponds (planted with reeds), located along the Northern boundary. These discharge to an arrangement of ditches before draining via pipework across Madingley Road to Washpit Brook. Car parks utilise By-Pass Interceptors. The existing buildings along the Western boundary (BAS and Aveva), attenuate flows on plot, before discharging via the surface water network to Washpit Brook. The existing attenuation ponds and ditches provide effective stages of treatment by slowing conveyance, with the reeds and vegetation encouraging the uptake of contaminants. The Western access road is drained by gullies and catchpits, which allow removal of solids, but provide limited benefit in removal of hydrocarbons and metals. Flows from these areas drain via a piped system to Washpit Brook.
7	<u>Pollution Risk Management</u> Land use is the primary influencing factor in the quality of urban surface water runoff (Royal Haskoning, 2010) and is used to assess the pollution hazard posed by the development. In accordance with CIRIA SuDS Manual 2015 guidance, it is proposed that the Simple Index Approach is used to assess pollution risk based upon land use.

TABLE 26.1 Approaches to water quality risk management

Design method	Hazard characterisation	Risk reduction	
		For surface water	For groundwater
Simple index approach	Simple pollution hazard indices based on land use (eg Table 26.2 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.3 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.4 or equivalent)

Note. All tables reproduced from CIRIA C753

It is acknowledged that while some of the site is Green field, much of it has already been developed for academic, commercial and residential use and can be considered Brownfield.

As is evident in Table 26.2, the risk of contamination from heavy metals, hydrocarbons and total suspended solids is considered low, although mitigation measures should be implemented to reflect current best practice, and which will integrate with existing SuDs and landscaping proposals to promote bio diversity.

Item	Subject
	Following the rationale set out in table 26.2 for the proposed development at West Cambridge, the following indices can be assigned by development land use:

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7

It is evident that the pollution hazard level from roof run off is very low. Also of note is the pollution hazard level for car parks and general access roads (including schools and offices with < 300 traffic movements a day) which is classed as low.

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index that equals or exceeds the total pollution hazard index (by contaminant type):

Total SuDS mitigation index ≥ pollution hazard index

Where run-off drains to surface water bodies, CIRIA guidance is that the mitigation indices shown in Table 26.3 should be applied.

Item	Subject
	TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

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

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required, where:

Total SuDS mitigation index = mitigation index1 + 0.5 (mitigation index2)

Where:
mitigation Index n = mitigation index for component n

A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components associated with already reduced inflow concentrations.

7.1 The SuDs Train

CIRIA C753 sets out a range at SuDs techniques which, depending upon land use can provide very effective mitigation measures especially when used in series. Of particular note, is that there can be some degree of flexibility in the selection of SuDs systems, which is largely dependent upon the constraints of the site. The key objective is to ensure that the SuDs components are linked in series, to meet the required mitigation index, i.e, a SuDs 'Management Train'. This approach provides some flexibility to meet water quantity, amenity and bio diversity design criteria in a range of different ways.

This approach has been applied at West Cambridge and will facilitate the capture, conveyance and storage of surface water runoff while delivering interception and pollution risk management.

Using a number of different SuDS components in series will help target a good range of particulate-bound and dissolved pollutants, will deliver gradual improvement in water quality and will act as a buffer for accidental spills and intermittent high pollutant loads. The suitability of different SuDS components within the Management Train is shown in Table 26.7.

Item	Subject

TABLE 26.7 Indicative suitability of SuDS components within the Management Train

SuDS component	Interception[1]	Close to source/ primary treatment	Secondary treatment	Tertiary treatment
Rainwater harvesting	Y			
Filter strip	Y	Y		
Swale	Y	Y	Y	
Filter drain	Y		Y	
Pervious pavements	Y	Y		
Bioretention	Y	Y	Y	
Green roof	Y	Y		
Detention basin	Y	Y	Y	
Pond	[3]	Y[2]	Y	Y
Wetland	[3]	Y[2]	Y	Y
Infiltration system (soakaways/ trenches/ blankets/basins)	Y	Y	Y	Y
Attenuation storage tanks	Y[4]			
Proprietary treatment systems		Y[5]	Y[5]	Y[5]

The drainage strategy aims to optimise the use of the existing SuD's components and supplement them with additional elements to provide the required level of treatment. From Table 26.7 the following measures are proposed, for the off-plot drainage infrastructure.

- Swales
- Bio retention areas
- Pervious pavements
- Ponds
- Attenuation storage tanks
- Proprietary treatment systems

All of these methods are acceptable SuDs techniques and comply with current best practice set out in C753

Appendix 2 illustrates the locations of existing and proposed strategic SuDs features.

With regards to on plot SuD's, it is expected that developers will have the flexibility to use all of the SuDs components set out in Table 26.7 except infiltration systems, which are not viable due to the low permeability of soils across the site.

It is envisaged that plot developers will be required to prepare SuDs maintenance plans, in order to maintain their future treatment functionality. Details submitted for Reserved Matters Applications will need to demonstrate that adequate treatment is delivered on plot. Any pollution and associated remedial maintenance will reside with the plot user.

7.2 Proposed Treatment Processes

In assessing pollution mitigation measures, it is important to consider the land use and potential sources of pollution. Under proposals, development will consist of office, academic research facilities, residential (existing) and shared facilities (e.g., restaurants). Research experiments generating waste water will be discharged directly to foul sewers. There will be no heavy industrial manufacturing processes, and therefore the risk of heavy metals entering receiving water courses is

Item	Subject
	considered low. The greatest pollution risk, is likely to be that arising from hydrocarbons e.g. oil leaks at car parking areas.

The SuDs system will deliver a range of water quality treatment processes.

These include:

1. Sedimentation
2. Bio-filtration
3. Bio-degradation
4. Plant uptake
5. Photolysis.

A brief description of how these processes work is included in Appendix 3. Their location within the proposed drainage strategy, is shown in Appendix 2.

7.3 Pollution Risk Mitigation

Based upon land use, the areas likely to pose the greatest risk of pollution are those incorporating, on street parking, hardstanding, or multi storey car parks.

Traffic distribution across the onsite road network ranges from lightly trafficked roads (e.g. Ada Lovelace) to more heavily trafficked roads such as Charles Babbage road. In assessing pollution risk, CIRIA C753 sets a threshold of 300 vehicle movements a day (Table 26.2).

Applying the pollution hazard indices for different land use classification and applying the threshold values for traffic movements; the total combined indices values for mitigation for pollution sources (multi storey/at grade car parking, and on street parking) would be as follows:

Traffic Movements/Day	Total Suspended Solids (TSS)	Metals	Hydro Carbons	Total Indices
>300	0.7	0.6	0.7	2.0
<300	0.5	0.4	0.4	1.3

Table A - Target Indices Values

In mitigating these target values, run off must be conveyed through the appropriate level of treatment stages within the SuDs train. PBA Drawing 31500/SK/WQ shows the post development catchments and treatment trains through which each catchment will flow.

Each of the SuDs elements forming the conveyance trains can be assigned a mitigation index, the total of which must exceed the total values set out in Table A in order to demonstrate effective treatment of flows.

Item	Subject
	The mitigation values for each catchment are also summarised in Table B.

Catchment	SuDs Element	Pollution Indices	Total Mitigation Indices
Western catchment (Green)	Lake and swale	2.0	2.75
Western car park areas (Green)	Proprietary treatment system	1.3	>1.3
Northern catchment (Blue)	Bio-retention zones	1.3	2.4
Southern catchment (A19/A18/A13) Pink	Swale	1.3	1.7
Northern /Central catchment (B08/B09/B07/B03/B02/B10 /B01/A17/A16/A14/A12) (Pink)	Bio Retention Zones	1.3	2.4
Northern catchment car park areas (B10/B01) Pink	Proprietary treatment system	1.3	>1.3
Eastern catchment (Brown) (A09a/A05b/A09b/A03/A04/ A08	Pond	1.3	1.9
Eastern catchment (Pink) (A11/A12/A07/A02) AO5a	Proprietary treatment system Swale	1.3 1.3	>1.3 1.7
Northern catchment car park (A01a) Pink	Proprietary treatment system	1.3	>1.3

Table B – Mitigation Indices Delivered

8 Conclusion

The redevelopment has the potential to increase pollutants entering the downstream receiving water bodies which are known to be sensitive. If not effectively mitigated, this could have a detrimental effect on water quality and ecology.

The SuDs Manual C753 sets out best practice for mitigating the effects of development on water quality. A range of SuDs measures can be used independently or in series to provide a treatment train, enabling flows to be conveyed through different stages of treatment where pollutants can be removed.

It is expected that plot developers will use the techniques set out in Table 26.7 to ensure water quality is not compromised. Furthermore, maintenance plans will be required to demonstrate that long term effectiveness of water treatment processes will not be compromised.

Each catchment has its own unique set of constraints requiring differing types of treatment. The proposed drainage strategy for West Cambridge sets out a number of different techniques which if implemented, should remove pollutants, such as metals, hydro carbons and total suspended solids from development areas.

Table B demonstrates that the risk of increased pollution risk from development can be adequately mitigated using a flexible range of SuDs techniques. Water quality can be maintained, and also help promote bio diversity within the existing and proposed green infrastructure areas.

Implementation of these measures should ensure there are no adverse impacts on either the Washpit Brook or Coton Brook.

Item	Subject
	APPENDIX 1 PBA Drawing No 31500/2001/149- 'Existing Drainage Arrangements'.

TECHNICAL NOTE

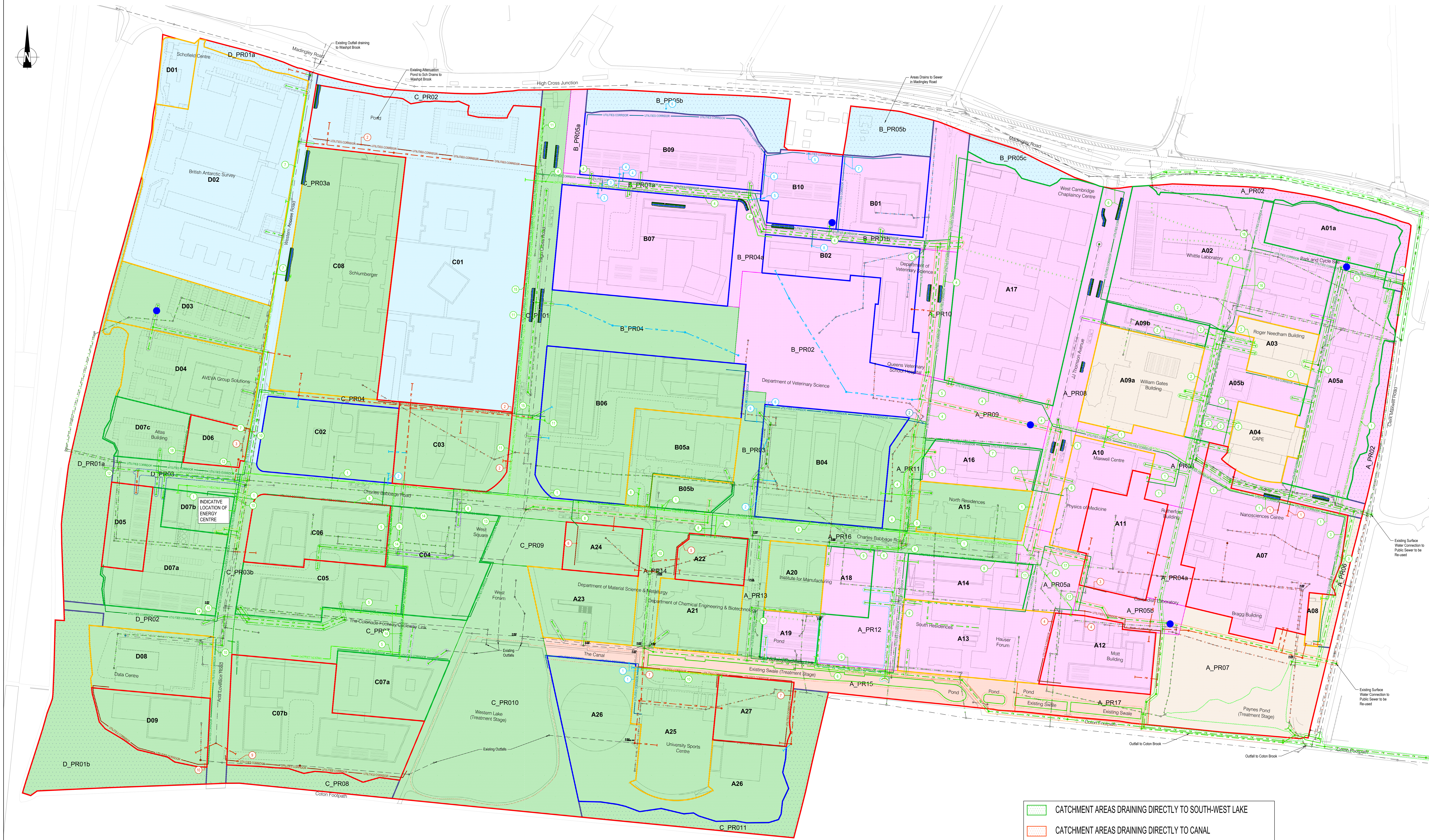
Item	Subject
	APPENDIX 2 PBA Drawing No 31500/SK/WQ1 – 'Proposed Water Quality Strategy'- SuDs Treatment'.

Item	Subject
	APPENDIX 3 The following sections provide further detail on the processes that will operate in mitigating potential pollution risks. **The following notes are reproduced from CIRIA C753.* **Sedimentation** Treatment effectiveness is strongly linked to the hydraulic control of runoff, ▪ Velocity control: sediment deposition, filtration and other removal processes occurring at low flow velocities during regular rainfall events (i.e through the control of velocities in SuDS components during frequent events, such as up to approximately the 1:1-year return period event) ▪ retention time: the removal of contaminants through settling, adsorption and other removal processes occurring (for events up to approximately the 1:1-year return period) over the period of time that the runoff is in contact with SuDS treatment media (e.g. the surface of a swale, the filtration media within a bio-retention system) or held within a permanent water storage volume (e.g. pond). Sedimentation is one of the primary removal mechanisms in SuDS. Most pollution in runoff is attached to sediment particles, and so removal of sediment results in a significant reduction in pollutant loads. Sedimentation is achieved by reducing flow velocities to a level at which the sediment particles fall out of suspension (finer particles requiring lower velocities) or by encouraging flocculation (which increases particle size). Very fine particles may remain in suspension and essentially be characterised as dissolved. Sediment requires periodic removal to permit the effective functioning of SuDS components. Sediment should be removed as far upstream in the drainage system as possible. Sediment control components that are located close to the runoff surface allow sediment build-up to occur gradually in dry features and at shallow depths, facilitating the breakdown and degradation of the organic particulates and straightforward and cost-effective sediment removal. Sediment trapping provides important removal of a range of contaminants that are adsorbed onto sediment surfaces and upstream sediment controls protect downstream components from damage or poor performance due to sediment build-up either on the surface or within subsurface media or soils. **Biofiltration** Pollutants that are conveyed in association with sediment may be filtered from runoff. This may occur through trapping within the soil or aggregate matrix, on plants or on geotextile layers within the construction. The location of any filtration will depend on the internal structure of the particular SuDS component. There will generally be a need to balance removal efficiency with the potential risk of blockage of the filtration component (and associated maintenance needs of the component, e.g. filter removal and replacement) although planting can often be used to help minimise blockage risks and lead to systems that are relatively self-maintaining. **Biodegradation** In addition to the physical and chemical processes that may occur on and within a SuDS component, biological treatment may also occur. Microbial communities are likely to be established within the soil or aggregate matrix, using the oxygen within the free-draining materials and the nutrients supplied with the inflows, to degrade organic pollutants such as oils and grease. The level of activity of such bioremediation will be affected by the environmental conditions such as temperature and the supply of oxygen and nutrients. It also depends on the physical conditions, such as the suitability of the materials for colonisation. Ammonia and ammonium ions can be oxidised by bacteria in the ground to form nitrate, which is a highly soluble form of nitrogen. Nitrate is readily used as a nutrient by plants. In oxygen-limiting conditions, anaerobic bacteria can facilitate denitrification, in which the participation of several species of bacteria can eventually result in the complete

Item	Subject
	reduction of nitrate to molecular nitrogen. This is an important process where excessive nitrate production threatens groundwater quality or eutrophication in surface waters. **Uptake by plants** In ponds and wetlands, uptake by plants (specifically via the biofilm growth around the plant structure) is an important removal mechanism for nutrients (phosphorous and nitrogen). Metals can also be removed in this manner, although intermittent maintenance may be required to remove the plants, otherwise there is the possibility that metals will be returned to the water when the plants die (Chapter 32). Die-back can also be accompanied by a release of nutrients. Plants also create suitable conditions for deposition of metals, such as sulphides, in the root zone and also provide a microbiological environment that supports the biodegradation of organic pollutants. **Photolysis** The breakdown of surface-held organic pollutants by exposure to UV light. **Proprietary Treatment Systems** Proprietary treatment systems are manufactured products that remove specified pollutants from surface water runoff. ***They are especially useful where site constraints preclude the use of other methods or where they offer specific benefits in facilitating the delivery of SuDS design criteria for a site. They are often (but not always) subsurface structures and can often be complementary to landscaped features, reducing pollutant levels in the runoff and protecting the amenity and/or biodiversity functionality of downstream SuDS components*****.** They can be useful in reducing the maintenance requirements of downstream SuDS or in avoiding the risk of disturbance of those areas during routine silt removal operations. Historically, they have only been considered as pre-treatment devices, but they can provide a valuable function in removing pollutants from runoff and may therefore be considered as an integral part of the Management Train in some situations. Systems are available that deliver reductions in a wide range of contaminants, and increasingly sophisticated proprietary systems are being developed for use in treating runoff from developments. When designed in accordance with C753 The SuDs Manual, SuDS components, such as pervious pavements and swales, generally deliver treatment alongside hydraulic control and amenity and biodiversity benefits. With proprietary treatment systems, Interception and attenuation will usually need to be delivered separately using either surface or subsurface storage, and alternative means of delivering amenity and biodiversity criteria will also need to be considered. **Hydrodynamic or vortex separators** The primary removal mechanism is sedimentation due to the increased residence time of water compared to a simple catch pit because the helical path from entrance to outlet is much longer than the straight distance between them. The circular movement also creates a vertical vortex (like a vertical whirlpool) in which the centrifugal forces created by the circular motion cause suspended particles to move to the centre of the device. Velocities here are lower and they settle down to a sump at the bottom. Vortex separators are most effective where the materials to be removed from runoff are able to be settled, or floatables (which can be captured). They cannot remove small diameter solids (e.g. < 115 µm) with poor settleability, emulsions or dissolved pollutants. Note that the removal of settleable particles is dependent on residence time and therefore flow rate. Reducing flow rates into a device increases residence time and enables removal of particles with longer settling times.

Item	Subject
	Proprietary filtration systems Filter systems work by routing surface water runoff through the filtering or sorbing medium, which traps particulates and/or soluble pollutants. They are particularly useful for removing small particles that may bypass any single gravitational process. Filtration systems can be purchased as prefabricated standard units or custom-made to suit site conditions. Some of the components on the market combine vortex separation and on-line filtration in one system. All events are treated by the vortex separator, with the filter then treating all flows up to the water quality treatment event. Excess flow will bypass the filter medium beneath the filter bed, thus avoiding the need for external diversion chambers. **Oil separators** Oil/water (or gravity) separators are widely used to prevent hazardous chemical and petroleum products from entering watercourses and public sewers. They should be installed close to the potential pollution source to minimise emulsification of oils and their coating of sediments. Separator designs are almost all based on the principle of separation by flotation, residence time and particle density and size. Globules of lower density oil or grease (LNAPLs) in clean non-turbulent water will rise due to buoyancy. The extent of particle displacement depends on the residence time. Once on the surface, they can be effectively removed by skimming, pumping etc. Gravity separators cannot be used for the removal of dissolved or emulsified oils and pollutants, such as coolants, soluble lubricants, glycols and alcohols. Since resuspension of accumulated sediments is possible during heavy storm events, separator units are typically installed offline. Gravity separators are available as prefabricated proprietary systems, but can also be built in situ. The facilities should comply with BS EN 858-1:2002. Guidance is also provided in Pollution Prevention Guidelines (PPG) 3 (EA/SEPA/EHSNI, 2006). The design criteria and specifications of a proprietary gravity separator unit should always be obtained from the manufacturer. There are two classes of systems. A Class 1 device means the resultant effluent should contain 5 mg/l hydrocarbon content or less under standard test conditions. Class 2 devices can contain up to 100 mg/l in their discharge and are appropriate where drainage is to a foul sewer. It should be noted that these are the test requirements; in practice the effluent may not meet these standards. Within the two classes are two types based on incoming and outgoing flow control – full retention or bypass separators. A full retention unit is designed to treat all the incoming flows to the designated class. Bypass separators are limited in treating events up to a certain flow rate, after which flows are bypassed to the receiving drainage system. Guidance on the selection of oil separators is provided in PPG 3 (EA/SEPA/EHSNI, 2006). The systems should be designed to be as shallow as possible but can often be located under roads, car parks and open space. There are instances where the use of proprietary SuDS can increase the length of time between maintenance for other components, and as a result can lower overall maintenance liability.

Appendix S Pollution Mitigation Strategy



NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM NEWLYN UNLESS NOTED OTHERWISE.
3. ALL COORDINATES ARE IN METRES RELATIVE TO ORDNANCE SURVEY NATIONAL GRID.
4. THE CONTRACTOR IS TO VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING WORK OR PREPARING SHOP DRAWINGS.
5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS AND ARCHITECTS DRAWINGS AND SPECIFICATIONS.
6. ALIGNMENT OF DRAINAGE/UTILITIES AND DISTRICT HEATING NETWORK ARE SHOWN INDICATIVELY FOR THE PURPOSE OF ESTABLISHING THE STRATEGY FOR THE OUTLINE PLANNING APPLICATION. THE EXACT ALIGNMENT, INCLUDING CO-ORDINATION WITH LANDSCAPING, WITH BE SUBJECT TO DESIGN DEVELOPMENT.
7. UTILITIES CORRIDOR ARE TO FOLLOW NJUG GUIDELINES "VOLUME 1 - NJUG GUIDELINES ON THE POSITIONING AND COLOUR CODING OF UNDERGROUND UTILITIES APPARATUS". ALL PIPE SIZES/DIAMETERS ARE SUBJECT TO CONFIRMATION BY THE RELEVANT UTILITIES COMPANY ONCE BUILDING DESIGN LOADS ARE CONFIRMED

LEGEND

PROPOSED:

- PROPOSED PHASE 1 INDICATIVE DISTRICT HEATING NETWORK
- PROPOSED PHASE 2 INDICATIVE DISTRICT HEATING NETWORK
- PROPOSED PHASE 3 INDICATIVE DISTRICT HEATING NETWORK
- PROPOSED PHASE 1 INDICATIVE UTILITIES CORRIDOR
- PROPOSED PHASE 2 INDICATIVE UTILITIES CORRIDOR
- PROPOSED PHASE 3 INDICATIVE UTILITIES CORRIDOR
- SEQUENCING FOR PHASE 1 DISTRICT HEATING NETWORK
- SEQUENCING FOR PHASE 2 DISTRICT HEATING NETWORK
- SEQUENCING FOR PHASE 3 DISTRICT HEATING NETWORK
- SEQUENCING FOR PHASE 1 UTILITIES CORRIDORS
- SEQUENCING FOR PHASE 2 UTILITIES CORRIDOR
- SEQUENCING FOR PHASE 3 UTILITIES CORRIDOR
- PHASE 1 PROPOSED SURFACE WATER DRAINAGE
- PHASE 1 PROPOSED FOUL WATER DRAINAGE
- PHASE 1 SURFACE DRAINAGE TO BE REMOVED
- PHASE 1 FOUL DRAINAGE TO BE REMOVED
- PHASE 2 PROPOSED SURFACE WATER DRAINAGE
- PHASE 2 PROPOSED FOUL WATER DRAINAGE
- PHASE 2 SURFACE DRAINAGE TO BE REMOVED
- PHASE 2 FOUL DRAINAGE TO BE REMOVED
- PHASE 3 PROPOSED SURFACE WATER DRAINAGE
- PHASE 3 PROPOSED FOUL WATER DRAINAGE
- PHASE 3 SURFACE DRAINAGE TO BE REMOVED
- PHASE 3 FOUL DRAINAGE TO BE REMOVED

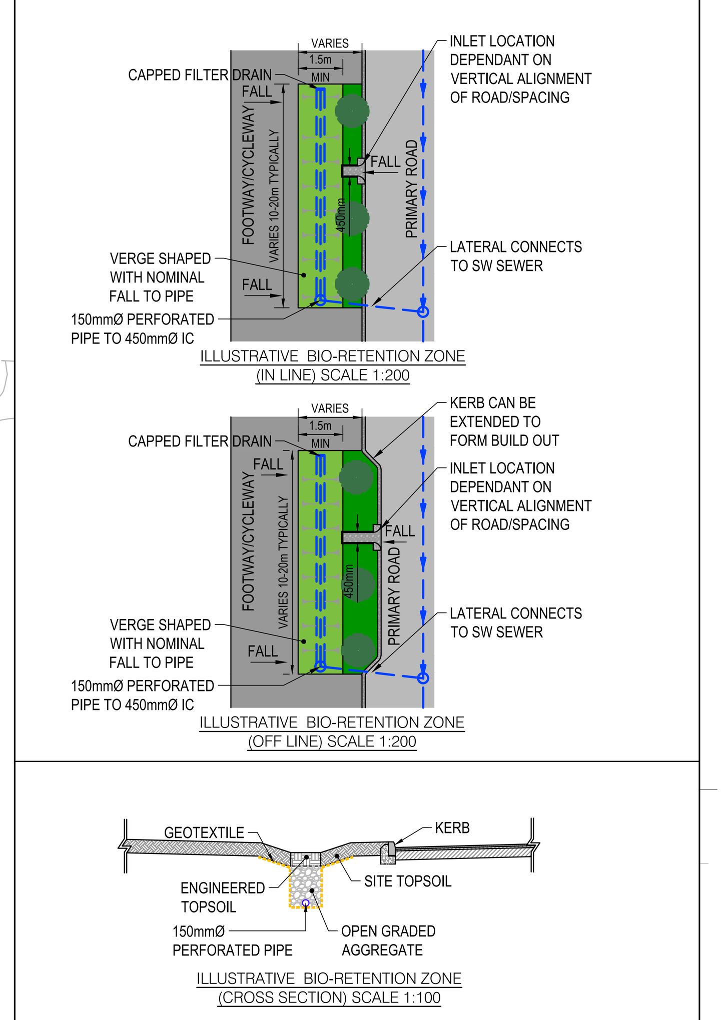
INFRASTRUCTURE (DRAINAGE) WORKS TRIGGERS

- CUED - PLOT A05a - REMOVES STORAGE AND FOUL CONNECTION FOR PLOTS A03, A04, A09 AND MSCP_A - PLOT A01a
- CYCLE HUB - PLOT B05b - INCREASED FLOW TO LAKE TRIGGERING LOWERING OF FLOW CONTROL
- CAVENDISH III - PLOT A17 - ALSO PROVIDES CONNECTION POINTS FOR PLOT A16 - SHARED FACILITIES HUB
- ENERGY CENTRE - PLOT D07b
- WEST FORUM - PLOT C04
- DEMOLITION OF ATLAS BUILDING AND PROVISION FOR AT-GRADE CAR PARKING - PLOT C07c
- ECO NORTH - PLOT C05
- PLOT A18 & A19
- MSCP_D - PLOT D07a
- LAKE WEST - PLOT C07a
- ENG 1 - PLOT A02 - & COMP LAB 2 - PLOT A09b
- INNOVATION CENTRE - PLOT A14
- ALL PHASE 1 PUBLIC REALM AREAS NOT COVERED BY OTHER STAGES

EXISTING:

- EXISTING FOUL WATER
- EXISTING SURFACE WATER

CATCHMENT AREAS



THIS DRAWING IS TO BE READ IN CONJUNCTION WITH TN 010 (SUPPLEMENTARY TECHNICAL NOTE TO WEST CAMBRIDGE (FRA) WATER QUALITY MITIGATION MEASURES).

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
PRELIMINARY

WEST CAMBRIDGE
PROPOSED WATER QUALITY STRATEGY

Client: UNIVERSITY OF CAMBRIDGE

Date of 1st Issue	Designed	Drawn
22.05.2017	ST	GC
A0 Scale	Checked	Approved
1:1250	ST	-

Drawing Number: 38814/2001/168
Revision: -

peterbrett
Offices throughout the UK and Europe
www.peterbrett.com

CAMBRIDGE
Tel: 01223 882000

File Location: j:\38814 - west cambridge\cad\dwgs\38814_2001_168 proposed water quality strategy.dwg

Appendix T Greenfield Run Off Rate Calculations (IoH 124 Method)

Job no:	31500
Calculation by:	CLW
Checked by:	
Date:	15/01/2015

Telford House
Fulbourn
Cambridge
CB1 5HB

Telephone 01223 882000
Fax 01223 881888
e-mail cambridge@hannahreed.co.uk

Notes
The purpose of this calculation is to re-estimate greenfield run-off rates for a development site off Madingley Road, Cambridge

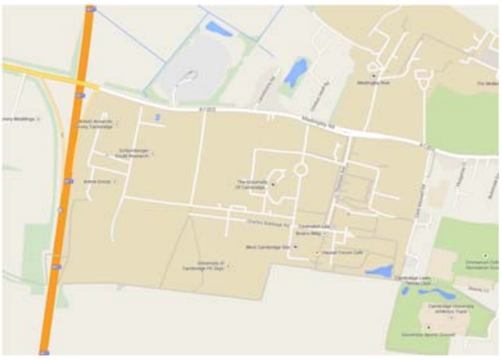
Calculation Brief

Calculate greenfield run-off rates for Madingley Road development:

- Rates previously estimated under job code:
- New plans to infill additional development on site
- EA have requested betterment to improve existing flood risk to properties downstream
- Sensitivity and range of greenfield estimates and QBAR required.

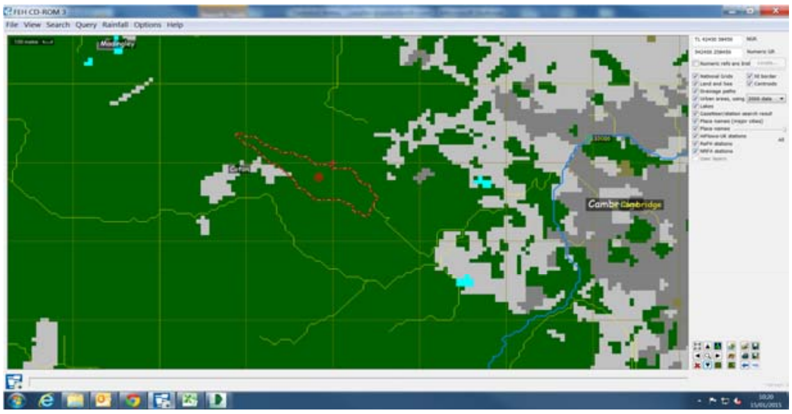
Site Overview

West Cambridge site is located between Madingley Road (A1303) and the M11, at approximately TL 426 590.
The site has been recently developed and drains south-eastwards via balancing ponds to Coton Brook.



Catchment Descriptors

The nearest catchment on the FEH CD-Rom appears to be: TL 42450 58450



VERSION	FEH CD-RO	Version	3	exported at
CATCHMEI	GB	542450	258450	TL 42450 58450
CENTROID	GB	541839	258808	TL 41839 58808
AREA	0.5			
ALTBAR	22			
ASPBAR	141			
ASPVAR	0.69			
BFIHOST	0.284	Not permeable		
DPLBAR	0.96			
DPSBAR	14.7			
FARL	1	No reservoir influence		
FPEXT	0.1443			
FPDBAR	0.587			
FPLOC	0.626			
LDP	2.18			
PROPWET	0.26			
RMED-1H	10.8			
RMED-1D	28.7			
RMED-2D	35.1			
SAAR	553			
SAAR4170	552			
SPRHOST	57.81	Not permeable		
URBCONC1	-999999			
URBEXT19	0	Not urban		
URBLOC19	-999999			
URBCONC2	-999999			
URBEXT20	0.0025	Not urban		
URBLOC20	-999999			
C	-0.02629			
D1	0.31375			
D2	0.26481			
D3	0.29901			
E	0.318			
F	2.44303			
C(1 km)	-0.026			
D1(1 km)	0.315			
D2(1 km)	0.261			
D3(1 km)	0.301			
E(1 km)	0.318			
F(1 km)	2.442			

Method Statement

EA Flow Estimation Guidelines recommends using FEH methods for small catchments and greenfield runoff, following SC090031.

"The current versions of the FEH statistical approach or the ReFH rainfall-runoff model should be used … For catchments smaller than 0.5 km2, runoff estimates should be derived from FEH methods applied to the nearest suitable catchment above 0.5 km2 for which descriptors can be derived from the FEH CD-Rom and scaled down by the ratio of catchment areas".

IoH 124 is however commonly recommended for greenfield runoff estimation in a wide range of guidance documents including the SUDS manual.
This recommendation was aimed largely at meeting the pragmatic needs of the industry, as the calculation is more straightforward.

In this study, use both IoH124 and ReFH methods and compare results.

Previous Greenfield Runoff Calcs

Extract from Phase 3 Infrastructure Surface Water Drainage Calculations (C-208087/RevA/August 2010):

In order to avoid an excessively large lake the Environment Agency (EA) has agreed to a staged outfall from the attenuation facility with discharge limited to the equivalent rural run-off rates for 100%, 3.33% and 1% annual probability rainfall events.

Rural run-off rates were estimated using the IoH124 method for a 50ha area, adjusted on a pro-rata basis to suit the actual catchment being considered here. This pro-rata adjustment follows the guidelines set out within IoH124.

Return Period	50 ha (l/s)	l/s/ha
100% (1yr)	144.1	2.88
3.33% (30yr)	398.0	7.96
1% (100yr)	589.7	11.79

The retained water level of the lake will be 15.30m AOD, this level will be maintained by a weir within the control structure. Discharge from the lake will be controlled by three in line staged vortex controls (Hydrobrakes) designed to regulate flows to the rural run-off rates described above. The calculations indicate that the top water level generated by a 1 in 100 year event + 30%cc will be 16.186m AOD, and this will be the level of the emergency overflow weir within the control structure. An extreme rainfall event may generate a higher water level, and in such a situation water will overflow the weir and into the swale. The swale will convey the flow to the Coton Ditch, which flows in an easterly direction to its outfall into a drain which runs beneath the Emmanuel College sports ground and into the sewer system on Wilberforce Road. Downstream protection to the more urban residential catchment will be achieved by the restriction on flow imposed by this 450mm diameter drain, with any above ground flooding contained within the sports ground area in the vicinity of the drain's inlet.

IH 124 Mean Annual Flood

Input

Return Period (years)	100	SAAR (mm)	550.000	Urban	0.000
Area (Ha)	50.000	Soil	0.450	Region Number	5

Results	l/s
QBAR Rural	165.7
QBAR Urban	165.7
Q 100 years	589.7
Q 1 year	144.1
Q 2 years	148.0
Q 5 years	213.7
Q 10 years	274.2
Q 20 years	346.3
Q 25 years	374.7
Q 30 years	398.0
Q 50 years	470.8
Q 100 years	589.7
Q 200 years	694.1
Q 250 years	727.2
Q 1000 years	954.2

Previous greenfield runoff estimates are as follows:

1 yr	2.88 l/s/ha
30 yr	7.96 l/s/ha
100 yr	11.79 l/s/ha

IoH 124 Method Summary

See separate IoH124 calculation sheet.

Summary of results:

Input data:	Area	0.5		
	SAAR	553		
	Soil	0.45		
	Region	5		
				Previous assessment:
Results:	QBAR	3.33	l/s/ha	3.31
	2 yr	2.97	l/s/ha	2.96
	30 yr	7.89	l/s/ha	7.96
	100 yr	11.87	l/s/ha	11.79

These results support those of the previous IoH124 assessment in MicroDrainage.

ReFH Method Summary

Catchment descriptors were input to a ReFH unit in ISIS.
Storm duration optimised to 6.1 hrs for 100 yr event.
All other options set to default.

Peak flow (m3/s)	0.177	0.382	0.515
Peak flow (l/s/ha)	3.54	7.64	10.3

Time (hr)	WCamb_2y	WCamb_3(	WCamb_100yr
0	0.0138	0.0138	0.0138
0.1	0.0138	0.0138	0.0138
0.2	0.0137	0.0138	0.0138
0.3	0.0137	0.0138	0.0139
0.4	0.0138	0.0139	0.014
0.5	0.0138	0.0141	0.0143
0.6	0.0139	0.0143	0.0146
0.7	0.014	0.0146	0.015
0.8	0.0142	0.015	0.0154
0.9	0.0144	0.0155	0.016
1	0.0146	0.016	0.0167
1.1	0.0149	0.0167	0.0176
1.2	0.0153	0.0174	0.0185
1.3	0.0156	0.0183	0.0197
1.4	0.0161	0.0193	0.021
1.5	0.0166	0.0204	0.0225
1.6	0.0173	0.0218	0.0242
1.7	0.0179	0.0232	0.0261
1.8	0.0187	0.0249	0.0282
1.9	0.0196	0.0268	0.0307
2	0.0206	0.029	0.0334
2.1	0.0217	0.0314	0.0365
2.2	0.023	0.034	0.04
2.3	0.0244	0.037	0.0439
2.4	0.0259	0.0403	0.0482
2.5	0.0277	0.0441	0.053
2.6	0.0296	0.0482	0.0584
2.7	0.0318	0.0528	0.0643
2.8	0.0341	0.0579	0.071
2.9	0.0367	0.0635	0.0784
3	0.0396	0.0697	0.0866
3.1	0.0428	0.0766	0.0956
3.2	0.0463	0.0841	0.106
3.3	0.05	0.0922	0.116
3.4	0.0539	0.101	0.128
3.5	0.058	0.11	0.14
3.6	0.0624	0.119	0.152
3.7	0.0668	0.129	0.166
3.8	0.0715	0.139	0.179

3.9	0.0762	0.15	0.193
4	0.081	0.161	0.208
4.1	0.086	0.172	0.222
4.2	0.0909	0.183	0.237
4.3	0.096	0.194	0.253
4.4	0.101	0.205	0.268
4.5	0.106	0.217	0.283
4.6	0.111	0.228	0.299
4.7	0.116	0.239	0.314
4.8	0.121	0.251	0.33
4.9	0.126	0.262	0.345
5	0.131	0.273	0.36
5.1	0.136	0.284	0.375
5.2	0.14	0.294	0.39
5.3	0.145	0.305	0.404
5.4	0.149	0.315	0.418
5.5	0.153	0.324	0.431
5.6	0.157	0.333	0.443
5.7	0.161	0.342	0.455
5.8	0.164	0.35	0.466
5.9	0.167	0.357	0.477
6	0.17	0.363	0.486
6.1	0.172	0.369	0.494
6.2	0.174	0.373	0.5
6.3	0.175	0.377	0.506
6.4	0.176	0.38	0.51
6.5	0.177	0.381	0.513
6.6	0.177	0.382	0.514
6.7	0.177	0.382	0.515
6.8	0.177	0.382	0.514
6.9	0.176	0.381	0.513
7	0.175	0.379	0.511
7.1	0.174	0.376	0.508
7.2	0.172	0.373	0.504
7.3	0.171	0.37	0.5
7.4	0.169	0.366	0.495
7.5	0.167	0.362	0.49
7.6	0.165	0.358	0.484
7.7	0.162	0.353	0.477
7.8	0.16	0.348	0.47
7.9	0.158	0.342	0.463
8	0.155	0.337	0.456
8.1	0.152	0.331	0.448
8.2	0.15	0.325	0.44
8.3	0.147	0.319	0.432
8.4	0.144	0.313	0.423
8.5	0.141	0.306	0.415
8.6	0.138	0.3	0.406
8.7	0.136	0.294	0.398
8.8	0.133	0.287	0.389

8.9	0.13	0.281	0.38
9	0.127	0.274	0.372
9.1	0.124	0.268	0.363
9.2	0.121	0.262	0.355
9.3	0.119	0.256	0.346
9.4	0.116	0.25	0.338
9.5	0.114	0.244	0.33
9.6	0.111	0.239	0.323
9.7	0.109	0.233	0.315
9.8	0.106	0.228	0.308
9.9	0.104	0.223	0.301
10	0.102	0.218	0.295
10.1	0.0998	0.213	0.288
10.2	0.0977	0.209	0.282
10.3	0.0957	0.204	0.275
10.4	0.0936	0.2	0.269
10.5	0.0917	0.195	0.263
10.6	0.0897	0.191	0.257
10.7	0.0878	0.186	0.251
10.8	0.0859	0.182	0.246
10.9	0.084	0.178	0.24
11	0.0822	0.174	0.234
11.1	0.0803	0.17	0.229
11.2	0.0785	0.166	0.223
11.3	0.0767	0.162	0.218
11.4	0.0749	0.158	0.213
11.5	0.0732	0.154	0.207
11.6	0.0714	0.15	0.202
11.7	0.0697	0.146	0.197
11.8	0.068	0.142	0.192
11.9	0.0663	0.139	0.187
12	0.0646	0.135	0.182
12.1	0.0629	0.131	0.177
12.2	0.0613	0.128	0.172
12.3	0.0596	0.124	0.167
12.4	0.058	0.12	0.162
12.5	0.0564	0.117	0.157
12.6	0.0548	0.113	0.152
12.7	0.0533	0.11	0.147
12.8	0.0517	0.106	0.143
12.9	0.0501	0.103	0.138
13	0.0486	0.0995	0.133
13.1	0.0471	0.0961	0.129
13.2	0.0456	0.0928	0.124
13.3	0.0442	0.0896	0.12
13.4	0.0428	0.0864	0.116
13.5	0.0414	0.0833	0.111
13.6	0.0401	0.0803	0.107
13.7	0.0387	0.0774	0.103
13.8	0.0375	0.0745	0.0993

13.9	0.0363	0.0718	0.0956
14	0.0351	0.0692	0.092
14.1	0.034	0.0667	0.0886
14.2	0.033	0.0644	0.0854
14.3	0.0321	0.0622	0.0824
14.4	0.0312	0.0602	0.0796
14.5	0.0304	0.0584	0.0771
14.6	0.0296	0.0567	0.0747
14.7	0.0289	0.0551	0.0725
14.8	0.0283	0.0537	0.0705
14.9	0.0277	0.0524	0.0687
15	0.0272	0.0512	0.067
15.1	0.0267	0.0501	0.0655
15.2	0.0262	0.0491	0.0641
15.3	0.0258	0.0481	0.0628
15.4	0.0255	0.0473	0.0616
15.5	0.0251	0.0465	0.0605
15.6	0.0248	0.0458	0.0595
15.7	0.0245	0.0451	0.0586
15.8	0.0242	0.0445	0.0578
15.9	0.024	0.044	0.057
16	0.0237	0.0435	0.0563
16.1	0.0235	0.043	0.0557
16.2	0.0233	0.0426	0.0551
16.3	0.0232	0.0423	0.0546
16.4	0.023	0.0419	0.0542
16.5	0.0228	0.0416	0.0537
16.6	0.0227	0.0413	0.0533
16.7	0.0226	0.041	0.053
16.8	0.0225	0.0408	0.0527
16.9	0.0224	0.0406	0.0524
17	0.0222	0.0404	0.0521
17.1	0.0222	0.0402	0.0519
17.2	0.0221	0.04	0.0517
17.3	0.022	0.0399	0.0515
17.4	0.0219	0.0398	0.0513
17.5	0.0218	0.0396	0.0511
17.6	0.0218	0.0395	0.0509
17.7	0.0217	0.0393	0.0507
17.8	0.0216	0.0392	0.0506
17.9	0.0215	0.0391	0.0504
18	0.0215	0.0389	0.0502
18.1	0.0214	0.0388	0.05
18.2	0.0213	0.0387	0.0499
18.3	0.0212	0.0385	0.0497
18.4	0.0212	0.0384	0.0495
18.5	0.0211	0.0382	0.0493
18.6	0.021	0.0381	0.0492
18.7	0.0209	0.038	0.049
18.8	0.0209	0.0378	0.0488

18.9	0.0208	0.0377	0.0487
19	0.0207	0.0376	0.0485
19.1	0.0206	0.0375	0.0483
19.2	0.0206	0.0373	0.0481
19.3	0.0205	0.0372	0.048
19.4	0.0204	0.0371	0.0478
19.5	0.0204	0.0369	0.0476
19.6	0.0203	0.0368	0.0475
19.7	0.0202	0.0367	0.0473
19.8	0.0201	0.0365	0.0471
19.9	0.0201	0.0364	0.047
20	0.02	0.0363	0.0468
20.1	0.0199	0.0362	0.0467
20.2	0.0199	0.036	0.0465
20.3	0.0198	0.0359	0.0463
20.4	0.0197	0.0358	0.0462
20.5	0.0197	0.0357	0.046
20.6	0.0196	0.0355	0.0458
20.7	0.0195	0.0354	0.0457
20.8	0.0194	0.0353	0.0455
20.9	0.0194	0.0352	0.0454
21	0.0193	0.035	0.0452
21.1	0.0192	0.0349	0.045
21.2	0.0192	0.0348	0.0449
21.3	0.0191	0.0347	0.0447
21.4	0.019	0.0346	0.0446
21.5	0.019	0.0344	0.0444
21.6	0.0189	0.0343	0.0443
21.7	0.0188	0.0342	0.0441
21.8	0.0188	0.0341	0.044
21.9	0.0187	0.034	0.0438
22	0.0186	0.0338	0.0436
22.1	0.0186	0.0337	0.0435
22.2	0.0185	0.0336	0.0433
22.3	0.0185	0.0335	0.0432
22.4	0.0184	0.0334	0.043
22.5	0.0183	0.0332	0.0429
22.6	0.0183	0.0331	0.0427
22.7	0.0182	0.033	0.0426
22.8	0.0181	0.0329	0.0424
22.9	0.0181	0.0328	0.0423
23	0.018	0.0327	0.0421
23.1	0.0179	0.0326	0.042
23.2	0.0179	0.0324	0.0418
23.3	0.0178	0.0323	0.0417
23.4	0.0178	0.0322	0.0416
23.5	0.0177	0.0321	0.0414
23.6	0.0176	0.032	0.0413
23.7	0.0176	0.0319	0.0411
23.8	0.0175	0.0318	0.041

23.9	0.0174	0.0317	0.0408
24	0.0174	0.0315	0.0407
24.1	0.0173	0.0314	0.0405
24.2	0.0173	0.0313	0.0404
24.3	0.0172	0.0312	0.0403
24.4	0.0171	0.0311	0.0401
24.5	0.0171	0.031	0.04
24.6	0.017	0.0309	0.0398
24.7	0.017	0.0308	0.0397
24.8	0.0169	0.0307	0.0396
24.9	0.0168	0.0306	0.0394
25	0.0168	0.0305	0.0393
25.1	0.0167	0.0304	0.0392
25.2	0.0167	0.0302	0.039
25.3	0.0166	0.0301	0.0389
25.4	0.0166	0.03	0.0387
25.5	0.0165	0.0299	0.0386
25.6	0.0164	0.0298	0.0385
25.7	0.0164	0.0297	0.0383
25.8	0.0163	0.0296	0.0382
25.9	0.0163	0.0295	0.0381
26	0.0162	0.0294	0.0379
26.1	0.0162	0.0293	0.0378
26.2	0.0161	0.0292	0.0377
26.3	0.016	0.0291	0.0375
26.4	0.016	0.029	0.0374
26.5	0.0159	0.0289	0.0373
26.6	0.0159	0.0288	0.0371
26.7	0.0158	0.0287	0.037
26.8	0.0158	0.0286	0.0369
26.9	0.0157	0.0285	0.0368
27	0.0157	0.0284	0.0366
27.1	0.0156	0.0283	0.0365
27.2	0.0155	0.0282	0.0364
27.3	0.0155	0.0281	0.0362
27.4	0.0154	0.028	0.0361
27.5	0.0154	0.0279	0.036
27.6	0.0153	0.0278	0.0359
27.7	0.0153	0.0277	0.0357
27.8	0.0152	0.0276	0.0356
27.9	0.0152	0.0275	0.0355
28	0.0151	0.0274	0.0354
28.1	0.0151	0.0273	0.0352
28.2	0.015	0.0272	0.0351
28.3	0.015	0.0271	0.035
28.4	0.0149	0.027	0.0349
28.5	0.0148	0.0269	0.0348
28.6	0.0148	0.0268	0.0346
28.7	0.0147	0.0268	0.0345
28.8	0.0147	0.0267	0.0344

28.9	0.0146	0.0266	0.0343
29	0.0146	0.0265	0.0342
29.1	0.0145	0.0264	0.034
29.2	0.0145	0.0263	0.0339
29.3	0.0144	0.0262	0.0338
29.4	0.0144	0.0261	0.0337
29.5	0.0143	0.026	0.0336
29.6	0.0143	0.0259	0.0334
29.7	0.0142	0.0258	0.0333
29.8	0.0142	0.0257	0.0332
29.9	0.0141	0.0257	0.0331
30	0.0141	0.0256	0.033
30.1	0.014	0.0255	0.0329
30.2	0.014	0.0254	0.0327
30.3	0.0139	0.0253	0.0326
30.4	0.0139	0.0252	0.0325
30.5	0.0138	0.0251	0.0324
30.6	0.0138	0.025	0.0323
30.7	0.0137	0.0249	0.0322
30.8	0.0137	0.0249	0.0321
30.9	0.0137	0.0248	0.032
31	0.0136	0.0247	0.0318
31.1	0.0136	0.0246	0.0317
31.2	0.0135	0.0245	0.0316
31.3	0.0135	0.0244	0.0315
31.4	0.0134	0.0243	0.0314
31.5	0.0134	0.0243	0.0313
31.6	0.0133	0.0242	0.0312
31.7	0.0133	0.0241	0.0311
31.8	0.0132	0.024	0.031
31.9	0.0132	0.0239	0.0309
32	0.0131	0.0238	0.0307
32.1	0.0131	0.0237	0.0306
32.2	0.013	0.0237	0.0305
32.3	0.013	0.0236	0.0304
32.4	0.013	0.0235	0.0303
32.5	0.0129	0.0234	0.0302
32.6	0.0129	0.0233	0.0301
32.7	0.0128	0.0233	0.03
32.8	0.0128	0.0232	0.0299
32.9	0.0127	0.0231	0.0298
33	0.0127	0.023	0.0297
33.1	0.0126	0.0229	0.0296
33.2	0.0126	0.0229	0.0295
33.3	0.0126	0.0228	0.0294
33.4	0.0125	0.0227	0.0293
33.5	0.0125	0.0226	0.0292
33.6	0.0124	0.0225	0.0291
33.7	0.0124	0.0225	0.029
33.8	0.0123	0.0224	0.0289

33.9	0.0123	0.0223	0.0288
34	0.0122	0.0222	0.0287
34.1	0.0122	0.0221	0.0286
34.2	0.0122	0.0221	0.0285
34.3	0.0121	0.022	0.0284
34.4	0.0121	0.0219	0.0283
34.5	0.012	0.0218	0.0282
34.6	0.012	0.0218	0.0281
34.7	0.0119	0.0217	0.028
34.8	0.0119	0.0216	0.0279
34.9	0.0119	0.0215	0.0278
35	0.0118	0.0215	0.0277
35.1	0.0118	0.0214	0.0276
35.2	0.0117	0.0213	0.0275
35.3	0.0117	0.0212	0.0274
35.4	0.0117	0.0212	0.0273
35.5	0.0116	0.0211	0.0272
35.6	0.0116	0.021	0.0271
35.7	0.0115	0.0209	0.027
35.8	0.0115	0.0209	0.0269
35.9	0.0115	0.0208	0.0268
36	0.0114	0.0207	0.0267
36.1	0.0114	0.0206	0.0266
36.2	0.0113	0.0206	0.0265
36.3	0.0113	0.0205	0.0264
36.4	0.0113	0.0204	0.0264
36.5	0.0112	0.0204	0.0263
36.6	0.0112	0.0203	0.0262
36.7	0.0111	0.0202	0.0261
36.8	0.0111	0.0201	0.026
36.9	0.0111	0.0201	0.0259
37	0.011	0.02	0.0258
37.1	0.011	0.0199	0.0257
37.2	0.0109	0.0199	0.0256
37.3	0.0109	0.0198	0.0255
37.4	0.0109	0.0197	0.0254
37.5	0.0108	0.0197	0.0254
37.6	0.0108	0.0196	0.0253
37.7	0.0108	0.0195	0.0252
37.8	0.0107	0.0194	0.0251
37.9	0.0107	0.0194	0.025
38	0.0106	0.0193	0.0249
38.1	0.0106	0.0192	0.0248
38.2	0.0106	0.0192	0.0247
38.3	0.0105	0.0191	0.0247
38.4	0.0105	0.019	0.0246
38.5	0.0105	0.019	0.0245
38.6	0.0104	0.0189	0.0244
38.7	0.0104	0.0188	0.0243
38.8	0.0104	0.0188	0.0242

38.9	0.0103	0.0187	0.0241
39	0.0103	0.0186	0.0241
39.1	0.0102	0.0186	0.024
39.2	0.0102	0.0185	0.0239
39.3	0.0102	0.0185	0.0238
39.4	0.0101	0.0184	0.0237
39.5	0.0101	0.0183	0.0236
39.6	0.0101	0.0183	0.0236
39.7	0.01	0.0182	0.0235
39.8	0.00999	0.0181	0.0234
39.9	0.00996	0.0181	0.0233
40	0.00992	0.018	0.0232
40.1	0.00989	0.0179	0.0231
40.2	0.00985	0.0179	0.0231
40.3	0.00982	0.0178	0.023
40.4	0.00979	0.0178	0.0229
40.5	0.00975	0.0177	0.0228
40.6	0.00972	0.0176	0.0227
40.7	0.00968	0.0176	0.0227
40.8	0.00965	0.0175	0.0226
40.9	0.00962	0.0174	0.0225
41	0.00958	0.0174	0.0224
41.1	0.00955	0.0173	0.0224
41.2	0.00952	0.0173	0.0223
41.3	0.00948	0.0172	0.0222
41.4	0.00945	0.0171	0.0221
41.5	0.00942	0.0171	0.022
41.6	0.00938	0.017	0.022
41.7	0.00935	0.017	0.0219
41.8	0.00932	0.0169	0.0218
41.9	0.00928	0.0168	0.0217
42	0.00925	0.0168	0.0217
42.1	0.00922	0.0167	0.0216
42.2	0.00919	0.0167	0.0215
42.3	0.00916	0.0166	0.0214
42.4	0.00912	0.0166	0.0214
42.5	0.00909	0.0165	0.0213
42.6	0.00906	0.0164	0.0212
42.7	0.00903	0.0164	0.0211
42.8	0.009	0.0163	0.0211
42.9	0.00897	0.0163	0.021
43	0.00893	0.0162	0.0209
43.1	0.0089	0.0162	0.0208
43.2	0.00887	0.0161	0.0208
43.3	0.00884	0.016	0.0207
43.4	0.00881	0.016	0.0206
43.5	0.00878	0.0159	0.0205
43.6	0.00875	0.0159	0.0205
43.7	0.00872	0.0158	0.0204
43.8	0.00869	0.0158	0.0203

43.9	0.00866	0.0157	0.0203
44	0.00863	0.0157	0.0202
44.1	0.0086	0.0156	0.0201
44.2	0.00857	0.0155	0.02
44.3	0.00854	0.0155	0.02
44.4	0.00851	0.0154	0.0199
44.5	0.00848	0.0154	0.0198
44.6	0.00845	0.0153	0.0198
44.7	0.00842	0.0153	0.0197
44.8	0.00839	0.0152	0.0196
44.9	0.00836	0.0152	0.0196
45	0.00833	0.0151	0.0195
45.1	0.0083	0.0151	0.0194
45.2	0.00827	0.015	0.0194
45.3	0.00824	0.015	0.0193
45.4	0.00821	0.0149	0.0192
45.5	0.00818	0.0148	0.0192
45.6	0.00816	0.0148	0.0191
45.7	0.00813	0.0147	0.019
45.8	0.0081	0.0147	0.019
45.9	0.00807	0.0146	0.0189
46	0.00804	0.0146	0.0188
46.1	0.00801	0.0145	0.0188
46.2	0.00799	0.0145	0.0187
46.3	0.00796	0.0144	0.0186
46.4	0.00793	0.0144	0.0186
46.5	0.0079	0.0143	0.0185
46.6	0.00788	0.0143	0.0184
46.7	0.00785	0.0142	0.0184
46.8	0.00782	0.0142	0.0183
46.9	0.00779	0.0141	0.0182
47	0.00777	0.0141	0.0182
47.1	0.00774	0.014	0.0181
47.2	0.00771	0.014	0.018
47.3	0.00768	0.0139	0.018
47.4	0.00766	0.0139	0.0179
47.5	0.00763	0.0138	0.0179
47.6	0.0076	0.0138	0.0178
47.7	0.00758	0.0137	0.0177
47.8	0.00755	0.0137	0.0177
47.9	0.00752	0.0137	0.0176
48	0.0075	0.0136	0.0175
48.1	0.00747	0.0136	0.0175
48.2	0.00745	0.0135	0.0174
48.3	0.00742	0.0135	0.0174
48.4	0.00739	0.0134	0.0173
48.5	0.00737	0.0134	0.0172
48.6	0.00734	0.0133	0.0172
48.7	0.00732	0.0133	0.0171
48.8	0.00729	0.0132	0.0171

48.9	0.00727	0.0132	0.017
49	0.00724	0.0131	0.0169
49.1	0.00721	0.0131	0.0169
49.2	0.00719	0.013	0.0168
49.3	0.00716	0.013	0.0168
49.4	0.00714	0.013	0.0167
49.5	0.00711	0.0129	0.0167
49.6	0.00709	0.0129	0.0166
49.7	0.00706	0.0128	0.0165
49.8	0.00704	0.0128	0.0165
49.9	0.00702	0.0127	0.0164
50	0.00699	0.0127	0.0164
50.1	0.00697	0.0126	0.0163
50.2	0.00694	0.0126	0.0162
50.3	0.00692	0.0126	0.0162
50.4	0.00689	0.0125	0.0161
50.5	0.00687	0.0125	0.0161
50.6	0.00685	0.0124	0.016
50.7	0.00682	0.0124	0.016
50.8	0.0068	0.0123	0.0159
50.9	0.00677	0.0123	0.0159
51	0.00675	0.0122	0.0158
51.1	0.00673	0.0122	0.0157
51.2	0.0067	0.0122	0.0157
51.3	0.00668	0.0121	0.0156
51.4	0.00666	0.0121	0.0156
51.5	0.00663	0.012	0.0155
51.6	0.00661	0.012	0.0155
51.7	0.00659	0.012	0.0154
51.8	0.00656	0.0119	0.0154
51.9	0.00654	0.0119	0.0153
52	0.00652	0.0118	0.0153
52.1	0.00649	0.0118	0.0152
52.2	0.00647	0.0117	0.0151
52.3	0.00645	0.0117	0.0151
52.4	0.00643	0.0117	0.015
52.5	0.0064	0.0116	0.015
52.6	0.00638	0.0116	0.0149
52.7	0.00636	0.0115	0.0149
52.8	0.00634	0.0115	0.0148
52.9	0.00632	0.0115	0.0148
53	0.00629	0.0114	0.0147
53.1	0.00627	0.0114	0.0147
53.2	0.00625	0.0113	0.0146
53.3	0.00623	0.0113	0.0146
53.4	0.00621	0.0113	0.0145
53.5	0.00618	0.0112	0.0145
53.6	0.00616	0.0112	0.0144
53.7	0.00614	0.0111	0.0144
53.8	0.00612	0.0111	0.0143

53.9	0.0061	0.0111	0.0143
54	0.00608	0.011	0.0142
54.1	0.00606	0.011	0.0142
54.2	0.00603	0.0109	0.0141
54.3	0.00601	0.0109	0.0141
54.4	0.00599	0.0109	0.014
54.5	0.00597	0.0108	0.014
54.6	0.00595	0.0108	0.0139
54.7	0.00593	0.0108	0.0139
54.8	0.00591	0.0107	0.0138
54.9	0.00589	0.0107	0.0138
55	0.00587	0.0106	0.0137
55.1	0.00585	0.0106	0.0137
55.2	0.00583	0.0106	0.0136
55.3	0.00581	0.0105	0.0136
55.4	0.00579	0.0105	0.0135
55.5	0.00577	0.0105	0.0135
55.6	0.00575	0.0104	0.0134
55.7	0.00572	0.0104	0.0134
55.8	0.0057	0.0104	0.0134
55.9	0.00568	0.0103	0.0133
56	0.00567	0.0103	0.0133
56.1	0.00565	0.0102	0.0132
56.2	0.00563	0.0102	0.0132
56.3	0.00561	0.0102	0.0131
56.4	0.00559	0.0101	0.0131
56.5	0.00557	0.0101	0.013
56.6	0.00555	0.0101	0.013
56.7	0.00553	0.01	0.0129
56.8	0.00551	0.00999	0.0129
56.9	0.00549	0.00996	0.0128
57	0.00547	0.00992	0.0128
57.1	0.00545	0.00989	0.0128
57.2	0.00543	0.00986	0.0127
57.3	0.00541	0.00982	0.0127
57.4	0.00539	0.00979	0.0126
57.5	0.00537	0.00975	0.0126
57.6	0.00536	0.00972	0.0125
57.7	0.00534	0.00968	0.0125
57.8	0.00532	0.00965	0.0124
57.9	0.0053	0.00962	0.0124
58	0.00528	0.00958	0.0124
58.1	0.00526	0.00955	0.0123
58.2	0.00524	0.00952	0.0123
58.3	0.00523	0.00948	0.0122
58.4	0.00521	0.00945	0.0122
58.5	0.00519	0.00942	0.0121
58.6	0.00517	0.00938	0.0121
58.7	0.00515	0.00935	0.0121
58.8	0.00514	0.00932	0.012

58.9	0.00512	0.00929	0.012
59	0.0051	0.00925	0.0119
59.1	0.00508	0.00922	0.0119
59.2	0.00506	0.00919	0.0119
59.3	0.00505	0.00916	0.0118
59.4	0.00503	0.00912	0.0118
59.5	0.00501	0.00909	0.0117
59.6	0.00499	0.00906	0.0117
59.7	0.00498	0.00903	0.0116
59.8	0.00496	0.009	0.0116
59.9	0.00494	0.00897	0.0116
60	0.00492	0.00893	0.0115
60.1	0.00491	0.0089	0.0115
60.2	0.00489	0.00887	0.0114
60.3	0.00487	0.00884	0.0114
60.4	0.00486	0.00881	0.0114
60.5	0.00484	0.00878	0.0113
60.6	0.00482	0.00875	0.0113
60.7	0.0048	0.00872	0.0112
60.8	0.00479	0.00869	0.0112
60.9	0.00477	0.00866	0.0112
61	0.00475	0.00863	0.0111
61.1	0.00474	0.0086	0.0111
61.2	0.00472	0.00857	0.0111
61.3	0.0047	0.00854	0.011
61.4	0.00469	0.00851	0.011
61.5	0.00467	0.00848	0.0109
61.6	0.00466	0.00845	0.0109
61.7	0.00464	0.00842	0.0109
61.8	0.00462	0.00839	0.0108
61.9	0.00461	0.00836	0.0108
62	0.00459	0.00833	0.0107
62.1	0.00457	0.0083	0.0107
62.2	0.00456	0.00827	0.0107
62.3	0.00454	0.00824	0.0106
62.4	0.00453	0.00821	0.0106
62.5	0.00451	0.00818	0.0106
62.6	0.0045	0.00816	0.0105
62.7	0.00448	0.00813	0.0105
62.8	0.00446	0.0081	0.0104
62.9	0.00445	0.00807	0.0104
63	0.00443	0.00804	0.0104
63.1	0.00442	0.00801	0.0103
63.2	0.0044	0.00799	0.0103
63.3	0.00439	0.00796	0.0103
63.4	0.00437	0.00793	0.0102
63.5	0.00436	0.0079	0.0102
63.6	0.00434	0.00788	0.0102
63.7	0.00433	0.00785	0.0101
63.8	0.00431	0.00782	0.0101

63.9	0.0043	0.00779	0.0101
64	0.00428	0.00777	0.01
64.1	0.00427	0.00774	0.00998
64.2	0.00425	0.00771	0.00995
64.3	0.00424	0.00768	0.00991
64.4	0.00422	0.00766	0.00988
64.5	0.00421	0.00763	0.00984
64.6	0.00419	0.0076	0.00981
64.7	0.00418	0.00758	0.00978
64.8	0.00416	0.00755	0.00974
64.9	0.00415	0.00752	0.00971
65	0.00413	0.0075	0.00967
65.1	0.00412	0.00747	0.00964
65.2	0.0041	0.00745	0.00961
65.3	0.00409	0.00742	0.00957
65.4	0.00408	0.00739	0.00954
65.5	0.00406	0.00737	0.00951
65.6	0.00405	0.00734	0.00947
65.7	0.00403	0.00732	0.00944
65.8	0.00402	0.00729	0.00941
65.9	0.004	0.00727	0.00937
66	0.00399	0.00724	0.00934
66.1	0.00398	0.00721	0.00931
66.2	0.00396	0.00719	0.00927
66.3	0.00395	0.00716	0.00924
66.4	0.00393	0.00714	0.00921
66.5	0.00392	0.00711	0.00918
66.6	0.00391	0.00709	0.00915
66.7	0.00389	0.00706	0.00911
66.8	0.00388	0.00704	0.00908
66.9	0.00387	0.00702	0.00905
67	0.00385	0.00699	0.00902
67.1	0.00384	0.00697	0.00899
67.2	0.00383	0.00694	0.00896
67.3	0.00381	0.00692	0.00892
67.4	0.0038	0.00689	0.00889
67.5	0.00379	0.00687	0.00886
67.6	0.00377	0.00685	0.00883
67.7	0.00376	0.00682	0.0088
67.8	0.00375	0.0068	0.00877
67.9	0.00373	0.00677	0.00874
68	0.00372	0.00675	0.00871
68.1	0.00371	0.00673	0.00868
68.2	0.00369	0.0067	0.00865
68.3	0.00368	0.00668	0.00862
68.4	0.00367	0.00666	0.00859
68.5	0.00366	0.00663	0.00856
68.6	0.00364	0.00661	0.00853
68.7	0.00363	0.00659	0.0085
68.8	0.00362	0.00656	0.00847

68.9	0.0036	0.00654	0.00844
69	0.00359	0.00652	0.00841
69.1	0.00358	0.00649	0.00838
69.2	0.00357	0.00647	0.00835
69.3	0.00355	0.00645	0.00832
69.4	0.00354	0.00643	0.00829
69.5	0.00353	0.0064	0.00826
69.6	0.00352	0.00638	0.00823
69.7	0.00351	0.00636	0.0082
69.8	0.00349	0.00634	0.00818
69.9	0.00348	0.00632	0.00815
70	0.00347	0.00629	0.00812
70.1	0.00346	0.00627	0.00809
70.2	0.00344	0.00625	0.00806
70.3	0.00343	0.00623	0.00803
70.4	0.00342	0.00621	0.00801
70.5	0.00341	0.00618	0.00798
70.6	0.0034	0.00616	0.00795
70.7	0.00338	0.00614	0.00792
70.8	0.00337	0.00612	0.00789
70.9	0.00336	0.0061	0.00787
71	0.00335	0.00608	0.00784
71.1	0.00334	0.00606	0.00781
71.2	0.00333	0.00603	0.00778
71.3	0.00331	0.00601	0.00776
71.4	0.0033	0.00599	0.00773
71.5	0.00329	0.00597	0.0077
71.6	0.00328	0.00595	0.00768
71.7	0.00327	0.00593	0.00765
71.8	0.00326	0.00591	0.00762
71.9	0.00325	0.00589	0.0076
72	0.00323	0.00587	0.00757
72.1	0.00322	0.00585	0.00754
72.2	0.00321	0.00583	0.00752
72.3	0.0032	0.00581	0.00749
72.4	0.00319	0.00579	0.00746
72.5	0.00318	0.00577	0.00744
72.6	0.00317	0.00575	0.00741
72.7	0.00316	0.00573	0.00739
72.8	0.00314	0.00571	0.00736
72.9	0.00313	0.00569	0.00733
73	0.00312	0.00567	0.00731
73.1	0.00311	0.00565	0.00728
73.2	0.0031	0.00563	0.00726
73.3	0.00309	0.00561	0.00723
73.4	0.00308	0.00559	0.00721
73.5	0.00307	0.00557	0.00718
73.6	0.00306	0.00555	0.00716
73.7	0.00305	0.00553	0.00713
73.8	0.00304	0.00551	0.00711

73.9	0.00303	0.00549	0.00708
74	0.00301	0.00547	0.00706
74.1	0.003	0.00545	0.00703
74.2	0.00299	0.00543	0.00701
74.3	0.00298	0.00541	0.00698
74.4	0.00297	0.00539	0.00696
74.5	0.00296	0.00538	0.00693
74.6	0.00295	0.00536	0.00691
74.7	0.00294	0.00534	0.00689
74.8	0.00293	0.00532	0.00686
74.9	0.00292	0.0053	0.00684
75	0.00291	0.00528	0.00681
75.1	0.0029	0.00526	0.00679
75.2	0.00289	0.00525	0.00677
75.3	0.00288	0.00523	0.00674
75.4	0.00287	0.00521	0.00672
75.5	0.00286	0.00519	0.0067
75.6	0.00285	0.00517	0.00667
75.7	0.00284	0.00515	0.00665
75.8	0.00283	0.00514	0.00663
75.9	0.00282	0.00512	0.0066
76	0.00281	0.0051	0.00658
76.1	0.0028	0.00508	0.00656
76.2	0.00279	0.00506	0.00653
76.3	0.00278	0.00505	0.00651
76.4	0.00277	0.00503	0.00649
76.5	0.00276	0.00501	0.00646
76.6	0.00275	0.00499	0.00644
76.7	0.00274	0.00498	0.00642
76.8	0.00273	0.00496	0.0064
76.9	0.00272	0.00494	0.00637
77	0.00271	0.00492	0.00635
77.1	0.0027	0.00491	0.00633
77.2	0.0027	0.00489	0.00631
77.3	0.00269	0.00487	0.00629
77.4	0.00268	0.00486	0.00626
77.5	0.00267	0.00484	0.00624
77.6	0.00266	0.00482	0.00622
77.7	0.00265	0.00481	0.0062
77.8	0.00264	0.00479	0.00618
77.9	0.00263	0.00477	0.00616
78	0.00262	0.00475	0.00613
78.1	0.00261	0.00474	0.00611
78.2	0.0026	0.00472	0.00609
78.3	0.00259	0.00471	0.00607
78.4	0.00258	0.00469	0.00605
78.5	0.00258	0.00467	0.00603
78.6	0.00257	0.00466	0.00601
78.7	0.00256	0.00464	0.00599
78.8	0.00255	0.00462	0.00596

78.9	0.00254	0.00461	0.00594
79	0.00253	0.00459	0.00592
79.1	0.00252	0.00458	0.0059
79.2	0.00251	0.00456	0.00588
79.3	0.0025	0.00454	0.00586
79.4	0.0025	0.00453	0.00584
79.5	0.00249	0.00451	0.00582
79.6	0.00248	0.0045	0.0058
79.7	0.00247	0.00448	0.00578
79.8	0.00246	0.00446	0.00576
79.9	0.00245	0.00445	0.00574
80	0.00244	0.00443	0.00572
80.1	0.00243	0.00442	0.0057
80.2	0.00243	0.0044	0.00568
80.3	0.00242	0.00439	0.00566
80.4	0.00241	0.00437	0.00564
80.5	0.0024	0.00436	0.00562
80.6	0.00239	0.00434	0.0056
80.7	0.00238	0.00433	0.00558
80.8	0.00238	0.00431	0.00556
80.9	0.00237	0.0043	0.00554
81	0.00236	0.00428	0.00552
81.1	0.00235	0.00427	0.0055
81.2	0.00234	0.00425	0.00548
81.3	0.00233	0.00424	0.00546
81.4	0.00233	0.00422	0.00544
81.5	0.00232	0.00421	0.00543
81.6	0.00231	0.00419	0.00541
81.7	0.0023	0.00418	0.00539
81.8	0.00229	0.00416	0.00537
81.9	0.00229	0.00415	0.00535
82	0.00228	0.00413	0.00533
82.1	0.00227	0.00412	0.00531
82.2	0.00226	0.0041	0.00529
82.3	0.00225	0.00409	0.00528
82.4	0.00225	0.00408	0.00526
82.5	0.00224	0.00406	0.00524
82.6	0.00223	0.00405	0.00522
82.7	0.00222	0.00403	0.0052
82.8	0.00221	0.00402	0.00518
82.9	0.00221	0.004	0.00517
83	0.0022	0.00399	0.00515
83.1	0.00219	0.00398	0.00513
83.2	0.00218	0.00396	0.00511
83.3	0.00218	0.00395	0.00509
83.4	0.00217	0.00394	0.00508
83.5	0.00216	0.00392	0.00506
83.6	0.00215	0.00391	0.00504
83.7	0.00215	0.00389	0.00502
83.8	0.00214	0.00388	0.00501

83.9	0.00213	0.00387	0.00499
84	0.00212	0.00385	0.00497
84.1	0.00212	0.00384	0.00495
84.2	0.00211	0.00383	0.00494
84.3	0.0021	0.00381	0.00492
84.4	0.00209	0.0038	0.0049
84.5	0.00209	0.00379	0.00488
84.6	0.00208	0.00377	0.00487
84.7	0.00207	0.00376	0.00485
84.8	0.00207	0.00375	0.00483
84.9	0.00206	0.00373	0.00482
85	0.00205	0.00372	0.0048
85.1	0.00204	0.00371	0.00478
85.2	0.00204	0.00369	0.00477
85.3	0.00203	0.00368	0.00475
85.4	0.00202	0.00367	0.00473
85.5	0.00201	0.00366	0.00472
85.6	0.00201	0.00364	0.0047
85.7	0.002	0.00363	0.00468
85.8	0.00199	0.00362	0.00467
85.9	0.00199	0.00361	0.00465
86	0.00198	0.00359	0.00463
86.1	0.00197	0.00358	0.00462
86.2	0.00197	0.00357	0.0046
86.3	0.00196	0.00355	0.00459
86.4	0.00195	0.00354	0.00457
86.5	0.00195	0.00353	0.00455
86.6	0.00194	0.00352	0.00454
86.7	0.00193	0.00351	0.00452
86.8	0.00193	0.00349	0.00451
86.9	0.00192	0.00348	0.00449
87	0.00191	0.00347	0.00447
87.1	0.00191	0.00346	0.00446
87.2	0.0019	0.00344	0.00444
87.3	0.00189	0.00343	0.00443
87.4	0.00189	0.00342	0.00441
87.5	0.00188	0.00341	0.0044
87.6	0.00187	0.0034	0.00438
87.7	0.00187	0.00338	0.00437
87.8	0.00186	0.00337	0.00435
87.9	0.00185	0.00336	0.00434
88	0.00185	0.00335	0.00432
88.1	0.00184	0.00334	0.00431
88.2	0.00183	0.00333	0.00429
88.3	0.00183	0.00331	0.00428
88.4	0.00182	0.0033	0.00426
88.5	0.00181	0.00329	0.00425
88.6	0.00181	0.00328	0.00423
88.7	0.0018	0.00327	0.00422
88.8	0.00179	0.00326	0.0042

88.9	0.00179	0.00325	0.00419
89	0.00178	0.00323	0.00417
89.1	0.00178	0.00322	0.00416
89.2	0.00177	0.00321	0.00414
89.3	0.00176	0.0032	0.00413
89.4	0.00176	0.00319	0.00411
89.5	0.00175	0.00318	0.0041
89.6	0.00175	0.00317	0.00409
89.7	0.00174	0.00316	0.00407
89.8	0.00173	0.00314	0.00406
89.9	0.00173	0.00313	0.00404
90	0.00172	0.00312	0.00403
90.1	0.00172	0.00311	0.00401
90.2	0.00171	0.0031	0.004
90.3	0.0017	0.00309	0.00399
90.4	0.0017	0.00308	0.00397
90.5	0.00169	0.00307	0.00396
90.6	0.00169	0.00306	0.00394
90.7	0.00168	0.00305	0.00393
90.8	0.00167	0.00304	0.00392
90.9	0.00167	0.00303	0.0039
91	0.00166	0.00302	0.00389
91.1	0.00166	0.003	0.00388
91.2	0.00165	0.00299	0.00386
91.3	0.00164	0.00298	0.00385
91.4	0.00164	0.00297	0.00384
91.5	0.00163	0.00296	0.00382
91.6	0.00163	0.00295	0.00381
91.7	0.00162	0.00294	0.0038
91.8	0.00162	0.00293	0.00378
91.9	0.00161	0.00292	0.00377
92	0.0016	0.00291	0.00376
92.1	0.0016	0.0029	0.00374
92.2	0.00159	0.00289	0.00373
92.3	0.00159	0.00288	0.00372
92.4	0.00158	0.00287	0.0037
92.5	0.00158	0.00286	0.00369
92.6	0.00157	0.00285	0.00368
92.7	0.00157	0.00284	0.00366
92.8	0.00156	0.00283	0.00365
92.9	0.00155	0.00282	0.00364
93	0.00155	0.00281	0.00363
93.1	0.00154	0.0028	0.00361
93.2	0.00154	0.00279	0.0036
93.3	0.00153	0.00278	0.00359
93.4	0.00153	0.00277	0.00358
93.5	0.00152	0.00276	0.00356
93.6	0.00152	0.00275	0.00355
93.7	0.00151	0.00274	0.00354
93.8	0.00151	0.00273	0.00353

93.9	0.0015	0.00272	0.00351
94	0.0015	0.00271	0.0035
94.1	0.00149	0.0027	0.00349
94.2	0.00149	0.0027	0.00348
94.3	0.00148	0.00269	0.00346
94.4	0.00148	0.00268	0.00345
94.5	0.00147	0.00267	0.00344
94.6	0.00146	0.00266	0.00343
94.7	0.00146	0.00265	0.00342
94.8	0.00145	0.00264	0.0034
94.9	0.00145	0.00263	0.00339
95	0.00144	0.00262	0.00338
95.1	0.00144	0.00261	0.00337
95.2	0.00143	0.0026	0.00336
95.3	0.00143	0.00259	0.00335
95.4	0.00142	0.00258	0.00333
95.5	0.00142	0.00258	0.00332
95.6	0.00141	0.00257	0.00331
95.7	0.00141	0.00256	0.0033
95.8	0.0014	0.00255	0.00329
95.9	0.0014	0.00254	0.00328
96	0.00139	0.00253	0.00326
96.1	0.00139	0.00252	0.00325
96.2	0.00138	0.00251	0.00324
96.3	0.00138	0.0025	0.00323
96.4	0.00138	0.0025	0.00322
96.5	0.00137	0.00249	0.00321
96.6	0.00137	0.00248	0.0032
96.7	0.00136	0.00247	0.00319
96.8	0.00136	0.00246	0.00317
96.9	0.00135	0.00245	0.00316
97	0.00135	0.00244	0.00315
97.1	0.00134	0.00243	0.00314
97.2	0.00134	0.00243	0.00313
97.3	0.00133	0.00242	0.00312
97.4	0.00133	0.00241	0.00311
97.5	0.00132	0.0024	0.0031
97.6	0.00132	0.00239	0.00309
97.7	0.00131	0.00238	0.00308
97.8	0.00131	0.00238	0.00306
97.9	0.0013	0.00237	0.00305
98	0.0013	0.00236	0.00304
98.1	0.0013	0.00235	0.00303
98.2	0.00129	0.00234	0.00302
98.3	0.00129	0.00233	0.00301
98.4	0.00128	0.00233	0.003
98.5	0.00128	0.00232	0.00299
98.6	0.00127	0.00231	0.00298
98.7	0.00127	0.0023	0.00297
98.8	0.00126	0.00229	0.00296

98.9	0.00126	0.00229	0.00295
99	0.00126	0.00228	0.00294
99.1	0.00125	0.00227	0.00293
99.2	0.00125	0.00226	0.00292
99.3	0.00124	0.00225	0.00291
99.4	0.00124	0.00225	0.0029
99.5	0.00123	0.00224	0.00289
99.6	0.00123	0.00223	0.00288
99.7	0.00123	0.00222	0.00287
99.8	0.00122	0.00222	0.00286
99.9	0.00122	0.00221	0.00285
100	0.00121	0.0022	0.00284

Event	Previous Analysis	This Analysis	
	IoH124	IoH124	ReFH
QBAR	3.31	3.33	3.98
1 yr	2.88	2.89	3.45
2 yr	2.96	2.97	3.54
30 yr	7.96	7.89	7.64
100 yr	11.79	11.87	10.3

Scaled by 1/0.89 to get from 2 yr to QBAR.
Scaled by ratio of 2yr to 1yr from MicroDrainage growth curve.

Greenfield runoff rates in l/s/ha

Appendix U Anglian Water Foul Water Impact Assessment

love every drop anglianwater

Addendum to the pre-planning assessment report dated 24 December 2015 – revision 1.0

Project Title:

Madingley Road, Cambridge

Anglian Water Services contact:

Rob Morris
Senior Growth Planning Engineer
Thorpe Wood House
Thorpe Wood
Peterborough
PE3 6WT
Mobile Number: 07702 341018
Our reference number: 4744
10 February 2015

1. Summary

This report has been undertaken in response to an enquiry from Peter Brett Associates LLP to determine the impact of flows from the site at Madingley Road, Cambridge on the performance of the existing foul sewer network. It should be read in conjunction with the pre-planning report dated 24 December 2014 and subsequent correspondence and meetings that took place in August and September of 2015, which indicated that a direct connection to the public foul sewer system with the revised proposed dry weather flow rate of 43l/s (129l/s Peak DWF) is likely to have a detrimental effect on the existing sewerage network. Further hydraulic modelling would be required to enable Anglian Water to provide a solution for draining the foul flows from the proposed development.

The analysis has been performed on the foul system only. There has been no consideration of the surface water flows as this is not within the scope of the study.

The additional foul flows from the development site which will expand the West Campus of the University of Cambridge were modelled connecting to two connection points; manhole reference no. TL43585604 (grid ref: TL4353358655) located on Wilberforce Road at a dry weather flow rate of 40l/s (120l/s Peak DWF) and to manhole reference no. TL42595201 (grid ref: TL4257859298) located on Madingley Road at a dry weather flow rate of 3l/s (9l/s Peak DWF).

The study concludes that the development will not cause detriment to the capacity of the sewerage system from the flow split at the two connection points and as such there is no requirement for off-site reinforcement.

The topography of the site indicates that a gravity regime is feasible to both connection points. Due to the proximity of the site to the connection point it is assumed that the developer will provide the necessary infrastructure to convey flows from the site to the network.

The contents of this report are based on the outputs generated by a desktop hydraulic model.

2. Hydraulic Modelling and Solutions

The proposed development site is located off Madingley Road on the West Campus of the University of Cambridge (see Figure 1). Foul flows from the site drain to Cambridge Water Recycling Centre (WRC) located to the north of the town. The proposed development comprises of a densification of the campus with a total estimated population of 18,954. The total dry weather flow is given as 43 l/s, which was calculated by the developer. The majority of the development (40l/s) will discharge to the Wilberforce Road connection point, the rest (3l/s) will discharge to the Madingley Road connection point (see figure 2).

To enable the analysis to be performed the existing hydraulic model for Cambridge was used. This was updated with manhole survey information that was carried out within the vicinity and downstream of the proposed development site as well as any other recent changes to the system.

The modelling assumptions are presented in Appendix 1.

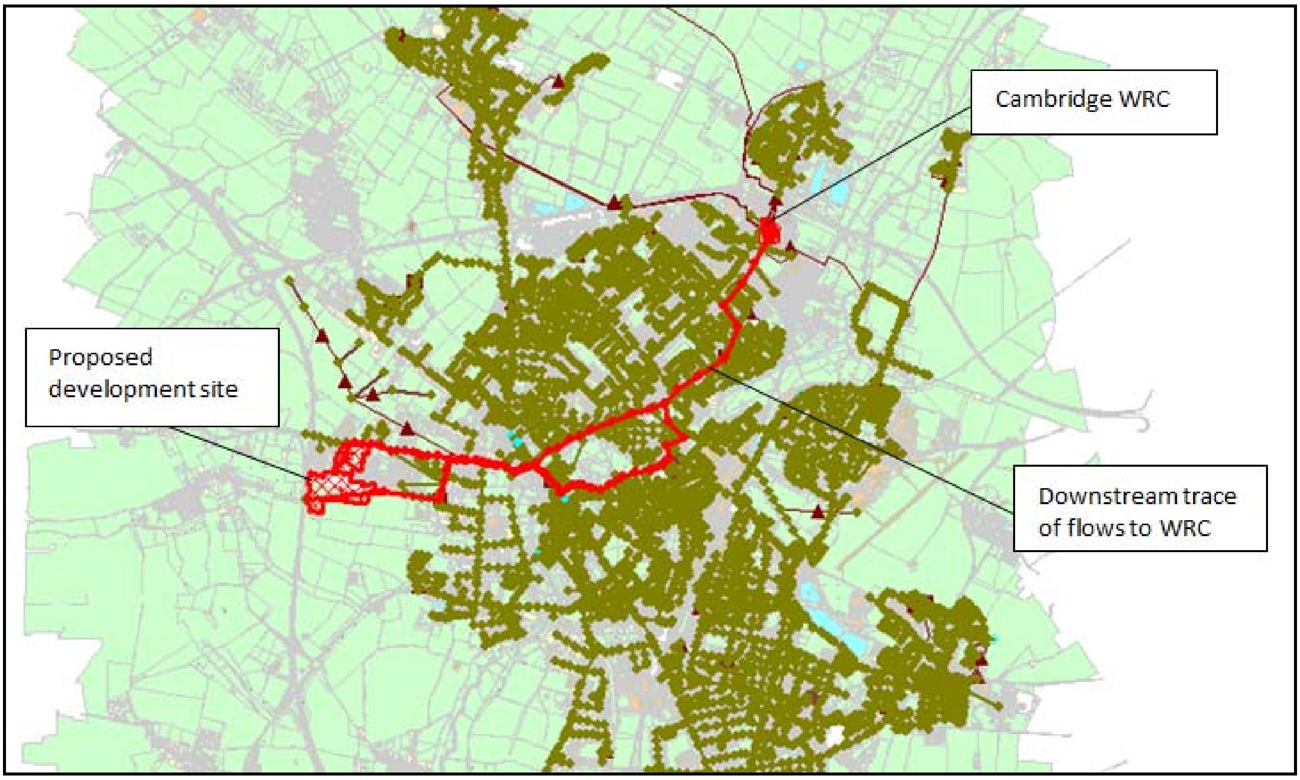


Figure 1: Showing the location of the development site and the proximity of the WRC

Proposed connection point

The proposed connection points for the development are manhole TL43585604 (NGR TL4353358655) located on Wilberforce Road and manhole TL42595201 (NGR TL4257859298) located on Madingley Road (see Figures 2, 3 and 4). The diameters of the sewers to which the proposed development will connect are 600mm (TL43585604) and 300mm (TL42595201) respectively. A review of the site topography indicates that gravity connections are feasible for both connection points.

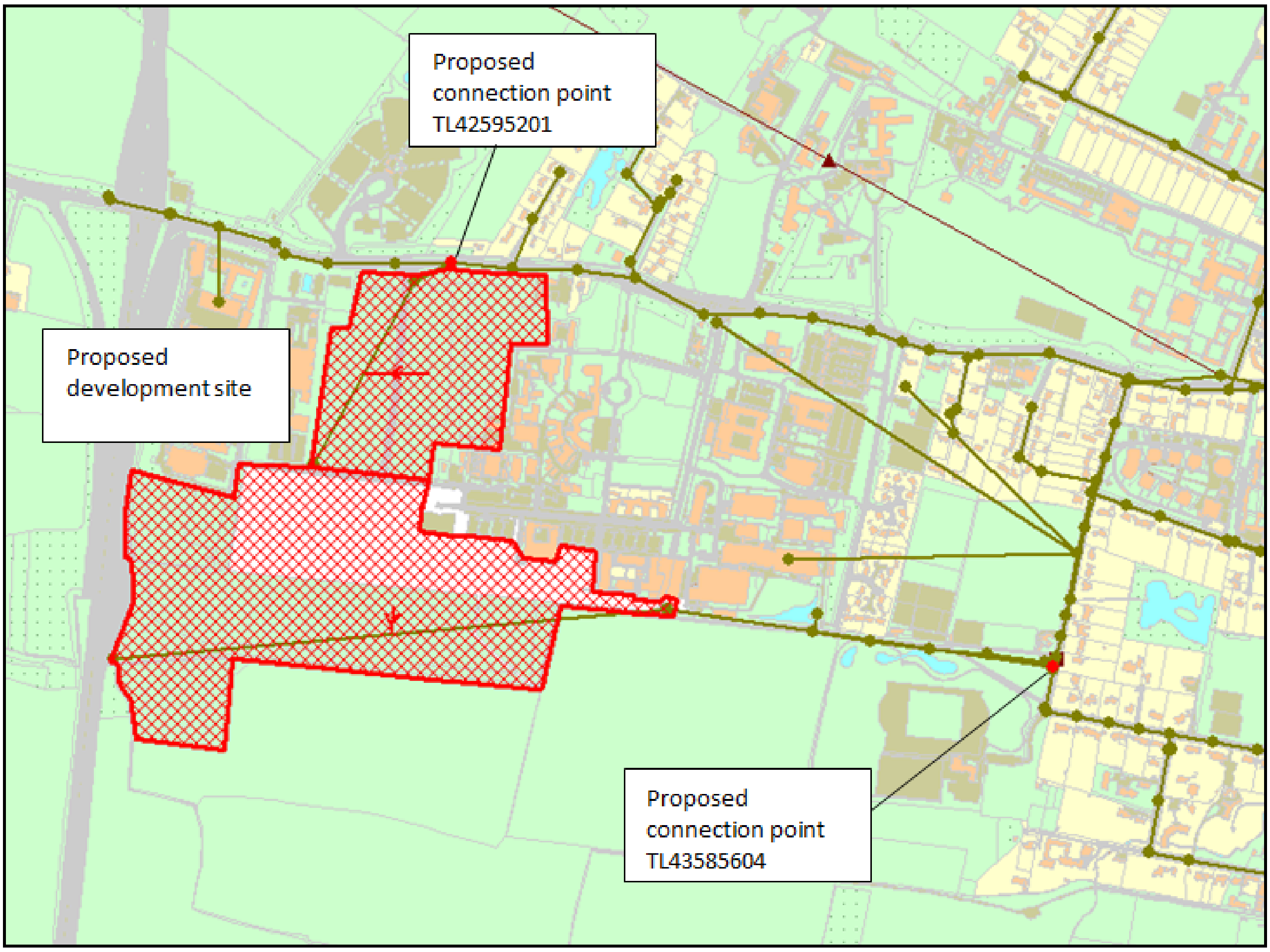


Figure 2: Showing the location of the proposed connection points

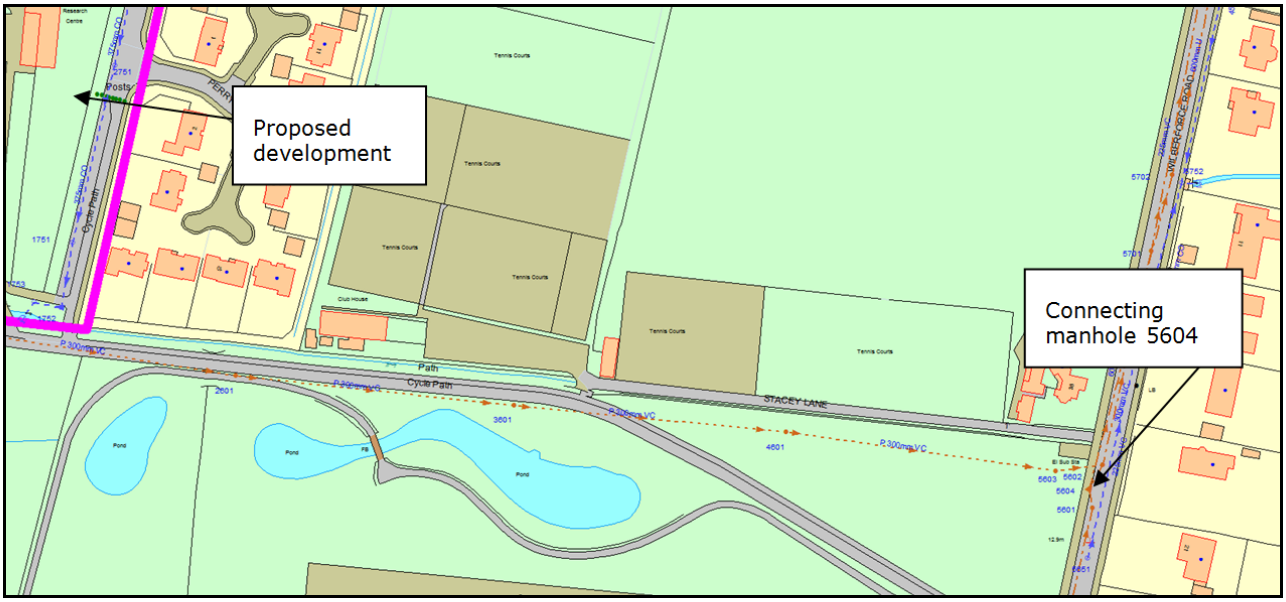


Figure 3: Showing the location of the proposed connection point in Wilberforce Road (40l/s)

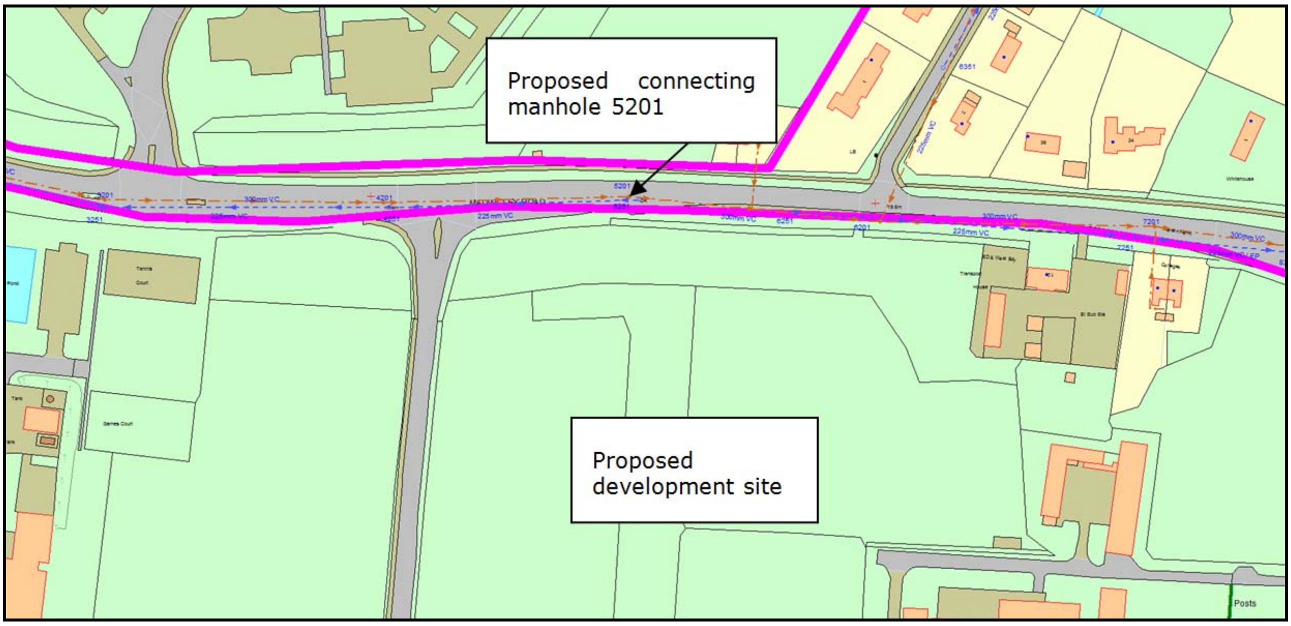


Figure 4: Showing the location of the proposed connection point in Madingley Road (3l/s)

Hydraulic modelling

The hydraulic model was run to determine the existing sewer performance during a 1 in 20 year design storm. The model was then re-run with the estimated flows from the site connecting to manhole TL43585604 (40l/s) and TL42595201 (3l/s) via gravity connections.

The model predicts no significant increase in flooding or surcharge within the sewerage network as a direct result from the flows of the new development.

It should be noted that the proposed combined total dry weather flow of 43l/s is additional to that which is currently being received from this site.

The level of detriment predicted within the existing sewerage network, due to the additional flows from the development, means that no mitigation will be required prior to the site connecting to the existing sewerage system.

3. Summary of Cost Estimates

The proposed connection points are close to the site boundary and as such it has been assumed that the developer will provide the infrastructure to convey the flows from the site to the respective connection points. Consequently, this report does not include any costs for the conveyance of flows.

4. Summary and recommendation

Estimated flows from the site at Madingley Road, Cambridge have been modelled connecting via gravity to the existing foul drainage system to two manholes reference no. TL43585604 and TL42595201 respectively, and detriment to the existing performance has not been predicted within the existing sewerage network. Therefore it is considered that there is no requirement for any off-site mitigation prior to connecting to the proposed manholes.

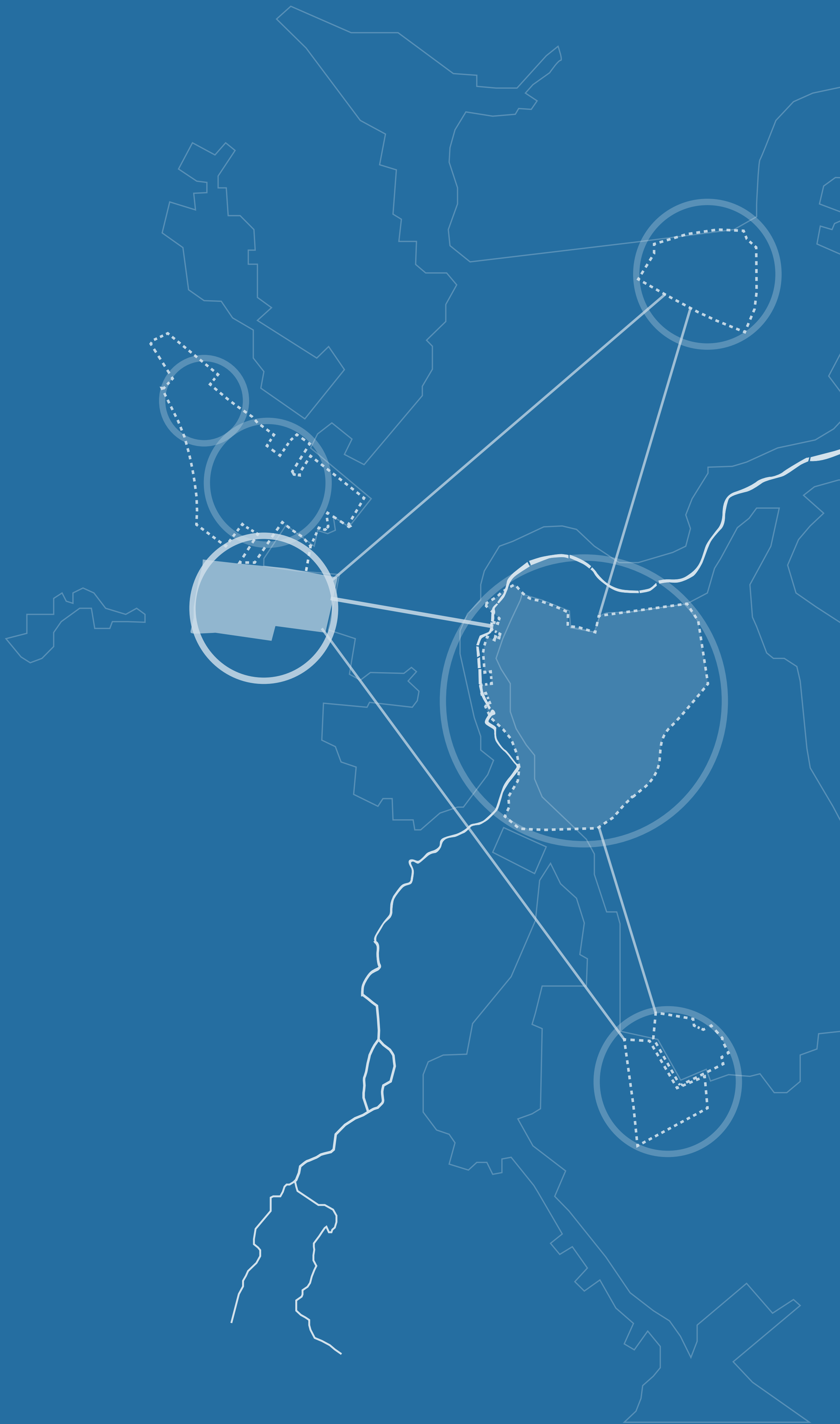
Conveyance of flows

It is assumed that the developer will provide the infrastructure to convey flows to the network. Therefore no costs have been provided.

This is a feasible solution for planning application purposes.

APPENDIX 1. - Development details

DWF Calculations				
	Attribute	**Value**	**Totals**	**Unit / Calculation**
	Development size	31.125		Ha (Digitised Sub-catchment area)
	Residential			
A	Residential dwellings	0		No.
B	Residential occupancy	0		No.
C	Residential population (P)	0		No. (A x B)
D	Residential PCC (G)	0		l/h/d
$E_{(avg)}$	*Residential demand - Average*		**0**	l/s (C x D)/86400
$E_{(peak)}$	*Residential demand - Peak*		**0**	l/s ($E_{(avg)}$ x 2.12)
F	**Infiltration**		**0**	l/s (0.25 x $E_{(avg)}$)
	Industrial/Trade			
G	Industrial/trade area	31.125		Ha
H	Industrial/trade discharge per ha	0.2		l/s
I	Industrial/trade domestic element per ha	0		l/s
$J_{(avg)}$	*Commercial/trade - Average*		**6.225**	l/s (GxH+GxI)
$J_{(peak)}$	*Commercial/trade- Peak*		**18.675**	l/s($J_{(avg)}$ x 3)
	Schools			
K	School PCC	0		l/h/d
L	School occupancy	0		No.
$M_{(avg)}$	*School demand - Average*		**0**	l/s (K x L)/86400
$M_{(peak)}$	*School demand - Peak*		**0**	l/s ($M_{(avg)}$ x 3)
	Other			
$N_{(avg)}$	*Other demand - Average*		**0**	l/s
$N_{(peak)}$	*Other demand - Peak*		**0**	l/s
$O_{(avg)}$	**Total Discharge - Average**		**6.225**	l/s ($E_{(avg)}+J_{(avg)}+M_{(avg)}+N_{(avg)}$)
$O_{(peak)}$	**Total Discharge - Peak**		**18.675**	l/s ($E_{(peak)}+J_{(peak)}+M_{(peak)}+N_{(peak)}$)
	DWF Total - Average		**6.225**	l/s($O_{(avg)}$ + F)
	DWF Total - Peak		**18.675**	l/s($O_{(peak)}$ + F)
	DWF modelled – Average (as per developer's calcs)		**43.0**	l/s
	DWF modelled – Peak		**129.0**	l/s



UNIVERSITY OF CAMBRIDGE

AECOM