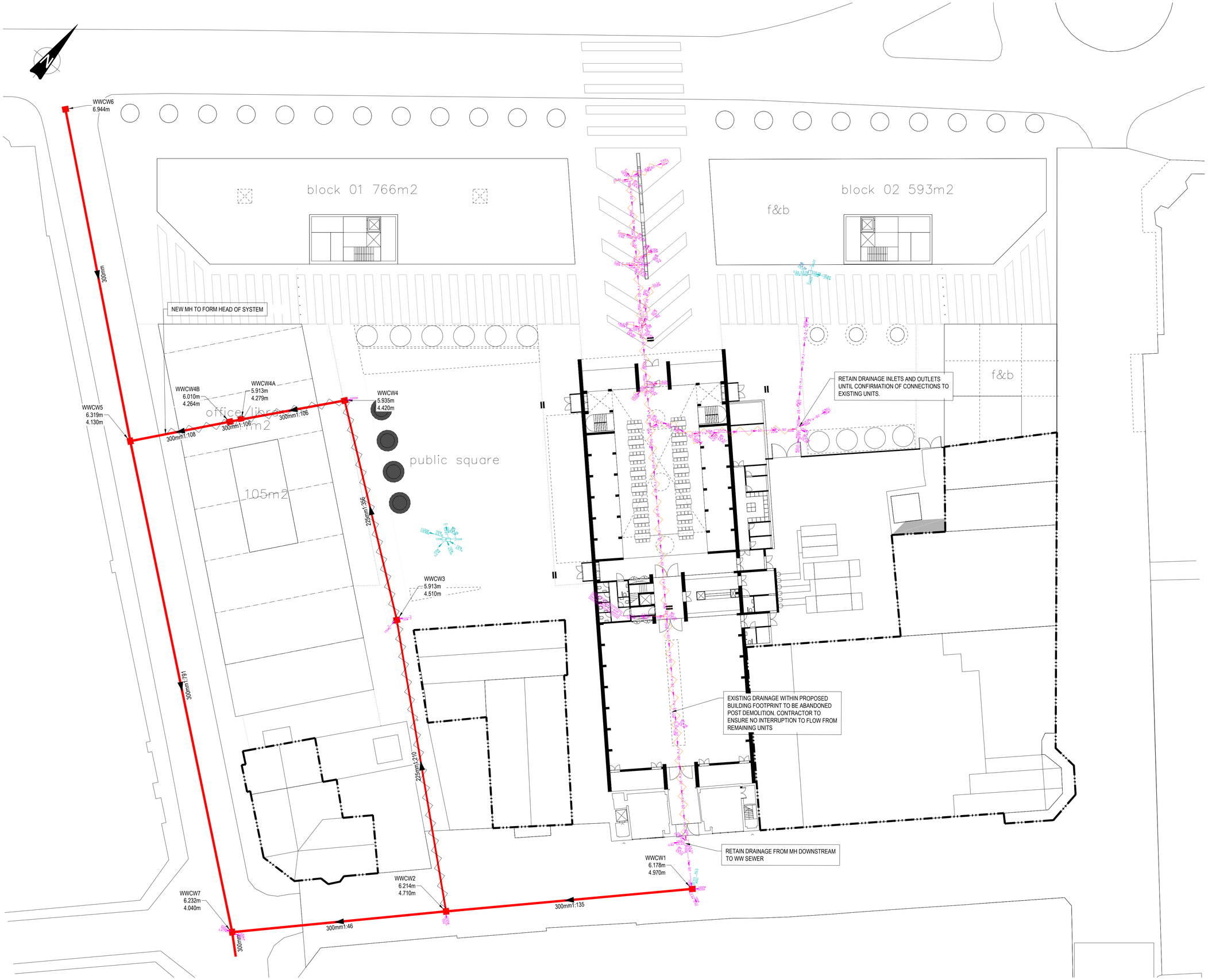

GENERAL NOTES:

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3. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.

EXISTING DRAINAGE NOTES:

1. DESIGN BASED ON TOPOGRAPHICAL SURVEY AND CCTV SURVEY INFORMATION AVAILABLE AT THE TIME OF DESIGN.
2. ALL EXISTING SEWERS, CONNECTIONS, PIPE SIZES AND INVERT LEVELS TO BE CONFIRMED BY CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS TO ENSURE CONNECTIVITY. ANY VARIANCE FROM THE INFORMATION SHOWN SHOULD BE REPORTED TO THE ENGINEER FOR REVIEW.
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4. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO COMMENCEMENT OF ANY DRAINAGE WORKS, AND WHERE NECESSARY PROTECTION OR DIVERSIONS TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORK.
5. AMENDMENTS SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.

KEY

WWCW
1000@1:150 — EXISTING WELSH WATER ASSETS

FW-B2 FW-B2 — GPR SURVEY FOUL / COMBINED DRAINAGE

SW-B2 SW-B2 — GPR SURVEY SURFACE WATER DRAINAGE

ABANDON WELSH WATER SEWERS

ABANDON PRIVATE DRAINAGE

EXISTING BUILDINGS TO REMAIN. CONTRACTOR TO ENSURE NO INTERRUPTION TO DRAINAGE FLOWS IF ENCOUNTERED.

OTHER DISCIPLINE DRAWING REFERENCES

THE DESIGN OF THIS SCHEME HAS BEEN DESIGNED IN ACCORDANCE WITH THE BELOW DRAWINGS AND INFORMATION.

TOPOGRAPHICAL SURVEY REF: SEP S20562-T-01_Topographical survey

UTILITIES SURVEY DRAWING REF: SEP S20613-U-01_Utilities Survey

ARCHITECTS DRAWING REF: SKM 200724 masterplan drawings (REC'D 24/07/20)

OTHER INFORMATION REF: WELSH WATER ASSETS PPA0004753 Sewer Plan v2

Rev:	Description:	Date:	By:	Chkd:
P01	ISSUED FOR PLANNING (S2)	31/07/20	JDB	AF

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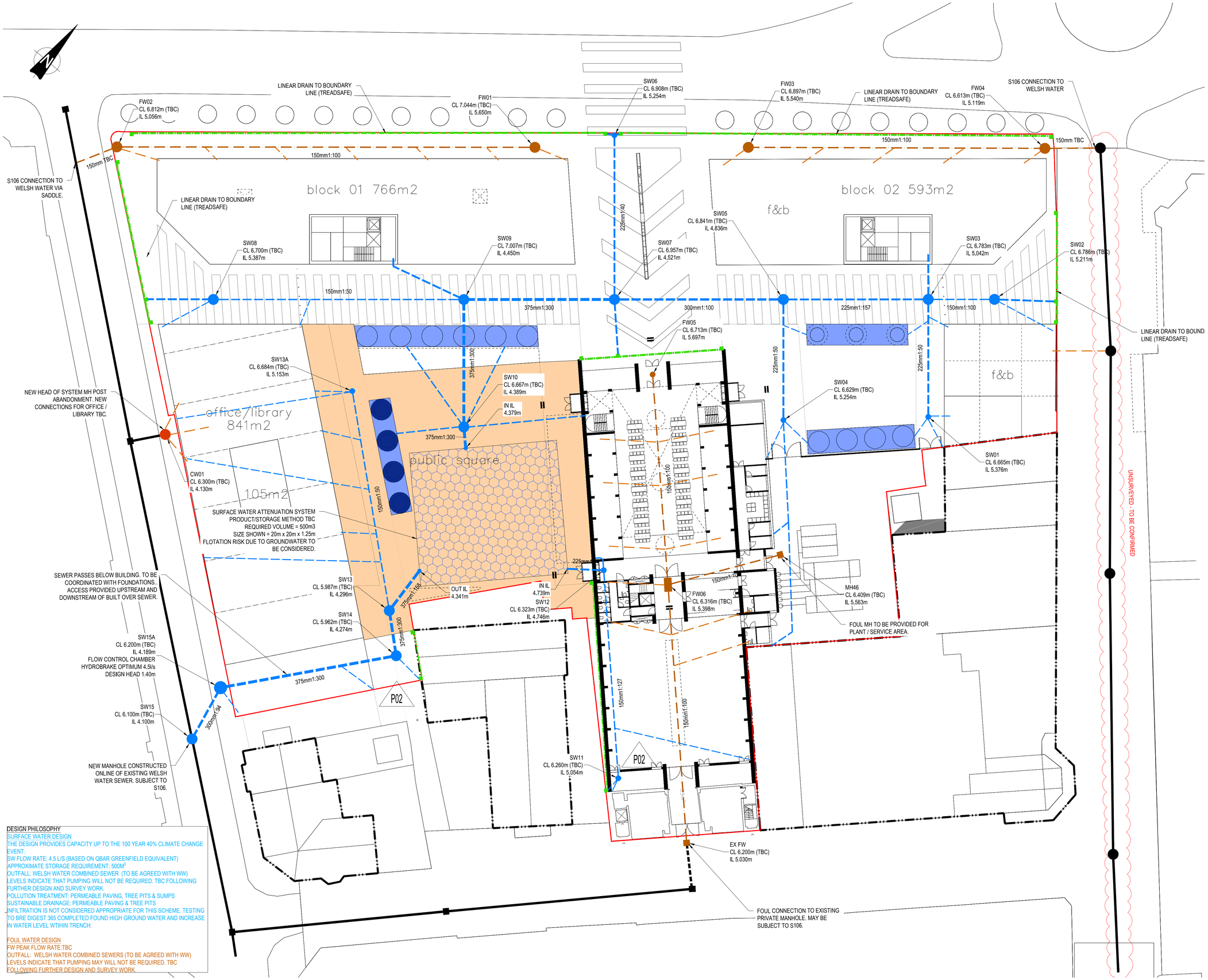
Status: ISSUED FOR INFORMATION — S2

Project: ION DEVELOPMENTS RHYL MARKET

Drg Title: DRAINAGE EXISTING DRAINAGE AMENDMENTS

Size:	Date:	Drawn By:	Designed By:	Checked By:
A1	31/07/2020	JDB	JDB	AF
Scale: 1:250				

Project No: 074024 - Originator: CUR - Volume: 00 - Level: XX - Type: DR - Role: C - Category / Number: 92001 - Rev: P01



DESIGN PHILOSOPHY

SURFACE WATER DESIGN
THE DESIGN PROVIDES CAPACITY UP TO THE 100 YEAR 40% CLIMATE CHANGE EVENT.
SW FLOW RATE: 4.5 L/S (BASED ON QBAR GREENFIELD EQUIVALENT)
APPROXIMATE STORAGE REQUIREMENT: 500M^3
OUTFALL: WELSH WATER COMBINED SEWER (TO BE AGREED WITH WW)
LEVELS INDICATE THAT PUMPING WILL NOT BE REQUIRED. TBC FOLLOWING FURTHER DESIGN AND SURVEY WORK.
POLLUTION TREATMENT: PERMEABLE PAVING, TREE PITS & SUMPS
SUSTAINABLE DRAINAGE: PERMEABLE PAVING & TREE PITS
INFILTRATION IS NOT CONSIDERED APPROPRIATE FOR THIS SCHEME. TESTING TO BRE DIGEST 365 COMPLETED FOUND HIGH GROUND WATER AND INCREASE IN WATER LEVEL WITHIN TRENCH.

FOUL WATER DESIGN
FW PEAK FLOW RATE:TBC
OUTFALL: WELSH WATER COMBINED SEWERS (TO BE AGREED WITH WW)
LEVELS INDICATE THAT PUMPING MAY WILL NOT BE REQUIRED. TBC FOLLOWING FURTHER DESIGN AND SURVEY WORK.

GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
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5. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO COMMENCEMENT OF ANY DRAINAGE WORKS, AND WHERE NECESSARY PROTECTION OR DIVERSIONS TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORK.
6. ALL RAINWATER AND FOUL POP UPS LOCATIONS AND SIZES INDICATIVE ONLY AND TO BE CONFIRMED BY THE ARCHITECT AND M&E ENGINEER.
7. COVER LEVELS, GULLY POSITIONS, AND BUILDINGS LOCATION ARE APPROXIMATE AND SHALL BE CONFIRMED BY ARCHITECT/ LANDSCAPE ARCHITECT.
8. ALL PIPE DIAMETERS GIVEN ARE NOMINAL INTERNAL PIPE DIAMETERS. THESE ARE TO BE CONFIRMED ONCE A DETAILED CAPACITY CHECK HAS BEEN UNDERTAKEN AT A LATER DESIGN STAGE.
9. OUTFALL CONNECTION(S) SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.

KEY

- EXISTING WELSH WATER ASSETS
- SW — 100Ø@1:150 — PRIVATE SW SEWER
- FW — 100Ø@1:150 — PRIVATE FW SEWER
- ATTENUATION SYSTEM (METHOD TBC) REQUIRED VOL = 500m^3
- TREE-PIT DRAINAGE SYSTEM WITH SOIL CELL. OVERFLOW TO NETWORK.
- PERMEABLE PAVING - FINISH TBC. WITH TYPE 3 SUB-BASE MEDIUM
- EXISTING BUILDINGS TO REMAIN. CONTRACTOR TO ENSURE NO INTERRUPTION TO DRAINAGE FLOWS IF ENCOUNTERED.
- LINEAR DRAINAGE (TREADSAFE FINISH)

OTHER DISCIPLINE DRAWING REFERENCES

THE DESIGN OF THIS SCHEME HAS BEEN DESIGNED IN ACCORDANCE WITH THE BELOW DRAWINGS AND INFORMATION.

TOPOGRAPHICAL SURVEY REF: SEP S20562-T-01_Topographical survey

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ARCHITECTS DRAWING REF: SKM 200724 masterplan drawings (REC'D 24/07/20)

OTHER INFORMATION REF: WELSH WATER ASSETS PPA0004753 Sewer Plan v2

Rev:	Description:	Date:	By:	Chkd:
P02	BOUNDARY SHOWN (S2)	08/09/20	JDB	AF
P01	ISSUED FOR PLANNING (S2)	31/07/20	JDB	AF

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Status: ISSUED FOR INFORMATION — S2

Project: ION DEVELOPMENTS RHYL MARKET

Drg Title: DRAINAGE PROPOSED DRAINAGE GENERAL ARRANGEMENT

Size:	Date:	Drawn By:	Designed By:	Checked By:
A1	31/07/2020	JDB	JDB	AF

Scale: 1:250

Project No:	Originator:	Volume:	Level:	Type:	Role:	Category / Number:	Rev:
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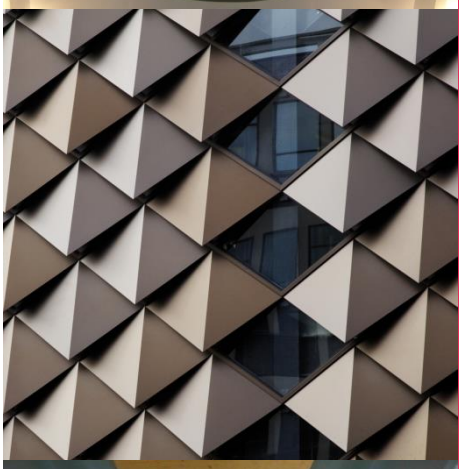

ION Developments, Rhyl Market Street

Drainage Strategy

Curtins Ref: 074024-CUR-00-XX-RP-C-00001

Revision: V02

Issue Date: 08 September 2020

Client Name: ION Developments

Client Address: 2 Queens Square, Liverpool, L1 1RH

Site Address: South of West Parade, Rhyl, Denbighshire, LL18 1

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Rev	Description	Issued by	Checked	Date
V01	Issued for Planning	JDB	AF	31/07/2020
V02	Issued for Planning	JDB	AF	08/09/2020

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Author	Signature	Date
Jake Busby Project Engineer		08/09/2020

Reviewed	Signature	Date
John Kelly Associate		08/09/2020

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Figures and Tables

Appendices

1.0 Summary of Report

The following is to be read in conjunction with the Flood Consequence Assessment (FCA) referred to as Queens Market FCA which identifies flood consequence within the development area. This document is prepared to be submitted with a detailed planning application for the works. The proposed layout for the finished development are included within Appendix A.

1.1 Flood Risk to Development

The following risks are considered relevant to the scheme;

- Fluvial flooding – low risk
- Tidal flooding – low risk (consideration taken in the event of a defence breach)
- Reservoir flooding – low risk
- Surface water flooding to the site – medium risk
- Surface water flooding from the site – low risk
- Groundwater flooding – medium risk
- Flooding from public sewers and water mains – low risk
- Flooding from highway infrastructure – low risk
- Flooding from canals, ponds and artificial watercourses – low risk

Sources of potential flooding are mostly considered low risk; however, groundwater and surface water flooding to the site are considered in more detail within this report.

2.0 Flood Risk

Further analysis of flood risk as a result of the development is given below.

2.1 Surface Water Flooding to the Site

A medium risk has been identified due to the findings of the FCA. A potential risk of surface water ponding within the vicinity of the site during the 1 in 100-year event and the 1 in 1000-year event is summarised in Figure 2.1 below (extracted from JBA FCA Figure 3-5).

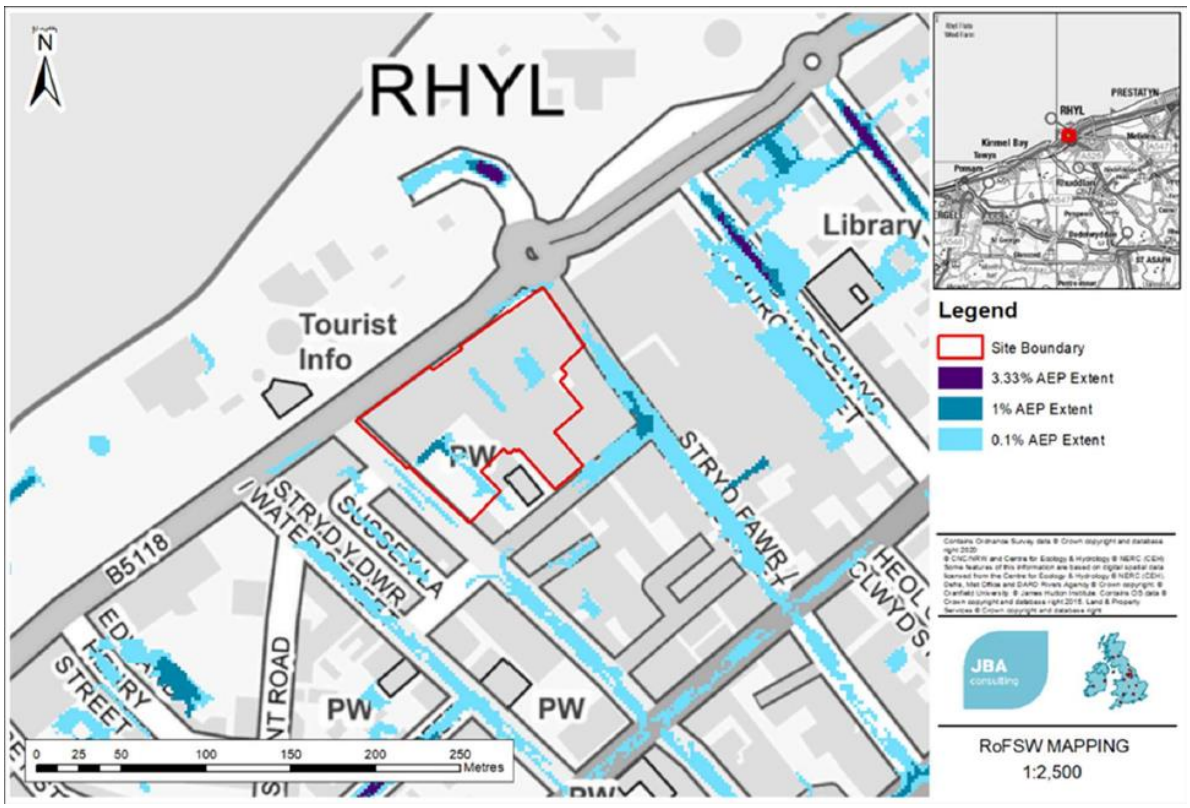


Figure 2.1 – Surface Water Flood Map (JBA©)

Reviewing the data given in the RoFSW mapping and the latest topographical survey suggests a maximum risk level of 6.300mAOD along High Street to the east of the site, and a maximum of 6.100mAOD along Sussex Street to the south. It is noted that this is a coarse methodology of predicting surface water flood risk.

To mitigate against the risk, FFL's will need to be set sufficiently above the existing risk or measures taken to ensure resilience during a flood event. The risk is within the 0.1% event and is unlikely to cause any impact to the site. The access from High Street to the west of the site should allow for a high point within the levels to ensure no ingress of surface water. As there is currently no route for overland flow into the site (due to building facades) this is non-detrimental to the risk elsewhere.

Current on site surface water flood risk will be removed by the inclusion of a positive drainage system.

2.2 Groundwater Flooding

Groundwater flooding is a potential risk on this site. The Denbighshire SFCA finds that there is a risk level between 50-75%.

Groundwater flooding tends to be more persistent than other sources of flooding, typically lasting for weeks or months rather than hours or days. Groundwater flooding does not generally pose a significant risk to life due to the slow rate at which the water level rises; however, it can cause significant risk to property.

Based on the lack of site specific groundwater levels it is recommended that groundwater levels are monitored further during on-going ground investigation works. Typically, groundwater levels are recorded during gas monitoring over a 3-month period. Fluctuations in groundwater levels should be assessed during ground investigation works and floor levels proposed based on being above the maximum levels recorded.

The development proposals do not include any below ground basement areas. Finished floor levels for the development are typically set above the existing levels and therefore are more resistant to any present groundwater flooding, there are no recorded incidents of flooding occurring.External ground levels across the site should fall away from the proposed buildings and ensure that the creation of low points is avoided (other than those used intentionally for drainage features) in order that in the unlikely event of groundwater flooding, the flood water is safely routed away from the buildings on site.

Some recommendations for managing the risk and providing resilience are outlined below;

- Install damp proof membrane or tanking material below the floor slab which ties into the external wall;
- Reinforced Concrete Floor;
- Sealing of Services;
- Install wall treatments to seal the property up to 1m above the ground level.

Based on the ongoing monitoring of groundwater, and the above recommendations are included in the design (if required based on monitoring) the risk of flooding due to groundwater can be considered low.

2.3 Overland Flows (Sea/Tidal flooding)

The FCA identifies that the future sea level will likely reach 6.800mAOD in the next 100 years. The scheme lifetime is considered to be 100 years and therefore may become affected by rising sea levels. Rhyl is currently defended from rising sea by a series of sea walls and other defence measures. The mapping within the FCA concludes that the site is not currently at risk. Reviewing the information suggests that in the event of a breach (or wave overtopping) the overland flow path is in the vicinity of the site. Figure 2.2 gives the extracted mapping (JBA FCA Figure 3-1).

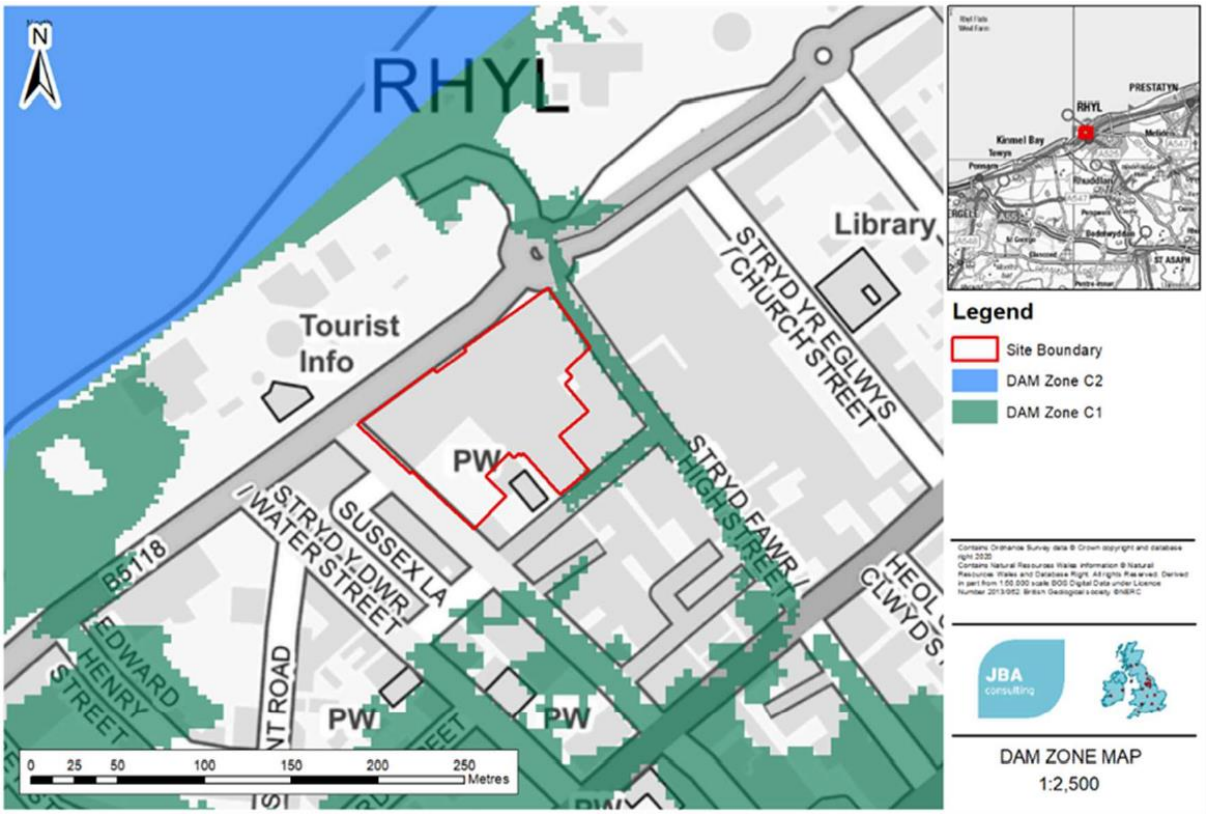


Figure 2.2 – DAM C1 (JBA©)

The findings of the DAM C1 zone suggest that an overland flow will run down High Street to the south in the event of a breach (or wave overtopping) and not directly affect the site. This is likely due to the existing building levels been above the modelled data. To ensure no risk to the site, it's essential to prevent ingress of water at two locations – the access from High Street and the main market access from Sussex Street. Levels here are not to be any less than existing and a feature should be introduced at the High Street access to prevent ingress, as an example this could be a suitable ramp to direct water away from the development.

The Sussex Street building access requires further consideration by the design team to ensure water ingress is reduced as much as possible, or flood resilience measures should be considered in the immediate access. The market building will require level access from Sussex Street, however, there is a proposal for an internal ramp meaning the main circulation areas will be outside of any risk.

As there is currently no route for overland flow into the site (due to building facades) this is non-detrimental to the risk elsewhere.

The risk of a sea wall failure and a breach of the defence is not considered likely.

3.0 Drainage Strategy

The scheme is subject to SAB approval and as such is required to address the 6 standards as outlined in Schedule 3 of the Flood and Water Management act 2010. Requirements outlined in TAN 15 are also considered in the design of the scheme.

3.1 Existing Discharge Rate

The site area for development is approximately 0.95ha in size, which excludes the buildings to remain. Using UK SuDS the equivalent greenfield discharge rate would be 4.45 l/s, refer to the calculation provided in Appendix B.

Based on the area of 0.95ha, using the modified rational method would give an estimation of the current discharge rate of 138 l/s. The existing drainage surveyed is shown on the plan within Appendix B which confirms connections to the existing Welsh Water (WW) combined sewer network.

3.2 Proposed Discharge Rate

The development will discharge a maximum of 4.45 l/s in all storms up to the 1 in 100-year event + 40% climate change, this provides a betterment of over 95%. The peak flow under each return period is identified below;

Return Period	Peak Flow Rate (l/s)
1 Year	3.9
QBAR	4.45
30 Year	7.9
100 Year + 40% Climate Change	9.65

Table 3.1 – Peak Flow Rates per Return Period

To achieve this restriction a flow-control is proposed on the final SW chamber prior to connection to the WW sewer. The flow control has an orifice size of 95mm and requires a minimum 1500mm chamber due to the size of the unit. It is proposed that an overflow is included within the final chamber so that in the event of a system failure, the water can bypass the flow control and enter the WW network, the overflow is to be set above the maximum modelled water level. The drainage calculations are within Appendix C.

3.3 Standard Principles

3.3.1 Standard 1 – Surface Water Runoff Destination

Surface water re-use is unlikely to be suitable for this development, however as the M&E design develops it's possible that some rainwater could be collected from roof areas and used for maintenance around the public areas. This is to be confirmed and won't be included in the hydraulic modelling.

Infiltration tests have been carried out and due to high groundwater levels, the excavation water level increased during the test. 0.5m made ground was encountered underlain by natural sand to at least 1.7m below ground level (bgl). Water was encountered at circa 1.5m bgl eventually rising to 1.4m bgl. The test confirmed that infiltration is not possible for the area.

Discharge to a watercourse/water body has been considered, however, the closest water body is the sea which is approximately 100m north of the site. The discharge point would need to be located within the tidal range of the sea and would not be permitted to discharge direct to the beach, therefore this is deemed unfeasible.

Priority 5 requires the presence of a surface water sewer or other drainage system, there is no evidence of either of these existing.

The development complies with Priority 6 of Standard 1 – all SW will be discharged to the combined sewer at a restricted QBAR rate.

3.3.2 Standard 2 – Surface Water Hydraulic Control

The development will discharge to the combined sewer at a greenfield QBAR rate of 4.45 l/s. The rate will be applied up to and including the 100-year storm with an appropriate allowance for climate change. The first 5mm of rainfall will be naturally lost through the proposed permeable paving and surface water attenuation features (including tree-pits). However, building drainage will likely discharge from the site within the first 5mm of rainfall.

Although surface level features are preferred there are some concerns from a safety perspective that any open water features pose a risk to users of the development. Attenuation of additional flows above the QBAR rate will be provided in the form of a below ground tank, other storage features are included such as tree-pits and permeable paving. The flow from site will be controlled by a hydrobrake flow control (or similar) designed to manage the build-up of run-off up to the maximum storm.

3.3.3 Standard 3 - Water Quality

The site is at low risk of contamination, there are no carparking spaces proposed and CIRIA guidelines suggest the site can be classified as "other roofs", however as some vehicles can

access the site for maintenance / deliveries a cautious approach is applied assuming the site can be classed as “non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day”.

The only discharge available as per Standard 1 is to a combined sewer meaning very low risk of contamination to any water feature in the area. Additionally, a number of sumps will be incorporated to minimise any silts leaving site. Run-off from external areas is mostly drained via permeable paving and tree-pits removing any contaminants which may be present. The indices from CIRIA Table 26.2 are given in table 2.2

Total Suspended Solids	Metals	Hydrocarbons
0.5	0.4	0.4

Table 3.2 – Pollution Hazard Indices

The proposed SuDS features offer more than sufficient treatment stages to manage these potential pollutants.

The current site is not known to be contaminated so any additional infiltration that may occur as part of the drainage design is unlikely to offer a new pathway for any ground water contamination. The ground water levels on the site are dictated by the sea and the groundwater is considered as having a “medium to high” vulnerability.

3.3.4 Standard 4 and 5 – Amenity and Biodiversity

The nature of the site is to be mostly hardstanding and new buildings, however, the inclusion of open public realm area and new tree pits are likely to significantly increase the amenity and biodiversity within the area. Information boards should be included as part of the scheme to inform visitors of the tree-pits and permeable paving, as well as provide insight on how the development has assisted in reducing flood risk elsewhere.

The drainage system will provide the trees with sufficient watering to ensure healthy growth and reduce the maintenance requirements.

3.3.5 Standard 6 - Design of drainage for Construction and Maintenance and Structural Integrity

Standard 6 will be complied with through the implementation of a drainage maintenance schedule. There will also be information boards to inform those around the area when there is a potential issue and to whom it should be reported. A manual will also be provided on what drainage features are included in the design and what to look out for in the event of a failure.

Features will be inspectable from the surface through a series of access chambers. The hydrobrake will allow for an emergency pull cord to be accessible at the surface in the event of a blockage so that the flow control can be bypassed. As outlined in section 3.4 there is further detailed design for the attenuation system to address structural integrity.

3.4 Attenuation System

To accommodate the additional run-off during a storm event which is impacted by the flow restriction, on site attenuation is required. Due to limited space within the boundary; a below ground system is proposed.

The proposed method of attenuation is to be confirmed pending ongoing ground investigations and groundwater level monitoring. Should cellular structures be provided the detailed design will need to consider the effect of floatation on the product. Large diameter pipes may be more effective in limiting flotation risk, however, additional space is required and using standard concrete pipework will likely result in excessive access chambers above ground. A proprietary large diameter pipe system should be considered in PVC, such as Weholite or Polypipe products.

3.5 SuDS

The external areas surrounding the buildings will be drained either via;

- Linear Channels
- Tree-pits or,
- Permeable Paving.

Maintenance is to be carried out as summarised in the maintenance strategy document.

3.6 Exceedance

There is no simulated exceedance within the 100 year + 40% climate change event.

A critical failure of the system through blockage of the hydrobrake and thus an assumed discharge of 0 l/s is assessed.

Return Period	Flood Exceedance (m^3)
1 Year	0
30 Year	0
100 Year + 40% Climate Change	240

Table 3.3 – Peak Exceedance per Return Period

All exceedances are from SW14 as the lowest point in the drainage network, these are located adjacent to buildings but in an area with levels falling away from the building. The likely scenario is that the

exceedance will pond within the residential area and spill out of the site into the existing drainage networks (highway / private). The inclusion of a overflow on SW14 in the drainage design prevents this occurrence from becoming a possibility.

There is a very low risk of access been restricted due to this. It is noted that the critical exceedance event is during a 24-hour rainfall event.

3.7 Foul Drainage

The site requires new foul drainage connections, the existing site levels and available sewer connections suggest this can be achieved via gravity. In order to minimise foul drainage within the site and the mixing of development types (residential, commercial etc) separate connections will be provided for each block.

There is no restriction on the foul discharge to the WW combined sewer network, multiple S106 applications to WW will be required to confirm the suitability of connection points. Where possible existing connections to the main sewer network are utilised, however, for due diligence the S106 should still be applied for.

4.0 Summary and Conclusion

Curtins has been appointed by ION Developments to prepare an drainage strategy in support of a planning application for the proposed development at the Queens market, Ryhl.

The strategy provides information on the nature of flood risk at the site and follows Government guidance with regards to development and flood risk (refer to JBA FCA). The report is based on current available information and preliminary discussions.

The assessment has been undertaken in accordance with the standing advice and requirements of NRW as outlined in the Welsh Assemble Government PPW and accompanying TAN 15 guidance.

The surface water management strategy has been reviewed in relation to the Statutory Standards for Sustainable Drainage Systems in Wales and the SABs guidance with respect to surface water methods, SuDS provision and outfall options.

The report concludes that:

- The site is located entirely within Flood Zone A, defined as having a little or no risk of flooding from rivers or the sea.
- In accordance with TAN 15, the site is multi use but the more vulnerable area is the residential buildings and therefore considered critical. According to TAN 15, this land use is appropriate for Flood Zone A without the need to apply the Justification Test.
- The site is considered as being at a low risk of flooding from all other sources.
- Overland flows from sea defence failure are considered and suitable methods are utilised to prevent the flow from impacting the site.
- Surface water discharge from the proposed development will be restricted to 4.5 l/s for all events up to and including the 1 in 100 (1%) Annual Probability plus 40% climate change event. This represents the equivalent Qbar greenfield runoff rate for the site.
- Surface water attenuation will be provided for all events up to and including the 1 in 100 (1%) Annual Probability plus 40% climate change event with no exceedance.
- Attenuation will be provided within attenuation tanks.
- Foul flows from the site will be discharged at an unrestricted rate to the combined public sewer.

5.0 Appendices

Appendix A **Proposed Site Layout**

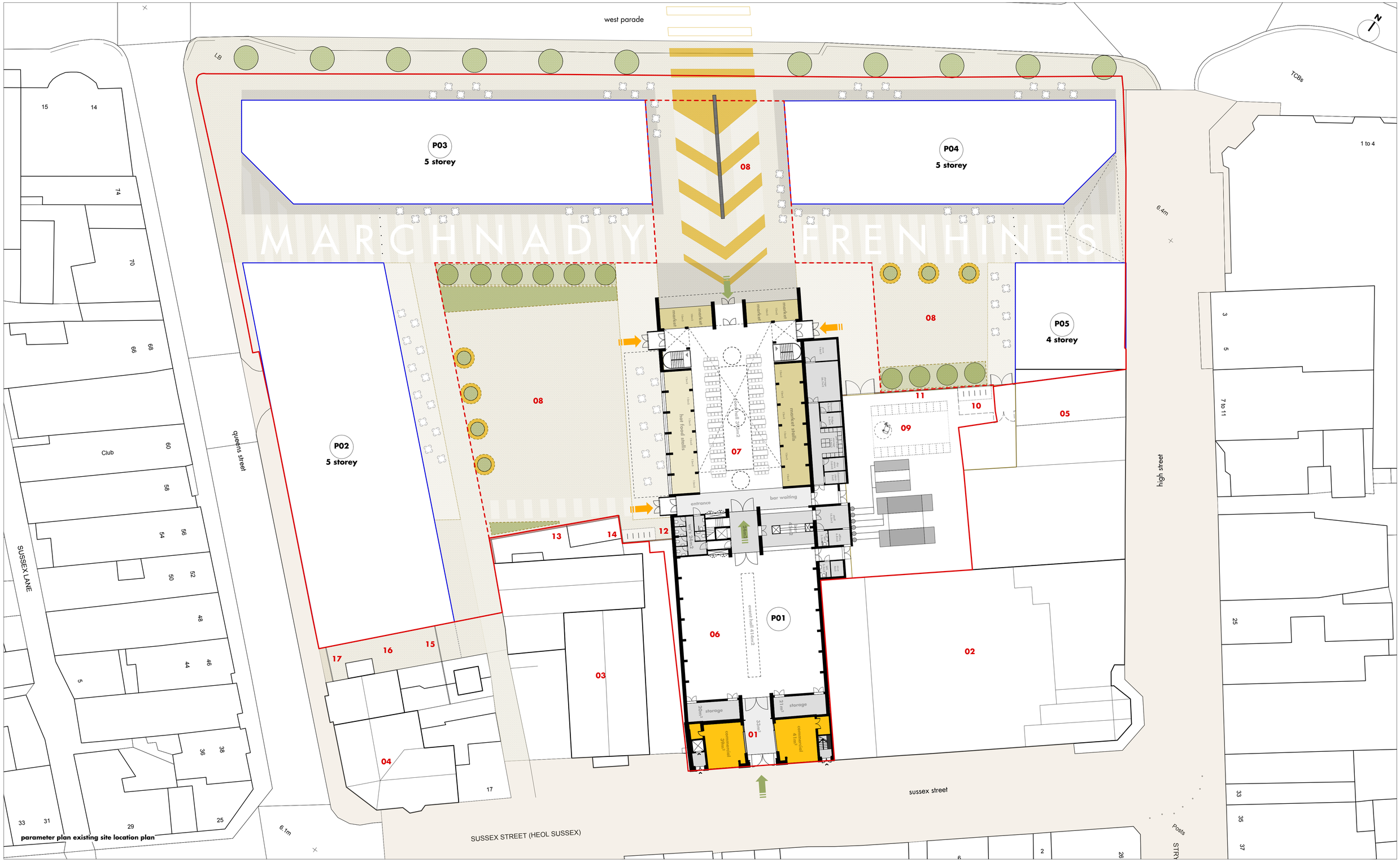
Appendix B **Brownfield Run-off Calculations**

Existing Drainage

Appendix C **Proposed Drainage Layout**

Proposed Drainage Calculations

Appendix A Proposed Site Layout



parameter plan existing site location plan

- hybrid application extents
- detailed application extent
- Outline application max building extent line refer to parameter plans for more detail

P01 detailed design componant - Queens Market
P02 outline application - Office/library
P03 outline application - resi above ground floor f&b
P04 outline application - resi above ground floor f&b
P05 outline application - office above ground floor f&b

01 queens chambers
02 old plaza cinema
03 christian centre
04 george hotel
05 fast food outlets
06 multipurpose event hall
07 food market hall
08 external landscaped courtyard/public realm
09 secure service yard
10 secure cycle storage
11 4m timber fence to conceal plant equipment
12 cycle storgae
13 existing brick wall retained
14 timber fence at same height as existing wall
15 2.4m secure barrier
16 secure service yard
17 2.4m secure barrier

rev • description	issued • drawn • checked
- • draft planning issue	03 08 20 • ab • ww

0m 50m

shedkm
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+44 (0)207 253 8881

project	queens market
client	ion developments
drawing number	(00)105 - DRAFT
scale	1:500@A1
status	**pre-application**

ga proposed site plan

Appendix B **Greendield Run-off Calculations**

Existing Drainage

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jake Busby
Site name:	ION Developments, Market
Site location:	Rhyl

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	53.32149° N
Longitude:	3.49227° W
Reference:	1073158567
Date:	Jul 30 2020 08:55

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.95

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	679	679
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

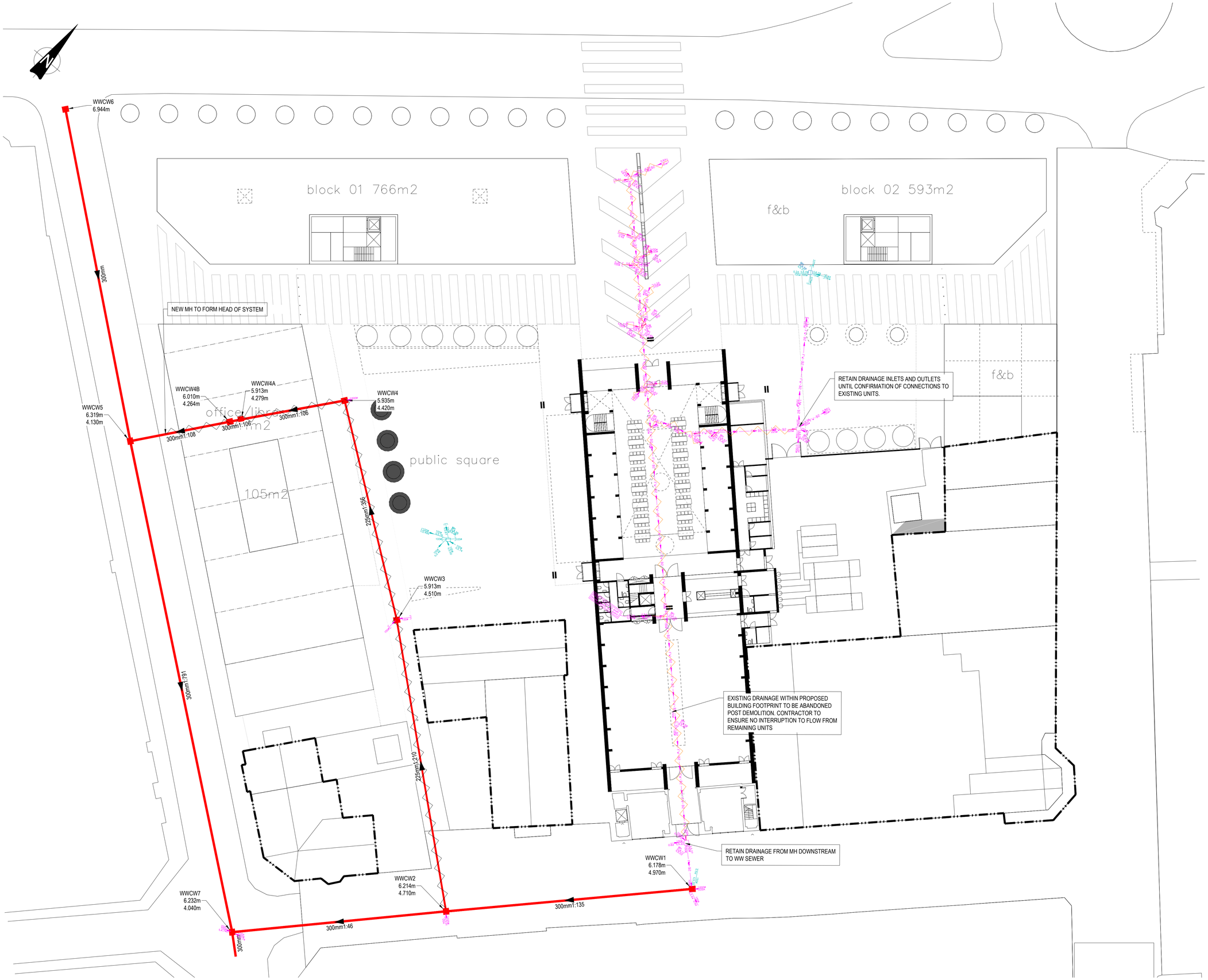
Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	4.43	4.43
1 in 1 year (l/s):	3.89	3.89
1 in 30 years (l/s):	7.88	7.88
1 in 100 year (l/s):	9.65	9.65
1 in 200 years (l/s):	10.89	10.89



GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
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3. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.

EXISTING DRAINAGE NOTES:

1. DESIGN BASED ON TOPOGRAPHICAL SURVEY AND CCTV SURVEY INFORMATION AVAILABLE AT THE TIME OF DESIGN.
2. ALL EXISTING SEWERS, CONNECTIONS, PIPE SIZES AND INVERT LEVELS TO BE CONFIRMED BY CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS TO ENSURE CONNECTIVITY. ANY VARIANCE FROM THE INFORMATION SHOWN SHOULD BE REPORTED TO THE ENGINEER FOR REVIEW.
3. WHERE EXISTING DRAINAGE IS BEING USED, ALLOWANCES SHOULD BE MADE TO REMEDIATE THIS DRAINAGE IN LINE WITH AVAILABLE CCTV SURVEY INFORMATION. IF NO SURVEY IS AVAILABLE, IT IS ADVISED TO OBTAIN ONE PRIOR TO COMMENCEMENT OF WORKS.
4. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO COMMENCEMENT OF ANY DRAINAGE WORKS, AND WHERE NECESSARY PROTECTION OR DIVERSIONS TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORK.
5. AMENDMENTS SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.

KEY

WWCW
1000@1:150 — EXISTING WELSH WATER ASSETS

FW-B2 FW-B2 — GPR SURVEY FOUL / COMBINED DRAINAGE

SW-B2 SW-B2 — GPR SURVEY SURFACE WATER DRAINAGE

ABANDON WELSH WATER SEWERS

ABANDON PRIVATE DRAINAGE

EXISTING BUILDINGS TO REMAIN. CONTRACTOR TO ENSURE NO INTERRUPTION TO DRAINAGE FLOWS IF ENCOUNTERED.

OTHER DISCIPLINE DRAWING REFERENCES

THE DESIGN OF THIS SCHEME HAS BEEN DESIGNED IN ACCORDANCE WITH THE BELOW DRAWINGS AND INFORMATION.

TOPOGRAPHICAL SURVEY REF: SEP S20562-T-01_Topographical survey

UTILITIES SURVEY DRAWING REF: SEP S20613-U-01_Utilities Survey

ARCHITECTS DRAWING REF: SKM 200724 masterplan drawings (REC'D 24/07/20)

OTHER INFORMATION REF: WELSH WATER ASSETS PPA0004753 Sewer Plan v2

Rev:	Description:	Date:	By:	Chkd:
P01	ISSUED FOR PLANNING (S2)	31/07/20	JDB	AF

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Status: ISSUED FOR INFORMATION — S2

Project: ION DEVELOPMENTS RHYL MARKET

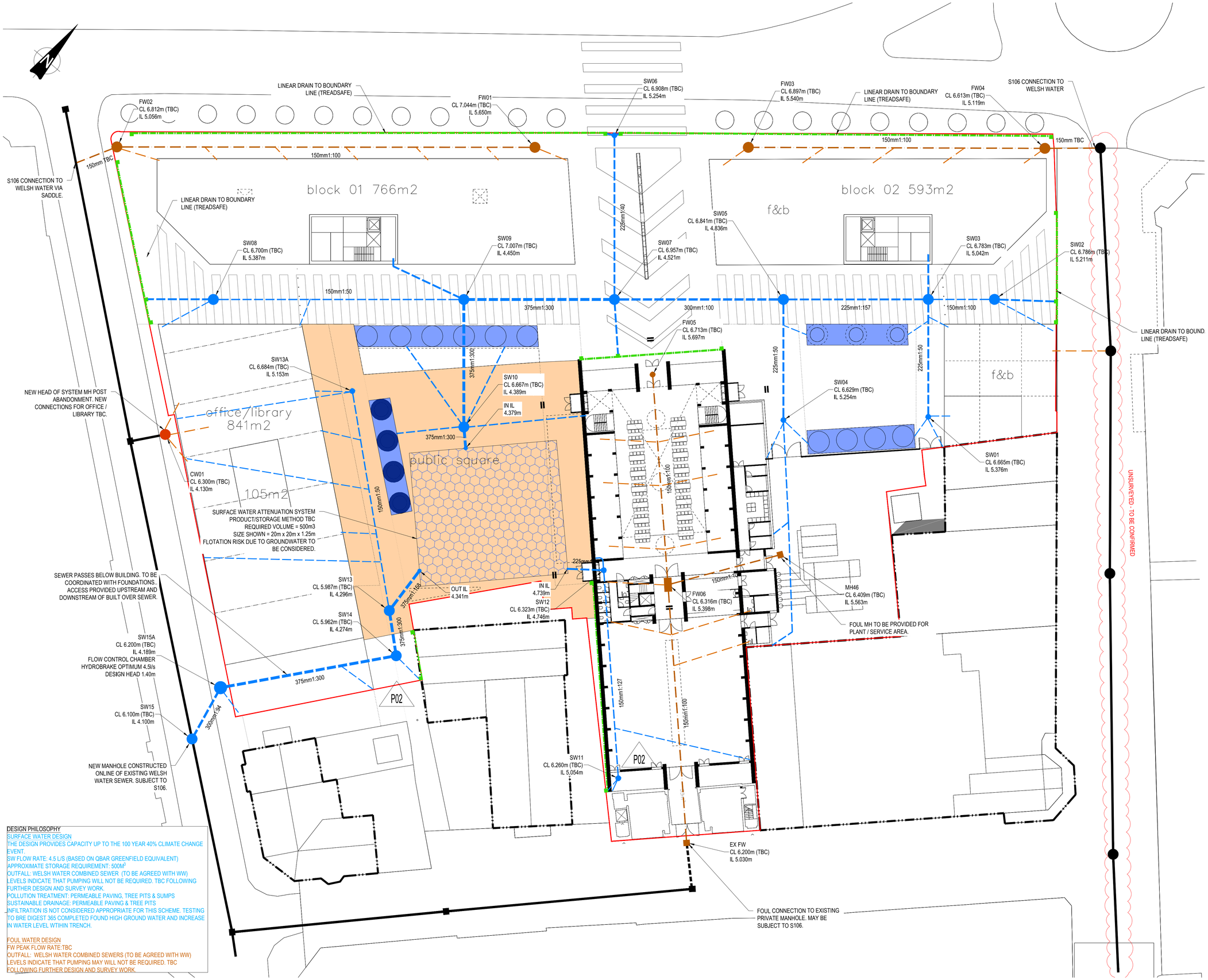
Drg Title: DRAINAGE EXISTING DRAINAGE AMENDMENTS

Size:	Date:	Drawn By:	Designed By:	Checked By:
A1	31/07/2020	JDB	JDB	AF
Scale: 1:250				

Project No: 074024 - Originator: CUR - Volume: 00 - Level: XX - Type: DR - Role: C - Category / Number: 92001 - Rev: P01

Appendix C **Proposed Drainage Layout**

Proposed Drainage Calculations



DESIGN PHILOSOPHY

SURFACE WATER DESIGN
THE DESIGN PROVIDES CAPACITY UP TO THE 100 YEAR 40% CLIMATE CHANGE EVENT.
SW FLOW RATE: 4.5 L/S (BASED ON QBAR GREENFIELD EQUIVALENT)
APPROXIMATE STORAGE REQUIREMENT: 500M^3
OUTFALL: WELSH WATER COMBINED SEWER (TO BE AGREED WITH WW)
LEVELS INDICATE THAT PUMPING WILL NOT BE REQUIRED. TBC FOLLOWING FURTHER DESIGN AND SURVEY WORK.
POLLUTION TREATMENT: PERMEABLE PAVING, TREE PITS & SUMPS
SUSTAINABLE DRAINAGE: PERMEABLE PAVING & TREE PITS
INFILTRATION IS NOT CONSIDERED APPROPRIATE FOR THIS SCHEME. TESTING TO BRE DIGEST 365 COMPLETED FOUND HIGH GROUND WATER AND INCREASE IN WATER LEVEL WITHIN TRENCH.

FOUL WATER DESIGN
FW PEAK FLOW RATE:TBC
OUTFALL: WELSH WATER COMBINED SEWERS (TO BE AGREED WITH WW)
LEVELS INDICATE THAT PUMPING MAY WILL NOT BE REQUIRED. TBC FOLLOWING FURTHER DESIGN AND SURVEY WORK.

GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
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3. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.

DRAINAGE NOTES:

1. DESIGN FOR PLANNING PURPOSES ONLY.
2. DESIGN BASED ON TOPOGRAPHICAL SURVEY AND CCTV SURVEY INFORMATION AVAILABLE AT THE TIME OF DESIGN.
3. ALL EXISTING SEWERS, CONNECTIONS, PIPE SIZES AND INVERT LEVELS TO BE CONFIRMED BY CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS TO ENSURE CONNECTIVITY. ANY VARIANCE FROM THE INFORMATION SHOWN SHOULD BE REPORTED TO THE ENGINEER FOR REVIEW.
4. WHERE EXISTING DRAINAGE IS BEING USED, ALLOWANCES SHOULD BE MADE TO REMEDIATE THIS DRAINAGE IN LINE WITH AVAILABLE CCTV SURVEY INFORMATION. IF NO SURVEY IS AVAILABLE, IT IS ADVISED TO OBTAIN ONE PRIOR TO COMMENCEMENT OF WORKS.
5. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO COMMENCEMENT OF ANY DRAINAGE WORKS, AND WHERE NECESSARY PROTECTION OR DIVERSIONS TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORK.
6. ALL RAINWATER AND FOUL POP UPS LOCATIONS AND SIZES INDICATIVE ONLY AND TO BE CONFIRMED BY THE ARCHITECT AND M&E ENGINEER.
7. COVER LEVELS, GULLY POSITIONS, AND BUILDINGS LOCATION ARE APPROXIMATE AND SHALL BE CONFIRMED BY ARCHITECT/ LANDSCAPE ARCHITECT.
8. ALL PIPE DIAMETERS GIVEN ARE NOMINAL INTERNAL PIPE DIAMETERS. THESE ARE TO BE CONFIRMED ONCE A DETAILED CAPACITY CHECK HAS BEEN UNDERTAKEN AT A LATER DESIGN STAGE.
9. OUTFALL CONNECTION(S) SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.

KEY

- EXISTING WELSH WATER ASSETS
- SW — 100Ø@1:150 — PRIVATE SW SEWER
- FW — 100Ø@1:150 — PRIVATE FW SEWER
- ATTENUATION SYSTEM (METHOD TBC) REQUIRED VOL = 500m^3
- TREE-PIT DRAINAGE SYSTEM WITH SOIL CELL. OVERFLOW TO NETWORK.
- PERMEABLE PAVING - FINISH TBC. WITH TYPE 3 SUB-BASE MEDIUM
- EXISTING BUILDINGS TO REMAIN. CONTRACTOR TO ENSURE NO INTERRUPTION TO DRAINAGE FLOWS IF ENCOUNTERED.
- LINEAR DRAINAGE (TREADSAFE FINISH)

OTHER DISCIPLINE DRAWING REFERENCES

THE DESIGN OF THIS SCHEME HAS BEEN DESIGNED IN ACCORDANCE WITH THE BELOW DRAWINGS AND INFORMATION.

TOPOGRAPHICAL SURVEY REF: SEP S20562-T-01_Topographical survey

UTILITIES SURVEY DRAWING REF: SEP S20613-U-01_Utilities Survey

ARCHITECTS DRAWING REF: SKM 200724 masterplan drawings (REC'D 24/07/20)

OTHER INFORMATION REF: WELSH WATER ASSETS PPA0004753 Sewer Plan v2

Rev:	Description:	Date:	By:	Chkd:
P02	BOUNDARY SHOWN (S2)	08/09/20	JDB	AF
P01	ISSUED FOR PLANNING (S2)	31/07/20	JDB	AF

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Status: ISSUED FOR INFORMATION — S2

Project: ION DEVELOPMENTS RHYL MARKET

Drg Title: DRAINAGE PROPOSED DRAINAGE GENERAL ARRANGEMENT

Size:	Date:	Drawn By:	Designed By:	Checked By:
A1	31/07/2020	JDB	JDB	AF

Scale: 1:250

Project No:	Originator:	Volume:	Level:	Type:	Role:	Category / Number:	Rev:
074024	CUR	00	XX	DR	C	92002	P02

\\fs03\projects\074024-Rhyl_Market_Street_Redevelopment\04-Production\4A-Models-Drawings\CIC/AD/S2\

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.000
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

	Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)	Notes
✓	SW01	0.045	5.00	6.665	600	1.289	Auto-design is off
✓	SW02	0.033	5.00	6.786	1200	1.575	Auto-design is off
✓	SW03	0.068	5.00	6.783	1200	1.741	Auto-design is off
✓	SW04	0.118	5.00	6.629	600	1.375	Auto-design is off
✓	SW05	0.000		6.841	1200	2.005	Auto-design is off
✓	SW06	0.080	5.00	6.908	600	1.654	Auto-design is off
✓	SW07	0.064	5.00	6.957	1200	2.436	Auto-design is off
✓	SW08	0.047	5.00	6.700	1200	1.313	Auto-design is off
✓	SW09	0.086	5.00	7.007	1200	2.557	Auto-design is off
✓	SW10	0.186	5.00	6.667	1200	2.278	Auto-design is off
✓	SW11	0.072	5.00	6.260	600	1.206	Auto-design is off
✓	SW12	0.039	5.00	6.323	600	1.652	Auto-design is off
✓	SW13A	0.060	5.00	6.684	600	1.510	Auto-design is off
✓	SW13	0.000		5.987	1200	1.691	Auto-design is off
✓	SW14	0.006	5.00	5.962	1200	1.688	Auto-design is off
✓	SW15	0.000		6.100	1200	2.000	Auto-design is off
✓	SW15A	0.030	5.00	6.200	1500	2.011	Auto-design is off

Links (Results)

	Name	US Node	DS Node	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)
✓	1.000	SW01	SW03	1.064	1.516	1.064	1.516	0.045
✓	2.000	SW02	SW03	1.425	1.516	1.425	1.516	0.033
✓	1.001	SW03	SW05	1.516	1.705	1.516	1.705	0.146
✓	3.000	SW04	SW05	1.150	1.705	1.150	1.705	0.118
?	1.002	SW05	SW07	1.705	2.061	1.705	2.061	0.264
?	4.000	SW06	SW07	1.429	2.061	1.429	2.061	0.080
?	1.003	SW07	SW09	2.061	2.182	2.061	2.182	0.408
?	5.000	SW08	SW09	1.163	2.182	1.163	2.182	0.047
?	1.004	SW09	SW10	2.182	1.903	1.903	2.182	0.541
✓	1.005	SW10	SW13	1.903	1.316	1.316	1.903	0.838
✓	6.000	SW11	SW12	1.056	1.427	1.056	1.427	0.072
?	6.001	SW12	SW10	1.427	2.053	1.427	2.053	0.111
✓	7.000	SW13A	SW13	1.360	1.295	1.295	1.360	0.060

Links (Results)

	Name	US Node	DS Node	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)
?	1.006	SW13	SW14	1.316	1.313	1.313	1.316	0.898
?	1.007	SW14	SW15A	1.313	1.636	1.313	1.636	0.904
?	1.008	SW15A	SW15	1.711	1.700	1.700	1.711	0.934

Node SW15A Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	4.189	Product Number	CTL-SHE-0095-4500-1400-4500
Design Depth (m)	1.400	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.5	Min Node Diameter (mm)	1200

Node SW10 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	4.389
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	400.0	0.0	1.250	400.0	0.0	1.251	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.44%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	10	5.417	0.041	5.4	0.0401	0.0000	OK
15 minute winter	SW02	10	5.261	0.050	3.9	0.0769	0.0000	OK
15 minute winter	SW03	10	5.146	0.104	17.3	0.1989	0.0000	OK
15 minute winter	SW04	10	5.323	0.069	14.1	0.1379	0.0000	OK
15 minute winter	SW05	10	4.948	0.112	30.5	0.1264	0.0000	OK
15 minute winter	SW06	10	5.306	0.052	9.5	0.0655	0.0000	OK
15 minute winter	SW07	10	4.707	0.186	47.1	0.3088	0.0000	OK
15 minute winter	SW08	10	5.435	0.048	5.6	0.0886	0.0000	OK
15 minute summer	SW09	10	4.659	0.209	60.3	0.3771	0.0000	OK
240 minute winter	SW10	192	4.575	0.186	19.8	74.8617	0.0000	OK
15 minute winter	SW11	10	5.127	0.073	8.6	0.1084	0.0000	OK
15 minute winter	SW12	10	4.756	0.085	12.9	0.0640	0.0000	OK
15 minute winter	SW13A	10	5.229	0.055	7.1	0.0591	0.0000	OK
240 minute winter	SW13	196	4.575	0.279	7.9	0.3153	0.0000	OK
240 minute winter	SW14	196	4.575	0.301	6.5	0.3615	0.0000	OK
15 minute summer	SW15	1	4.100	0.000	4.4	0.0000	0.0000	OK
240 minute winter	SW15A	196	4.575	0.386	5.7	0.7967	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW01	1.000	SW03	5.3	0.484	0.072	0.1906	
15 minute winter	SW02	2.000	SW03	3.8	0.780	0.216	0.0462	
15 minute winter	SW03	1.001	SW05	16.9	0.971	0.408	0.3578	
15 minute winter	SW04	3.000	SW05	13.9	1.392	0.188	0.1709	
15 minute winter	SW05	1.002	SW07	30.6	1.289	0.275	0.5727	
15 minute winter	SW06	4.000	SW07	9.4	1.365	0.114	0.1600	
15 minute winter	SW07	1.003	SW09	47.8	0.844	0.417	1.2516	
15 minute winter	SW08	5.000	SW09	5.4	1.132	0.215	0.1705	
15 minute winter	SW09	1.004	SW10	64.5	1.948	0.558	0.6327	
30 minute summer	SW10	1.005	SW13	10.2	0.393	0.089	1.3338	
15 minute winter	SW11	6.000	SW12	8.3	0.995	0.459	0.2484	
15 minute winter	SW12	6.001	SW10	13.0	1.479	0.252	0.3076	
15 minute winter	SW13A	7.000	SW13	6.9	1.205	0.275	0.1817	
15 minute summer	SW13	1.006	SW14	10.9	0.543	0.094	0.3951	
60 minute summer	SW14	1.007	SW15A	6.9	0.231	0.060	2.3632	
240 minute winter	SW15A	Hydro-Brake®	SW15	4.5				108.1

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.44%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	10	5.440	0.064	13.1	0.0625	0.0000	OK
15 minute winter	SW02	10	5.294	0.083	9.6	0.1290	0.0000	OK
15 minute winter	SW03	11	5.241	0.199	42.3	0.3814	0.0000	OK
15 minute winter	SW04	10	5.368	0.114	34.3	0.2286	0.0000	OK
15 minute winter	SW05	10	5.031	0.195	74.5	0.2201	0.0000	OK
15 minute winter	SW06	10	5.335	0.081	23.3	0.1014	0.0000	OK
360 minute winter	SW07	352	4.956	0.435	16.6	0.7203	0.0000	SURCHARGED
15 minute winter	SW08	10	5.465	0.078	13.7	0.1444	0.0000	OK
360 minute winter	SW09	352	4.956	0.506	21.3	0.9128	0.0000	SURCHARGED
360 minute winter	SW10	352	4.956	0.567	32.7	228.3651	0.0000	SURCHARGED
15 minute winter	SW11	11	5.246	0.192	21.0	0.2830	0.0000	SURCHARGED
360 minute winter	SW12	352	4.956	0.285	4.5	0.2152	0.0000	SURCHARGED
15 minute winter	SW13A	10	5.268	0.094	17.5	0.1015	0.0000	OK
360 minute winter	SW13	352	4.956	0.660	6.5	0.7468	0.0000	SURCHARGED
360 minute winter	SW14	360	4.956	0.682	5.7	0.8193	0.0000	SURCHARGED
15 minute summer	SW15	1	4.100	0.000	4.5	0.0000	0.0000	OK
360 minute winter	SW15A	352	4.956	0.767	5.1	1.5847	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW01	1.000	SW03	13.0	0.569	0.176	0.3848	
15 minute winter	SW02	2.000	SW03	9.5	0.847	0.537	0.1194	
15 minute winter	SW03	1.001	SW05	41.2	1.179	0.995	0.7148	
15 minute winter	SW04	3.000	SW05	34.1	1.675	0.463	0.3572	
15 minute winter	SW05	1.002	SW07	74.3	1.271	0.669	1.3880	
15 minute winter	SW06	4.000	SW07	23.1	1.334	0.281	0.5775	
15 minute winter	SW07	1.003	SW09	115.8	1.116	1.010	2.2169	
15 minute winter	SW08	5.000	SW09	13.5	1.348	0.536	0.3792	
15 minute winter	SW09	1.004	SW10	153.8	2.275	1.331	1.3580	
15 minute summer	SW10	1.005	SW13	-21.3	-0.383	-0.186	2.5074	
15 minute winter	SW11	6.000	SW12	19.6	1.154	1.083	0.4980	
15 minute winter	SW12	6.001	SW10	30.5	1.634	0.589	0.8054	
15 minute winter	SW13A	7.000	SW13	17.1	1.504	0.679	0.3596	
15 minute summer	SW13	1.006	SW14	16.0	0.546	0.138	0.6888	
30 minute summer	SW14	1.007	SW15A	6.5	0.242	0.057	2.7980	
15 minute summer	SW15A	Hydro-Brake®	SW15	4.5				66.4

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.44%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	12	6.137	0.761	23.7	0.7464	0.0000	SURCHARGED
15 minute winter	SW02	12	6.197	0.986	17.4	1.5276	0.0000	SURCHARGED
15 minute winter	SW03	12	6.106	1.064	66.2	2.0344	0.0000	SURCHARGED
15 minute winter	SW04	11	5.966	0.712	62.0	1.4240	0.0000	SURCHARGED
15 minute winter	SW05	11	5.705	0.869	118.5	0.9830	0.0000	SURCHARGED
600 minute winter	SW06	585	5.597	0.343	4.0	0.4287	0.0000	SURCHARGED
600 minute winter	SW07	585	5.597	1.076	19.6	1.7818	0.0000	SURCHARGED
15 minute winter	SW08	11	5.681	0.294	24.7	0.5423	0.0000	SURCHARGED
600 minute winter	SW09	585	5.597	1.147	25.6	2.0691	0.0000	SURCHARGED
600 minute winter	SW10	585	5.597	1.208	40.6	486.5110	0.0000	SURCHARGED
15 minute winter	SW11	12	6.127	1.073	37.9	1.5850	0.0000	FLOOD RISK
600 minute winter	SW12	585	5.597	0.926	5.5	0.6991	0.0000	SURCHARGED
15 minute winter	SW13A	11	5.654	0.480	31.6	0.5172	0.0000	SURCHARGED
600 minute winter	SW13	585	5.597	1.301	5.8	1.4711	0.0000	SURCHARGED
600 minute winter	SW14	585	5.597	1.323	5.3	1.5898	0.0000	SURCHARGED
15 minute summer	SW15	1	4.100	0.000	4.5	0.0000	0.0000	OK
600 minute winter	SW15A	585	5.597	1.408	4.9	2.9080	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW01	1.000	SW03	20.2	0.599	0.273	0.6636	
15 minute summer	SW02	2.000	SW03	16.4	0.931	0.923	0.1656	
15 minute winter	SW03	1.001	SW05	64.7	1.627	1.565	0.8186	
15 minute winter	SW04	3.000	SW05	56.2	1.707	0.763	0.6816	
15 minute winter	SW05	1.002	SW07	118.9	1.689	1.070	1.6907	
15 minute winter	SW06	4.000	SW07	38.8	1.228	0.470	0.9273	
15 minute winter	SW07	1.003	SW09	183.5	1.664	1.601	2.3604	
15 minute summer	SW08	5.000	SW09	21.6	1.297	0.856	0.6266	
15 minute winter	SW09	1.004	SW10	246.1	2.430	2.129	1.9969	
15 minute winter	SW10	1.005	SW13	-35.6	-0.500	-0.311	3.1055	
15 minute summer	SW11	6.000	SW12	32.7	1.856	1.805	0.5214	
15 minute winter	SW12	6.001	SW10	50.9	1.723	0.984	1.1313	
15 minute winter	SW13A	7.000	SW13	29.7	1.686	1.178	0.5567	
15 minute winter	SW13	1.006	SW14	12.9	0.574	0.112	0.7151	
15 minute summer	SW14	1.007	SW15A	-10.1	0.285	-0.088	2.7980	
600 minute winter	SW15A	Hydro-Brake®	SW15	4.5				202.5

Node SW15A Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	4.189	Design Flow (l/s)	4.5
Replaces Downstream Link	✓	Design Depth (m)	1.400		

Depth (m)	Flow (l/s)
5.000	0.000

Node SW10 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	4.389
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	400.0	0.0	1.250	400.0	0.0	1.251	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.21%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	10	5.417	0.041	5.4	0.0401	0.0000	OK
15 minute winter	SW02	10	5.261	0.050	3.9	0.0769	0.0000	OK
15 minute winter	SW03	10	5.146	0.104	17.3	0.1990	0.0000	OK
15 minute winter	SW04	10	5.323	0.069	14.1	0.1379	0.0000	OK
15 minute winter	SW05	10	4.948	0.112	30.5	0.1264	0.0000	OK
15 minute winter	SW06	10	5.306	0.052	9.5	0.0655	0.0000	OK
1440 minute winter	SW07	1680	4.855	0.334	2.6	0.5530	0.0000	OK
15 minute winter	SW08	10	5.435	0.048	5.6	0.0886	0.0000	OK
1440 minute winter	SW09	1680	4.855	0.405	3.4	0.7304	0.0000	SURCHARGED
1440 minute winter	SW10	1620	4.855	0.466	5.7	187.6048	0.0000	SURCHARGED
15 minute winter	SW11	10	5.127	0.073	8.6	0.1084	0.0000	OK
1440 minute winter	SW12	1530	4.855	0.184	0.8	0.1389	0.0000	OK
15 minute winter	SW13A	10	5.229	0.055	7.1	0.0591	0.0000	OK
1440 minute winter	SW13	1590	4.855	0.559	0.6	0.6321	0.0000	SURCHARGED
1440 minute winter	SW14	1680	4.855	0.581	0.3	0.6979	0.0000	SURCHARGED
15 minute summer	SW15	1	4.100	0.000	0.0	0.0000	0.0000	OK
1440 minute winter	SW15A	1680	4.855	0.666	0.3	1.3756	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW01	1.000	SW03	5.3	0.484	0.072	0.1907	
15 minute winter	SW02	2.000	SW03	3.8	0.780	0.216	0.0462	
15 minute winter	SW03	1.001	SW05	16.9	0.971	0.408	0.3578	
15 minute winter	SW04	3.000	SW05	13.9	1.392	0.188	0.1709	
15 minute winter	SW05	1.002	SW07	30.6	1.290	0.275	0.5730	
15 minute winter	SW06	4.000	SW07	9.4	1.365	0.114	0.1600	
15 minute winter	SW07	1.003	SW09	47.8	0.845	0.417	1.2522	
15 minute winter	SW08	5.000	SW09	5.4	1.132	0.215	0.1705	
15 minute winter	SW09	1.004	SW10	64.5	1.948	0.559	0.6328	
15 minute winter	SW10	1.005	SW13	-8.6	-0.240	-0.075	1.2780	
15 minute winter	SW11	6.000	SW12	8.3	0.995	0.459	0.2484	
15 minute winter	SW12	6.001	SW10	13.0	1.478	0.252	0.3223	
15 minute winter	SW13A	7.000	SW13	6.9	1.206	0.275	0.1817	
15 minute summer	SW13	1.006	SW14	7.6	0.479	0.065	0.4036	
15 minute winter	SW14	1.007	SW15A	-3.3	0.184	-0.028	2.1604	
15 minute summer	SW15A	Depth/Flow	SW15	0.0				0.0

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.21%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	10	5.440	0.064	13.1	0.0625	0.0000	OK
1440 minute winter	SW02	1650	5.408	0.197	0.5	0.3059	0.0000	SURCHARGED
1440 minute winter	SW03	1650	5.408	0.366	2.0	0.7003	0.0000	SURCHARGED
1440 minute winter	SW04	1560	5.408	0.154	1.6	0.3084	0.0000	OK
1440 minute winter	SW05	1560	5.408	0.572	3.6	0.6471	0.0000	SURCHARGED
1440 minute winter	SW06	1650	5.408	0.154	1.1	0.1926	0.0000	OK
1440 minute winter	SW07	1560	5.408	0.887	5.6	1.4689	0.0000	SURCHARGED
15 minute winter	SW08	10	5.465	0.078	13.7	0.1444	0.0000	OK
1440 minute winter	SW09	1560	5.408	0.958	7.2	1.7282	0.0000	SURCHARGED
1440 minute winter	SW10	1530	5.408	1.019	12.3	410.3912	0.0000	SURCHARGED
1440 minute winter	SW11	1650	5.408	0.354	1.0	0.5234	0.0000	SURCHARGED
1440 minute winter	SW12	1650	5.408	0.737	1.5	0.5565	0.0000	SURCHARGED
1440 minute winter	SW13A	1620	5.408	0.234	0.8	0.2521	0.0000	SURCHARGED
1440 minute winter	SW13	1350	5.416	1.120	1.0	1.2668	0.0000	SURCHARGED
1440 minute winter	SW14	1260	5.444	1.170	1.0	1.4061	0.0000	SURCHARGED
15 minute summer	SW15	1	4.100	0.000	0.0	0.0000	0.0000	OK
1440 minute winter	SW15A	1590	5.408	1.219	0.4	2.5187	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW01	1.000	SW03	13.0	0.569	0.176	0.3848	
15 minute winter	SW02	2.000	SW03	9.5	0.848	0.537	0.1194	
15 minute winter	SW03	1.001	SW05	41.2	1.179	0.995	0.7148	
15 minute winter	SW04	3.000	SW05	34.1	1.675	0.463	0.3573	
15 minute winter	SW05	1.002	SW07	74.3	1.263	0.669	1.3874	
15 minute winter	SW06	4.000	SW07	23.1	1.331	0.281	0.5766	
15 minute winter	SW07	1.003	SW09	115.8	1.116	1.010	2.2152	
15 minute winter	SW08	5.000	SW09	13.5	1.348	0.537	0.3768	
15 minute winter	SW09	1.004	SW10	153.6	2.273	1.330	1.4074	
15 minute winter	SW10	1.005	SW13	-22.1	-0.422	-0.194	2.7950	
15 minute winter	SW11	6.000	SW12	19.6	1.153	1.083	0.4980	
15 minute winter	SW12	6.001	SW10	30.5	1.634	0.589	0.8124	
15 minute winter	SW13A	7.000	SW13	17.1	1.504	0.679	0.3596	
15 minute summer	SW13	1.006	SW14	10.4	0.482	0.090	0.6982	
15 minute summer	SW14	1.007	SW15A	-8.4	0.202	-0.073	2.7884	
15 minute summer	SW15A	Depth/Flow	SW15	0.0				0.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.21%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	12	6.137	0.761	23.7	0.7465	0.0000	SURCHARGED
15 minute winter	SW02	12	6.196	0.985	17.4	1.5275	0.0000	SURCHARGED
15 minute winter	SW03	12	6.106	1.064	66.2	2.0346	0.0000	SURCHARGED
960 minute winter	SW04	600	5.999	0.745	4.0	1.4883	0.0000	SURCHARGED
960 minute winter	SW05	600	5.996	1.160	8.5	1.3120	0.0000	SURCHARGED
960 minute winter	SW06	600	5.986	0.732	2.7	0.9155	0.0000	SURCHARGED
960 minute winter	SW07	600	5.989	1.468	13.2	2.4307	0.0000	SURCHARGED
960 minute winter	SW08	600	5.992	0.605	1.6	1.1178	0.0000	SURCHARGED
960 minute winter	SW09	600	5.985	1.535	17.5	2.7696	0.0000	SURCHARGED
960 minute winter	SW10	600	5.980	1.591	30.4	504.5982	0.0000	SURCHARGED
15 minute winter	SW11	12	6.131	1.077	37.9	1.5905	0.0000	FLOOD RISK
960 minute winter	SW12	600	5.984	1.313	3.7	0.9916	0.0000	SURCHARGED
720 minute winter	SW13A	480	5.965	0.791	2.6	0.8519	0.0000	SURCHARGED
960 minute winter	SW13	600	5.966	1.670	23.0	1.8890	0.0000	FLOOD RISK
1440 minute winter	SW14	870	5.962	1.688	17.1	2.0290	241.9422	FLOOD
15 minute summer	SW15	1	4.100	0.000	0.0	0.0000	0.0000	OK
1440 minute winter	SW15A	870	5.964	1.775	1.4	3.6676	0.0000	FLOOD RISK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW01	1.000	SW03	20.1	0.599	0.273	0.6636	
15 minute summer	SW02	2.000	SW03	16.4	0.929	0.921	0.1656	
15 minute winter	SW03	1.001	SW05	64.7	1.626	1.564	0.8186	
15 minute winter	SW04	3.000	SW05	56.2	1.709	0.762	0.6816	
15 minute winter	SW05	1.002	SW07	118.8	1.688	1.070	1.6907	
15 minute winter	SW06	4.000	SW07	38.8	1.228	0.470	0.9273	
15 minute winter	SW07	1.003	SW09	183.3	1.662	1.599	2.3604	
15 minute summer	SW08	5.000	SW09	21.7	1.297	0.860	0.6266	
15 minute winter	SW09	1.004	SW10	245.8	2.417	2.127	1.9969	
15 minute winter	SW10	1.005	SW13	-41.4	-0.520	-0.362	3.1055	
15 minute summer	SW11	6.000	SW12	32.7	1.856	1.804	0.5214	
15 minute winter	SW12	6.001	SW10	50.9	1.722	0.984	1.1313	
15 minute winter	SW13A	7.000	SW13	29.7	1.686	1.178	0.5567	
960 minute winter	SW13	1.006	SW14	22.9	0.220	0.198	0.7151	
15 minute winter	SW14	1.007	SW15A	-15.1	0.229	-0.131	2.7980	
15 minute summer	SW15A	Depth/Flow	SW15	0.0				0.0

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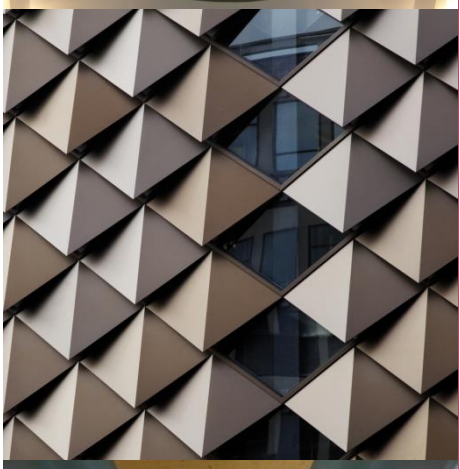

ION Developments, Rhyl Market Street

Drainage Maintenance Requirements

Curtins Ref: 074024-CUR-00-XX-RP-C-00002

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Client Name: ION Developments

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Author	Signature	Date
Jake Busby Project Engineer		31/07/2020

Reviewed	Signature	Date
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1.0 Maintenance Requirements

This report is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy and in relation to typical details. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints.

A management and maintenance plan for the lifetime of the development shall include the arrangements for a maintenance/management contract where required to secure the operation of the sustainable urban drainage scheme throughout its lifetime.

The recommended operations and frequencies are typical only and should be more frequent initially to ensure that there are no unforeseen issues with the operation and then adjusted to suit the site requirements.

1.1 Proposed Development

Plot A will remain under Denbighshire County Council (DCC) ownership and will be subject to routine maintenance as with other drainage assets. The following items are proposed for the drainage scheme;

- Pipes;
- Permeable Paving;
- Tree Pits
- Manholes;
- Linear Drains;
- Flow Control.

It is assumed that the maintenance of the drainage network for the development will not be let to a maintenance and management contractor but will be maintained by DCC's in-house teams. It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event. During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris or litter

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the filter drains and the upstream/downstream chambers.

1.1.1 Pipes

Pipes are proprietary products and the materials can vary across the site and as such where used the manufacture's recommendations should be followed. Regardless of the product used the pipes will be fully compliant with the Curtins drainage specification.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers and manholes.

Regular inspection and maintenance is important to identify areas which may have been obstructed/clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection should be provided as post construction CCTV survey.	N/A
Regular maintenance\ inspection	Inspect for evidence of poor operation via water level in chambers. If required, take remedial action.	3-monthly, 48 hours after large storms.
	Check and remove large vegetation growth near pipe runs.	Monthly or as required
Remedial Action	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

1.1.2 Permeable Paving

The permeable pavements have designed in accordance with CIRIA C697 and BS7533-13.

The permeable pavements are intended to be water quality and attenuation storage features. These features are intended to be dry except during rainfall events. The permeable pavements may also be utilised as an infiltration area or soakaway for other areas of the development.

The surface has been designed to be porous or to contain gaps where rain can flow through the upper construction layers into the voided stone which makes up the subbase.

Access for maintenance is provided as this is a surface feature only.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect feature surface to identify evidence of erosion, compaction, ponding, and contamination. Record areas where water is ponding for >48 hours.	Every three months and after large storms.
	Check features surface for even gradients	Half yearly
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly.
	Inspect silt accumulation rates and establish appropriate removal frequencies.	Half yearly.
	Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving.	Annually.
Regular maintenance\ inspection	Litter and debris removal	Monthly or as required
	Removal of weed.	Monthly (at start, then as required).
	Brushing and vacuuming	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site-

Maintenance Schedule	Required Action	Frequency
		specific observations of clogging.
Remedial Actions	Re-level uneven surfaces and reinstate design levels. This may be required as part of sediment removal.	As required.

1.1.3 Tree Pits

Guidance on delivering trees in hard landscape areas is provided by the Trees and Design Action Group (TDAG), CIRIA C753 Chapter 19 and SuDS in London Design Guide.

The tree pits are intended to be water quality features. They provide storage of storm water runoff through the use of structural soils or proprietary crate systems. Soils and geotextiles that make up the construction of tree pits remove silts and particulates that may be present in runoff water.

The location of below ground services and drainage should be identified to ensure root zones, utilities and other below ground infrastructure are all coordinated. Protection for both long-term root growth and below ground infrastructure can be provided with root barriers.

Maintenance requirements of trees will be greatest during the first few years, when the tree is becoming established. Early maintenance should involve regular inspection, removal of invasive vegetation and possibly irrigation during long dry periods, particularly in soils with high void ratios.

Tree roots need to establish good root-soil contact before they can effectively extract water from the soil. The expertise of a landscape architect with local knowledge should be sought regarding appropriate irrigation schedules.

Maintenance responsibility for a tree pit or planter should always be placed with an appropriate organisation.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets for blockages, and clear if required.	Monthly and after large storms.

Maintenance Schedule	Required Action	Frequency
Regular maintenance\ inspection	Remove litter and debris & inspect inlets and outlets	Monthly
	Manage other vegetation and remove nuisance plants	Monthly
	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary.	Annually, or as required.
	Water	As required (in periods of drought)
Remedial Actions	Repair/rehabilitation of inlets.	As required.

1.1.4 Manholes

Access points have been located at the head of each run, at a change in direction and at a change of pipe size in accordance with Building Regulations Part H.

The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Maintenance Manager prior to any access.

1.1.5 Linear Drainage

Channels should be inspected and cleaned in accordance with the manufacturer's details. Channel units can be cleaned through the use of a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should be kept clear at all times to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.

Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection including channel outlet boxes.	Half yearly and after large storms.
Regular maintenance\ inspection	Litter and debris removal	Monthly or as required.
	Check and remove large vegetation growth near channel runs.	Monthly or as required
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving.	3-monthly, 48 hours after large storms.
Remedial Action	Inspect access/outlet boxes and rod through poorly performing channels and outlets as initial remediation.	As required.

1.1.6 Flow Control Units

The flow control units are intended for flood control and flow restriction.

The flow controls are specified as Hydro-brake or similar approved and are proprietary products; therefore, manufacturer's recommendations should also be taken in to consideration.

Access for maintenance has been provided by locating within manhole chambers.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets for blockages, and clear if required. If faults persist jetting and CCTV survey may be required.	Monthly and after large storms.

Maintenance Schedule	Required Action	Frequency
Regular maintenance\ inspection	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly.
	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and flow control chambers.	Annually (or as required after heavy rainfall events)
Remedial Actions	Repair/rehabilitation of inlets.	As required.

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