Canham Consulting

Structural Civil Building Engineers

Drainage Strategy



Project Ref:	218070
Document Ref:	218070-CCL-XX-00-RP-01001
Site:	Redevelopment of Battery Green and the Marina Centre, Lowestoft
Client:	East Suffolk Council
Prepared By:	Matthew Herring MEng CEng MICE
Date of Report:	17 Nov 2023
Revision:	P01
Status Code:	S3

Canham Consulting Ltd | Consultants to the Construction Industry
Second Floor, 69-75 Thorpe Road, Norwich, Norfolk, NR1 1UA
Registered in England & Wales | Company Registration No 02710417
01603 430650 | clientservice@canhamconsulting.co.uk | www.canhamconsulting.co.uk

Document Issue Record

The table below provides a record of document issue and revision history:

Revisions					
Rev	Description	Prepared By	Checked By	Approved By	Date
P1	For Approval	MH	JL	MR	17/11/23

Contents

Appendices

List of Figures

List of Tables

1 INTRODUCTION

Canham Consulting Ltd have been commissioned by Lowestoft Town Council to produce a Drainage Strategy in support of a full planning application for a mixed use development on a brownfield site at Battery Green in Lowestoft. The development consists of public amenity space including café, restaurant, internal and external exhibition space and arts venue. A plan of the development can be found in Appendix A.

This Drainage Strategy will build on the Flood Risk Assessment ref 218070-CCL-XX-00-RP-01000 which detailed the flood risks associated with the proposed development and identified mitigation measures for the development. Through the report, we will outline how the drainage design is able to address the requirements and guidance set out in National Planning Policy Framework (NPPF), the National Planning Policy Guidance (NPPG), alongside other relevant Local Authority policies and guidance notes from authorities such as the Environment Agency (EA), Anglian Water, CIRIA, The SuDS Manual (C753) and Suffolk County Councils Guidance on SuDS (Sustainable Drainage Systems) Design.

The following data was collected as part of this FRA and Drainage Strategy:

- Topographical Survey
- Anglian Water Utility Plans
- Canham Consulting FRA ref 218070-CCL-XX-00-RP-01000

1.1 Site History

The site is currently used primarily for retail and parking associated with the retail use. To enable the development, we will need to undertake some demolition to existing structures to allow level site areas.

1.2 Site Context and Location

The site development will need to accommodate the buildings and various areas of hardstanding and soft landscaping areas which will be designed to ensure continued function of the drainage and hardstanding aspects and mitigate potential flood risk.

The layout delivers good use of the site covering just over 0.9 hectares and splits the site into distinct areas with the soft landscaping and car parking to the east of the site and the public realm alongside the main structures to the west.

The development areas are currently covered by buildings and hard landscaping. A Topographic Survey of the existing site is included within Appendix B. The topographic survey indicates that the proposed development is in an area with a maximum ground level of approximately 6m AOD in the centre and east of the of the site and a minimum ground level of approximately 5m AOD in the west of the site.

The site location is indicated below on Figure 1 and is centred on Grid Reference TM55079312.

Figure 1: Site Location Plan

The site is surrounded immediately by local highway infrastructure and beyond that, retail and industrial buildings on each side. Waveney Dock and Hamilton Dock are beyond the site to the east side (70m to the east) and the North Sea is beyond that. Lowestoft Railway Station is 150m to the north-west.

2 CLIMATE CHANGE

Climate change factors, as defined by NPPF Technical Guidance, should be applied to the peak rainfall intensity.

National Guidance on Flood Risk Assessments and climate change allowances, shown in Table 2 of the guidance.
(https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances), shows that in small and urban catchments a central level of 20% and upper end of 45% peak rainfall intensity allowance should be used to assess the range of impacts.

For the purposes of this report, it is proposed that a conservative approach is considered and that a climate change factor of +45% is utilised on all drainage calculations.

3 DETAILED DEVELOPMENT PROPOSAL

3.1 Introduction

The FRA demonstrated that the site carries a low risk of flooding and despite the location, does not need excessive mitigation to enable development to take place. The existing site is a brownfield, and the development will offer opportunities to provide betterment to the surface water drainage system delivering on the requirements of the SuDS Manual and the Four Pillars which are defined as follows:

- Water Quantity - Control the quantity of run off
- Water Quality - Manage the quality of the runoff
- Amenity – Create and sustain better places for people
- Biodiversity – Create and sustain better places for nature

.

3.2 Proposed Surface Water Drainage Strategy

3.2.1 SuDS Hierarchy

When deciding what SuDS options are appropriate for a development, it is important to understand how the site will drain. The LLFA has the following surface water drainage hierarchy that developers must follow:

- Rainwater harvesting (including a combination of green and blue roofs);
- Infiltration techniques and green roofs;
- Rainwater attenuation in open water features for gradual release;
- Rainwater discharge direct to a watercourse (unless not appropriate);
- Rainwater attenuation above ground (including blue roofs);
- Rainwater attenuation below ground;
- Rainwater discharge to a surface water sewer or drain; and
- Rainwater discharge to a combined sewer.

Reviewing the above list from the top down, there is scope in exploring the potential for each of the potential discharge solutions but the prime focus as a drainage strategy, with the priority being to enable self-sufficient function, would be to seek to understand the feasibility of an infiltration method.

As part of the solution, we will need to protect any groundwater source protection zones which may exist at or near to the site. Surface water will need to be treated to a suitable level before leaving site to ensure that there are no adverse environmental impacts resulting from the proposed development and the discharge of any surface water via infiltration take place at a level no lower than 2m below existing ground level.

Table 26.1 of the SuDS Manual (C753) indicates that a simple index approach is suitable for assessing the risk to ground water.

The Harrison Geotechnical report (as included in Appendix F) outlines the suitability of infiltration as a suitable mechanism for surface water drainage for the proposed development. The Desk Study report undertaken by Harrisons Geotechnical advised with respect to groundwater as follows:

Information from the hydrogeological map indicate that the groundwater is at approximately 0maOD. The site is in close proximity to the North Sea and therefore groundwater is anticipated

to be shallow. Historic boreholes in the area have recorded groundwater at approximately 5.9mbgl.

The aquifer status of the site is linked to the underlying soil types. The superficial geology (Happisburgh Glacigenic Formation – Sand) is designated as a secondary 'A' aquifer, and the solid geology (Crag Group – Sand) is classified as a principal aquifer. However, it is likely that these are in hydraulic continuity.

Alongside the groundwater comments, further information was detailed with respect to potential for contamination.

The investigation of the site history has indicated potentially contaminative past uses associated with the site. These include the potential for on site sources such as made ground, leaks and spills from vehicles accessing the site and railway sidings highlighted as being on site by the Groundsure report (ref GS9003388). Off site contaminants include local industries introduce a wide variety of contaminants from Waveney Market and the dock/port, in addition to the potential for made ground beneath the former railway tracks. These varied activities present the potential risk of contamination to be present in the near surface soils and pose a threat of impact on the groundwater. The deep made ground beneath the railway sidings and railway tracks may generate ground gases.

It is normal to consider the contamination implications of a specific land use to formulate a list of key contaminants, using documents such as CLR 8 'Potential Contaminants for the Assessment of Land', and the relevant Department of the Environment Industry Profiles. In this case, the industry profile 'Railway Land' has been considered given the nature of the previous land use and potential for redevelopment. Therefore, chemical analysis could include metals, acids/alkalis, organic compounds, hydrocarbons (fuels and lubricating oils), PCB contaminants and ethylene glycol to provide evidence of the potential for contamination issues present.

If infiltration could be demonstrated as a suitable method of surface water management for the proposed development, infiltration would be considered as a first preference, however, owing to the shallow depth of groundwater and the presence of substantial areas of made ground on site, infiltration is not expected to be a viable method of discharge of surface water flows. We will however undertake infiltration, groundwater and contamination testing to establish if infiltration is feasible.

The East Suffolk Pre App response (see Appendix G) advised as follows with respect to the drainage design strategy.

Flood Risk & Drainage
Policy WLP8.24 requires development proposals to consider flooding from all sources and take into account climate change. It goes on to explain that developments should use sustainable drainage systems to drain surface water. Sustainable drainage systems (SuDS) should be integrated into the landscaping scheme and the green infrastructure provision of the development and not detract from the design quality of the scheme. As a Local Authority project this should be leading the way in innovative green solutions for this.

The Lead Local Flood Authority have reviewed the submission and provided the below comments for review ahead of the submission of a planning application:
- *Assumed from the lack of open attenuation that crate storage will be required to provide the necessary storage to allow a greenfield runoff rate to be achieved. Whilst this is acceptable at this*

location, we would like to see the opportunity explore for a blue roof that can attenuate at least some of the smaller storm events. Should the green/blue roof be removed during the development process we would then like to see some open attenuation provided.

- *Assumed that upstream hydrobrakes of a reasonably small sub-100mm diameter will be required on this scheme. If so, we would like to see a 'sealed' system in which there are no traditional downpipes. For example, there is potential for larger pieces of debris to enter the system.*
- *The raingardens to the main southern parcel of the site do not seem to function as raingardens at present. They are surrounded by permeable paving and thus do not appear to be required. What could be provided as an alternative is a sunken area and an urban microbasin provided as a landscaping feature that receives flows from the roof or other areas.*
- *It would be beneficial to explore the use of above ground rills and dished channels and the link to minimise the network of underground pipes. It could provide a nice, continuous minor conveyance feature through the site. There are opportunities on sites like this one to incorporate some interesting urban type SuDS, alongside the green, which are 'harder' than green features but can be incorporated into more of the site.*

The East Suffolk Pre App response is beneficial in providing further demonstration of the suitable SuDS approach to be taken into account for the design of the drainage at Battery Green.

3.2.2 SuDS Selection

The suitability of the SuDS detailed within Table 7.1 of the SuDS Manual has been considered for the proposed development. Table 1 below summarises this information.

Component Type	Collection Mechanism	Design Criteria						Suitable	Reason
		Water Quantity			Water Quality	Amenity	Biodiversity		
		Peak Run off	Runoff Volume						
			Small Events	Large Events					
Rainwater Harvesting Systems	P		●	●		●		Y	Would be appropriate for the public WC facilities
Green Roofs	S	○	●		●	●	●	Y	Suited to wide areas of the building roofs
Infiltration Systems	P	●	●	●	●	●	●	N	Unlikely to be suitable depending on the results of the Phase 2 Ground Investigation
Proprietary Treatment Systems	P				●			N	Unlikely to be needed based on treatment via other means
Filter Strips	L		●		●	○	○	N	Unlikely to be required based on other SuDS provided
Filter Drains/Rain Gardens	L	●			●	○	○	Y	To be provided as part of surface water drainage within eastern site areas and external works
Swales	L	●	●	●	●	●	●	N	No requirement based on alternative SuDS being proposed.
Bio-retention Systems	P	●	●	●	●	●	●	N	Insufficient space within footprint to allow alongside wider site function
Trees	P	●	●		●	●	●	Y	To be provided as part of landscape design
Pervious Pavements	S	●	●	●	●	○	○	Y	To be provided extensively across site
Attenuation Storage Tanks	P	●						Y	To be provided towards end of system to enable achievement of small runoff rate
Detention Basins	P	●	●		●	●	●	N	Insufficient space within footprint to allow alongside wider site function
Ponds and Wetlands	P	●			●	●	●	N	

Key: P = Point, L=Lateral, S=Surface, ●=Likely Valuable Contribution, ○=Some potential contribution

Table 1: SuDS Component Assessment

Table 1 above demonstrates the available SuDS for the site. Based on our current understanding with infiltration being unlikely and there being a lack of local surface water features in close proximity to which we could form a straightforward connection, we believe that the most appropriate method of discharge of surface water from the site will be via the existing Anglian

Water surface water drainage system at a restricted rate with a discharge to the sewers to the east and to the west of the site.

Ahead of the discharge, some of the measures as outlined in Table 1 will be employed to ensure that the surface water is sufficiently treated to accord with the SuDS Manual guidelines. This will include a range of treatment as outlined below:

- Rain gardens
- Green roofs
- Permeable surfacing
- Tree pits
- Filter drains

The (SuDS selected) have been designed in line with SuDS Manual guidance and accounts for a 1 in 100-year storm with a 45% allowance for climate change, catering for the full area of the site.

The greenfield runoff rate has been calculated in Appendix E as 2.8l/s. Compared to the current site drainage system, which is unrestricted, delivering 4l/s across two separate discharges of under 2l/s delivering as close as reasonably practicable towards greenfield runoff demonstrates a substantial improvement. The brownfield rate is estimated in Appendix E which suggests a Q1 rate of 76l/s.

The results of the calculations are as included in Appendix H and show the flowrate restricted to suit the likely Anglian Water stipulations; which means reduction of the flowrate to greenfield runoff or 2l/s (whichever is greater). As we are seeking to form two connections, we will be looking to achieve two connections at under 2l/s resulting in an overall site discharge of under 4l/s.

3.2.3 SuDs Design

Table 26.1 of the SuDS Manual (C753) indicates that a simple index approach is suitable for assessing the risk to ground water. Table 26.2 indicates the pollution indices associated with different land uses. Table 2 below summarises the pollution indices that are relevant for the proposed development.

Land Use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydro-carbons
Other Roofs (commercial)	Low	0.3	0.2	0.05
Non-residential parking with infrequent change	Low	0.5	0.4	0.4
Commercial yard and delivery areas	Medium	0.7	0.6	0.7

Table 2: Pollution Hazard Indices

Table 3 below compares the level of treatment offered by the proposed SuDS elements for the various areas of site which are associated with the proposed surface water strategy (outlined above) against the pollution indices shown above in Table 2.

Land Use	Pollution Hazard	Total Suspended Solids	Metals	Hydro-carbons
All Main Buildings On Site				
Other Roofs (commercial)	Low	0.3	0.2	0.05
Green Roof/Permeable Pavement		0.4/0.7	0.4/0.6	0.4/0.7
Sufficient Treatment Provided?		Y	Y	Y
Car Parking Areas				
Non-residential parking with infrequent change/external areas	Low	0.5	0.4	0.4
Permeable pavement		0.7	0.6	0.7
Sufficient Treatment Provided?		Y	Y	Y
Trafficked External Site Areas				
Commercial yard and delivery areas	Medium	0.7	0.6	0.7
Permeable Pavement		0.7	0.6	0.7
Filter Drain/Rain Garden (assumed 50% effective if in combination with other treatment forms)		0.4	0.4	0.4
Sufficient Treatment Provided?		Y	Y	Y

Table 3: Indices Suitability Comparison

The information presented above shows a range of SuDS may be incorporated in the development to address the quality improvement intent. The proposed SuDS will sufficiently treat the surface water prior to discharge to the Anglian Water sewer. The precise treatment and SuDS components will form part of the detailed drainage design.

3.2.4 Proposed Drained Areas

The area of all drained areas which include the hardstanding surfaces and roof areas within the development has been calculated to be 0.9ha which has been used in the Microdrainage calculation as seen in Appendix H. The proposed impermeable areas plan can be seen in Appendix C.

3.2.5 Exceedance Event

Should a storm greater than the critical design event (1 in 100 year plus climate change) occur, the site may flood. This possibility has been considered, and an exceedance flow plan has been

produced for the proposed development indicating surface water overland flow routes all of which are directed away from buildings and to the eastern and western ends of the site.

3.2.6 Four Pillars

As outlined in Section 5.2.1, we can demonstrate how we have addressed the four pillars of SuDS design across our drainage strategy as outlined in Table 4 below:

Pillar	Demonstration of Pillar
Water Quantity – Control the quantity of run off	The current site is a brownfield with unrestricted runoff in all events. The proposal for surface water is to reduce to two discharges via gravity at under 2l/s in line with Anglian Water standard guidelines which offers restriction as close as practicable to the greenfield rate and clear betterment compared to the existing scenario.
Water Quality – Manage the quality of the runoff	The solutions have been demonstrated to address the pollution mitigation indices as outlined within the SuDS Manual accounting for the various sources and methods deployed embracing green roof areas, rain gardens, permeable surfacing and filter drains.
Amenity – Create and sustain better places for people	The proposals will reduce the impact of surface water drainage on adjacent sites and provide an example for the development of similar sites elsewhere. The current site serves as a retail space with associated car parking. The resulting facility will allow SuDS to sit alongside the public amenity.
Biodiversity – Create and sustain better places for nature	The current site offers nothing in terms of biodiversity. The proposed development will offer rain gardens and soft landscaped areas to the east side and green roof areas to the main buildings; both of these functions will deliver enhanced biodiversity to the site.

Table 4: Four Pillars of SuDS Design

3.3 Proposed Foul Water Strategy

Foul drainage connections are assumed to be required in the following building areas:

- Staff and customer toilets
- Cleaners Store
- Tea Point/Kitchenette
- Pump Rooms
- Waste reception/storage areas

The foul water system will be designed in accordance with:

- Building Regulations Approved Document Part H
- BE EN 752-4:2008 – Drains & Sewer Systems Outside Buildings
- Code for Adoption and Sewerage Sector Guidance
- Design and Construction Guidance

The locations of the foul connections from the proposed buildings are to be determined so locations of the proposed foul manholes and inspection chambers will be positioned based on the current proposed site layout.

There is an existing Anglian Water sewer to the west side of the site (on Marina at a level of 2.01m AoD). Our foul system will need to be designed to connect to that system via gravity though further discussion will be needed with Anglian Water to determine the suitability of that connection.

3.4 Drainage Drawings

The proposed drainage design is outlined across drawing ref 218070-CCL-XX-00-DR-C-3000 included in Appendix H. All new drainage installations have been designed in accordance with the current Building Regulations – Part H and in line with the Anglian Water requirements, as defined by the current details outlined in Design and Construction Guidance published by Water UK. The construction details can be seen in Appendix H outlining the specification of the drainage designs.

3.5 Non-Statutory Technical Standards for Sustainable Drainage

The proposed drainage design can be shown to confirm to the Non-Statutory Technical Standards for Sustainable Drainage as outlined in Table 5 below.

Technical Standards Criteria	Technical Standard Requirement	Design Consideration
Flood Risk Outside the Development	*S1 - Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control standards and volume control technical standards need not apply.*	The current site is a brownfield. We will limit discharge from site to as close as reasonably practicable to approach the greenfield rate of 2.8l/s via two separate discharges of less than 2l/s to the east and west of the site (so 4l/s from site in total). The drainage will not impact on areas beyond the site boundary fundamentally avoiding an impact on flood risk on and off site.
Peak Flow Control	*S2 - For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.* *S3 - For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield*	S2 will be covered through our design where we will have reduced the flowrate towards equivalent greenfield runoff with two separate discharges of under for which we will seek Anglian Water approval. S3 will be achieved. The current brownfield site enables an unrestricted runoff and we will be able to improve on this through demonstration of two separate restricted discharges of under 2l/s.

	runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.	
Volume Control	*S4 - Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.* *S5 - Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.* *S6 - Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*	We will be discharging as close as reasonably practicable towards greenfield run off rate and our flowrate will be limited to mitigate an impact on the volume in the designed event; as such, will not adversely impact on flood risk.
Flood Risk within the Development	*S7 - The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.* *S8 - The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.* *S9 - The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of*	S7-S9 are all dealt with through the drainage design with all flows being managed for events up to 1 in 100 plus 45% climate change. See Appendix H for surface water drainage calculations.

	a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.	
Structural Integrity	*S10 - Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.* *S11 - The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.*	S10 and S11 are enabled through our details and specification provided as part of this Drainage Strategy. All structures are specified in line with manufacturer recommendations re loadings.
Designing for Maintenance Considerations	*S12 - Pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.*	All drainage will function via gravity and as such, S12 will not be applicable
Construction	*S13 - The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the sewerage or drainage system.* *S14 - Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is considered to be completed.*	S13 and S14 will be dealt with via the Anglian Water technical approval and site inspection/sign-off process which will ensure that the design and installation are in line with their normal standards and damage to the existing system is mitigated.

Table 5: Demonstration of Non-Statutory Technical Standards for Sustainable Drainage

4 FLOOD RISK MANAGEMENT MEASURES

Due to the construction of impermeable areas, although they are replacing existing impermeable areas, mitigation measures will be required relating to drainage which tie in with current requirements for SuDS. It is therefore proposed that the following flood risk management measures will be undertaken as part of the proposed scheme.

4.1 Level Strategy

To mitigate the flood risk presented by overland flow, the external ground levels will fall away from building entrances. This will ensure that should the drainage system fail, the flood flow paths flow away from the buildings. The details of the levels strategy will be a function of the detailed design, however, floor levels of buildings should be constructed 150mm above the surrounding ground level and towards non-building areas.

An exceedance flow plan showing the proposed overland flow routes can be seen in Appendix I.

4.2 SuDS Maintenance

SuDS schemes require more maintenance than traditional drainage piped systems and as such it is imperative that a suitable maintenance regime is established to ensure that the drainage features are maintained and function as required.

The exact maintenance requirements of the SuDS will depend upon the product or SuDS provided as a function of detailed design and a maintenance strategy will be completed for the site outlining the maintenance requirements. This maintenance strategy can be found in Appendix J.

In terms of responsibility for the maintenance of the SuDS, East Suffolk Council or a maintenance company operating on their behalf take ownership.

5 RESIDUAL RISKS

The residual risks to the development are considered as:

5.1 Lack of Maintenance

As mentioned above, SuDS drainage systems are more likely to fail due to lack of maintenance than traditional piped networks. In order to minimise this risk, it is proposed that East Suffolk Council or a maintenance company operating on their behalf will be responsible for the maintenance of the SuDS and drainage network.

The proposed levels regime means that should the SuDS fail through lack of maintenance, then the areas which will flood will be non-critical, non-building areas.

5.2 Construction Surface Water Run-Off

During construction, the SuDS will not be installed and therefore the contractor should account for exceedance events and contaminated surface water runoff. This is necessary to suitably manage surface water onsite during construction and to prevent construction related pollution entering the ground or the adjacent highway drainage.

As the approach can differ and contractors have different preferred methods, it is proposed that this item is covered by a suitable worded condition to ensure that these risks are appropriately considered prior to commencement of construction.

5.3 Exceedance Event

Should a rainfall event greater than the 1-in-100-year, plus climate change event occur, then surface water flooding may occur. The levels will be designed to ensure that building thresholds are kept safe from flooding. Appendix I contains an exceedance flow plan showing overland flow routes which are intended to fall to the east and west and away from building areas.

6 OFF SITE IMPACTS

6.1 Impact of Surface Water Drainage

The introduction of a strategy to cope with the 1-in-100-year event, plus climate change, offers an improvement to the existing scenario as surface water discharging from the site is restricted towards the Q1 greenfield runoff rate with an overall discharge rate of under 2l/s in two positions compared to a greenfield rate of 2.8l/s; substantially below the brownfield rate of 76l/s. Surface water associated with the site drainage system is being contained within the site boundary. Therefore, the impact of the Surface Water Drainage System is considered to be positive.

6.2 Impact of Development on Hydrological Morphology

The proposed surface water drainage system will not impinge on the hydrological morphology of the area and therefore the site is considered as neutral.

7 SUMMARY

The proposed development consists of public amenity space including café, restaurant, internal and external exhibition space and arts venue at Battery Green in Lowestoft.

A desktop assessment of geological mapping and nearby borehole records suggests that infiltration is unlikely to be feasible due to the groundwater level and presence of extensive depths of made ground. This will be confirmed through the Phase 2 ground investigation.

Floor levels of buildings should be constructed 150mm above the surrounding ground level to mitigate the flood risk and offer overland runoff to flow safely across the site without affecting property.

The surface water design has proposed two separate discharges to the east and west of the site to the Anglian Water system. These discharges will be restricted to under 2l/s each which is a substantial improvement on the current unrestricted rate. Ahead of discharge, the surface water will receive treatment via a combination of permeable surfacing, rain gardens, filter drains and green roof areas to deliver on the SuDS Manual requirement for quality improvements.

Foul water drainage is proposed to discharge into the existing sewer to the west side of the site. This gravity based system will require Anglian Water S106 approval which will be sourced ahead of the works.

The responsibility for the continuous operation and maintenance of the SuDS will fall on East Suffolk Council; the extent of this is included in the Management and Maintenance Strategy.

Appendix A
Proposed Development Plan

LB

Ramped Access

Existing substation retained

Reception

Lobby

Stage Area

UP

FFL 6403

FFL 5323

FFL 6415

Integrated timber slatted seating

Curb lined planting beds - ref to landscape design

Indicative Steps shown 1m change in level. Ramp to follow 1:21

Bollards to stop vehicles only access to Waterside car park

5.2m

4.6t Light Van

MARINA

MARINA

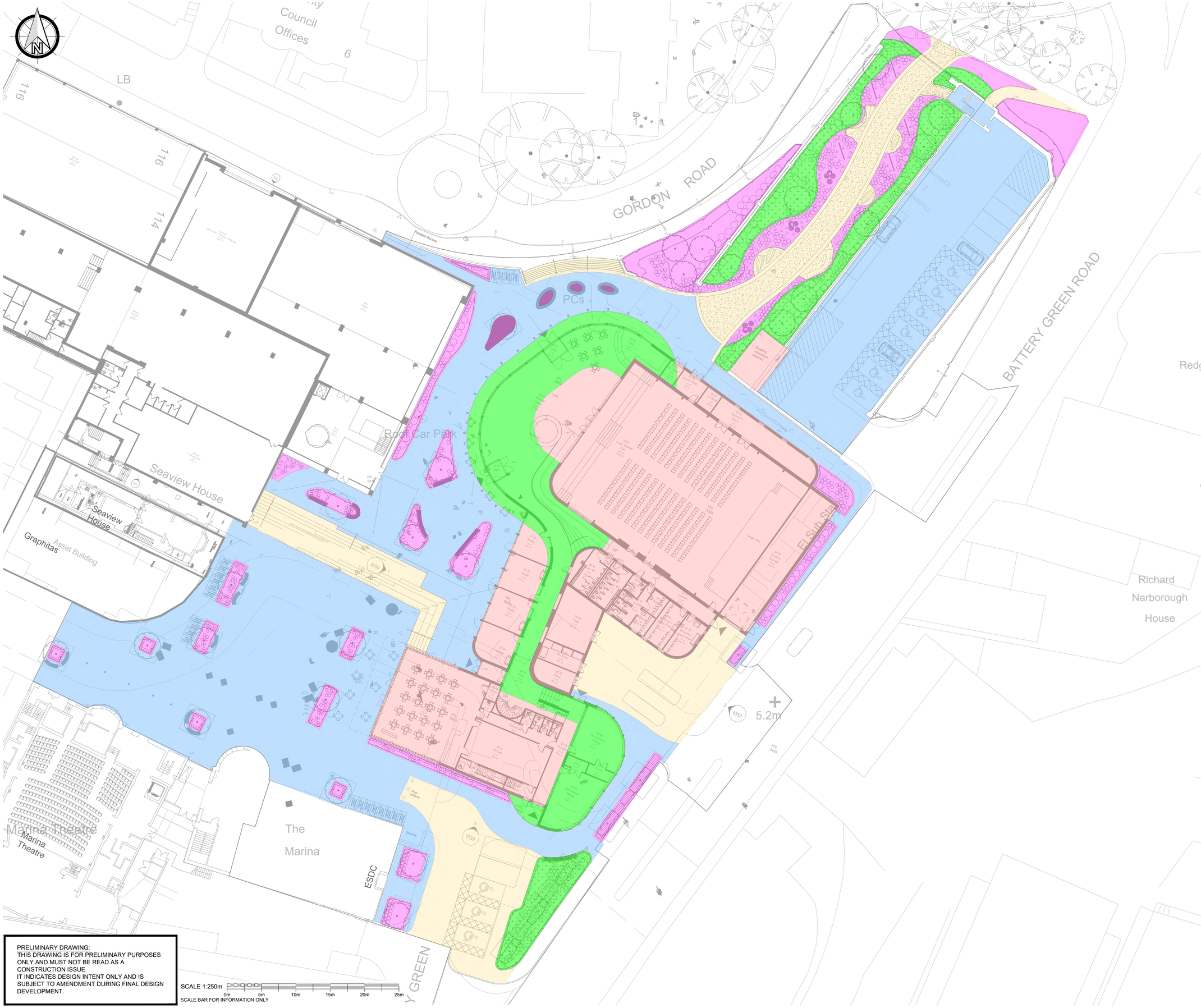
BS

FFL 6403

Appendix B
Topographic Survey

STNPLS1
STNPLS2
STNPLS3
STNPLS4
STNPLS5
STNPLS7
STNPLS8
STNPLS10
STNPLS11
STNPLS12
STNPLS13
STNPLS14
STNPLS15
STNPLS16
Gordon Road
A47 Battery Green Road
CAR PARK ONLY
20
LOADING ONLY
DISABLED
KEEP CLEAR
TURN LEFT
Bike Shelter
Marina
Yellow Box
5.2m

Appendix C
Impermeable Areas Plan



PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE.
IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

SCALE 1:250m
0m 5m 10m 15m 20m 25m
SCALE BAR FOR INFORMATION ONLY

PLANNING GENERAL NOTES:

1. THE DRAWINGS, DESIGN AND ALL INFORMATION CONTAINED THEREIN ARE THE SOLE COPYRIGHT OF CANHAM CONSULTING LTD AND ANY REPRODUCTION IS FORBIDDEN UNLESS PERMISSION IS OBTAINED IN WRITING.
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT OTHER DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES BETWEEN THE INFORMATION GIVEN BY THE ENGINEER, AND THAT PROVIDED BY OTHERS, MUST BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORKS PROCEED.
4. DIMENSIONS MUST NOT BE SCALED FROM THE ENGINEER'S DRAWINGS.
5. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
6. THE INFORMATION SHOWN DOES NOT CONSTITUTE TECHNICAL APPROVAL FROM THE RELEVANT AUTHORITIES AND COULD BE SUBJECT TO CHANGE POST PLANNING.
7. THE PROPOSED SITE LAYOUT SHOWN ON THIS DRAWING IS BASED UPON THE CHAPLIN FARRENT DRAWING BGMC-CF-Z-XX-M2-A-6832, DATED 2023.10.10.

LEGEND

- PERMEABLE PAVING DRAINING TO SURFACE WATER NETWORK (0.318ha)
- RAIN GARDENS (0.042ha)
- GREEN ROOF (0.067ha)
- IMPERMEABLE ROOF (0.186ha)
- HARD LANDSCAPING (0.109ha)
- SOFT LANDSCAPING (0.081ha)

rev	date	details	drawn	check
P01	17.11.23	PRELIMINARY ISSUE	GPC	MH

Canham Consulting
Structural Civil Building Engineers
+44 (0)1603 430650 | mail@canhamconsulting.co.uk | www.canhamconsulting.co.uk

client
EAST SUFFOLK COUNCIL

architect
CHAPLIN FARRANT

project
REDEVELOPMENT OF BATTERY GREEN AND THE MARINA CENTRE

title
DRAINAGE STRATEGY:
PROPOSED IMPERMEABLE AREAS PLAN

CCL ref:	drawn	design	checked	scale	size	date
218070	GPC	GPC	MH	1:250	A1 (L)	17.11.2023

status:
S3 - SUITABLE FOR REVIEW & COMMENT

drawing number: 218070-CCL-XX-00-DR-C-3001
revision: P01

PLANNING GENERAL NOTES:

1. THE DRAWINGS, DESIGN AND ALL INFORMATION CONTAINED THEREIN ARE THE SOLE COPYRIGHT OF CANHAM CONSULTING LTD AND ANY REPRODUCTION IS FORBIDDEN UNLESS PERMISSION IS OBTAINED IN WRITING.
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT OTHER DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES BETWEEN THE INFORMATION GIVEN BY THE ENGINEER, AND THAT PROVIDED BY OTHERS, MUST BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORKS PROCEED.
4. DIMENSIONS MUST NOT BE SCALED FROM THE ENGINEER'S DRAWINGS.
5. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
6. THE INFORMATION SHOWN DOES NOT CONSTITUTE TECHNICAL APPROVAL FROM THE RELEVANT AUTHORITIES AND COULD BE SUBJECT TO CHANGE POST PLANNING.
7. THE PROPOSED SITE LAYOUT SHOWN ON THIS DRAWING IS BASED UPON THE CHAPLIN FARRENT DRAWING BGMC-CF-Z-XX-M2-A-6832, DATED 2023.10.10.
8. THE TOPOGRAPHICAL INFORMATION REPRODUCED ON THIS DRAWING IS SHOWN FOR CO-ORDINATION AND DESIGN PURPOSES ONLY AND TAKEN FROM THE LAND PARISH SURVEYS DRAWING PLS-1254, DATED 06.09.2022. LIABILITY FOR THIS INFORMATION REMAINS WITH LAND PARISH SURVEYS: CANHAM CONSULTING LTD CANNOT ACCEPT ANY LIABILITY FOR THE CONTENT AND ACCURACY OF THE TOPOGRAPHIC SURVEY.

LEGEND

- IMPERMEABLE ROOF (0.475ha)
- HARD LANDSCAPING (0.245ha)
- SOFT LANDSCAPING (0.025ha)
- ROAD (0.082ha)

PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE.
IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

SCALE 1:250m
0m 5m 10m 15m 20m 25m
SCALE BAR FOR INFORMATION ONLY

rev	date	details	drawn	check
P01	17.11.23	PRELIMINARY ISSUE	GPC	MH

Canham Consulting
Structural Civil Building Engineers
+44 (0)1603 430650 | mail@canhamconsulting.co.uk | www.canhamconsulting.co.uk

client: EAST SUFFOLK COUNCIL

architect: CHAPLIN FARRANT

project: REDEVELOPMENT OF BATTERY GREEN AND THE MARINA CENTRE

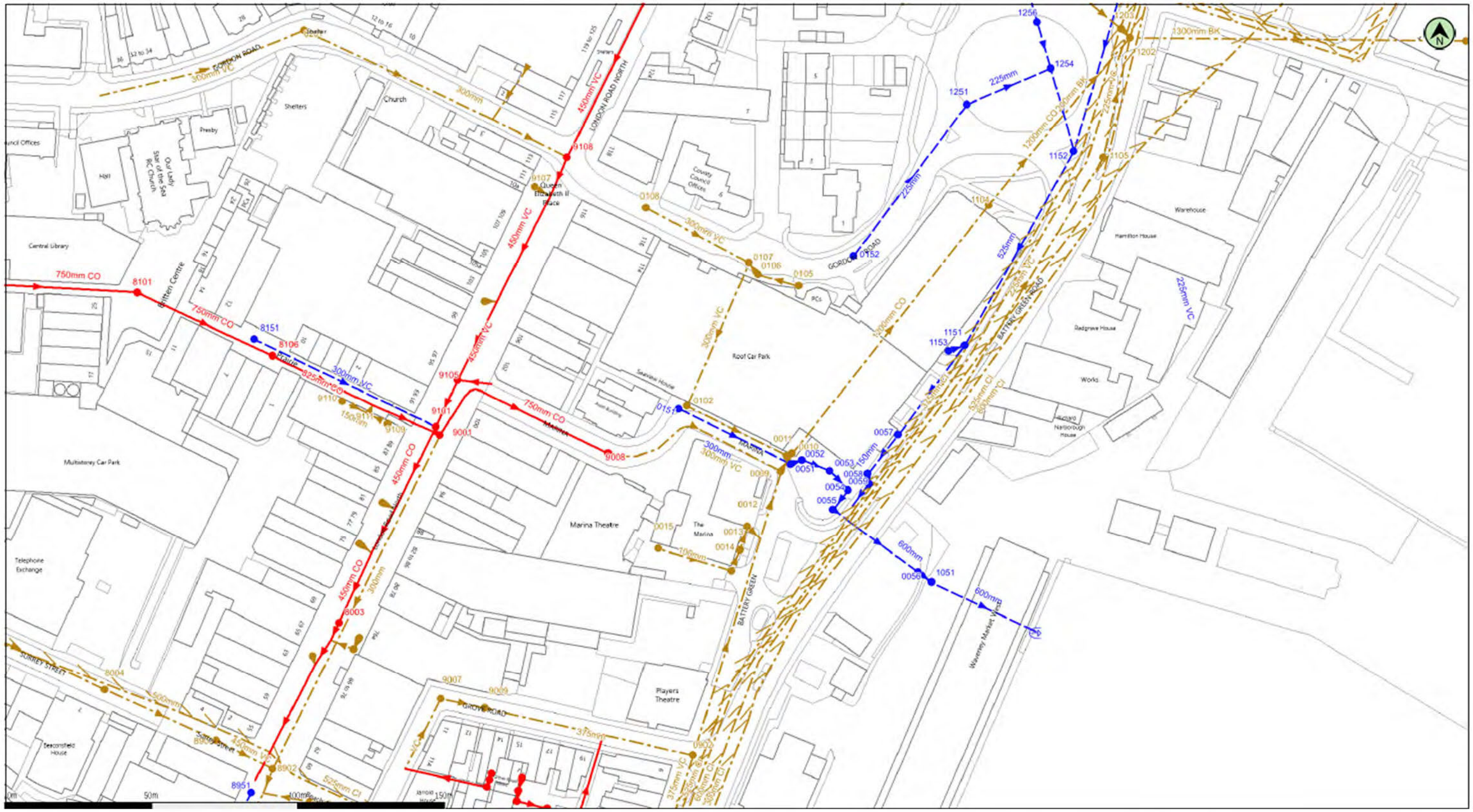
title: DRAINAGE STRATEGY: EXISTING IMPERMEABLE AREAS PLAN

CCL ref:	drawn	design	checked	scale	size	date
218070	GPC	GPC	MH	1:250	A1 (L)	17.11.2023

status: S3 - SUITABLE FOR REVIEW & COMMENT

drawing number: 218070-CCL-XX-00-DR-C-3002 revision: P01

Appendix D
Anglian Water Sewer Records



(c) Crown copyright and database rights 2022 Ordnance Survey 100022432 | Date: 29/09/22 | Scale: 1:1250 | Map Centre: 655035,293108 | Data updated: 31/08/22 | Our Ref: 963568 - 5 | Wastewater Plan A3

This plan is provided by Anglian Water pursuant its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately reoord, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2022 Ordnance Survey 100022432.This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

- Foul Sewer
- Surface Sewer
- Combined Sewer
- Final Effluent
- Rising Main*
- Private Sewer*
- Decommissioned Sewer*
- Outfall*
- Inlet*
- Manhole*
- Sewage Treatment Works
- Public Pumping Station
- Decommissioned Pumping Station

*(Colour denotes effluent type)

duncan@cornerstoneprojects.co.uk
#6832

love every drop anglianwater

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
8003	C	3.82	2.25	1.57
8101	C	4.557	-	-
8106	C	4.768	-	-
9001	C	4.36	0.16	4.2
9008	C	4.909	-	-
9101	C	4.407	-	-
9105	C	4.736	-	-
9108	C	6.25	-	-
0009	F	0.19	-4.98	5.17
0010	F	5.395	-0.025	5.42
0011	F	6.067	3.197	2.87
0012	F	-	-	-
0013	F	-	-	-
0014	F	-	-	-
0015	F	-	-	-
0102	F	5.543	3.533	2.01
0105	F	7.278	6.008	1.27
0106	F	6.946	5.776	1.17
0107	F	6.803	4.093	2.71
0108	F	6.298	4.528	1.77
0902	F	4.898	0.518	4.38
1104	F	5.848	-0.202	6.05
1105	F	4.897	2.787	2.11
1202	F	5.162	-0.168	5.33
1203	F	5.633	1.773	3.86
2202	F	4.12	0.64	3.48
8004	F	3.529	1.249	2.28
8201	F	6.622	-	-
8902	F	3.451	0.851	2.6
8903	F	3.548	1.058	2.49
8908	F	3.421	1.651	1.77
9007	F	3.976	-	-
9009	F	4.137	-	-
9107	F	6.159	-	-
9109	F	-	-	-
9110	F	-	-	-
9111	F	-	-	-
0051	S	6.005	0.795	5.21
0052	S	5.349	-0.061	5.41
0053	S	5.3	3.09	2.21
0054	S	5.309	0.939	4.37
0055	S	6.04	0.81	5.23
0056	S	5.369	-0.031	5.4
0057	S	-	-	-
0058	S	-	-	-
0059	S	-	-	-
0151	S	5.353	4.403	0.95
0152	S	-	-	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
1051	S	2.737	-0.233	2.97
1151	S	-	-	-
1152	S	-	-	-
1153	S	-	-	-
1251	S	-	-	-
1254	S	-	-	-
1256	S	-	-	-
8151	S	4.16	3.31	0.85
8951	S	3.34	1.67	1.67

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix E
Greenfield and Brownfield Runoff Rate Calculations

Greenfield Run Off Calculations

Project:	Project Ref:	Date:	By:	Checked:
Battery Green	218070	27/07/2023	MH	JL

Canham Consulting
Structural Engineers | Civil Engineers | Building Surveyors

GREENFIELD RUN OFF

QBAR (1.08(A/100)^0.89)*(SAAR^1.17)*(SPR^2.17)

A=		50	
SAAR (mm)=		650	
SPR=		0.4	
	QBAR=	155.986	
	PER ha	3.120	
	SITE	0.907	ha
SITE QBAR (MEAN ANNUAL PEAK FLOW)		2.83	l/s
	GC30	2.4	
	GC100	3.5	

SITE Q1yr	(SITE QBAR/A)*0.85	2.41	l/s/ha
SITE Q30yr	(SITE QBAR/A)*GC30	6.79	l/s/ha
SITE Q100yr	(SITE QBAR/A)*GC100	9.90	l/s/ha

Note: Calculations based on "Rainfall runoff management for developments" Report SC030219 by Environment Agency

Brownfield Surface Water Run Off Calculations

Project:	Project Ref:	Date:	By:	Checked:
Battery Green Development	218070	17/11/2023	MH	JL

The flow rate as given by the Modified Rational Method is:

Q=2.78 x Cv x Cr x rainfall intensity x impermeable area

Cv (Volumetric Runoff Coefficient) =	0.75	
Cr (routing coefficient) =	1.3	
A (contributing area) =	0.907	ha

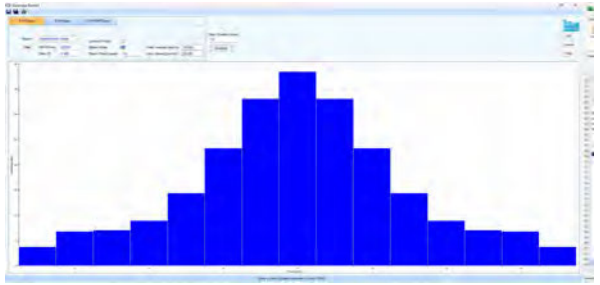
Rainfall Intensity Calculation:

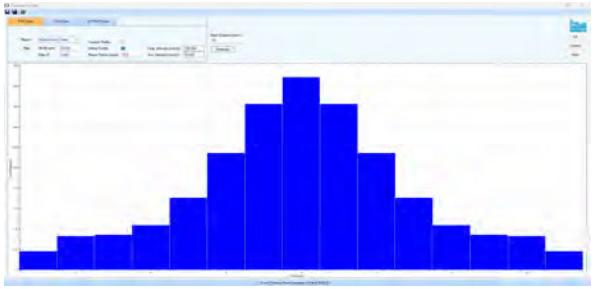
M5-60 =	20	mm/hr
Ratio R =	0.40	
Storm Duration	15	min
M1-15	30.991	
M30-15	76.035	
M100-15	98.681	

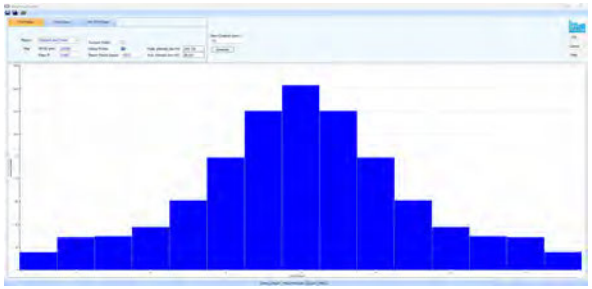
Therefore based on an impermeable area runoff coefficient of 75%, the peak run off rates for 0.907 hectare are:

Peak Run off Rates		
Q1	**76.19**	**l/s**
Q30	**186.93**	**l/s**
Q100	**242.60**	**l/s**

Calculation as per "The Wallingford Procedure: Design and Analysis of Urban Storm Drainage" Volume 4. Using average intensity rainfall taken from MicroDrainage







Appendix F
Geotechnical Desk Study

Document: Desk Study Report

Project: Cultural Quarter, Lowestoft

Reference No.: GN25418_DS

Date: October 2022

Prepared for: East Suffolk Council

harrisongeotechnical
ENGINEERING

A division of Harrison Group Environmental Limited

HARRISON GROUP ENVIRONMENTAL LIMITED

Document: **Desk Study Report**

Project: **Cultural Quarter, Lowestoft**

Reference No.: **GN25418_DS**

Date: **October 2022**

Prepared For: **East Suffolk Council**

REPORT STATUS:

Revision	Comments	Prepared By	Approved By	Issued By	Audited By
0	First issue	INIT CC SIGN COMMENTS DATE 15/09/22	INIT JE SIGN COMMENTS DATE 21/09/22	INIT JE SIGN COMMENTS DATE 14/10/22	INIT JA SIGN COMMENTS DATE 14/10/22
		INIT SIGN COMMENTS DATE	INIT SIGN COMMENTS DATE	INIT SIGN COMMENTS DATE	INIT SIGN COMMENTS DATE
		INIT SIGN COMMENTS DATE	INIT SIGN COMMENTS DATE	INIT SIGN COMMENTS DATE	INIT SIGN COMMENTS DATE
		INIT SIGN COMMENTS DATE	INIT SIGN COMMENTS DATE	INIT SIGN COMMENTS DATE	INIT SIGN COMMENTS DATE

CONTENTS

FOREWORD

General Conditions Relating to a Tier One, Stage One (Desk Study) Report

This investigation has been devised to generally comply with the relevant principles and requirements of BS10175:2011+A2:2017 'Investigation of potentially contaminated sites - Code of practice', the 'Land contamination: technical guidance' collection (Environment Agency, 2016) and 'Land contamination: risk management' (Environment Agency, 2021). This report is a preliminary stage of investigation designed to identify potential contamination hazards and undertake preliminary hazard assessment, as such it is possible that further work may be recommended based on the findings.

The recommendations made and opinions expressed in this report by the writers are based on the information obtained from the sources described using a methodology intended to provide reasonable consistency and robustness.

The desk study has been compiled and extended into hazard identification and assessment in line with the risk-based methods referred to in Part IIA of the Environment Protection Act 1990, introduced by section 57 of the Environment Act 1995 and brought into force in April 2000.

Information gained during the initial stages of the desk study was collated to form a conceptual ground model of the site, which detailed the characteristic ground conditions and the elements of the surrounding environment. The ground model assists with identifying the potential sources of contamination, the possible receptors to the contamination and the conceivable pathways between them. It is referred to as the source-pathway-receptor linkage (or pollutant linkage) and is defined in Part IIA of the Environment protection Act 1990, and is in accordance with BS10175:2011+A2:2017.

Some items of the desk study have been provided by third parties and whilst Harrison Group have no reason to doubt the accuracy, the items relied on have not been verified. No responsibility can be accepted for errors within third party items presented in this report.

Parts of the study based on non-invasive techniques cannot guarantee that the area investigated has the properties described in the report. Furthermore, there may be additional issues on the site, not foreseen during the survey, which involve potentially hazardous substances.

This report is produced in accordance with the scope of Harrison Group's appointment and is subject to the terms of appointment. Harrison Group accepts no liability for any use of this document other than by its client and only for the purposes, for which it was designed and produced. No responsibility can be accepted for any consequences of this information being passed to a third party who may act upon its contents/recommendations.

Any advice, opinions, or recommendations within this document should be read and relied upon only in the context of the document as a whole. The contents of this document are not to be construed as providing legal, business or tax advice or opinion.

CLIENT SUMMARY

Location	The site is located adjacent to Battery Green Road, Lowestoft, Suffolk and is identified by National Grid Reference 655050, 293110.
Previous Site Use	The site was formerly a skating rink, warehouse and residential dwellings. The site was also part of Battery Green open space, which became an open car park over the course of time. Historic records also identified railway sidings in the east of the site.
Current Site Use	At the time or our assessment, the site comprised a retail premises together with a level car park and a former multi-storey car park. The multi-storey car park had been vacant since 2018 and was partially demolished to the north due to structural issues. The ground level contained retail shops and a loading bay to service the shops. In the south of the site, the Marina Centre building is a two-storey office space operated by East Suffolk Council (ESC).
Geology/Hydrology	The site is anticipated to be underlain by superficial deposits of the Happisburgh Glacigenic Formation – Sand. Blown Sand was noted in close proximity to the east of the site adjacent to the coast. Deposits of the Lowestoft Formation Diamicton are anticipated approximately 350m to the north. It is not anticipated that cohesive soils are present across the site, however, glacial deposits are known to be variable and could comprise both cohesive and granular deposits. The bedrock of the Crag Group - Sand was shown to be underlying the superficial deposits, and comprises interbedded sands, gravels, silts and clays with gravels dominated by flint with occasional quartzite. The groundwater table is anticipated to be variable and can be expected at sea level (0maOD). Ground level is anticipated to be between 8maOD in the north and west and 6maOD in the south and east and therefore groundwater is anticipated to be 6-8m below ground level (mbgl). A nearby historic borehole encountered groundwater at approximately 5.9mbgl, which confirms the ground model.
Background Information	Potentially contaminative industrial sites on site include made ground, leaks and spills from vehicles and railway sidings associated with the railway tracks that connected Lowestoft Station with the Waveney Market to the west of site. Off site potentially contaminative sources include historical land uses surrounding the site, the railway tracks which could comprise thicknesses of made ground and Waveney Market and docks/ports to the south east of the site. Potentially contaminative off site sources that have not been considered further are the electricity substation and pressurised water tanks both noted immediately to the east of the site. A disused sewage works and pumping station and a former gas works and tanks located north east. These sources are unlikely to impact the site due to their distance and direction.
Geotechnical Hazards	Shrinkable superficial clay deposits are not anticipated on site with the superficial deposits predominantly expected, which comprise granular soils of the Happisburgh Glacigenic Formation - Sand. Although the site is shown to be underlain by sand and gravel deposits, local borehole records outline the potential in variability within the superficial deposits. There is the potential for uncontrolled backfill and relict structures beneath the existing multi-storey car park due to the many different land uses during its history. Relict structures from historic buildings and foundations from the existing buildings are likely to be present, which will require digging out and being removed from the ground prior to redevelopment. The site and the surrounding area have a high risk of UXO being present. Bomb records show that a bomb strike occurred to the east of the site. Further consideration is needed such as a detailed UXO risk assessment and mitigation measures during any intrusive investigations (UXO supervision) and during construction.
Contamination	From the desk-based research, the identified potential sources of contamination are thought to include sources on site such as made ground from historical land uses (particularly anticipated beneath the existing multi-storey car park), leaks and spills from vehicular access and parking, and railway sidings. Off site sources comprise the varying industrial uses surrounding the site, demolished railway tracks, the Waveney Market and dock/port areas. These possible sources have the potential to have contaminated near-surface soils, impact groundwater and generate ground gases. It is important to assess whether key contaminants and significant deleterious made ground are present.

Recommendations	Intrusive investigation is advised on completion of the demolition of the multi-storey car park in order to assess the potential for the contaminative hazards identified across the site which may impact the sensitive receptors. Further investigation could include: • Drilling of dynamic continuous boreholes and/or trial pits across the footprint of the multi-storey car park and in close proximity to the Marina Centre to assess the soil types and to collect samples. • Some investigation may be completed before demolition, if an earlier understanding of the potential extent and cost is required. Should soft landscaping be proposed as part of the development then these areas should also be investigated. • Collection of soil samples and laboratory testing to provide data for contamination assessment. • Contamination hazard assessment and evaluation. • Groundwater/leachate testing should be undertaken if elevated concentrations of contaminants are recorded or significant thickness of made ground is encountered. • Ground gas monitoring is advised. • Consideration could be given to producing a geotechnical assessment to inform the design of foundations, floor slabs, pavements/roads and drainage.

STAGE ONE, TIER ONE ASSESSMENT (DESK STUDY REPORT)
FOR A SITE AT
BATTERY GREEN ROAD , LOWESTOFT

1 TERMS OF REFERENCE & INTRODUCTION

The work covered by this report was undertaken on behalf of East Suffolk Council (ESC), in accordance with Harrison Geotechnical Engineering quotation dated 2nd August 2022 and instruction from the client on the 17th August 2022.

The purpose of the report was to provide preliminary environmental and geotechnical information for a site off Battery Green Road, Lowestoft. The report was requested in order to inform the client of possible contamination and geotechnical hazards prior to potential redevelopment, as well as for submission to the local authority as part of the planning process.

The site was located on land between Battery Green Road and Grove Road, Lowestoft, as indicated on drawing GN25418-DR002 presented in the appendix. At the time of our assessment the site comprised a disused and partially demolished multi-storey car park, previously associated with the commercial brand Wilkinson, Marina Theatre and the Marina Centre to the west. The Marina Centre was still in use as offices for ESC. We understand that the northern portion of the multi-storey car park was demolished in 2018 due to structural issues. The northern and western portion of the multi-storey car park is not part of the site boundary being assessed by this report.

The client representative suggested that the Marina Centre is to be repurposed from current office space utilised by ESC, to a ground floor restaurant with outdoor seating and the first floor to provide additional space for the Marina Theatre. The multi-storey car park is anticipated to be demolished and reconstructed as a two-storey socialising and events space, offering flexibility to enable a variety of pop-up events and drawing well-recognised commercial brands that may attract other businesses. A copy of the annotated site plan has been presented in the appendix as drawing GN25418-DR002, showing the approximate boundary, representative site photos and the location of features within the site.

2 BACKGROUND INFORMATION

2.1 Site Description

The site under consideration covers an area of approximately 0.38ha and can be identified by National Grid Reference 655050, 293110. Examination of Ordnance Survey data for the area shows the elevation of the site as approximately 6 to 8 metres above Ordnance Datum (maOD) sloping from north to south towards the outer harbour and east towards the docks. At the time of the walkover the site was an office and a disused multi-storey car park with retail shops underneath. To the east of the disused structure is a carpark that is currently been used to service the retail shops on the ground floor. Directly behind the structure, were more retail buildings. The client representative who was on site during the walkover noted that the northern portion of the multi-storey car park was demolished in approximately 2018 due to structural issues.

A site walkover was undertaken on the 1st of September 2022, the findings of which are presented in table 2.1 below. The table should be read in conjunction with the appended annotated site plan (GN25418-DR002). Photographs referred to below have been included with the plan.

Current Uses	The site comprised a two-storey disused car park with retail shops on the ground floor of the structure and the Marina Centre to the south, which was used by the ESC. The multi-storey car park itself showed some signs of structural distress, with the northern portion of the car park and exterior access ramp having been demolished in 2018. The ground level contained retail shops and included a loading bay to service the shops. Directly behind the structure were other buildings which housed retail stores.
Access	The site was accessible via Battery Green Road (A47) to the east and The Marina and Gordon Road which separated the multi-storey car park and The Marina Centre. Access into the multi-storey car park was secured by locked doors. However, the interior of the structure is not accessible for vehicles because the access ramp was recently demolished due to it being in a state of structural disrepair. The Marina Centre was accessible from the rear of the property (northwest).

Vegetation	There was no vegetation noted on site.
Topography	The site sloped gradually from 8m above ordnance datum (maOD) in the north to 6m in the south. The site also sloped south and east towards the Outer Harbour and the North Sea, with elevations reaching 0maOD.
Existing buildings/structures	During the site walkover the site comprised the above ground multi-storey car park, ground floor retail shops and the Marina Centre offices, which housed the ESC. During our site visit, we disused the car park where it was included within the site boundary, with part of the car park demolished due to structural issues. The surrounding area comprised high street retail buildings on London Road to the west, the Marina Theatre immediately next to the Marina Centre, the ground floor car park to the north which were still in use, commercial buildings and the inner harbour to the east.
Site surface	The site surface predominantly consisted of concrete and tarmac hard standing.
Above/below ground tanks	We are not aware of any storage tanks on the site. There were two large tanks present immediately east of the site. The tanks were stainless steel and were not externally bunded. These were located to the east of the multi-storey car park. The client representative who told us during the site walkover that the tanks are likely to be pressurised water storage tanks to supply the retail shops on the ground floor.
Services	No overhead power cables were seen crossing the site. An electrical substation was noted immediately to the east of the site.
Surface Water	No surface water features were present on the site. Lowestoft Outer Harbour and Docks approximately 100m to the east, which connects to the North Sea.
Surrounding Area	The Marina Road splits the site with the multi-storey car park and retail units to the north and the Marina Centre building located to the south. The land around the site comprises mixed retail, Marina Theatre and residential with the Lowestoft Marina and Outer Harbour located in the east. Lowestoft Train Station is situated approximately 150m to the southwest. Ancillary structures such as pressurised water tanks and a substation were immediately off site to the east.

Table 2.1: Details of the Site Walkover

2.2 Environmental Setting

The environmental setting background information (geology, hydrology, hydrogeology and database information) and site history have been researched as part of this report. A summary of the environmental and geological setting is given in the following sections.

Table 2.2 below gives background information from mapping, online and literature sources.

	Data Source	Data Summary
Topography	Google Earth aerial imagery, accessed September 2022.	The site sloped gradually from 8m above ordnance datum (maOD) in the north and west and 6m in the south. The site sloped to the south and east towards the Inner Harbour where elevations of 0maOD were noted.
Geology	1:50,000 BGS Digital Mapping. Groundsure Enviro+GeoInsight Report Reference GS-9003388. BGS Borehole Reference: TM59SE15, TM59 SE16, TM59 SE17.	The site was shown to be underlain by superficial deposits of the Happisburgh Glacigenic Formation – Sand. Blown Sand was noted in close proximity to the east along the coast along with tidal deposits seen to the southwest of the site. Deposits of the Lowestoft Formation – Diamicton was seen in close proximity to the north of the site. The Crag Group bedrock was indicated to be underlying the superficial deposits, and comprises interbedded sands, gravels, silts and clays with gravels dominated by flint with occasional quartzite.

	Data Source	Data Summary
Hydrogeology	1:125,000 Hydrogeological map of Northern East Anglia, Sheet 4. BGS Borehole Reference: TM59SE16, TM59 Groundsure Enviro+Geoinsight Report Reference GS-9003388. Hydrological map of Northern East Anglia – sheet 1 chalk, Crag and lower cretaceous sands: Geological Structure.	Information from the hydrogeological map indicate that the groundwater is at approximately 0maOD. The site is in close proximity to the North Sea and therefore groundwater is anticipated to be shallow. Historic boreholes in the area have recorded groundwater at approximately 5.9mbgl. The aquifer status of the site is linked to the underlying soil types. The superficial geology (Happisburgh Glacigenic Formation – Sand) is designated as a secondary 'A' aquifer, and the solid geology (Crag Group – Sand) is classified as a principal aquifer. However, it is likely that these are in hydraulic continuity. No groundwater abstraction licences were noted on the site. There was one surface abstraction licence that was noted 383m northeast of the site which was a historical borehole used as a ground water source of supply for Lowestoft Cold Store Limited.
Hydrology	Groundsure Enviro+GeoInsight Report Reference GS-9003388.	There were no surface water features on site. The North Sea was located approximately 97m to the east. Lake Lothing is noted approximately 500m to the south of the site with the Inner Harbour approximately 150m to the east. The site is not located within a groundwater source protection zone (SPZ).
Natural Hazards	Groundsure Enviro+GeoInsight Report Reference GS-9003388.	A negligible risk of shrinking/swelling clay soils and compressible deposits. There is a very low risk of collapsible deposits, collapsible deposits and running sand on site.
Unexploded Ordnance	Zetica Website accessed September 2022	The site is located in a high-risk area for unexploded ordnance (UXO). Bomb records of the local area show there was a bomb strike to the warehouse east of the site on Hamilton Dock.
Environmental Database Information	GroundSure Enviro+GeoInsight Report Reference GS-9003388.	Historic industrial land uses were recorded on site, attributed to docks and quays, dated to 1982-1992 mapping. Furthermore, an unspecified tank as well as railway sidings were noted on site from 1904 (although we are uncertain of the evidence for this). An electrical substation was noted on site between 1949-1979. When the multi-storey car park was constructed, the substation was subsequently relocated off site to the east. 14m to the north historic surface ground workings were attributed to a coastguard station. 145m to the east, the North Sea was noted. 232m to the northeast sewage works were also noted. Four historic environmental permits to sewage discharges – sewer storm overflow and sewage discharges – final/treated effluent were noted between 181m and 213m to the north of the site. The Groundsure report highlighted that historic railway sidings were present across the eastern portion of the site. These railway sidings were not noted on the series of old maps but should still be considered further. Twenty licensed discharges of treated or untreated effluent to controlled waters were present within 500m of the site with one discharge of special category effluents to the public sewer noted within 350m north east of the site. Potentially contaminative industrial sites in the surrounding area were noted 27m to the northwest which relate to an unspecified factory, 78m to the northwest relating to an unspecified pit and 106/109m to the north and northeast relating to a unspecified tanks. A grade two listed building (St. Margaret's House) is noted 35m northwest. The site is not located within a flood risk zone. A medium flood risk zone is located to the southeast of the site, which is categorised as less than 1 in 30 but greater than or equal to 1 in 200 year chance. A flood zone 2 (fluvial/tidal models) and flood zone 3 (fluvial models) are mapped approximately 30m and 35m to the southeast of the site respectively. The site is at negligible risk from surface water flooding and low risk from groundwater flooding.

Table 2.2: Background Information

2.3 Site History

The history of the site has been researched from historical mapping sources along with information provided from the client. Copies of the Ordnance Survey maps examined have been presented in the appendix and a summary is provided in table 2.3.

Date of Mapping	Scale of Mapping	Detail	
1883-1888	1:1,500 & 1:10,560	**On site:**	To the south of the site a skating rink was mapped. Marina Road lay to the west of the site with Battery Green embankment laying to the east. The northeast corner consisted of soft landscaping. To the centre of the site two unnamed terraced buildings are present. These buildings are situation between Marina Road to the west and Battery Green Road to the east.
		Off site:	Lowestoft railway station was noted approximately 150m southwest of the site. Railway tracks/sidings were located to the south and east of the site which connected the fish market with the station. At their closest, the tracks were within 40m of the site. A Herring and Mackerel Market was located approximately 100m to the east, along with Herring Basin (dock). Two lighthouses were mapped to the southeast of the site at the confluence of the Outer Harbour and the North Sea. The latter being noted to the east of the site. The lighthouses were situated at the ends of the North Pier and South Pier. Towards the west of the site was a Methodist chapel (St Margaret's) with a Sunday school building attached. Many Victorian terraced-style residential buildings were mapped to the west of the site. To the north of the site was a coastguard station and school, as well as residential dwellings and a hospital. The surrounding area was occupied by further residential dwellings as well as the east coast factory noted to the west and the Suffolk Hotel noted to the southwest. Lowestoft Railway station was noted approximately 285m to the southwest of the site. A gas works is noted approximately 500m northeast of the site.
1904	1:2,500 & 1:10,560	**On site:**	The skating rink was no longer mapped. A 'Smack Boys Home' (orphans apprenticed to the fishing smacks) was surveyed in its place and to the south of the site.
		Off site:	The Marina Theatre was mapped to the west of the site. Further residential housing was added to the north along with a hospital approximately 350m northwest of the site, a football ground and brickworks approximately 700m to the northwest of the site. Watch houses were noted to the northeast along the coast. A Herring Basin was mapped approximately 150m to the east, immediately adjacent to the Herring and Mackerel Market.
1926-1938	1:2,500 & 1:10,560	**On site:**	The building associated with the Smack Boys Home had been developed and extended further south. A 'club' had been developed towards the very north of the site with the building slightly encroaching onto the site.
		Off site:	150m to the east of the site Hamilton Dock had been constructed where marshland had been. The dock expanded the Herring and Mackerel Market which was located on the newly named Waveney Dock. A sewage pumping station was noted approximately 400m to the south of the site. An iron works was noted 500m to the southwest.
1946- 1951	1:2,500 & 1:10,560	**On site:**	An electrical substation and public lavatory was noted on the eastern portion of the site. The buildings located centrally to the site were recorded as The Alders. A small outbuilding was mapped north of The Alders.
		Off site:	Telephone call boxes were noted bordering the site to the east. A café, engineering works and pumping house were mapped less than 100m to the east of the site. Battery Green was converted to a car park.
1960-1974	1:2,500 & 1:10,560	**On site:**	The Smack Boys Home was converted to a warehouse with further extensions being made to the building.
		Off site:	The Battery Green Embankment to the northeast had been converted from a car park to a coach station. The engineering works noted approximately 50m to the east of Battery Green Road had been converted into a warehouse and works of unspecified industry with an attached garage. The Methodist Church (St. Margaret) noted approximately 50m to the west had been demolished and converted into residential housing. An ice factory was constructed 100m southeast of the site. Unspecified tanks were noted approximately 300m to the northeast of the site off Hamilton Road.
1977-1979	1:1,250	**On site:**	The two main buildings central to the site and formerly known as The Alders and The Gables appear to have been demolished.
		Off site:	Battery Green coach station was extended northwards along with the extension of the coastguard station. The Herring and Mackerel Market was labelled the Waveney Fish Market.

Date of Mapping	Scale of Mapping	Detail	
1982-1984	1:1,250 & 1:10,000	**On site:**	The multi-storey car park had been developed, extending off site to the northeast and west. The substation and lavatory were no longer noted on site.
		Off site:	The telephone call boxes bordering the site to the east were no longer noted. A roundabout was added along Battery Green Road to the north of the site. County Council office buildings were developed approximately 50m north of the site. The rail tracks that connected the station with the fish market had been removed. An electrical substation was noted immediately off site to the east.
1990-1994	1:1,250 & 1:10,000	**On site:**	The warehouse (former Boys Home) had become a job centre.
		Off site:	No significant changes were noted.
2001-2003, 2010, 2022	1:1,250 & 1:10,000	**On site:**	No significant changes were noted.
		Off site:	No significant changes were noted.

Table 2.3: Historical Setting from Maps

2.4 Summary of Background Research

The site comprised a disused two-storey car park in the north, with retail shops on the ground floor level, as well as the two-storey Marina Centre to the south of Marina Road used as an office space by ESC. The car park was constructed of reinforced concrete and brick and appeared to be in poor condition, with the northern part of the car park and exterior access ramp having been demolished between 2017 and 2018. The Marina Centre building was a brick-built structure and appeared to be in relatively good condition.

The site has undergone significant redevelopment, multiple times. This may leave a legacy of made ground and buried structures/foundations. It is therefore considered that there is the potential for an unknown thickness of made ground to be present beneath the site. This could pose a risk of soil contamination, ground gas generation and potentially an impact on the groundwater. The site is anticipated to be 6-8maOD with groundwater is anticipated to be at 0maOD and therefore approximately 6-8mbgl. The potential for made ground should be considered further as a possible source of contamination.

Aside from the potential for made ground, the potential for past activity on site to generate contamination is largely limited to the risk of leaks and spills of oils and fuels from vehicular access and historic railway sidings highlighted along the eastern portion of the site in the Groundsure report (reference: GS-9003388). These railway sidings may also comprise significant backfill, which should be considered further. Off site sources such as the railway tracks were located approximately 36m to 100m to the east and south of the site respectively with various industrial land uses and the Waveney Market and docks/port also identified which should also be considered further.

The record of additional off site potentially contaminative industrial sites includes an electrical substation and pressurised water tanks both noted immediately to the east of the site. The client representative that met us on site during the walkover identified these tanks to be approximately 40 years old and appeared to be in good condition. These sources are unlikely to cause significant contamination of the site and therefore have not been considered further. A disused sewage works and pumping station are also noted within 500m of the site boundaries but are not expected to pose significant contaminative issues to the site. A former gas works and tanks located northeast from the site are also very unlikely to impact the site due to their distance and direction.

The geology underlying the site is anticipated to comprise granular superficial deposits of the Happisburgh Glaciogenic Formation - Sand. Blown Sand was noted close to the east of the site. Lowestoft Formation – Diamicton is anticipated approximately 500m to the north of the site. These superficial deposits are shown to overly the Crag Group – Sand bedrock.

3 HAZARD IDENTIFICATION AND ASSESSMENT

Contamination hazard identification has been undertaken and this has been developed to include source-pathway-receptor principles. Geotechnical hazards are also identified and commented upon.

3.1 Geotechnical Hazard Identification

Table 3.1 below contains an initial assessment of the geotechnical hazards that could be present at the site.

Hazard	Requires further consideration?	Comment
Shrink/swell potential	No	Cohesive (potentially shrinkable) soils are not anticipated beneath the site and therefore potential shrink/swell hazards are negligible. The superficial deposits are anticipated to comprise granular soils of the Happisburgh Glacigenic Formation.
High groundwater level/flooding	No	The site is not located within a zone at risk of flooding from rivers and the sea. The site is also not considered to be within a flood zone. Surface water flooding is also negligible.
Poor drainage	No	Granular deposits with high permeability rates and good drainage characteristics are anticipated. However, cohesive deposits with poor drainage characteristics are noted nearby. In-situ soakaway testing to BRE 365 method is recommended to provide expected infiltration rates for drainage design.
Dissolution Features	No	The risk of dissolution features across the site is negligible and has not been considered further.
Potential variable deposits	**Yes**	Although the anticipated geology across the site is shown to be predominantly sand and gravel deposits, local borehole records outline the potential for variability within the superficial deposits, including some cohesive soils.
Unexploded ordnance (UXO)	**Yes**	A review of freely available online sources suggests that the site and the surrounding area has a high risk for UXO. Bomb records show that there was a bomb strike to the east of the site. Further action is recommended, such as a detailed UXO risk assessment and mitigation measures (e.g. UXO supervision) during intrusive investigations and construction.
Uncontrolled backfill/Potential for unknown made/filled ground	**Yes**	The Groundsure report has mapped railway sidings along the eastern portion of the site. The former railway tracks to the east and south of the site that connected the Lowestoft Station with the fish market were demolished in the 1980's. The nature of the backfilled material is unknown and could potentially include contaminated material. However, the tracks were downslope and approximately 50-100m from the site, therefore it is unlikely to pose a significant risk. However, due to likelihood of made ground, there is a potential ground gas risk on site. Furthermore, current structures have been present on site since the mid-1980s according to historical maps. Throughout history, the site has had a variety of uses (including a skating rink since the earliest mapping series of 1883, orphanage, warehouse, car park and office) with the potential for made ground across the site due to the many changes in land use.
Relict foundations/ below ground structures.	**Yes**	Examination of available historic map data shows the site have had a variety of structures on site since at least1885. Therefore, after demolition, relict structures and foundations to the existing buildings are likely which will require grubbing out and subsequently removed prior to redevelopment.

Table 3.1: Initial Geotechnical Hazard Identification

This table is based on the information stated above; however, it should be revised if additional relevant data was identified at any time.

3.2 Environmental Hazard Identification

In this part of the report, environmental hazard identification is undertaken, leading to the development of a conceptual ground model for the site. Contamination sources are specified based on the information previously presented in this report as well as identified receptors, in association with a list of potential contaminants. As an initial step, the viability of the potential sources are considered in table 3.2a below.

Potential Source	Distance (m)	Direction	Initial Assessment	Requires Further Consideration?
Made ground	On site		Due to the age and variety of structures (skate rink, warehouse, residential homes and car park) present on site during its history, made ground is likely beneath the site. Potential source for ground gas which should be considered further.	**Yes**

Potential Source	Distance (m)	Direction	Initial Assessment	Requires Further Consideration?
Leaks and spills from vehicles accessing the site.	On site		The structure to the north of the site was a multi-storey car park that was used between its construction in 1977 and 2017/2018 when it was closed due to structural issues. The age and use of the structure introduces a variety of contaminants such as oils, lubricants and other hydrocarbons from leaks from vehicles.	**Yes**
Railway sidings	On site		Contaminants (PAH, heavy metals and hydrocarbons) associated with this potential source are considered a risk. As well as this and due to the unknown thickness of made ground, there is also a potential source for ground gases, which should be considered further.	**Yes**
Electrical substation	0 to 5	E	Contaminants such as polychlorinated biphenyls (PCBs) associated with this source are generally relatively immobile, therefore these are unlikely to impact the site.	No
Pressurised water tanks	0 to 5	SE	The pressurised water tanks appeared to be in good condition during the time of our site walkover and contain fresh water so pose very minimal risk of contaminating the site.	No
Local historical industries	14 to 500	NE and SW	Contaminants from historic industries (iron works, goods yard and unspecified factories mapped in the northeast and southwest) introduces a wide variety of contaminants which may leach down gradient and towards site therefore posing a risk.	**Yes**
Railway tracks	36	SE	Contaminants (PAH, heavy metals and hydrocarbons) associated with this potential source are considered most likely to flow down the hydrological gradient taking them away from the site and therefore is not considered further. However, due to the potential for made ground, there is the potential for ground gases to be generated.	**Yes**
Waveney Market and dock/port	18	SE	Contaminants (metals, hydrocarbons, acids/alkalis and organic compounds) associated with this source could impact the site due to its proximity to the site as well as the length of time the docks and market was used for 1883 to present day.	**Yes**
Engineering works	49	NE	Contaminants (hydrocarbons and heavy metals) associate with this potential source are considered most likely to flow down the hydrological gradient, taking them away from the site.	No
Unspecified tanks	57 and 218	SE and NW	The unknown nature and age of these tanks could pose a risk of contamination to the site as it introduces a variety of contamination. Distance from the site suggests that these tanks are unlikely to pose a significant risk.	No
Sewage pumping station	320	SW	Contaminants (metals, acids/alkalis and inorganic compounds) associated with this potential source are considered to be too distant from the site and are most likely to flow down the hydrological gradient taking them away from the site.	No
Gas work	459	NE	Contaminants (coal tar, ammonia and heavy metals) associate with this potential source are considered too far away from the site to present a significant risk.	No

Table 3.2a: Initial Assessment of Potential Sources of Contamination

Of these potential sources, the on site sources such as made ground, leaks and spills from vehicle access and former railway sidings and off site sources such as the long historical industrial uses,

Waveney Market and docks/port and railway tracks are believed to be the most significant sources of potential contamination and will be considered further in the assessment process.

The hazard identification is based on the assumptions presented below:

- The site under consideration is proposed for redevelopment of the disused multi-storey car park and re-purposing of the Marina Centre for commercial/retail use. Development plans are yet to be developed however, it is understood that outdoor seating and areas of soft landscaped areas may also be proposed as part of the development.
- The site will be assessed based on its former and proposed use from information provided in DEFRA/ Environment Agency (EA), 2021 'land contamination: risk management' and Science Report 3 'Updated technical background to the CLEA model' (Environment Agency, 2009).
- Drinking water will be from mains supply.

In advance of any demolition, it may be advisable for an asbestos survey to be undertaken and if asbestos is noted in the existing buildings, its removal and dispose should be undertaken in accordance with the 'Duty of Care' and applicable legislation.

The identified contamination hazards/sources and sensitive receptors are summarised in tables 3.2b and 3.2c below.

Contamination Hazards/Sources			
On Site		**Off Site**	
Source	**Implication**	**Source**	**Implication**
Potential for made ground.	Soils impacted by total & leachable contaminants.	Local historic industries.	Groundwater and soils impacted by total & leachable contaminants.
Leaks and spills from vehicles accessing the site.	Fuel and oil contamination to groundwater and soils.	Former railway tracks.	Groundwater and soils impacted by leachable contaminants. Ground gas generation.
Former railway sidings on site	Soils impacted by total & leachable contaminants and potential thicknesses of made ground. Ground gas generation.	Waveney Market and dock/port.	Groundwater and soils impacted by leachable contaminants.

Table 3.2b: Potential Contamination Sources and Implications

Sensitive Receptors
People using the site during and post development construction.
Principal and secondary aquifer (groundwater).
Local flora & fauna.

Table 3.2c: Potential Sensitive Receptors

3.3 Key Contaminants List

The investigation of the site history has indicated potentially contaminative past uses associated with the site. These include the potential for on site sources such as made ground, leaks and spills from vehicles accessing the site and railway sidings highlighted as being on site by the Groundsure report (ref GS9003388). Off site contaminants include local industries introduce a wide variety of contaminants from Waveney Market and the dock/port, in addition to the potential for made ground beneath the former railway tracks. These varied activities present the potential risk of contamination to be present in the near surface soils and pose a threat of impact on the groundwater. The deep made ground beneath the railway sidings and railway tracks may generate ground gases.

It is normal to consider the contamination implications of a specific land use to formulate a list of key contaminants, using documents such as CLR 8 'Potential Contaminants for the Assessment of Land', and the relevant Department of the Environment Industry Profiles. In this case, the industry profile

'Railway Land' has been considered given the nature of the previous land use and potential for redevelopment. Therefore, chemical analysis could include metals, acids/alkalis, organic compounds, hydrocarbons (fuels and lubricating oils), PCB contaminants and ethylene glycol to provide evidence of the potential for contamination issues present.

3.4 Schematic Section

In order to identify potential pollutant linkages, a schematic section has been included below as figure 3.4b, with figure 3.4a showing the trend line for the section.

Figure 3.4a. Trend Line of the Schematic Section Across the Site.

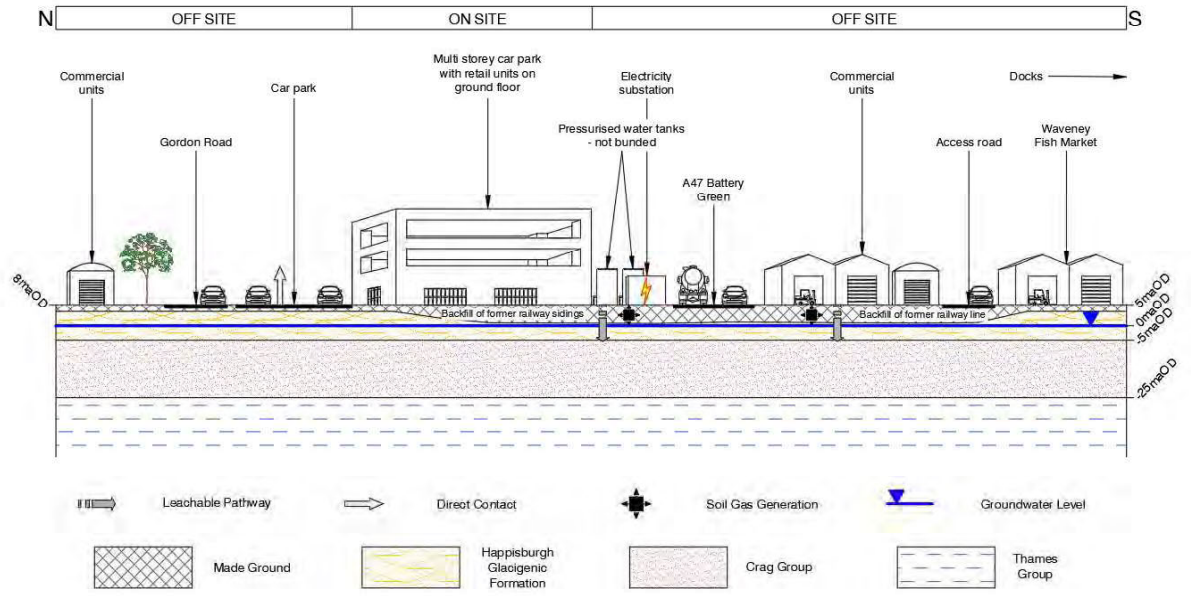


Figure 3.4b: Schematic Section

The model shows predicted geology and topography, potential contamination sources and receptors from data present in the report. Generalised pathways are shown, which are discussed throughout the report and are developed in section 3.5 to allow an initial hazard assessment. The schematic section should not be considered to scale. The section should be revisited and updated if the proposed use changes, or if additional information comes to light.

3.5 Hazard Assessment

An initial assessment of the risk posed by each pollutant linkage has been carried out. This is included as table 3.5 below and identifies a low to high hazard ranking with recommended subsequent activity having the potential to include:

- Action required (AR) in the short term to break existing source-pathway-receptor link;
- Site investigation (SI) with objectives for risk estimation, or;
- No action (NA) at this stage

Some pollutant linkages (source-pathway-receptor relationships) have been assessed to require further action. Recommendations for further work are largely with regard to the investigation of the ground conditions; these are discussed in section 4.

Hazard Identification				Hazard Assessment			
Link No.	**Source/ Hazard**	**Pathway**	**Receptor**	**Probability**	**Consequence**	**Hazard Ranking**	**Hazard Assessment:** - **Action required (AR)** - **Site Investigation (SI)** - **No Action (NA)**
1	Hazardous vapours / soil gas from deep made ground associated from on and off site sources such as the former railway sidings, railway tracks and deep made ground from historical land uses including the Waveney Market and port/docks.	Ingress into excavations, structures and confined spaces, and subsequent inhalation.	People on the site during development construction.	Likely	Severe	High Risk	**SI** – If significant made ground is present across the site then ground gas monitoring and assessment would be required.
2		Ingress into structures and confined spaces, and subsequent inhalation.	People using the site post development construction.	Likely	Severe	High Risk	
3	Contaminated soil from previous and present contamination sources both on and off site such as the former railway sidings, railway tracks and deep made ground from historical land uses including the Waveney Market and port/docks.	Ingestion of soil through direct contact, eating with dirty hands and dust inhalation.	People on the site during development construction.	Low Likelihood	Medium	Moderate/ Low Risk	**SI** - Chemical testing and assessment of risk is recommended to determine whether contaminated made ground soil is present across the site.
4			People using the site post development construction.	Low Likelihood	Medium	Moderate/ Low Risk	
5		Leaching.	Groundwater (principal aquifer)	Low Likelihood	Medium	Moderate/ Low Risk	**SI** - Possibility of contamination across the site. This should be considered if significant deleterious conditions are encountered as part of investigation.
7		Plant uptake.	Local flora and fauna.	Low Likelihood	Mild	Low Risk	NA - Chemical testing and assessment of risk required only if significantly deleterious conditions encountered during intrusive investigation works.
8		Direct Contact	Building structures	Low Likelihood	Mild	Low Risk	NA - Chemical testing and assessment of risk required only if significantly deleterious conditions encountered during invasive investigation works.
9	Possible asbestos containing material (ACM).	Fibres becoming airborne during demolition of existing buildings and potentially during excavation/construction activities.	People on the site during development construction.	Low Likelihood	Severe	Moderate Risk	**AR -** An asbestos survey is recommended to be carried out prior to demolition. if ACM is identified then this needs to be removed in a controlled manner by licensed specialist before demolition.
10			People using the site post development construction.	Low Likelihood	Severe	Moderate Risk	

Table 3.5: Initial Hazard Identification and Hazard Assessment (Table of Pollutant Links)

4 DISCUSSION & RECOMMENDATIONS

4.1 Discussion

The stage one, tier one contamination and geotechnical assessment (desk study report) was undertaken for a site located off Battery Green Road, Lowestoft. The tier one assessment was undertaken in order to establish how potential contamination and geotechnical hazards could impact the future development of the site.

At the time of the site walkover the site comprised a disused and partially demolished multi-storey car park and council building which was still in active use. The multi-storey car park consisted of retail shops on the ground floor and has two levels of car parking spaces. Due to the age of construction, the structure is likely to contain asbestos containing materials (ACM). Off site and to the south-east of the car park were two cylindrical pressurised water storage tanks for the retailers. An electrical substation was also noted off site immediately to the east. The car park was in a state of disrepair and an exterior access ramp and northern portion of the multi-storey car park had been removed recently due to structural issues (the client representative noted this to have occurred in 2017-2018). The southernmost building which was used as an office space for East Suffolk Council (ESC) was in good condition and was being used as an office space with adjoining car park at the time of site walkover. At the time of the walkover, proposed development plans had not been drafted. However, the client representative suggested that the council building is to be repurposed from office space to a ground floor restaurant with outdoor seating; the first floor is earmarked to provide additional space for the marina theatre. The multi-storey car park is anticipated to be demolished and reconstructed as a two-storey socialising and events space, offering flexibility to enable a variety of pop-up events. Therefore, a commercial setting has been considered as part of this assessment and anchor offerings.

The surrounding area consisted of industrial units/buildings and dockyards to the south, east and northeast. Six unknown tanks and a large gas works were noted to the northeast. The North Sea is located to the east of the site.

The site is anticipated to be underlain by superficial deposits comprising granular soils associated with the Happisburgh Glacigenic Formation. Blown Sand was noted in close proximity to the east of the site in close proximity to the North Sea. Superficial deposits of the Lowestoft Formation – Diamicton is anticipated approximately 500m north of the site. These superficial deposits overly the Crag Group – Sand. The most sensitive receptors identified were humans using the site during development (construction workers) and post development (end-users) and groundwater (secondary and principal aquifers).

No intrusive investigation has been undertaken as part of the tier one assessment. Based on the site history and background information, after the multi-storey car park is demolished, it is deemed necessary to consider a ground investigation in relation to the potential for contamination and the assessment of geotechnical issues. At the same time, it may be prudent to assess the ground conditions for the purposed of foundation designs. It should be made clear that the contamination hazards may not prove to be significant, but their nature and number lead us to recommend site investigation in order to properly assess them. If a better understanding is required of the potential for contamination, the extent of it and possible costs associated with remediating contamination, some investigation could be completed prior to demolition.

4.2 Geotechnical Risks

Potential shrinkable and compressible deposits are considered unlikely, unless nearby cohesive soil deposits extend into the site. The potential for significant uncontrolled backfill and relict structures have been identified as potential geotechnical hazards. Especially at the location of the existing multi-storey car park. The underlying soils could be variable in nature, although the anticipated superficial soils of the Happisburgh Glacigenic Formation is generally consistent granular soils. An intrusive geotechnical investigation is recommended at the location of the multi-storey car park once demolition has been completed and prior to any construction, to allow for adequate design of foundations and pavements and to confirm the geology and depth to groundwater.

The risk of UXO is considered to be high on site and within the surrounding area. Historical bomb maps show that there were strikes on Battery Green Road directly east of site as well as along Hamilton Road

to the northeast. Therefore, advice from a UXO specialist should be sought before intrusive works, demolition or construction commences.

4.3 Environmental Risks

The site is understood to have had a variety of uses since historical records began in 1885. This includes railway sidings, a warehouse, skating rink, a Smack Boys orphanage, electrical substation, residential dwellings, a multi-storey car park, retail stores and an office space. These activities on site may have generated made ground and contaminants.

The age of the current structures on site introduces the possibility of ACM. Furthermore, the unknown nature of the historical warehouse (dated from 1927 to 1990) and residential housing noted on site from 1883 to 1977, introduce the potential for ACM within made ground on site. For these reasons, the soil beneath the site should be investigated for the potential presence of ACM.

The on site sources such as the potential for uncontrolled backfill and ground gas generation from historic made ground, railway sidings and leaks and spills from vehicular access are a significant risk and should be considered further.

As well as the on site sources there are possible off site sources of contamination in soil and ground gas generation from sources including Waveney Market and dock/port, local historical industries surrounding the site and potential thicknesses of made ground from the former railway tracks, which present a ground gas risk and therefore should also be considered.

Ground gas monitoring may be warranted within the footprint of the multi-storey car park should there be a significant thickness of made ground, which can also generate soil gas.

Prior to the commencement of any redevelopment and post demolition of the multi-storey car park, we would recommend that an intrusive stage one tier two generic quantitative risk assessment (intrusive investigation) is carried out across the site in order to identify whether contamination is present, and whether a significant risk exists to people on site during construction and end-users to properly assess them. The client representative suggested that soft landscaped areas may form part of the redevelopment and therefore should be targeted as part of the intrusive investigations should they be included within the proposed design.

4.4 Site Investigation Strategy

Prior to redevelopment of the site, characterisation of the existing ground conditions is believed to be required. The scope is considered necessary as part of an assessment of potentially contaminated land, and for the purposes of geotechnical hazard assessment. In particular the site investigation should aim to assess the potential for contamination within the shallow made ground at discrete locations across the footprint of the multi-storey car park on completion of the demolition. We understand that the Marina Centre is proposed to be repurposed from office space to retail units. Although the land use will still be considered as commercial end use, it is recommended that a site investigation should be undertaken in the vicinity of the Marina Centre in order to assess the potential for contamination. This will look to assess the potential presence of contamination and the risk to the sensitive receptors identified. Soil chemical laboratory analysis should be undertaken and ground gas monitoring should significant thicknesses of made ground be identified. If elevated concentrations are recorded from the soil analysis, leachate and groundwater analyses may be advisable.

Investigation could include the following scope of works:

- Direct investigation of the ground by trial pit excavation and the drilling of dynamic continuous (window sampler) boreholes to determine the soil types and to collect soil samples.
- Selective analysis of shallow soil samples highlighted in the key contaminants list collected from the fieldwork to provide data for a contamination assessment.
- Preparation of contamination hazard assessment and evaluation.
- Groundwater/leachate testing if elevated total soil concentrations are recorded.
- If significant thickness of made ground is encountered and identified then a representative number of boreholes should be installed with ground gas monitoring standpipes.

The scope of works outlined above is designed to aid in the assessment of contamination issues on the site, particularly if unsuitable or questionable ground conditions are encountered. The exact scope of work could vary, depending on client and regulator requests and recommendations. Additionally, certain aspects of the work could be reduced or increased, depending on the initial findings from in-situ investigation, as outlined in the guidance given by the British Standard 10175:2011+A2:2017 investigation of potentially contaminated sites - code of practice, and the principles of European Code 7 – geotechnical design.

The client may wish to include an assessment of the geotechnical issues on site and to inform the design of foundations, floor slabs and pavements/roads.

4.5 Summary and Implications

The basic requirement for redevelopment standards in the UK is that land should be 'suitable for use' or 'fit for purpose', rather than apply a blanket 'clean' or 'all uses policy'. It is important to consider the limited nature of this investigation, and the possibility of as yet unknown contaminant sources existing.

Taking the proposed redevelopment forward, we understand that a development plan has not yet been designed, however we understand that it is proposed to repurpose the Marina Centre from office space to retail which is a two-storey building currently operational by ESC. We understand the building is to be repurposed to provide a ground floor restaurant with outdoor seating with soft landscaped areas also proposed.

It is also understood that the multi-storey car park is proposed to be demolished and replaced with a two-storey socialising and event space. Therefore, on completion of the demolition it is recommended that a stage one tier two generic quantitative assessment is appropriate which shall assess the potential contaminative uses and geotechnical hazards identified across the entire site before the site can be considered suitable. Any areas of proposed soft landscaping should also be investigated. We understand currently that there are no proposed development plans. The investigation should include an assessment of the potential for contaminated soil from the historic uses of the site and the potential for migration of contamination from surrounding areas.

Harrison group Environmental Limited would be pleased to offer further assistance with the recommended woks if requested, and if the client or regulators have any comments or questions we would be glad to discuss them.

Report prepared by:	Report checked and approved
[redacted]	[redacted]
Cara Cooper BSc (Hons) Graduate Geotechnical Engineer	Jamie Etherington BSc (Hons) FGS Senior Geotechnical Engineer

Appendix G
Pre App Response ref DC/23/2839/PREAPP

Chaplin Farrant
51 Yarmouth Road
Norwich
Norfolk
NR7 0ET

Your ref:
Our ref: DC/23/2839/PREAPP
Date: 29 September 2023
Please ask for: Andrew Martin
Direct dial:
Email: planning@eastsuffolk.gov.uk

Pre-application planning advice

Application ref: DC/23/2839/PREAPP

Location:
Battery Green Cultural Quarter
Gordon Road
Lowestoft
Suffolk
NR32 1HA

Proposal:
Pre Application Advice - Battery Green Cultural Quarter

Officer advice

Pre-application advice is sought in relation to the redevelopment proposal for the Battery Green site in central Lowestoft. A MS Teams meeting was held on 29 August to discuss the proposal. The below response covers the policy considerations relevant to the proposed development having particular regard to the principle of development, design, heritage, biodiversity, flood risk and drainage, and highways. In addition, there has been some initial input into the design development from the Design Champion and Specialist Services Manager, who has also contributed to this response, alongside the Senior Landscape Officer, and Senior Design and Conservation Officer. Comments have also been received from the Flood and Water Engineer at the Lead Local Flood Authority, Suffolk County Council.

It is noted that there has previously been a working group exploring the design opportunities for the development of the site. In May the design proposals had reached a concept stage. This means that the design has evolved from a high-level concept to detailed proposal between May and the submission of this pre-application enquiry in July. It is unclear how the site has evolved within that time. Some of the issues identified within this response may stem from a lack of engagement between the concept and detailed design stages.

Overall, it is concluded that the proposed development would be acceptable in principle, as the site is allocated for redevelopment under Policy WLP2.7, however, whilst the general design intent and vision is sound, there are aspects of the proposal which require improvement and, on the basis that the final detailed design has yet to be developed, some judgement is reserved in relation to the treatment of the buildings and open spaces. This is discussed further below.

Site Description

The site measures approximately 1.2 ha and comprises of a former car park; an existing wing of the Marina Theatre; and a section of Marina Street. In terms of its surroundings, Powerpark, a significant future employment development, is located to the north; the A47 and harbour is located to the east; and a range of town centre uses and businesses can be found to the south and west of the site, with a concentration within the High Street.

Proposal

The proposal comprises the partial demolition of the existing buildings on the site, as well as part of the Marina Centre; the construction of two new buildings connected by a covered, flat- and green-roofed walkway; and the refurbishment of the Battery Green Car Park.

Principle of Development

There are major growth and regeneration ambitions for Lowestoft, with Battery Green forming an important component of the future vision for the town. The site is included as the Cultural Quarter of the Lowestoft Town Centre Masterplan. That document is more of a vision than a true masterplan and has no planning status, however it is a comprehensive document which has received significant praise and government backing. It is essential that the visionary objectives of that document are now fleshed out through a full design process such as this. Consideration also needs to be given to what has changed since that was produced and what public desires for this area are. Policy WLP2.7 allocates the site for a comprehensive redevelopment of town centre uses, including retail and leisure development. The uses referred to within the policy are A1, A2, A3, A4, C1 and D2, but these have since been superseded by uses E(a)-(d) [formerly A1, A2, A3, and D2]; F.2 [formerly A1], and sui generis [drinking establishments were previously A4, but now fall under sui generis].

As part of the pre-application enquiry, the following uses have been proposed:

- 2,495 sqft of restaurant
- 10,000 sqft open plan flexible space (music performances – 600 people; exhibitions; digital art; museum and heritage; roller skating rink; conferences – 800 people)
- 5,000 sqft flexible space (conferences; office space; radio)
- 1,485 sqft large performance making, divided across 3 cells (radio; podcasts; retail; workshop; art studios)
- 600 sqft small performance making, divided across 4 cells (radio; podcasts; retail; workshop; art studios)
- 1,000 sqft café
- 3,500 sqft informal space

A key point in respect of the above is, why are an established architect submitting a detailed design document quoting areas in square feet? It should be known that for all planning and building regulations matter, square metres is the only measurement to use.

The majority of the above uses fall within the policy prescribed uses for the site with the exception of office space, which would fall under Use Class E(g). There is not necessarily an objection to the incorporation of some ancillary office space, however, as an application for full planning permission is to be submitted, there needs to be clarity on the internal floor plan arrangements and specific uses classes considered against policy and conditioned appropriately. A high-level conceptual/flexible approach is unlikely to be successful where the uses intended to share a space have such different operational requirements unless submitting an outline planning application. For instance, a conference room will require an open floor plan, whereas an office would require more formalised space for office related furniture and different policy considerations may apply to those two different uses.

Office/employment orientated uses should be kept to a minimum, given the premise of the allocation is to enhance and compliment the town centre's recreational and leisure offering. It is also notable that significant employment space will come forward as part of the wider redevelopment of the area, particularly PowerPark.

Further consideration needs to be given to the way in which uses can be planned to bring activity to the open spaces on the site, particularly during the evening. This would prevent the open spaces from becoming hubs for antisocial behaviour. Having active uses around the open spaces, during the day and the evening, will also act as a draw for visitors. Currently, the plans show rooftop uses that could be brought down to the street level.

There is also potential to introduce residential uses to the site, with the pre-text to Policy WLP2.7 recognising this potential subject to there being no unacceptable impacts upon residential amenity when having regard to the industrial and port related uses to be delivered in the neighbouring PowerPark. Having an element of residential development would bring passive surveillance and a permanent presence of use and activity to the site. Mixed use areas are a positive part of the urban realm, see for example the Arc Shopping Centre in Bury St Edmunds where this has been successfully implemented. There is a risk, with low night time activity, of this area becoming oppressive and potential unsafe to those passing through without sufficient activity.

In addition to the above, a strong focus of the proposal is on the arts and cultural offering to be delivered, including space for exhibitions, digital art, music performances, and a museum, yet there are several other regeneration projects coming forward within the town that have a similar focus. Subsequently, it is queried whether this the best use of the site in terms of enhancing the vitality and viability of the town centre. Essentially, if the objective of the redevelopment is to increase dwell time within the town centre, what is unique or different about the offering of this site within the wider context of the town centre and the other redevelopment projects? How does this scheme successful expand the period of town centre activity? These are questions to ensure you address in your submission in making such a change to public realm.

Overall, the principle of the site's redevelopment is firmly established by Policy WLP2.7. Nonetheless, careful consideration still needs to be given to the mix and arrangement of uses to ensure that the allocation policy's objective of enhancing the vitality and viability of the town centre is met.

Design

Policy WLP8.29 requires all new developments to achieve a high standard of design that reflects local distinctiveness. Policy WLP8.30 requires proposals which would create open space to utilise inclusive design for people of all ages and abilities. Policy WLP8.31 sets out that developments should be designed to support the needs of older people and those with dementia through the creation of environments which are familiar, legible, distinctive, accessible, comfortable, and safe.

Policy WLP2.7 states that the new development should be designed to the highest possible architectural standard, creating a landmark building for the town. The policy also specifies that blank walls should be avoided adjacent to public viewpoints; visual links and connections should be provided to London Road North and Marina Street; and that an active frontage should be provided along Gordon Road.

The design concept is centred around providing new cells of development within the setting of enhanced green infrastructure environment. This works well as a concept, building on the existing site's identity as 'Battery Green'. As set out above, the proposal comprises various elements. Principally, the proposal involves the partial demolition of existing buildings; the conversion and refurbishment of the Battery Green Car Park; and the construction of two new buildings. The layout also incorporates an area of central, public open space and a small park towards the northern boundary, which is situated between Gordon Road and the A47, adjacent to the Gordon Road Roundabout.

Northern Green Space/retained Car Park

One particular concern is the green space or park proposed towards the northern boundary of the site. There is no clear relationship between the space and the rest of the site, given it is bounded predominantly by main roads and a car park. The design of the proposed building to the south, which has a recessed entrance and a form that narrows the space between it and the refurbished Battery Green building, further prevents flow from the park into the rest of the site. Careful consideration needs to be given to the way in which users of the park area would be drawn into the site, and equally consideration needs to be given to the reasons why people would want to dwell in the space. If the park is not well-used and effectively tied in with the rest of the site, there is a risk that it will attract anti-social activity and use, particularly as there would be limited passive surveillance.

The existing car park adjacent to the park is proposed for retention, but it is not incorporated into the plans for the site. It will be important to outline how the car park and the green space will connect and interact. Opportunities should be taken to improve the relationship between the retained car park and the existing and proposed public realm. Even updating the wall and entrance to the car park, along the Battery Green Road boundary, would help to integrate this existing car park into the new identity of the wider site's redevelopment.

Upper Terrace and Civic Square

The proposal incorporates the creation of a new central area of public open space which has been described as comprising two parts, an upper terrace and a civic square. Several of the visualisations provided indicate that both of these spaces would be accessible by steps. Graded access is required to these spaces, to ensure that they function well for all users, including wheelchair users and cyclists etc. It is noted that some of the visualisations do indicate ramps, but no railings or barriers. This is only noted as in some instances barriers or railings can be required and if not considered from the outset, they are a detail which when added later can erode the quality of a scheme.

Aside from the need to widen and enhance the northern gateway to the site, which is discussed elsewhere in this response, the general layout of the upper terrace and civic square is acceptable. However, it is important to highlight at this stage that the selection of materials and landscaping will make or break this part of the scheme. These matters are discussed further below under the 'landscaping' heading. Incorporating elements of shade/shelter within the civic square element will increase the resilience of the space.

New Buildings

In terms of the building designs, there are two distinguishable buildings linked by a colonnade structure with timber supports, glazed elevations, and a green roof. The link itself is extensive, particularly its width at the point where people would enter and leave the site through the gap between the new build element and the retained part of the Battery Green Car Park building. As already noted above, the narrow external route into and out of the site could restrict permeability, or not adequately promote permeability through the site, when the buildings/linking structure are not open or in use. There is too much reliance on internal space for circulation and connectivity. This situation could be improved by widening the space between the Battery Green Cark Park building and the new build element. The design of the northern access to the internal spaces would also benefit from refinement to improve legibility and draw people into the site. Greater activation of the frontage with Gordon Road would contribute towards this with Policy WLP2.7 specifically requires an active frontage along Gordon Road.

The northern building has an industrial appearance with its shed-like form, metal cladding, and sawtooth roof. This is a reference to the industrial, port-related character of the area. There is no objection to the principle of this approach to the building's design, however, it needs to be made clear that the building is not in an industrial use. Additionally, the blank appearance of the elevations, and the absence of any visual breaks, cannot be supported. The elevation adjacent to Battery Green Road is the most problematic and makes no attempt to activate or bring interest to the street scene. There is a risk that such a design approach without maintaining extremely high standards of detailing and materials could appear as an industrial building in a town centre, which is not what we should achieve in a regeneration project. Currently, a complete rethink of the entire Battery Green Road frontage is needed. It is understood that service areas are necessary, but exposed service areas combined with blank elevations, a recessed building to the south, and an island of isolated green would do not result in a comprehensive, high standard of design.

To address the Battery Green Road frontage concerns, the northern buildings street-facing elevation needs could be activated/broken-up through the use of glazing or the creative use of

materials. Meanwhile, the service yard needs to have its own high-quality boundary treatment, to reduce its prominence when viewed from public vantages. To create more of a presence in the street scene, the southern building, with its triangular form, could be extended towards the road, reducing the emphasis on the single-storey colonnade. The integration of landscaped areas into the scheme is discussed below under the 'landscaping' heading.

Turning to the appearance of the southern building, it has a distinctive design with its modest ground floor and prominent first floor. The prominence of the first floor is amplified through the use of a high ridgeline; the angular roof form; the louvre features that define the gable-ends; and the selection of bold materials. The quality of the cladding would be integral to the overall quality of this building, and samples of the proposed fibre board would be required. It would also be helpful to provide examples of where the material has been successfully used elsewhere. Details of the materials proposed for the louvres would also be necessary.

From the information submitted, it is unclear how the glazing would be incorporated with the louvres. Given the proposed uses of the first-floor space, it needs to be understood whether the acoustic properties have been fully considered. There is otherwise a risk that the types of uses proposed could influence changes to the final design. A further consideration is whether sufficient space has been provided for the restaurant space to spill out into the new civic square. This an important part of the objective to bring life into the public open space and provide cross-engagement with the Theatre. Access to the kitchen and its store should also be facilitated in a discrete location, rather than from the public facing elevation, as currently shown on the floorplan.

Battery Green Car Park

The majority of the retained ground floor space would continue to be occupied by the existing retailers. In terms of proposed interventions, at the ground floor level there would be a new atrium and space for indoor climbing, as part of the competitive leisure offering. Key to the success of the building's re-use will be the activation of the ground-floor. Introducing glazing to the elevations facing onto the proposed public open space will help, but active uses would go further, or at the very least clear sign-posting to the uses provided throughout the refurbished parts of the building.

As part of the conceptual visualisations, 'meanwhile flexible space' is shown on the roof of the building. It is not clear how 'meanwhile' the use would be, or what the use would be. There is of course flexibility for a range of uses, subject to compliance the uses allocated under Policy WLP2.7, but some clarity on what they are envisaged to be would assist in determining the way in which the space needs to function. If the roof is to be utilised, the detail of the associated paraphernalia, such as safety barriers, would need to be carefully considered at an early stage to prevent the overall design quality being diminished at a later date.

In terms of delivering a comprehensive approach to the whole site, temporary/pop-up uses would be more effective if they were provided for at ground level, either within the public open space, or within the informal space that makes up the 'public spine' green route. It feels would be a missed opportunity if the busiest part of the site were to be the car park roof.

An illuminated beacon (use of polycarbonate sheets to emit external glow from internal lighting) is proposed to the roof of the building to draw people into the site and create visual interest. It should be considered how future proofed such a feature is, given its exposure in this coastal location, if materials were to degrade over the years and maintenance/replacement was costly, this could become a negative design feature. There is no objection to the use of a beacon feature, but the building would also benefit from additional alterations to enhance the identity of the overall scheme and its immediate surroundings. For instance, whilst the majority of the Gordon Road elevation would be unchanged, consideration should be given to opportunities to activate the street scene. Providing an access from Gordon Road would help, and there is a large expanse of black brickwork that could potentially be utilised for public art or a mural.

Marina Centre

Demolishing the northern wing of the Marina Centre will help to unlock the southern part of the site. It would facilitate the realignment of Marina Street which would improve east-west connectivity, as well as opening up the entrance to the new civic square. This element of the scheme is supported. Further detail will though need to be provided on the treatment of the road surface. If any protective barriers or bollards are proposed these will need to be detailed as part of any planning application submission.

There are existing buildings, one in a mixed-use and the other approved for an intensified residential use, adjacent to the western edge of the proposed civic square which would become detached from Marina Street as a result of its realignment. The loading area to the Marina Theatre would also be displaced by the realignment. How will the loading area, residential/business parking and bin areas be accommodated within the proposed scheme?

A further query is whether the pavement outside of the Marina Theatre is to be widened? The width shown on the plans, even the existing plans, seems so show a more generous area of paving than is perceptible in person.

Character of Area

Whilst consideration has clearly been given to the creation of unique buildings that could individually, subject to the above concerns being addressed, be considered to represent a suitably high standard of design, there is some initial concern that the buildings have been designed in isolation of one another and their surroundings. Given the mixture of existing buildings addressing the site, in combination with the concrete car park, timber 'informal space, and industrial style new builds, it is unclear whether the scheme would create a new place with unifying characteristics, or just a collection of individual design interventions.

As raised by Chris during the meeting, it would be beneficial to understand what the common design theme is across the site. At present the public realm appears to be the consistent design element throughout the scheme, but it is questioned whether there should be some common architectural elements to draw the buildings together.

<u>Landscaping</u>

Policy WLP8.29 states that development proposals will be expected to include hard and soft landscaping schemes to aid in the integration of the development into its surroundings. Similarly,

Policy WLP8.30 requires open spaces to be designed and landscape to a high standard to enhance the public realm.

The Council's Landscape Officer has reaffirmed much of what has already been outlined in terms of design, given the intrinsic relationship between design and landscaping. They support the incorporation of skateable elements within the landscaping scheme, but feel that this thread should be continued more widely across the site, rather than having just a few token features.

The proposal to 'green' the site is appreciated, however, planting needs to be carefully designed so that it can be demonstrated how the landscaping will be able to cope with the challenging urban and coastal conditions. Directing surface water run-off into the planting beds and tree pits is a useful irrigation source, however, it should not be assumed that as planting forms part of the SUDS system it will not require additional irrigation to successfully establish and survive the in the long-term.

Similarly, the green roof area is large and thought needs to be given to how this will be treated. Although they are generally low maintenance, sedum roofs still need a water supply, and this region is incredibly dry. Therefore, the success of a green roof on this scale is questioned. Successfully establishing and maintaining green roofs in coastal locations is difficult, so this is not a quick 'green' fix, and the long-term management will be required. Has suitable consideration been given to seagull nesting issues associated with flat roofs in this area? Some preventative measures might not be as possible on a green roof.

The overall success of the public realm will be dependent on the selection of high quality material choices and detailing. The stair and ramp combination needs to be very carefully considered so as not to create a physical or visual barrier across the site. The removal of the Marina Centre's northern wing provides opportunities to create interesting views to and from the High Street and should be explored further. The use of raise planters should be avoided due to their high maintenance requirements. Where trees are proposed in areas of hardstanding, special tree pit design, e.g. GreenBlue urban crate systems, should be used to ensure adequate soil volumes for trees to survive. Species suited to harsh urban and coastal locations should be carefully selected. It would also be helpful to understand whether there will be a shared approach to signage/wayfinding for the different redevelopments across Lowestoft. If this is the case, then the development should also tie in some of these branded elements.

<u>Heritage</u>
Policy WLP8.37 requires development proposals to conserve or enhance heritage assets and their settings.

The site affects the setting of a number of designated and non-designated heritage assets. These are as follows:

- St Margaret's House, a Grade II Listed Building
- South Lowestoft and Kikley Conservation Area
- The Marina Theatre, a non-designated heritage asset
- The Players Theatre, a non-designated heritage asset

There would be little change to the elevation of the Battery Green Car Park building which faces towards St. Margaret's House and as such the proposals would conserve the setting of the Grade II Listed Building.

The demolition and public realm improvements to the south of the site would improve the setting of the Marina Theatre, creating a more open setting from which to appreciate the historic, principal façade of the non-designated heritage asset.

The site forms part of the backdrop in views of The Players Theatre when approaching from the south, in addition to part of the setting of the South Lowestoft and Kirkley Conservation Area. Further consideration is required as to the impact of the proposals on these views. This should be undertaken as part of a Heritage Impact Assessment to accompany any planning application. The site is prominent in views towards the Conservation Area from Battery Green Road, and the impact of the proposals on these views needs to be fully considered.

Residential Amenity

Policy WLP8.29 requires new developments to protect the amenity of the wider environment, neighbouring uses and provide a good standard of amenity for future occupiers of the proposed development.

The site is largely separated from sensitive receptors, with the exception of two properties adjacent to the western edge of the proposed civic square. Given the residential use of these properties, careful consideration needs to be given to providing defensible space between the public and private realm. This is to prevent users and activities from the civic square spilling over into the neighbouring properties.

At present the two properties have access to parking spaces to their frontages. The conceptual plans do not seem to provide for the retention or relocation of the spaces. Further detail on how this part of the site will function needs to be addressed within any planning application submission.

There is potential for a variety of flexible uses within the civic square space. To inform appropriate uses, and to assist in identifying any mitigation/restrictions on hours of operation for any noise generating uses, such as music events, a Noise Assessment should be submitted for consideration by the Environmental Protection team.

Flood Risk & Drainage

Policy WLP8.24 requires development proposals to consider flooding from all sources and take into account climate change. It goes on to explain that developments should use sustainable drainage systems to drain surface water. Sustainable drainage systems (SuDS) should be integrated into the landscaping scheme and the green infrastructure provision of the development and not detract from the design quality of the scheme. As a Local Authority project this should be leading the way in innovative green solutions for this.

The Lead Local Flood Authority have reviewed the submission and provided the below comments for review ahead of the submission of a planning application:

- Assumed from the lack of open attenuation that crate storage will be required to provide the necessary storage to allow a greenfield runoff rate to be achieved. Whilst this is acceptable at this location, we would like to see the opportunity explore for a blue roof that can attenuate at least some of the smaller storm events. Should the green/blue roof be removed during the development process we would then like to see some open attenuation provided.
- Assumed that upstream hydrobrakes of a reasonably small sub-100mm diameter will be required on this scheme. If so, we would like to see a 'sealed' system in which there are no traditional downpipes. For example, there is potential for larger pieces of debris to enter the system.
- The raingardens to the main southern parcel of the site do not seem to function as raingardens at present. They are surrounded by permeable paving and thus do not appear to be required. What could be provided as an alternative is a sunken area and an urban microbasin provided as a landscaping feature that receives flows from the roof or other areas.
- It would be beneficial to explore the use of above ground rills and dished channels and the link to minimise the network of underground pipes. It could provide a nice, continuous minor conveyance feature through the site. There are opportunities on sites like this one to incorporate some interesting urban type SuDS, alongside the green, which are 'harder' than green features but can be incorporated into more of the site.

Highways

All proposals should incorporate measures to promote active and sustainable modes of transport. The site is in a sustainable location where such design measures should include, but not be limited to:

- Secure covered cycle parking (guidance with regard to the proportionate quantity of spaces for the site can be found in the Suffolk Guidance for Parking Technical Guidance (2019)).
- Covered mobility scooter storage.
- Enhancement of pedestrian and cyclist routes across the site.
- Facilities for charging plug-in and other ultra-low emission vehicles.

In respect of all of these requirements, this Local Authority, public realm project should be an opportunity to lead the way on high quality sustainable transport installations. It is recommended that input from members in this respect is sought so this project can set the best example of what is needed for a less car reliant future. As noted above, the Suffolk Guidance for Parking is the starting point for determining the amount of car parking spaces that need to be provided. However, the guidance does permit the relaxation of parking standards in urban areas, including where there is good provision for public transport and high quality infrastructure for walking and cycling. In this instance, the site is located in a town centre location, within a town that the submission indicates has a surplus of parking available. Early engagement should be undertaken with the Highway Authority to confirm the parking requirements for the scheme.

On the basis that highway works are proposed as part of the development, including the realignment of Marina Street, pre-application engagement with the Highway Authority will be critical to the success of any planning application submitted.

The planning application would need to be supported by a Transport Assessment and a Parking Assessment.

Biodiversity

Policy WLP8.34 states that development will be supported where it can be demonstrated that it maintains, restores or enhances the existing green infrastructure network and positively contributes towards biodiversity through creation of new green infrastructure and improvement to linkages between habitats. The policy also requires the submission of ecological surveys, undertaken by a suitably qualified person, where there is reason to suspect the presence of protected species.

The planning application will need to be supported by a preliminary ecological appraisal, including any surveys identified as necessary within the appraisal. This is acknowledged within the submitted 'Site Analysis' document which indicates that there is potential for Black-legged Kittiwakes to be present within the site.

Biodiversity Net Gain calculations should also be submitted as part of the planning application to demonstrate how net gains are going to be provided for biodiversity in accordance with the NPPF.

Archaeology

As identified on the Suffolk Historic Environment Record, the site is located within an area of archaeological importance (medieval and early post medieval town core). As the site has a high potential for archaeology, any planning application must be supported by the results of a programme of archaeological evaluation, including appropriate fieldwork, and should demonstrate the impacts of development on archaeological remains and proposals for managing those impacts. Where proposals affect archaeological sites, preference will be given to preservation in situ appropriate to the significance of the remains unless it can be shown that recording of remains, assessment, analysis reporting, dissemination and deposition of archive for access and curation is more appropriate.

Archaeological conditions or planning obligations will be imposed on consents as appropriate, considering the level of significance. Measures to disseminate and promote information about archaeological assets to the public will be supported.

For further advice on these matters, the applicant is advised to engage with the Suffolk County Council Archaeological Service.

Contamination

Where there is reason to believe contamination could be an issue on a proposed development site, proportionate but sufficient site investigation information is required to determine the risks it may pose to users so that the risks can be satisfactorily reduced to an acceptable level. As a minimum, a Phase 1 assessment/study would be required, which consists of a desktop study, site walkover and initial risk assessment. The study must be carried out by a competent and suitably qualified person. Where the Phase 1 Assessment identifies a potential risk of contamination, a Phase 2 Assessment will be required, which involves more in-depth investigation than Phase 1, including on site investigation. The purpose is to determine if there are any unacceptable risks to

people and the environment. The Environmental search must be dated within 12 months of the date of the application and have a minimum search radius of 250 metres.

Sustainable Construction

Policy WLP8.28 requires the proposed development to demonstrate through the submission of a sustainability statement that, where practical, it has incorporated:

- Improved efficiency of heating, cooling, and lighting of buildings by maximising daylight and passive solar gain through the orientation and design of buildings.
- Sustainable water management measures, such as the use of sustainable urban drainage systems, green roofs and/or rainwater harvesting systems.
- Local sources and recycled materials.
- Renewable and low carbon energy generation into the design of new developments.
- Minimising construction water, including designing out water during the design stage, selecting sustainable and efficient building materials and reusing materials where possible.
- Accessible and unobtrusive sustainable waste management facilities such as adequate provision of refuse/recycling/composting bin storage.

All new office developments equal to or greater than 1,000sqm of gross floorspace are required to achieve the BREEAM 'Very Good' standard or equivalent, unless it can be demonstrated that it is not viable or feasible to do so.

Designing out Crime

Given this is public realm in a town centre where there is some existing anti-social behaviour and there is a chance of this area either improving or exacerbating that, the effect of proposals on public behaviour and crime risks in the area needs to be considered. There are often conflicts between 'Secured by Design' principals and good urban design principles, and at times compromise and balance needs to be struck. The final proposal should have reference to Secured by Design guidance Secured by Design - Design Guides. This is an expectation of both the NPPF and Local Plan. Engagement should take place with the Designing Out Crime Officer (DOCO) to inform the proposals, and they would also be a consultee within the planning application.

Andrew Gallant

Email andrew.gallant@suffolk.police.uk

Phone Number 07952737751

EIA

The proposed development falls under Schedule 2, Class 10 (b) of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 ("EIA Regulations") as it consists of an "urban development project" where the overall site area would be in excess of one hectare.

A screening opinion is therefore required to determine whether the scheme is considered Environmental Impact Assessment development. More information about the EIA process can be found here: Environmental Impact Assessment - GOV.UK (www.gov.uk)

Community Engagement

At the time of writing this response, a public engagement event on 4th October had been publicised. Informal feedback has already been given in respect of the short notice of such an event, the need for a suitable length of consultation and the expectation for regeneration and public realm works to be heavily informed by community input. Community engagement is a really essential component of any regeneration project, ensuring that it both uplifts the quality of the area and addresses the desires and needs to of the community who live, work in and visit that area. Its should be apparent in any submission how communities have helped to shape both the concept and detailed design of such a scheme. There should be reference to the adopted East Suffolk Planning Statement of Community Involvement and the guidance in that and you would need to submit your own Statement of Community Involvement as a part of your planning application, documenting your process and its outcomes. This is something that members of the new administration are very keen on and this was emphasised by the Cabinet Member for Planning in the recent Town/Parish and Developers Forums. Whilst it is not for the Local Planning Authority to dictate how you engage, you should not paragraph Para 132 of the NPPF which states "Applicants should work closely with those affected by their proposals to evolve designs that take account of the views of the community. Applications that can demonstrate early, proactive and effective engagement with the community should be looked on more favourably than those that cannot."

In appraising public opinion on this project ad preparing your application, you should also reflect on whether any changes to the area and circumstances (including a post-Covid world) have caused any need for variance from the 'Town Centre Masterplan'. Such a Vision document is not a fixed plan but something which guides direction and allows a flexible direction of development. Given other developments of a similar nature in the town, the concept and range of uses, and their long term viability in making such a change to the area, should be an evident consideration.

Conclusion

To conclude, the principle of the proposed development is firmly established through the allocation of the site under Policy WLP2.7. The site is also located within the development boundary of Lowestoft where the principle of new development is generally acceptable under Policy WLP1.2, subject to compliance with the remaining policies of the Local Plan.

The overall view of officers is that whilst the general design intent and vision for the site is sound, further consideration needs to be given to the mix and distribution of uses; the relationship between the buildings and their surroundings; elements of the detailed design of the buildings; and the way in which open spaces would be function.

As a major development project, a number of other thematic issues have been discussed which need to be considered/addressed as part of the submission of a planning application.

Validation

The East Suffolk Local Validation Requirements should referred to when preparing the planning application submission. For completeness, a list of validation requirements will be provided to follow this written response next week.

Planning policy

WLP1.1 - Scale and Location of Growth (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP1.2 - Settlement Boundaries (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP1.3 - Infrastructure (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP2.1 - Central and Coastal Lowestoft Regeneration (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP2.7 - Former Battery Green Car Park (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.21 - Sustainable Transport (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.24 - Flood Risk (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.18 - New Town Centre Use Developemnt (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.28 - Sustainable Construction (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.29 - Design (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.30 - Design of Open Spaces (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.31 - Lifetime Design (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.34 - Biodiversity and Geodiversity (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.37 - Historic Environment (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.39 - Conservation Areas (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

WLP8.40 - Archaeology (East Suffolk Council - Waveney Local Plan, Adopted March 2019)

Constraints

Article 4 (1) Direction - Name: Direction Under Article 4(1) Housing In Multiple Occupation
SCC Archaeological Sites - MONUID REF: MSF18346

SCC Archaeological Sites - MONUID REF: MSF18347
Community Infrastructure Levy SCDC WDC - CIL Charging Zone: Zone 2
DC Case Polygons - DC Reference: DC/81/1387/HIS
DC Case Polygons - DC Reference: DC/81/1385/HIS
DC Case Polygons - DC Reference: DC/82/1288/HIS
DC Case Polygons - DC Reference: DC/82/1290/HIS
DC Case Polygons - DC Reference: DC/19/4324/ADN
DC Case Polygons - DC Reference: DC/82/1289/HIS
DC Case Polygons - DC Reference: DC/80/1542/HIS
DC Case Polygons - DC Reference: DC/79/0680/FUL
DC Case Polygons - DC Reference: DC/09/0863/FUL
DC Case Polygons - DC Reference: DC/09/0672/ADI
DC Case Polygons - DC Reference: DC/09/0671/FUL
DC Case Polygons - DC Reference: DC/07/2013/FUL
DC Case Polygons - DC Reference: DC/97/0347/FUL
DC Case Polygons - DC Reference: DC/09/0727/DRC
DC Case Polygons - DC Reference: DC/05/0413/RG3
DC Case Polygons - DC Reference: DC/99/1086/FUL
DC Case Polygons - DC Reference: DC/09/0156/ADI
DC Case Polygons - DC Reference: DC/08/1383/FUL
DC Case Polygons - DC Reference: DC/21/2905/FUL
DC Case Polygons - DC Reference: DC/07/1296/COU
DC Case Polygons - DC Reference: DC/82/0532/FUL
DC Case Polygons - DC Reference: DC/18/0004/RG3
DC Case Polygons - DC Reference: DC/78/1098/HIS
DC Case Polygons - DC Reference: DC/23/2847/FUL
DC Case Polygons - DC Reference: DC/93/1026/ADI
DC Case Polygons - DC Reference: DC/91/0296/FUL
DC Case Polygons - DC Reference: DC/12/0717/COU
DC Case Polygons - DC Reference: DC/87/0423/FUL
DC Case Polygons - DC Reference: DC/15/4119/FUL
DC Case Polygons - DC Reference: DC/86/0485/FUL
DC Case Polygons - DC Reference: DC/88/0465/FUL
DC Case Polygons - DC Reference: DC/77/0671/FUL
DC Case Polygons - DC Reference: DC/89/0405/FUL
DC Case Polygons - DC Reference: DC/86/1483/ADN
DC Case Polygons - DC Reference: DC/14/3035/FUL
DC Case Polygons - DC Reference: DC/86/1482/ADI
DC Case Polygons - DC Reference: DC/08/1369/RG3
DC Case Polygons - DC Reference: DC/20/0271/FUL
DC Case Polygons - DC Reference: DC/20/0272/ADN
DC Case Polygons - DC Reference: DC/95/1054/ADI
DC Case Polygons - DC Reference: DC/82/1287/HIS
DC Case Polygons - DC Reference: DC/81/1386/HIS
DC Case Polygons - DC Reference: DC/80/1543/HIS
DC Case Polygons - DC Reference: DC/17/4201/DEM

DC Case Polygons - DC Reference: DC/80/1541/HIS
Planning Enforcement - Planning Enforcement Reference: ENF/2009/0233/DEV
Planning Enforcement - Planning Enforcement Reference: ENF/84/0014/COND
LB Listed Buildings - Listed Building Reference: LB1097
LB Listed Buildings - Listed Building Reference: LLB0446/2011
Waveney Local Plan (Adopted March 2019) - Name: Policy WLP2.7 - Former Battery Green Car Park
Waveney Local Plan (Adopted March 2019) - Name: Policy WLP8.18 - New Town Centre Use Development
Waveney Local Plan (Adopted March 2019) - Name: Policy WLP1.2 - Settlement Boundaries
Waveney Local Plan (Adopted March 2019) - Name: Policy WLP8.19 - Vitality And Viability Of Town Centres
Mineral Consultation Area - Mineral Consultation Area: 1
Recreational Disturbance Avoidance - Name: RAMS Zone B
Recreational Disturbance Avoidance - Name: RAMS - Zone Of Influence
Suffolk Water - Water Resource Zone - Name: Suffolk Water - Water Resource Zone

As with all pre-application advice, the Council is not bound with regard to its final decision on any future application. Please note – this pre-application advice is given on the basis of National and Local Planning Policies applicable on the date the advice is given.

Additional Planning and Building Control information can be found online at www.planningportal.gov.uk. If a planning application is needed online applications can be submitted at the same address.

Case Officer: Andrew Martin, Principal Planner (Major Sites)
Authorising Officer: Ben Woolnough, Planning Manager – Development Management, Major Sites and Infrastructure

Philip Ridley BSc (Hons) MRTPI | Head of Planning & Coastal Management
East Suffolk Council

Appendix H

Proposed Surface Water Drainage Layout and Microdrainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	10	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	80	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.700
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm at outfall (pipe 2.005)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.157	4-8	0.042

Total Area Contributing (ha) = 0.199

Total Pipe Volume (m³) = 2.835

Time Area Diagram at outfall (pipe 5.011)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.402	4-8	0.202

Total Area Contributing (ha) = 0.604

Total Pipe Volume (m³) = 15.206

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.000	10.031	0.084	120.0	0.009	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.000	80.00	5.18	5.341	0.009	0.0	0.0	0.0	0.92	16.2	2.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.001	9.476	0.079	120.0	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	21.677	0.181	120.0	0.021	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	13.668	0.114	120.0	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	12.717	0.106	120.0	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.002	16.065	0.134	120.0	0.010	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.003	12.830	0.148	86.7	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.003	11.490	1.070	10.7	0.017	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	19.190	0.128	150.0	0.038	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	20.650	0.138	150.0	0.027	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.002	5.521	0.107	51.6	0.022	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.004	5.397	0.036	150.0	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.005	1.716	0.025	68.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	22.305	0.272	82.1	0.040	5.00	0.0	0.600	o	225	Pipe/Conduit	
5.001	10.244	0.173	59.3	0.031	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.002	12.498	0.062	200.0	0.006	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.003	20.464	0.091	225.0	0.025	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.004	29.113	0.116	250.0	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.001	80.00	5.35	5.257	0.024	0.0	0.0	0.0	0.92	16.2	5.2
2.002	80.00	5.75	5.178	0.045	0.0	0.0	0.0	0.92	16.2	9.7
3.000	80.00	5.25	5.500	0.011	0.0	0.0	0.0	0.92	16.2	2.3
3.001	80.00	5.48	5.386	0.028	0.0	0.0	0.0	0.92	16.2	6.2
3.002	80.00	5.77	5.280	0.038	0.0	0.0	0.0	0.92	16.2	8.3
3.003	80.00	5.97	5.146	0.042	0.0	0.0	0.0	1.08	19.1	9.2
2.003	80.00	6.03	4.998	0.104	0.0	0.0	0.0	3.09	54.6	22.6
4.000	80.00	5.39	4.000	0.038	0.0	0.0	0.0	0.82	14.5	8.3
4.001	80.00	5.81	3.872	0.066	0.0	0.0	0.0	0.82	14.5	14.3
4.002	80.00	5.88	3.734	0.088	0.0	0.0	0.0	1.40	24.8	19.0
2.004	80.00	5.11	3.627	0.000	2.0	0.0	0.0	0.82	14.5	2.0
2.005	80.00	5.13	3.591	0.000	2.0	0.0	0.0	1.22	21.6	2.0
5.000	80.00	5.26	4.600	0.040	0.0	0.0	0.0	1.44	57.4	8.7
5.001	80.00	5.36	4.328	0.071	0.0	0.0	0.0	1.70	67.7	15.5
5.002	80.00	5.58	4.155	0.078	0.0	0.0	0.0	0.92	36.6	16.8
5.003	80.00	5.98	4.093	0.102	0.0	0.0	0.0	0.87	34.5	22.2
5.004	80.00	6.57	4.002	0.124	0.0	0.0	0.0	0.82	32.7	27.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.005	13.456	0.054	250.0	0.025	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.006	7.243	0.036	200.0	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.007	5.582	0.037	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.008	20.745	0.092	225.0	0.055	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	8.208	0.055	150.0	0.017	5.00	0.0	0.600	o	225	Pipe/Conduit	
6.001	12.686	0.085	149.2	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.009	19.834	0.088	225.0	0.019	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	2.830	0.047	60.0	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.000	24.057	0.401	60.0	0.059	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	12.175	0.203	60.0	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit	
8.002	17.158	0.286	60.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
8.003	16.194	0.657	24.6	0.022	0.00	0.0	0.600	o	150	Pipe/Conduit	
9.000	19.092	0.085	225.0	0.056	5.00	0.0	0.600	o	225	Pipe/Conduit	
9.001	20.956	0.093	225.0	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.002	12.057	0.071	169.6	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.003	11.251	0.210	53.6	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.004	10.419	0.070	148.8	0.010	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.005	80.00	6.84	3.886	0.149	0.0	0.0	0.0	0.82	32.7	32.3
5.006	80.00	6.95	3.757	0.189	0.0	0.0	0.0	1.11	78.3	40.9
5.007	80.00	7.02	3.721	0.189	0.0	0.0	0.0	1.28	90.6	40.9
5.008	80.00	7.35	3.683	0.244	0.0	0.0	0.0	1.04	73.8	52.9
6.000	80.00	5.13	3.806	0.017	0.0	0.0	0.0	1.07	42.4	3.6
6.001	80.00	5.33	3.751	0.029	0.0	0.0	0.0	1.07	42.5	6.4
5.009	80.00	7.67	3.591	0.292	0.0	0.0	0.0	1.04	73.8	63.3
7.000	80.00	5.04	3.750	0.011	0.0	0.0	0.0	1.30	23.0	2.4
8.000	80.00	5.31	5.200	0.059	0.0	0.0	0.0	1.30	23.0	12.8
8.001	80.00	5.46	4.799	0.075	0.0	0.0	0.0	1.30	23.0	16.2
8.002	80.00	5.68	4.596	0.075	0.0	0.0	0.0	1.30	23.0	16.2
8.003	80.00	5.82	4.310	0.097	0.0	0.0	0.0	2.04	36.0	21.0
9.000	80.00	5.37	4.400	0.056	0.0	0.0	0.0	0.87	34.5	12.2
9.001	80.00	5.77	4.315	0.085	0.0	0.0	0.0	0.87	34.5	18.4
9.002	80.00	5.97	4.222	0.100	0.0	0.0	0.0	1.00	39.8	21.7
9.003	80.00	6.07	4.151	0.121	0.0	0.0	0.0	1.79	71.2	26.2
9.004	80.00	6.24	3.941	0.131	0.0	0.0	0.0	1.07	42.5	28.5

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
10.000	9.722	0.065	150.0	0.008	5.00	0.0	0.600	o	225	Pipe/Conduit	
10.001	6.644	0.044	150.0	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.005	18.769	0.293	64.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.010	5.120	0.017	300.0	0.057	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.011	4.677	0.016	289.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
10.000	80.00	5.15	3.980	0.008	0.0	0.0	0.0	1.07	42.4	1.8
10.001	80.00	5.26	3.915	0.016	0.0	0.0	0.0	1.07	42.4	3.5
9.005	80.00	6.43	3.871	0.147	0.0	0.0	0.0	1.64	65.1	31.9
5.010	80.00	5.09	3.503	0.000	2.0	0.0	0.0	0.90	63.8	2.0
5.011	80.00	5.18	3.486	0.000	2.0	0.0	0.0	0.92	65.0	2.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	6.200	0.859	Open Manhole	1200	2.000	5.341	150				
2	6.200	0.943	Open Manhole	1200	2.001	5.257	150	2.000	5.257	150	
3	6.200	1.022	Open Manhole	1200	2.002	5.178	150	2.001	5.178	150	
4	6.300	0.800	Open Manhole	1200	3.000	5.500	150				
5	6.300	0.914	Open Manhole	1200	3.001	5.386	150	3.000	5.386	150	
6	6.300	1.020	Open Manhole	1200	3.002	5.280	150	3.001	5.280	150	
7	6.300	1.154	Open Manhole	1200	3.003	5.146	150	3.002	5.146	150	
8	6.200	1.202	Open Manhole	1200	2.003	4.998	150	2.002	4.998	150	
								3.003	4.998	150	
9	4.700	0.700	Open Manhole	1200	4.000	4.000	150				
10	4.700	0.828	Open Manhole	1200	4.001	3.872	150	4.000	3.872	150	
11	4.700	0.966	Open Manhole	1200	4.002	3.734	150	4.001	3.734	150	
12	5.250	1.623	Open Manhole	1200	2.004	3.627	150	2.003	3.928	150	300
								4.002	3.627	150	
13	5.172	1.580	Open Manhole	1200	2.005	3.591	150	2.004	3.591	150	
	5.182	1.616	Open Manhole	0		OUTFALL		2.005	3.566	150	
14	5.200	0.600	Open Manhole	1200	5.000	4.600	225				
15	5.200	0.872	Open Manhole	1200	5.001	4.328	225	5.000	4.328	225	
16	5.200	1.045	Open Manhole	1200	5.002	4.155	225	5.001	4.155	225	
17	6.300	2.207	Open Manhole	1200	5.003	4.093	225	5.002	4.093	225	
18	6.000	1.998	Open Manhole	1200	5.004	4.002	225	5.003	4.002	225	
19	6.000	2.114	Open Manhole	1200	5.005	3.886	225	5.004	3.886	225	
20	6.000	2.243	Open Manhole	1200	5.006	3.757	300	5.005	3.832	225	
21	5.677	1.956	Open Manhole	1200	5.007	3.721	300	5.006	3.721	300	
22	6.000	2.317	Open Manhole	1200	5.008	3.683	300	5.007	3.683	300	
23	4.943	1.137	Open Manhole	1200	6.000	3.806	225				
24	5.034	1.282	Open Manhole	1200	6.001	3.751	225	6.000	3.751	225	
25	5.169	1.578	Open Manhole	1200	5.009	3.591	300	5.008	3.591	300	
								6.001	3.666	225	
26	5.300	1.550	Open Manhole	1200	7.000	3.750	150				
27	6.000	0.800	Open Manhole	1200	8.000	5.200	150				
28	6.000	1.201	Open Manhole	1200	8.001	4.799	150	8.000	4.799	150	
29	6.000	1.404	Open Manhole	1200	8.002	4.596	150	8.001	4.596	150	
30	5.400	1.090	Open Manhole	1200	8.003	4.310	150	8.002	4.310	150	
31	5.200	0.800	Open Manhole	1200	9.000	4.400	225				
32	5.200	0.885	Open Manhole	1200	9.001	4.315	225	9.000	4.315	225	
33	5.149	0.927	Open Manhole	1200	9.002	4.222	225	9.001	4.222	225	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
34	5.200	1.049	Open Manhole	1200	9.003	4.151	225	9.002	4.151	225	
35	5.348	1.407	Open Manhole	1200	9.004	3.941	225	9.003	3.941	225	
36	5.157	1.177	Open Manhole	1200	10.000	3.980	225				
37	5.186	1.270	Open Manhole	1200	10.001	3.915	225	10.000	3.915	225	
38	5.172	1.302	Open Manhole	1200	9.005	3.871	225	9.004	3.871	225	
								10.001	3.871	225	
39	5.193	1.690	Open Manhole	1200	5.010	3.503	300	5.009	3.503	300	
								7.000	3.703	150	50
								8.003	3.653	150	
								9.005	3.578	225	
40	5.213	1.727	Open Manhole	1200	5.011	3.486	300	5.010	3.486	300	
	5.153	1.683	Open Manhole	0		OUTFALL		5.011	3.470	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	655093.021	293139.083	655093.021	293139.083	Required	
2	655099.278	293146.924	655099.278	293146.924	Required	
3	655105.091	293154.408	655105.091	293154.408	Required	
4	655082.066	293146.046	655082.066	293146.046	Required	
5	655090.678	293156.660	655090.678	293156.660	Required	
6	655098.389	293166.772	655098.389	293166.772	Required	
7	655108.481	293179.271	655108.481	293179.271	Required	
8	655118.589	293171.370	655118.589	293171.370	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
9	655101.075	293135.326	655101.075	293135.326	Required	
10	655112.910	293150.432	655112.910	293150.432	Required	
11	655125.570	293166.746	655125.570	293166.746	Required	
12	655130.002	293170.038	655130.002	293170.038	Required	
13	655135.296	293168.990	655135.296	293168.990	Required	
	655136.216	293170.438			No Entry	
14	655100.659	293119.500	655100.659	293119.500	Required	
15	655082.695	293132.721	655082.695	293132.721	Required	
16	655077.960	293141.805	655077.960	293141.805	Required	
17	655066.004	293145.444	655066.004	293145.444	Required	
18	655046.132	293140.558	655046.132	293140.558	Required	
19	655033.656	293114.254	655033.656	293114.254	Required	
20	655021.460	293119.940	655021.460	293119.940	Required	
21	655018.205	293113.470	655018.205	293113.470	Required	
22	655018.640	293107.904	655018.640	293107.904	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
23	654994.031	293087.273	654994.031	293087.273	Required	
24	654997.958	293094.481	654997.958	293094.481	Required	
25	655009.524	293089.270	655009.524	293089.270	Required	
26	655026.273	293083.056	655026.273	293083.056	Required	
27	655048.109	293136.848	655048.109	293136.848	Required	
28	655042.324	293113.497	655042.324	293113.497	Required	
29	655049.080	293103.369	655049.080	293103.369	Required	
30	655034.036	293095.119	655034.036	293095.119	Required	
31	655084.978	293094.515	655084.978	293094.515	Required	
32	655075.795	293077.776	655075.795	293077.776	Required	
33	655063.001	293061.178	655063.001	293061.178	Required	
34	655053.827	293053.355	655053.827	293053.355	Required	
35	655050.469	293064.093	655050.469	293064.093	Required	
36	655037.224	293058.136	655037.224	293058.136	Required	
37	655039.885	293067.486	655039.885	293067.486	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
38	655044.277	293072.472	655044.277	293072.472	Required	
39	655027.268	293080.407	655027.268	293080.407	Required	
40	655025.102	293075.768	655025.102	293075.768	Required	
	655029.363	293073.838			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.000	o	150	1	6.200	5.341	0.709	Open Manhole	1200
2.001	o	150	2	6.200	5.257	0.793	Open Manhole	1200
2.002	o	150	3	6.200	5.178	0.872	Open Manhole	1200
3.000	o	150	4	6.300	5.500	0.650	Open Manhole	1200
3.001	o	150	5	6.300	5.386	0.764	Open Manhole	1200
3.002	o	150	6	6.300	5.280	0.870	Open Manhole	1200
3.003	o	150	7	6.300	5.146	1.004	Open Manhole	1200
2.003	o	150	8	6.200	4.998	1.052	Open Manhole	1200
4.000	o	150	9	4.700	4.000	0.550	Open Manhole	1200
4.001	o	150	10	4.700	3.872	0.678	Open Manhole	1200
4.002	o	150	11	4.700	3.734	0.816	Open Manhole	1200
2.004	o	150	12	5.250	3.627	1.473	Open Manhole	1200
2.005	o	150	13	5.172	3.591	1.430	Open Manhole	1200
5.000	o	225	14	5.200	4.600	0.375	Open Manhole	1200
5.001	o	225	15	5.200	4.328	0.647	Open Manhole	1200
5.002	o	225	16	5.200	4.155	0.820	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.000	10.031	120.0	2	6.200	5.257	0.793	Open Manhole	1200
2.001	9.476	120.0	3	6.200	5.178	0.872	Open Manhole	1200
2.002	21.677	120.0	8	6.200	4.998	1.052	Open Manhole	1200
3.000	13.668	120.0	5	6.300	5.386	0.764	Open Manhole	1200
3.001	12.717	120.0	6	6.300	5.280	0.870	Open Manhole	1200
3.002	16.065	120.0	7	6.300	5.146	1.004	Open Manhole	1200
3.003	12.830	86.7	8	6.200	4.998	1.052	Open Manhole	1200
2.003	11.490	10.7	12	5.250	3.928	1.172	Open Manhole	1200
4.000	19.190	150.0	10	4.700	3.872	0.678	Open Manhole	1200
4.001	20.650	150.0	11	4.700	3.734	0.816	Open Manhole	1200
4.002	5.521	51.6	12	5.250	3.627	1.473	Open Manhole	1200
2.004	5.397	150.0	13	5.172	3.591	1.430	Open Manhole	1200
2.005	1.716	68.2		5.182	3.566	1.466	Open Manhole	0
5.000	22.305	82.1	15	5.200	4.328	0.647	Open Manhole	1200
5.001	10.244	59.3	16	5.200	4.155	0.820	Open Manhole	1200
5.002	12.498	200.0	17	6.300	4.093	1.982	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.003	o	225	17	6.300	4.093	1.982	Open Manhole	1200
5.004	o	225	18	6.000	4.002	1.773	Open Manhole	1200
5.005	o	225	19	6.000	3.886	1.889	Open Manhole	1200
5.006	o	300	20	6.000	3.757	1.943	Open Manhole	1200
5.007	o	300	21	5.677	3.721	1.656	Open Manhole	1200
5.008	o	300	22	6.000	3.683	2.017	Open Manhole	1200
6.000	o	225	23	4.943	3.806	0.912	Open Manhole	1200
6.001	o	225	24	5.034	3.751	1.057	Open Manhole	1200
5.009	o	300	25	5.169	3.591	1.278	Open Manhole	1200
7.000	o	150	26	5.300	3.750	1.400	Open Manhole	1200
8.000	o	150	27	6.000	5.200	0.650	Open Manhole	1200
8.001	o	150	28	6.000	4.799	1.051	Open Manhole	1200
8.002	o	150	29	6.000	4.596	1.254	Open Manhole	1200
8.003	o	150	30	5.400	4.310	0.940	Open Manhole	1200
9.000	o	225	31	5.200	4.400	0.575	Open Manhole	1200
9.001	o	225	32	5.200	4.315	0.660	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.003	20.464	225.0	18	6.000	4.002	1.773	Open Manhole	1200
5.004	29.113	250.0	19	6.000	3.886	1.889	Open Manhole	1200
5.005	13.456	250.0	20	6.000	3.832	1.943	Open Manhole	1200
5.006	7.243	200.0	21	5.677	3.721	1.656	Open Manhole	1200
5.007	5.582	150.0	22	6.000	3.683	2.017	Open Manhole	1200
5.008	20.745	225.0	25	5.169	3.591	1.278	Open Manhole	1200
6.000	8.208	150.0	24	5.034	3.751	1.057	Open Manhole	1200
6.001	12.686	149.2	25	5.169	3.666	1.278	Open Manhole	1200
5.009	19.834	225.0	39	5.193	3.503	1.390	Open Manhole	1200
7.000	2.830	60.0	39	5.193	3.703	1.340	Open Manhole	1200
8.000	24.057	60.0	28	6.000	4.799	1.051	Open Manhole	1200
8.001	12.175	60.0	29	6.000	4.596	1.254	Open Manhole	1200
8.002	17.158	60.0	30	5.400	4.310	0.940	Open Manhole	1200
8.003	16.194	24.6	39	5.193	3.653	1.390	Open Manhole	1200
9.000	19.092	225.0	32	5.200	4.315	0.660	Open Manhole	1200
9.001	20.956	225.0	33	5.149	4.222	0.702	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.002	o	225	33	5.149	4.222	0.702	Open Manhole	1200
9.003	o	225	34	5.200	4.151	0.824	Open Manhole	1200
9.004	o	225	35	5.348	3.941	1.182	Open Manhole	1200
10.000	o	225	36	5.157	3.980	0.952	Open Manhole	1200
10.001	o	225	37	5.186	3.915	1.045	Open Manhole	1200
9.005	o	225	38	5.172	3.871	1.077	Open Manhole	1200
5.010	o	300	39	5.193	3.503	1.390	Open Manhole	1200
5.011	o	300	40	5.213	3.486	1.427	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.002	12.057	169.6	34	5.200	4.151	0.824	Open Manhole	1200
9.003	11.251	53.6	35	5.348	3.941	1.182	Open Manhole	1200
9.004	10.419	148.8	38	5.172	3.871	1.077	Open Manhole	1200
10.000	9.722	150.0	37	5.186	3.915	1.045	Open Manhole	1200
10.001	6.644	150.0	38	5.172	3.871	1.077	Open Manhole	1200
9.005	18.769	64.1	39	5.193	3.578	1.390	Open Manhole	1200
5.010	5.120	300.0	40	5.213	3.486	1.427	Open Manhole	1200
5.011	4.677	289.3		5.153	3.470	1.383	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
2.000	User	-	100	0.009	0.009	0.009
2.001	User	-	100	0.015	0.015	0.015
2.002	User	-	100	0.021	0.021	0.021
3.000	User	-	100	0.011	0.011	0.011
3.001	User	-	100	0.018	0.018	0.018
3.002	User	-	100	0.010	0.010	0.010
3.003	User	-	100	0.004	0.004	0.004
2.003	User	-	100	0.017	0.017	0.017
4.000	User	-	100	0.038	0.038	0.038
4.001	User	-	100	0.027	0.027	0.027
4.002	User	-	100	0.022	0.022	0.022
2.004	User	-	100	0.007	0.007	0.007
2.005	-	-	100	0.000	0.000	0.000
5.000	User	-	100	0.040	0.040	0.040
5.001	User	-	100	0.031	0.031	0.031
5.002	User	-	100	0.006	0.006	0.006
5.003	User	-	100	0.025	0.025	0.025
5.004	User	-	100	0.022	0.022	0.022
5.005	User	-	100	0.025	0.025	0.025
5.006	User	-	100	0.040	0.040	0.040
5.007	-	-	100	0.000	0.000	0.000
5.008	User	-	100	0.055	0.055	0.055
6.000	User	-	100	0.017	0.017	0.017
6.001	User	-	100	0.013	0.013	0.013
5.009	User	-	100	0.019	0.019	0.019
7.000	User	-	100	0.011	0.011	0.011
8.000	User	-	100	0.059	0.059	0.059
8.001	User	-	100	0.015	0.015	0.015
8.002	-	-	100	0.000	0.000	0.000
8.003	User	-	100	0.022	0.022	0.022
9.000	User	-	100	0.056	0.056	0.056
9.001	User	-	100	0.029	0.029	0.029
9.002	User	-	100	0.015	0.015	0.015
9.003	User	-	100	0.021	0.021	0.021
9.004	User	-	100	0.010	0.010	0.010
10.000	User	-	100	0.008	0.008	0.008
10.001	User	-	100	0.008	0.008	0.008
9.005	-	-	100	0.000	0.000	0.000
5.010	User	-	100	0.039	0.039	0.039
	User	-	100	0.018	0.018	0.057
5.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.804	0.804	0.804

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
2.000	1	150	0.279	0.833	Unclassified	1200	0	0.709	Unclassified
2.001	2	150	0.793	0.904	Unclassified	1200	0	0.793	Unclassified
2.002	3	150	0.872	1.060	Unclassified	1200	0	0.872	Unclassified
3.000	4	150	0.650	0.764	Unclassified	1200	0	0.650	Unclassified
3.001	5	150	0.764	0.874	Unclassified	1200	0	0.764	Unclassified
3.002	6	150	0.870	1.004	Unclassified	1200	0	0.870	Unclassified
3.003	7	150	1.004	1.052	Unclassified	1200	0	1.004	Unclassified
2.003	8	150	0.043	1.172	Unclassified	1200	0	1.052	Unclassified
4.000	9	150	0.550	0.678	Unclassified	1200	0	0.550	Unclassified
4.001	10	150	0.678	0.816	Unclassified	1200	0	0.678	Unclassified
4.002	11	150	0.816	1.473	Unclassified	1200	0	0.816	Unclassified
2.004	12	150	1.430	1.473	Unclassified	1200	0	1.473	Unclassified
2.005	13	150	1.429	1.466	Unclassified	1200	0	1.430	Unclassified
5.000	14	225	0.141	0.720	Unclassified	1200	0	0.375	Unclassified
5.001	15	225	0.647	1.913	Unclassified	1200	0	0.647	Unclassified
5.002	16	225	0.820	2.247	Unclassified	1200	0	0.820	Unclassified
5.003	17	225	1.773	2.795	Unclassified	1200	0	1.982	Unclassified
5.004	18	225	1.773	2.325	Unclassified	1200	0	1.773	Unclassified
5.005	19	225	1.752	1.943	Unclassified	1200	0	1.889	Unclassified
5.006	20	300	1.656	1.943	Unclassified	1200	0	1.943	Unclassified
5.007	21	300	1.587	2.017	Unclassified	1200	0	1.656	Unclassified
5.008	22	300	1.278	2.017	Unclassified	1200	0	2.017	Unclassified
6.000	23	225	0.912	1.057	Unclassified	1200	0	0.912	Unclassified
6.001	24	225	1.057	1.278	Unclassified	1200	0	1.057	Unclassified
5.009	25	300	1.278	1.452	Unclassified	1200	0	1.278	Unclassified
7.000	26	150	1.323	1.400	Unclassified	1200	0	1.400	Unclassified
8.000	27	150	0.650	1.334	Unclassified	1200	0	0.650	Unclassified
8.001	28	150	1.051	1.305	Unclassified	1200	0	1.051	Unclassified
8.002	29	150	0.918	1.254	Unclassified	1200	0	1.254	Unclassified
8.003	30	150	0.940	1.390	Unclassified	1200	0	0.940	Unclassified
9.000	31	225	0.575	0.715	Unclassified	1200	0	0.575	Unclassified
9.001	32	225	0.660	0.817	Unclassified	1200	0	0.660	Unclassified
9.002	33	225	0.702	0.923	Unclassified	1200	0	0.702	Unclassified
9.003	34	225	0.824	1.182	Unclassified	1200	0	0.824	Unclassified
9.004	35	225	0.999	1.182	Unclassified	1200	0	1.182	Unclassified
10.000	36	225	0.952	1.045	Unclassified	1200	0	0.952	Unclassified
10.001	37	225	1.045	1.087	Unclassified	1200	0	1.045	Unclassified
9.005	38	225	1.077	1.390	Unclassified	1200	0	1.077	Unclassified
5.010	39	300	1.390	1.427	Unclassified	1200	0	1.390	Unclassified
5.011	40	300	1.383	1.427	Unclassified	1200	0	1.427	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
2.005		5.182	3.566	0.000	0	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
5.011		5.153	3.470	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	30
Number of Online Controls	3	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	10	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Storm

Orifice Manhole: 8, DS/PN: 2.003, Volume (m³): 1.9

Diameter (m) 0.046 Discharge Coefficient 0.600 Invert Level (m) 4.998

Hydro-Brake® Optimum Manhole: 12, DS/PN: 2.004, Volume (m³): 2.1

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	3.627
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.0
Flush-Flo™	0.247	1.3
Kick-Flo®	0.506	1.1
Mean Flow over Head Range	-	1.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	1.200	1.6	3.000	2.4	7.000	3.6
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.7
0.300	1.3	1.600	1.8	4.000	2.7	8.000	3.8
0.400	1.3	1.800	1.9	4.500	2.9	8.500	3.9
0.500	1.1	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.2	2.200	2.1	5.500	3.2	9.500	4.1
0.800	1.3	2.400	2.2	6.000	3.3		
1.000	1.5	2.600	2.3	6.500	3.4		

Hydro-Brake® Optimum Manhole: 39, DS/PN: 5.010, Volume (m³): 4.2

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57

Hydro-Brake® Optimum Manhole: 39, DS/PN: 5.010, Volume (m³): 4.2

Invert Level (m) 3.503
Minimum Outlet Pipe Diameter (mm) 75
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.0
Flush-Flo™	0.247	1.3
Kick-Flo®	0.506	1.1
Mean Flow over Head Range	-	1.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	1.200	1.6	3.000	2.4	7.000	3.6
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.7
0.300	1.3	1.600	1.8	4.000	2.7	8.000	3.8
0.400	1.3	1.800	1.9	4.500	2.9	8.500	3.9
0.500	1.1	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.2	2.200	2.1	5.500	3.2	9.500	4.1
0.800	1.3	2.400	2.2	6.000	3.3		
1.000	1.5	2.600	2.3	6.500	3.4		

Storage Structures for Storm

Filter Drain Manhole: 2, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	5.168	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	10.0		

Filter Drain Manhole: 3, DS/PN: 2.002

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	1.028	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	10.0		

Filter Drain Manhole: 4, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	5.350	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	5.0		

Filter Drain Manhole: 5, DS/PN: 3.001

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	5.236	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	5.0		

Filter Drain Manhole: 6, DS/PN: 3.002

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	5.130	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	5.0		

Cellular Storage Manhole: 8, DS/PN: 2.003

Invert Level (m) 4.998 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	75.0	75.0	0.401	0.0	91.0
0.400	75.0	91.0			

Porous Car Park Manhole: 9, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	15.0
Max Percolation (l/s)	208.3	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	3.950	Membrane Depth (mm)	150

Porous Car Park Manhole: 10, DS/PN: 4.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	15.0
Max Percolation (l/s)	208.3	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	3.950	Membrane Depth (mm)	150

Cellular Storage Manhole: 11, DS/PN: 4.002

Invert Level (m) 3.734 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	135.0	135.0	0.401	0.0	160.6
0.400	135.0	160.6			

Porous Car Park Manhole: 14, DS/PN: 5.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	5.0
Max Percolation (l/s)	34.7	Slope (1:X)	250.0
Safety Factor	15.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.450	Membrane Depth (mm)	150

Porous Car Park Manhole: 15, DS/PN: 5.001

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	34.7
Membrane Percolation (mm/hr)	5000	Safety Factor	1.5

Porous Car Park Manhole: 15, DS/PN: 5.001

Porosity	0.30	Slope (1:X)	250.0
Invert Level (m)	4.450	Depression Storage (mm)	5
Width (m)	5.0	Evaporation (mm/day)	3
Length (m)	5.0	Membrane Depth (mm)	150

Porous Car Park Manhole: 16, DS/PN: 5.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	7.5
Max Percolation (l/s)	52.1	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.450	Membrane Depth (mm)	150

Porous Car Park Manhole: 17, DS/PN: 5.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	69.4	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.550	Membrane Depth (mm)	150

Filter Drain Manhole: 18, DS/PN: 5.004

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	3.852	Cap Volume Depth (m)	0.000
Trench Width (m)	1.5	Cap Infiltration Depth (m)	0.000
Trench Length (m)	30.0		

Filter Drain Manhole: 19, DS/PN: 5.005

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	3.736	Cap Volume Depth (m)	0.000
Trench Width (m)	1.5	Cap Infiltration Depth (m)	0.000
Trench Length (m)	14.0		

Filter Drain Manhole: 20, DS/PN: 5.006

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	1.5
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	7.0
Safety Factor	1.5	Pipe Diameter (m)	0.225
Porosity	0.35	Pipe Depth above Invert (m)	0.100
Invert Level (m)	3.607	Number of Pipes	1

Filter Drain Manhole: 20, DS/PN: 5.006

Slope (1:X) 250.0 Cap Infiltration Depth (m) 0.000
Cap Volume Depth (m) 0.000

Porous Car Park Manhole: 23, DS/PN: 6.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.193	Membrane Depth (mm)	150

Porous Car Park Manhole: 24, DS/PN: 6.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	25.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.284	Membrane Depth (mm)	150

Porous Car Park Manhole: 25, DS/PN: 5.009

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	5000	Length (m)	15.0
Max Percolation (l/s)	312.5	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.419	Membrane Depth (mm)	150

Cellular Storage Manhole: 26, DS/PN: 7.000

Invert Level (m) 3.750 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	165.0	165.0	1.201	0.0	228.6
1.200	165.0	228.6			

Porous Car Park Manhole: 28, DS/PN: 8.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.250	Membrane Depth (mm)	150

Porous Car Park Manhole: 29, DS/PN: 8.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.250	Membrane Depth (mm)	150

Porous Car Park Manhole: 30, DS/PN: 8.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.650	Membrane Depth (mm)	150

Porous Car Park Manhole: 32, DS/PN: 9.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	7.5
Max Percolation (l/s)	52.1	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.550	Membrane Depth (mm)	150

Porous Car Park Manhole: 33, DS/PN: 9.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	7.5
Max Percolation (l/s)	52.1	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.399	Membrane Depth (mm)	150

Porous Car Park Manhole: 34, DS/PN: 9.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.450	Membrane Depth (mm)	150

Porous Car Park Manhole: 35, DS/PN: 9.004

Infiltration Coefficient Base (m/hr)	0.00000	Invert Level (m)	4.598
Membrane Percolation (mm/hr)	5000	Width (m)	5.0
Max Percolation (l/s)	52.1	Length (m)	7.5
Safety Factor	1.5	Slope (1:X)	250.0
Porosity	0.30	Depression Storage (mm)	5

Porous Car Park Manhole: 35, DS/PN: 9.004

Evaporation (mm/day) 3 Membrane Depth (mm) 150

Porous Car Park Manhole: 36, DS/PN: 10.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.407	Membrane Depth (mm)	150

Porous Car Park Manhole: 37, DS/PN: 10.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.5
Membrane Percolation (mm/hr)	5000	Length (m)	7.5
Max Percolation (l/s)	78.1	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.436	Membrane Depth (mm)	150

Porous Car Park Manhole: 39, DS/PN: 5.010

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	5000	Length (m)	15.0
Max Percolation (l/s)	312.5	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.443	Membrane Depth (mm)	150

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	30
Number of Online Controls	3	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 45, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
2.000	1	15 Winter	100	+45%					5.408
2.001	2	15 Winter	100	+45%					5.373
2.002	3	1440 Winter	100	+45%					3.952
3.000	4	15 Winter	100	+45%					5.564
3.001	5	15 Winter	100	+45%					5.504
3.002	6	30 Winter	100	+45%	100/30 Winter				5.430
3.003	7	30 Winter	100	+45%					5.284
2.003	8	120 Winter	100	+45%	30/30 Winter				5.270
4.000	9	720 Winter	100	+45%	100/240 Winter				4.294
4.001	10	720 Winter	100	+45%	30/120 Winter				4.294
4.002	11	720 Winter	100	+45%	30/30 Summer				4.293
2.004	12	720 Winter	100	+45%	1/180 Winter				4.293
2.005	13	15 Summer	100	+45%					3.626
5.000	14	60 Winter	100	+45%	100/15 Winter				4.997
5.001	15	60 Winter	100	+45%	30/15 Summer				4.986
5.002	16	60 Winter	100	+45%	30/15 Summer				4.974

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.000	1	-0.083	0.000	0.41			5.9	OK	
2.001	2	-0.034	0.000	0.93		12	13.4	OK	
2.002	3	-1.376	0.000	0.00			0.0	OK	
3.000	4	-0.086	0.000	0.38			5.6	OK	
3.001	5	-0.032	0.000	0.89			13.2	OK	
3.002	6	0.000	0.000	1.00		24	15.1	SURCHARGED	
3.003	7	-0.012	0.000	0.97			16.9	OK	
2.003	8	0.123	0.000	0.04		106	2.2	SURCHARGED	
4.000	9	0.144	0.000	0.15		291	2.0	SURCHARGED	
4.001	10	0.272	0.000	0.23		303	3.2	SURCHARGED	
4.002	11	0.409	0.000	0.06			1.3	SURCHARGED	
2.004	12	0.515	0.000	0.11			1.3	SURCHARGED	
2.005	13	-0.115	0.000	0.12			1.3	OK	
5.000	14	0.172	0.000	0.23		30	11.8	FLOOD RISK	
5.001	15	0.432	0.000	0.26		37	14.5	FLOOD RISK	
5.002	16	0.593	0.000	0.39		35	12.4	FLOOD RISK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
5.003	17	60 Winter	100	+45%	30/15 Summer				4.958
5.004	18	1440 Winter	100	+45%	30/15 Summer				4.941
5.005	19	1440 Winter	100	+45%	30/15 Summer				4.940
5.006	20	1440 Winter	100	+45%	1/60 Winter				4.939
5.007	21	1440 Winter	100	+45%	1/30 Winter				4.939
5.008	22	1440 Winter	100	+45%	1/15 Winter				4.938
6.000	23	1440 Winter	100	+45%	1/30 Winter				4.938
6.001	24	1440 Winter	100	+45%	1/15 Winter				4.938
5.009	25	1440 Winter	100	+45%	1/15 Summer				4.938
7.000	26	1440 Winter	100	+45%	1/30 Winter				4.937
8.000	27	15 Winter	100	+45%					5.287
8.001	28	15 Winter	100	+45%	100/15 Summer				5.128
8.002	29	15 Winter	100	+45%	30/15 Summer				5.009
8.003	30	1440 Winter	100	+45%	30/15 Summer				4.937
9.000	31	1440 Winter	100	+45%	30/15 Summer				4.940
9.001	32	1440 Winter	100	+45%	30/15 Summer				4.939
9.002	33	1440 Winter	100	+45%	30/15 Summer				4.939
9.003	34	1440 Winter	100	+45%	30/15 Summer				4.938
9.004	35	1440 Winter	100	+45%	30/15 Summer				4.938
10.000	36	1440 Winter	100	+45%	30/15 Summer				4.937
10.001	37	1440 Winter	100	+45%	30/15 Summer				4.937
9.005	38	1440 Winter	100	+45%	30/15 Summer				4.937
5.010	39	1440 Winter	100	+45%	1/15 Summer				4.937
5.011	40	1440 Winter	100	+45%					3.523

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.003	17	0.640	0.000	0.52			16.2	SURCHARGED	
5.004	18	0.714	0.000	0.08			2.4	SURCHARGED	
5.005	19	0.829	0.000	0.10			2.9	SURCHARGED	
5.006	20	0.882	0.000	0.07			3.9	SURCHARGED	
5.007	21	0.918	0.000	0.06			3.9	SURCHARGED	
5.008	22	0.955	0.000	0.08			5.5	SURCHARGED	
6.000	23	0.907	0.000	0.01			0.3	FLOOD RISK	
6.001	24	0.961	0.000	0.01		1459	0.4	FLOOD RISK	
5.009	25	1.046	0.000	0.06			3.6	FLOOD RISK	
7.000	26	1.037	0.000	0.04			0.5	SURCHARGED	
8.000	27	-0.063	0.000	0.63			13.7	OK	
8.001	28	0.179	0.000	0.78		3	16.4	SURCHARGED	
8.002	29	0.263	0.000	0.95		5	20.3	SURCHARGED	
8.003	30	0.477	0.000	0.05		836	1.6	SURCHARGED	
9.000	31	0.315	0.000	0.05			1.6	FLOOD RISK	
9.001	32	0.399	0.000	0.06		1343	1.9	FLOOD RISK	
9.002	33	0.492	0.000	0.06			2.0	FLOOD RISK	
9.003	34	0.563	0.000	0.04		1468	2.2	FLOOD RISK	
9.004	35	0.772	0.000	0.07		1228	2.4	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
10.000	36	0.732	0.000	0.00			0.1	FLOOD RISK	
10.001	37	0.797	0.000	0.01			0.3	FLOOD RISK	
9.005	38	0.842	0.000	0.04			2.6	FLOOD RISK	
5.010	39	1.134	0.000	0.04			1.7	FLOOD RISK	
5.011	40	-0.263	0.000	0.04			1.7	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	45
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	80	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.700
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm at outfall (pipe 2.005)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.161	4-8	0.039

Total Area Contributing (ha) = 0.199

Total Pipe Volume (m³) = 3.570

Time Area Diagram at outfall (pipe 5.011)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.411	4-8	0.193

Total Area Contributing (ha) = 0.604

Total Pipe Volume (m³) = 18.352

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.000	10.031	0.084	120.0	0.009	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	9.476	0.079	120.0	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	21.677	0.181	120.0	0.021	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	13.668	0.114	120.0	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	12.717	0.106	120.0	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.002	16.065	0.134	120.0	0.010	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.003	12.830	0.148	86.7	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.003	11.490	1.070	10.7	0.017	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	19.190	0.128	150.0	0.038	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	20.650	0.138	150.0	0.027	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.002	5.521	0.107	51.6	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.004	5.397	0.036	150.0	0.007	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.005	1.716	0.025	68.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.000	22.305	0.272	82.1	0.040	5.00	0.0	0.600	o	225	Pipe/Conduit	
5.001	10.244	0.173	59.3	0.031	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.002	12.498	0.062	200.0	0.006	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.003	20.464	0.091	225.0	0.025	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.000	80.00	5.18	5.341	0.009	0.0	0.0	0.9	0.92	16.2	2.9
2.001	80.00	5.35	5.257	0.024	0.0	0.0	2.4	0.92	16.2	7.6
2.002	80.00	5.75	5.178	0.045	0.0	0.0	4.4	0.92	16.2	14.1
3.000	80.00	5.25	5.500	0.011	0.0	0.0	1.0	0.92	16.2	3.4
3.001	80.00	5.48	5.386	0.028	0.0	0.0	2.8	0.92	16.2	8.9
3.002	80.00	5.77	5.280	0.038	0.0	0.0	3.7	0.92	16.2	12.0
3.003	80.00	5.97	5.146	0.042	0.0	0.0	4.1	1.08	19.1	13.3
2.003	80.00	6.03	4.998	0.104	0.0	0.0	10.2	3.09	54.6	32.8
4.000	80.00	5.39	4.000	0.038	0.0	0.0	3.7	0.82	14.5	12.1
4.001	80.00	5.71	3.797	0.066	0.0	0.0	6.4	1.07	42.4	20.7
4.002	80.00	5.76	3.659	0.088	0.0	0.0	8.6	1.83	72.6	27.6
2.004	80.00	5.08	3.552	0.000	2.0	0.0	0.6	1.07	42.4	2.0
2.005	80.00	5.10	3.516	0.000	2.0	0.0	0.9	1.59	63.1	2.9
5.000	80.00	5.26	4.600	0.040	0.0	0.0	3.9	1.44	57.4	12.6
5.001	80.00	5.36	4.328	0.071	0.0	0.0	7.0	1.70	67.7	22.4
5.002	80.00	5.58	4.155	0.078	0.0	0.0	7.6	0.92	36.6	24.4
5.003	80.00	5.98	4.093	0.102	0.0	0.0	10.0	0.87	34.5	32.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.004	29.113	0.116	250.0	0.022	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.005	13.456	0.054	250.0	0.025	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.006	7.243	0.036	200.0	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.007	5.582	0.037	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.008	20.745	0.092	225.0	0.055	0.00	0.0	0.600	o	375	Pipe/Conduit	
6.000	8.208	0.055	150.0	0.017	5.00	0.0	0.600	o	225	Pipe/Conduit	
6.001	12.686	0.085	149.2	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.009	19.834	0.088	225.0	0.019	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	2.830	0.047	60.0	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.000	24.057	0.401	60.0	0.059	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	12.175	0.203	60.0	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.002	17.158	0.286	60.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.003	16.194	0.657	24.6	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.000	19.092	0.085	225.0	0.056	5.00	0.0	0.600	o	225	Pipe/Conduit	
9.001	20.956	0.093	225.0	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.002	12.057	0.071	169.6	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.003	11.251	0.210	53.6	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.004	80.00	6.47	3.927	0.124	0.0	0.0	12.1	0.99	70.0	39.1
5.005	80.00	6.69	3.811	0.149	0.0	0.0	14.5	0.99	70.0	46.9
5.006	80.00	6.80	3.757	0.189	0.0	0.0	18.4	1.11	78.3	59.4
5.007	80.00	6.88	3.721	0.189	0.0	0.0	18.4	1.28	90.6	59.4
5.008	80.00	7.16	3.608	0.244	0.0	0.0	23.8	1.20	133.0	76.6
6.000	80.00	5.13	3.806	0.017	0.0	0.0	1.6	1.07	42.4	5.2
6.001	80.00	5.33	3.751	0.029	0.0	0.0	2.9	1.07	42.5	9.2
5.009	80.00	7.48	3.591	0.292	0.0	0.0	28.5	1.04	73.8«	91.8
7.000	80.00	5.04	3.750	0.011	0.0	0.0	1.1	1.30	23.0	3.4
8.000	80.00	5.31	5.200	0.059	0.0	0.0	5.8	1.30	23.0	18.6
8.001	80.00	5.43	4.724	0.075	0.0	0.0	7.3	1.69	67.3	23.4
8.002	80.00	5.60	4.521	0.075	0.0	0.0	7.3	1.69	67.3	23.4
8.003	80.00	5.70	4.235	0.097	0.0	0.0	9.4	2.65	105.2	30.4
9.000	80.00	5.37	4.400	0.056	0.0	0.0	5.5	0.87	34.5	17.6
9.001	80.00	5.77	4.315	0.085	0.0	0.0	8.3	0.87	34.5	26.7
9.002	80.00	5.97	4.222	0.100	0.0	0.0	9.7	1.00	39.8	31.4
9.003	80.00	6.07	4.151	0.121	0.0	0.0	11.8	1.79	71.2	38.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
9.004	10.419	0.070	148.8	0.010	0.00	0.0	0.600	o	225	Pipe/Conduit	
10.000	9.722	0.065	150.0	0.008	5.00	0.0	0.600	o	225	Pipe/Conduit	
10.001	6.644	0.044	150.0	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.005	18.769	0.293	64.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.010	5.120	0.017	300.0	0.057	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.011	4.677	0.016	289.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
9.004	80.00	6.24	3.941	0.131	0.0	0.0	12.8	1.07	42.5	41.3
10.000	80.00	5.15	3.980	0.008	0.0	0.0	0.8	1.07	42.4	2.6
10.001	80.00	5.26	3.915	0.016	0.0	0.0	1.6	1.07	42.4	5.0
9.005	80.00	6.43	3.871	0.147	0.0	0.0	14.4	1.64	65.1	46.3
5.010	80.00	5.09	3.503	0.000	2.0	0.0	0.6	0.90	63.8	2.0
5.011	80.00	5.18	3.486	0.000	2.0	0.0	0.9	0.92	65.0	2.9

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	6.200	0.859	Open Manhole	1200	2.000	5.341	150				
2	6.200	0.943	Open Manhole	1200	2.001	5.257	150	2.000	5.257	150	
3	6.200	1.022	Open Manhole	1200	2.002	5.178	150	2.001	5.178	150	
4	6.300	0.800	Open Manhole	1200	3.000	5.500	150				
5	6.300	0.914	Open Manhole	1200	3.001	5.386	150	3.000	5.386	150	
6	6.300	1.020	Open Manhole	1200	3.002	5.280	150	3.001	5.280	150	
7	6.300	1.154	Open Manhole	1200	3.003	5.146	150	3.002	5.146	150	
8	6.200	1.202	Open Manhole	1200	2.003	4.998	150	2.002	4.998	150	
								3.003	4.998	150	
9	4.700	0.700	Open Manhole	1200	4.000	4.000	150				
10	4.700	0.903	Open Manhole	1200	4.001	3.797	225	4.000	3.872	150	
11	4.700	1.041	Open Manhole	1200	4.002	3.659	225	4.001	3.659	225	
12	5.250	1.698	Open Manhole	1200	2.004	3.552	225	2.003	3.928	150	300
								4.002	3.552	225	
13	5.172	1.655	Open Manhole	1200	2.005	3.516	225	2.004	3.516	225	
	5.182	1.691	Open Manhole	0		OUTFALL		2.005	3.491	225	
14	5.200	0.600	Open Manhole	1200	5.000	4.600	225				
15	5.200	0.872	Open Manhole	1200	5.001	4.328	225	5.000	4.328	225	
16	5.200	1.045	Open Manhole	1200	5.002	4.155	225	5.001	4.155	225	
17	6.300	2.207	Open Manhole	1200	5.003	4.093	225	5.002	4.093	225	
18	6.000	2.073	Open Manhole	1200	5.004	3.927	300	5.003	4.002	225	
19	6.000	2.189	Open Manhole	1200	5.005	3.811	300	5.004	3.811	300	
20	6.000	2.243	Open Manhole	1200	5.006	3.757	300	5.005	3.757	300	
21	5.677	1.956	Open Manhole	1200	5.007	3.721	300	5.006	3.721	300	
22	6.000	2.392	Open Manhole	1350	5.008	3.608	375	5.007	3.683	300	
23	4.943	1.137	Open Manhole	1200	6.000	3.806	225				
24	5.034	1.282	Open Manhole	1200	6.001	3.751	225	6.000	3.751	225	
25	5.169	1.653	Open Manhole	1350	5.009	3.591	300	5.008	3.516	375	
								6.001	3.666	225	
26	5.300	1.550	Open Manhole	1200	7.000	3.750	150				
27	6.000	0.800	Open Manhole	1200	8.000	5.200	150				
28	6.000	1.276	Open Manhole	1200	8.001	4.724	225	8.000	4.799	150	
29	6.000	1.479	Open Manhole	1200	8.002	4.521	225	8.001	4.521	225	
30	5.400	1.165	Open Manhole	1200	8.003	4.235	225	8.002	4.235	225	
31	5.200	0.800	Open Manhole	1200	9.000	4.400	225				
32	5.200	0.885	Open Manhole	1200	9.001	4.315	225	9.000	4.315	225	
33	5.149	0.927	Open Manhole	1200	9.002	4.222	225	9.001	4.222	225	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
34	5.200	1.049	Open Manhole	1200	9.003	4.151	225	9.002	4.151	225	
35	5.348	1.407	Open Manhole	1200	9.004	3.941	225	9.003	3.941	225	
36	5.157	1.177	Open Manhole	1200	10.000	3.980	225				
37	5.186	1.270	Open Manhole	1200	10.001	3.915	225	10.000	3.915	225	
38	5.172	1.302	Open Manhole	1200	9.005	3.871	225	9.004	3.871	225	
								10.001	3.871	225	
39	5.193	1.690	Open Manhole	1200	5.010	3.503	300	5.009	3.503	300	
								7.000	3.703	150	50
								8.003	3.578	225	
								9.005	3.578	225	
40	5.213	1.727	Open Manhole	1200	5.011	3.486	300	5.010	3.486	300	
	5.153	1.683	Open Manhole	0		OUTFALL		5.011	3.470	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	655093.021	293139.083	655093.021	293139.083	Required	
2	655099.278	293146.924	655099.278	293146.924	Required	
3	655105.091	293154.408	655105.091	293154.408	Required	
4	655082.066	293146.046	655082.066	293146.046	Required	
5	655090.678	293156.660	655090.678	293156.660	Required	
6	655098.389	293166.772	655098.389	293166.772	Required	
7	655108.481	293179.271	655108.481	293179.271	Required	
8	655118.589	293171.370	655118.589	293171.370	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
9	655101.075	293135.326	655101.075	293135.326	Required	
10	655112.910	293150.432	655112.910	293150.432	Required	
11	655125.570	293166.746	655125.570	293166.746	Required	
12	655130.002	293170.038	655130.002	293170.038	Required	
13	655135.296	293168.990	655135.296	293168.990	Required	
	655136.216	293170.438			No Entry	
14	655100.659	293119.500	655100.659	293119.500	Required	
15	655082.695	293132.721	655082.695	293132.721	Required	
16	655077.960	293141.805	655077.960	293141.805	Required	
17	655066.004	293145.444	655066.004	293145.444	Required	
18	655046.132	293140.558	655046.132	293140.558	Required	
19	655033.656	293114.254	655033.656	293114.254	Required	
20	655021.460	293119.940	655021.460	293119.940	Required	
21	655018.205	293113.470	655018.205	293113.470	Required	
22	655018.640	293107.904	655018.640	293107.904	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
23	654994.031	293087.273	654994.031	293087.273	Required	
24	654997.958	293094.481	654997.958	293094.481	Required	
25	655009.524	293089.270	655009.524	293089.270	Required	
26	655026.273	293083.056	655026.273	293083.056	Required	
27	655048.109	293136.848	655048.109	293136.848	Required	
28	655042.324	293113.497	655042.324	293113.497	Required	
29	655049.080	293103.369	655049.080	293103.369	Required	
30	655034.036	293095.119	655034.036	293095.119	Required	
31	655084.978	293094.515	655084.978	293094.515	Required	
32	655075.795	293077.776	655075.795	293077.776	Required	
33	655063.001	293061.178	655063.001	293061.178	Required	
34	655053.827	293053.355	655053.827	293053.355	Required	
35	655050.469	293064.093	655050.469	293064.093	Required	
36	655037.224	293058.136	655037.224	293058.136	Required	
37	655039.885	293067.486	655039.885	293067.486	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
38	655044.277	293072.472	655044.277	293072.472	Required	
39	655027.268	293080.407	655027.268	293080.407	Required	
40	655025.102	293075.768	655025.102	293075.768	Required	
	655029.363	293073.838			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.000	o	150	1	6.200	5.341	0.709	Open Manhole	1200
2.001	o	150	2	6.200	5.257	0.793	Open Manhole	1200
2.002	o	150	3	6.200	5.178	0.872	Open Manhole	1200
3.000	o	150	4	6.300	5.500	0.650	Open Manhole	1200
3.001	o	150	5	6.300	5.386	0.764	Open Manhole	1200
3.002	o	150	6	6.300	5.280	0.870	Open Manhole	1200
3.003	o	150	7	6.300	5.146	1.004	Open Manhole	1200
2.003	o	150	8	6.200	4.998	1.052	Open Manhole	1200
4.000	o	150	9	4.700	4.000	0.550	Open Manhole	1200
4.001	o	225	10	4.700	3.797	0.678	Open Manhole	1200
4.002	o	225	11	4.700	3.659	0.816	Open Manhole	1200
2.004	o	225	12	5.250	3.552	1.473	Open Manhole	1200
2.005	o	225	13	5.172	3.516	1.430	Open Manhole	1200
5.000	o	225	14	5.200	4.600	0.375	Open Manhole	1200
5.001	o	225	15	5.200	4.328	0.647	Open Manhole	1200
5.002	o	225	16	5.200	4.155	0.820	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.000	10.031	120.0	2	6.200	5.257	0.793	Open Manhole	1200
2.001	9.476	120.0	3	6.200	5.178	0.872	Open Manhole	1200
2.002	21.677	120.0	8	6.200	4.998	1.052	Open Manhole	1200
3.000	13.668	120.0	5	6.300	5.386	0.764	Open Manhole	1200
3.001	12.717	120.0	6	6.300	5.280	0.870	Open Manhole	1200
3.002	16.065	120.0	7	6.300	5.146	1.004	Open Manhole	1200
3.003	12.830	86.7	8	6.200	4.998	1.052	Open Manhole	1200
2.003	11.490	10.7	12	5.250	3.928	1.172	Open Manhole	1200
4.000	19.190	150.0	10	4.700	3.872	0.678	Open Manhole	1200
4.001	20.650	150.0	11	4.700	3.659	0.816	Open Manhole	1200
4.002	5.521	51.6	12	5.250	3.552	1.473	Open Manhole	1200
2.004	5.397	150.0	13	5.172	3.516	1.430	Open Manhole	1200
2.005	1.716	68.2		5.182	3.491	1.466	Open Manhole	0
5.000	22.305	82.1	15	5.200	4.328	0.647	Open Manhole	1200
5.001	10.244	59.3	16	5.200	4.155	0.820	Open Manhole	1200
5.002	12.498	200.0	17	6.300	4.093	1.982	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.003	o	225	17	6.300	4.093	1.982	Open Manhole	1200
5.004	o	300	18	6.000	3.927	1.773	Open Manhole	1200
5.005	o	300	19	6.000	3.811	1.889	Open Manhole	1200
5.006	o	300	20	6.000	3.757	1.943	Open Manhole	1200
5.007	o	300	21	5.677	3.721	1.656	Open Manhole	1200
5.008	o	375	22	6.000	3.608	2.017	Open Manhole	1350
6.000	o	225	23	4.943	3.806	0.912	Open Manhole	1200
6.001	o	225	24	5.034	3.751	1.057	Open Manhole	1200
5.009	o	300	25	5.169	3.591	1.278	Open Manhole	1350
7.000	o	150	26	5.300	3.750	1.400	Open Manhole	1200
8.000	o	150	27	6.000	5.200	0.650	Open Manhole	1200
8.001	o	225	28	6.000	4.724	1.051	Open Manhole	1200
8.002	o	225	29	6.000	4.521	1.254	Open Manhole	1200
8.003	o	225	30	5.400	4.235	0.940	Open Manhole	1200
9.000	o	225	31	5.200	4.400	0.575	Open Manhole	1200
9.001	o	225	32	5.200	4.315	0.660	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.003	20.464	225.0	18	6.000	4.002	1.773	Open Manhole	1200
5.004	29.113	250.0	19	6.000	3.811	1.889	Open Manhole	1200
5.005	13.456	250.0	20	6.000	3.757	1.943	Open Manhole	1200
5.006	7.243	200.0	21	5.677	3.721	1.656	Open Manhole	1200
5.007	5.582	150.0	22	6.000	3.683	2.017	Open Manhole	1350
5.008	20.745	225.0	25	5.169	3.516	1.278	Open Manhole	1350
6.000	8.208	150.0	24	5.034	3.751	1.057	Open Manhole	1200
6.001	12.686	149.2	25	5.169	3.666	1.278	Open Manhole	1350
5.009	19.834	225.0	39	5.193	3.503	1.390	Open Manhole	1200
7.000	2.830	60.0	39	5.193	3.703	1.340	Open Manhole	1200
8.000	24.057	60.0	28	6.000	4.799	1.051	Open Manhole	1200
8.001	12.175	60.0	29	6.000	4.521	1.254	Open Manhole	1200
8.002	17.158	60.0	30	5.400	4.235	0.940	Open Manhole	1200
8.003	16.194	24.6	39	5.193	3.578	1.390	Open Manhole	1200
9.000	19.092	225.0	32	5.200	4.315	0.660	Open Manhole	1200
9.001	20.956	225.0	33	5.149	4.222	0.702	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.002	o	225	33	5.149	4.222	0.702	Open Manhole	1200
9.003	o	225	34	5.200	4.151	0.824	Open Manhole	1200
9.004	o	225	35	5.348	3.941	1.182	Open Manhole	1200
10.000	o	225	36	5.157	3.980	0.952	Open Manhole	1200
10.001	o	225	37	5.186	3.915	1.045	Open Manhole	1200
9.005	o	225	38	5.172	3.871	1.077	Open Manhole	1200
5.010	o	300	39	5.193	3.503	1.390	Open Manhole	1200
5.011	o	300	40	5.213	3.486	1.427	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.002	12.057	169.6	34	5.200	4.151	0.824	Open Manhole	1200
9.003	11.251	53.6	35	5.348	3.941	1.182	Open Manhole	1200
9.004	10.419	148.8	38	5.172	3.871	1.077	Open Manhole	1200
10.000	9.722	150.0	37	5.186	3.915	1.045	Open Manhole	1200
10.001	6.644	150.0	38	5.172	3.871	1.077	Open Manhole	1200
9.005	18.769	64.1	39	5.193	3.578	1.390	Open Manhole	1200
5.010	5.120	300.0	40	5.213	3.486	1.427	Open Manhole	1200
5.011	4.677	289.3		5.153	3.470	1.383	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
2.000	User	-	100	0.009	0.009	0.009
2.001	User	-	100	0.015	0.015	0.015
2.002	User	-	100	0.021	0.021	0.021
3.000	User	-	100	0.011	0.011	0.011
3.001	User	-	100	0.018	0.018	0.018
3.002	User	-	100	0.010	0.010	0.010
3.003	User	-	100	0.004	0.004	0.004
2.003	User	-	100	0.017	0.017	0.017
4.000	User	-	100	0.038	0.038	0.038
4.001	User	-	100	0.027	0.027	0.027
4.002	User	-	100	0.022	0.022	0.022
2.004	User	-	100	0.007	0.007	0.007
2.005	-	-	100	0.000	0.000	0.000
5.000	User	-	100	0.040	0.040	0.040
5.001	User	-	100	0.031	0.031	0.031
5.002	User	-	100	0.006	0.006	0.006
5.003	User	-	100	0.025	0.025	0.025
5.004	User	-	100	0.022	0.022	0.022
5.005	User	-	100	0.025	0.025	0.025
5.006	User	-	100	0.040	0.040	0.040
5.007	-	-	100	0.000	0.000	0.000
5.008	User	-	100	0.055	0.055	0.055
6.000	User	-	100	0.017	0.017	0.017
6.001	User	-	100	0.013	0.013	0.013
5.009	User	-	100	0.019	0.019	0.019
7.000	User	-	100	0.011	0.011	0.011
8.000	User	-	100	0.059	0.059	0.059
8.001	User	-	100	0.015	0.015	0.015
8.002	-	-	100	0.000	0.000	0.000
8.003	User	-	100	0.022	0.022	0.022
9.000	User	-	100	0.056	0.056	0.056
9.001	User	-	100	0.029	0.029	0.029
9.002	User	-	100	0.015	0.015	0.015
9.003	User	-	100	0.021	0.021	0.021
9.004	User	-	100	0.010	0.010	0.010
10.000	User	-	100	0.008	0.008	0.008
10.001	User	-	100	0.008	0.008	0.008
9.005	-	-	100	0.000	0.000	0.000
5.010	User	-	100	0.039	0.039	0.039
	User	-	100	0.018	0.018	0.057
5.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.804	0.804	0.804

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
2.000	1	150	0.279	0.833	Unclassified	1200	0	0.709	Unclassified
2.001	2	150	0.793	0.904	Unclassified	1200	0	0.793	Unclassified
2.002	3	150	0.872	1.060	Unclassified	1200	0	0.872	Unclassified
3.000	4	150	0.650	0.764	Unclassified	1200	0	0.650	Unclassified
3.001	5	150	0.764	0.874	Unclassified	1200	0	0.764	Unclassified
3.002	6	150	0.870	1.004	Unclassified	1200	0	0.870	Unclassified
3.003	7	150	1.004	1.052	Unclassified	1200	0	1.004	Unclassified
2.003	8	150	0.043	1.172	Unclassified	1200	0	1.052	Unclassified
4.000	9	150	0.550	0.678	Unclassified	1200	0	0.550	Unclassified
4.001	10	225	0.678	0.816	Unclassified	1200	0	0.678	Unclassified
4.002	11	225	0.816	1.473	Unclassified	1200	0	0.816	Unclassified
2.004	12	225	1.430	1.473	Unclassified	1200	0	1.473	Unclassified
2.005	13	225	1.429	1.466	Unclassified	1200	0	1.430	Unclassified
5.000	14	225	0.141	0.720	Unclassified	1200	0	0.375	Unclassified
5.001	15	225	0.647	1.913	Unclassified	1200	0	0.647	Unclassified
5.002	16	225	0.820	2.247	Unclassified	1200	0	0.820	Unclassified
5.003	17	225	1.773	2.795	Unclassified	1200	0	1.982	Unclassified
5.004	18	300	1.773	2.325	Unclassified	1200	0	1.773	Unclassified
5.005	19	300	1.752	1.943	Unclassified	1200	0	1.889	Unclassified
5.006	20	300	1.656	1.943	Unclassified	1200	0	1.943	Unclassified
5.007	21	300	1.587	2.017	Unclassified	1200	0	1.656	Unclassified
5.008	22	375	1.278	2.017	Unclassified	1350	0	2.017	Unclassified
6.000	23	225	0.912	1.057	Unclassified	1200	0	0.912	Unclassified
6.001	24	225	1.057	1.278	Unclassified	1200	0	1.057	Unclassified
5.009	25	300	1.278	1.452	Unclassified	1350	0	1.278	Unclassified
7.000	26	150	1.323	1.400	Unclassified	1200	0	1.400	Unclassified
8.000	27	150	0.650	1.334	Unclassified	1200	0	0.650	Unclassified
8.001	28	225	1.051	1.305	Unclassified	1200	0	1.051	Unclassified
8.002	29	225	0.918	1.254	Unclassified	1200	0	1.254	Unclassified
8.003	30	225	0.940	1.390	Unclassified	1200	0	0.940	Unclassified
9.000	31	225	0.575	0.715	Unclassified	1200	0	0.575	Unclassified
9.001	32	225	0.660	0.817	Unclassified	1200	0	0.660	Unclassified
9.002	33	225	0.702	0.923	Unclassified	1200	0	0.702	Unclassified
9.003	34	225	0.824	1.182	Unclassified	1200	0	0.824	Unclassified
9.004	35	225	0.999	1.182	Unclassified	1200	0	1.182	Unclassified
10.000	36	225	0.952	1.045	Unclassified	1200	0	0.952	Unclassified
10.001	37	225	1.045	1.087	Unclassified	1200	0	1.045	Unclassified
9.005	38	225	1.077	1.390	Unclassified	1200	0	1.077	Unclassified
5.010	39	300	1.390	1.427	Unclassified	1200	0	1.390	Unclassified
5.011	40	300	1.383	1.427	Unclassified	1200	0	1.427	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
2.005		5.182	3.491	0.000	0	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
5.011		5.153	3.470	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	4320
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	5

Number of Input Hydrographs	0	Number of Storage Structures	30
Number of Online Controls	3	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Rainfall Profile Details

Event Name	1 in 100 plus 1 in 10	Timestep (mins)	1
Duration (mins)	4320	Profiles	1

Online Controls for Storm

Orifice Manhole: 8, DS/PN: 2.003, Volume (m³): 1.9

Diameter (m) 0.046 Discharge Coefficient 0.600 Invert Level (m) 4.998

Hydro-Brake® Optimum Manhole: 12, DS/PN: 2.004, Volume (m³): 2.3

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	3.552
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.0
Flush-Flo™	0.247	1.3
Kick-Flo®	0.506	1.1
Mean Flow over Head Range	-	1.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	1.200	1.6	3.000	2.4	7.000	3.6
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.7
0.300	1.3	1.600	1.8	4.000	2.7	8.000	3.8
0.400	1.3	1.800	1.9	4.500	2.9	8.500	3.9
0.500	1.1	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.2	2.200	2.1	5.500	3.2	9.500	4.1
0.800	1.3	2.400	2.2	6.000	3.3		
1.000	1.5	2.600	2.3	6.500	3.4		

Hydro-Brake® Optimum Manhole: 39, DS/PN: 5.010, Volume (m³): 4.5

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57

Hydro-Brake® Optimum Manhole: 39, DS/PN: 5.010, Volume (m³): 4.5

Invert Level (m) 3.503
Minimum Outlet Pipe Diameter (mm) 75
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.0
Flush-Flo™	0.247	1.3
Kick-Flo®	0.506	1.1
Mean Flow over Head Range	-	1.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	1.200	1.6	3.000	2.4	7.000	3.6
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.7
0.300	1.3	1.600	1.8	4.000	2.7	8.000	3.8
0.400	1.3	1.800	1.9	4.500	2.9	8.500	3.9
0.500	1.1	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.2	2.200	2.1	5.500	3.2	9.500	4.1
0.800	1.3	2.400	2.2	6.000	3.3		
1.000	1.5	2.600	2.3	6.500	3.4		

Storage Structures for Storm

Filter Drain Manhole: 2, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	5.168	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	10.0		

Filter Drain Manhole: 3, DS/PN: 2.002

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	1.028	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	10.0		

Filter Drain Manhole: 4, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	5.350	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	5.0		

Filter Drain Manhole: 5, DS/PN: 3.001

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	5.236	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	5.0		

Filter Drain Manhole: 6, DS/PN: 3.002

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	5.130	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	5.0		

Cellular Storage Manhole: 8, DS/PN: 2.003

Invert Level (m) 4.998 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	75.0	75.0	0.401	0.0	91.0
0.400	75.0	91.0			

Porous Car Park Manhole: 9, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	15.0
Max Percolation (l/s)	208.3	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	3.950	Membrane Depth (mm)	150

Porous Car Park Manhole: 10, DS/PN: 4.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	15.0
Max Percolation (l/s)	208.3	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	3.950	Membrane Depth (mm)	150

Cellular Storage Manhole: 11, DS/PN: 4.002

Invert Level (m) 3.734 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	135.0	135.0	0.401	0.0	160.6
0.400	135.0	160.6			

Porous Car Park Manhole: 14, DS/PN: 5.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	5.0
Max Percolation (l/s)	34.7	Slope (1:X)	250.0
Safety Factor	15.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.450	Membrane Depth (mm)	150

Porous Car Park Manhole: 15, DS/PN: 5.001

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	34.7
Membrane Percolation (mm/hr)	5000	Safety Factor	1.5

Porous Car Park Manhole: 15, DS/PN: 5.001

Porosity	0.30	Slope (1:X)	250.0
Invert Level (m)	4.450	Depression Storage (mm)	5
Width (m)	5.0	Evaporation (mm/day)	3
Length (m)	5.0	Membrane Depth (mm)	150

Porous Car Park Manhole: 16, DS/PN: 5.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	7.5
Max Percolation (l/s)	52.1	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.450	Membrane Depth (mm)	150

Porous Car Park Manhole: 17, DS/PN: 5.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	69.4	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.550	Membrane Depth (mm)	150

Filter Drain Manhole: 18, DS/PN: 5.004

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	3.852	Cap Volume Depth (m)	0.000
Trench Width (m)	1.5	Cap Infiltration Depth (m)	0.000
Trench Length (m)	30.0		

Filter Drain Manhole: 19, DS/PN: 5.005

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	1.5	Number of Pipes	1
Porosity	0.35	Slope (1:X)	250.0
Invert Level (m)	3.736	Cap Volume Depth (m)	0.000
Trench Width (m)	1.5	Cap Infiltration Depth (m)	0.000
Trench Length (m)	14.0		

Filter Drain Manhole: 20, DS/PN: 5.006

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	1.5
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	7.0
Safety Factor	1.5	Pipe Diameter (m)	0.225
Porosity	0.35	Pipe Depth above Invert (m)	0.100
Invert Level (m)	3.607	Number of Pipes	1

Filter Drain Manhole: 20, DS/PN: 5.006

Slope (1:X) 250.0 Cap Infiltration Depth (m) 0.000
Cap Volume Depth (m) 0.000

Porous Car Park Manhole: 23, DS/PN: 6.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.193	Membrane Depth (mm)	150

Porous Car Park Manhole: 24, DS/PN: 6.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	25.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.284	Membrane Depth (mm)	150

Porous Car Park Manhole: 25, DS/PN: 5.009

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	5000	Length (m)	15.0
Max Percolation (l/s)	312.5	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.419	Membrane Depth (mm)	150

Cellular Storage Manhole: 26, DS/PN: 7.000

Invert Level (m) 3.750 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	165.0	165.0	1.201	0.0	228.6
1.200	165.0	228.6			

Porous Car Park Manhole: 28, DS/PN: 8.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.250	Membrane Depth (mm)	150

Porous Car Park Manhole: 29, DS/PN: 8.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.250	Membrane Depth (mm)	150

Porous Car Park Manhole: 30, DS/PN: 8.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.650	Membrane Depth (mm)	150

Porous Car Park Manhole: 32, DS/PN: 9.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	7.5
Max Percolation (l/s)	52.1	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.550	Membrane Depth (mm)	150

Porous Car Park Manhole: 33, DS/PN: 9.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	5000	Length (m)	7.5
Max Percolation (l/s)	52.1	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.399	Membrane Depth (mm)	150

Porous Car Park Manhole: 34, DS/PN: 9.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.450	Membrane Depth (mm)	150

Porous Car Park Manhole: 35, DS/PN: 9.004

Infiltration Coefficient Base (m/hr)	0.00000	Invert Level (m)	4.598
Membrane Percolation (mm/hr)	5000	Width (m)	5.0
Max Percolation (l/s)	52.1	Length (m)	7.5
Safety Factor	1.5	Slope (1:X)	250.0
Porosity	0.30	Depression Storage (mm)	5

Porous Car Park Manhole: 35, DS/PN: 9.004

Evaporation (mm/day) 3 Membrane Depth (mm) 150

Porous Car Park Manhole: 36, DS/PN: 10.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	5000	Length (m)	10.0
Max Percolation (l/s)	138.9	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.407	Membrane Depth (mm)	150

Porous Car Park Manhole: 37, DS/PN: 10.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.5
Membrane Percolation (mm/hr)	5000	Length (m)	7.5
Max Percolation (l/s)	78.1	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.436	Membrane Depth (mm)	150

Porous Car Park Manhole: 39, DS/PN: 5.010

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	5000	Length (m)	15.0
Max Percolation (l/s)	312.5	Slope (1:X)	250.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.443	Membrane Depth (mm)	150

Summary of Results for Measured Rainfall - 1 in 100 plus 1 in 10 (Storm)

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep 2.5 Second Increment (Extended)	
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

WARNING: Half Drain Time has not been calculated as the structure is too full.

Warning: The analysis runtime is less than twice the storm duration.

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
2.000	1	5.350	-0.141	0.000	0.01			0.2	OK
2.001	2	5.275	-0.132	0.000	0.03			0.5	OK
2.002	3	4.330	-0.999	0.000	0.00			0.0	OK
3.000	4	5.510	-0.140	0.000	0.01			0.2	OK
3.001	5	5.405	-0.131	0.000	0.04			0.6	OK
3.002	6	5.302	-0.128	0.000	0.05			0.8	OK
3.003	7	5.168	-0.129	0.000	0.05			0.9	OK
2.003	8	5.080	-0.068	0.000	0.02		3070	1.1	OK
4.000	9	4.023	-0.127	0.000	0.06			0.8	OK
4.001	10	3.963	-0.059	0.000	0.03		225	1.3	OK
4.002	11	3.962	0.078	0.000	0.03		430	1.3	SURCHARGED
2.004	12	3.963	0.186	0.000	0.04			1.3	SURCHARGED
2.005	13	3.547	-0.195	0.000	0.04			1.3	OK
5.000	14	4.648	-0.177	0.000	0.02			0.8	OK
5.001	15	4.648	0.095	0.000	0.03			1.4	SURCHARGED
5.002	16	4.648	0.267	0.000	0.05			1.4	SURCHARGED
5.003	17	4.647	0.329	0.000	0.06			1.9	SURCHARGED
5.004	18	4.647	0.420	0.000	0.03			1.7	SURCHARGED
5.005	19	4.647	0.536	0.000	0.03			2.0	SURCHARGED
5.006	20	4.646	0.590	0.000	0.05			2.6	SURCHARGED
5.007	21	4.646	0.625	0.000	0.04			2.6	SURCHARGED
5.008	22	4.646	0.662	0.000	0.03			3.6	SURCHARGED
6.000	23	4.645	0.614	0.000	0.01			0.2	FLOOD RISK
6.001	24	4.645	0.669	0.000	0.01			0.4	SURCHARGED
5.009	25	4.645	0.754	0.000	0.05			3.3	SURCHARGED
7.000	26	4.645	0.745	0.000	0.06			0.8	SURCHARGED
8.000	27	5.213	-0.137	0.000	0.02			0.4	OK
8.001	28	4.735	-0.214	0.000	0.01		145	0.6	OK
8.002	29	4.645	-0.101	0.000	0.01			0.7	OK
8.003	30	4.645	0.185	0.000	0.01			1.1	SURCHARGED
9.000	31	4.647	0.022	0.000	0.04			1.1	SURCHARGED
9.001	32	4.647	0.107	0.000	0.05			1.4	SURCHARGED
9.002	33	4.647	0.200	0.000	0.05			1.6	SURCHARGED
9.003	34	4.646	0.270	0.000	0.03			1.9	SURCHARGED
9.004	35	4.646	0.480	0.000	0.06			2.0	SURCHARGED
10.000	36	4.645	0.440	0.000	0.00			0.1	SURCHARGED
10.001	37	4.645	0.505	0.000	0.01			0.2	SURCHARGED
9.005	38	4.645	0.549	0.000	0.04			2.2	SURCHARGED

Summary of Results for Measured Rainfall - 1 in 100 plus 1 in 10 (Storm)

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
5.010	39	4.645	0.842	0.000	0.03			1.5	SURCHARGED
5.011	40	3.521	-0.265	0.000	0.03			1.5	OK

ATTENUATION TANK 1
CL: 6.200m
IL: 4.998m
LENGTH: 15m (15 UNITS)
WIDTH: 5m (10 UNITS)
DEPTH: 0.4m (1 UNIT)
TOTAL UNITS: 150 UNITS
STORAGE VOLUME: 28.5m³

SIDES AND BASE OF ATTENUATION TANK AND ALL CONNECTIONS WRAPPED IN IMPERMEABLE MEMBRANE, POLYPROPYLENE 1mm GAUGE WITH WELDED JOINTS:VISQUEEN HEAVY DUTY UDG (OSA). SEALED TANK TO BE TESTED FOR WATER TIGHTNESS AFTER CONSTRUCTIONS

S8 - FLOW CONTROL CHAMBER
CL: 6.200m
IL: 4.998m
COVER: B125
OUTFLOW RESTRICTED TO 10.0l/s USING 46mm STAINLESS STEEL ORIFICE PLATE.

S13
MANHOLE TO BE CONSTRUCTED ONLINE OF ANGLIAN WATER SEWER

S12 - FLOW CONTROL CHAMBER
CL: 5.250m
IL: 3.627m
COVER: B125

OUTFLOW RESTRICTED TO 2.0l/s USING HYRDO INTERNATIONAL HYDRO-BRAKE OPTIMUM REF MD-SHE-0057-2000-2000-2000. INSTALLED IN LINE WITH MANUFACTURERS GUIDANCE

ATTENUATION TANK 2
CL: 4.700m
IL: 3.734m
LENGTH: 27m (54 UNITS)
WIDTH: 5m (10 UNITS)
DEPTH: 0.4m (1 UNIT)
TOTAL UNITS: 540 UNITS
STORAGE VOLUME: 51.3m³

SIDES AND BASE OF ATTENUATION TANK AND ALL CONNECTIONS WRAPPED IN IMPERMEABLE MEMBRANE, POLYPROPYLENE 1mm GAUGE WITH WELDED JOINTS:VISQUEEN HEAVY DUTY UDG (OSA). SEALED TANK TO BE TESTED FOR WATER TIGHTNESS AFTER CONSTRUCTIONS

F15
MANHOLE TO BE CONSTRUCTED ONLINE OF ANGLIAN WATER SEWER

ATTENUATION TANK 3
CL: 5.300m
IL: 3.750m
LENGTH: 15m (30 UNITS)
WIDTH: 11 (22 UNITS)
DEPTH: 1.2 (3 UNITS)
TOTAL UNITS: 1980 UNITS
STORAGE VOLUME: 188.1m³

SIDES AND BASE OF ATTENUATION TANK AND ALL CONNECTIONS WRAPPED IN IMPERMEABLE MEMBRANE, POLYPROPYLENE 1mm GAUGE WITH WELDED JOINTS:VISQUEEN HEAVY DUTY UDG (OSA). SEALED TANK TO BE TESTED FOR WATER TIGHTNESS AFTER CONSTRUCTIONS

S39 - FLOW CONTROL CHAMBER
CL: 5.193m
IL: 3.503m
COVER: B125

OUTFLOW RESTRICTED TO 2.0l/s USING HYRDO INTERNATIONAL HYDRO-BRAKE OPTIMUM REF MD-SHE-0057-2000-2000-2000. INSTALLED IN LINE WITH MANUFACTURERS GUIDANCE

S40
MANHOLE TO BE CONSTRUCTED ONLINE OF ANGLIAN WATER SEWER

PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE.
IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

SCALE 1:250m
0m 5m 10m 15m 20m 25m
SCALE BAR FOR INFORMATION ONLY

PLANNING GENERAL NOTES:

1. THE DRAWINGS, DESIGN AND ALL INFORMATION CONTAINED THEREIN ARE THE SOLE COPYRIGHT OF CANHAM CONSULTING LTD AND ANY REPRODUCTION IS FORBIDDEN UNLESS PERMISSION IS OBTAINED IN WRITING.
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT OTHER DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES BETWEEN THE INFORMATION GIVEN BY THE ENGINEER, AND THAT PROVIDED BY OTHERS, MUST BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORKS PROCEED.
4. DIMENSIONS MUST NOT BE SCALED FROM THE ENGINEER'S DRAWINGS.
5. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
6. THE INFORMATION SHOWN DOES NOT CONSTITUTE TECHNICAL APPROVAL FROM THE RELEVANT AUTHORITIES AND COULD BE SUBJECT TO CHANGE POST PLANNING.
7. THE PROPOSED SITE LAYOUT SHOWN ON THIS DRAWING IS BASED UPON THE CHAPLIN FARRENT DRAWING BGMC-CF-Z-XX-M2-A-6832, DATED 2023.10.10.

LEGEND

- PROPOSED PRIVATE SURFACE WATER PIPE
- PROPOSED PRIVATE PERFORATED SURFACE WATER PIPE
- PROPOSED PRIVATE SURFACE WATER MANHOLE
- PROPOSED PRIVATE ATTENUATION TANK (CRATE SYSTEM)
- PROPOSED FILTER TRENCH
- PROPOSED PRIVATE SURFACE WATER FLOW CONTROL CHAMBER
- PROPOSED PERMAVOID DIFFUSER UNIT
- PROPOSED PERMEABLE PAVING
- PROPOSED RAIN GARDEN
- PROPOSED GREEN ROOF
- PROPOSED PRIVATE FOUL WATER PIPE
- PROPOSED PRIVATE FOUL WATER MANHOLE
- PROPOSED PRIVATE FOUL WATER INSPECTION CHAMBER

rev	date	details	drawn	check
P03	17.11.23	DRAINAGE REVISED IN LINE WITH DESIGN DEVELOPMENT	GPC	MH
P02	02.11.23	DRAINAGE REVISED IN LINE WITH DESIGN DEVELOPMENT	GPC	MH
P01	04.07.23	PRELIMINARY ISSUE	MH	NB

Canham Consulting
Structural Civil Building Engineers
+44 (0)1603 430650 | mail@canhamconsulting.co.uk | www.canhamconsulting.co.uk

client
EAST SUFFOLK COUNCIL

architect
CHAPLIN FARRANT

project
REDEVELOPMENT OF BATTERY GREEN AND THE MARINA CENTRE

title
OUTLINE SURFACE & FOUL WATER DRAINAGE STRATEGY

CCL ref:	drawn	design	checked	scale	size	date
218070	MH	JL	NB	1:250	A1 (L)	04.07.23

status:
S3 - SUITABLE FOR REVIEW & COMMENT

drawing number: 218070-CCL-XX-00-DR-C-3000 revision: P03

THIS DESIGN IS PRODUCED IN ACCORDANCE WITH THE CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2015 INCORPORATING THE APPROVED CODE OF PRACTICE. REGULATIONS 2, 9 AND 11 - THOSE ALTERING THE DESIGN WITHOUT THE AUTHORITY OF CANHAM CONSULTING LTD SHOULD BE AWARE THEY MAY ALSO ASSUME RESPONSIBILITY FOR THOSE DUTIES.

PLANNING GENERAL NOTES:

1. THE DRAWINGS, DESIGN AND ALL INFORMATION CONTAINED THEREIN ARE THE SOLE COPYRIGHT OF CANHAM CONSULTING LTD AND ANY REPRODUCTION IS FORBIDDEN UNLESS PERMISSION IS OBTAINED IN WRITING.
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT OTHER DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES BETWEEN THE INFORMATION GIVEN BY THE ENGINEER, AND THAT PROVIDED BY OTHERS, MUST BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORKS PROCEED.
4. DIMENSIONS MUST NOT BE SCALED FROM THE ENGINEER'S DRAWINGS.
5. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
6. THE INFORMATION SHOWN DOES NOT CONSTITUTE TECHNICAL APPROVAL FROM THE RELEVANT AUTHORITIES AND COULD BE SUBJECT TO CHANGE POST PLANNING.
7. THE PROPOSED SITE LAYOUT SHOWN ON THIS DRAWING IS BASED UPON THE CHAPLIN FARRENT DRAWING BGMC-CF-Z-XX-M2-A-6832, DATED 2023.10.10.

SURFACE WATER MANHOLE SCHEDULE

U/S MH REFERENCE	U/S MH LOCATION		U/S COVER LEVEL (m)	U/S INVERT LEVEL (m)	U/S MH DEPTH (m)	D/S MH REFERENCE	D/S MH INVERT LEVEL (m)	PIPE #	PIPE LENGTH (m)	PIPE DIAMETER (mm)	SLOPE (1:X)	U/S MH SIZE (DIA - mm)	U/S MH TYPE	U/S MH COVER
	EASTING (m)	NORTHING (m)												
S1	655093.021	293139.083	6.200	5.341	0.859	S2	5.257	2.000	10.031	150	120.0	1200	C	B125
S2	655099.278	293146.924	6.200	5.257	0.943	S3	5.178	2.001	9.476	150	120.0	1200	C	B125
S3	655105.091	293154.408	6.200	5.178	1.022	S8	4.998	2.002	21.677	150	120.0	1200	C	B125
S4	655082.066	293146.046	6.300	5.500	0.800	S5	5.386	3.000	13.668	150	120.0	1200	C	B125
S5	655090.678	293156.660	6.300	5.386	0.914	S6	5.280	3.001	12.717	150	120.0	1200	C	B125
S6	655098.389	293166.772	6.300	5.280	1.020	S7	5.146	3.002	16.065	150	120.0	1200	C	B125
S7	655108.481	293179.271	6.300	5.146	1.154	S8	4.998	3.003	12.830	150	86.7	1200	C	B125
S8	655118.589	293171.370	6.200	4.998	1.202	S12	3.928	2.003	11.490	150	10.7	1200	C	B125
S9	655101.075	293135.326	4.700	4.000	0.700	S10	3.872	4.000	19.190	150	150.0	1200	C	D400
S10	655112.910	293150.432	4.700	3.797	0.903	S11	3.659	4.001	20.650	225	150.0	1200	C	D400
S11	655125.570	293166.746	4.700	3.659	1.041	S12	3.552	4.002	5.521	225	51.6	1200	C	D400
S12	655130.002	293170.038	5.250	3.552	1.698	S13	3.516	2.004	5.397	225	150.0	1200	C	B125
S13	655135.296	293168.990	5.172	3.516	1.655	-	-	-	-	-	-	1200	C	B125
S14	655100.659	293119.500	5.200	4.600	0.600	S15	4.328	5.000	22.305	225	82.1	1200	C	B125
S15	655082.695	293132.721	5.200	4.328	0.872	S16	4.155	5.001	10.244	225	59.3	1200	C	B125
S16	655077.960	293141.805	5.200	4.155	1.045	S17	4.093	5.002	12.498	225	200.0	1200	C	B125
S17	655066.004	293145.444	6.300	4.093	2.207	S18	4.002	5.003	20.464	225	225.0	1200	B	B125
S18	655046.132	293140.558	6.000	3.927	2.073	S19	3.811	5.004	29.113	300	250.0	1200	B	B125
S19	655033.656	293114.254	6.000	3.811	2.189	S20	3.757	5.005	13.456	300	250.0	-	-	-
S20	655021.460	293119.940	6.000	3.757	2.243	S21	3.721	5.006	7.243	300	200.0	-	-	-
S21	655018.205	293113.470	5.677	3.721	1.956	S22	3.683	5.007	5.582	300	150.0	1200	B	B125
S22	655018.640	293107.904	6.000	3.608	2.392	S25	3.516	5.008	20.745	375	225.0	1350	B	B125
S23	654994.031	293087.273	4.943	3.806	1.137	S24	3.751	6.000	8.208	225	150.0	1200	C	B125
S24	654997.958	293094.481	5.034	3.751	1.282	S25	3.666	6.001	12.686	225	149.2	1200	C	B125
S25	655009.524	293089.270	5.169	3.591	1.653	S39	3.503	5.009	19.834	300	225.0	1350	C	B125
S26	655026.273	293083.056	5.300	3.750	1.550	S39	3.703	7.000	2.830	150	60.0	1200	C	B125
S27	655048.109	293136.848	6.000	5.200	0.800	S28	4.799	8.000	24.057	150	60.0	1200	C	B125
S28	655042.324	293113.497	6.000	4.724	1.276	S29	4.521	8.001	12.175	225	60.0	1200	C	B125
S29	655049.080	293103.369	6.000	4.521	1.479	S30	4.235	8.002	17.158	225	60.0	1200	C	B125
S30	655034.036	293095.119	5.400	4.235	1.165	S39	3.578	8.003	16.194	225	24.6	1200	C	B125
S31	655084.978	293094.515	5.200	4.400	0.800	S32	4.315	9.000	19.092	225	225.0	1200	C	B125
S32	655075.795	293077.776	5.200	4.315	0.885	S33	4.222	9.001	20.956	225	225.0	1200	C	B125
S33	655063.001	293061.178	5.149	4.222	0.927	S34	4.151	9.002	12.057	225	169.6	-	PERMAVOID DEFUSER	B125
S34	655053.827	293053.355	5.200	4.151	1.049	S35	3.941	9.003	11.251	225	53.6	-	PERMAVOID DEFUSER	B125
S35	655050.469	293064.093	5.348	3.941	1.407	S38	3.871	9.004	10.419	225	148.8	1200	C	D400
S36	655037.224	293058.136	5.157	3.980	1.177	S37	3.915	10.000	9.722	225	150.0	1200	C	B125
S37	655039.885	293067.486	5.186	3.915	1.270	S38	3.871	10.001	6.644	225	150.0	1200	C	B125
S38	655044.277	293072.472	5.172	3.871	1.302	S39	3.578	9.005	18.769	225	64.1	1200	C	D400
S39	655027.268	293080.407	5.193	3.503	1.690	S40	3.486	5.010	5.120	300	300.0	1200	C	B125
S40	655025.102	293075.768	5.213	3.486	1.727	-	-	-	-	-	-	1200	B	B125

FOUL WATER MANHOLE SCHEDULE

U/S MH REFERENCE	U/S MH LOCATION		U/S COVER LEVEL (m)	U/S INVERT LEVEL (m)	U/S MH DEPTH (m)	D/S MH REFERENCE	D/S MH INVERT LEVEL (m)	PIPE #	PIPE LENGTH (m)	PIPE DIAMETER (mm)	SLOPE (1:X)	U/S MH SIZE (DIA - mm)	U/S MH TYPE	U/S MH COVER
	EASTING (m)	NORTHING (m)												
F1	655067.587	293096.452	5.200	4.400	0.800	F2	4.248	F1.000	12.167	100	80.0	450	IC	B125
F2	655077.522	293089.429	5.200	4.248	0.952	F4	4.131	F1.001	9.385	100	80.0	450	IC	B125
F3	655064.763	293087.159	5.200	4.400	0.800	F4	4.131	F2.000	13.001	100	48.3	450	IC	B125
F4	655075.752	293080.212	5.200	4.131	1.069	F5	3.915	F1.002	21.587	100	100.0	450	IC	B125
F5	655063.083	293062.734	5.200	3.915	1.285	F6	3.812	F1.003	10.302	100	100.0	450	IC	B125
F6	655052.920	293064.422	5.200	3.812	1.388	F7	3.724	F1.004	8.736	100	100.0	450	IC	B125
F7	655048.365	293071.877	5.300	3.724	1.576	F8	3.654	F1.005	7.054	100	100.0	450	IC	B125
F8	655041.882	293074.658	5.300	3.654	1.646	F9	3.532	F1.006	12.212	100	100.0	450	IC	B125
F9	655030.797	293079.781	5.300	3.358	1.942	F12	3.200	F1.007	15.813	100	100.0	450	IC	D400
F10	655052.697	293109.610	6.000	4.900	1.100	F11	4.102	F3.000	19.610	100	24.6	450	IC	D400
F11	655045.169	293091.502	6.000	4.102	1.898	F12	3.200	F3.001	9.020	100	10.0	450	IC	D400
F12	655036.651	293094.470	5.400	3.200	2.200	F15	2.847	F1.008	15.044	100	42.6	450	IC	B125
F13	655022.098	293118.032	6.000	4.432	1.568	F14	3.321	F4.000	11.108	100	10.0	450	IC	B125
F14	655032.132	293113.267	6.000	3.321	2.679	F15	2.847	F4.001	4.737	100	10.0	450	IC	B125
F15	655034.880	293109.409	5.200	2.847	2.353	-	-	-	-	-	-	1800	A	B125

PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE.
IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

SCALE 1:250m
0m 5m 10m 15m 20m 25m
SCALE BAR FOR INFORMATION ONLY

rev	date	details	drawn	check
P01	17.11.23	PRELIMINARY ISSUE	GPC	MH

Canham Consulting
Structural Civil Building Engineers
+44 (0)1603 430650 | mail@canhamconsulting.co.uk | www.canhamconsulting.co.uk

client
EAST SUFFOLK COUNCIL

architect
CHAPLIN FARRANT

project
REDEVELOPMENT OF BATTERY GREEN AND THE MARINA CENTRE

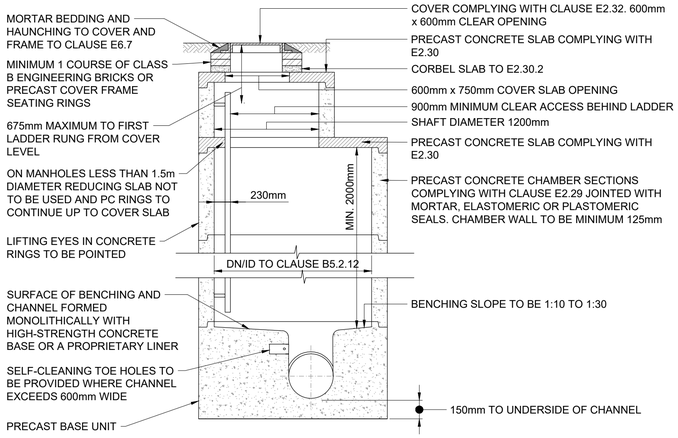
title
DRAINAGE STRATEGY:
SURFACE & FOUL WATER MAHHOLE SCHEDULES

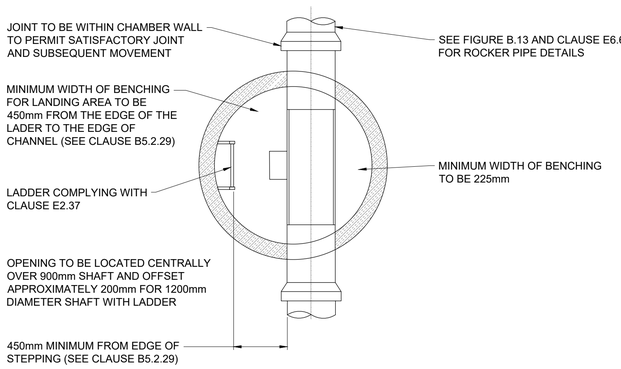
CCL ref:	drawn	design	checked	scale	size	date
218070	GPC	GPC	MH	N.T.S.	A1 (L)	17.11.2023

status:
S3 - SUITABLE FOR REVIEW & COMMENT

drawing number: 218070-CCL-XX-00-DR-C-3004 revision: P01

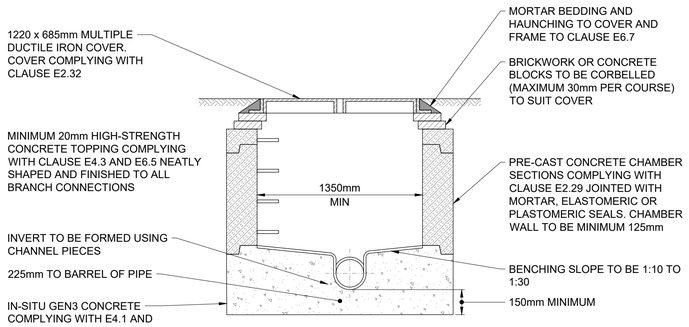
THIS DESIGN IS PRODUCED IN ACCORDANCE WITH THE CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2015 INCORPORATING THE APPROVED CODE OF PRACTICE, REGULATIONS 2, 9 AND 11. THOSE ALTERING THE DESIGN WITHOUT THE AUTHORITY OF CANHAM CONSULTING LTD SHOULD BE AWARE THEY MAY ALSO ASSUME RESPONSIBILITY FOR THOSE DUTIES





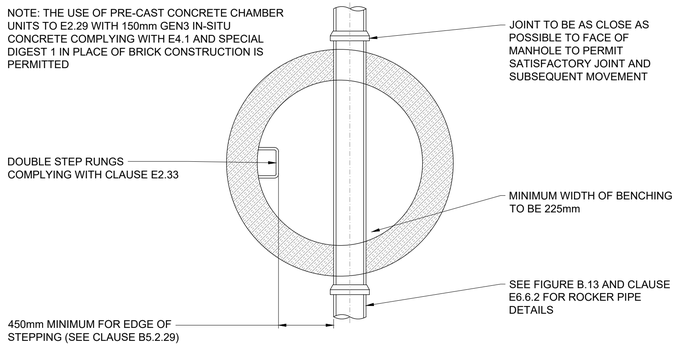
TYPICAL MANHOLE DETAIL - TYPE A1

DEPTH FROM COVER LEVEL TO SOFFIT OF PIPE 3m TO 6m WITH LADDER AND REDUCING SLAB
RIGID MATERIAL CONSTRUCTION WITHOUT CONCRETE SURROUND
SCALE NTS



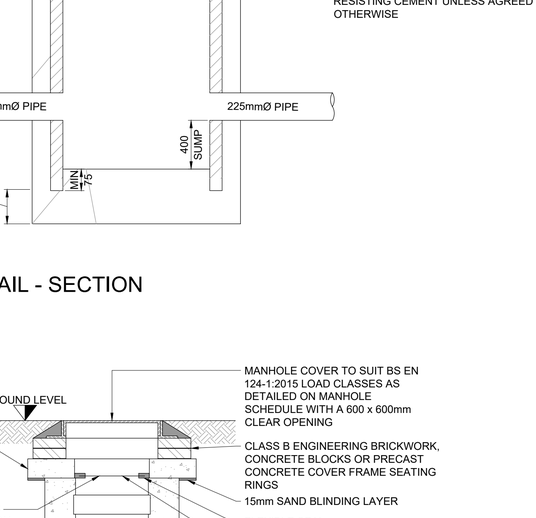
INTERNAL DIMENSIONS OF MANHOLE NORMALLY 1200 x 900mm, BUT MANHOLE WIDTH SHOULD BE INCREASED FOR PIPES LARGER THAN 450mmØ TO GIVE 225mm BENCHING EACH SIDE AND BRICKWORK/MASONRY UNITS CORBELLED DOWN TO SUIT COVER

NOTE: THE USE OF PRE-CAST CONCRETE CHAMBER UNITS TO E2.29 WITH 150mm GEN3 IN-SITU CONCRETE COMPLYING WITH E4.1 AND SPECIAL DIGEST 1 IN PLACE OF BRICK CONSTRUCTION IS PERMITTED



TYPICAL MANHOLE DETAIL - TYPE C

DEPTH FROM COVER LEVEL TO SOFFIT OF PIPE LESS THAN 1.5m
MAXIMUM PIPE SIZE 450mmØ, RIGID MATERIAL CONSTRUCTION
SCALE 1:25



CATCHPIT DETAIL (PLAN)

SCALE 1:25

CATCHPIT DETAIL - SECTION A-A

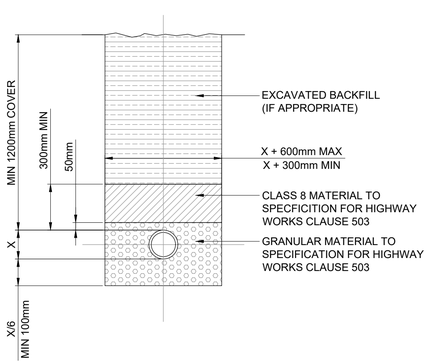
SCALE 1:25

NOTE:
WAVIN REFERENCE

- 315 IC CHAMBER BASE WITH 30NE002 RAISING PIECES TO SUIT (OSA) OR;
- 450 IC CHAMBER BASE WITH 40NE300 RAISING PIECES TO SUIT (OSA) BOTH WITH PREFORMED 100/110mmØ INLETS TO SUIT;
- 600 IC CHAMBER BASE WITH 60NE002 RAISING PIECES TO SUIT (OSA) WITH PREFORMED 300mmØ TO SUIT.

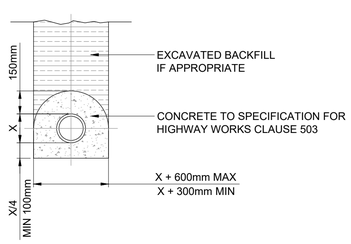
TYPICAL INSPECTION CHAMBER DETAIL (IC): 315, 450 & 600mm DIAMETER

SCALE 1:20



CLASS S BEDDING (PIPES UP TO 600mm)

NOT TO SCALE



CLASS Z BEDDING (PIPES UP TO 600mm)

NOT TO SCALE

PLANNING GENERAL NOTES:

1. THE DRAWINGS, DESIGN AND ALL INFORMATION CONTAINED THEREIN ARE THE SOLE COPYRIGHT OF CANHAM CONSULTING LTD AND ANY REPRODUCTION IS FORBIDDEN UNLESS PERMISSION IS OBTAINED IN WRITING.
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT OTHER DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES BETWEEN THE INFORMATION GIVEN BY THE ENGINEER, AND THAT PROVIDED BY OTHERS, MUST BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORKS PROCEED.
4. DIMENSIONS MUST NOT BE SCALED FROM THE ENGINEER'S DRAWINGS.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
6. THE INFORMATION SHOWN DOES NOT CONSTITUTE TECHNICAL APPROVAL FROM THE RELEVANT AUTHORITIES AND COULD BE SUBJECT TO CHANGE POST PLANNING.

PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE.
IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

rev	date	details	drawn	check
P01	16.11.23	PRELIMINARY ISSUE	GPC	MH

Canham Consulting
Structural Civil Building Engineers
+44 (0)1603 430650 | mail@canhamconsulting.co.uk | www.canhamconsulting.co.uk

client
EAST SUFFOLK COUNCIL

architect
CHAPLIN FARRANT

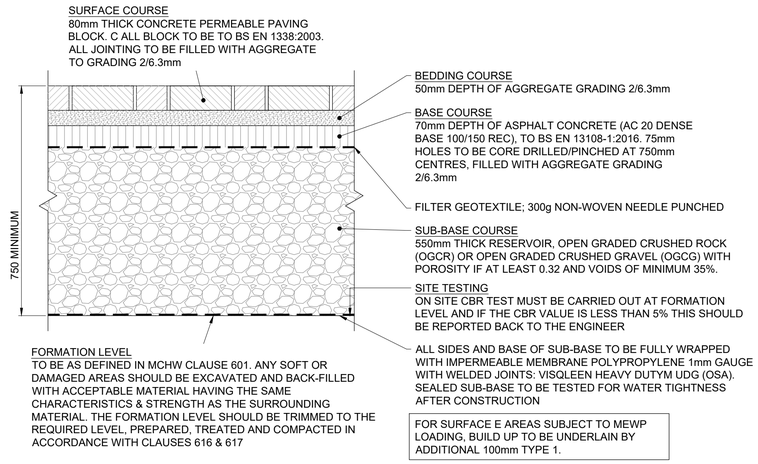
project
REDEVELOPMENT OF BATTERY GREEN AND THE MARINA CENTRE

title
DRAINAGE STRATEGY:
CONSTRUCTION DETAILS
SHEET 1 OF 2

CCL ref:	drawn	design	checked	scale	size	date
218070	GPC	GPC	MH	AS SHOWN	A1 (L)	16.11.2023

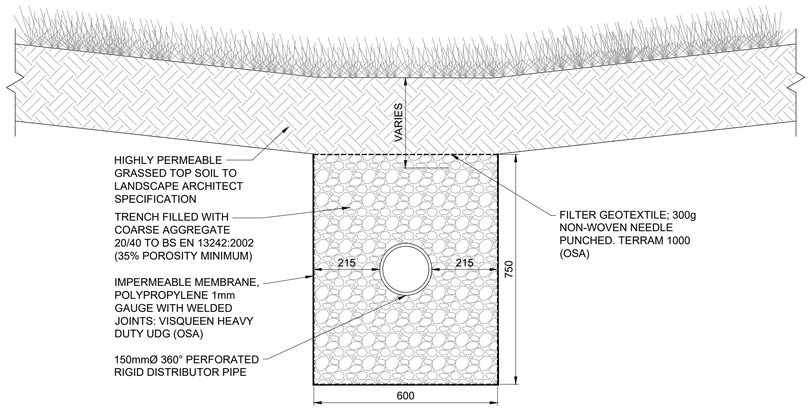
status:
S3 - SUITABLE FOR REVIEW & COMMENT

drawing number: 218070-CCL-XX-00-DR-C-3900
revision: P01



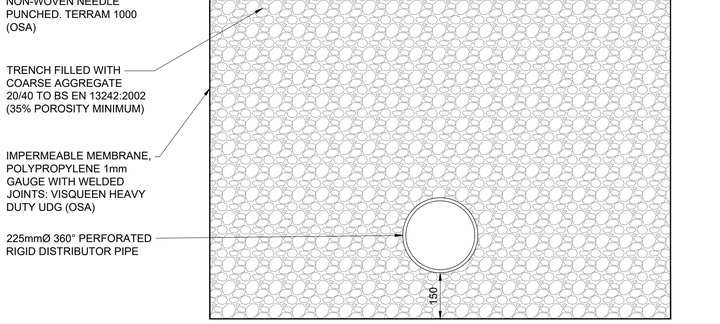
PROPOSED PERMEABLE BLOCK PAVING

SCALE 1:10



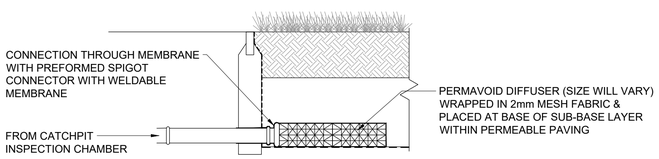
TYPICAL RAIN GARDEN DETAIL

SCALE 1:10



TYPICAL FILTER TRENCH DETAIL

SCALE 1:10



PERMAVOID RAINWATER DIFFUSER UNIT TYPICAL CONFIGURATION

SCALE 1:20

PLANNING GENERAL NOTES:

1. THE DRAWINGS, DESIGN AND ALL INFORMATION CONTAINED THEREIN ARE THE SOLE COPYRIGHT OF CANHAM CONSULTING LTD AND ANY REPRODUCTION IS FORBIDDEN UNLESS PERMISSION IS OBTAINED IN WRITING.
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT OTHER DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES BETWEEN THE INFORMATION GIVEN BY THE ENGINEER, AND THAT PROVIDED BY OTHERS, MUST BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORKS PROCEED.
4. DIMENSIONS MUST NOT BE SCALED FROM THE ENGINEER'S DRAWINGS.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
6. THE INFORMATION SHOWN DOES NOT CONSTITUTE TECHNICAL APPROVAL FROM THE RELEVANT AUTHORITIES AND COULD BE SUBJECT TO CHANGE POST PLANNING.

PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE.
IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

rev	date	details	drawn	check
P01	17.11.23	PRELIMINARY ISSUE	GPC	MH

Canham Consulting
Structural Civil Building Engineers
+44 (0)1603 430650 | mail@canhamconsulting.co.uk | www.canhamconsulting.co.uk

client
EAST SUFFOLK COUNCIL

architect
CHAPLIN FARRANT

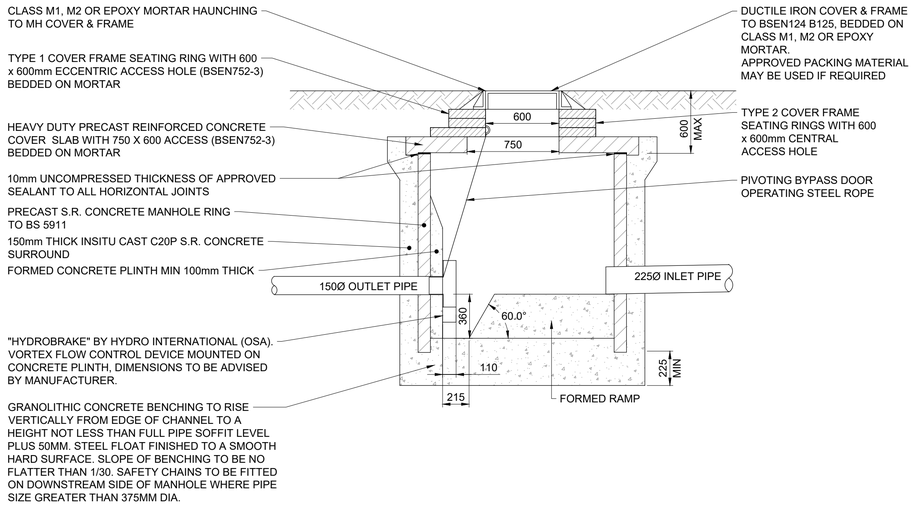
project
REDEVELOPMENT OF BATTERY GREEN AND THE MARINA CENTRE

title
DRAINAGE STRATEGY:
CONSTRUCTION DETAILS
SHEET 1 OF 2

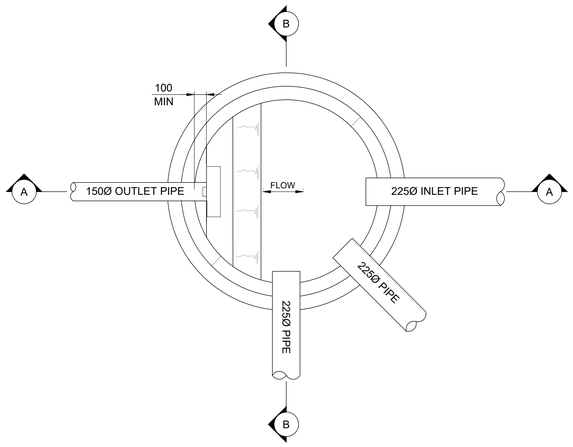
CCL ref:	drawn	design	checked	scale	size	date
218070	GPC	GPC	MH	AS SHOWN	A1 (L)	17.11.2023

status:
S3 - SUITABLE FOR REVIEW & COMMENT

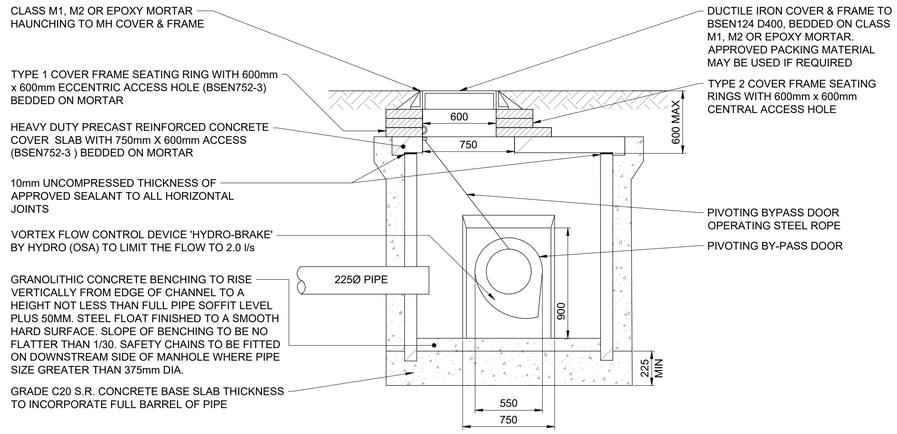
drawing number: 218070-CCL-XX-00-DR-C-3900
revision: P01



SECTION A-A
THROUGH TYPICAL FLOW CONTROL CHAMBER
SCALE 1:25



PLAN ON TYPICAL FLOW CONTROL CHAMBER
SCALE 1:25



SECTION B-B
THROUGH TYPICAL FLOW CONTROL CHAMBER
SCALE 1:25

PLANNING GENERAL NOTES:

1. THE DRAWINGS, DESIGN AND ALL INFORMATION CONTAINED THEREIN ARE THE SOLE COPYRIGHT OF CANHAM CONSULTING LTD AND ANY REPRODUCTION IS FORBIDDEN UNLESS PERMISSION IS OBTAINED IN WRITING.
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT OTHER DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES BETWEEN THE INFORMATION GIVEN BY THE ENGINEER, AND THAT PROVIDED BY OTHERS, MUST BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORKS PROCEED.
4. DIMENSIONS MUST NOT BE SCALED FROM THE ENGINEER'S DRAWINGS.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
6. THE INFORMATION SHOWN DOES NOT CONSTITUTE TECHNICAL APPROVAL FROM THE RELEVANT AUTHORITIES AND COULD BE SUBJECT TO CHANGE POST PLANNING.

PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE.
IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

rev	date	details	drawn	check
P01	17.11.23	PRELIMINARY ISSUE	GPC	MH

Canham Consulting
Structural Civil Building Engineers
+44 (0)1603 430650 | mail@canhamconsulting.co.uk | www.canhamconsulting.co.uk

client
EAST SUFFOLK COUNCIL

architect
CHAPLIN FARRANT

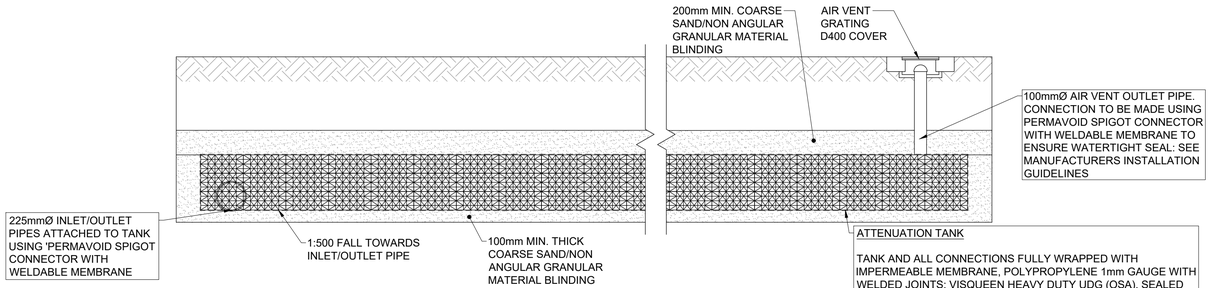
project
REDEVELOPMENT OF BATTERY GREEN AND THE MARINA CENTRE

title
DRAINAGE STRATEGY:
CONSTRUCTION DETAILS
SHEET 1 OF 2

CCL ref:	drawn	design	checked	scale	size	date
218070	GPC	GPC	MH	AS SHOWN	A1 (L)	17.11.2023

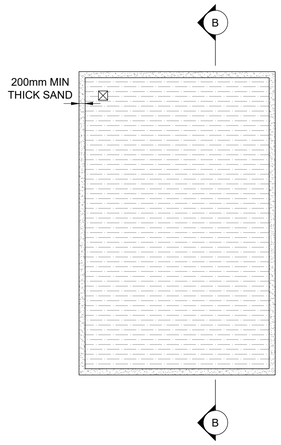
status:
S3 - SUITABLE FOR REVIEW & COMMENT

drawing number: 218070-CCL-XX-00-DR-C-3900
revision: P01



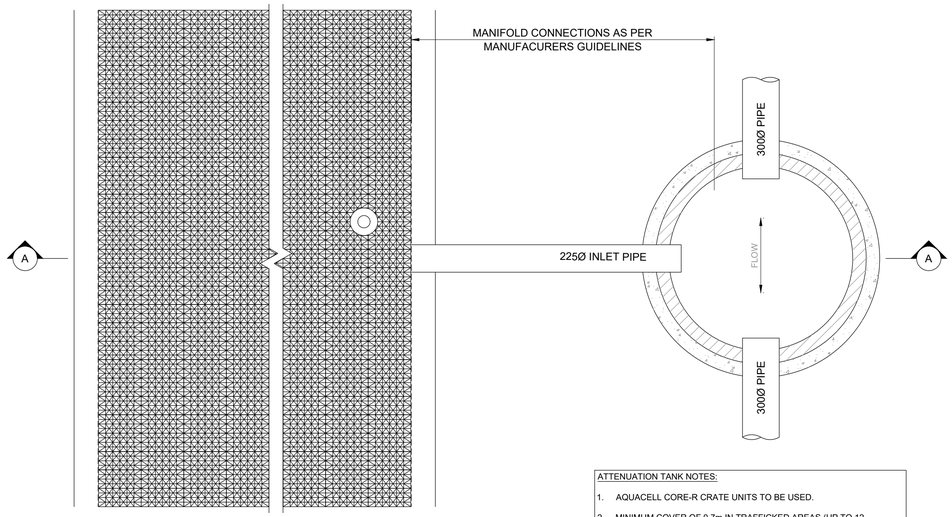
TYPICAL ATTENUATION TANK - SECTION B-B

SCALE 1:25



TYPICAL ATTENUATION TANK PLAN

1:100

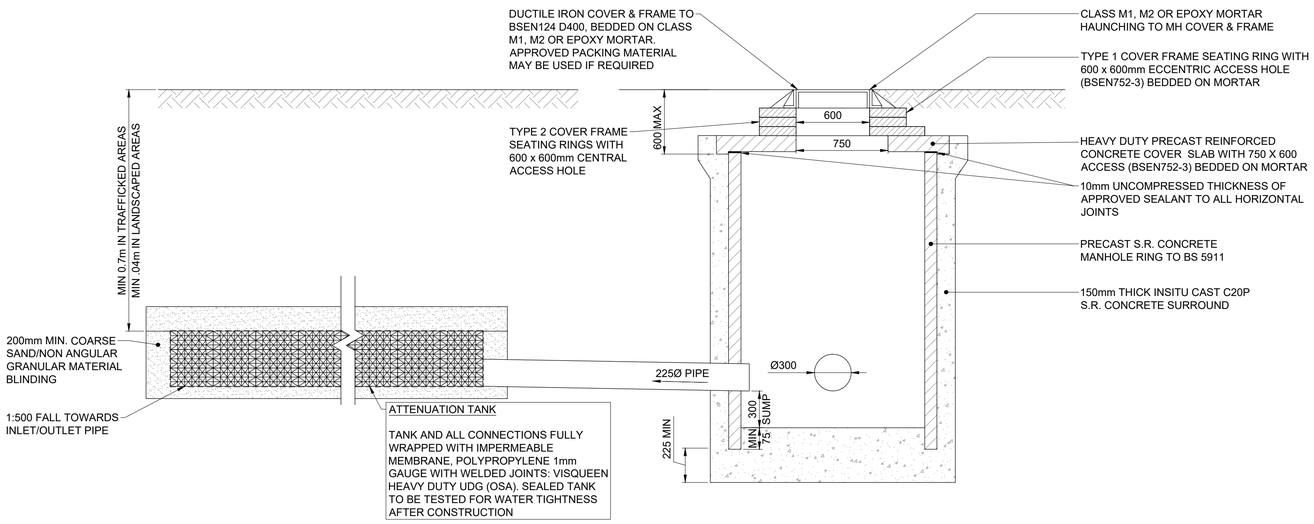


TYPICAL ATTENUATION TANK & CONNECTION DETAIL

SCALE 1:25

ATTENUATION TANK NOTES:

1. AQUACELL CORE-R CRATE UNITS TO BE USED.
2. MINIMUM COVER OF 0.7m IN TRAFFICKED AREAS (UP TO 12 TONNES) & .04m IN LANDSCAPED AREAS.
3. REFER TO MANUFACTURERS GUIDANCE FOR MAXIMUM DEPTHS.
4. AQUACELL UNITS TO BE INSTALLED IN LINE WITH MANUFACTURERS GUIDANCE. INDIVIDUAL UNITS TO BE CLIPPED TOGETHER & MULTI LAYER APPLICATIONS MUST USE SHEAR CONNECTORS.
5. TANK REQUIRES VENTING. 100mm VENT PIPE TO CONNECT TO CHAMBER ABOVE TANK TOP LEVEL. ALTERNATIVE VENT TO GROUND LEVEL WITH PROTECTIVE GRATE.



TYPICAL ATTENUATION TANK & CONNECTION - SECTION A-A

SCALE 1:25

TYPICAL TYPE B CATCHPIT DETAIL- SECTION A-A

SCALE 1:25

PLANNING GENERAL NOTES:

1. THE DRAWINGS, DESIGN AND ALL INFORMATION CONTAINED THEREIN ARE THE SOLE COPYRIGHT OF CANHAM CONSULTING LTD AND ANY REPRODUCTION IS FORBIDDEN UNLESS PERMISSION IS OBTAINED IN WRITING.
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT OTHER DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES BETWEEN THE INFORMATION GIVEN BY THE ENGINEER, AND THAT PROVIDED BY OTHERS, MUST BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORKS PROCEED.
4. DIMENSIONS MUST NOT BE SCALED FROM THE ENGINEER'S DRAWINGS.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
6. THE INFORMATION SHOWN DOES NOT CONSTITUTE TECHNICAL APPROVAL FROM THE RELEVANT AUTHORITIES AND COULD BE SUBJECT TO CHANGE POST PLANNING.

PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE.
IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

rev	date	details	drawn	check
P01	17.11.23	PRELIMINARY ISSUE	GPC	MH

Canham Consulting
Structural Civil Building Engineers
+44 (0)1603 430650 | mail@canhamconsulting.co.uk | www.canhamconsulting.co.uk

client
EAST SUFFOLK COUNCIL

architect
CHAPLIN FARRANT

project
REDEVELOPMENT OF BATTERY GREEN AND THE MARINA CENTRE

title
DRAINAGE STRATEGY:
ATTENUATION TANK DETAILS

CCL ref:	drawn	design	checked	scale	size	date
218070	GPC	GPC	MH	AS SHOWN	A1 (L)	17.11.2023

status:
S3 - SUITABLE FOR REVIEW & COMMENT

drawing number: 218070-CCL-XX-00-DR-C-3903 revision: P01

Appendix I
Exceedance Flow Plan

PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE.
IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

SCALE 1:250m
0m 5m 10m 15m 20m 25m
SCALE BAR FOR INFORMATION ONLY

PLANNING GENERAL NOTES:

1. THE DRAWINGS, DESIGN AND ALL INFORMATION CONTAINED THEREIN ARE THE SOLE COPYRIGHT OF CANHAM CONSULTING LTD AND ANY REPRODUCTION IS FORBIDDEN UNLESS PERMISSION IS OBTAINED IN WRITING.
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT OTHER DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES BETWEEN THE INFORMATION GIVEN BY THE ENGINEER, AND THAT PROVIDED BY OTHERS, MUST BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORKS PROCEED.
4. DIMENSIONS MUST NOT BE SCALED FROM THE ENGINEER'S DRAWINGS.
5. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
6. THE INFORMATION SHOWN DOES NOT CONSTITUTE TECHNICAL APPROVAL FROM THE RELEVANT AUTHORITIES AND COULD BE SUBJECT TO CHANGE POST PLANNING.
7. THE PROPOSED SITE LAYOUT SHOWN ON THIS DRAWING IS BASED UPON THE CHAPLIN FARRENT DRAWING BGMC-CF-Z-XX-M2-A-6832, DATED 2023.10.10.

LEGEND

FLOOD EXCEEDANCE DIRECTION
FLOOD EXCEEDANCE DIRECTION (AT BASE OF BUILDING)

rev	date	details	drawn	check
P01	17.11.23	PRELIMINARY ISSUE	GPC	MH

Canham Consulting
Structural Civil Building Engineers
+44 (0)1603 430650 | mail@canhamconsulting.co.uk | www.canhamconsulting.co.uk

client
EAST SUFFOLK COUNCIL

architect
CHAPLIN FARRANT

project
REDEVELOPMENT OF BATTERY GREEN AND THE MARINA CENTRE

title
DRAINAGE STRATEGY:
EXCEEDANCE FLOW PLAN

CCL ref:	drawn	design	checked	scale	size	date
218070	GPC	GPC	MH	1:250	A1 (L)	17.11.2023

status:
S3 - SUITABLE FOR REVIEW & COMMENT

drawing number: 218070-CCL-XX-00-DR-C-3003
revision: P01

Appendix J
Maintenance Strategy

Canham Consulting

Structural Civil Building Engineers

Maintenance Strategy



Project Ref:	**218070**
Document Ref:	**218070-CCL-XX-00-RP-01002**
Site:	**Redevelopment of Battery Green and the Marina Centre, Lowestoft**
Client:	**East Suffolk Council**
Prepared By:	**Matthew Herring MEng CEng MICE**
Date of Report:	**17 Nov 2023**
Revision:	**P01**
Status Code:	**S3**

Canham Consulting Ltd | Consultants to the Construction Industry
Second Floor, 69-75 Thorpe Road, Norwich, Norfolk, NR1 1UA
Registered in England & Wales | Company Registration No 02710417
01603 430650 | clientservice@canhamconsulting.co.uk | www.canhamconsulting.co.uk

Document Issue Record

The table below provides a record of document issue and revision history:

Revisions					
Rev	**Description**	**Prepared By**	**Checked By**	**Approved By**	**Date**
P1	For Approval	MH	JL	MR	17/11/23

Contents

Appendices

1 INTRODUCTION

This SuDS Operation and Maintenance Strategy has been produced in line with the recommendations of the CIRIA SuDS Manual (C753) and includes a number of extracts from that document.

For further information please refer to the full document, which can be downloaded free of charge at:

http://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

In addition to the recommendations in this manual, please also refer to the specific maintenance guidelines provided by the manufacturers of any proprietary products that have been used in the construction of the SuDS.

2 SUDS COMPONENTS WITHIN THE DEVELOPMENT

The development contains a number of SuDS components that will require on-going inspection and maintenance. The primary components are as follows:

- **Permeable Paving** (a surface suitable for pedestrian and/or vehicular traffic, that provides a treatment medium and allows rainwater to be temporarily stored and infiltrate into the ground);
- **Gully** (grated opening in the road surface to collect rain water);
- **Catch Pit** (chambers to facilitate the collection of sediment);
- **Attenuation Crates** (a purpose-built system, designed to store rainwater during high intensity storms)
- **Filter Drain** (a linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage. For treatment of surface water)
- **Rain Gardens** (are uniformly graded and gently sloping strips of grass or other dense vegetation that are designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration);
- **Pipes** (used to convey water within the drainage network)
- **Green Roof** (living roof, provides attenuation and treatment of rainwater)

3 SUMMARY OF DESIGN INTENT

The development consists of public amenity space including café, restaurant, internal and external exhibition space and arts venue in place of the existing Battery Green retail, residential and car parking elements which form the existing brownfield site.

The site will feature treatment via a combination of permeable surfacing, rain gardens, filter drains and green roof areas to deliver on the SuDS Manual requirement for quality improvements and to ensure continued function, effective and regular maintenance is essential in line with the details outlined in this Strategy.

4 INSPECTIONS

As part of the on-going management of most SuDS components there is a need for regular inspections to ensure that blockages, silt and excess litter are not adversely affecting the component or scheme. It is important that this is carried out and time is allowed for corrective action to be taken.

Routine inspections should be carried out once a month for most components, particularly for the first year after installation. This frequency can then be reviewed (and if appropriate reduced). It is proposed that Lowestoft Town Council or a maintenance company operating on their behalf will maintain the proposed drainage system and all SuDS associated with the proposed development.

Recurring attendance by the same person ensures monitoring of the drainage system, a rapid response to problems and "ownership" of the SuDS components. The inspections should be recorded on a maintenance record.

5 OPERATION AND MAINTENACE REQUIREMENTS FOR PERMEABLE PAVING

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

6 OPERATION AND MAINTENANCE REQUIREMENTS FOR GULLY

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Removal of litter and debris.	6 monthly.
Occasional Maintenance	Jetting of system	As required.
	Removal of sediment, oil, grease and floatables.	As required.
Remedial Actions	Clear pipework blockages.	As required.
Monitoring	Inspect for evidence of poor operation.	Six monthly.
	Inspect system and establish appropriate replacement frequencies.	Six monthly.
	Inspect sediment accumulation rates and establish appropriate replacement frequencies.	Monthly during first half year of operation, then every six months.

7 OPERATION AND MAINTENANCE REQUIREMENTS FOR CATCHPIT

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Removal of litter and debris.	6 monthly.
Occasional Maintenance	Change of filter media.	As required.
	Removal of sediment, oil, grease and floatables.	As required.
Remedial Actions	Clear perforated pipework blockages.	As required.
Monitoring	Inspect for evidence of poor operation.	Six monthly.
	Inspect filter media and establish appropriate replacement frequencies.	Six monthly.
	Inspect sediment accumulation rates and establish appropriate replacement frequencies.	Monthly during first half year of operation, then every six months.

8 OPERATION AND MAINTENANCE REQUIREMENTS FOR ATTENUATION TANKS

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	Remove sediment from pre-treatment structures	Annually (or as required)
Remedial Actions	Repair/rehabilitation of inlets, outlets, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually

9 OPERATION AND MAINTENANCE REQUIRED FOR FILTER DRAINS

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove littler (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional Maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods	As required
	At locations with higher pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

10 OPERATION AND MAINTENANCE REQUIRED FOR RAIN GARDENS

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass-to retain grass height within the specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then every 6 months)
	Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (e.g. oils)	Monthly (at start, then every 6 months)
	Check flow spreader and filter strip surface for even gradients	Monthly (at start, then every 6 months)
	Inspect gravel flow spreader upstream of filter strip for clogging	Monthly (at start, then every 6 months)
	Inspect silt accumulation rates and establish appropriate removal frequencies	Monthly (at start, then every 6 months)
Occasional Maintenance	Reseed areas of poor vegetation growth; alter plant types to better suit conditions if required	As required or if bare soil is exposed over >10% of the filter strip area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	

11 OPERATION AND MAINTENANCE REQUIREMENTS FOR PIPES

The drainage network has been designed to ensure the pipes are at self-cleansing velocities. However maintenance measures are still prudent and the below table shows the suggested inspection and maintenance requirements.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove debris or silt from the system	Annually, or as required
Remedial Actions	High pressure jetting to clean pipe network	As required
Monitoring	Inspect catchpits and chambers for silt build-up	Monthly for 3 months, then annually

13 OPERATION AND MAINTENANCE REQUIREMENTS FOR GREEN ROOFS

The maintenance for the Bauder Lightweight Sedum Green Roof System will be maintained in line with the Bauder "General Maintenance Lightweight Sedum System".

The guide suggests as follows:

The appearance of the vegetation on an extensive green roof will change over the year. The growth and flowering of the individual species within the vegetation mix will be dependant upon fluctuations in the seasonal weather. Extensive green roofs and sedum plants will not always be green. In the winter, sedum will become smaller and turn red/brown in colour as they prepare themselves to withstand the coming winter frosts.
Bauder recommends that all green roofs have a way of watering during prolonged periods without rain. All green roofs will benefit from water during droughts. Generally sedums are much more drought tolerant than native wildflowers but both will benefit from a prolonged soaking (not little and often) to prevent them from fully drying out (see Bauder's Watering Guide).
All green roofs will require feeding from time to time. Bauder's lightweight Xero Flor Sedum Blanket contains little in the way of natural nutrient, so fertiliser must be applied annually to ensure that the plants become resistant to extremes of weather and temperature.
The Bauder Sedum Blanket contains approximately 14-17 different plant species. Not every species incorporated will survive and the more dominant will prevail over time dependant on location.
General maintenance is best carried out annually during springtime. However, increasing the number of visits will improve the aesthetics of the roof.

Further details can be found at https://www.bauder.co.uk/technical-centre/downloads/maintenance/extensive-green-roofs.pdf

14 EMERGENCY ACTION IN CASE OF SPILLAGES

Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of substances that are known to be harmful to the environment should be removed where possible using soak mats as recommended by the Environment Agency, with residual spillage allowed to bioremediate in the drainage system.

In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s). (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or closely woven fabric.)

Contact the Environment Agency immediately on the following number.

24-hour incident hotline – 0800 80 70 60

Or if less urgent contact the regional office:

Iceni House, Cobham Road, Ipswich, Suffolk, IP3 9JD. Tel. 03708506506

Queries regarding a design feature – In the event of a concern or failure of a SuDS design feature contact:

Canham Consulting
Second Floor, 69-75 Thorpe Road, Norwich, NR1 1UA
T: (01603) 430650
E: clientservice@canhamconsulting.co.uk
W: www.canhamconsulting.co.uk

Appendix A
SuDS Maintenance Inspection Checklist

Appendix A – SuDS Maintenance Inspection Checklist			
General Information			
Site ID			
Site location and co-ordinates (GIS if appropriate)			
Elements forming the SuDS scheme		Approved drawing reference(s)	
Inspection frequency		Approved specification reference	
Type of development		Specific purpose of any parts of the scheme (eg biodiversity, wildlife and visual aspects)	
Inspection date			

	Details	**Y/N**	**Action required**	**Date completed**	**Details**	**Y/N**	**Action required**	**Date completed**
General inspection items								
Is there any evidence of erosion, channelling, ponding (where not desirable) or other poor hydraulic performance?								
Is there any evidence of accidental spillages, oils, poor water quality, odours or nuisance insects?								
Have any health and safety risks been identified to either the public or maintenance operatives?								
Is there any deterioration in the surface of permeable or porous surfaces (eg rutting, spreading of blocks or signs of ponding water)?								
Silt/sediment accumulation								
Is there any sediment accumulation at inlets (or other defined accumulation zones such as the surface of filter drains or infiltration basins and within proprietary devices)? If **yes**, state depth (mm) and extent. Is removal required? If **yes**, state waste disposal requirements and confirm, that all waste management requirements have been complied with (consult environmental regulator)								

Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground (eg underdrained swale or infiltration basin)?								
Does permeable or porous surfacing require sweeping to remove silt?								
System blockages and litter build-up								
Is there evidence of litter accumulation in the system? If **yes**, is this a blockage risk?								
Is there any evidence of any other clogging or blockage of outlets or drainage paths?								
Vegetation								
Is the vegetation condition satisfactory (density, weed growth, coverage etc)? (Check against approved planting regime.)								
Does any part of the system require weeding, pruning or mowing? (Check against maintenance frequency stated in approved design.)								
Is there any evidence of invasive species becoming established? If **yes**, state action required								
Infrastructure								
Are any check dams or weirs in good condition?								
Is there evidence of any accidental damage to the system (eg wheel ruts?)								
Is there any evidence of cross connections or other unauthorised inflows?								
Is there any evidence of tampering with the flow controls?								
Are there any other matters that could affect the performance of the system in relation to the design objectives for hydraulic, water quality, biodiversity and visual aspects? (Specify.)								
Other observations								
Information appended (eg photos)								

Suitability of current maintenance regime								
Continue as current								
Increase maintenance								
Decrease maintenance								
Next inspection								
Proposed date for next inspection								

Canham Consulting

Structural Civil Building Engineers

Canham Consulting Ltd
Second Floor, 69-75 Thorpe Road
Norwich, Norfolk, NR1 1UA

Tel: 01603 430650
Email: clientservice@canhamconsulting.co.uk
www.canhamconsulting.co.uk