



UNIVERSAL DESTINATIONS & EXPERIENCES UK PROJECT

Former Kempston Hardwick Brickworks
and adjoining land, Bedford

Environmental Statement Volume 3

Appendix 12.3 - Drainage Strategy

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EXECUTIVE SUMMARY - *FOR INFORMATION*

This Drainage Strategy (DS) has been prepared in support of the planning proposal for the Proposed Development as described in **Chapter 2: Description of the Proposed Development (Volume 1)** of the Environmental Statement (ES).

The Site comprises a total area of 268.0 hectares (ha) and is located approximately 5km southwest of Bedford town centre. The Ordnance Survey (OS) Grid Reference for the approximate centre of the Site is National Grid Reference 502812, 244795.

This DS includes a surface water drainage strategy that has been designed in line with the most recent Environment Agency (EA) Climate Change Guidance¹ to consider and manage the impact of a 100-year plus climate change rainfall event and is presented within this report. Where surface water originates from off-site, the sitewide level strategy will ensure that flood water is directed to sustainable drainage systems (SuDS) features or existing watercourses, natural storage volumes will be retained, and levels will ensure that exceedance flows are not directed off-Site.

The impermeable nature of the bedrock within the Site in combination with shallow deposits of alluvium and head in isolated areas of the Site presents the possibility of emergence of groundwater when surface flows are unable to infiltrate away, however the implementation of the DS will mitigate this risk by capturing surface water and attenuating the flows.

The DS incorporates SuDS features to adequately treat flows for quality in line with *CIRIA* guidance²². The Site's surface water will be attenuated and reduced to greenfield run-off rates in line with Bedford BC and IDB requirements before discharging into the nearby IDB maintained watercourses. The surface water drainage strategy considers surface water run-off management: the solutions proposed ensure that for the 100-year plus 40% climate change allowance event surface water will be accommodated within the Site and therefore prevent potential exceedance flows off-Site. Rainwater re-use has been considered and is proposed for inclusion within the development.

Foul drainage for the Site is proposed to discharge to the Anglian Water sewer network via an on-site drainage strategy described within the report. Anglian Water (AW) has confirmed that currently their sewer network does not have capacity to accept the Site's domestic flows, AW anticipates providing connection point(s) to the foul water network and will continue to work with UDX regarding flow rates and loadings. The final point of connection location and connection strategy is awaiting further investigation and design development.. Anglian Water has confirmed that Bedford WRC will be upgraded under their Assessment Management Plan AMP8 (2025-2030) which is independent of the proposed development. These commitments are recorded in the SoAP with Anglian Water appended to the **Planning Statement (Document Reference 6.1.0)**.

Engagement with the EA, AW, Bedford BC Lead Local Flood Authority (LLFA) and IDB has been carried out throughout the preparation of this DS to ensure their awareness of the proposals, their ability to advise on Site constraints and on the proposed surface water drainage strategy.

¹ Environment Agency (2022) *Flood risk assessments: climate change allowances*. Available at: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> [Accessed: 13 August 2024].

1. INTRODUCTION - *FOR INFORMATION*

1.1. APPOINTMENT AND BRIEF

- 1.1.1. This Drainage Strategy (DS) has been prepared in support of the planning proposal for the Proposed Development as described in **Chapter 2: Description of the Proposed Development (Volume 1)** of the Environmental Statement.

1.2. OBJECTIVE OF STUDY AND METHODOLOGY

- 1.2.1. **Section 5, Section 6, Annex 1, Annex 2 and Annex 3** of this report contains the proposed mitigation measures for storm water attenuation, controlled discharge rates and SuDS systems. Sections 1, 2, 3, 4 and 7 are labelled 'For Information' and are intended to be for information only, as they contain an Introduction, Climate Change, Existing Site and Policy Context, which are required to support the mitigation described in Section 5, Section 6, Annex 1, Annex 2 and Annex 3.
- 1.2.2. This DS establishes the mitigation measures required to ensure the sustainability and safety of the Proposed Development over its lifetime.
- 1.2.3. As detailed design emerges post consent, further information including detailed drainage design that aligns with this Drainage Strategy, will be submitted for approval. Where drainage design requires approvals and consent e.g. Land Drainage Consent, Water Framework Directive (WFD), Discharge Permits, this will be sought through engagement with and approval from other bodies such as the Bedford Group of Internal Drainage Boards (IDB) and/or the Environment Agency (EA) prior to submission of detailed drainage design proposals to MHCLG.
- 1.2.4. Where reference is made to agreements with the EA, Anglian Water (AW) and IDB, these discussions and agreements are captured in the Summaries of Agreed Position (SoAP) (Appendix 4 of the **Planning Statement (Document Reference 6.1.0))**.
- 1.2.5. The DS has been produced in line with the requirements of the *National Planning Policy Framework* (NPPF)², the *Flood Risk and Coastal Change Planning Practice Guidance* (PPG)³ and the *Environment Agency (EA) Standing Advice*⁴, as well as through engagement with LLFA, Bedford Group of IDB and AW.
- 1.2.6. A site visit was undertaken in April 2024 by representatives of the WSP team undertaking the DS to assess the general topography of the area and understand the existing drainage regime.
- 1.2.7. The following documents and policies have been reviewed to inform this report:
- LLFA - Strategic Flood Risk Assessment (SFRA - Level 1) (2020)⁵;

² Ministry of Housing, Communities and Local Government (2024) *National Planning Policy Framework*. Available at: [National Planning Policy Framework](#) [Accessed: 13 August 2024].

³ Ministry of Housing, Communities and Local Government (2022) *Planning Practice Guidance - Flood risk and coastal change*. Available at: <https://www.gov.uk/guidance/flood-risk-and-coastal-change> [Accessed: 13 August 2024].

⁴ Environment Agency (2024) *Preparing a flood risk assessment: standing advice*. Available at: <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice> [Accessed: 29 October 2024].

⁵ Bedford Borough Council (2020) *Bedford Borough Council Level 1 Strategic Flood Risk Assessment*. Available at: <https://edrms.bedford.gov.uk/OpenDocument.aspx?id=li3cQOt63E3W8glO2AEmuQ%3d%3d&name=BBC%20Strategic%20Flood%20Risk%20Assessment%20Level%201%20Nov%202020.pdf> [Accessed: 13 August 2024].

- LLFA - Strategic Flood Risk Assessment (SFRA - Level 2 (2022)⁶;
- LLFA - Preliminary Flood Risk Assessment (PFRA) (2011)⁷;
- LLFA - Local Flood Risk Management Strategy (LFRMS) (2022)⁸;
- Bedford BC - Local Plan 2030 (Adopted 2020)⁹;
- 40SEVEN - Topographical Survey (2023) (**Annex 1 of Appendix 12.1: Flood Risk Assessment (Volume 3)** of the ES);
- Anglian Water Asset Records (2024) (**Annex 2 of Appendix 12.1: Flood Risk Assessment (Volume 3)** of the ES);
- British Geological Society (BGS) Online Viewer, 1:50,000 Bedrock and Superficial deposits¹⁰;
- DEFRA's online Magic Map¹¹;
- IDB Fluvial Flood Mapping¹²;
- Flood Map for Planning¹³;
- Long Term Flood Maps¹⁴;
- WSP **Appendix 11.2: Ground Investigation Technical Note (Volume 3)**; and
- Delta-Simons 'Bedford Business Park ES Appendix 10' 2018¹⁵.

1.2.8. In undertaking this study, the local policies discussed in Section 2 of this report have also been considered.

1.2.9. This report makes use of third-party information and contains EA information.

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- ⁶ Bedford Borough Council (2022) *Bedford Borough Council Level 2 Strategic Flood Risk Assessment*. Available at: <https://www.bedford.gov.uk/media/5087/download?inline> [Accessed: 13 August 2024].
- ⁷ Bedford Group of Internal Drainage Board (2011) *Upper River Great Ouse Tri Lead Local Flood Authority Preliminary Flood Risk Assessment for Bedford Borough Council, Central Bedfordshire Council and Milton Keynes Council*. Available at: https://www.centralbedfordshire.gov.uk/migrated_images/preliminary-flood-risk-assessment_tcm3-7812.pdf [Accessed 13 August 2024].
- ⁸ Bedford Borough Council (2022) *Local Flood Risk Management Strategy*. Available at: <https://www.bedford.gov.uk/media/4802/download?inline> [Accessed: 13 August 2024].
- ⁹ Bedford Borough Council (2020) *Local Plan 2030*. Available at: <https://www.bedford.gov.uk/media/4011/download?inline> [Accessed: 13 August 2024].
- ¹⁰ British Geological Survey (n.d.) *BGS Geology Viewer*. Available at: https://geologyviewer.bgs.ac.uk/?_ga=2.132188366.1163400577.1730132662-1184848800.1730132662 [Accessed: 28 October 2024].
- ¹¹ Department for Environment Food and Rural Affairs (n.d.) *Magic Map*. Available at: <https://magic.defra.gov.uk/> [Accessed: 28 October 2024].
- ¹² Internal Drainage Boards Map (2020) *Association of Drainage Authorities*. Available at: <https://www.ada.org.uk/idb-map/> [Accessed: 16 June 2025].
- ¹³ Environment Agency (n.d.) *Get flood risk information for planning in England*. Available at: <https://flood-map-for-planning.service.gov.uk/> [Accessed: 28 October 2024].
- ¹⁴ Environment Agency (n.d.) *Check the long term flood risk for an area in England*. Available at: <https://www.gov.uk/check-long-term-flood-risk> [Accessed: 28 October 2024].
- ¹⁵ Delta Simons (2018) *Bedford Business Park ES, Appendix 10*.

- 1.2.10. The insurance industry applies its own assessments to properties in terms of determining premiums and the insurability for flood risk. Those intending to undertake development in areas which may be at risk of flooding are advised to contact their insurers or the Association of British Insurers (ABI) to seek further guidance prior to commencement.

2. CLIMATE CHANGE - FOR INFORMATION

2.1.1. EA guidance *Flood risk assessments: climate change allowances* issued on the 19 February 2016 (updated May 2022)¹ provides up to date information on expected changes in rainfall, river flows and sea level rise as a consequence of climate change.

2.1.2. Climate change allowances for peak river flows and rainfall are based on the lifespan of the development, in this case typically 75 years for a non-residential development, as per PPG Flood Risk Coastal Change Paragraph 006.

The lifetime of a non-residential development depends on the characteristics of that development but a period of at least 75 years is likely to form a starting point for assessment.

2.1.3. PPG also states:

Where development has an anticipated lifetime significantly beyond 100 years such as some major infrastructure projects, or where it would create significant land-use change such as a new settlement or substantial urban extension, it may be appropriate to consider a longer period for the lifetime of development when assessing the potential impacts of climate change on flood risk or coastal change and considering the future prospects for flood and coastal erosion risk management infrastructure. It may also be a consideration when identifying existing development that may not be sustainable in the long term, and seeking opportunities for relocation.

2.1.4. As a cautious worst case approach when selecting the appropriate climate change allowances the highest available Epoch for Rivers (2080s) and Rainfall (2070s) has been used based on the Environment Agency climate change allowances.

**Use '2050s' for development with a lifetime up to 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.*

2.1.5. Allowances for peak river flows are shown as variable on a regional basis; allowances are also based on percentiles, whereby a percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level (e.g. a 50th percentile means that the allowance has a 50% chance of not being exceeded).

2.1.6. On this basis key allowances for peak river flows based on percentiles are:

- Central allowance - based on the 50th percentile;
- Higher central allowance - based on the 70th percentile; and
- Upper end allowance - based on the 90th percentile.

2.1.7. These allowances are detailed in Table 1 (Peak river flow allowances by river basin District) of the EA *Flood risk assessments: climate change allowances* guidance¹.

- 2.1.8. As stated in the EA *Flood risk assessments: climate change allowances guidance*¹, the choice of the appropriate allowance for peak river flow (e.g. central or higher central) should reflect the risk for the Proposed Development and therefore is linked to the expected hazard, vulnerability, and resilience of the scheme; recommendations on the appropriate allowances to be considered are provided in the EA Guidance. For this Site, based on the guidance the development proposals (considered more vulnerable in flood risk terms) should be reviewed against the central allowance for peak river flow and given the development lifespan, the 2080s epoch should be assessed. The river basin for the Site is the Upper and Bedford Ouse Management Catchment.
- 2.1.9. Rainfall allowances are also shown as variable on a regional basis and are based on percentiles in the same way as peak river flow explained above, with a central and upper end allowance.
- 2.1.10. The EA¹ recommends that development with a lifespan beyond 2100, such as the Site, uses the upper allowance for rainfall in the 2070s epoch within the catchment, in this case the Upper and Bedford Ouse Management Catchment.

Table 2-1 - Summary of Climate Change Factors

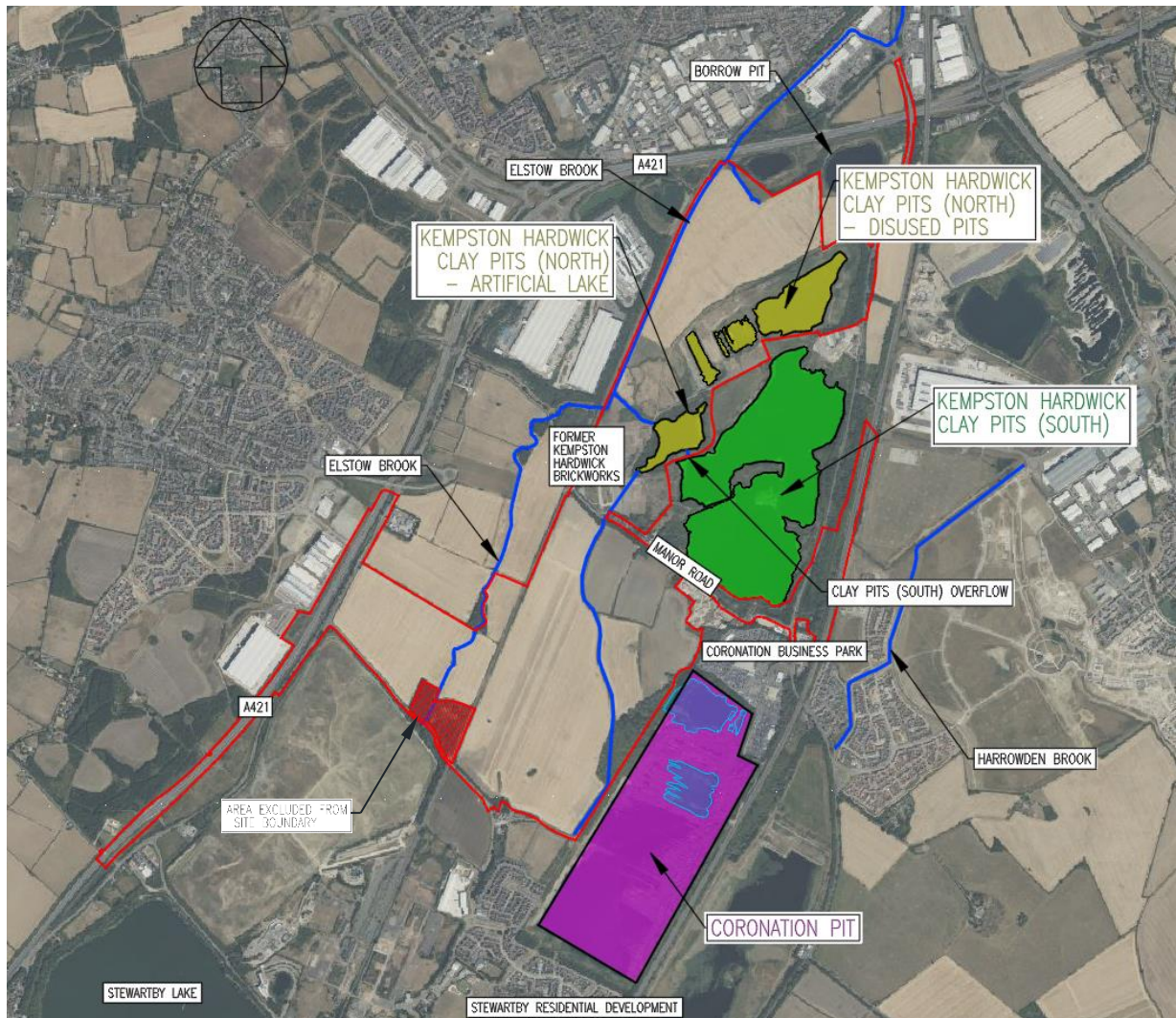
Flood Criteria	Climate Change Factor¹
Peak River Flow	19% (central allowance in the Upper and Bedford Ouse Management Catchment for the 2080s epoch)
Peak Run-off	40% for the 2070s epoch (upper end allowance for the Upper and Bedford Ouse Management Catchment)

3. EXISTING SITE - *FOR INFORMATION*

3.1.1. The following information can be found in Section 4 of Appendix 12.1: Flood Risk Assessment (Volume 3) of the ES:

- Site Location;
- Site Description;
- Geology and Hydrology;
- Existing Watercourses, Flood Defences and Structures;
- Existing Sewers/Drainage; and
- Topography.

Image 3-1 - Existing Site Waterbodies Flood Defences (Figure 4-5 App 12.1 FRA)



4. SURFACE WATER MANAGEMENT - POLICY CONTEXT - FOR INFORMATION

4.1. SUSTAINABLE DRAINAGE SYSTEMS WRITTEN STATEMENT HCWS161 (DECEMBER 2014)

- 4.1.1. The Secretary of State for Communities and Local Government laid a Written Ministerial Statement¹⁶ in the House of Commons on 18 December 2014 setting out changes to planning that will apply for major development from 6 April 2015. This confirms that:

“in considering planning applications, local planning authorities should engage the relevant lead local flood authority on the management of surface water; satisfy themselves that the proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.”

- 4.1.2. Therefore, from 6 April 2015 local planning policies and decisions on planning applications relating to major development are required to ensure that sustainable drainage systems (SuDS) are used for the management of surface water.

- 4.1.3. Major development is development involving any one or more of the following:

- The winning and working of minerals or the use of land for mineral-working deposits;
- Waste development;
- The provision of 10 dwellings or more;
- The provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or
- Development carried out on a site having an area of 1 hectare or more.

4.2. DEFRA SUSTAINABLE DRAINAGE SYSTEMS NON-STATUTORY TECHNICAL STANDARDS FOR SUSTAINABLE DRAINAGE SYSTEMS (MARCH 2015)

- 4.2.1. This document¹⁷ sets out non-statutory technical standards for sustainable drainage systems. It should be read in conjunction with the *NPPF*² and *PPG*³.

¹⁶ Department for Communities and Local Government (2014) *House of Commons: Written Statement (HCWS161)*, Available at: <https://www.parliament.uk/globalassets/documents/commons-vote-office/December-2014/18-December/6.-DCLG-sustainable-drainage-systems.pdf> [Accessed: 14 August 2024].

¹⁷ Department for Environment, Food and Rural Affairs (2015) *Sustainable Drainage Systems Non-Statutory Technical Standards for Sustainable Drainage Systems*. Available at: <https://assets.publishing.service.gov.uk/media/5a815646ed915d74e6231b43/sustainable-drainage-technical-standards.pdf> [Accessed: 14 August 2024].

4.2.2. Some of the key principles stated in this document are as follows:

“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.

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.

Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with the above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

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.

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

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

4.3. **BRITISH STANDARD 8582:2013 CODE OF PRACTICE FOR SURFACE WATER MANAGEMENT FOR DEVELOPMENT SITES (NOVEMBER 2013)**

- 4.3.1. In the absence of specific local guidance on the management of surface water run-off, *BS 8582*¹⁸ should be considered as best practice guidance for the development of surface water drainage strategies for new development sites.

4.4. **FLOOD AND WATER MANAGEMENT ACT 2010**

- 4.4.1. *The Flood and Water Management Act*¹⁹ provided the legislative basis for a number of recommendations in the Pitt Review. In October 2010, Section 9 of the Act came into force requiring all LLFAs in England to develop, maintain, review, update as well as apply and monitor the application of a strategy for local flood risk in their area. This is known as a Local Flood Risk Management Strategy.

¹⁸ British Standards Institution (2013) *BS 8582:2013 – Code of practice for surface water management for development sites*.

¹⁹ HM Government (2010) *Flood and Water Management Act*. Available at: <https://www.legislation.gov.uk/ukpga/2010/29/contents> [Accessed: 14 August 2024].

- 4.4.2. Schedule 3 of the Act¹⁹ provides a framework for the approval and adoption of drainage systems, a sustainable drainage system approving body within unitary and county councils, and national standards on the design, construction, operation, and maintenance of sustainable drainage systems for the lifetime of the development. It also makes the right to connect surface water run-off to public sewers conditional upon the drainage system being approved before any construction work can start. Implementation of the new approach in England is awaited with no clear date set by Government.

4.5. BEDFORD BOROUGH COUNCIL SUPPLEMENTARY PLANNING DOCUMENT FOR SUSTAINABLE DRAINAGE SYSTEMS (FEBRUARY 2018)

- 4.5.1. This *Supplementary Planning Document*²⁰ intends to address sustainable development across Bedford Borough by defining the requirement for the implementation of SuDS in future developments. The *Supplementary Planning Document*²⁰ provides a framework to promote sustainable development within Bedford Borough through planning standards and objectives set out in this document.
- 4.5.2. Flow rates depend on whether a variable or fixed flow control is used, which relates to the approach to storage. The preferable approach where long term storage is provided is that an outflow via infiltration or controlled discharge is to be limited to 2l/s/ha. Where long term storage is not provided a variable flow rate (1 in 1 - 1 in 100 annual probability greenfield run-off rates) will be allowed. Greenfield run-off rates will be included for all rainfall events up to the and including the 1 in 100-year probability event plus climate change.
- 4.5.3. The least preferable approach is to limit the outflow to Q_{Bar} or Q_{Med} or 2l/s/ha, whichever is greater for all rainfall events up to and including the 1 in 100-year probability rainfall event plus climate change.

4.6. BEDFORD BOROUGH COUNCIL LOCAL PLAN 2030 (ADOPTED JANUARY 2020)

- 4.6.1. The purpose of the Local Plan 2030⁹ is to assist the planning of Bedford Borough's growth until 2030 with a focus on sustainable development to consider social, economic, and environmental factors together.

²⁰ Bedford Borough Council (2018) *Supplementary Planning Document for Sustainable Drainage Systems*. Available at: <https://edrms.bedford.gov.uk/OpenDocument.aspx?id=SE%2fYvEcHkpieCiSGAkjD9w%3d%3d&name=SuDS%20SPD.pdf> [Accessed: 14 August 2024].

- 4.6.2. Local Plan⁹ Policies 50S 92 and 93 require surface water and groundwater to be considered in the sustainable development of Bedford Borough to reduce flood risk via sustainable choice of site location and use of SuDS, while also requiring water quality regulation or improvement. Proposals involving non-mains (foul) drainage will only be considered acceptable by Bedford BC where it is not feasible to connect to an existing sewer and proposals would not have a detrimental impact on ground or surface water. All development proposals must include for appropriate surface water drainage systems tailored to the specific characteristics of the site. Post-development runoff rates should aim to match those of existing greenfield conditions. The proposed surface water drainage system should be designed to prevent flooding of internal properties and neighbouring areas for all rainfall events up to the 1% annual exceedance probability event, including additional allowances for climate change. Additionally, provisions must be made for the safe conveyance and storage of floodwaters in case the capacity of the proposed drainage system is exceeded. Policy states that priority should be given to the following order of discharge locations for surface water drainage:
- To ground via infiltration;
 - To an above ground water body; and
 - To surface water sewers.

5. DRAINAGE STRATEGY

5.1. OVERVIEW

- 5.1.1. It is essential for any new development that surface water is managed effectively to limit the risk off-Site as well as on Site and with consideration of local and national policy.
- 5.1.2. This section of the report discusses the principles of the proposed surface and foul water drainage strategy, with appropriate design calculations and drainage maintenance requirements. All agreements, permits or applications for connections to watercourses and sewers will be made post planning consent through engagement with Bedford BC, the IDB and AW.
- 5.1.3. The principals set out have been developed in conjunction with the EA, IDB and AW – please refer to the SoAPs for the EA, IDB and AW in Appendix 6 of the **Planning Statement (Document Reference 6.1.0)**.
- 5.1.4. Best practice for the management of surface water is based on Bedford BC *Supplementary Planning Document for Sustainable Drainage Systems*²⁰, *Building Regulations Document H 2010*²¹ Part H and *CIRIA C753 SuDS Design Manual*²² along with *BS 8582:2013 - Code of Practice for Surface Water Management for Development Sites*¹⁸.
- 5.1.5. The Bedford Local Plan 2030⁹ Policy 93 requires drainage to discharge surface water in accordance with the following hierarchy:
 - 1. Infiltration;
 - 2. Existing watercourse/above ground waterbody; and
 - 3. Existing sewer.
- 5.1.6. As stated in **Appendix 11.2: Ground Investigation Technical Note (Volume 3)** of the ES, based on the Site's geology and the presence of relatively shallow groundwater it is unlikely that the Site will be able to discharge via soakaway or adequate infiltration system. This will be confirmed by Site specific infiltration testing prior to detailed design as site preparation and investigation works.
- 5.1.7. All catchments have been designed to discharge to existing watercourses at a restricted flow rate to match greenfield Q_{Bar} run-off rates.

5.2. EXISTING SITE DRAINAGE REGIME

DRAINED AREA

- 5.2.1. The Site's total drained catchment area is 236.2ha, the area split per zone is as follows; the Core Zone (96.7ha), the Lake Zone (98.8ha), the West Gateway Zone (26.7ha) and the East Gateway Zone (14.4ha).

²¹ Ministry of Housing, C.& L.G. (2018 to 2021) (2010) *Drainage and waste disposal: Approved document H*, GOV.UK. Available at: <https://www.gov.uk/government/publications/drainage-and-waste-disposal-approved-document-h> [Accessed: 30 October 2024].

²² Construction Industry Research and Information Association (2015) *The SuDS Manual (C753)*.

DRAINAGE REGIME

5.2.2. A description of the existing site drainage can be found in Section 4 of **Appendix 12.1: Flood Risk Assessment (Volume 3)**. Reference should also be made to the Existing Surface Water Regime Plan in **Annex 4 of Appendix 12.1: Flood Risk Assessment (Volume 3)** of the ES. This section describes the existing flow regime based on site visits, engagement with the LLFA/IDB and professional judgement of existing drainage conditions:

- As identified in Section 3 there is an existing IDB controlled watercourse that runs southeast to northwest through the Core Zone. For the eastern and southern areas of the Zone existing run-off is collected within the watercourse. The IDB watercourse outfalls north, under Manor Road via a culvert, estimated to be 850mm in diameter, to the Kempston Hardwick Clay Pits (North) - artificial lake located in the south of in the Lake Zone. For the western area there is a network of existing land drains (details can be found in **Annex 6 of Appendix 12.1: Flood Risk Assessment (Volume 3)**) consisting of below ground porous plastic pipes ranging in diameter between 60 and 170mm. From records the majority of the land drainage discharges directly to the IDB watercourse, with approximately 3.2 ha towards the centre of the zone discharging west beneath the Marston Vale Railway line towards Elstow Brook.
- As per the drainage strategy mentioned in planning application 14 03135 MAR, surface water runoff flows from the Stewartby Park development, south of the Site, and discharges into the Coronation Pits. The total area discharging from the Stewartby Park development to the Coronation Pit is 29ha based on the information from the planning application, and verified by measurement on drawing 320-1000-P-CE000 in Annex 2. The IDB confirmed that surface water discharging to the pits accumulate over a period of approximately 25 years with no discharge from the pits until water levels reach a maximum level of 32.4m AOD. Once this water level is reached, surface water will overflow via a proposed weir to an existing outfall watercourse located on the western side of the pits. This will then discharge to the Core Zone watercourse which flows to the Lake Zone artificial lake, and in turn overflows to the Elstow Brook. The Stewartby Park planning application 13/00889/FUL also states that the overflow from Coronation Pits will occur once water levels reach 32.4m AOD, with peak flows controlled to a maximum of 4 l/s/ha for up to, and including, the 1 in 100 year rainfall event plus climate change. The IDB confirmed in May 2025 that the weir wall had not been built, and it is the responsibility of the landowner/operator to construct and manage the surface water runoff and weir overflow described, in order not to increase flood risk both on-and-off Site. The IDB have powers under the Land Drainage Act 1991 to enforce the construction of the weir should the drainage system fall in disrepair.

- Flows from Lake Zone currently outfall to several locations including approximately 50ha of farmers field to Elstow Brook, the Former Brickworks via surface water runoff to Elstow Brook, and the former Clay Pits located to the north east, receiving localised runoff from the surrounding soft landscaped surface. There is an existing Land Drainage network to the north of the Lake Zone (details can be found in **Annex 6 of Appendix 12.1: Flood Risk Assessment (Volume 3)**), which consists of a series of clay pipes ranging in size from 75-150mm, conveying flows west to Elstow brook in the western area and east in the eastern area towards the existing ordinary watercourse network routing east. The Kempston Hardwick Clay Pits (South) have an overflow to the Kempston Hardwick Clay Pits (North) - artificial lake. However, currently as of April 2025, visual observations noted that the water level in the Kempston Clay Pits (South) is below the level of the overflow structure. The Kempston Hardwick Clay Pits (North) artificial lake has an identified overflow outfall, however the invert level of this feature (approximately 0.9m above surveyed water levels), and the lack of connectivity to a receiving watercourse from this outfall indicate that the artificial lake does not have a point of discharge outside of extreme storm events. Kempston Hardwick Clay Pits (North) - disused pits located in the north east of Lake Zone is approximately 6m lower than Elstow Brook, and does not have a constructed overflow or point of discharge to the wider network. Rainfall over the area collects over time in the disused clay pits and previously collected water was pumped out in 2018 to Elstow Brook for future development;
- It is understood from the IDB that the Coronation Business Park to the east of the Core Zone discharges to the Kempston Hardwick Clay Pits (South) beneath Manor Road;
- Run-off from the West Gateway Zone discharges directly to the Elstow Brook and a tributary flowing west to east through the Site; and
- Run-off from the East Gateway Zone predominantly drains south to an ordinary watercourse which flows to the east beneath the rail line which outfalls to the Harrowden Brook.
- 9m byelaws ('IDB Byelaw Zone') remain from existing top of banks for IDB Maintained watercourses on both sides and including culverts. The Land Drainage Consent (under the Land Drainage Act 1991) to be submitted and approved by the IDB, permits activities within this margin. Proposals in the IDB Byelaw Zone will predominantly consist of landscaped vegetation to protect riparian habitat.

Greenfield Run-off Rates

- 5.2.3. The following tables, **Table 5-1** to Table 5-3, set out the summary of results from the HR Wallingford Greenfield Runoff Rate Estimation Tool (FEH Statistical method) for each Zone's catchment - refer to **Annex 1 of Appendix 12.3: Drainage Strategy (Volume 3)** for details. Where a catchment is less than 50ha in size, greenfield runoff rates have been derived for a 50ha catchment and scaled appropriately in line with EA guidance.

Table 5-1 - Core and Lake Zone - Greenfield Runoff Rates

Return Period (years)	Existing Surface Water Discharge Rates [196ha total drained area of the Core and Lake Zones] (l/s)
Q_{Bar}	500.38
1 in 1	435.33

Return Period (years)	Existing Surface Water Discharge Rates [196ha total drained area of the Core and Lake Zones] (l/s)
1 in 30	1225.93
1 in 100	1781.36

- 5.2.4. Based on **Table 5-4** the total area of 196ha and calculated flow rate of 500.38 l/s, the Core and Lake Zone resultant Q_{Bar} Greenfield run-off rate per hectare is 2.5l/s/ha.

Table 5-2 - East Gateway Zone - Greenfield Run-off Rates

Return Period (years)	Existing Surface Water Discharge Rates [per 50 ha] (l/s)
Q_{Bar}	156.46
1 in 1	136.12
1 in 30	383.34
1 in 100	557.01

- 5.2.5. Based on a 50ha catchment area (in accordance with EA guidance) and the calculated rate of 156.46 l/s, the East Gateway Zone resultant Q_{Bar} Greenfield run-off rate per hectare is 3.13l/s/ha.

Table 5-3 - West Gateway Zone - Greenfield Run-off Rates

Return Period (years)	Existing Surface Water Discharge Rates [per 50 ha] (l/s)
Q_{Bar}	156.46
1 in 1	136.12
1 in 30	383.34
1 in 100	557.01

- 5.2.6. Based on a 50ha catchment area (in accordance with EA guidance) and the calculated rate of 156.46 l/s, the West Gateway Zone resultant Q_{Bar} Greenfield run-off rate per hectare is 3.13l/s/ha.

5.3. PROPOSED SURFACE WATER DRAINAGE STRATEGY

- 5.3.1. Refer to **Annex 2 of Appendix 12.3: Drainage Strategy (Volume 3)** for the proposed site wide surface water strategy drawing reference 320-1000-P-CE100.

5.3.2. The Site development area (drained area) is 236.2ha and for the purpose of the outline surface water drainage strategy a cautious worst case approach has been taken (which provides a robust assessment of likely significant effects), with the assumption of a 90% impermeability factor applied to the entirety of the Proposed Development area. Drained areas do not account for 100% of the total development area due to landscaping and informal drained arrangements. The following locations are hydraulically isolated from the main Site drainage network and surface water runoff will be managed locally by their own isolated systems to a nearby suitable outfall, controlled at existing greenfield rates, with pollution prevention measures in accordance with CIRIA C753 Simple Index Approach (SIA). Where existing drainage systems are in place and function as intended, they will continue to be used or be locally upgraded/repaired where necessary;

- A421;
- Ampthill B530 (north);
- Kempston Hardwick Station;
- Midland Main Railway Line to the east; and
- Marston Vale Railway Line.

5.3.3. Any increase in impermeable area as a result of detailed design for these areas will drain to localised SuDS with appropriate pollution prevention measures.

Table 5-4 - Drained Area by Zone

Zone	Drained area in ha (total 236.2 ha)
Core Zone	96.7
East Gateway Zone	14.0
Lake Zone	98.8
West Gateway Zone	26.7

5.3.4. Due to the risk of surface water flooding identified in the location of the Site and the lifespan of the development (refer to Section 2), a climate change allowance of 40% will be applied to rainfall when sizing drainage infrastructure for the 1 in 100-year probability return period.

5.3.5. The proposed surface water discharge rates are based on greenfield run-off rates in accordance with the requirements of the Bedford BC Level 2 SFRA⁶/Supplementary Planning Document for Sustainable Drainage Systems, using the FEH Statistical Method as per the *Environment Agency Flood Estimation Guidelines (FEG) Version 9 dated December 2022*. The proposed surface water discharge rates per hectare are shown in **Table 5-5**, below. This approach has been agreed with the IDB, please refer to the joint IDB - EA SoAP (Appendix 6 of the **Planning Statement (Document Reference 6.1.0)**).

Table 5-5 - Proposed Surface Water Discharge Rates

Zone	Surface Water Discharge Rates (l/sha)
Core and Lake Zone	2.5

Zone	Surface Water Discharge Rates (l/sha)
East Gateway Zone	3.13
West Gateway Zone	3.13

5.3.6. The Site has been split into three drainage catchments, each with their own outfall location:

CORE AND LAKE ZONES

- 5.3.7. As described in Section 3, the Core Zone has an existing ordinary watercourse routing through the centre of the Site in a southeast to northwest direction. To allow for the Proposed Development, this watercourse is proposed to be diverted along the eastern boundary of the Site and the form, shape and appearance will be enhanced through a meandering low flow channel within the main channel base (note that tops of bank remain straight) which may include alternate berms in the channel to vary flow and provide sinuosity, varied side slopes, landscaping vegetation, improved gradients, and cross-sectional shape.
- 5.3.8. The watercourse diversion will be designed in engagement with the IDB and will include a 10m riparian protection zone (the “Riparian Zone”) set back from the top of bank. The Riparian Zone has important benefits including habitat and habitat connectivity, strengthening riverbanks, diffusing pollution mitigation, reducing risk of flooding, and amenity/recreation. Existing vegetation in the Riparian Zone will be protected and if disturbed (during the Primary Construction Phase) will be replaced with similar or improved landscape vegetation. Proposed permanent constructed features e.g. roads, car parking, hard pavements, buildings, barriers, walls and fences, will not be located within 10m of the top of bank.
- 5.3.9. Also included is the IDB Byelaw Zone which currently exists for the existing watercourse route and will be transferred to the diverted watercourse location. The 9m distance from the top of bank on both sides allows the IDB to control activities within this zone, to undertake operation, maintenance or improvement of any watercourse within its region, enforced under the power and authority vested in the IDB by the Land Drainage Act 1991. Works or structures may be permitted within the IDB Byelaw Zone subject to the formal consenting process under the Land Drainage Consent which the Board must approve before works take place. A Land Drainage Application will be submitted to the IDB for technical approval post planning consent at the detailed design stage. UDX will maintain all drainage and watercourses within Core and Lake Zone to **Annex 3** SUDS Maintenance Schedule. Bedford Group IDB have a duty to exercise a general supervision relating to drainage within its district. Under the Land Drainage Act 1991 there are permissive legal powers that permit the IDB to access, maintain and improve watercourses within its area should the systems fall into disrepair or poor condition through lack of maintenance.

- 5.3.10. It is proposed that the Core Zone will drain to the diverted watercourse, this watercourse will then discharge into the Kempston Hardwick Clay Pits (North) - artificial lake, in the Lake Zone, via a proposed culvert connection beneath Manor Road, replacing the existing culverted connection. Typical sections for the diverted watercourse can be found in **Annex 2 of Appendix 12.3: Drainage Strategy (Volume 3)** (reference 320-1000-S-CE001). The diverted watercourse and culvert beneath Manor Road are to be adequately sized to take Site flows, any existing off-site flows and the future overflow originating from the Coronation Pit as advised by the IDB. From here the Kempston Hardwick Clay Pits (North) - artificial lake will discharge to the proposed Lake Zone strategic attenuation.
- 5.3.11. The Lake Zone strategic attenuation will be a wetland feature with a permanent level of water, attenuation volume for the Core and Lake Zones and adequate storage for water harvesting requirements and emergency storage in the event of pump failure. The disused pits will be carefully reprofiled, existing rubble/bricks/sediment will be removed as required and reused where possible. Surface Water run-off will be conveyed through multiple levels of treatment and stored in the pits. The proposed bank treatment includes varied side slopes, flat landings, and enhanced landscaping, which provides a supporting environment, encouraging biodiversity and self-sustaining resilient ecosystems. The top of bank for the wetland feature will have a minimum of 10m clearance from areas of slope instability within the existing clay pits. The Lake discharge will be pumped and returned to the Utility Compound in the southern part of the Lake Zone where a water processing and collection plant is to be located it will enter a valve complex and either;
- Discharge via a further rising main to the water processing and collection plant and provide process water for the Proposed Development or;
 - At times when the water processing and collection plant does not require inflows, discharge to the Kempston Hardwick Clay Pits (North) - artificial lake or Elstow Brook at a rate not to exceed the greenfield QBar run-off rate for the contributing catchment.
- 5.3.12. Discharge to the Elstow Brook will be maintained at a minimum equivalent greenfield rate for the 50ha of the Lake Zone currently draining directly to the Elstow Brook for all return period events to ensure the watercourse is not starved of flows.
- 5.3.13. The valve compound telemetry will be configured to make sure flows are released to the correct receptor (Elstow Brook or the artificial lake) so as not increase surface water flood risk on or off-Site.
- 5.3.14. Lake Zone includes isolated works to the existing artificial lake where existing surface water drainage connections are located which will be upgraded to accommodate increased flow rates. However, the artificial lake is not designed for attenuation storage, thus protecting the existing water level fluctuation and maintaining the habitat zone located along the bank near to waters-edge.

WEST GATEWAY ZONE

- 5.3.15. The West Gateway Zone will discharge to the Elstow Brook to the east of the Zone at the Greenfield Q_{Bar} rate, with attenuation storage provided for events up to and including the 1 in 100-year plus 40 % climate change annual probability event within the zone. Attenuation is to be provided within on-Site attenuation basins supplemented by upstream SuDS devices where appropriate. Where the proposed road crosses the existing Elstow Brook a clear span bridge structure, the soffit level will be set 600mm higher than the 1 in 100 year plus climate change modelled river level and proposed to ensure that flow is maintained within the watercourse and flooding is not increased upstream. The bridge abutments will be set back 10m from the top of bank with detailed design informed by riparian habitat, bank stability and ecological importance to reduce impacts. The bridge will be designed in engagement with the IDB and the EA under the Land Drainage Act 1991.

EAST GATEWAY ZONE

- 5.3.16. The East Gateway Zone will discharge to the nearby ordinary watercourse located south of the Zone which drains via gravity to Harrowden Brook. Flows will be restricted to the Greenfield Q_{Bar} rate, with attenuation storage provided for events up to and including the 1 in 100-year plus 40% climate change annual probability event within the zone. Attenuation is to be provided on-site via attenuation basins supplemented by upstream SuDS devices where appropriate for pollution prevention.
- 5.3.17. Approved planning permission 23/02136/M73 for the 'Railway Quarter' is located outside of the Site boundary to the east of the Midland Main Railway Line. Associated surface water infrastructure will discharge runoff to Harrowden Brook, utilising existing surface water stubs provided on the Harrowden Green development, along with flow controls, attenuation and pollution prevention measures. The 'Railway Quarter' proposal is separate to the East Gateway proposed development and there are no interdependencies relating to surface water systems.

ATTENUATION VOLUMES

- 5.3.18. As part of the Proposed Development each area has been modelled using Infodrainage to determine the required amount of attenuation to accommodate the 1 in 100-year probability rainfall event +40% climate change allowance and to ensure that the Site's discharge rate does not exceed greenfield run-off rates for each storm event. The results of this modelling are provided within **Annex 1 of Appendix 12.3: Drainage Strategy (Volume 3)**, and attenuation requirements for each catchment area are summarised below.

CORE AND LAKE ZONE ATTENUATION

- 5.3.19. The strategic attenuation volume requirements and associated greenfield discharge rates for the Core and Lake Zones will be phased based on the buildout of the development across three distinct stages, an area summary of each stage can be found below in **Table 5-6** to
- 5.3.20. **Table 5-8.**
- Stage 1: Opening Year; Run-off received from the Core Zone development, Manor Road Improvement Works, the self-area of the Lakes and a Construction Compound;
 - Stage 2: Full Buildout ; Run-off received from all areas within stage 1 with the addition of the Lake Zone development;

- Stage 3: Full Buildout plus Coronation Pit overflow; This Stage represents the maximum drained area, with run-off received from all areas in stages 1 and 2 with the addition of flows from the Coronation Pit (as described above). Also included are flows from the Kempston Hardwick Claypit South and the Coronation Business Park to represent a cautious worst case scenario for required attenuation volumes; and
- Storage will also be provided at each stage for rainwater harvesting requirements (further details can be found in Section 5.5) and an emergency storage volume of 125m³/ha in the event of pump failure in accordance with the methodology described in the Design and Construction Guidance from *Water UK's Codes for Adoption*²³.

Table 5-6 - Core and Lake Zone Strategic Attenuation Stage 1 Drained Area

Stage	Catchment	Catchment Area (ha)	Percentage Impermeable	Impermeable Area (ha)
Stage 1	Core Zone	93.6	90%	84.2
	Manor Road Improvement Works	5	90%	5
	Lakes Self Area	23	100%	23
	Lake Zone Construction Compound	10	90%	9
	Total	131.6	-	121.2
Discharge Rate (Greenfield Q_{Bar}) 2.5l/s/ha				303

Table 5-7 - Core and Lake Zone Strategic Attenuation Stage 2 Drained Area

Stage	Catchment	Catchment Area (ha)	Percentage Impermeable	Impermeable Area (ha)
Stage 2	Opening Year Stage	131.6	n/a	121.2
	Lake Zone	56	90%	50
	Total	187.6	-	171.2
Discharge Rate (Greenfield Q_{Bar}) 2.5l/s/ha				428

²³ Water UK (2021) *Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England ("the Code")*. Available at: <https://www.water.org.uk/wp-content/uploads/2021/07/SSG-App-C-Des-Con-Guide.pdf> [Accessed: 29 October 2024].

Table 5-8 - Core and Lake Zone Strategic Attenuation Stage 3 Drained Area

Stage	Catchment	Catchment Area (ha)	Percentage Impermeable	Impermeable Area (ha)
Stage 3	Full Buildout Stage	187.6	n/a	171.2
	Kempston Hardwick Clay Pits South	48	100%	48
	Coronation Business Park	12	90%	11
	Coronation Pit	59	100%	59
	Stewartby Development	29	70%	20
	Total	335.6	-	309.2
Discharge Rate (Greenfield Q_{Bar}) 2.5 l/s/ha				773

5.3.21. The attenuation for the Core and Lake Zones is to be provided within a strategic wetland attenuation feature in the north of the Lake Zone, the volume requirements and associated maximum discharge rates for each of the three buildout stages are itemised in **Table 5-9** to **Table 5-11**, below. Storage depths provided are above the level of permanent water and are based on a feature with a base area of permanent water of 109,800m² as shown in the Proposed Site Wide Surface Water Strategy drawing in **Annex 2** of **Appendix 12.3: Drainage Strategy (Volume 3)**, reference 320-1000-P-CE100.

Table 5-9 - Core and Lake Zone Strategic Attenuation Stage 1 Storage Requirements

Storage Requirement	Storage Volume (m3)	Storage Depth [based on 109,800m2 base area] (m)
1:100-year +40% CC Attenuation Volume	127,025	1.16
35-day Rainwater Harvesting Volume	48,355	0.68 (Pit 3 only)
Pump Failure Emergency Storage Volume	15,150	0.14
Total	190,510	1.98(+500mm Freeboard)

Table 5-10 - Core and Lake Zone Strategic Attenuation Stage 2 Storage Requirements

Storage Requirement	Storage Volume (m3)	Storage Depth [based on 109,800m2 base area] (m)
1:100-year +40% CC Attenuation Volume	179,500	1.63
35-day Rainwater Harvesting Volume	50,470	0.71 (Pit 3 only)

Storage Requirement	Storage Volume (m3)	Storage Depth [based on 109,800m2 base area] (m)
Pump Failure Emergency Storage Volume	21,400	0.20
Total	251,370	2.54(+500mm Freeboard)

Table 5-11 - Core and Lake Zone Strategic Attenuation Stage 3 Storage Requirements

Storage Requirement	Storage Volume (m3)	Storage Depth [based on 109,800m2 base area] (m)
1:100-year +40% CC Attenuation Volume	323,950	2.95
35-day Rainwater Harvesting Volume	50,470	0.71 (Pit 3 only)
Pump Failure Emergency Storage Volume	39,650	0.35
Total	413,070	4.01(+500mm Freeboard)

- 5.3.22. Typical sections for the strategic attenuation feature can be found in **Annex 2 of Appendix 12.3: Drainage Strategy (Volume 3)**, reference 320-1000-S-CE002 including indicative water levels for each of the build out phases.

EAST AND WEST GATEWAY ZONES ATTENUATION

- 5.3.23. The attenuation for the East and West Gateway Zones is to be provided within both the East Gateway Zone and the West Gateway Zone. In the West Gateway Zone this will take the form of a detention basin, and for the East Gateway Zone attenuation will be provided within a feature within the zone, the form of this will be determined during detailed design. The details of the attenuation requirements are in **Table 5-12**, below.

Table 5-12 - Proposed Attenuation requirements East and West Gateway Zones

Zone	Catchment Area (ha)	Impermeable Area (ha)	Max Discharge Rate (l/s)	Required Attenuation (m³)
East Gateway Zone (outside of planning applications 23/02136/M73 and 23/02629/MDC3)	6	5.4	18.8	5,950
West Gateway Zone	30	27	84.5	26,700

PRE AND POST DEVELOPMENT SITE DISCHARGE RATES

- 5.3.24. **Table 5-13** below, summarises the pre and post development discharge rates for the Site for all events up to and including the 1 in 100-year storm event plus 40% climate change.

Table 5-13 - Pre and Post Development Discharge Rates

Zone	Post Development Maximum Discharge Rate (l/s) Q_{Bar}	Greenfield 1 in 1-Year Discharge Rate (l/s)	Greenfield 1 in 30-year Discharge Rate (l/s)	Greenfield 1 in 100-year Discharge Rate (l/s)
East Gateway Zone	18.8	16.3	46	66.8
West Gateway Zone	84.5	82	230	334
Core and Lake Zones (Stage 1)	303	255.5	718.8	1,236.3
Core and Lake Zones (Stage 2)	428	385.3	1,084.4	1,865.1
Core and Lake Zones (Stage 3)	773	691.8	1,946.9	3,348.6

CAPTURE AND CONVEYANCE

- 5.3.25. Surface water will be conveyed via a gravity system in all cases aside from the discharge from the strategic attenuation in the Lake Zone, which will be pumped to the water processing and collection plant in the south of the Lake Zone or when flows are not required for process water, pumped to an outfall at the Elstow Brook at a maximum of greenfield Q_{Bar} rates. The collection mechanism for surface water may include but not be limited to; swales, below ground pipe networks, green roofs and rain gardens.
- 5.3.26. To ensure the effectiveness of the proposed drainage strategy a robust maintenance regime, in accordance with *CIRIA guidance*²², will be implemented to ensure future performance of all SuDS and drainage components. The SuDS Maintenance and Management Plan can be found in **Annex 3 of Appendix 12.3: Drainage Strategy (Volume 3)**.
- 5.3.27. The above strategy identifies the general principles of surface water drainage management at the Site. Assumptions and design solutions proposed will be refined at the detailed design stage and all necessary approvals sought.

WATER FRAMEWORK DIRECTIVE CONSIDERATION AND ASSESSMENT

- 5.3.28. The Water Framework Directive (WFD) applies to surface waters and groundwaters, and focuses on ensuring good qualitative and quantitative health, reducing, and removing pollution, and ensuring adequate quantity of water in the WFD classified receptor.
- 5.3.29. The Proposed Development has been designed with embedded WFD Consideration, details are contained in **Chapter 12: Water Resources (Volume 1)** Section 12.6.3 to 12.6.8. A WFD Screening and Scoping Assessment will be submitted at detailed design stage and approved by the Environment Agency under permitting or a similar mechanism in agreement with the stakeholder, to deliver on the embedded commitments made under WFD Consideration, resulting in no significant impact to biological and chemical status of Elstow Brook and Harrowden Brook, and no deterioration to WFD status and future objectives.

5.4. SURFACE WATER MODELLING ASSUMPTIONS AND RESULTS

5.4.1. When undertaking the modelling for the surface water drainage strategy the following assumptions were made:

- Infodrainage simulation software has been used for all hydraulic design;
- FEH 2022 rainfall data has been used;
- HR Wallingford Greenfield Run-off Rate Estimation Tool²⁴ has been used to determine the proposed greenfield run-off rates;
- All development land uses are assumed to be 90% impermeable at this preliminary stage and will be reviewed at detailed design stage;
- CV values are set at 1.0 (100%) within Infodrainage, for conservative measures at this stage, at the detailed design this figure will be reviewed in engagement with the LLFA;
- Total development area is 236.6ha, which will be split into three separate drainage networks with their own outfall location. These can be categorised as Core and Lake Zone (195.5ha), East Gateway Zone (14.7ha) and West Gateway Zone (26ha);
- For the purpose of the drainage strategy the existing Site has been considered as greenfield. This is a cautious worst case approach as the Lake Zone is currently partially impermeable due to the former brickworks and existing clay pits;
- The proposed drained area of the Site is considered to be 212.94ha (based on 90% of proposed Site as impermeable); and
- The proposed drainage strategy has been designed for the 1 in 100-year probability rainfall event plus 40% climate change allowance.

5.4.2. Modelling results are available in **Annex 1 of Appendix 12.3: Drainage Strategy (Volume 3)**.

5.5. SURFACE WATER REUSE AND RECYCLING

5.5.1. As part of the DS, surface water captured where practicable will be re-used as the water supply for the on-site process water. As such, an allowance for rainwater harvesting volumes has been made when determining the total surface water storage volumes for the Core and Lake Zones.

5.5.2. Outline rainwater storage volume requirements have been assessed on the basis of British Standard BS EN 16941-1:2024²⁵, assuming provision of harvested water for a typical UK dry period. This calculation assumes all impermeable areas are drained from the Core and Lake Zones and are to be stored in the enhanced Kempston Hardwick Clay Pits as described in the drainage strategy.

²⁴ HR Wallingford (n.d.) *Tools for SuDS design*. Available at: <https://www.uksuds.com/> [Accessed: 29 October 2024].

²⁵ British Standards Institution (2024) *BS EN 16941-1:2024 – On-site non-potable water systems - Systems for the use of rainwater*.

- 5.5.3. Refer to **Appendix 12.2: Water Strategy (Volume 3)** of the ES, for full details of rainwater harvesting requirements. The British Standard²⁵ states that a typical dry period is 18 days with no rainfall however a 35-day period has been allowed for in the below calculations based on Site demands. Based on this the following calculation has been undertaken to inform the volume of stored water required for the different phases of buildout within the Core and Lake Zones, below is the example for Stage 2, Full Buildout Stage:

daily average rainfall volume x 35 days of storage = required storage volume

$$1,442 \text{ m}^3/\text{day} \times 35 \text{ days} = 50,470 \text{ m}^3$$

Required storage volume/attenuation wetland (Enhanced Clay Pits) base area = depth of storage within Lake Zone

$$50,470 \text{ m}^3 / 71,650 \text{ m}^2 = 0.704 \text{ m} \approx 0.70 \text{ m}$$

- 5.5.4. Details of the rainwater harvesting volumes required at different stages of buildout for the Core and Lake Zones are in Section 5.3 above.
- 5.5.5. Detailed volume requirements will be assessed in later design stages, including requirements for the West and East Gateway Zones.

5.6. SURFACE WATER QUALITY CONTROL

- 5.6.1. SuDS provide natural variability in their ability to remove contamination from surface water run-off which drains across a site, therefore the management of water quality is founded on a risk-based approach. The current SuDS Manual (C753)²² suggests an approach based on land use type and specific contaminants.
- 5.6.2. Section 26 of the manual outlines the Simple Index Approach (SIA) for low-risk developments, which follows a three-step process, namely:
- Allocate suitable pollution hazard indices for the proposed land uses;
 - Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index; and
 - Where the discharge is protected surface waters or groundwater, consider the need for a more precautionary approach.
- 5.6.3. To successfully deliver adequate treatment, the chosen SuDS components will have a total pollution mitigation index that equals or exceeds the pollution hazard index.

Total SuDS mitigation index \geq Pollution hazard index

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

$$\text{Total SuDS mitigation index} = \text{mitigation index}_1 + 0.5 (\text{mitigation index}_2)$$

Where:

Mitigation Index_n = mitigation index for component n

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

Table 5-14 - Pollution Hazard Indices for Different Land Use Classes

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from roof)	0.05
Individual property driveways, residential car parks. Low traffic roads (e.g. cul-de-sacs, home zones and general access roads) and non-residential car parks with infrequent change (e.g. schools, offices) - i.e. <300 traffic movements/day.	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential parking with frequent change (e.g. hospitals/retail); all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites); sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial site; trunk roads and motorways. ¹	High	0.8 ²	0.8 ²	0.9 ²

¹ Motorways and trunk roads should follow the guidance and risk assessment process set out in the Design Manual for Roads and Bridges LA 113²⁶.

² These should only be used if considered appropriate as part of a detailed risk assessment –required for all these land use types (see also SuDS manual Table 4.3). When dealing with high hazard sites, the environmental regulator should first be engaged for pre-permitting advice. This will help to determine the most appropriate treatment approach to the development of a design solution

Source: SuDS Manual CIRIA C753²²

²⁶ Standards for Highways (2020) *Design Manual for Roads and Bridges: LA 113 - Road drainage and the water environment*. Available at: <https://www.standardsforhighways.co.uk/search/d6388f5f-2694-4986-ac46-b17b62c21727> [Accessed: 14 May 2025].

- 5.6.5. Given the nature of the Proposed Development, WSP considers that the cautious worst case pollution hazard indices for the Site are as shown in **Table 5-15**, all areas are assessed against this hazard level.

Table 5-15 - Pollution Hazard Indices for the Proposed Development

Area	Pollution Hazard Level	TSS	Metals	Hydrocarbons
Commercial yard and delivery areas, non-residential parking with frequent change (e.g. hospitals/retail); all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7

- 5.6.6. The surface water run-off from the Proposed Development has a medium pollution hazard level. This assessment of pollution hazard levels is based on current design proposals.
- 5.6.7. SuDS Mitigation Indices for each catchment are identified in **Table 5-16 to Table 5-18**, below (reproduced from information in Table 26.3 of C753²²).

Table 5-16 - SuDS Mitigation Indices for Core and Lake Zone

Type of SuDS Component	TSS	Metals	Hydrocarbons
Wetland	0.8	0.8	0.8
Total SuDS Mitigation Index	0.8	0.8	0.8

- 5.6.8. The wetland for the Core Zone and Lake Zone will be provided as part of the surface water attenuation in the Kempston Hardwick water feature system. The wetland will be reliant on good sediment and source control using SuDS within the catchment. From the table above the SuDS mitigation indices for the Zone are higher than the pollution hazard indices and therefore meet the requirements of the SIA in CIRIA C753²².

Table 5-17 - SuDS Mitigation Indices for West Gateway Zone

Type of SuDS Component	TSS	Metals	Hydrocarbons
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Total SuDS Mitigation Index	0.85	0.85	0.85

- 5.6.9. A detention basin and pond are to be provided for surface water attenuation within the West Gateway Zone and will provide the required mitigation for the Zone. For the secondary component (pond) a factor of 0.5 has been accounted for the reduced performance associated with already reduced inflow concentration. From **Table 5-15** above the SuDS mitigation indices for the Zone are higher than the pollution hazard indices and therefore meet the requirements of the SIA in CIRIA C753²².

Table 5-18 - SuDS Mitigation Indices for East Gateway Zone

Type of SuDS Component	TSS	Metals	Hydrocarbons
Proprietary System: Up-Flo Filter Sand by Hydro International or similar	0.8	0.6	0.7
Total SuDS Mitigation Index	0.8	0.6	0.7

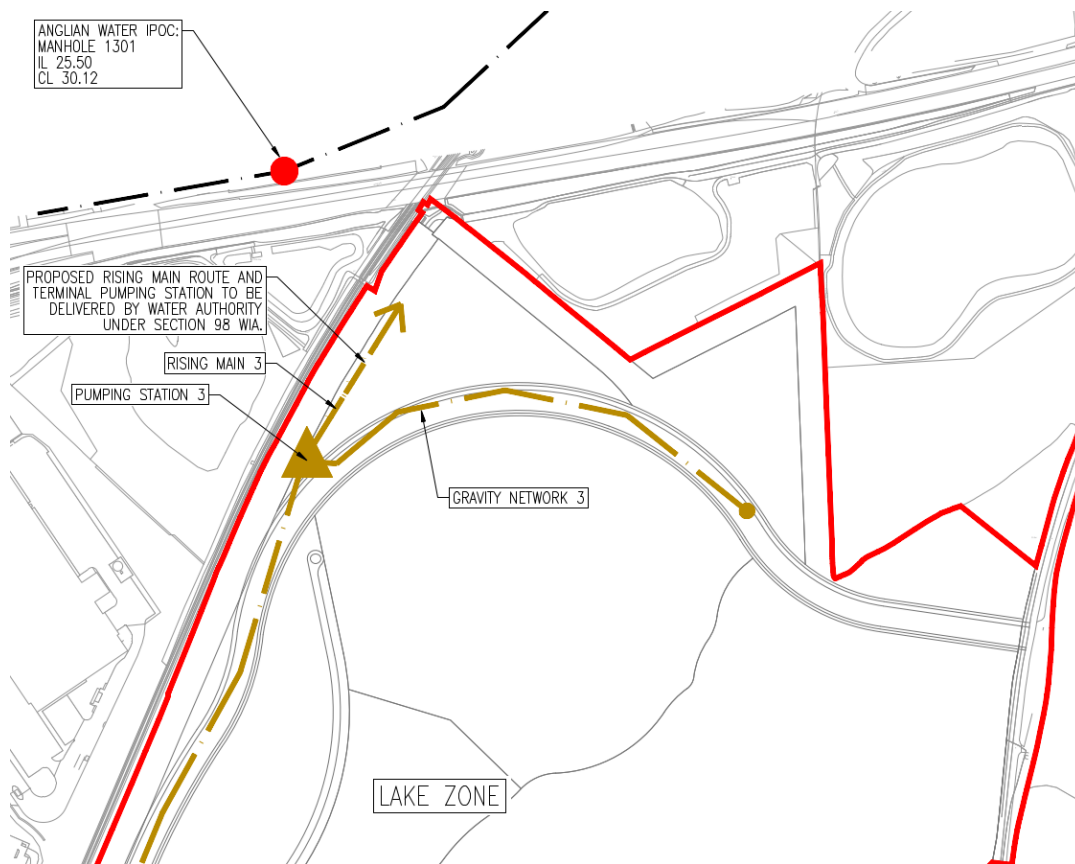
- 5.6.10. East Gateway Zone will be served by a proprietary treatment device such as Hydro-International's Up-Flo Filter Sand to treat run-off in a 4-5 stage treatment train in a single device. From **Table 5-18** the SuDS mitigation indices for the Zone are equal or higher than the pollution hazard indices and therefore meet the requirements of the SIA in CIRIA C753²².

5.7. PROPOSED FOUL WATER STRATEGY

- 5.7.1. A pre-development enquiry to identify if capacity is available in the local sewer infrastructure for foul flows from the Site was submitted to AW. Refer to **Annex 3** of **Appendix 12.1: Flood Risk Assessment (Volume 3)** for the AW pre-planning enquiry report. A SoAP is also included in Appendix 4 of the **Planning Statement (Document Reference 6.1.0)** which states that AW will provide all domestic foul connection points, upgrade existing infrastructure where required, and continue working with UDX regarding flow rates and loadings, including the volume and timings so that AW can design and construct the supporting infrastructure for the Site.
- 5.7.2. AW advised that based on the anticipated Site flows a 525mm diameter sewer is required to drain the Site. They confirmed the nearest suitable connection point is at manhole 1301, northwest of the Site (grid ref TL 03128 46311) as shown in

- 5.7.3. **Image 5-1.** AW state there is currently insufficient capacity within this existing sewer to accommodate the proposed flows from the Site, however as stated in AW SOAP (Appendix 4 of the **Planning Statement (Document Reference 6.1.0)**) will upgrade existing infrastructure where required.
- 5.7.4. The foul drainage from the Site is in the catchment of Bedford Water Recycling Centre (WRC). AW has advised that Bedford WRC does not currently have capacity to treat flows from the Site. However, as stated in the site-specific Pre-Planning Application reference PPE-0200598, AW acknowledged that they are obligated to accept the domestic foul flows (e.g., flows from toilets and kitchens, etc.) from the Proposed Development with the benefit of planning consent. Anglian Water has confirmed that Bedford WRC will be upgraded under their Assessment Management Plan AMP8 (2025-2030) which is independent of the proposed development. Upgrades of all existing infrastructure required for the development will be undertaken by Anglian Water as stated in the AW SoAP appended to the **Planning Statement (Document Reference 6.1.0)**. Further to a meeting dated 14 June 2024 (minutes can be found in **Appendix 12.1: Flood Risk Assessment (Volume 3)**) AW confirmed that Bedford WRC will be upgraded under the Asset Management Plan cycle AMP8 2025-2030 which will be complete toward the end of that cycle.

Image 5-1 - Proposed Location of Foul Water Connection



- 5.7.5. The private foul drainage network will be further developed during detailed design stages. However, a preliminary strategy for each Zone is shown in **Annex 2 of Appendix 12.3: Drainage Strategy (Volume 3)**.
- 5.7.6. West Gateway Zone will have a gravity network draining to a pumping station at the zone low point. A rising main will then connect into the Core Zone gravity network, which will drain to a pumping station at the northern part of Core Zone low point. East Gateway will drain to a local pumping station and then route along the proposed Manor Road alignment and connect to the northern part of Core Zone network via a rising main. Flows from the Core Zone pumping station will be pumped into a gravity system within Lake Zone which falls towards the northwest of Lake Zone to the Site terminal pumping station. It is anticipated that the local water authority will deliver the terminal pumping station and rising main route which will connect into Anglian Water manhole 1301, via a Sewer Requisition, Section 98 of the Water Industry Act 1991.
- 5.7.7. As per approved planning application 23/02136/M73, the 'Railway Quarter' located outside of the Site boundary discharges proposed foul flows to Harrowden Green development which is separate to East Gateway Zone, and there are no interdependencies in relation to foul water systems.
- 5.7.8. Refer to **Annex 2 of Appendix 12.3: Drainage Strategy (Volume 3)** for an indicative foul water strategy, reference 320-1000-P-CE200.

6. OFF-SITE EFFECTS

6.1. SURFACE WATER FLOODING

- 6.1.1. The surface water drainage strategy demonstrates that the drainage network at the Site is designed to accommodate run-off during all events up to and including the 1 in 100-year probability event plus 40% climate change allowance and will discharge at the greenfield Q_{Bar} rate, therefore preventing potential exceedance flows off-Site. Refer to **Annex 2 of Appendix 12.3: Drainage Strategy (Volume 3)** for the drainage strategy plan, including exceedance flow routes to direct flows towards SuDS features and watercourses.
- 6.1.2. **Section 7.2 of Appendix 12.1: Flood Risk Assessment (Volume 3)** provides a description of the mitigation on-site against existing identified surface water flood risk and prevention of increase in offsite risk.

6.2. PUBLIC DRAINAGE NETWORK

- 6.2.1. No discharge of surface waters to public sewers is proposed. In terms of foul drainage, AW have provided an infrastructure point of connection northwest of the Site for foul drainage and stated that the public foul water drainage network has insufficient capacity within the sewerage network and the receiving water recycling centre. Anglian Water has confirmed that Bedford WRC will be upgraded under their Assessment Management Plan AMP8 (2025-2030) which is independent of the Proposed Development. They confirmed their obligation to accept domestic foul flows and will take the necessary steps to make sure that there is sufficient capacity in line with the project programme. This will make sure there is adequate headroom within AW's infrastructure and that the Site does not contribute to any sewer flooding off-site. Further details on the necessary upgrade works can be found in **Section 5.7** which references the AW SoAP (Appendix 6 of the **Planning Statement (Document Reference 6.1.0)**).

6.3. FLUVIAL EFFECTS

- 6.3.1. The Proposed Development land use is being applied on a sequential basis, allocating the most sensitive land uses to areas at lowest risk of flooding. Flood compensation is to be provided for the loss of Flood Zone 3 within the Site on a level for level basis and therefore no off-site flooding will be exacerbated. Details can be found in **Appendix 12.1: Flood Risk Assessment (Volume 3)** of the ES.

7. CONCLUSIONS - *FOR INFORMATION*

- 7.1.1. This DS has been prepared in support of the planning proposal for the Proposed Development as described in **Chapter 2: Description of the Proposed Development (Volume 1)** of the ES.
- 7.1.2. The proposed surface water drainage strategy demonstrates the ability to accommodate surface water run-off during all events up to and including the 100-year plus 40% climate change allowance scenario, to prevent potential exceedance flows off-site. Proposed finished ground levels will be engineered to prevent ponding, direct surface water flows towards the drainage system and mitigation provided to reduce off-site flood risk.
- 7.1.3. The potential for groundwater emergence has been identified due to the presence of an impermeable bed rock with isolated shallow deposits of alluvium and head. This will be mitigated by the DS intercepting surface water run-off and attenuating flows prior to discharge.
- 7.1.4. The proposed surface water drainage strategy optimises the use of SuDS in accordance with best practice, national and local policy and has been developed in discussion with the relevant stakeholders. Proposed surface water run-off will be attenuated to greenfield Q_{Bar} rates on Site and then discharged to the existing watercourses within or near the Site. Appropriate attenuation features will be provided for the storage volumes required for the 100-year + 40% climate change. The diverted watercourse within the Core Zone will be designed and sized to accommodate and convey on-Site flows and off-Site flows from areas upstream of the Site. This approach will not increase flood risk upstream or downstream of the Site. Details of flood risk are included in **Appendix 12.1: Flood Risk Assessment (Volume 3)** of the ES.
- 7.1.5. Rainwater re-use is included within the Proposed Development and volumes will be stored in the Kempston Hardwick Clay Pits (North) disused pits. Details are included in **Appendix 12.2: Water Strategy (Volume 3)** of the ES.
- 7.1.6. AW has provided an infrastructure point of connection for foul flows and confirmed that although there is currently insufficient capacity within their network, they have an obligation to accept domestic foul flows and will take the necessary steps to make sure that there is sufficient capacity, further detail can be found in Section 5.7 which refers to the AW SoAP (Appendix 6 of the **Planning Statement (Document Reference 6.1.0)**). On-Site foul flows will be conveyed by a series of gravity and pumped systems, out falling to an existing AW manhole to the northwest of the Site adjacent to the A421.
- 7.1.7. Based on the contents within this report it is concluded that, in terms of drainage, the Proposed Development is sustainable.

Annex 1

MODELLING RESULTS

wsp

Calculated by:	Joseph Leslie
Site name:	Core & Lake Zones
Site location:	Project 320, Bedford

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

Site Details

Latitude:	52.09057° N
Longitude:	0.49902° W
Reference:	2161662159
Date:	Oct 09 2024 13:55

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha):	196
-----------------------	-----

Methodology

Q _{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.316
Q _{MED} (l/s):	
Q _{BAR} / Q _{MED} factor:	1.12

Hydrological characteristics

	Default	Edited
SAAR (mm):	562	587
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

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

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

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

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

(3) Is $SPR/SPRHOST \leq 0.3$?

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

Q_{BAR} (l/s):		500.38
1 in 1 year (l/s):		435.33
1 in 30 years (l/s):		1225.93
1 in 100 year (l/s):		1781.36
1 in 200 years (l/s):		2106.61

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Calculated by: Joseph Leslie

Site name: East Gateway Zone

Site location: Project 320, Bedford

Site Details

Latitude: 52.08699° N

Longitude: 0.48796° W

Reference: 151930739

Date: Oct 09 2024 13:45

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

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 50

Methodology

Q_{MED} estimation method: Calculate from BFI and SAAR

BFI and SPR method: Specify BFI manually

HOST class: N/A

BFI / BFIHOST: 0.316

Q_{MED} (l/s):

Q_{BAR} / Q_{MED} factor: 1.12

Hydrological characteristics

	Default	Edited
SAAR (mm):	560	587
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

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

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

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

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

(3) Is $SPR/SPRHOST \leq 0.3$?

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

Q_{BAR} (l/s):		156.46
1 in 1 year (l/s):		136.12
1 in 30 years (l/s):		383.34
1 in 100 year (l/s):		557.01
1 in 200 years (l/s):		658.71

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Calculated by: Joseph Leslie

Site name: West Gateway Zone

Site location: Project 320, Bedford

Site Details

Latitude: 52.08702° N

Longitude: 0.51302° W

Reference: 2937761665

Date: Oct 09 2024 13:53

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

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 50

Methodology

Q_{MED} estimation method: Calculate from BFI and SAAR

BFI and SPR method: Specify BFI manually

HOST class: N/A

BFI / BFIHOST: 0.316

Q_{MED} (l/s):

Q_{BAR} / Q_{MED} factor: 1.12

Hydrological characteristics

	Default	Edited
SAAR (mm):	566	587
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

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

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

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

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

(3) Is $SPR/SPRHOST \leq 0.3$?

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

Q_{BAR} (l/s):		156.46
1 in 1 year (l/s):		136.12
1 in 30 years (l/s):		383.34
1 in 100 year (l/s):		557.01
1 in 200 years (l/s):		658.71

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix F – InfoDrainage Modelling Results

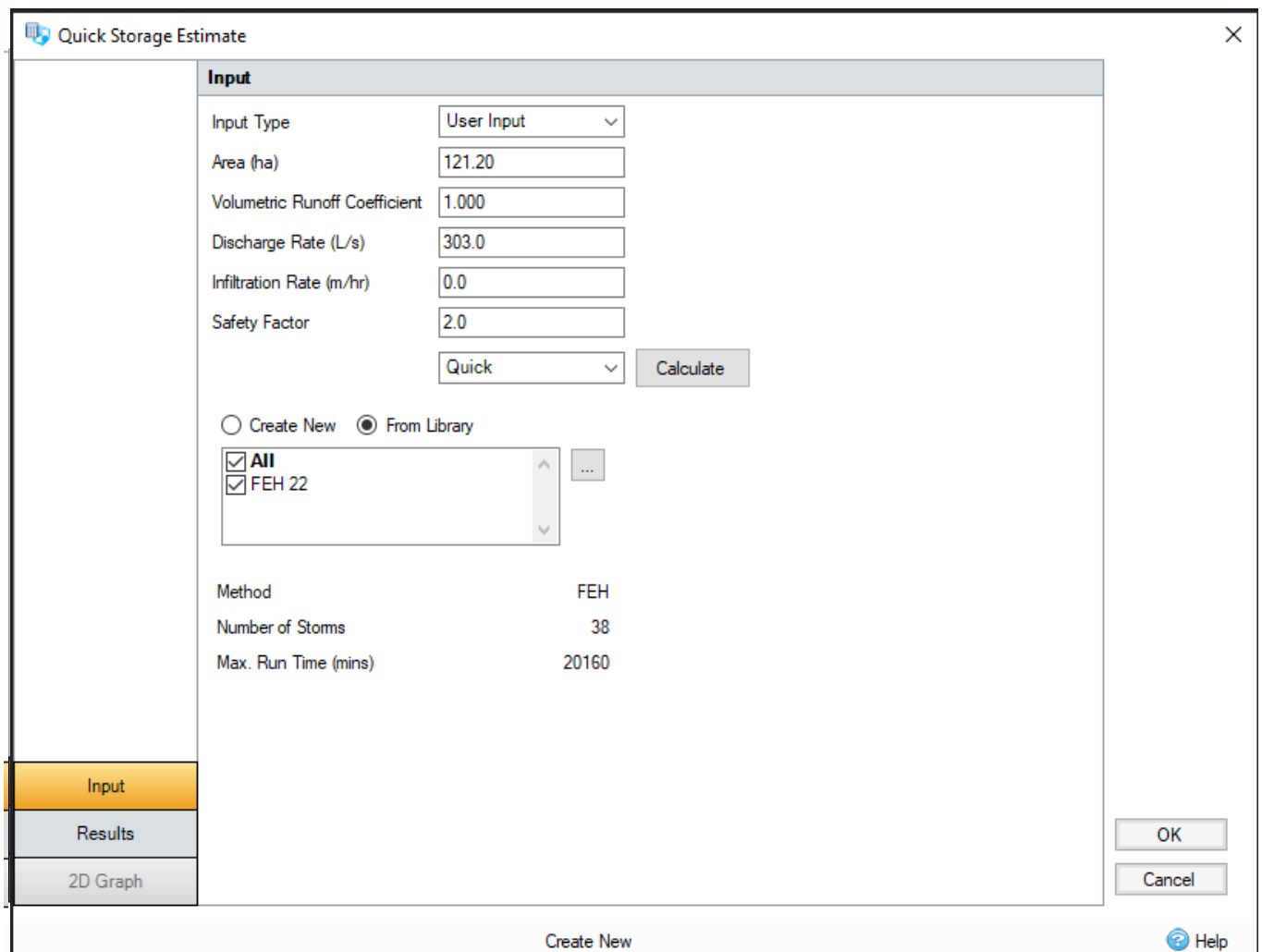
INTRODUCTION

The following calculations have been obtained using the Quick Storage Estimate (QSE) function in InfoDrainage software Version 2024.4 using FEH 2022 Rainfall Data to determine an estimate for the volume of attenuation required for each catchment for the 1 in 100 year annual probability event plus a 40% allowance for Climate Change.

CORE AND LAKE ZONE

1. Core and Lake Zone Strategic Attenuation Stage 1 (Initial Buildout) Storage Requirements

a. Inputs



The screenshot displays the 'Quick Storage Estimate' (QSE) software interface. The 'Input' tab is selected, showing various parameters for storage estimation. The 'Input Type' is set to 'User Input'. The 'Area (ha)' is 121.20, 'Volumetric Runoff Coefficient' is 1.000, 'Discharge Rate (L/s)' is 303.0, 'Infiltration Rate (m/hr)' is 0.0, and 'Safety Factor' is 2.0. The 'Quick' button is highlighted. Below these inputs, there are radio buttons for 'Create New' and 'From Library', with 'From Library' selected. A list of methods is shown, with 'All' and 'FEH 22' checked. The 'Method' is set to 'FEH', 'Number of Storms' is 38, and 'Max. Run Time (mins)' is 20160. The 'Calculate' button is visible. At the bottom, there are 'OK' and 'Cancel' buttons, and a 'Create New' button.

Input	
Input Type	User Input
Area (ha)	121.20
Volumetric Runoff Coefficient	1.000
Discharge Rate (L/s)	303.0
Infiltration Rate (m/hr)	0.0
Safety Factor	2.0
	Quick
<input type="radio"/> Create New <input checked="" type="radio"/> From Library	
<input checked="" type="checkbox"/> All <input checked="" type="checkbox"/> FEH 22	
Method	FEH
Number of Storms	38
Max. Run Time (mins)	20160

Calculate

Input Results 2D Graph

OK Cancel

Create New Help



b. Results

Quick Storage Estimate

Results

Quick Storage Estimate variables require approximate storage of between 100832m³ - 127025m³.

These values are estimates only and should not be used for final design purposes.

Input

Results

2D Graph

OK

Cancel

Create New

Help

2. Core and Lake Zone Strategic Attenuation Stage 2 (Final Buildout) Storage Requirements

a. Inputs

Quick Storage Estimate

×

Input

Input Type

User Input

Area (ha)

171.20

Volumetric Runoff Coefficient

1.000

Discharge Rate (L/s)

428.0

Infiltration Rate (m/hr)

0.0

Safety Factor

2.0

Quick

Calculate

☐ Create New
 ☒ From Library

☒ All
 ☒ FEH 22

...

Method

FEH

Number of Storms

38

Max. Run Time (mins)

20160

Input

Results

2D Graph

OK

Cancel

Create New

Help

b. Results

Quick Storage Estimate

×

Results

Quick Storage Estimate variables require approximate storage of between 142317m³ - 179405m³.

These values are estimates only and should not be used for final design purposes.

Input

Results

2D Graph

OK

Cancel

Create New

Help

3. Core and Lake Zone Strategic Attenuation Stage 3 (Final Buildout + Coronation Pit Overflow) Storage Requirements

a. Inputs

Quick Storage Estimate

Input

Input Type

User Input

Area (ha)

309.20

Volumetric Runoff Coefficient

1.000

Discharge Rate (L/s)

773.0

Infiltration Rate (m/hr)

0.0

Safety Factor

2.0

Quick

Calculate

☐ Create New
 ☒ From Library

☒ All
 ☒ FEH 22

...

Method

FEH

Number of Storms

38

Max. Run Time (mins)

20160

Input

Results

2D Graph


OK

Cancel

Create New

Help

b. Results

 Quick Storage Estimate
 ×

Results

Quick Storage Estimate variables require approximate storage of between 256625m³ - 323934m³.

These values are estimates only and should not be used for final design purposes.

Input


Results

2D Graph

OK


Cancel

Create New

 Help

EAST GATEWAY DISTRICT

a. Inputs

 Quick Storage Estimate
 ×

Input

Input Type

User Input

Area (ha)

6.00

Volumetric Runoff Coefficient

1.000

Discharge Rate (L/s)

18.78

Infiltration Rate (m/hr)

0.0

Safety Factor

2.0

Full (inc. graphs)

Calculate

☐ Create New
 ☒ From Library

☒ All
 ☒ FEH 22

...

Method

FEH

Number of Storms

38

Max. Run Time (mins)


20160

Input

Results

2D Graph

Create New

 Help

OK

Cancel

b. Results

Results

Quick Storage Estimate variables require approximate storage of between 4800m³ - 5928m³.

These values are estimates only and should not be used for final design purposes.

Input

Results

2D Graph

OK

Cancel

Create New

 Help



WEST GATEWAY DISTRICT

a. Inputs

Quick Storage Estimate

Input

Results

2D Graph

Input Type

User Input

Area (ha)

27.00

Volumetric Runoff Coefficient

1.000

Discharge Rate (L/s)

84.51

Infiltration Rate (m/hr)

0.0

Safety Factor

2.0

Full (inc. graphs)

Calculate

Create New

From Library

All

FEH 22

...

Method

FEH

Number of Storms

38

Max. Run Time (mins)

20160


OK

Cancel

Create New

Help

b. Results

 Quick Storage Estimate
 ×

Results

Quick Storage Estimate variables require approximate storage of between 21589m³ - 26676m³.

These values are estimates only and should not be used for final design purposes.

Input


Results

2D Graph

OK

Cancel

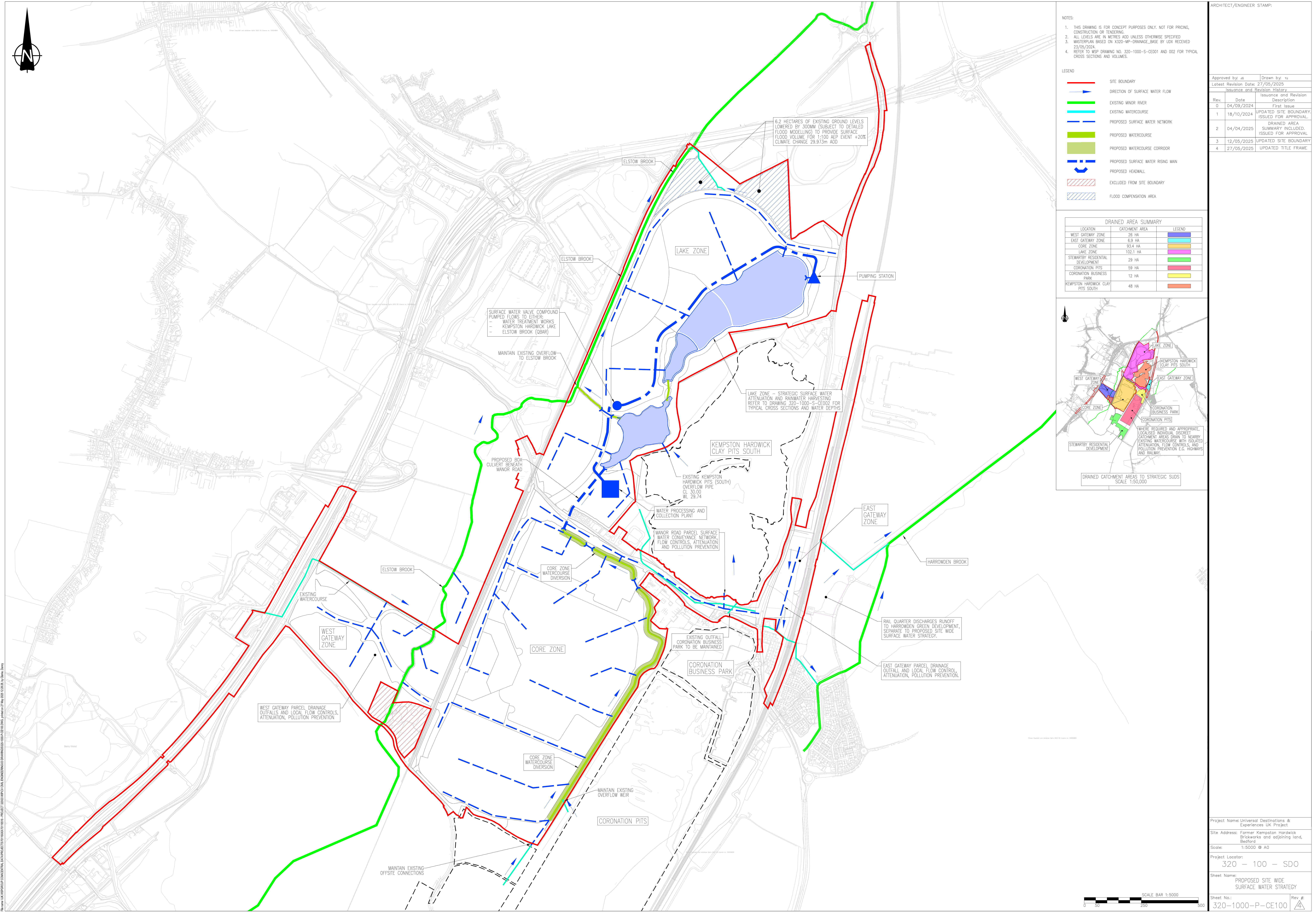
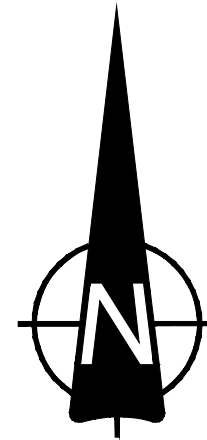
Create New

 Help

Annex 2



WSP DRAINAGE STRATEGY DRAWING



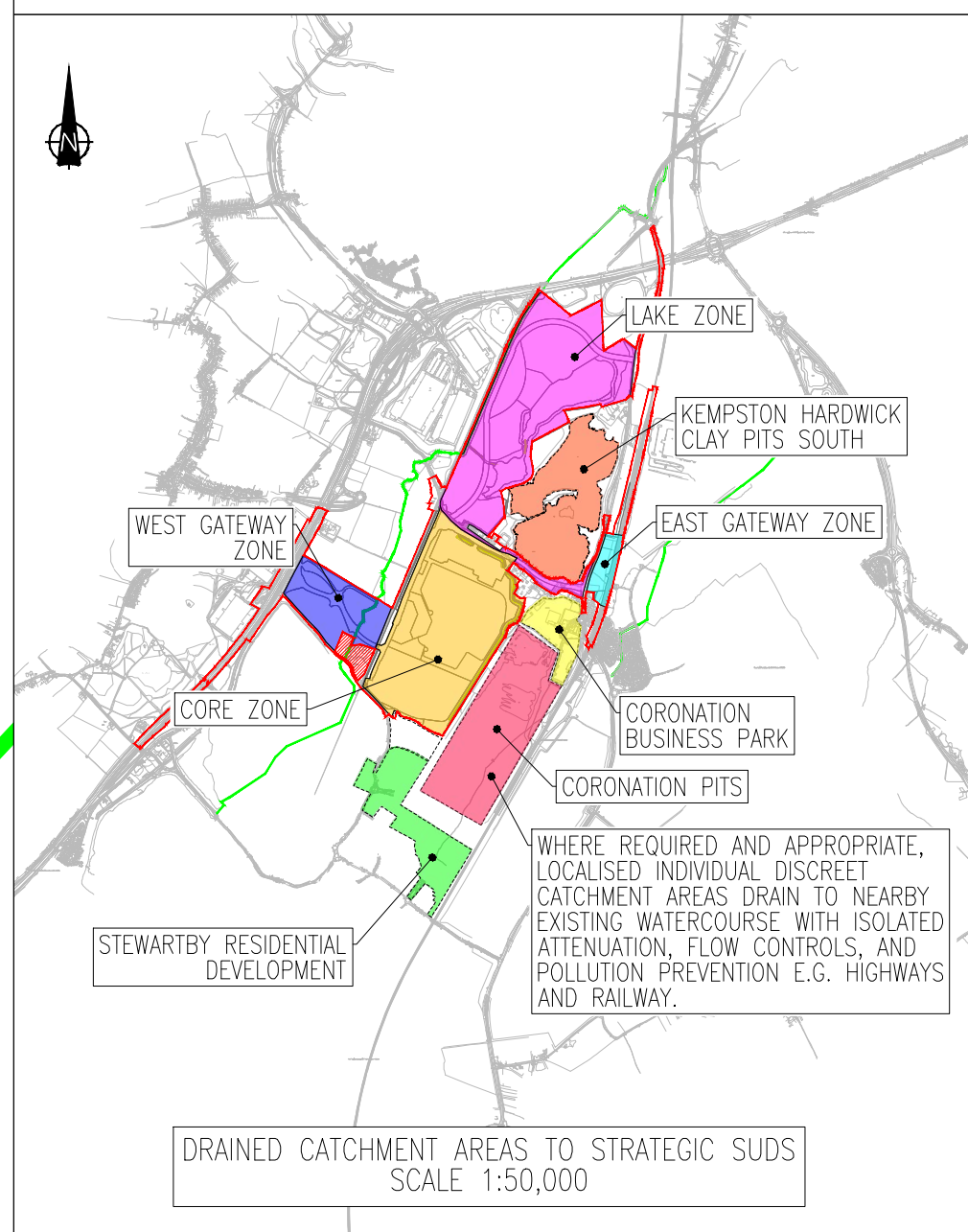
NOTES:

1. THIS DRAWING IS FOR CONCEPT PURPOSES ONLY. NOT FOR PRICING, CONSTRUCTION OR TENDERING.
2. ALL LEVELS ARE IN METRES AOD UNLESS OTHERWISE SPECIFIED
3. MASTERPLAN BASED ON X320-MP-DRAINAGE-BASE BY UDX RECEIVED 23/05/2024.
4. REFER TO WSP DRAWING NO. 320-1000-S-CE001 AND 002 FOR TYPICAL CROSS SECTIONS AND VOLUMES.

LEGEND

- SITE BOUNDARY
- DIRECTION OF SURFACE WATER FLOW
- EXISTING MINOR RIVER
- EXISTING WATERCOURSE
- PROPOSED SURFACE WATER NETWORK
- PROPOSED WATERCOURSE
- PROPOSED WATERCOURSE CORRIDOR
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED HEADWALL
- EXCLUDED FROM SITE BOUNDARY
- FLOOD COMPENSATION AREA

DRAINED AREA SUMMARY		
LOCATION	CATCHMENT AREA	LEGEND
WEST GATEWAY ZONE	26 HA	
EAST GATEWAY ZONE	6.9 HA	
CORE ZONE	93.4 HA	
LAKE ZONE	102.1 HA	
STEWARTBY RESIDENTIAL DEVELOPMENT	29 HA	
CORONATION PITS	59 HA	
CORONATION BUSINESS PARK	12 HA	
KEMPSTON HARDWICK CLAY PITS SOUTH	48 HA	



ARCHITECT/ENGINEER STAMP:

Approved by: <i>as</i>		Drawn by: <i>rs</i>
Latest Revision Date: 27/05/2025		
Issuance and Revision History		
Rev	Date	Issuance and Revision Description
0	04/09/2024	First Issue
1	18/10/2024	UPDATED SITE BOUNDARY, ISSUED FOR APPROVAL.
2	04/04/2025	DRAINED AREA SUMMARY INCLUDED, ISSUED FOR APPROVAL.
3	12/05/2025	UPDATED SITE BOUNDARY
4	27/05/2025	UPDATED TITLE FRAME

Project Name: Universal Destinations & Experiences UK Project	
Site Address: Former Kempston Hardwick Brickworks and adjoining land, Bedford	
Scale: 1:5000 @ A0	
Project Location: 320 - 100 - SDO	
Sheet Name: PROPOSED SITE WIDE SURFACE WATER STRATEGY	
Sheet No.: 320-1000-P-CE100	Rev #:

1. THIS DRAWING IS FOR CONCEPT PURPOSES ONLY. NOT FOR PRICING OR
PLANNING, CONSTRUCTION OR TENDERING.
2. ALL LEVELS ARE IN METRES A68 UNLESS OTHERWISE SPECIFIED
3. MASTERPLAN BASED ON XREF_226817A_OS_MASTER BY SLR RECEIVED
08/02/2024.

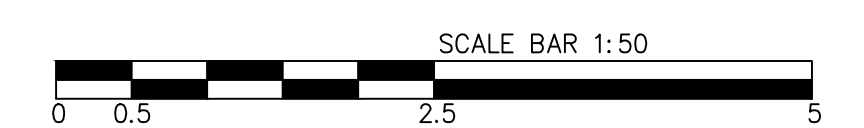
— — — — — EXISTING SURFACE PROFILE

— — — — — PROPOSED WATER LEVEL

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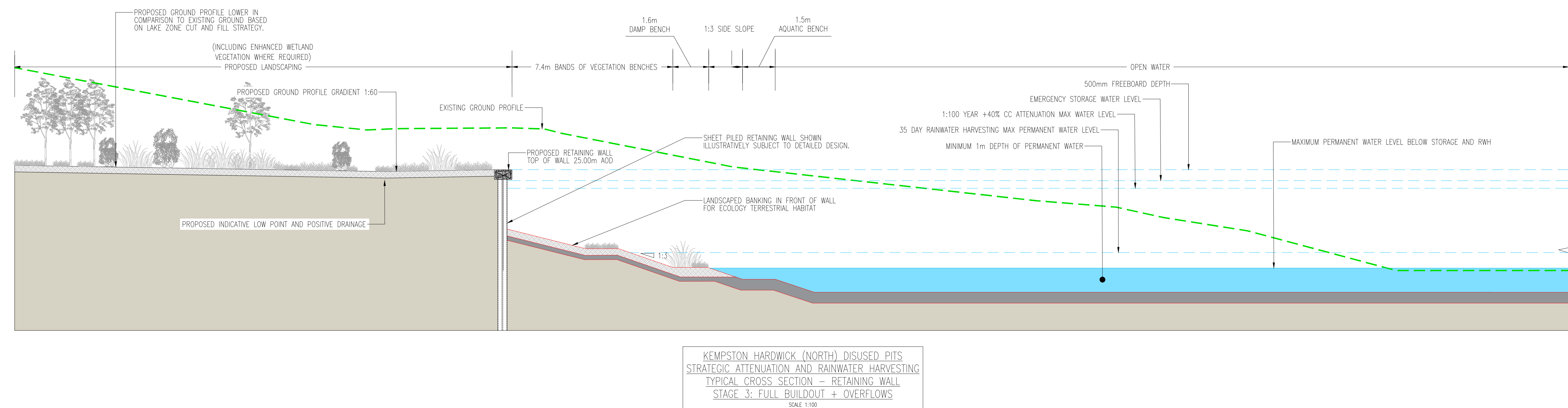
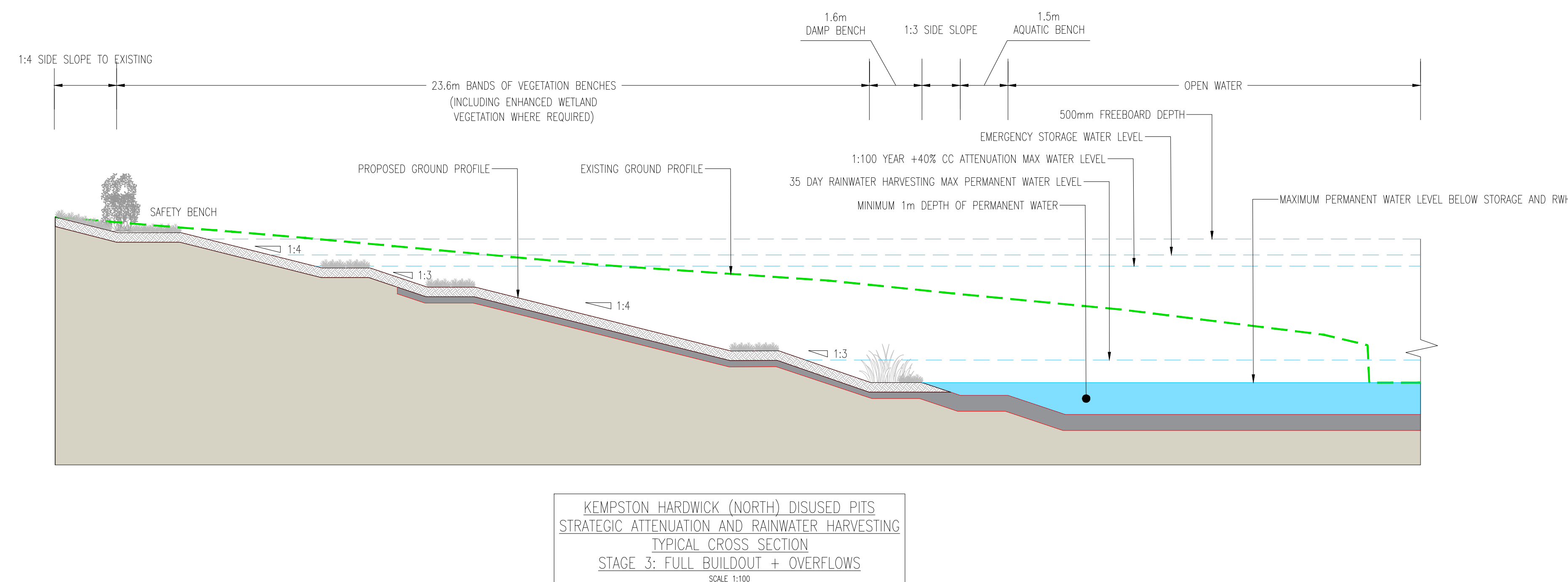
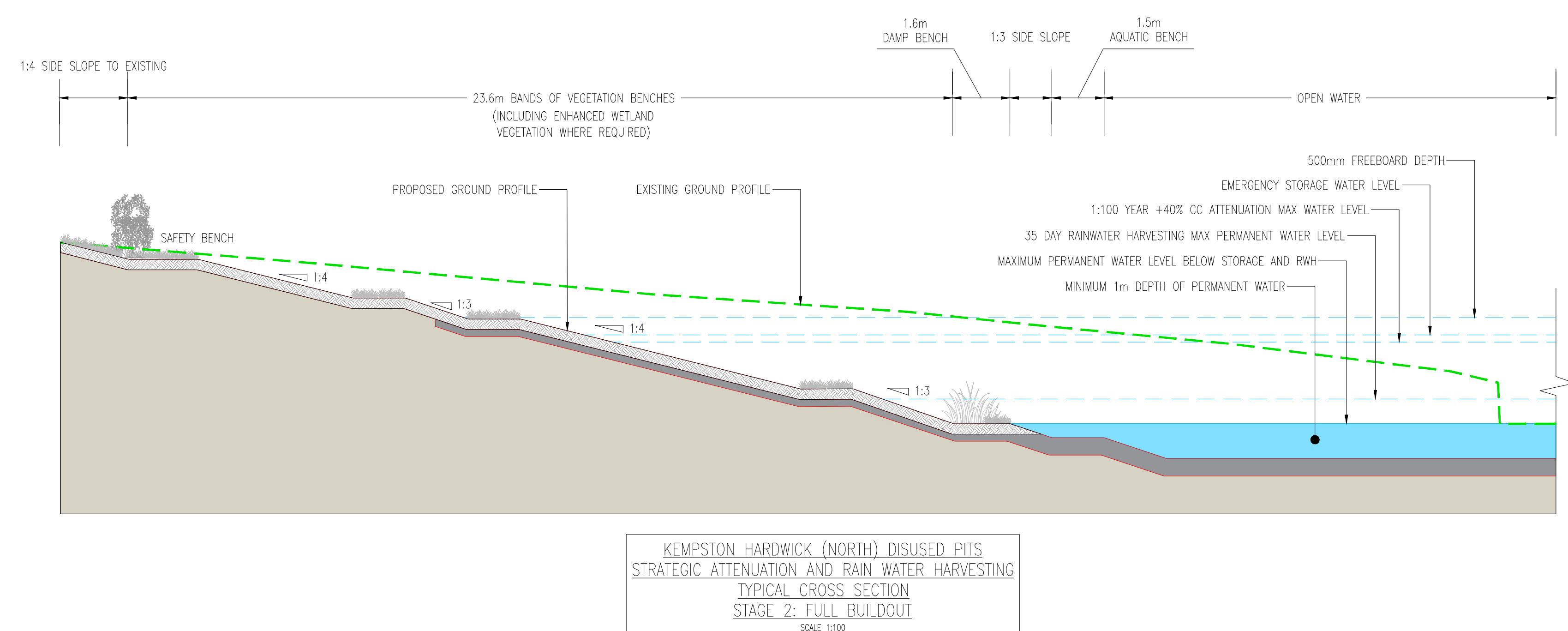
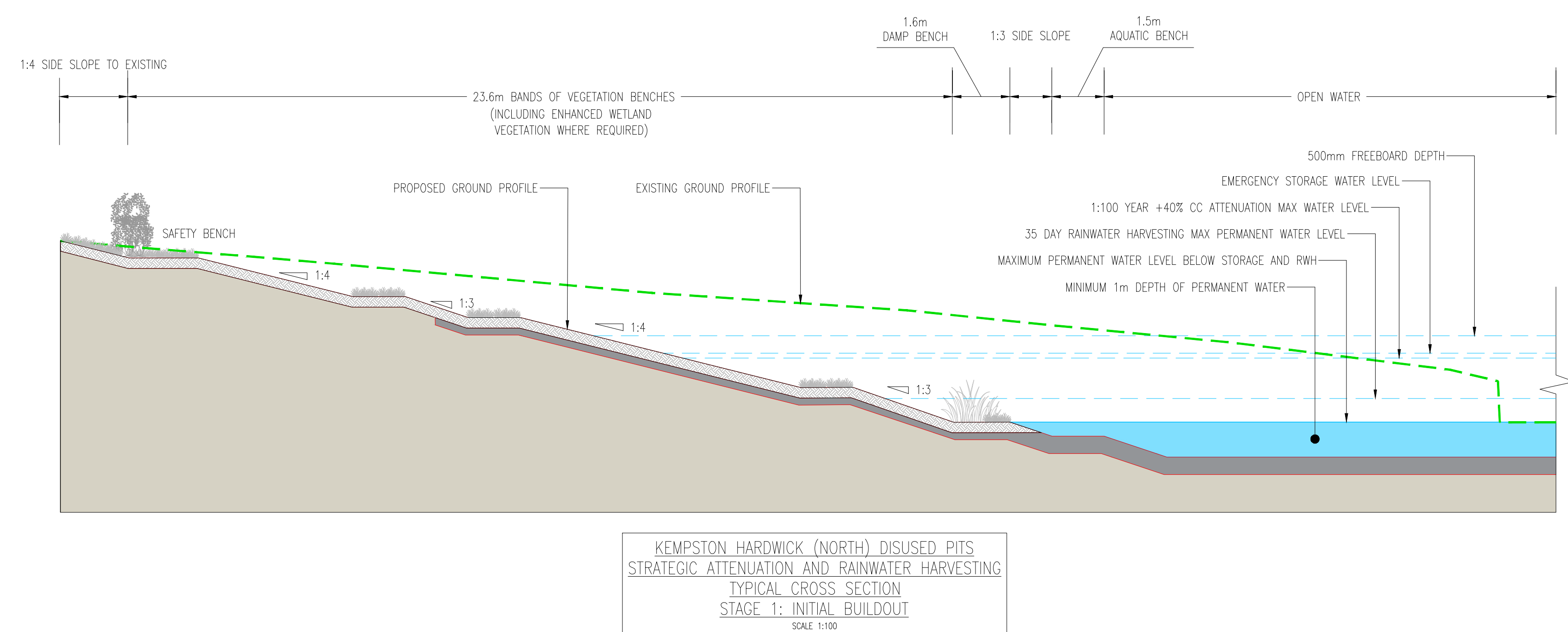
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Approved by: JS		Drawn by: CB	
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Issuance and Revision History			
Rev.	Date	Issuance and Revision Description	
1	16/05/2024	First Issue	
2	04/07/2024	FRAME AND SHEET NAME REWEIT	
3	16/08/2024	UPDATED DRAWING FRAME	



Sheet No.:	Rev #:
320 1000 S CE001	A

de name /UK INSP GROUP/ CENTRAL DATA PROJECTS/ 2016/000/001/165/16 - PROJECT 325/03 WIP/PCY ON/IL ENGINEERING/03 DRAWING/SU20-1006-S-CE/001/DWG, printed on 16 August 2024 17:14:18, by Giddings, Jason



NOT PERMEABLE AREA	121.2	HA	STORAGE DEPTH (M) BASE AREA 109,800M2	PROCESS WATER SUPPLY M3/D	DAVIS SWANSON (20% PROVISION) @ 721M3/D
DISCHARGE RATE (GREENFIELD OBR) 2.5 L/S/HA	303	L/S	N/A		
1:100 YEAR 4+0C2 ATMOSPHERIC VOLUME	127,005	M3	1.16		
15 DAY RUNNERS HARVESTING VOLUME	48,335	M3	0.68 (PH 3 ONLY BASE AREA 71,000M2)	1,381	67
PUMP FAILURE EMERGENCY STORAGE VOLUME	15,150	M3	0.14		
TOTAL STORAGE VOLUME	190,510	M3	1.98		

TOTAL IMPERMEABLE AREA	171.2	HA	STORAGE DEPTH (IN) BASE AREA 109,800M2	PROCESS WATER SUPPLY M3/D	DAYS DEMAND PER CYCLE (N=1,563.8)
DISCHARGE RATE (GREENFIELD DRAIN) 2.5 L/S/HA	428	L/S	N/A		
1:100 YEAR 4+00SC ATTENUATION VOLUME	178,500	M3	1.63		
25 DAY RAINFALL HARVESTING VOLUME	50,470	M3	0.77 (PT 3 ONLY BASE AREA 71,200M2)	1.442	32
PUMP FAILURE EMERGENCY STORAGE VOLUME	21,400	M3	0.2		
TOTAL STORAGE VOLUME	251,370	M3	2.54		

TOTAL IMPERMEABLE AREA	309.2	HA	STORAGE DEPTH (M) BASE AREA 109,800M ²	PROCESS WATER SUPPLY M ³ /D	DAYS DEM @ 1.558M ³ /D
DISCHARGE RATE (GREENFIELD QUAD) 2.5 L/S/HA	773	L/S	N/A		
1:100 YEAR +40°C/C ATTENUATION VOLUME	323,950	M ³	2.95		
35 DAY RAINWATER HARVESTING VOLUME	50,470	M ³	0.71 (PT @ ONLY BASE AREA 71,000M ²)	1,442	32
PUMP FAILURE EMERGENCY STORAGE VOLUME	38,650	M ³	0.35		
TOTAL STORAGE VOLUME	413,070	M ³	4.01		

1. INITIAL BUILDOUT STAGE			
CATCHMENT	CATCHMENT AREA (HA)	PERCENTAGE IMPERMEABLE	IMPERMEABLE (HA)
CORE ZONE	93.6	90%	84.2
MAJOR ROAD IMPROVEMENT WORKS	5	90%	5
LAKE SELF AREA	23	100%	23
LAKE ZONE CONSTRUCTION	10	90%	9

2. FULL BUILDOUT STAGE			
CATCHMENT	CATCHMENT AREA (HA)	PERCENTAGE IMPERMEABLE	IMPERMEABLE (HA)
INITIAL BUILDOUT STAGE	131.6	N/A	121.2
1 AKF ZONE	56	none	50

3. FINAL BUILDOUT + CORONATION PIT OVERFLOW STAGE			
CATCHMENT	CATCHMENT AREA (HA)	PERCENTAGE IMPERMEABLE	IMPERMEABLE AREA (HA)
FINAL BUILDOUT STAGE	187.6	N/A	171.2
KEMPSTON HARDWICK CLAY PITS SOUTH	48	100%	48
CORONATION BUSINESS PARK	12	90%	11
CORONATION PIT	59	100%	59
STEAMWATER TREATMENT	29	70%	20

NOTES:

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2. ALL LEVELS ARE IN METRES ADD UNLESS OTHERWISE SPECIFIED
3. MASTERPLAN BASED ON XREF_226817A_OS_MASTER BY SLR RECEIVED 08/02/2024.

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— — — — — EXISTING SURFACE PROFILE
— — — — — PROPOSED WATER LEVEL

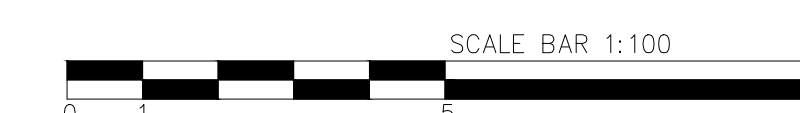
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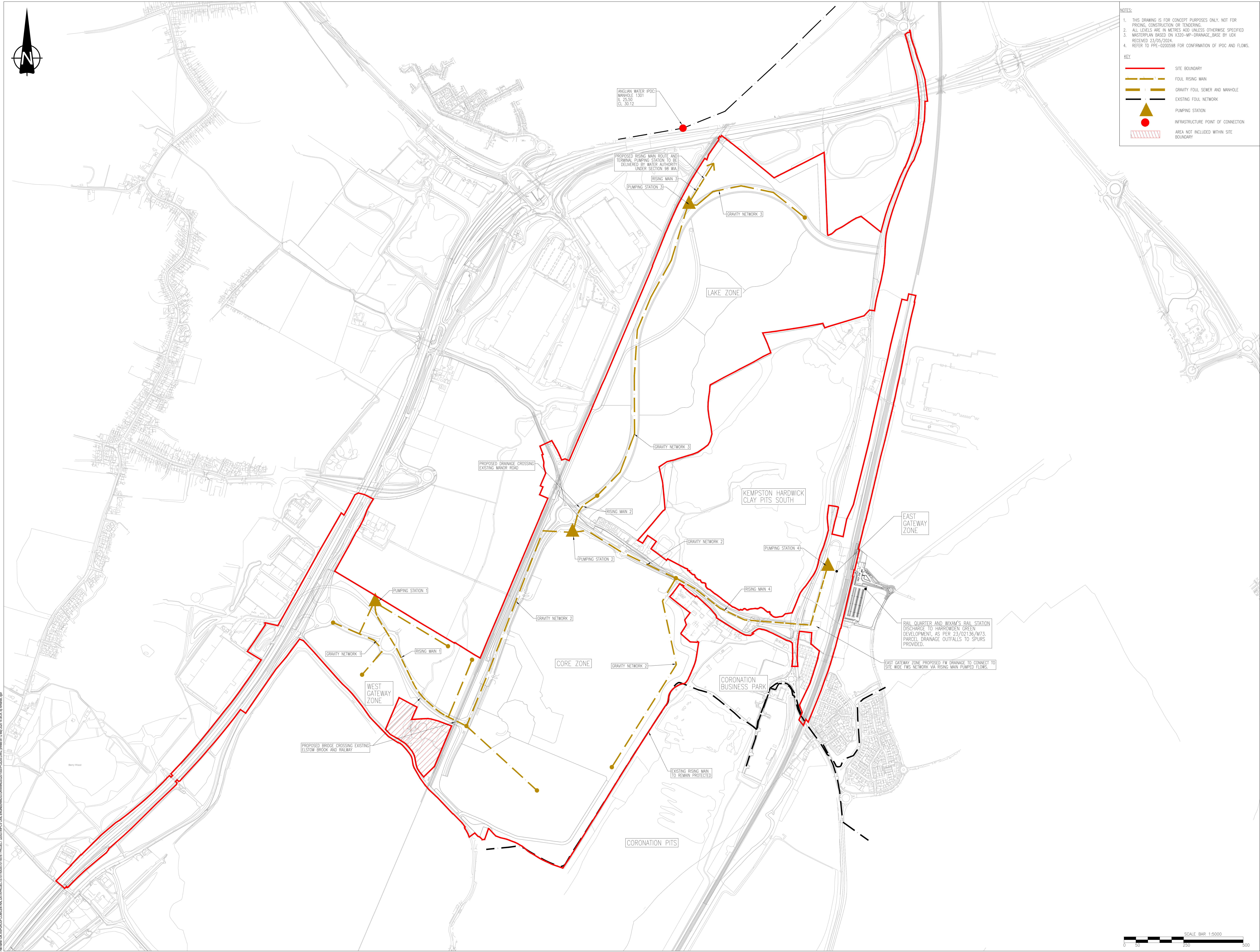
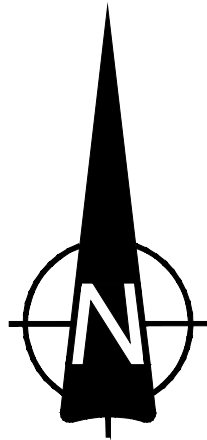


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Latest Revision Date: <u>25/10/2024</u>			
Issuance and Revision History			
Rev.	Date	Issuance and Revision Description	
1	16/05/2024	First Issue	
2	23/05/2024	WATER LEVELS UPDATED TO REFLECT LATEST SITE MASTERPLAN	
3	19/06/2024	PROPOSED RETAINING WALL SECTIONS ADDED	
4	16/07/2024	RAINWATER HARVESTING VOLUMES UPDATED	
5	16/08/2024	RAINWATER HARVESTING VOLUMES UPDATED	
6	28/08/2024	"ROLLING ENHANCED MITIGATION VEGETATION WHERE REQUIRED" TEXT ADDED TO SECTIONS	
7	25/10/2024	WATER LEVELS AND RAINWATER HARVESTING VOLUMES UPDATED TO REFLECT LATEST SITE MASTERPLAN	





NOTES:

1. THIS DRAWING IS FOR CONCEPT PURPOSES ONLY. NOT FOR PRICING, CONSTRUCTION OR TENDERING.
2. ALL LEVELS ARE IN METRES AOD UNLESS OTHERWISE SPECIFIED
3. MASTERPLAN BASED ON X320-WP-DRAINAGE_BASE BY UDX RECEIVED 23/05/2024.
4. REFER TO PPE-0200598 FOR CONFIRMATION OF IPOC AND FLOWS.

KEY

- SITE BOUNDARY
- FOUL RISING MAIN
- GRAVITY FOUL SEWER AND MANHOLE
- EXISTING FOUL NETWORK
- PUMPING STATION
- INFRASTRUCTURE POINT OF CONNECTION
- AREA NOT INCLUDED WITHIN SITE BOUNDARY

VENDOR

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Approved by: as Drawn by: ru

Latest Revision Date: 12/05/2025

Issuance and Revision History		
Rev.	Date	Description
1	19/04/2024	First Issue
2	23/05/2024	MINOR MODIFICATIONS
3	28/05/2024	UPDATED SITE BOUNDARY
4	16/08/2024	UPDATED SITE BOUNDARY
5	28/08/2024	"AREA NOT INCLUDED WITHIN SITE BOUNDARY" ADDED TO THE KEY
6	18/10/2024	UPDATED SITE BOUNDARY, ISSUED FOR APPROVAL
7	04/04/2025	UPDATED FW DRAINAGE, ISSUED FOR APPROVAL
8	12/05/2025	UPDATED SITE BOUNDARY

Drawing Status: For Approval

Project Name: Universal Destinations & Experiences UK Project

Site Address: Former Kempston Hardwick Brickworks and adjoining land, Bedford

Project Locator: 320 - 100 - 000

Sheet Name: PROPOSED SITE WIDE FOUL WATER REGIME

Sheet No.: 320-1000-P-CE200 Rev #:

As per the RECORD OF CONSULTATION, ALL PROPOSED CHANGES TO THE ENGINEERING DOCUMENTS HAVE BEEN REVIEWED AND APPROVED BY THE DESIGN TEAM. THE DESIGN TEAM HAS REVIEWED THE RECORD OF CONSULTATION AND HAS REVIEWED THE RECORD OF CONSULTATION AND HAS REVIEWED THE RECORD OF CONSULTATION.

Annex 3

WSP SUDS MAINTENANCE SCHEDULE





Universal Destinations and Experiences

SUDS MAINTENANCE AND MANAGEMENT PLAN



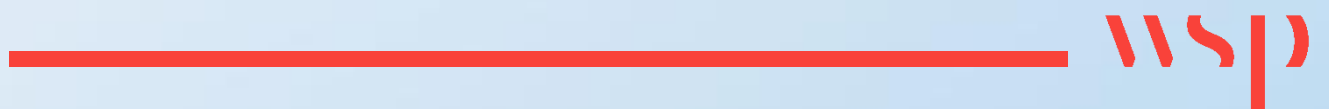


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1

INTRODUCTION



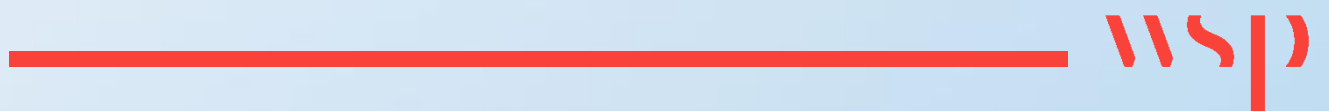
1. INTRODUCTION

1.1. INTRODUCTION

- 1.1.1.1. This SuDS Maintenance and Management Plan has been prepared on behalf of Universal Destinations & Experiences (UDX) to support a proposal for a special development order (SDO) for the construction and operation of an entertainment resort complex and associated development. The Site is located south-west of Bedford, Bedfordshire and is broadly to the east of the A421 and west of the Midland Main Line on the former Kempston Hardwick brickworks and agricultural land as well as the site of the planned Wixams rail station. The proposed development is divided into four main land areas referred to as the Core Zone, Lake Zone, West Gateway Zone, and East Gateway Zone. The development within these zones comprises a theme park and related uses including retail, dining, entertainment, hotels and conference facilities, together with transport infrastructure to connect the Site to the road and rail network (including two new railway stations, a slip road off the A421, local roadway improvements and active travel (foot and cycle) connections.
- 1.1.2. This report gives guidance on the maintenance of Sustainable Drainage Systems (SuDS) and outlines who will be responsible for the maintenance. The surface water drainage proposals for the site include a strategic wetland, diverted watercourse conveyance and piped networks within the Core and Lake Zones. Additional SuDS are to be included upstream and within the East and West Gateway Zones subject to detailed design and may include; Attenuation Storage Tanks, Permeable Paving, Bioretention Systems, Detention Basin Ponds And Wetlands, Filter Drains, Filter Strips, Vortex Flow Control/Orifice Flow Controls, Proprietary Treatment Systems and Swales.

2

METHOD STATEMENT



2. METHOD STATEMENT

2.1. ATTENUATION STORAGE TANK

2.1.1. These attenuation features serve the purpose of collecting and storing surface water runoff prior to discharge to the receiving waterbody.

2.1.2. The operation and maintenance requirements are given in the table below:

Table 2-1 – Attenuation Tank Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspection and identification of any areas that are not operating correctly. Remedial action should be taken if required.	Monthly for the first 3 months and then annually.
	Where it may cause risks to performance the removal of debris from the catchment surface is required.	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter, remove and replace surface infiltration medium as necessary.	Annually
	Removal of sediments from pre-treatment structures and/or internal forebays.	Annually as required
Remedial Actions	Rehabilitation/Repair of inlets, outlets, overflows and vents.	As required
Monitoring	Inspection of inlets, outlets, vents and overflows for the insurance of good condition and operation according to design.	Annually
	Structural and sediment survey to be conducted in the interior of the tank for the structural condition and sediment build-up and remedial action, silt removal if necessary.	Every 5 years or as required

2.2. PERMEABLE PAVING

- 2.2.1. The function of permeable paving is to provide a pre-treatment to the surface water before it enters a below ground system and can also provide additional attenuation storage.
- 2.2.2. The operation and maintenance requirements are given in the table below:

Table 2-2 – Permeable Paving Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduced frequency as required. Based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an application 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 50mm of the level of the paving	As required
	Remediate 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
	Removal of weeds or management using glyphosate applied directly into the weeds by an application rather than spraying	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

Maintenance Schedule	Required Action	Recommended Frequency
	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action	Three monthly, 48H after larger storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

2.3. BIORETENTION SYSTEMS

2.3.1. These systems, including raingardens, serve the purpose of reducing surface water runoff and treating pollution through use of engineered soils and vegetation.

2.3.2. The operation and maintenance requirements are given in the table below:

Table 2-3 – Bioretention Systems Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Inspections	Inspect infiltration surface for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is required	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc. and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular Maintenance	Removal of litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replacement of any plants to maintain planting density	As required
	Removal of sediment, litter and debris build-up from around inlets or from forebays	Quarterly to Biannually
Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required

Maintenance Schedule	Required Action	Recommended Frequency
	Removal of weeds or management using glyphosate applied directly into the weeds by an application rather than spraying	As required
Remedial Actions	Removal and replacement filter medium and vegetation above	As required but likely to be > 20 years

2.4. DETENTION BASIN

- 2.4.1. The detention basin will require ongoing regular maintenance to ensure continuing operation to design performance standards. Adequate access must be provided to all detention areas for inspection and maintenance.
- 2.4.2. Grass cutting should ideally retain grass lengths of 75-150 mm with cuttings to be disposed of offsite. Detention basins should be inspected to note rate of sediment accumulation, sediment should be removed once exceeding 25mm depth.

The operation and maintenance requirements are given in the table below:

Table 2-4 – Detention Basin Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove Litter and Debris	Monthly
	Cut Grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut Grass – Meadow Grass in and around Basin	Half Yearly (Spring – before nesting season, and after autumn)
	Manage other vegetation and removed nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect Inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year) then annually or as required

Maintenance Schedule	Required Action	Recommended Frequency
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in chapter 23)
Occasional Maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, foray, and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial Actions	Repair Erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rip	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

2.5. PONDS AND WETLANDS

- 2.5.1. These features include a permanent pool of water that provides both attenuation and treatment of surface water runoff.
- 2.5.2. The operation and maintenance requirements are given in the table below:

Table 2-5 – Ponds and Wetlands Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove Litter and Debris	Monthly (or as required)
	Cut Grass – Public Areas	Monthly (during growing season)

Maintenance Schedule	Required Action	Recommended Frequency
	Cut the Meadow Grass	Half Yearly (Spring – before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides structures, pipework etc. for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly
	inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices (e.g. penstocks)	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay	Every 1-5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays	Every 5 years, or as required
Occasional Maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment (e.g. every 25-50 years)

Maintenance Schedule	Required Action	Recommended Frequency
Remedial Actions	Repair Erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of Eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair/rehabilitate inlets, outlets and overflows	As required

2.6. FILTER DRAINS

- 2.6.1. These linear drainage features are visible SuDS components serving the purposes of conveyance, treatment of surface water runoff.
- 2.6.2. The operation and maintenance requirements are given in the table below:

Table 2-6 – Filter Drain Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Removal of litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly, or as required
	Inspection of filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspection of pre-treatment systems, inlets and perforated pipework for silt accumulation and establish appropriate silt removal; frequencies	Every six months
	Removal of sediment from pre-treatment devices	Every six months or as required
Occasional Maintenance	Removal or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg njug, 2007 or bs 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlaying filter medium	Every five years or as required
	Clear perforated pipework of blockages	As required

2.7. FILTER STRIPS

2.7.1. These drainage features are visible SuDS components serving the purposes of conveyance, treatment of surface water runoff.

2.7.2. The operation and maintenance requirements are given in the table below:

Table 2-7 – Filter Strip Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove Litter and Debris	Monthly (or as required)
	Cut Grass – to retain grass height within specific design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect filter strips surface to identify evidence of erosion, poor vegetation growth, compaction, ponding sedimentation and contamination (eg oils)	Monthly (at start, then every six months)
	Check flow spreader and filter strip surface for even gradients	Monthly (at start, then every six months)
	Inspect gravel flow spreader upstream of filter strip for clogging	Monthly (at start, then every six months)
	Inspect silt accumulation rates and establish appropriate removal frequencies	Monthly (at start, then every six months)
Occasional Maintenance	Reseed areas of poor vegetation growth; after plant types to better suit conditions, if required	
Remedial Actions	Relevel uneven surfaces and reinstate design levels	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 a top of filter strip	As required

	Remove and dispose of oils or petrol residues using safe standard practices	As required
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2.8. VORTEX FLOW CONTROL / ORIFICE FLOW CONTROLS

2.8.1. These are proprietary systems which are custom made to control the onsite flows. Some of the proposed flow controls may be prone to blocking and should be monitored closely.

2.8.2. The operation and maintenance requirements are given in the table below:

Table 2-8 – Orifice Flow Control Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter and debris and grass cutting and removal of cuttings from the upstream SuDS to prevent these being washed into the control. Inspection of control chamber and removal of any sediments, debris etc.	Quarterly or as required following Monitoring
Remedial Actions	Check the orifice flow control fixings to manhole chamber and access into the control chamber is functional.	Quarterly or as required following Monitoring
Monitoring	Inspect flow controls and overflows and check flow are not impeded.	Monthly or after periods of heavy rainfall

2.9. PROPRIETARY TREATMENT SYSTEMS

2.9.1. These systems are manufactured products that remove pollutants from surface water runoff.

2.9.2. The operation and maintenance requirements are given in the table below:

Table 2-9 – Proprietary Treatment System Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil grease and floatables	As necessary - indicated by system inspections or immediately following significant spill
Remedial Actions	Replace malfunctioning parts or structures	As required

Maintenance Schedule	Required Action	Recommended Frequency
Monitoring	Inspect for evidence of poor operation	Every six months
	Inspect filter media and establish appropriate replacement frequencies	Every six months
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every 6 months

2.10. SWALES

2.10.1. These linear drainage features are visible SuDS components serving the purposes of conveyance, treatment of surface water runoff.

2.10.2. The operation and maintenance requirements are given in the table below:

Table 2-10 – Swale Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut Grass - to retain grass height within specified design range	Monthly (during growing season or as required)
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect Vegetation coverage	Monthly for 6 months, quarterly for 2 years , then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half Yearly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.	As required or if bare soil is exposed over 10% or more the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseed	As required

Maintenance Schedule	Required Action	Recommended Frequency
	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 surfaces	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

2.11. RAINWATER HARVESTING TANKS

2.11.1. These features are for the collection of rainwater which is stored, treated and then suitable for reuse.

2.11.2. The operation and maintenance requirements are given in the table below:

Table 2-11 – Rainwater Harvesting Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pumps, fillers	Annually (and following poor performance)
	Cleaning of tank, inlets outlets, gutters, withdrawal devices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional Maintenance	Cleaning and/or replacement of any filters	Three monthly (or as required)
Remedial Actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repair	As required

2.12. DESIGN LIFE

2.12.1. The design life of the development is likely to be similar to the design life of each of the SuDS components listed above.

2.12.2. During the routine inspections of any drainage components it may become apparent that they have reached the end of their functional lifetime. In the interest of sustainability repairs should be the first-

choice solution where practicable. If this is not the case then it will be necessary for the property owners to undertake complete replacement of the component in question.

- 2.12.3. Maintenance of drainage features within the Core and Lake Zones will be the responsibility of UDX, drainage features within the West and East Gateway Zones will be the responsibility of the relevant undertaker.
- 2.12.4. For watercourses that fall within the jurisdiction of the internal drainage board (IDB), access will be required to allow the IDB to maintain these features if they fall into a state of disrepair in line with the requirements of the Land Drainage Act.



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