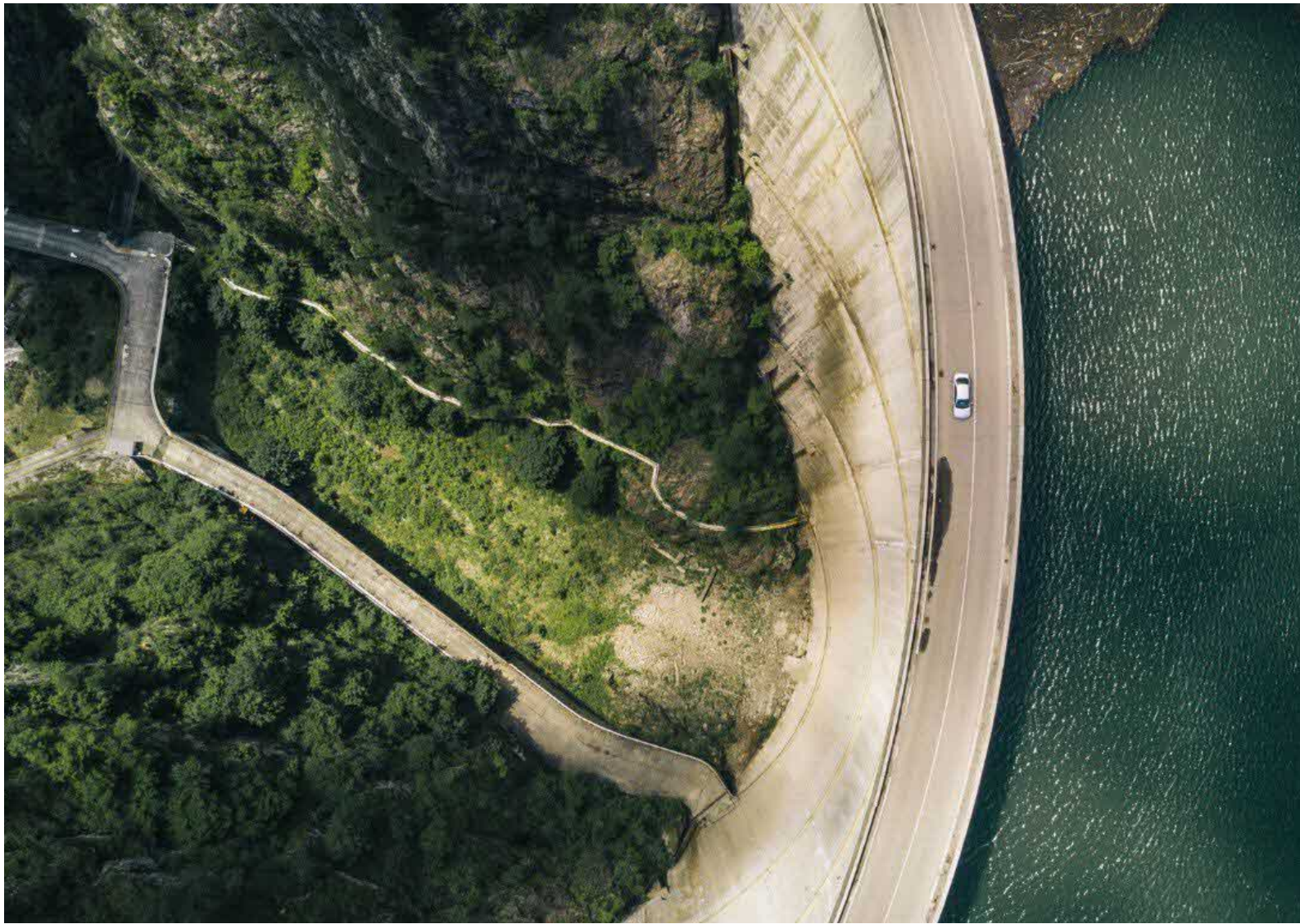
Phase 3 Drainage Management Plan

Havant Thicket Reservoir

Future Water

26 June 2024

→ **The Power of Commitment**



Project name	Havant Thicket Reservoir						
Document title	Phase 3 Drainage Management Plan | Havant Thicket Reservoir						
Project number	12547181						
File name	HTR-GHD-ZZ-ZZ-RP-D-0002						
Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	P01	R.Pedley	D. Roberson	[redacted]			
S3	P02	R.Pedley	D. Roberson		E. Peacock	[redacted]	26/06/24

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The Power of Commitment

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1. Introduction

1.1 Purpose of this report

This Phase 3 Drainage Management Plan (DMP) supports a planning application to Havant Borough Council (HBC), on behalf of Future Water, for the development of a pumped storage reservoir and associated infrastructure (the Approved Scheme), on land at Havant Thicket (reference APP/20/0090). Specifically, this report is to address the Reserved Matters Application, which is applicable to Phase 3 of the scheme. This phase includes the main embankment, outlet culvert and valve tower only.

The scheme is located adjacent to Sir George Staunton Country Park, Middle Park Way, Havant and involves the construction of a new winter storage reservoir, to provide the minimum required total storage capacity of 8,700 million litres. This will support the planned bulk supply transfer of at least 21 million litres per day in extreme drought conditions.

As part of the hybrid application, HBC, as Local Planning Authority, granted full planning permission on 16th October 2021, for construction of a reservoir, embankment, overflow discharge/spillway and new junctions on the B2149 Manor Lodge Road and Swanmore Road, subject to Planning Conditions. Additionally, outline planning was granted for a control house, visitor centre, wetland and access routes, subject to Reserved Matters Application and Planning Conditions.

The development is to be completed in nine phases (see Appendix A for the detailed phasing plan). This report is intended to outline the drainage strategy for elements of Phase 3 of the scheme only, to satisfy planning condition 32 relating to flood risk, which is outlined below. It should be noted that this DMP will address the second bullet point of the condition, identified by ***bold*** text:

Condition 32

"No phase of the development approved under Condition 4 shall commence until a detailed scheme, to ensure the development will not increase the risk of flooding, has been submitted to, and approved in writing by, the local planning authority. Specifically further details should be provided where relevant to the phase including:

A detailed drainage management plan that adequately details the management of the drainage associated with the phase.

Detailed information surrounding a number of permanent structural elements including the proposed dimensions and height of the embankment, associated spillway, control house and wetland retaining structure (including the proposed piped controls).

Detailed information including the long-term maintenance scheduled for the proposed development.

Detailed information on the proposed location and design of the visitor centre, including proposed finished floor levels.

Should the proposed access routes to and from the visitor centre be situated within proximity to main river or within the flood zone then further details should be provided on the associated impacts on flood risk and the proposed mitigation measures.

The scheme shall be fully implemented and subsequently maintained, in accordance with the scheme's timing/phasing arrangements, or within any other period as many subsequently be agreed, in writing, by the Local Planning Authority."

1.2 Scope and limitations

This report has been prepared by GHD for Future Water and may only be used and relied on by Future Water for the purpose agreed between GHD and Future Water.

GHD otherwise disclaims responsibility to any person other than Future Water arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring after the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

This report discusses drainage only within Phase 3 of the development, limited to the main embankment, culvert and valve tower. Drainage elements within other or future phases that are the receiving systems of Phase 3 will be referenced and detailed as necessary, however there will be no additional information relating to these phases. This will be provided within the Drainage Management Plans for those specific phases, in due course.

This report will only address those drainage flows which are a direct consequence of precipitation and overland surface water flows. It will not include for those elements which originate from process, geological or structural features.

The scope of this report is as defined by, and agreed with, Future Water on 17th May 2024 and subsequently summarised to the Environment Agency by Future Water on 22nd May 2024.

2. Development Site

2.1 Site Location

The development site is situated in the county of Hampshire and is located directly north of the town of Havant. Much of the eastern boundary is bordered by the B2149, with Stein Wood, Red Hill and Rowlands Castle located further east, beyond the B2149. The A3(M) and Waterlooville lie to the west of the site, with Sir George Staunton Country Park to the south. Phase 3 of the development is situated to south of the planning boundary and encompasses the main embankment, culvert, and valve tower only.

Figure 1 shows the location of the development and its surroundings, as well as the Phase 3 boundary.

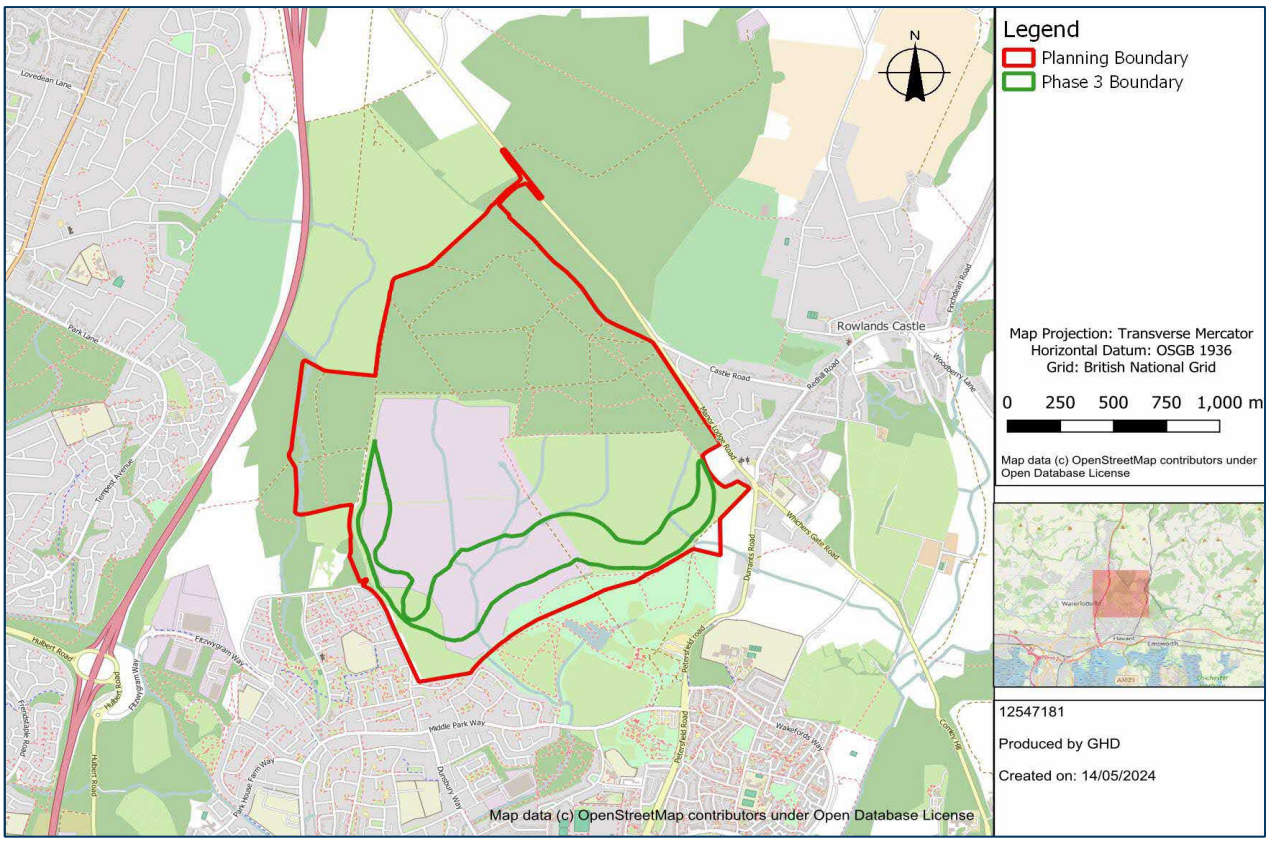


Figure 1 Site Location Overview

2.2 Proposed Phase 3 Scheme

A detailed phasing plan was prepared by Future Water for the works at Havant Thicket Reservoir (see Appendix A). This document is required to satisfy Condition 4 of the permissions:

> *"Prior to the commencement of development, a detailed phasing plan for the development shall be submitted to and approved by the Local Planning Authority. […]"*

In total, nine phases are proposed. Phase 3, which is the only phase this report will cover, encompasses only the main embankment, including the crest track, culvert, and valve tower (refer also to Figure 1 for location). All other elements of the design are included within previous or subsequent phases and so will not be covered in detail in this document.

2.3 Existing Hydrological Features

South of the site boundary, there are five main rivers: the Park Lane Stream, Hermitage Stream, Riders Lane Stream, Durrants Stream and Lavant Stream. Main rivers are typically larger watercourses, on which the Environment Agency are responsible for carrying maintenance and improvement works. Smaller rivers are referred to as Ordinary Watercourses, and the management of these watercourses from a flood risk perspective is carried out by the Lead Local Flood Authority or District Councils. Figure 2 shows the watercourses within and near to the planning boundary.

An assessment of existing watercourse catchment areas, show two watercourses originating from within the proposed reservoir site: Riders Lane Stream and Durrants Stream. Upstream of the proposed reservoir embankment, Riders Lane Stream, which is generally located in the western portion of the site, has a catchment area of c.215ha, whilst Durrants Stream to the east, is c.27ha. The upper catchment of the Riders Lane Stream includes five other ordinary watercourses, which are ephemeral in nature and so often run dry during periods of limited rainfall.

Most of the site area, in the predevelopment scenario, discharges to Riders Lane Stream with a significant proportion of the remaining area discharging to Durrants Stream. There are two smaller catchments within the site boundary, to the extreme east and west, which discharge to the Lavant Stream and Park Lane Stream respectively. The location and extent of these catchment are shown in Figure 3.

The eastern catchment drains via small unnamed watercourses which are ditch-like still-water headwaters that drain eastwards into the Lavant Stream. The western catchment drains to the Park Lane Stream (part of the Hermitage Stream catchment) which is classed as an Ordinary Watercourse for the reach upstream of the culvert, within Warren Park, East of St Clares Avenue, whereupon it becomes a main river. The confluence of the Park Lane Stream with the Hermitage Stream is just upstream of the confluence of the Hermitage Stream with the Riders Lane Stream.

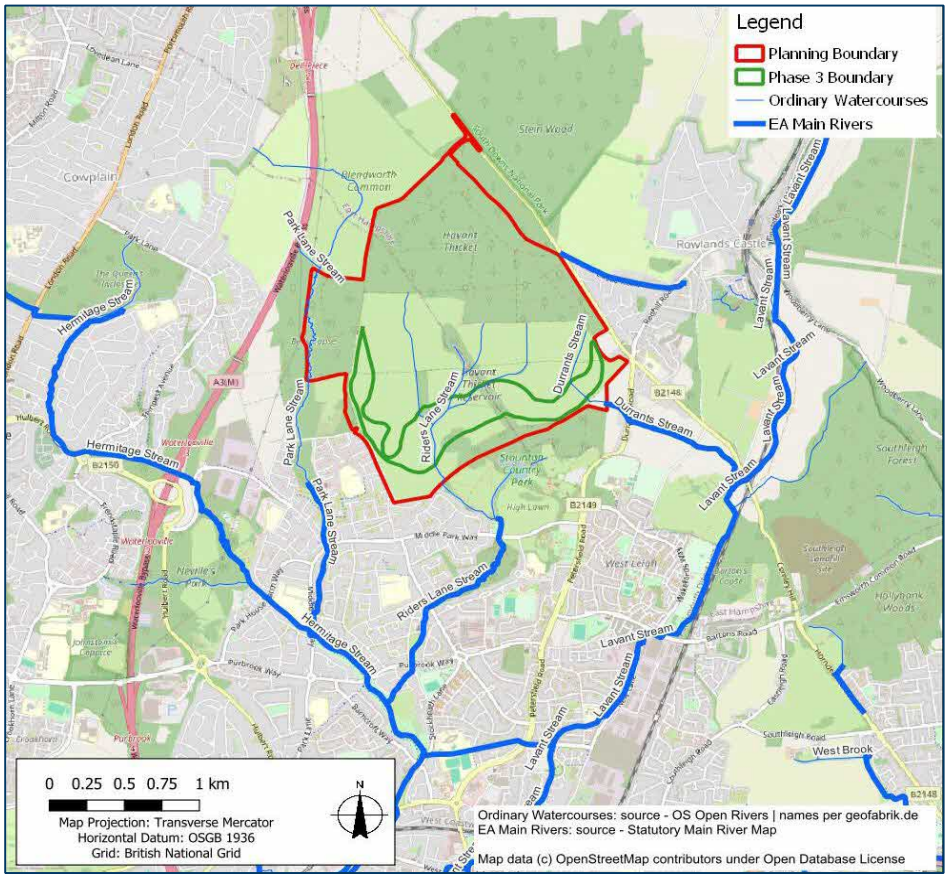


Figure 2 Existing Watercourses

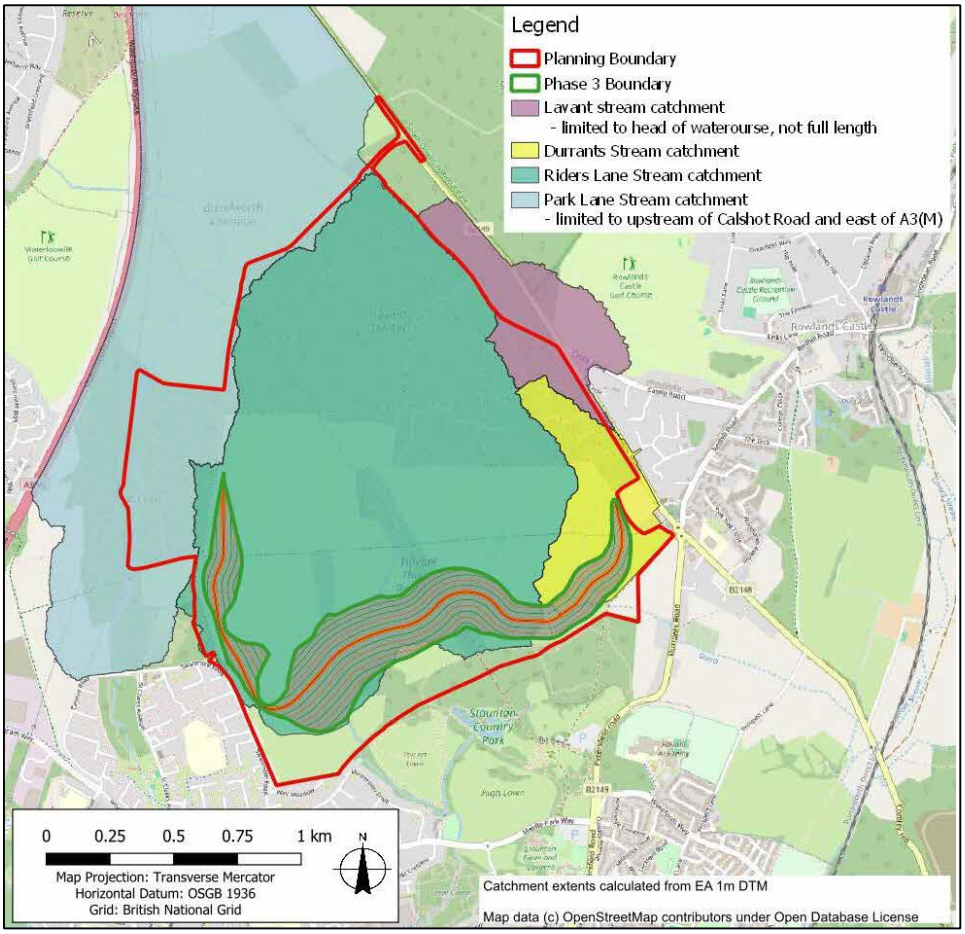


Figure 3 Catchments within the Planning Boundary

3. Planning Policy and Guidance

Every new development is obliged to be in accordance with the latest national and local planning policies regarding flooding and drainage. An overview of the latest and most relevant regulations in relation to drainage are presented in the following sections.

3.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) was first published in March 2012, and updated in July 2018, February 2019, July 2021, September 2023 and most recently in December 2023. This sets out the governments planning policies for England and how these are expected to be applied.

The NPPF states that major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems should:

> "*a) take account of advice from the lead local flood authority.*
>
> *b) have appropriate proposed minimum operational standards*
>
> *c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and*
>
> *d) where possible, provide multifunctional benefits*."

3.2 Local Planning Policy

The Havant Borough Local Plan 2036 was withdrawn for examination in March 2022 and work has commenced on a new Local Plan for the borough. Havant Borough Council's 'Core Strategy – Local Development Framework' (2011) sets out the planning framework for the community until 2026.

The strategy contains one key policy relating to drainage:

Policy CS15 Flood and Coastal Erosion Risk:

> *"…All development will be required to ensure that there is no net increase in surface water runoff. Priority should be given to incorporating Sustainable Drainage Systems (SuDS) to main surface water drainage, unless that it is proven that SuDS are not appropriate. Where SuDS are provided arrangements must be put in place for their whole life management and maintenance."*

3.3 Local Flood and Water Management Strategy

Hampshire County Council (HCC) Local Flood and Water Management Strategy (LFWMS) sets out how local flood risks will be managed in the county by the authorities involved.

The strategy contains one policy that encompasses drainage:

Policy 4. To ensure successful and sustainable growth Hampshire County Council will support the planning process by encouraging resilient development:

> *"…Require developments to utilise Sustainable Drainage Systems (SuDS) and the drainage hierarchy based on current best practice and industry standards for water quality and quantity".*

Further information relating to drainage and flood risk was found within the LFWMS under the heading **Advising on Sustainable Drainage Systems in new developments**, which looked at how surface water can be managed as close to the source as possible and how they will follow best practice requirements when responding to Surface Water Management consultations:

"Ensuring sufficient attenuation of surface water flood water, up to a 1 in 100-year event plus the appropriate extra percentage for the expected climate change. […]

…Ensuring that the drainage system consider the required water quality and is designed appropriately for the development use and the associated discharge point, including the wider sensitivity of these locations. […].

Also, within this chapter, HCC outlines its policy in relation to SuDS:

SuDS Policy 1:

"Underlying these options is the requirement to ensure that, post development, no greater volume of water leaves the site and/or no surface water leaves the site at a faster rate than occurred predevelopment or, preferably, the discharge rate is limited to greenfield runoff rates. The County Council will object to planning developments if the net effect on the flood risk in an area is too great".

Under the chapter **Climate Change**, the LFWMS outlines how climate resilience and mitigation can be promoted across the Council's key policies and sectors, and refers to drainage requirements:

…Hampshire County Council, as LLFA for Hampshire, accounts for Climate Change during the planning process by uplifting drainage requirements in line with the Environment Agency's Climate Change Allowances".

3.4 Strategic Flood Risk Assessment (SFRA)

The Partnership for South Hampshire Level 1 Strategic Flood Risk Assessment (SFRA) was commissioned by Portsmouth City Council (PCC) on behalf of ten planning authorities in South Hampshire, including Havant Borough Council. The SFRA was published in February 2024 and provides a summary of flood risk and directs development away from areas at highest risk of flooding within the area.

Section 3.7 **Assessing the cumulative impact of development** looks at the cumulative impacts in, or affecting, local areas susceptible to flooding. Section 3.7.2 is relevant to the management of surface water and is outlined below:

"When allocating land for development, or assessing planning applications, consideration must be given to the potential for development to impact flood risk elsewhere. The increase in impermeable surfaces and resulting increase in runoff increases the chances of surface water flooding if suitable mitigation measures, such as SuDS, are not put in place. Additionally, the increase in runoff may result in more flow entering watercourses, increasing the risk of fluvial flooding downstream. Whilst individual development with appropriate site mitigation measures should not result in measurable local effects with respect to hydrology and flood risk, the cumulative effect of multiple development may be more severe at downstream locations in the catchment. Locations where there are existing flood risk issues will be particularly sensitive to cumulative effects".

4. Phase 3 Drainage

Phase 3 encompasses the main embankment, culvert and valve tower only, and as such, there is limited positive infrastructure provided within the extent of this phase, which relates specifically to management of surface water flows.

Drainage within Phase 3 is limited to core drainage within the embankment, which ensures that any minor seepage flows within the core of the main embankment are adequately drained away through preferential pathways. These systems are not provided specifically for the management of flows which may have been generated by precipitation. Appendix H shows the location of the five core drainage outlets from within the embankment.

Surface water flows generated from the crest track, atop of the embankment, and the downward face of the embankment itself, will shed overland into positive drainage networks installed at the toe of the embankment. These receiving drainage networks are to be located within Phase 4 (Southern Access Road) and Phase 8 (Remaining Areas of hard and soft landscaping, not previously approved in earlier planning submissions). These phases, and their respective drainage elements, are therefore not included within this planning application for Phase 3.

The networks within Phase 4 and Phase 8 will also receive the discharges from the core drainage, with typical and extreme flows at the outlets ranging from between 0.09-0.20l/s and 26-55l/s, respectively. The core drainage discharge rates will be factored into the overall discharge rate for the site.

To provide comfort that due consideration has been given to drainage and its potential impact on flood risk, Sections 5 and 6 of this report will outline the receiving drainage systems within Phases 4 and 8 and provide an overview of the surface water drainage design criteria to be applied. This shall ensure that a complete picture is provided for those surface water flows generated within Phase 3 and how they are proposed to be intercepted, controlled, treated and discharged in line with the planning policies and best practice. This will not extend to the provision of drainage designs and supporting hydraulic modelling, as this element of work is to be completed as part of the detailed design of the subsequent phases.

5. Surface Water Drainage Design Criteria

Surface water flows generated within Phase 3 of the scheme will be intercepted by positive drainage networks within Phases 4 and 8. This section outlines the surface water drainage design criteria and drainage principles that are to be applied when designing the drainage networks in subsequent phases.

Prior to commencement of any design works of the receiving systems, HCC was consulted to review and confirm the fundamental elements of the surface water design criteria and principles that all aspects of the drainage design for the scheme will adhere to.

The design criteria outlined below was presented by GHD to HCC on 11th October 2023, who subsequently responded on 17th October 2023, confirming the design criteria was appropriate for the site and that they had no initial concerns. See Appendix B for the full correspondence with HCC.

5.1 Design Return Periods

HCC, as Lead Local Flood Authority (LLFA), is the statutory consultee on all major planning applications in Hampshire in relation to surface water drainage. The HCC 'Surface Water Checklist Guidance' document (no date) is designed to provide advice to developers and applicants and notes design return periods that major planning applications should follow. Calculations must show that the proposed run off rates do not exceed the existing run-off rates. This must be shown for the following events:

1 in 1 year (100% Annual Exceedance Probability, or AEP)

1 in 30 year (3.33% AEP)

1 in 100 year (1% AEP) with additional climate change allowance

5.2 Runoff Co-efficient

Runoff coefficients (Cv value) vary depending upon the surface type or material and the proposed gradient or slope of the surface. To ensure that the various elements of surface water drainage system are appropriately designed, each drainage catchment area within the proposed scheme will have the following Cv values applied, specific to the corresponding surface type:

Table 1 - Runoff Co-efficient (Cv value) per surface material

Land Use / Material	Cv Value
Grass slopes of dam wall (>10% slope)	0.4
'Flat' (2-10% slope) grassed areas	0.3
Gravel tracks, assumed to be generally flat	0.8
Tarmac (sealed roads), assumed to be generally flat	0.9

These values were accepted by HCC in their correspondence received in October 2023, refer to Appendix B.

5.3 Discharge Locations and Rates

Further correspondence was sent to HCC on 27th October 2023 to outline the proposed discharge rates and locations for the surface water drainage systems serving the proposed scheme. This was reviewed and the methodology agreed and accepted by HCC on December 20th, 2023. See Appendix C for the full correspondence with HCC. The following section provides further detail and rationale with respect to discharge locations and rates.

5.3.1 Discharge Location

The Building Regulations Part H sets out a hierarchy for the choice of a discharge point for a rainwater system. In order of priority, the possibilities are given as:

> An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,
>
> A watercourse or where that is not reasonably practicable,
>
> A sewer.

The above hierarchy sets out the order in which surface water discharge points should be considered, the suitability of each is discussed below.

5.3.1.1 Discharge via Infiltration

A review of Soilscapes website suggests that soils are *'slowly permeable seasonally wet slightly acid but base-rich loamy and clayey* soils' with drainage described as being impeded. A review of the online British Geological Survey (BGS) maps indicates the Phase 3 boundary to have a bedrock geology of '*London Clay Formation – Clay, silt and sand'*, with superficial deposits of *'Head – clay, silt, sand and gravel'*.

BGS online borehole records include records within the planning boundary. Several records from between 1977-1979 confirm the presence of red, light grey and brown silty clay with traces of silt, with groundwater reports of 1.3m and 2.1 bgl (below ground level) at two locations on the southern edge of the Phase 3 boundary.

Based on the information recorded by the BGS, infiltration is considered unsuitable on the basis that the site is characterised by clayey soils, the impeded infiltration of which would not permit the satisfactory discharge of surface water flows to ground. The presence of a high-water table as noted within the borehole records further limits the potential for satisfactory drainage via infiltration. Additionally, there are significant constraints on the use of infiltration drainage in the vicinity of an engineered embankment, such as the proposed dam structure on this scheme, due to the potential for interference with ground and structure stability.

Therefore, infiltration is not considered suitable as a means of discharging surface water from the site.

5.3.1.2 Discharge to a Watercourse

With infiltration drainage discounted, the next point of discharge as identified in Section 5.3.1, is to a watercourse. As previously discussed, mapping has identified two watercourses originating from within the proposed reservoir area: Riders Lane Stream to the west and Durrants Stream to the east. Topographical data of the site in the pre-development condition shows that land falls south towards both Riders Lane Stream and Durrants Stream and so these are considered viable locations into which surface water flows could be discharged. Therefore. in line with the drainage hierarchy, discharge to a watercourse is proposed.

5.3.2 Discharge Rates

Much of the site area, in the predevelopment scenario, discharges to Riders Lane Stream with a significant proportion of the remaining area discharging to Durrants Stream. Both watercourses originate from within the proposed reservoir area. Upstream of the proposed reservoir embankment, Riders Lane Stream, which is generally located in the western portion of the site, has a catchment area of c.215ha, whilst Durrants Stream to the east, is c.27ha.

The coordinates of the outlet points (which also represent the point at which the proposed dam crosses the watercourse) are shown in Figure 4, together with the upstream catchment for that location. This represents the extent of upslope catchment which would have discharged (pre-development) to that location.

The SuDS Manual sets out two approaches for managing flows and volumes from a development site. The first approach requires that flows from attenuation storage are controlled at Qbar, for all rainfall events up to and including the 1 in 100-year rainfall event. The second approach requires that flow rates discharged from attenuation storage are controlled at a rate equivalent to the runoff from a greenfield site for a 1 in 1 year return period (whenever a 1 in 1 year rainfall event occurs), up to the equivalent runoff from a Greenfield site for a 1 in 100-year return period (whenever a 1 in 100-year rainfall event occurs). For the second approach, long term storage must be provided; whereby a specified volume of water is held on site for a longer period in comparison to the attenuated storage volume. For this site, providing long term storage is not practicable, given the suitable space available to accommodate the additional volume of runoff generated from variable discharge rates. Secondly, limiting all flows to Qbar, satisfies HBC's Local Planning Policy and the SFRA in ensuring that flood-risk off site is minimised. Therefore, it is proposed that all discharges are restricted to no more than the equivalent Qbar rate for all events.

The existing runoff rates were assessed using a range of methods. This is largely due to the size of Riders Lane catchment being more than 200 hectares, but also allows for a comparison such that an appropriate discharge rate can be established. The methods used in assessing existing runoff rates from each catchment are tabulated below.

Table 2 – Comparison of methods used in assessing existing runoff rates.

Method Used	Comment	Closest Return Period to Qbar and flow rate
Durrants Stream		
ICP SuDS	Used for the Durrants Stream catchment, as the area is less than 50 ha. SAAR (800mm) and soil value (0.47) taken from outlet location	**Qbar – 152.3 l/s**
Riders Lane Stream		
IH124	Applied to Riders Lane Stream despite catchment being over recommended upper limit of 200 ha. SAAR (800mm) and soil value (0.47) taken from outlet location.	**Qbar – 1034.5 l/s**
FEH Rainfall Runoff	Based on FEH catchment descriptors modified to catchment area, with hand calculated storm duration and time to peak of 4.08 hours and 2.27 hours respectively.	**1:2.4 year – 1075 l/s**
ReFH2	Based on FEH catchment descriptors modified to catchment area, with software default storm duration of 4.5 hours and timestep of 30 minutes.	**1:2 year – 1413 l/s**
FEH Statistical Method	Based on FEH catchment descriptors modified to catchment area, with pooling group that has 525 years of data for gauged catchments and donor adjusted QMED	**1:2 year – 1183 l/s**

The calculated rate will represent the maximum allowable discharge rate for the proposed drainage serving the dam. For flow estimations other than for ICP SuDS or IH124 methodologies, Qbar is not a default return period and is broadly equivalent to the 1:2.4-year event. Where a fraction of a year was not able to be specified, the lower return period of 1:2 year (Qmed) was used.

As the IH124 method is recommended for catchments less than 200ha, it was discounted for Riders Lane Stream. Therefore, the ICP SUDS and FEH rainfall runoff methods offer the lowest existing runoff rates for Durrants Stream and Riders Lane Stream, respectively.

Based on the above methodologies, the proposed peak discharge rates for the two outfalls are:

152.3 l/s to Durrants Stream
1075 l/s to Riders Lane Stream

The lowest estimated rate is proposed, to ensure the design is conservative from a flood risk perspective.

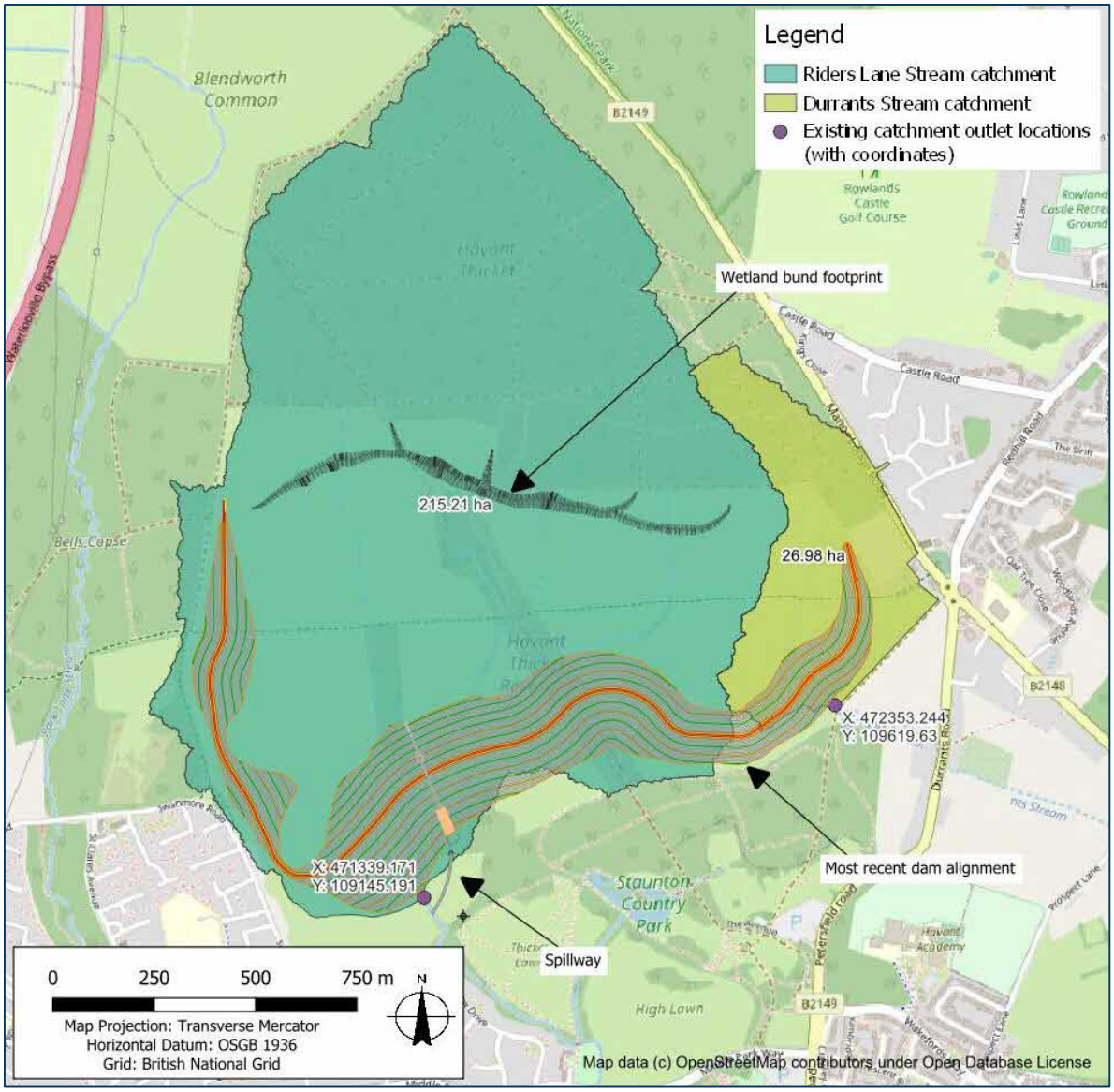


Figure 4 Drainage Catchments and Outlet Locations

5.3.2.1 Compensation Flows

There is a requirement for there to be a continual flow, or discharge, of water from the reservoir into Riders Lane Stream to maintain the ecological and habitat health of the watercourse downstream of the scheme. This will ensure that during prolonged periods of low rainfall volumes, the watercourse flows are maintained despite the impounding of the natural flows which would have occurred in the pre-development scenario. It will therefore be necessary to make allowances for those flows in relation to the proposed peak discharges from the surface water drainage. It is proposed that the surface water drainage discharging to the watercourse will be pro-rata reduced to ensure the combined flow rate (drainage discharges, plus compensation flow) will not exceed the equivalent pre-development Qbar rate.

In line with the Clients requirements document, the compensation flows for Riders Lane Stream are assumed to be 0.3m^3/s, equating to 300l/s. Therefore, the peak surface water discharges to Riders Lane Stream should not exceed 775l/s.

Given the relatively small size of the Durrants stream catchment compared to Riders Lane Stream (see Figure 4) and the proportionally small overall loss in catchment area, there is insufficient evidence to understand the natural flow variability of the stream and to suitably replicate this in the post-development scenario. It is also understood by GHD that Durrants Stream is seasonal and so currently dries up during prolonged periods of limited rainfall. As such, a design compensation flow for Durrant's stream has not been provided.

5.4 Climate Change Allowances

To ensure that the proposed discharge rate is not exceeded, it will be necessary to provide surface water attenuation within the development. Climate Change allowances are included within the design criteria to increase resilience to flooding. HCC, as LLFA for Hampshire, accounts for Climate Change during the planning process by uplifting drainage requirements in line with the EA's Climate Change Allowances. EA guidance states that for site scale applications, such as drainage design, climate change allowances should be taken from the Peak Rainfall Allowances map, which shows the anticipated changes in rainfall intensity.

The design life of the Dam/Reservoir earthworks shall be no less than 100 years. In accordance with the local planning policies, the DEFRA Peak Rainfall Allowances map has been used to define a range of suitable climate change values. The site falls within the East Hampshire Management Catchment, which have the following Climate Change allowances for developments for a lifetime between 2016 and 2125.

40% for the 3.3% (1 in 30 year) AEP rainfall event

45% for the 1% (1 in 100 year) AEP rainfall event

5.4.1 Storage Requirements (with consideration for Climate Change)

To ensure that the proposed discharge rates can be achieved, it will be necessary to provide surface water attenuation within the development. As outlined above, a 45% climate change allowance uplift has been factored into the attenuation/storage assessment.

Considering the lifespan of the development and the anticipated increase in rainfall intensity due to climate change, an estimate for surface water attenuation volume has been carried out for the development using industry standard software, InfoDrainage. Typically, the in-built Quick Storage Estimate (QSE) tool would be used to provide an initial indication of the typical attenuation required, however only a single Cv value can be entered within this function. Therefore, due to the multiple different Cv values of individual contributing areas within the development (refer also to Section 5.2), using the QSE to derive indicative attenuation volumes was deemed unsuitable. Instead, a coarse hydraulic model was created, which included the individual catchment areas and their respective Cv values, discharging directly to an attenuation feature. A range of rainfall return periods and durations were applied to the simulation, to derive the maximum storage volume requirement.

For the proposed drainage catchment west of Riders Lane Stream, which will accept flows from the crest track, embankment (the limit of Phase 3), the southern access road and access tracks (Phases 4 and 8 respectively), the peak discharge rate assumed for design purposes is 325l/s. This is the proportional rate given the total catchment area which must discharge to Riders Lane Stream (the remaining 750 l/s being used for the eastern catchment, compensation flows and core drainage discharge rates). The estimated attenuation storage required to maintain a peak discharge rate of 325l/s has been calculated to be 1,445m^3. The InfoDrainage model outputs for this model is included in Appendix D.

For the proposed drainage catchment east of Riders Lane Stream (and west of Durrants Stream), which will accept flows from the crest track, embankment (the limit of Phase 3) and access track (Phases 8), the peak discharge rate assumed for design purposes is 400l/s. This is the proportional rate given the total catchment area which must discharge to Riders Lane Stream (the remaining 675 l/s being used for the western catchment, compensation flows and core drainage discharge rates). The estimated attenuation storage required to maintain a peak discharge rate of 400l/s has been calculated to be 2,941m^3. The InfoDrainage model outputs for this model is included in Appendix E.

Similar principles apply to the discharges to Durrants Stream, whereby there is a catchment on either side of the watercourse (one from the east and another from the west). The existing Qbar discharge rate to Durrants Stream of 152.3l/s was split proportional to the proposed catchment areas. Therefore 52.3l/s is assumed for the smaller catchment west of Durrants Stream and 100l/s for the larger catchment east of the watercourse. Using these parameters, the attenuation storage volumes required are 268m^3 and 353m^3, west and east of Durrants Stream respectively. The InfoDrainage model outputs for the models west and east of Durrants stream are included in Appendices F and G respectively.

The basins have been sized to attenuate 100% of the estimated volume and so represents a worst-case scenario. The location and summary of requirements for these basins are shown in Appendix H. It should be noted that the models used to derive these volumes do not make allowances for carrier networks, interception features/SuDS elements and manholes. Therefore, there are discreet volumes of additional storage volume not represented in the basin volumes stated above. This provides a conservative estimate of the attenuation required.

The proposed surface water drainage design that will intercept runoff from Phase 3, is outlined in Section 6.

6. Proposed Surface Water Drainage

6.1 Proposed Surface Water Drainage Design

As outlined in Section 4, there is no dedicated surface water drainage network within Phase 3. It will instead drain/discharge into networks located in other successive phases of the scheme (predominantly Phases 4 and 8). Therefore, this section seeks to outline the strategy for these successive phases to provide a background to the overall drainage scheme which Phase 3 will utilise.

An outline of a potential surface water drainage solution, which will intercept or receive runoff from Phase 3 is shown in Appendix H. The proposed drainage network will intercept, convey, and treat surface water runoff from the crest track and downface of the embankment. This constitutes most of the drainage from Phase 3. Furthermore, it will also intercept, convey, and treat surface water flows from the access road, access tracks and grass verges (elements not with Phase 3) within one single network. The interception features and main drainage carrier networks are generally situated beyond the access track, furthest from the embankment.

The SuDS Manual (CIRIA C753, 2015) details a wide range of drainage techniques, some of which will be incorporated into the proposed scheme to decrease the runoff rate, and volume where possible, across the site.

Filter drains will be located adjacent to the access track, furthest from the embankment, to intercept and treat runoff before conveying it downstream. Filter drains improve runoff water quality by reducing total suspended solids (TSS), copper, zinc and other metals. At regular intervals, the filter drains will discharge, into a single carrier network to maximise storage capacity within the drainage system. Core drainage will also discharge to the main carrier network at 5no. location, to enable identification and monitoring of seepage flows, and to allow for sampling when required.

On-line detention basins located south of the Phase 3 planning boundary are proposed to attenuate the remining volume of surface water unable to be stored within the upstream network. This is to ensure the discharge rate does not exceed the allowed Qbar rate of 1075l/s to Riders Lane Stream (including compensation flow) and 152.3 l/s into Durrants Stream. Detention basins also provide sediment removal and help to reduce levels of nutrients, heavy metals and toxic materials entering the downstream network.

6.2 Treatment provision of Surface Water through SuDS

The SuDS Manual (CIRIA C753, 2015) states that to deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (PMI) that equals or exceeds the pollution hazard index (PHI).

Table 3 shows an extract from Table 26.2 from the SuDS Manual (CIRIA C753, 2015) of pollution hazard indices.

Table 3 - Extract from Table 26.2 from SuDS Manual (CIRIA C753, 2015)

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. <300 traffic movements a day	Low	0.5	0..4	0.4

In determining the land use classification of the various areas within Phase 3, consideration was given to its final use. The access tracks were considered most like ‘low traffic roads’ since access to the site is likely to be infrequent.

Table 4 shows the PMI for individual SuDS components and the total SuDS PMI for each pollution hazard, where:

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

Table 4 – Pollution Mitigation Indices (PMI)

	Mitigation Indices		
Type of SuDS Component	**TSS**	**Metals**	**Hydrocarbons**
Filter Drains	**0.4**	**0.4**	**0.4**
Detention Basin	**0.5**	**0.5**	**0.6**
Total SuDS PMI	**0.65**	**0.65**	**0.7**

Table 4 demonstrates that the proposed SuDS treatment train can suitably treat the surface water such that it exceeds the necessary PMI values for TSS, Metals and Hydrocarbons respectively.

7. Maintenance

As previously noted in Section 4, there is no dedicated surface water drainage network within Phase 3. Surface water will drain/discharge into networks located in successive phases of the scheme (Phases 4 and 8). Therefore, this section outlines the principles of good practice for operation and maintenance of drainage features within these later phases, which will ensure the effectiveness and reliability of the system over the lifespan of the development. An outline of the surface water drainage network is discussed in Section 6.1.

7.1 Management of Surface Water Runoff during construction of the drainage system

The construction of the proposed drainage infrastructure is to be undertaken by a competent Civil Engineering Contractor in accordance with their approved method statement(s). All drainage will need to be protected from sedimentation during the construction phase then fully inspected to ensure they function prior to completion.

The Principal Contractor shall be responsible for the collection, treatment, and disposal of surface waters to a suitable location. During construction phase there will be several activities, which could reduce surface water quality with respect to physical contaminants. These include but are not limited to; materials handling, storage, stockpiling, spillage and disposal, earthworks, construction of the proposed development and movement and use of plant/construction vehicles. These construction activities may lead to the disturbance and mobilisation of physical contaminants. During periods of heavy rainfall, vehicle movements resulting in damage to soil structures may generate increased sedimentation within surface water runoff.

During periods of dry, windy weather, wind-blown dusts generated by the excavation of soils have the potential to enter open or incomplete elements of the drainage network. These activities may therefore result in sediments directly or indirectly entering surface water features, influencing the physical, chemical, and biological quality of the surface water receptors in the surrounding area.

During construction of the surface water drainage system, additional measures are to be implemented, including:

The Principal Contractor will ensure that no debris or silt enters the drainage system during construction.

- They will take appropriate action to remove and dispose of any debris/ siltation, which does occur.

All open ends of drains are to be capped off as the work proceeds using manufactures caps (not makeshift caps that could be flushed into the wider drainage network).

All manholes will be cleaned out and have covers fitted as soon as they are constructed.

Open landscaping should be constructed where possible at the end of the construction phase.

- This will minimise erosion and sedimentation.

The Principal Contractor will ensure all landscaping activities are carefully designed and carried out to prevent the deposition of topsoil, turf and other materials on the hard paved surfaces.

7.2 Maintenance Requirements

Havant Thickett Reservoir will be owned and operated by Portsmouth Water, and so all elements of the drainage network will be integrated into their wider maintenance and management of the scheme.

Visits should be made as often as is necessary to fulfil the required standard of maintenance. The required maintenance can be divided into two categories:

1. Regular maintenance: basic tasks done on a frequent and predictable schedule,
2. Supplementary maintenance: tasks that are likely to be required only periodically

The client will be provided with a 'Maintenance Record' so that they are aware of the function and maintenance requirements of the drainage system. The record should include:

- Details of the drainage system
- Specific operation and maintenance requirements for proprietary products including flow control structures.

Inspections of the drainage network are to be conducted as per the maintenance schedule and could be integrated with any relevant Landscape Management activities, like grass cutting or vegetation pruning, which may also be undertaken at similar intervals.

It is recommended that the frequency of inspections is to be increased during the first year of operation so that inspections are also conducted after every significant storm event to ensure that it is functioning correctly and if necessary, implement improvement works to optimise performance. Elements that are to be inspected are included in the table below.

Table 5 Regular and Supplementary Maintenance Requirements

Regular Maintenance	Supplementary Maintenance
Inlets and outlets – ensure that inlets and outlets are clear and that flows in/out are not impeded. Any obstruction or build-up of material must be removed as soon as it is seen or reported.	To ensure the long-term effectiveness of the SuDS scheme, accumulated sediment should be periodically removed. The frequency will vary over the lifetime of the scheme.
Structure – a visual inspection of attenuation basin and associated pipework to check for any seepages. Any defects are to be remediated as soon as practicably possible once it has been seen or reported.	Accumulation will be most acute during the construction period until the drainage catchment is well established and all works are complete. At this point, the amount of sediment entering the SuDS scheme will likely be reduced.
Water Quality – Is there evidence of poor water quality in the surface water systems, e.g. algae, oils or odours. If so, further inspection remedial actions are to be taken.	Until all development is complete, careful consideration should be given to sediment build up during the regular inspections outlined above. Following completion, the frequency at which sediment removal will be required could be between 15 to 25 years.
Sediment build-up by carrying out a visual inspection of the manholes and filter drains to determine whether there is evidence of silt build up. Any evidence of silt build up is to be reported and inspected further by an appropriate engineer to determine whether silt removal is to be initiated	Sediment removal should be undertaken in such a way as to prevent damage to the SuDS features, minimise the impact on ecological systems and maintain aesthetic appearance. The method of removal will depend upon the SuDS feature, access, wildlife concerns and sediment depth.
Litter, debris or vegetation to be checked by carrying out a visual inspection of the filter drains to determine the presence invasive vegetation and the overall health of the systems. Removal of invasive vegetation is critical to the performance of the basin. Remedial actions are to be taken immediately when an appropriate engineer deems it necessary.	As these tasks are intermittent tasks that are required to be rectify this is likely to be due to unforeseen events, and therefore timings are difficult to predict. A contingency sum of 15-20% should be added to the annual maintenance costs to cover the risk in accordance with the recommendations of CIRIA C753.

7.3 Drainage Infrastructure Maintenance Requirements

7.3.1 Pipework, Manhole Access and General Maintenance

The following maintenance schedules are recommended:

- Local repair or local replacement of damaged pipes or other structures
- Cleaning and removal of sediments, obstructions etc. to restore hydraulic capacity.
- Jetting/vacuum of sewers to be undertaken as often as necessary to remove silts and ordinary debris.

If any extraordinary issues are encountered during an inspection, further information may be required such as a CCTV survey report.

Maintenance to be undertaken on a six-monthly schedule.

All manhole covers should be lifted, and the manholes visually inspected for silt, debris, and signs of blockages within the drainage system. Check manhole covers and frames for damage and ensure correctly bolted together (six monthly).

Should any debris or blockages be detected, the manholes should be cleaned along with associated pipe runs using a high pressure jetter. On completion a CCTV surveyed should be undertaken to verify/identify that no further remedial works are required.

To avoid damaging the pipe, PSI pressures need to be verified before jetting of plastic twin wall sewers. Cleaning of drainage systems may require the temporary sealing of the system and careful collection of the effluent for disposal off site.

7.3.2 Detention Basin

An experienced team with the appropriate training and safety qualifications (in accordance with the maintenance plan specified by the manufacturer) should conduct the maintenance.

The responsibility for ensuring that the maintenance schedule is delivered will be the client, Portsmouth Water.

Monthly maintenance requirements shall include removing litter and debris, cutting grass in and around the basin, inspecting inlets, outlets and overflows for blockages and physical damage. Sediments should be removed from inlets and outlets on an annual basis (or in response to emerging issues between visits) and repairs/rehabilitation of inlets and outlets should be undertaken as required.

7.3.3 Filter Drains

The following maintenance schedules are recommended:

Remove litter (inc. leaf litter) and debris from filter drain surface and access chambers (six monthly)

Inspect filter drain surface and inlet/outlet pipework for any signs of blockages, clogging or standing water (six monthly).

Remove or control tree roots where they encroach the sides of the filter drains (as required)

Inspect inlet and perforated pipework for silt accumulation and establish appropriate silt removal frequencies (six monthly)

7.3.4 Flow Control

To limit flows from the site to greenfield rates, control features are required. It is proposed these are a hydrobrake vortex control (or equivalent). The control points should be inspected in line with the manufacturer specifications and as a minimum at the same interval as the rest of the site drainage system. The flow control chambers are to be located at the outlet of each basin shown in Appendix H.

8. Conclusion

GHD were asked to produce a DMP to support the Reserved Matters Application for Phase 3 of the Havant Thicket Reservoir scheme. This report aimed to satisfy planning condition 32 relating to flood risk, to demonstrate that the development will not increase the risk of flooding to the area.

Phase 3 encompasses the main embankment, culvert and valve tower only, and as such, there is limited positive surface water drainage infrastructure provided within the extent of this phase. Drainage within Phase 3 is largely limited to core drainage within the embankment, which ensures that any minor seepage flows within the core of the main embankment are adequately drained away through preferential pathways. Surface water flows generated by the specific elements of Phase 3, which include the crest track, atop of the embankment and the downward face of the embankment itself, will shed overland into positive drainage networks installed beyond the toe of the embankment. These receiving drainage networks are to be located within Phases 4 and 8 of the schemes.

The receiving network within successive phases will adequately convey and treat surface water runoff within a system of filter drains, conventional pipework, and attenuation basins. They will discharge to Riders Lane Stream and Durrants Stream at rates no greater than Qbar at, 1075l/s (inclusive of compensation flows) and 152.3l/s respectively. This is in accordance with HCC's Local Flood and Water Management Strategy. Overall, there is no increased flood risk to the area because of the proposed Phase 3 development.

This DMP provides appropriate detail about the sustainable management of surface water from Phase 3, such that local and national planning policies are deemed to be satisfied, together with the pertinent points of Planning Condition 32 which required a drainage management plan that adequately details the management of the drainage associated with the phase. Furthermore, this DMP outlines the maintenance of the proposed drainage system which will serve Phase 3, such that comfort can be given that appropriate consideration has been given to the long-term serviceability of the system.

Appendix A Detailed Phasing Plan

Future Water MJJV Ltd

Portsmouth Water

Havant Thicket Reservoir

Detailed Phasing Plan

For Reserved Matters Applications

23/01/2024 | v9

Document Reference: HTR-FUW-RZ-RE-DP-W-0507

1.0 - Introduction

In 2020, planning applications (ref APP/20/00990 and 51680/001) were submitted to Havant Borough Council (HBC) and East Hampshire District Council (EHDC) for permission to develop a reservoir for raw water storage. Planning permission was subsequently granted in 2021 subject to Conditions. Whilst planning consent was received from two authorities, the wording of the decision notices is identical and therefore the same Conditions apply to both permissions.

This detailed phasing plan has been prepared by Future Water MJJV for the works at Havant Thicket Reservoir.
This document is required to discharge Condition 4 of the permissions. The requirements of Condition 5 and where within this document the requirements are addressed are set out in **Table 1** below**.**

Condition 4 - Phasing	**Where Addressed**
Prior to the commencement of development, a detailed phasing plan for the development shall be submitted to and approved by the Local Planning Authority. The development shall be carried out in accordance with the approved phasing plan and no variation shall be made without the prior written approval of the Local Planning Authority. *Approval will not be given if in the reasonable opinion of the Local Planning Authority the proposed variations creates new environmental impacts which exceed the range or scale of those measured and assessed in the Environmental Statement (including the further information) and which the Local Planning Authority considers may require further or additional mitigation measures.*	*Section 1.0 – page 2* *Pages 3-5*

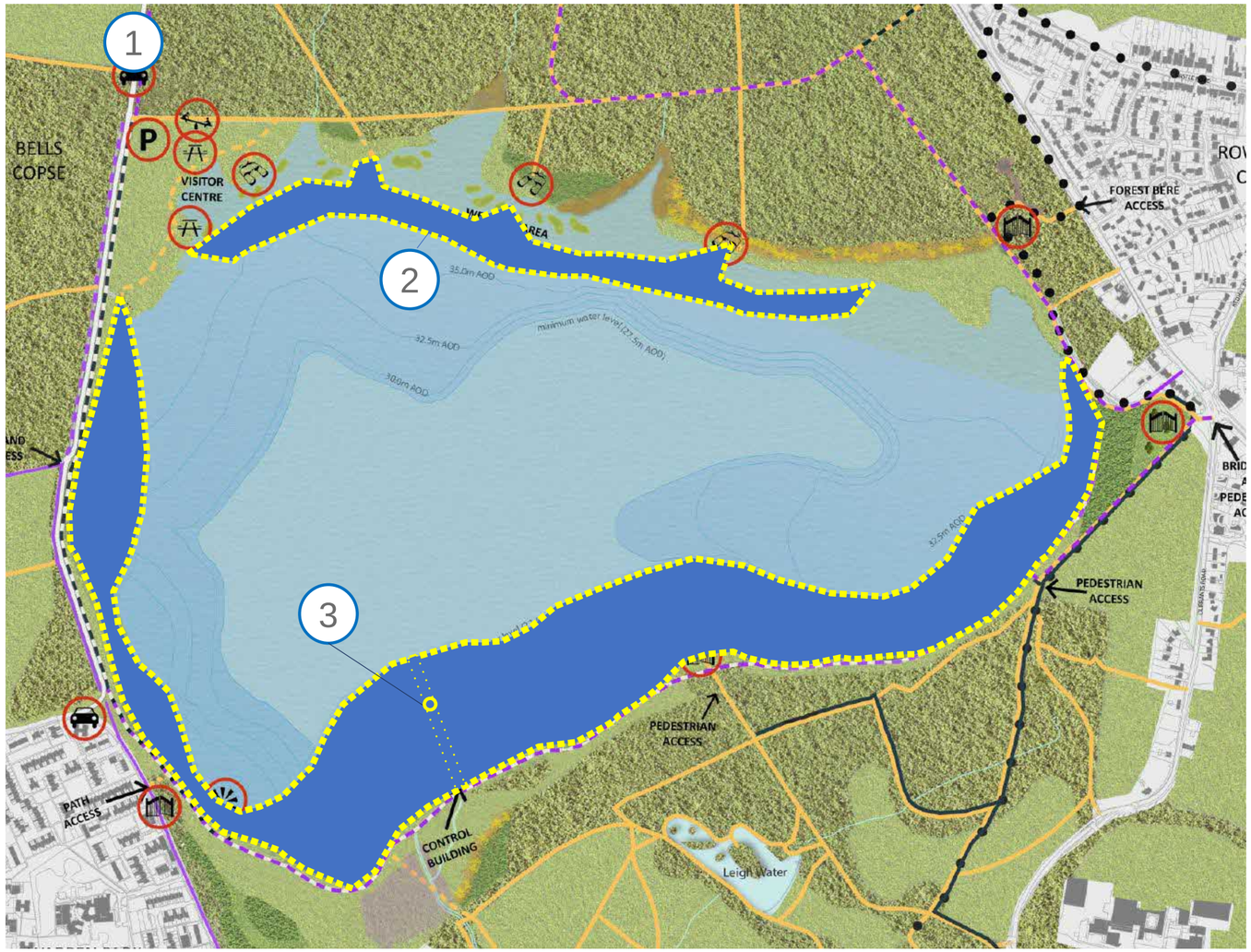
The Phasing Plan will remain a live document, being reviewed and updated as required. Each of these updated plans will be submitted to HBC &EHBC for approval prior to the implementation of any changes.

Explanatory Note:

The programme dates for submission of the reserved matters applications for the individual phases of the development are provided based on the development programme at the date of submission. The dates are given as periods of two quarters (e.g. Q1 – Q2 of 2023) and the target date for submission would fall into this period.

Should the timing for submission differ significantly then a variation to the Phasing Plan would be submitted for re-approval, however as an example, a submission one quarter earlier or later would not trigger the need for the phasing plan to be re-submitted.

Reserved Matters Phasing



Ref	Element Covered	Proposed Submission Timing	Additional Information
1	Northern Access Route		Approved Feb 2023
2	Wetland Retaining Earthworks and Structures	Q1 2024	RM
3	Main Embankment, Culvert & Valve Tower	Q1 2024	Section 73 & RM

Dates subject to change following further schedule development

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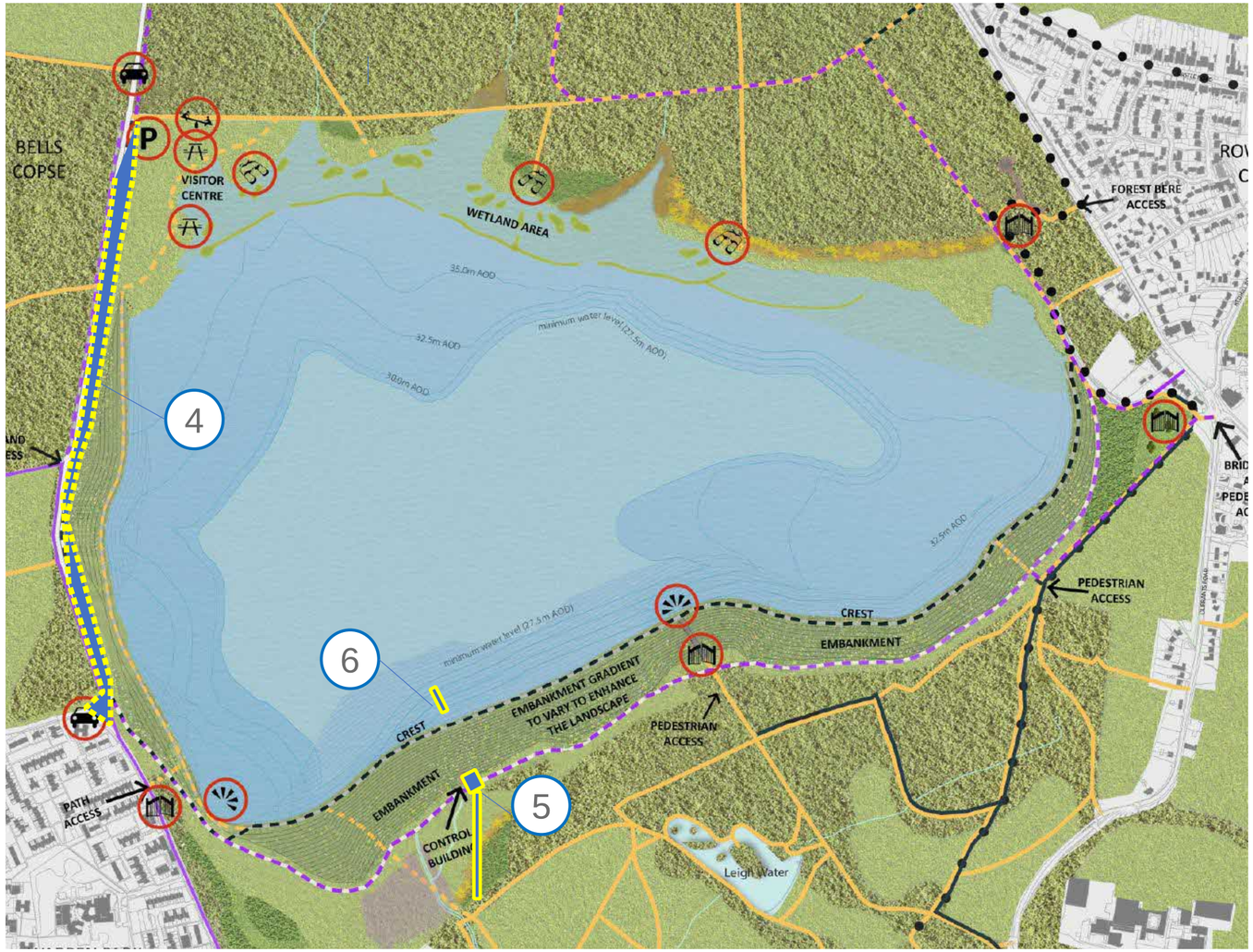
Portsmouth Water

Reserved Matters Phasing



Dates subject to change following further schedule development

Ref	Element Covered	Proposed Submission Timing	Additional Information
4	Southern Access Road	Q2 2024	RM
5	Control house and Pipe	Q3 2024	RM
6	Secondary means of access to outlet tower	Q1 2025	RM (Following new application)

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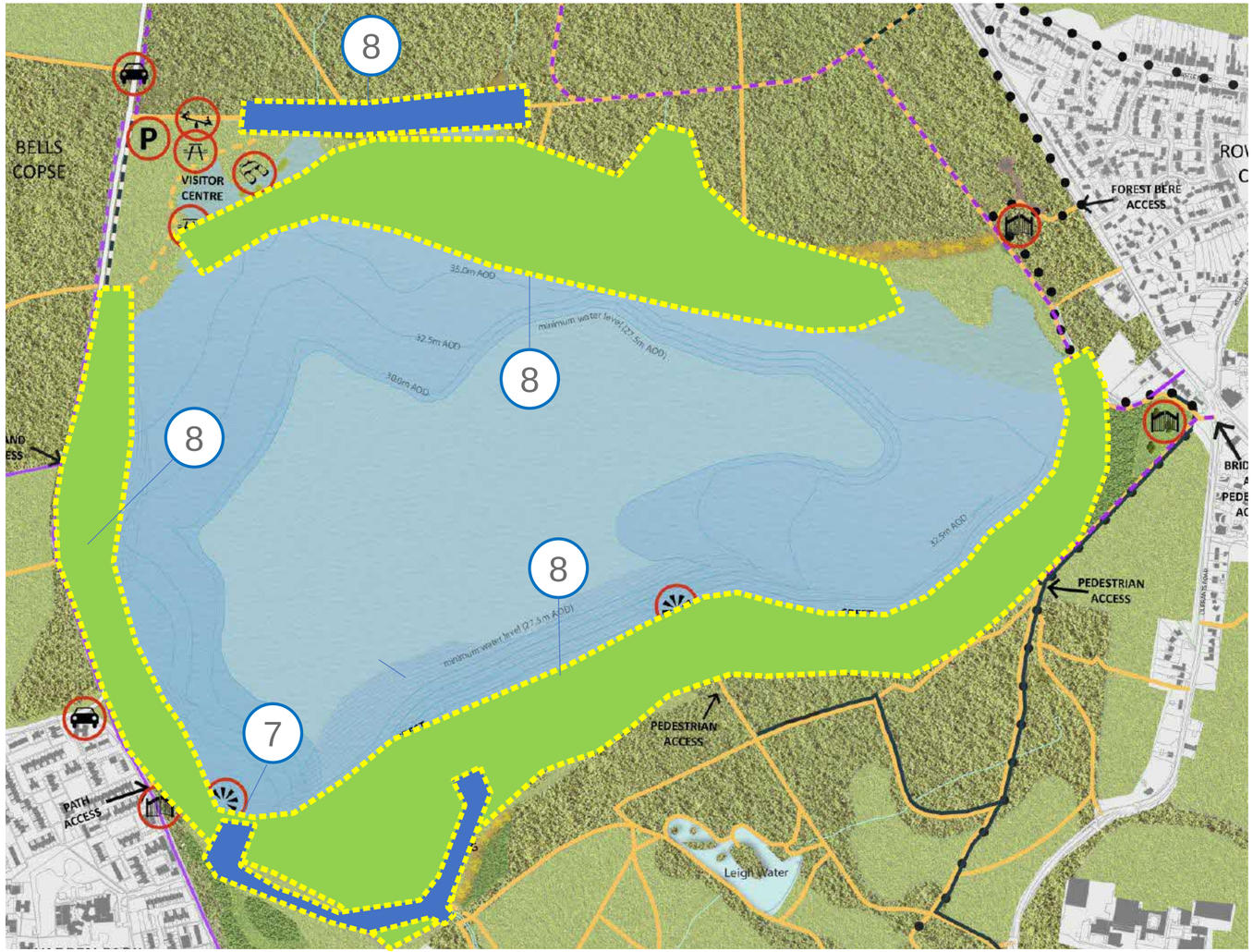
Portsmouth Water

Reserved Matters Phasing



Dates subject to change following further schedule development

Ref	Element Covered	Proposed Submission Timing	Additional Information
7	Spillway	Q4 2025	RM
8	Remaining Areas of hard and soft landscaping, not previously approved, Forestry England Track Culverts	Q2 2026	RM

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Portsmouth Water

Reserved Matters Phasing

Dates subject to change following further schedule development

Ref	Element Covered	Proposed Submission Timing	Additional Information
9	Visitors Centre	Post 2026	Pending Award

Future Water MJJV Ltd

Portsmouth Water

Appendix B Response from HCC - 17th October 2023

From: [redacted]
Sent: Tuesday, October 17, 2023 12:17 PM
To: [redacted]
Cc: [redacted]
Subject: RE: Havant Thicket Reservoir - Surface Water Drainage Design Criteria

Dear [redacted]
Thank you for your email and apologies for the time taken to get back to you.

Having looked through the criteria, these look appropriate for the site and I don't have any issues to raise.

Regards
[redacted]

[redacted]
Flood and Water Management
[redacted]

Click here to chat to me on MS Teams

From: [redacted]
Sent: Wednesday, October 11, 2023 9:06 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Havant Thicket Reservoir - Surface Water Drainage Design Criteria

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Hi [redacted]

I was just curious as to whether you have had the opportunity to review the email below?

If you need any further clarifications or wish to discuss specific elements of it, such that you can approve in principle, then please let [redacted] or I know.

Kind regards

[redacted]

GHD
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[redacted]

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Please consider the environment before printing this email

From: [redacted]
Sent: Friday, September 22, 2023 2:10 PM
To: [redacted]
Cc: [redacted]
Subject: Havant Thicket Reservoir - Surface Water Drainage Design Criteria

Hello [redacted]

Thank you for your time speaking to my colleague [redacted] with regards to the drainage design criteria for Havant Thicket Reservoir.

Based on the discussion you had with [redacted], we have summarised our proposed surface water drainage design criteria for the scheme. These networks will primarily intercept those flows from the dry side of the reservoir embankment, together with associated access roads, tracks and footways.

Would you be able to review the criteria below, and confirm whether you agree in principle to our proposals? We can then integrate these design requirements in to our next phase of design work.

Design return periods and performance criteria
From the Hampshire County Council Surace Water Checklist Guidance:

- 1 in 1 year (100% Annual Exceedance Probability, or AEP)
- 1 in 30 year (3.33% AEP). No drainage flooding permitted.
- 1 in 100 year (1% AEP) with climate change allowance. Flooding permitted, but to be retained within the site.

Climate change allowances
From the DEFRA Climate Change Allowances map:

- 40% for the 3.3%AEP and
- 45% for the 1%AEP

Discharge rate criteria
From the discussions undertaken with you, this could be equal to the equivalent Qbar discharge rate for all events up to the 1% AEP plus 45%CC storm.

Runoff co-efficient
Based on guidance documents from both the UK and internationally, the following peak Cv values are proposed. These vary depending upon the surface type/covering, and the proposed gradient or slope of the surface. Each drainage catchment area will have the relative Cv value applied, specific to its surface type.

Land use/ surface type	Cv value
Grass slopes of dam wall (>10% slope)	0.4
‘Flat’ (2-10% slope) grass areas	0.3
Gravel tracks, assumed to be generally flat	0.8
Tarmac (sealed) roads, assumed to be generally flat	0.9

Rainfall data
The FSR rainfall data, as built into InfoDrainage.

Water quality
Evidence that sufficient water treatment has been provided in accordance with the methodology in the Ciria SuDS Manual using the Simple index Criteria (Box 26.2).

I would be grateful if you could agree in principle to the above criteria. However, if you require anything further or wish to discuss them, please reach out to either [redacted] or myself.

Kind regards

[redacted]

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[redacted]

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Appendix C Response from HCC – 20th December 2023

From: [redacted]
Sent: Wednesday, December 20, 2023 11:52 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Havant Thicket Reservoir - Surface Water Drainage. Discharge rates and locations

> Some people who received this message don't often get email from [redacted] Learn why this is important

Hi [redacted]
As discussed, your methodology makes sense and I have no issues with the information set out below.

I do have some queries which I appreciate are detailed and are still being discussed:
What happens in events beyond the design – I can't remember what you are designing to but would need an understanding of potential 'overtopping' points and there may be a need for localised low stops so flows can re-enter the watercourses safely and not back up / overflow in new locations.

The proposals below are reducing flows in the watercourse to Qbar. This would have a reduction in downstream flows during higher events so there may be other impacts in relation to ecology / biodiversity which are outside my remit.

From a LLFA perspective, we ask for no increase in flows from the pre-development situation so there is potential for complex flow control at the higher order events i.e. discharge at the 1:100 + cc can match Q100

Hope this helps

Regards
[redacted]

[redacted]
Flood and Water Management
[redacted]

Click here to chat to me on MS Teams

From: [redacted]
Sent: Wednesday, December 6, 2023 9:21 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Havant Thicket Reservoir - Surface Water Drainage. Discharge rates and locations

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Hi [redacted]

I don't recall seeing a response to this, but apologies if I've missed it.

I'll give you a call to discuss; can you let me know which day and time this week suits you best?

Kind regards

[redacted]

GHD
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[redacted]

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Please consider the environment before printing this email

From: [redacted]
Sent: Thursday, November 23, 2023 10:10 AM
To: [redacted]
Cc: [redacted]

[redacted]

Subject: RE: Havant Thicket Reservoir - Surface Water Drainage. Discharge rates and locations

Hi [redacted],

I was just curious as to whether you have had the opportunity to review the latest email, below?

If you need any further clarifications or wish to discuss specific elements of it, such that you can approve in principle, then please let [redacted] or I know.

Kind regards

[redacted]

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[redacted]

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Please consider the environment before printing this email

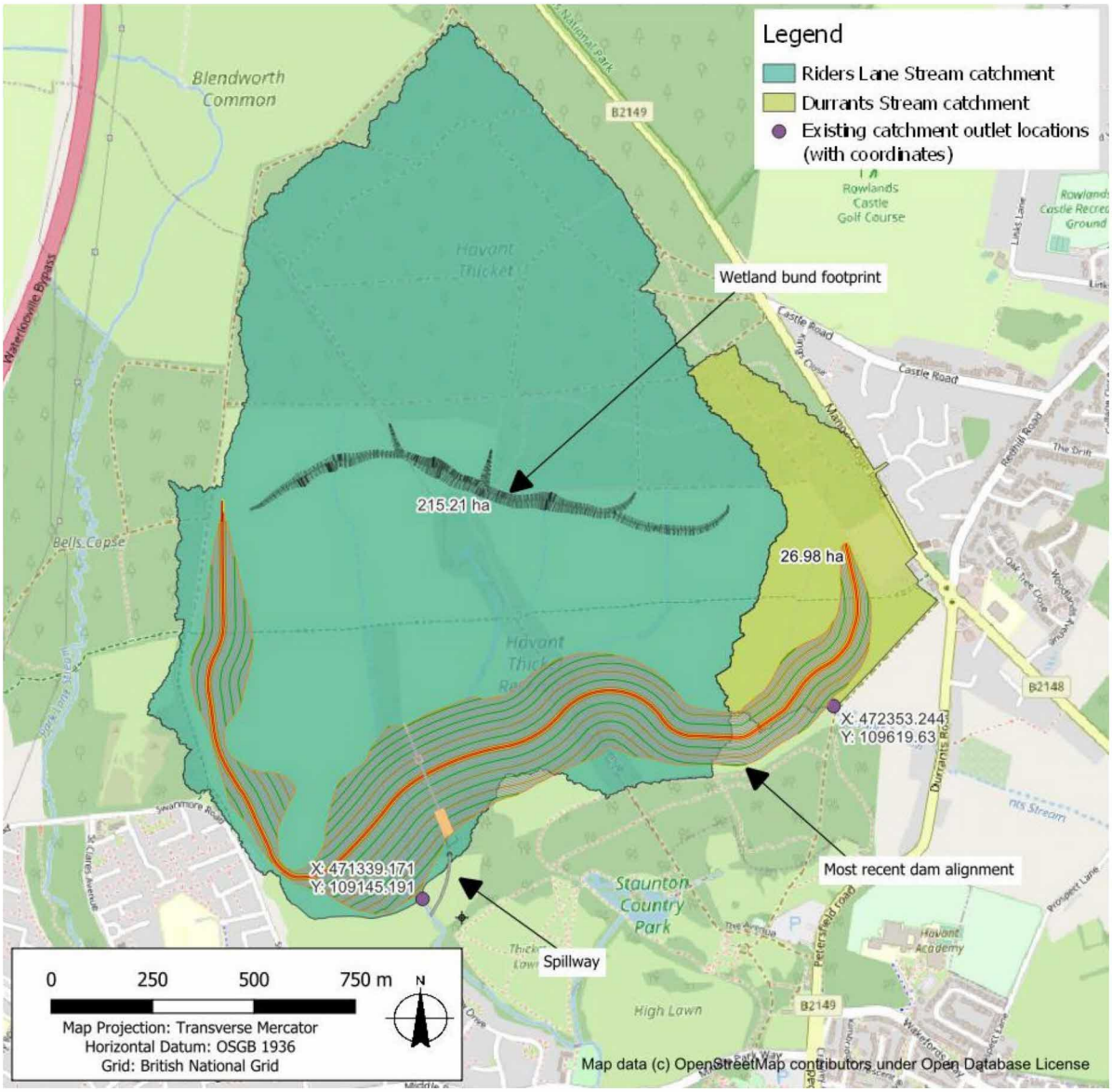
From: [redacted]
Sent: Friday, October 27, 2023 5:16 PM
To: [redacted]
Cc: [redacted]
Subject: Havant Thicket Reservoir - Surface Water Drainage. Discharge rates and locations

Hi [redacted],

Further to our last email regarding the Havant Thickett Reservoir design criteria, we have now completed an assessment of the existing catchment areas in order to derive the pre-development discharges rates. These will therefore represent the maximum peak flows which are to be used in the surface water drainage design. There are two watercourses originating from within the proposed reservoir area, these are:

- Riders Lane Stream, to the west, covering 215.21 hectares
- Durrants Stream, to the east, covering 26.98 hectares

The coordinates of the outlet points (which also represent the point at which the proposed dam crosses the watercourse) are shown below, together with the corresponding upstream catchment for that location. This represents the extent of upslope catchment which will would have discharged (pre-development) to that location.



The existing runoff rates have been assessed using a range of methods. This was largely due to the size of the Riders Lane Stream catchment, being in excess of 200 hectares, but also allows for a comparison such that an appropriate discharge/flow rate can be established. The methods used in assessing existing runoff rates from each catchment are tabulated below for ease of review.

Method used	Comment	Closest return period to Qbar and flow rate
Durrants Stream		
ICP SuDS	Used for the Durrants Stream catchment, as the area is less than 50 hectares. SAAR (800mm) and soil value (0.47) taken from outlet location.	Qbar – 152.3 litres per second
Riders Lane Stream		
IH124	Applied to Riders Lane Stream despite catchment being over recommended upper limit of 200 hectares. SAAR (800mm) and soil value (0.47) taken from outlet location.	Qbar – 1034.5 litres per second
FEH rainfall runoff	Based on FEH catchment descriptors modified to catchment area, with hand calculated storm duration and time to peak of 4.08 hours and 2.27 hours respectively.	1:2.4 year – 1075 litres per second

ReFH2	Based on FEH catchment descriptors modified to catchment area, with software default storm duration of 4.5 hours and timestep of 30 minutes.	1:2 year – 1413 litres per second
FEH statistical method	Based on FEH catchment descriptors modified to catchment area, with pooling group that has 525 years of data for gauged catchments and donor adjusted QMED.	1:2 year – 1183 litres per second

As can be seen in the above table, a range of methods were used to establish what (if any) variability there was, across the differing methods of peak flow estimation for the full catchment area.

The calculated rate will represent the maximum allowable discharge rate for the proposed drainage serving the dam, for all events up to an including the 1% AEP, plus 45% climate change, rainfall event. As outlined in our earlier email regarding the design criteria, it is proposed that all discharges are restricted to no more than the equivalent 'Qbar' rate for all events. For flow estimations other than for ICP SUDS or IH124 methodologies, Qbar is not a default return period. For the purposes of this assessment, Qbar is considered to be broadly equivalent to the 1:2.4 year event. Where a fraction of a year was not able to be specified, the lower return period of 1:2 year (Qmed) was used.

Since the IH124 method is recommended for catchments less than 200ha, it has been discounted for Riders Lane Stream. Therefore, the ICP SUDS and FEH rainfall runoff methods offer the lowest existing runoff rates for Durrants Stream and Riders Lane Stream respectively.

Based on the above methodologies, the proposed peak discharge rates for the two outfalls for all rainfall events up to and including the 1% AEP plus 45% climate change allowance is:

- **152.3 litres per second to Durrants Stream**
- **1075 litres per second to Riders Lane Stream**

The lowest estimated rate is proposed, in order to ensure the design is conservative from a flood risk perspective, as was discussed a little while ago with Duncan.

It should be noted that for Riders Lane Stream, the Qbar rate will also include the compensation flows from the proposed reservoir. Therefore, the surface water drainage discharging to the watercourse will be pro-rata reduced to ensure the combined flow rate (drainage discharge plus compensation flow) is not exceeded for the Qbar event.

The proposed drainage designs and calculations will include for any areas of existing green space from the catchment, that will continue to drain to the outfall but via the proposed positive drainage network (and not be intercepted by the dam). This will avoid duplication of runoff areas and will ensure that the two streams are not deprived of existing flows during 'day to day' rainfall events.

I would be grateful if you could agree in principle to the above catchment area and runoff rate assessment. However, if you require anything further or wish to discuss them, please feel free to reach out.

Kind Regards

[redacted]

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Appendix D InfoDrainage Model Outputs West of Riders Lane Stream

Project:	Date:		
Havant Thicket Reservoir Model Outputs West of Riders Lane Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP		
Report Details:	Company Address:		
Type: Stormwater Controls Storm Phase: Phase			

Pond

Type : Pond

Dimensions

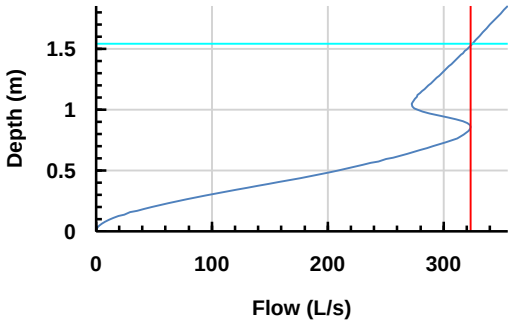
Exceedance Level (m)	19.100
Depth (m)	1.800
Base Level (m)	17.300
Freeboard (mm)	300
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	3.037
Total Volume (m³)	1446.202

Depth (m)	Area (m²)	Volume (m³)
0.000	725.00	0.000
1.500	1225.00	1446.202

Outlets

Outlet (1)

Outgoing Connection	Pipe
Outlet Type	Hydro-Brake®
Invert Level (m)	17.300
Design Depth (m)	1.542
Design Flow (L/s)	325.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐
Unit Reference	CHE-0566-3250-1542-3250



Advanced

Perimeter	Circular
Length (m)	150.430
Friction Scheme	Manning's n
n	0.025

Project:	Date:		
Havant Thicket Reservoir Model Outputs West of Riders Lane Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP		
Report Details:	Company Address:		
Type: Network Design Criteria Storm Phase: Phase			

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

Pipe Options

Lock Slope Options	None
Design Level	Level Soffits
Min. Cover Depth (m)	1.200
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Project:	Date:		
Havant Thicket Reservoir Model Outputs West of Riders Lane Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP		
Report Title:	Company Address:		
Rainfall Analysis Criteria			

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Reduced
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FSR

Type: FSR

Region	England And Wales
M5-60 (mm)	19.6
Ratio R	0.335
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
100.0	45.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
240	480
360	720
480	960
960	1920
1440	2880

Project:	Date:		
Havant Thicket Reservoir Model Outputs West of Riders Lane Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP		
Report Details:	Company Address:		
Type: Stormwater Control Results Storm Phase: Phase			

Pond
Critical by Return Period: FSR: 100 years: Increase Rainfall (%): +45: 120 mins: Summer

Type : Pond

Tables

Time (mins)	Total Inflow (L/s)	US Depth (m)	DS Depth (m)	Resident Volume(m³)	Flooded Volume (m³)	Outlet (1) (L/s)	Total Outflow (L/s)
0	0.0	0.000	0.000	0.000	0.000	0.0	0.0
5	109.3	0.085	0.000	16.126	0.000	0.0	0.0
10	118.1	0.122	0.001	50.346	0.000	0.0	0.0
15	125.1	0.141	0.095	86.309	0.000	4.8	4.8
20	134.7	0.171	0.160	122.258	0.000	12.7	12.7
25	148.7	0.216	0.210	159.670	0.000	21.4	21.4
30	167.4	0.264	0.260	199.035	0.000	32.3	32.3
35	193.2	0.316	0.312	241.414	0.000	45.7	45.7
40	240.9	0.375	0.371	291.069	0.000	62.6	62.6
45	335.6	0.451	0.447	355.192	0.000	87.3	87.3
50	517.8	0.561	0.556	451.438	0.000	126.6	126.6
55	784.7	0.722	0.717	600.089	0.000	187.3	187.3
60	1143.9	0.947	0.943	822.375	0.000	258.7	258.7
65	1150.0	1.188	1.185	1080.259	0.000	315.6	315.6
70	795.2	1.362	1.361	1279.784	0.000	274.3	274.3
75	525.4	1.458	1.458	1395.183	0.000	276.9	276.9
80	340.3	1.496	1.496	1441.000	0.000	280.4	280.4
85	243.3	1.498	1.499	1444.596	0.000	280.7	280.7
90	194.4	1.483	1.483	1426.388	0.000	279.1	279.1
95	168.2	1.459	1.460	1397.444	0.000	277.0	277.0
100	149.2	1.430	1.430	1362.341	0.000	274.7	274.7
105	135.1	1.397	1.397	1322.937	0.000	272.9	272.9
110	125.3	1.361	1.361	1280.106	0.000	274.3	274.3
115	118.3	1.320	1.320	1232.431	0.000	295.8	295.8
120	111.3	1.267	1.267	1171.933	0.000	323.2	323.2
125	1.9	1.197	1.197	1091.840	0.000	317.0	317.0
130	0.0	1.112	1.112	998.761	0.000	301.8	301.8
135	0.0	1.030	1.030	911.148	0.000	282.0	282.0
140	0.0	0.952	0.952	829.639	0.000	261.3	261.3
145	0.0	0.878	0.878	754.420	0.000	240.0	240.0
150	0.0	0.808	0.808	685.657	0.000	218.4	218.4
155	0.0	0.744	0.744	623.361	0.000	196.9	196.9
160	0.0	0.685	0.685	568.402	0.000	175.5	175.5
165	0.0	0.631	0.631	518.801	0.000	155.1	155.1
170	0.0	0.583	0.583	474.961	0.000	136.8	136.8
175	0.0	0.540	0.540	436.286	0.000	120.6	120.6
180	0.0	0.502	0.502	402.159	0.000	106.6	106.6
185	0.0	0.467	0.467	372.018	0.000	94.3	94.3
190	0.0	0.436	0.436	345.274	0.000	83.8	83.8
195	0.0	0.409	0.409	321.542	0.000	74.5	74.5
200	0.0	0.384	0.384	300.385	0.000	66.4	66.4
205	0.0	0.361	0.361	281.498	0.000	59.5	59.5
210	0.0	0.341	0.341	264.535	0.000	53.6	53.6
215	0.0	0.322	0.322	249.235	0.000	48.4	48.4
220	0.0	0.305	0.305	235.416	0.000	43.7	43.7
225	0.0	0.290	0.290	222.918	0.000	39.6	39.6
230	0.0	0.276	0.276	211.539	0.000	36.2	36.2
235	0.0	0.263	0.263	201.158	0.000	33.0	33.0
240	0.0	0.251	0.251	191.581	0.000	30.2	30.2

Appendix E InfoDrainage Model Outputs East of Riders Lane Stream

Project:	Date:		
Havant Thicket Reservoir Model Outputs East of Riders Lane Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Details: Type: Stormwater Controls Storm Phase: Phase Flow Path: Flow Path	Company Address:		

Pond

Type : Pond

Dimensions

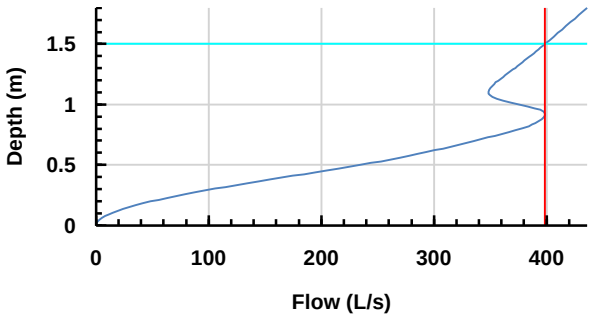
Exceedance Level (m)	21.000
Depth (m)	1.800
Base Level (m)	19.200
Freeboard (mm)	300
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	3.013
Total Volume (m³)	2953.958

Depth (m)	Area (m²)	Volume (m³)
0.000	1625.00	0.000
1.500	2335.00	2953.958

Outlets

Outlet

Outgoing Connection	Pipe
Outlet Type	Hydro-Brake®
Invert Level (m)	19.200
Design Depth (m)	1.500
Design Flow (L/s)	400.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐
Unit Reference	CHE-0620-4000-1500-4000



Advanced

Perimeter	Circular
Length (m)	132.078
Friction Scheme	Manning's n
n	0.025

Project:	Date:		
Havant Thicket Reservoir Model Outputs East of Riders Lane Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Details: Type: Network Design Criteria Storm Phase: Phase	Company Address:		

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

Pipe Options

Lock Slope Options	None
Design Level	Level Soffits
Min. Cover Depth (m)	1.200
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Project:	Date:		
Havant Thicket Reservoir Model Outputs East of Riders Lane Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Title:	Company Address:		
Rainfall Analysis Criteria			

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Reduced
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FSR

Type: FSR

Region	England And Wales
M5-60 (mm)	19.6
Ratio R	0.335
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
100.0	45.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
240	480
360	720
480	960
960	1920
1440	2880

Project:	Date:		
Havant Thicket Reservoir Model Outputs East of Riders Lane Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Details: Type: Stormwater Control Results Storm Phase: Phase Flow Path: Flow Path	Company Address:		

Pond
Critical by Return Period: FSR: 100 years: Increase Rainfall (%): +45: 120 mins: Summer

Type : Pond

Tables

Time (mins)	Total Inflow (L/s)	US Depth (m)	DS Depth (m)	Resident Volume(m³)	Flooded Volume (m³)	Outlet(L/s)	Total Outflow (L/s)
0	0.0	0.000	0.000	0.000	0.000	0.0	0.0
5	194.4	0.069	0.000	28.680	0.000	0.0	0.0
10	209.9	0.100	0.000	89.422	0.000	0.0	0.0
15	222.4	0.115	0.073	153.927	0.000	3.6	3.6
20	239.5	0.139	0.131	220.248	0.000	11.2	11.2
25	264.3	0.179	0.174	291.139	0.000	19.7	19.7
30	297.7	0.222	0.220	367.794	0.000	30.7	30.7
35	343.4	0.271	0.269	452.499	0.000	45.3	45.3
40	428.6	0.328	0.325	551.711	0.000	64.8	64.8
45	597.3	0.401	0.398	683.649	0.000	93.3	93.3
50	922.1	0.507	0.504	876.750	0.000	140.7	140.7
55	1397.9	0.663	0.660	1171.644	0.000	217.0	217.0
60	2038.2	0.884	0.881	1607.570	0.000	311.9	311.9
65	2044.5	1.126	1.125	2114.293	0.000	390.6	390.6
70	1409.1	1.309	1.309	2517.729	0.000	354.1	354.1
75	930.6	1.417	1.418	2761.760	0.000	352.9	352.9
80	602.7	1.471	1.471	2885.624	0.000	359.1	359.1
85	431.5	1.491	1.491	2932.785	0.000	361.9	361.9
90	345.0	1.494	1.494	2940.709	0.000	362.3	362.3
95	298.7	1.489	1.489	2928.713	0.000	361.6	361.6
100	265.0	1.479	1.479	2905.044	0.000	360.2	360.2
105	240.1	1.465	1.465	2873.063	0.000	358.4	358.4
110	222.8	1.449	1.449	2835.338	0.000	356.2	356.2
115	210.3	1.431	1.431	2793.760	0.000	354.2	354.2
120	197.8	1.411	1.411	2749.038	0.000	352.1	352.1
125	1.9	1.378	1.378	2674.572	0.000	349.3	349.3
130	0.0	1.332	1.332	2569.980	0.000	349.4	349.4
135	0.0	1.284	1.284	2463.494	0.000	364.7	364.7
140	0.0	1.233	1.233	2349.482	0.000	393.6	393.6
145	0.0	1.178	1.178	2230.287	0.000	397.8	397.8
150	0.0	1.123	1.123	2111.903	0.000	390.5	390.5
155	0.0	1.069	1.069	1996.368	0.000	377.8	377.8
160	0.0	1.017	1.017	1885.600	0.000	360.4	360.4
165	0.0	0.966	0.966	1779.999	0.000	343.2	343.2
170	0.0	0.917	0.917	1679.649	0.000	325.6	325.6
175	0.0	0.870	0.870	1584.562	0.000	308.3	308.3
180	0.0	0.826	0.826	1494.662	0.000	290.7	290.7
185	0.0	0.783	0.783	1410.036	0.000	273.2	273.2
190	0.0	0.743	0.743	1330.592	0.000	256.2	256.2
195	0.0	0.705	0.705	1256.306	0.000	238.8	238.8
200	0.0	0.669	0.669	1187.182	0.000	221.7	221.7
205	0.0	0.636	0.636	1123.154	0.000	204.9	204.9
210	0.0	0.605	0.605	1063.901	0.000	189.9	189.9
215	0.0	0.576	0.576	1009.068	0.000	175.6	175.6
220	0.0	0.549	0.549	958.376	0.000	162.3	162.3
225	0.0	0.523	0.523	911.510	0.000	150.1	150.1
230	0.0	0.500	0.500	868.137	0.000	139.1	139.1
235	0.0	0.478	0.478	827.878	0.000	129.1	129.1
240	0.0	0.458	0.458	790.301	0.000	119.7	119.7

Appendix F InfoDrainage Model Outputs West of Durrants Stream

Project:	Date:		
Havant Thicket Reservoir Model Outputs West of Durrants Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		

Pond

Type : Pond

Dimensions

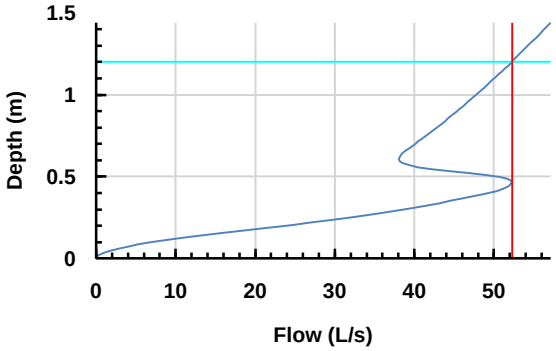
Exceedance Level (m)	31.500
Depth (m)	1.500
Base Level (m)	30.000
Freeboard (mm)	300
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	3.078
Total Volume (m³)	270.427

Depth (m)	Area (m²)	Volume (m³)
0.000	135.00	0.000
1.200	330.00	270.427

Outlets

Outlet

Outgoing Connection	Pipe (1)
Outlet Type	Hydro-Brake®
Invert Level (m)	30.000
Design Depth (m)	1.200
Design Flow (L/s)	52.3
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐
Unit Reference	CHE-0282-5230-1200-5230



Advanced

Perimeter	Circular
Length (m)	35.105
Friction Scheme	Manning's n
n	0.025

Project:	Date:		
Havant Thicket Reservoir Model Outputs West of Durrants Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Details:	Company Address:		
Type: Network Design Criteria Storm Phase: Phase			

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

Pipe Options

Lock Slope Options	None
Design Level	Level Soffits
Min. Cover Depth (m)	1.200
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Project:	Date:		
Havant Thicket Reservoir Model Outputs West of Durrants Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Title:	Company Address:		
Rainfall Analysis Criteria			

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Reduced
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FSR

Type: FSR

Region	England And Wales
M5-60 (mm)	19.6
Ratio R	0.335
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
100.0	45.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
240	480
360	720
480	960
960	1920
1440	2880

Project:	Date:		
Havant Thicket Reservoir Model Outputs West of Durrants Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Details: Type: Stormwater Control Results Storm Phase: Phase	Company Address:		

Pond
Critical by Return Period: FSR: 100 years: Increase Rainfall (%): +45: 120 mins: Summer

Type : Pond

Tables

Time (mins)	Total Inflow (L/s)	US Depth (m)	DS Depth (m)	Resident Volume(m³)	Flooded Volume (m³)	Outlet(L/s)	Total Outflow (L/s)
0	0.0	0.000	0.000	0.000	0.000	0.0	0.0
5	21.2	0.042	0.000	3.087	0.000	0.0	0.0
10	22.9	0.070	0.068	9.487	0.000	1.7	1.7
15	24.3	0.111	0.111	15.681	0.000	4.4	4.4
20	26.2	0.149	0.149	21.444	0.000	7.8	7.8
25	28.9	0.183	0.183	26.833	0.000	11.4	11.4
30	32.6	0.216	0.215	32.049	0.000	15.2	15.2
35	37.5	0.248	0.248	37.385	0.000	19.4	19.4
40	46.9	0.284	0.283	43.509	0.000	24.2	24.2
45	65.3	0.332	0.332	52.077	0.000	30.7	30.7
50	100.8	0.410	0.410	66.676	0.000	39.3	39.3
55	152.8	0.532	0.532	91.291	0.000	50.3	50.3
60	222.8	0.719	0.719	133.480	0.000	38.1	38.1
65	223.5	0.930	0.930	188.320	0.000	43.3	43.3
70	153.9	1.077	1.077	231.396	0.000	46.8	46.8
75	101.6	1.156	1.152	255.406	0.000	48.6	48.6
80	66.1	1.180	1.185	265.780	0.000	49.2	49.2
85	47.0	1.194	1.191	267.875	0.000	49.4	49.4
90	37.7	1.187	1.185	265.806	0.000	49.3	49.3
95	32.7	1.173	1.174	261.552	0.000	49.0	49.0
100	28.9	1.157	1.155	256.198	0.000	48.6	48.6
105	26.2	1.138	1.137	249.993	0.000	48.2	48.2
110	24.3	1.117	1.114	243.182	0.000	47.7	47.7
115	23.0	1.092	1.092	235.989	0.000	47.2	47.2
120	21.6	1.068	1.068	228.617	0.000	46.6	46.6
125	0.2	1.034	1.032	218.072	0.000	45.8	45.8
130	0.0	0.987	0.985	204.472	0.000	44.7	44.7
135	0.0	0.941	0.938	191.253	0.000	43.6	43.6
140	0.0	0.895	0.893	178.354	0.000	42.4	42.4
145	0.0	0.847	0.844	165.799	0.000	41.1	41.1
150	0.0	0.801	0.800	153.658	0.000	39.9	39.9
155	0.0	0.752	0.753	141.824	0.000	38.7	38.7
160	0.0	0.706	0.704	130.393	0.000	38.1	38.1
165	0.0	0.658	0.654	118.642	0.000	42.2	42.2
170	0.0	0.593	0.589	104.083	0.000	52.2	52.2
175	0.0	0.520	0.519	88.693	0.000	49.4	49.4
180	0.0	0.451	0.451	74.811	0.000	43.4	43.4
185	0.0	0.389	0.390	62.719	0.000	37.2	37.2
190	0.0	0.334	0.334	52.517	0.000	30.9	30.9
195	0.0	0.287	0.287	44.258	0.000	24.7	24.7
200	0.0	0.248	0.248	37.641	0.000	19.5	19.5
205	0.0	0.217	0.217	32.421	0.000	15.4	15.4
210	0.0	0.191	0.191	28.251	0.000	12.4	12.4
215	0.0	0.170	0.170	24.903	0.000	10.0	10.0
220	0.0	0.153	0.153	22.184	0.000	8.2	8.2
225	0.0	0.138	0.138	19.948	0.000	6.7	6.7
230	0.0	0.126	0.126	18.085	0.000	5.7	5.7
235	0.0	0.116	0.116	16.518	0.000	4.8	4.8
240	0.0	0.107	0.107	15.173	0.000	4.1	4.1

Appendix G InfoDrainage Model Outputs East of Durrants Stream

Project:	Date:		
Havant Thicket Reservoir Model Outputs East of Durrants Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		

Pond

Type : Pond

Dimensions

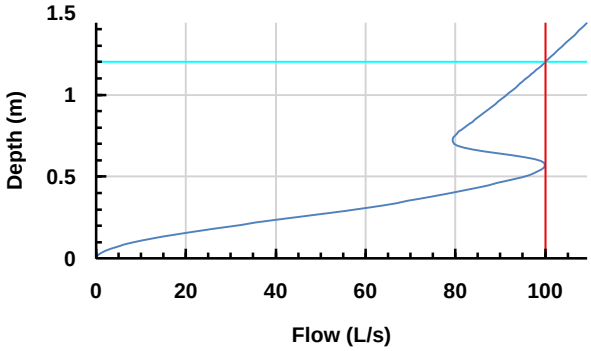
Exceedance Level (m)	31.500
Depth (m)	1.500
Base Level (m)	30.000
Freeboard (mm)	300
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	3.097
Total Volume (m³)	354.321

Depth (m)	Area (m²)	Volume (m³)
0.000	190.00	0.000
1.200	415.00	354.321

Outlets

Outlet

Outgoing Connection	Pipe
Outlet Type	Hydro-Brake®
Invert Level (m)	30.000
Design Depth (m)	1.200
Design Flow (L/s)	100.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐
Unit Reference	CHE-0370-1000-1200-1000



Advanced

Perimeter	Circular
Length (m)	46.439
Friction Scheme	Manning's n
n	0.025

Project:	Date:		
Havant Thicket Reservoir Model Outputs East of Durrants Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Details: Type: Network Design Criteria Storm Phase: Phase	Company Address:		

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

Pipe Options

Lock Slope Options	None
Design Level	Level Soffits
Min. Cover Depth (m)	1.200
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Project:	Date:		
Havant Thicket Reservoir Model Outputs East of Durrants Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Title:	Company Address:		
Rainfall Analysis Criteria			

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Reduced
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FSR

Type: FSR

Region	England And Wales
M5-60 (mm)	19.6
Ratio R	0.335
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
100.0	45.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
240	480
360	720
480	960
960	1920
1440	2880

Project:	Date:		
Havant Thicket Reservoir Model Outputs East of Durrants Stream	04.06.2024		
	Designed by:	Checked by:	Approved By:
	RP	DR	DR
Report Details: Type: Stormwater Control Results Storm Phase: Phase	Company Address:		

Pond
Critical by Return Period: FSR: 100 years: Increase Rainfall (%): +45: 60 mins: Summer

Type : Pond

Tables

Time (mins)	Total Inflow (L/s)	US Depth (m)	DS Depth (m)	Resident Volume(m³)	Flooded Volume (m³)	Outlet(L/s)	Total Outflow (L/s)
0	0.0	0.000	0.000	0.000	0.000	0.0	0.0
5	51.0	0.066	0.002	7.476	0.000	0.0	0.0
10	58.7	0.119	0.116	23.371	0.000	5.6	5.6
15	71.4	0.195	0.194	39.877	0.000	15.0	15.0
20	98.0	0.278	0.278	58.852	0.000	28.6	28.6
25	192.7	0.407	0.406	90.368	0.000	53.6	53.6
30	435.7	0.664	0.663	162.398	0.000	94.2	94.2
35	438.6	0.978	0.977	267.400	0.000	82.9	82.9
40	197.5	1.157	1.157	336.710	0.000	90.9	90.9
45	99.8	1.197	1.197	353.344	0.000	92.7	92.7
50	72.0	1.193	1.193	351.272	0.000	92.5	92.5
55	59.0	1.173	1.173	343.339	0.000	91.7	91.7
60	52.0	1.147	1.147	332.735	0.000	90.5	90.5
65	0.7	1.099	1.100	313.723	0.000	88.5	88.5
70	0.0	1.032	1.031	287.727	0.000	85.4	85.4
75	0.0	0.964	0.964	262.519	0.000	82.3	82.3
80	0.0	0.896	0.896	238.281	0.000	79.7	79.7
85	0.0	0.826	0.826	214.223	0.000	83.8	83.8
90	0.0	0.739	0.739	185.688	0.000	99.8	99.8
95	0.0	0.645	0.645	156.672	0.000	91.9	91.9
100	0.0	0.557	0.557	130.940	0.000	79.5	79.5
105	0.0	0.477	0.477	108.981	0.000	67.0	67.0
110	0.0	0.408	0.408	91.064	0.000	54.2	54.2
115	0.0	0.351	0.351	76.565	0.000	42.8	42.8
120	0.0	0.304	0.304	64.956	0.000	33.6	33.6

Appendix H Indicative Drainage Network Serving Phase 3

KEY

- MANHOLE
- FILTER DRAIN
- SURFACE WATER CARRIER NETWORK
- CORE DRAINAGE (SEE NOTE 3)

NOTES

1. ESTIMATED ATTENUATION VOLUME BASED ON 100 YEAR + 45 CLIMATE CHANGE ALLOWANCE
2. DISCHARGE RATE TO RIDERS LANE STREAM AND DURRANTS STREAM AT GREENFIELD RUNOFF, EQUIVALENT TO 1075l/s AND 152.3l/s RESPECTIVELY (ACCOUNTING FOR COMPENSATION FLOWS AND CORE DRAINAGE).
3. CORE DRAINAGE TAKEN FROM COFFEY PRELIM DRAINAGE SKETCH CIRCULATED 15th MAY 2023

LAYOUT SHOWN IS INDICATIVE ONLY AND IS SUBJECT TO DETAILED DESIGN

0 10 20 30 40 50m

SCALE 1:1000 AT ORIGINAL SIZE

Rev	Description	Checked	Approved	Date
P01	ISSUED FOR COMMENT	DR	EP	04.06.24

Author	RP	Drafting Check	DR
Designer	RP	Design Check	DR

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Registered Office: PO Box 8 West Street
Havant Hampshire PO9 1LG
REGISTERED IN ENGLAND No. 2536455

Portsmouth Water

Future Water MJJV Ltd

GHD

Project No. 12547181

Client: PORTSMOUTH WATER

Project: HAVANT THICKET RESERVOIR

Status: FOR APPROVAL — Status Code: S3

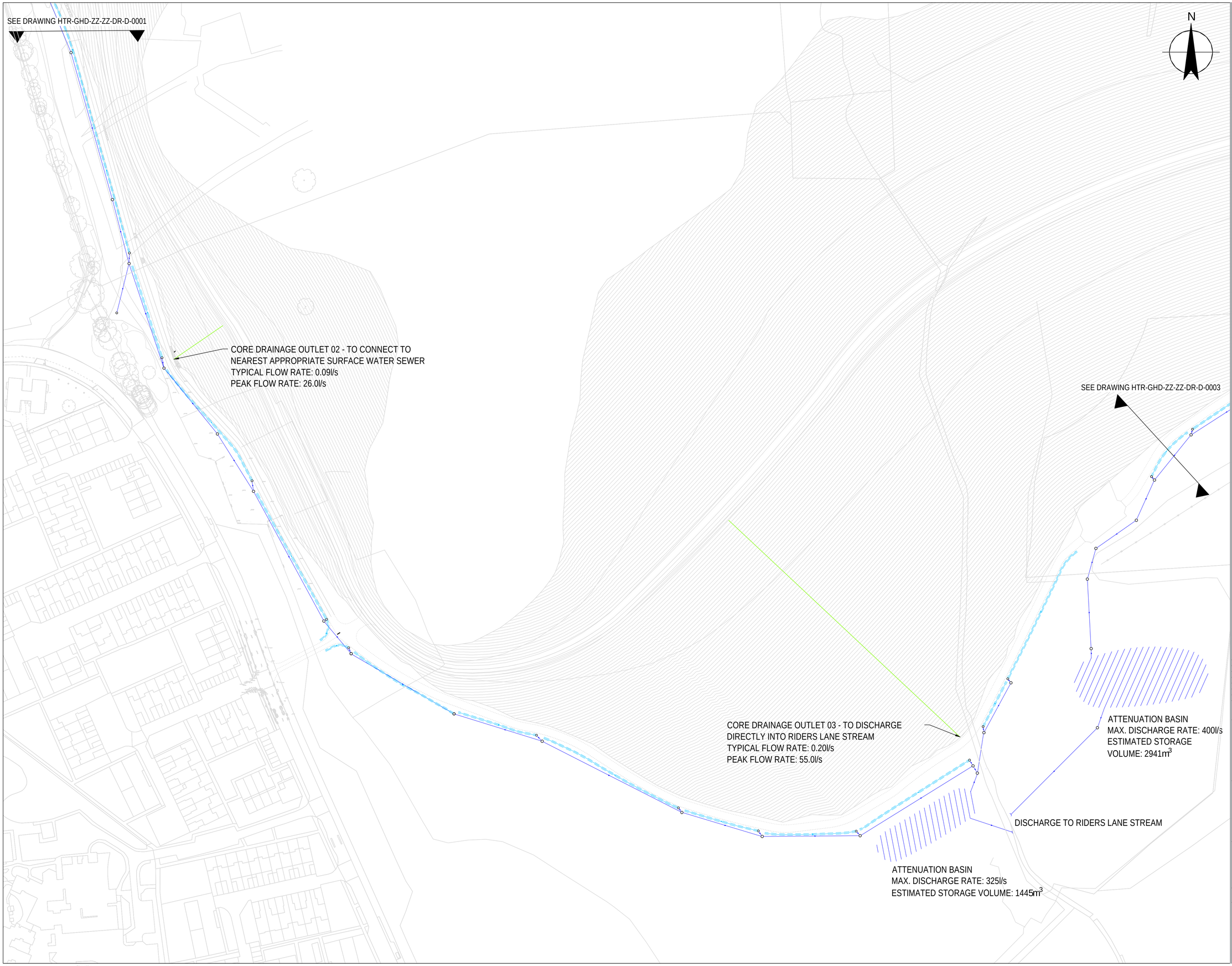
Drawing Title: INDICATIVE DRAINAGE LAYOUT SERVING PHASE 3 SHEET 1 OF 4

Size: A1

Drawing No.: HTR-GHD-ZZ-ZZ-DR-D-0001

Rev: P01

Plot Date: Plotted by: File Name:



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Status FOR APPROVAL

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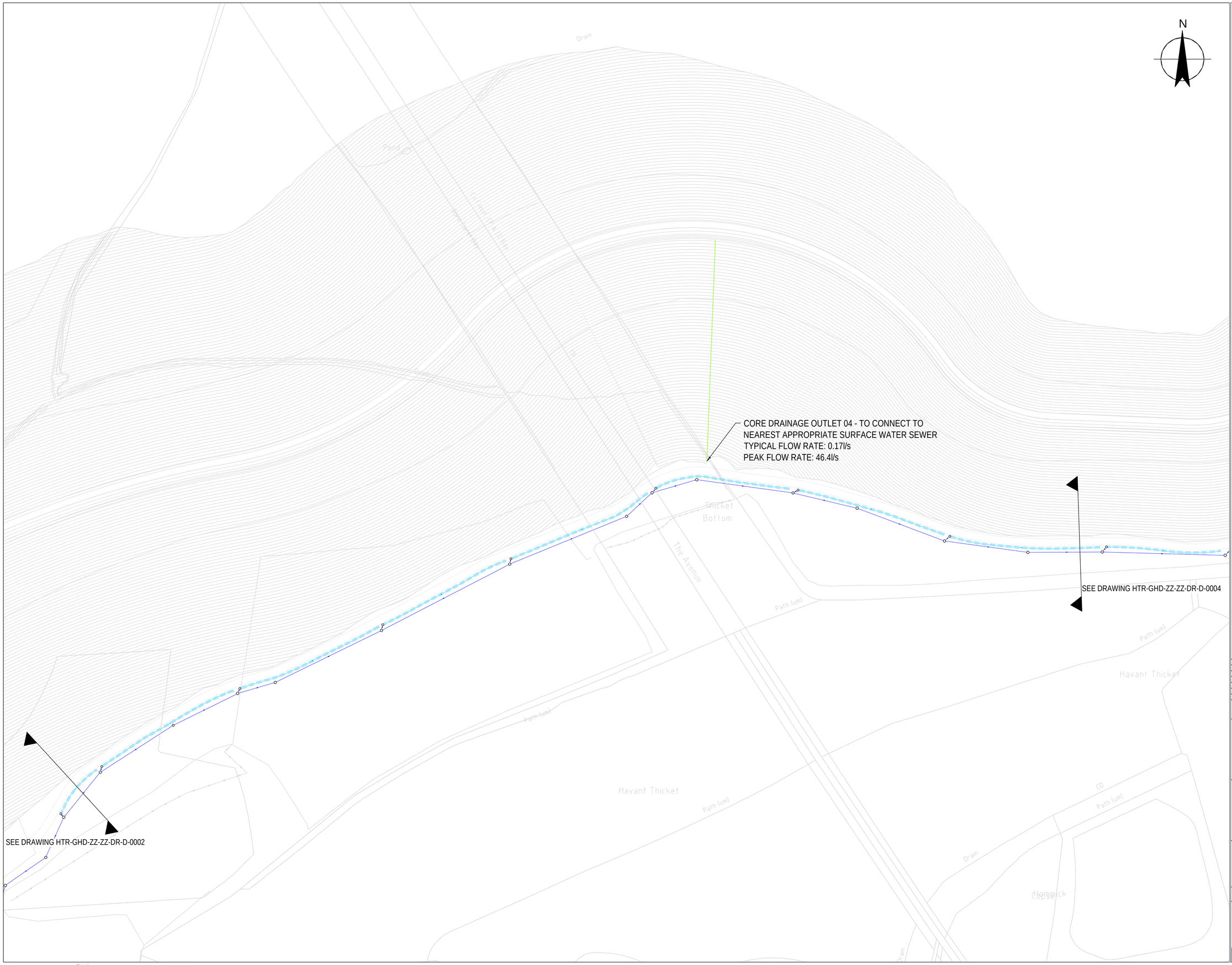
Drawing Title INDICATIVE DRAINAGE LAYOUT SERVING PHASE 3 SHEET 2 OF 4

Size A1

Drawing No. HTR-GHD-ZZ-ZZ-DR-D-0002

Rev P01

Plot Date: Plotted by: File Name:



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Status FOR APPROVAL Status Code S3

Drawing Title INDICATIVE DRAINAGE LAYOUT SERVING PHASE 3 SHEET 3 OF 4

Size A1

Drawing No. HTR-GHD-ZZ-ZZ-DR-D-0003 Rev P01

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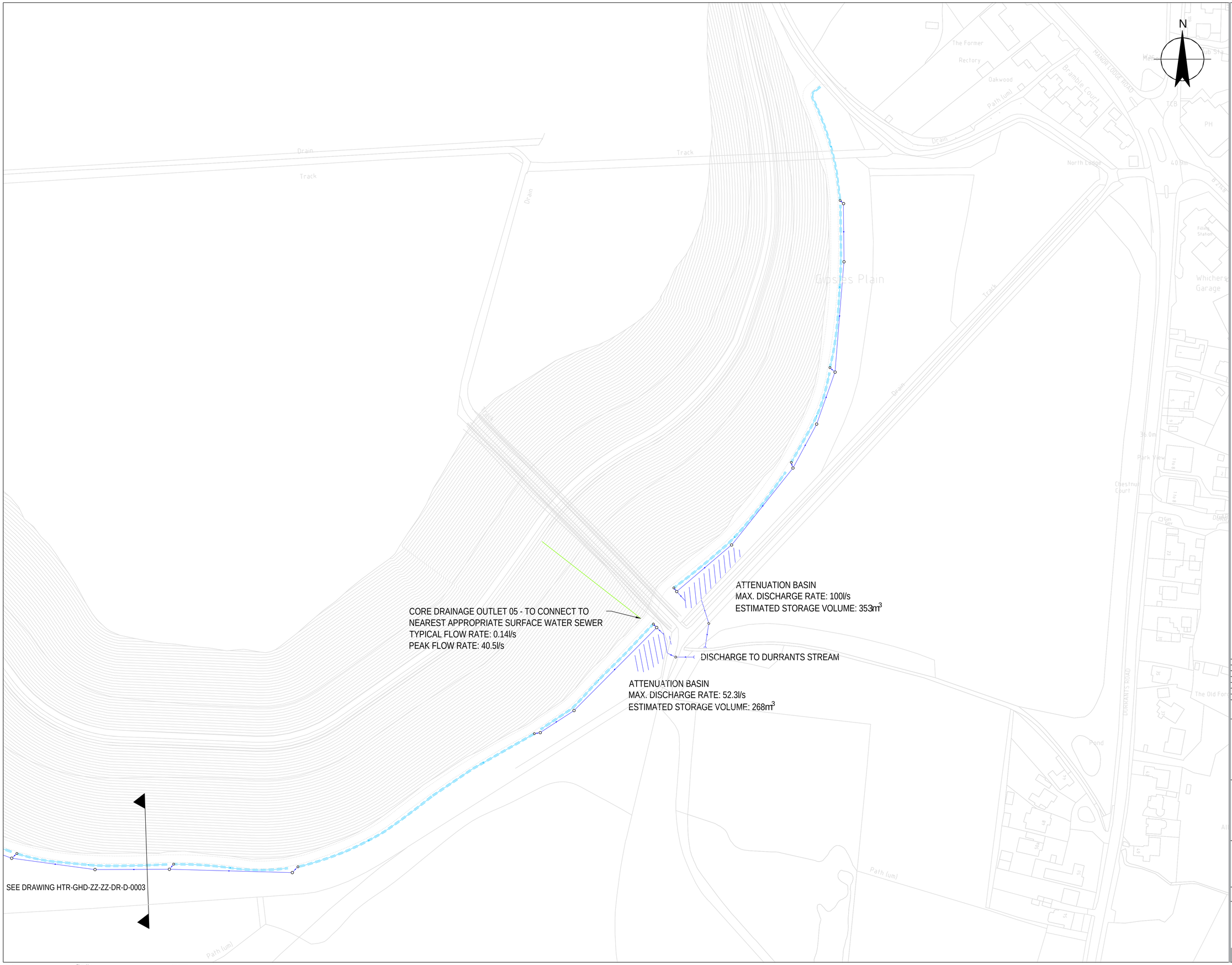

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Drawing Title INDICATIVE DRAINAGE LAYOUT SERVING PHASE 3 SHEET 4 OF 4

Size A1

Drawing No. HTR-GHD-ZZ-ZZ-DR-D-0004

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