Land to North of Rectory Farm, Yatton

Persimmon Severn Valley

Proof of Evidence

August 2024

Contents

1 Introduction

1.1 My name is Simon Mirams C.WEM, CSci, MCIWEM, BSc (Hons) who holds over 15 years' professional experience in the flood risk and drainage sector. I hold the position of Director of Water Environment at Rappor – a multidisciplinary engineering consultancy based in the Southwest.

1.2 I have extensive knowledge and experience in dealing with flooding and the implications of flood risk in supporting planning submissions and appeals across the UK. I have acted as Expert Witness on multiple occasions. As part of this, and through involvement with the Chartered Institute of Water and Environmental Management (CIWEM) I sat on the Environmental Industries Commission (EIC) panel providing advice (with other industry leaders) to help inform Green Policies, actions and strategies.

1.3 This Proof of Evidence ('PoE') – Flood Risk, has been prepared by Rappor on behalf of Persimmon Homes in order to provide expert flood risk evidence to support the ongoing appeal (Ref APP/D0121/W/24/3343144) in relation to outline planning application (Ref 23/P/0664/OUT) for the development of up to 190no. homes (including 50% affordable homes) to include flats and semi-detached, detached and terraced houses with a maximum height of 3 storeys at an average density of no more than 20 dwellings per net acre, 0.13ha of land reserved for Class E uses, allotments, car parking, earthworks to facilitate sustainable drainage systems, orchards, open space comprising circa 70% of the gross area including children's play with a minimum of 1no. LEAP and 2no. LAPS, bio-diversity net gain of a minimum of 20% in habitat units and 40% in hedgerow units, and all other ancillary infrastructure and enabling works with means of access from Shiners Elms for consideration. All other matters (means of access from Chescombe Road, internal access, layout, appearance and landscaping) reserved for subsequent approval.

1.4 I highlight here that to assist in reading my Proof particularly in respect to flood risk-related reports supporting this appeal that documents from 'Hydrock' and 'Brookbanks' alongside those of Rappor are referenced. The former are my previous employers under which relevant reports were prepared by me.

1.5 This PoE will focus on the Safe Access / Increase Flooding points raised with other PoEs addressing the other issues raised. For the avoidance of doubt, this proof has been prepared to respond to Para 1.1, Point 2, see below:

The proposal, on account of the lack of a safe access to the development and increased flooding to neighbouring properties during the 1 in 200 year plus climate change flood event, would fail to adequately mitigate against the risks of flooding, contrary to Policy CS3 (Environmental impacts and flood risk management) of the Core Strategy and paragraph 173 of the National Planning Policy Framework.

1.6 In preparing this PoE I have considered North Somerset Council's (NSC) Statement of Case (SoC). It is also informed by discussions with the Local Lead Flood Authority (LLFA) and the Environment Agency (EA) again on relevant matters.

1.7 My PoE is structured so to provide the flood risk scenario against which the appeal scheme is set. It summarises the relevant planning policy framework and material considerations then moving to a technical response to what are the two points raised in NSC's SoC: (i) increased flooding; and (ii) access and egress. In addressing these two points, my PoE covers these through evidence in relation to the following key matters: (i) Scale of

Development; (ii) the Sequential Test; (iii) Safe Access/Increased Flooding, and (iv) the loss of a Site safeguarded for a new primary school.

1.8 NSC's SoC makes no reference to Statutory Consultees and their position in respect of the appeal scheme. I therefore comment on this in my Proof. I also draw upon the work undertaken in response to the Environment Agency's (EA) consultation response which involved a series of meetings with, and reporting through Technical Notes, the EA, Key documents, and meetings held since the first objection (Ref WX/2023/137123/01-L01, dated May 2023) are summarised below:

- A series of meetings have been held with the EA and numerous technical notes also provided.
- The EA issued a further objection to the scheme (Ref WX/2023/137123/01-L01, Date April 2024). Whilst this letter (included in the Core Documents) does not provide a reason for the objection, a subsequent meeting was held with the EA on 16 May 2024 to discuss and better understand the EA's position. This meeting confirmed that the EA objection was due to the 'increased flooding' off site.
- To address the above and following the discussions and as agreed between the parties, a Technical Note (Ref Flood Risk Technical Note, dated May 2023) was submitted. My PoE helpfully summarises the meeting along with a technical response to the EA's comments – which were solely focussed on the 'increased flooding' identified – and therefore relevant to this PoE owing to the parallels with the comments raised in the SOC para 1.1, point 2.
- The EA provided a response to the above on 10th July.

1.9 In addition to the above, other key documents prepared and provided are as follows:

a) Technical Note (prepared by Brookbanks on 12th September 2023)
b) Technical Note (prepared by Brookbanks on 2nd August)
c) Technical Note (prepared by Rappor on 29th January 2024
d) Technical Note (prepared by Rappor on 21st May 2024)

1.10 To avoid repetition, this PoE does not provide a summary of the Planning History for the development, nor does it introduce the site or the proposals to any extent – these matters being agreed between the parties by others.

2 Evidence of an Increase in Flood Risk

Introduction

2.1 This section of the PoE addresses the comment raised within para 6.2 of NSC's SoC related to the claim that the proposals would result in an increased flood risk. My evidence will demonstrate this not to be the case through explaining the approach adopted to identifying the site's flood risk level – and with that leading to a technical response. Para 6.2 of that SoC is as follows:

It is noted that the appellant's Flood Consequence Assessment shows that the land raising required to prevent flooding to the development reduces the area available for flood storage and that this would increase flood risk to land and housing to the east of the site. The flood level in the 1 in 200 plus climate change flood event, flood levels to the east of the site, would increase by 1.7cm. This forms part of the basis for an objection by the Environment Agency. The Council will argue that the proposal would therefore be contrary to paragraph 173 of the NPPF, which requires that development not increase flood risk elsewhere. Were the Exceptions Test to be applicable, the Council will demonstrate that this would also be failed as a result, in accordance with paragraph 170 of the NPPF.

2.2 Para 6.2 also refers to para 170 and 173 of the NPPF inasmuch that the 'increase' in risk would be contrary to these. For clarity and reference purposes, these paragraphs state:

Para 170

The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. To pass the exception test it should be demonstrated that:

(a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

(b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Para 173

When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

(a) within the site, the most vulnerable development is in areas of lowest flood risk, unless there are overriding reasons to prefer a different location.

(b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment.

(c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate.

(d) any residual risk can be safely managed; and

(e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

2.3 To address the above comment, it is important to outline the history of this scheme in terms of flood risk and supporting documents. I shall first cover the Flood Risk Assessment (my work at Hydrock) associated with the application when submitted; then on to a further Assessment in response to EA comments (my work at Brookbanks) and finally the work undertaken subsequently at Rappor in relation to the ongoing discussions with the EA around the remain points. A further section has been provided in relation to comments received from North Somerset Council's drainage officer. These comments related to the surface water drainage strategy (undertaken by others) and whilst these are outside the appeal process (i.e. a consultation comment) it was felt important to raise these in this document.

Background – Flood Risk Assessment, March 2023

2.4 The original Flood Risk Assessment (FRA) (Ref:23257-HYD-XX-XX-RP-FR-0002, prepared by Hydrock Consultants Limited, March 2023) and which accompanied the planning application was submitted to the EA on March 2023. It should be noted that the NSC SoC refers to this report as a Flood Consequence Assessment which is incorrect and a suspected typographical error. Flood Consequence Assessments are required to support planning applications in Wales under Technical Advice Note 15 and whilst similar are subtly different in their requirements.

2.5 The FRA provided an assessment of risks to the proposed development site for all sources of flooding as identified in NPPF (tidal, fluvial, pluvial, groundwater, artificial sources, and sewer flooding). This assessment (and as referenced in previous EA correspondence) identified that the dominant source of risk to the site is from tidal sources. To inform ongoing discussion on flooding mechanisms, relevant potential flood levels and therefore risk levels, along with the "Woodspring Bay Model" (prepared by consultancy, JBA and used by NSC and the EA) which is a tidal and coastal flood risk model was obtained through a Freedom for Information request. As explained in the FRA, and maintained throughout all submitted documents since, the site is shown as being within Flood Zone 3 and therefore, within the vulnerability classification of Flood Zone 3 being 'highly vulnerable' and so of a 'high risk' of tidal flooding. The Woodspring Bay model provided outputs for both a defended and undefended scenario. This confirmed that during the 1 in 200-year event (i.e. that used to determine Flood Zone 3 in accordance with NPPF) the site was protected by the existing flood defences.

2.6 During the 1 in 200-year event the application site (and surrounding area) is shown (by the Woodspring Model) as being free from flooding when allowing for the existing standard of protection offered by the existing flood defences. On review of the impacts of climate change (noting a 100year design life for residential development is required) the FRA provides confirmation that towards the end of the development design life, the existing flood defences would be overwhelmed by tidal flooding, and this would be when flooding at the site would occur. This is therefore considered as a 'residual risk'. The mechanism is such that flooding from the coast would travel across land from the north before then 'filling up' an identified flood cell behind the Strawberry Line which sits on an embankment to the west of the site.

2.7 It is important to highlight here a shortcoming of the Woodspring Bay model. Having undertaken a site walkover and outside of the application site boundary, it was noted that several culverts that flow under the Strawberry Line are not included within the EA modelling, nor were rhynes crossing the appeal site. I know, (and as noted in previous EA consultee responses) that a neighbouring development (Planning Application Ref: 21/P/0236/OUT), at the request of the Drainage Officer at North Somerset (note this is not the same Officer commenting on this application), had been asked to include these culverts to ensure land to the east of the Strawberry Line, and the location of the Rectory Farm South Site, could 'drain' as per what occurs 'on site'. Several of the identified culverts for inclusion within the Strawberry Line are located adjacent to the Application Site along the western/south western boundary.

2.8 As such, and following site survey works, all observed culverts (and example is shown in Figure 1.1 below) were included within an updated run of the Woodspring Bay model as these are considered to provide a significant flow route and hydraulically connect land either side of the Strawberry Line (and the application site to the direction from which tidal flooding come in the 'residual risks') and failure to recognise this (i.e. as per the Woodspring Bay model) would not provide an accurate assessment of flood risk to the site or surrounding area. This process was discussed and agreed with the EA as acceptable and, during a meeting in May 2024, the EA agreed that not including this would increase impact the representativeness of the existing Woodspring Bay modelling in and around this location and the Rectory Farm development sites (both north and south).

Figure 1-1 – Example of Culvert not included in Woodspring Bay Model through Strawberry Line

2.9 In addition to the culverts that had been omitted from the original assessment, the modelling was also updated to include the latest climate change allowances (i.e. up until 2125 to reflect development design life) and to include the existing ditch/rhyne network that flows through the site. The failure to include these significantly underestimates conveyance routes and volumes as they pass through the site. As such, as shown in figure 1.2 below, the Rhyne network was included and linked to a series of culverts that flow beneath the embankment to more accurately reflect the appeal site and neighbouring areas' drainage regimes.

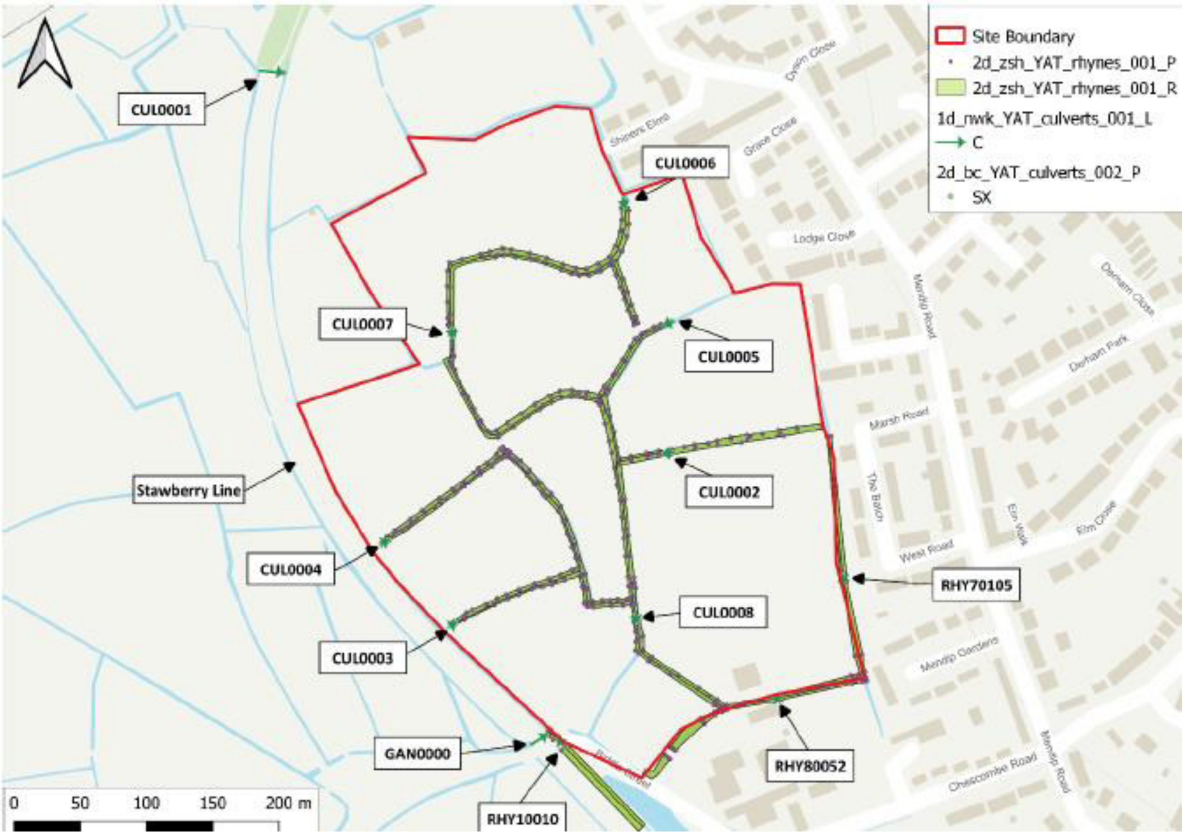

Figure 1-2 – Details of Rhyne Network adding to model to better represent site drainage conditions.

2.10 The above figure identifies two small sections of Rhyne that have not been included. These are upstream of CUL0005 and GAN0000. These areas had not been included on the topographical survey and, on review during a site walkover, were shown as being heavily overground and/or dry and not provided an active conveyance route.

2.11 The updated modelling (with changes outlined above) provided a similar flood extent to the supplied model, but flood depths were reduced owing to the inclusion of the additional flow routes through and out of the site – as explained through proper inclusion of the culverts and rhyne. The modelling confirmed that the site would be free from flooding during the ‘present day’ 200year event due to the defences but confirmed that during the climate adjusted events, the appeal site (undeveloped) would experience flooding with depths of up to 2.5m. This is based on no improvement / upgrading works being undertaken on the existing defences – which is unlikely owing to their strategic nature and is therefore aligned with the SoS decision for Silverthorne Lane, Bristol (Application Ref 19/03867/P and 19/03868/LA, appeal ref APP/Z0116/V/20/3264641 and 3264642). Within this decision the Secretary of State (or more Minister of State for Housing, Stuart Andrew MP) stated:

Analysis on modelled impacts…and is mindful that the scenarios are considered on the basis that there is no additional flood protection in place.

2.12 The key point that is therefore referred to is whether the development in isolation would be safe (para 21 of the decision notice). Whilst it is noted that at the time of the Silverthorne Lane decision the Bristol Avon Flood Strategy (BAFS) was being progressed it was well publicised that there was a significant funding shortfall and, again at the time of the appeal being heard, had not be submitted for planning.

2.13 It should also be noted that whilst climate change projections are currently shown (and agreed) as exceeding the existing level of defences, there is a known situation which would solve this, the upgrading of the existing defences. Whilst documents available confirm that there are no plans in the 'short to medium term' for any such updates, the impacts of climate change (i.e. the point at which climate change would exceed the existing defences) would sit within what is classified as the 'long term' and post 2079 based on the provided, and agreed, modelling being used to inform this assessment.

2.14 Owing to the identified residual risk (in the event of defence failure or at the extreme limit of the climate adjusted event assuming no upgrading works), and as required in line with Para 170 (as highlighted in the SoC) an Exception Test would be required. This test is to ensure the development is safe throughout its design life whilst also ensuring no increase in flood risk to third party land. However, and owing to the presence of the flood defences, and the expected upgrading works that are to be undertaken due to the strategic nature (and area benefitting) the risk towards the end of the development design life (and beyond the point at which predicted flood levels exceeded the existing defences) is considered a hypothetical risk. This approach having been agreed within the Silverthorne Lane decision. Additionally, this is referred to within the Justice Holgate decision (Case No: AC-2023-LON-002327 and AC-2023-LON-002481) in which it states that policy requires a review as time progresses, when a cost benefit analysis will be more pressing.

2.15 Within the submitted FRA this was proposed to be achieved through raising ground levels in the site to be above the modelled (and agreed) tidal flood level with a freeboard. This approach went above and beyond that adopted for another planning application in North Somerset at Lynchmead Farm (Planning Application Ref:20/9/1579/OUT) and specifically the supporting Flood Risk Assessment (Ref: 184199, Date February 2021)) which proposed no ground raising and located all habitable rooms at first floor level (i.e. above the flood level). This lesser approach to mitigation was approved by the EA in that case and therefore the proposals for the Lynchmead Farm application site were acceptable in ensuring the development was safe. I draw from this an unhelpful inconsistency in the approach to addressing flood levels through a scheme of mitigation - and this has been discussed with various officers at the EA.

Background – Flood Risk Assessment, September 2023

2.16 Whilst the EA in principle agreed with the proposed measures to raise site levels, objections were received to a further Flood Risk Assessment report was prepared (Ref 11069_FRA_Rv0, prepared by Brookbanks, dated September 2023). The purpose of this Flood Risk Assessment was to reply to the comments received from the EA in May 2023; providing some further evidence as to the 'low' risk posed by pluvial and fluvial source; but also to better understand the impact of the proposed ground raising on the tidal flooding and what, if any, impact this had on flood depths within the surrounding area – though the EA accepted at various meetings that compensation storage would not be required and this was more to 'understand the impact'.

2.17 To understand the impact of the proposed development, the Woodspring Bay model was updated by Brookbanks in September 2023 to include the proposed development levels as stated within the original planning application FRA (produced by Hydrock). The outputs from this assessment were compared to the baseline (i.e. no development) scenario to better understand the impact of the development. With the 'full ground raising' this demonstrated that there would be localised difference in flood depth to the east of the site beyond the site boundary. The 'full raising' referred to was to set all development parcel ground levels (and access routes in/out of the application site) 600mm above the modelling 1 in 200 years plus climate change flood level of 7.88m AOD.

2.18 Further to acknowledging the offsite differences in flood risk because of the model tolerance, a series of meetings were held with the EA (July-September 2023) to review the outputs and understand what options were available to either confirm the model tolerances are acceptable, or alternatively investigate and agree options to manage the risk. Conversations were also around understanding the implications on the potential upgrading of the strategic flood defences given recent SoS decisions. Following these discussions, it was agreed that the 'full ground raising' option could be reviewed/revised, adopting a lower proposed ground level provided a suitable flood resilient approach to the development was adopted. Flood resilient measures are to include habitable rooms above the flood level, forms of construction and a range of other industry acceptable positive measures. All measures considered have been discussed within the EA (July 2023) and agreed as appropriate and detailed within the submitted (Hydrock) Flood Risk Assessment.

2.19 In assessing the revised option, other constraints to the development were considered to better to understand the lowest level of ground raising that could be achieved. Whilst this was principally in relation to ensure the development was considered 'safe' with respect to flooding and posing limited risk to third party land, it also yielded benefits for other planning considerations including neighbouring and visual amenity, ecology, and drainage. In doing this, the proposed ground levels would be 6.43m AOD which would be above the 200 year plus climate change flood level but with finished flood levels being proposed as being, with freeboard, further raised to a level of 6.68m AOD. These levels easily meet the industry standard approaches but also a design for exceedance approach.

2.20 Following discussions, and detailed modelling of the proposed ground level of 6.43m AOD, the EA were accepting of the above approach provided a flood resilient approach to design was adopted and, as a minimum, habitable rooms were set at first floor to ensure these were set above the 1 in 200 year plus climate change residual risk.

2.21 This revised option resulted in a difference of 17mm between the pre and post modelling flood levels (as referenced in the SoC) which the EA did not accept owing to it being outside 'acceptable tolerance' applied to the Woodspring Bay Model. This approach to model tolerances, their extent and application has been queried with the EA. Confirmation was sought as to where policy, guidance, documentation states the 'acceptable tolerance' level. The EA have subsequently confirmed (as of 10th July 2024) that the tolerance value they are applying to the Woodspring Bay Model which is a strategic flood model is *considered a reasonable "rule-of-thumb" for a calculation tolerance but the uniform application of this value* (i.e. as they are applying specific to this development) *is not supported by any evidence.* This therefore confirms that a tolerance is model specific, and the uniform approach being adopted by the EA (i.e. +/- 10mm) is contrary to the EA's position in their latest response.

Response – Model Tolerances

2.22 It is my professional opinion that any tolerance within a hydraulic modelling should be specific to the study area, data, and complexities and therefore agreed and stated on a model-by-model basis. Presenting a 'tolerance' helps in the interpretation and application of the model and should accompany it. Typically, the larger the model, the larger the tolerance owing to greater limitations and greater complexities. For example, a small fluvial model with detailed survey (both channel and floodplain) would be considered as being more accurate than a wider area tidal model (such as the Woodspring Bay model) which is strategic in scale and which uses tidal data at various gauged locations and often significant distances from the site/area of interest, relies on wider area lidar for topographical information, and does not include all drainage feature such as culverts, and this should be acknowledged within the individual model tolerances and agreed through detailed review. In summary, and owing to the strategic nature of the model, and the locations on the inflows (as agreed with the Woodspring Bay modellers themselves) this model should have, and be expected to have, a broader tolerance range.

2.23 That aside, it should be noted that the comparison of the grids has shown the 'increase' as constant and consistent 17mm across a wide area of floodplain and covers areas to the north, south, and west of the site in this worst-case flood event. Other areas where level exceed the EA's +/- 10mm tolerance depths are observed to the southwest of the site but these are not hydraulically connected to the site. These areas are prevented from reaching these areas owing to existing raised ground in the form of road/rail embankments. As discussed with the EA, these area of raised flood depths are the result of the inclusion of the culverts under the Strawberry Line and providing more conveyance route into this area as these culverts are not in the baseline assessment so this would explain the increases.

2.24 Given the scale, complexity and known assumptions/limitation of the Woodspring Bay model a higher tolerance has been stated within the supporting JBA modelling report and the EA agreed that a 150mm tolerance would be 'more reasonable'. This is still a lower value than the 300mm quoted within the supporting modelling report for the Woodspring Bay model that was prepared by JBA Consultants (K14).

2.25 Whilst the modelling generates a difference in flood depth, and in the instance of the EA of the 10mm tolerance (despite agreeing technically this should be greater) consideration should be given as to the cause of the 17mm difference between the pre and post development modelling rather than the assumption that this is an 'increase'. For example, this could be reasonably attributed to numerical oscillations in the numerical stability of the model and could be because of (for example) uneven ground levels within the lidar causing a sudden numerical jump/change and therefore misrepresenting a change in flood level/depth of a very specific location and timestep within the model.

2.26 Additionally, and noting that this is a tidally driven floodplain, it is a fixed volume system that forms part of the wider regional tidal flood. On this basis, and as detailed in a report issued (Ref, Flood Risk Technical Note , prepared by Rappor, Dated 20th May 2024) to the EA in May 2024, a relatively high-level assessment was undertaken to understand the volume of land raising being proposed in the 1 in 200 year plus climate change floodplain and the volume where flood depths were higher in the post development scenario.

2.27 This demonstrated that the proposed ground raising (to the revised and lowered levels) resulted in **105,357m^3** of land being raised. As such, and in simplistic terms, given the tidal nature of the flooding it is considered that the areas where flood depths are higher should have a combined volume of a relatively similar amount to what is being raised. However, calculations have shown that the sum of all the 17mm areas where numerical oscillations exceed the current EA position, accumulate to a volume of **136,834m^3** – which is **a 30% increase** on what has been lost. This equates to the volume of water within the model itself and given the finite volumes being entered (i.e. the tidal curves) this volume is unchanged between the pre- and post – development conditions and it is expected (again accepting model tolerances) that the volumes should be largely the same and certainly within a +/-2% variance – which is considerably lower than being experienced. This point has been discussed with the EA and is considered to confirm the limitations of the modelling and provides further evidence as to why a 10mm tolerance for this model (for planning purposes) is beyond the limits of the model and therefore more consideration should be given to a model-by-model and site-by-site assessed as to potential difference in depth. This is something the EA have agreed within their latest response, as outlined above.

2.28 Through discussions the EA agreed that the model tolerances of the Woodspring Bay model would be in the order of 150mm (i.e. nearly ten times the difference between post and predevelopment), but they would only consider a 10mm difference 'for planning', within the EA Response (Dated 10th July 2024).

Response – Para 173 – Increased Risk

2.29 Whilst the acceptability of the increase/tolerance value remains a point of discussion, it is stated in Para 173 of the NPPF that development should *ensure that flood risk is not increased elsewhere*. Whilst this is stated no definition of 'flood risk' is provided and this was something discussed with the EA during a meeting on 28th February 2024 in that a modelling increase in depth does not necessarily result in an increase in flood risk to persons or properties. This is supported by the Planning Practice Guidance which defines flood risk as *the probability and consequence of flooding.*

2.30 The modelling outputs have been reviewed there is no increase in flood extent as a result of the proposed ground raising. On this basis no new properties or areas of land are 'at risk' during the 1 in 200 years plus climate change event and once the defences have been overwhelmed. Therefore, the identified 17mm only affects land that is currently shown to be liable, and susceptible, to flooding when making an allowance for climate change (and no improvements to the defences) with all areas being shown (by the provided and updated Woodspring Bay model) to flood to depths of between 400mm and 1200mm which equates to between a 1.4% to 4% increase and therefore considered de minimis.

2.31 The areas of numerical oscillations would, on paper, affect existing properties to the east of the site. In the event that it is not agreed that this increase is a product of model tolerance / limitations then it should be noted that these properties are already shown as being within Flood Zone 3 on the EA's flood zone mapping and, when making an allowance for climate change and no upgrading works to the defences, would experience flooding to a depth of circa 500-700mm and would be expected to experience internal flooding under current baseline situations (i.e. no development). Therefore, and as has been accepted previously within central Bristol at Plot 3, Dalby Avenue and Whitehouse Lane (Planning Application Ref: 20/04934/P), the consequence of the 17mm would be negligible and unnoticeable when considering the depths prior to the development – so presenting no increase in flood risk – i.e. a negligible consequence.

2.32 To refer to the wording of Para 173, it states flood risk should not be increased elsewhere. The proposals and the resultant 17mm currently shown, would, to be clear, pose no increase in flood risk and no new areas of land are to be affected because of the proposals. This again highlights that the consequence of the shown numerical oscillations to existing landowners/properties would be negligible owing to the existing depths in the unlikely event of such flooding occurring.

2.33 Whilst this is the case, it should be noted that through the proposed ground raising, setting of finished floor levels with a freeboard above proposed ground levels, and the proposed flood resilience measures this would also meet the requirements of *Points a through c of Para 173* as outlined above but also provides confirmation that the site would be safe throughout its design and therefore *in accordance with Para 170*. The planning application also includes a surface water drainage strategy (undertaken by Hydrock) which incorporates sustainable drainage systems, where at all possible. This therefore meets point c. In confirmation that the model doesn't pose an increased risk, as outlined, this would be *in accordance with Para 170* of the NPPF

2.34 With respect to the outstanding points of Para 173 these are addressed in Section 4 – Access and Egress.

Exception Test

2.35 The Council's SoC does not make specific reference to the Exception Test within the 'flood risk' comments nor within any of the correspondence received from the EA to date through the consultations. On this basis, NSC don't allege conflict with Part A of the Exception Test and agree with the principles being proposed to ensure the development is safe through its design life.

2.36 For the avoidance of doubt and noting that the proposed measures to meet Part A of the Exception Test have altered from those within the originally submitted Flood Risk Assessment (Ref:23257-HYD-XX-XX-RP-FR-0002) the current proposals (which have been discussed and agreed with the EA) are for a reduced raising of ground levels compared to the original strategy. The current proposals are for ground raising to be to a level of 6.28m AOD with then finished floor levels of proposed units being at 6.68m AOD to include a suitable (and agreed) freeboard and above the worst-case flood levels both in the present day (i.e. defended) but also across the development design life on the basis there are no improvements to the defences (not expected).

2.37 The reduction in proposed ground levels not only result in less imported material but will also reduce transitional slope between the ditches and the development and therefore provide a narrow corridor through the development. It is noted that at the time of writing, the approach for level raised, transitional slopes, easements to the rhynes and surface water drainage have been agreed (by Hydrock) with both the Internal Drainage Board and North Somerset on the higher values. Given this reduction, the impact of the development would be less on these points whilst maintaining a gravity connection for the drainage system.

2.38 With respect to the outstanding points of Para 173 these are addressed in Section 4 – Access and Egress.

3 Access and Egress

3.1 The SoC also raised (para 6.2) concerns with respect to access and egress from the site. This is something that has not been raised in any of the discussions held with the EA or NSC during the last 12-14months and has not been reference in any consultation responses. However, their comment is as follows:

Furthermore, the Council will demonstrate that the appeal scheme would lack safe access and egress in the event of the 1 in 200 plus climate change event. The FCA shows that floodwater would restrict safe vehicular and pedestrian access to the site from the Shiners Elms entrance. Safe access would be possible from the south if the planning permission reference 21/P/0236/OUT were to be completed. However, this development has not commenced on site and there is no guarantee that it will. Therefore, the proposal would be contrary to paragraph 173 of the NPPF, which requires that safe access and escape route be provided in the event of an emergency. Again, the development would fail the Exceptions Test if this were applicable, as paragraph 170 of the NPPF requires that development will be safe for its lifetime taking account of the vulnerability of its users.

3.2 It is a requirement of planning to demonstrate that a site can be access and egressed in the event of a flood event. However, their SoC comment does not refer to section 4.1.2 of the original Flood Risk Assessment. This section outlines the identified risks to the development in terms of flood depths and hazard ratings but also includes a review of the timings of the flooding as the hazard and depth data presented are for the very peak of the event whereas in reality the modelling shows that from the first out of bank flooding (some 4.5km to the north west of the site) the flood water would take 15hours to first affect the site. At this point flood water has only entered the very northern and western sections of the site (see figure 3-1 below) and safe access through the site onto the surrounding road network at this point can still be achieved.

3.3 As quoted within the FRA Ref:23257-HYD-XX-XX-RP-FR-0002, prepared by Hydrock Consultants Limited, March 2023):

Given the minimum lead in time of <u>15hours</u> on a predictable event it is considered that through preparation of a Flood Warning and Evacuation Plan suitable measures will have time to be implemented such that access and egress can be achieved safely through the site.

3.4 Noting that the application is for Outline, it is considered that the recommendation of the Flood Warning and Evacuation Plan could be secured (as is commonplace) via a pre-occupation condition and suggested wording for this (taken from previously approved planning conditions) would be as follows:

Prior to the first occupation of the development, a Flood Management Plan shall be submitted to and approved in writing by the Local Planning Authority. This shall include measures, including signage, to manage the impacts of flooding.

3.5 The evidence provided within the submitted FRA (and repeated above) appears not to have been factored in when the SoC has been prepared as in my professional opinion this provides suitable evidence that access and egress can be suitable managed from the proposed development and secured via a planning condition. The lead in time (15hours) is considered more than suitable to ensure any process outlined in the FWEP document can be implemented to minimise, and potential remove, the risk and is acceptable owing to the Outline nature of the application.

3.6 It should also be noted that the principles of access and egress (i.e. managed through an evacuation plan) aligned with those outlined within the ‘at building level’ within North Somerset Council’s Local Flood Risk Management Strategy and specifically those raised within section 5, which state (at abuilding level):

a) *Understand how a flood would impact your building, what areas are likely to be damaged, are there precious items stored where a flood may damage them? Can this be changed? •*
b) *Creating a flood plan for your building, business or home and implementing those actions before a flood.*
c) *• Preparing your building, business or home for a flood as set out in your flood plan.*
d) *• Consider the use of property level protection described further in this document.*

3.7 Within Section 6 of the Local Flood Risk Management Strategy reference is also made to flood resilience being an accepted approach to reducing the impact of flooding, and this is what is being proposed, along with a management plan (at building/development level) to manage the identified residual risk.

3.8 This approach to access and egress would also be considered acceptable for any potential residual risk in the event of overtopping or breach of the defences due to suitable warning. As such, Section 4.1.2 of the originally submitted FRA meets the requirements of points d and e of para 173 of the NPPF.

4 Surface Water Drainage Strategy

4.1 Whilst not included within NSC's SoC, correspondence has been provided from the Lead Local Flood Authority in relation to *clarification´* being sought as to the approach for surface water drainage. This clarification has been sought owing to the previous strategy being based on the 'full raising' option for ground levels (i.e. 8.48m AOD). As outlined above this is no longer being progressed and a reduced ground level option (to ensure no increase in flood risk) has now been adopted. This change has evolved following discussions with the EA with respect to ground floor levels and, as such, an updated drainage strategy has been prepared by Hydrock which demonstrates a technically acceptable approach to drain the site with the revised, and lowered, ground levels.

5 Conclusion

5.1 As has been outlined, this Proof of Evidence has been prepared providing a response to the Flood Risk related points raised within Council's SoC. This proof has set out evidence to confirm that the development site is not contrary to para 170 and 173 of the NPPF and can be developed safely through its design life without posing an increased risk. The proposed housing and Class E uses will not be affected by flooding in the 1 in 200 year event owing to the existing defences and therefore and risk is considered as 'residual'.

5.2 Section 2 above provided evidence to demonstrate that whilst it is the EA's view that the development results in an 'increased risk' through a 17mm numerical oscillation being shown, this is a product of oscillations in the modelling rather than a real risk. This has been discussed with likely reasons for this but also supported by confirmation from the EA that the model tolerance would be 'more reasonable' to be 150mm rather than the standard (and unquantified) 10mm being quoted by the EA. On this basis, and accepting the limitations of the model (inflows, levels, culverts etc) it is considered that the 17mm being referenced as an increase would fall well within a model specific tolerance owing to the strategic nature and agreed (with EA) limitation of the hydrological data. Therefore, this numerical oscillation is acceptable on this basis.

5.3 Even if the EA remain of the view that this is not a modelling 'oddity' it should be noted that the wording of policy identified that flood risk should not be increased. This, in my professional opinion, relates to understanding the consequence of the numerical oscillations and not just the difference in risk itself (as it is clear accepted that model tolerances vary). In the case of this model and site and accepting the position regarding model tolerance and potential upgrading of flood defences works, the impact of the development is inconsequential. The post development mapping results in no increase in flood extent with no 'new areas' being shown as risk because of the development. Additionally, it should be noted that the areas where the EA have highlighted a 17mm difference are already susceptible to flooding to depths of between 400mm to 1200mm and therefore the increase would equate to between 1-4%, so negligible. Therefore, the properties along the eastern boundary of the site would already experience internal flooding and the even accepting the numerical oscillations fall within the now agreed model tolerance, would not impact this or affect the risk.

5.4 With respect to the site itself, mitigation measures are proposed that involve a combination of ground raising, raising of finished floor levels and a flood resilient approach to ensure all development is set above the predicted 1 in 200 years plus climate change flood level but also adopted a design for exceedance approach. This would ensure the development is safe throughout its design life.

5.5 This PoE has also addressed the new comment raised in relation to Access and Egress, this having not been raised previously. However, it should be noted that the original FRA provides details relating to the approach for managing access and egress through preparation of an agreed emergency plan. This being possible owing to the 15hour lead in time from first out of bank flooding to it reaching the site. This is proposed to be addressed within a Flood Warning Evacuation Plan and secured via planning condition – as it a widely accepted approach.

5.6 Reference within this proof has also highlighted that whilst the site is within Flood Zone 3 it should be noted that the design event used for the assessment of risk is the 1 in 200 years plus climate change event assuming that there are to be no upgrading works to these defences over the next 100years. The EA agree that this is not realistic and upgrading works will occur, but this cannot be relied upon as no scheme has been agreed. In reality it is considered that at a point in the future the defences would be upgraded, and the site (and surrounding area) would be defended against the flood levels being discussed in this PoE and ultimately these wouldn't occur or impact the site.

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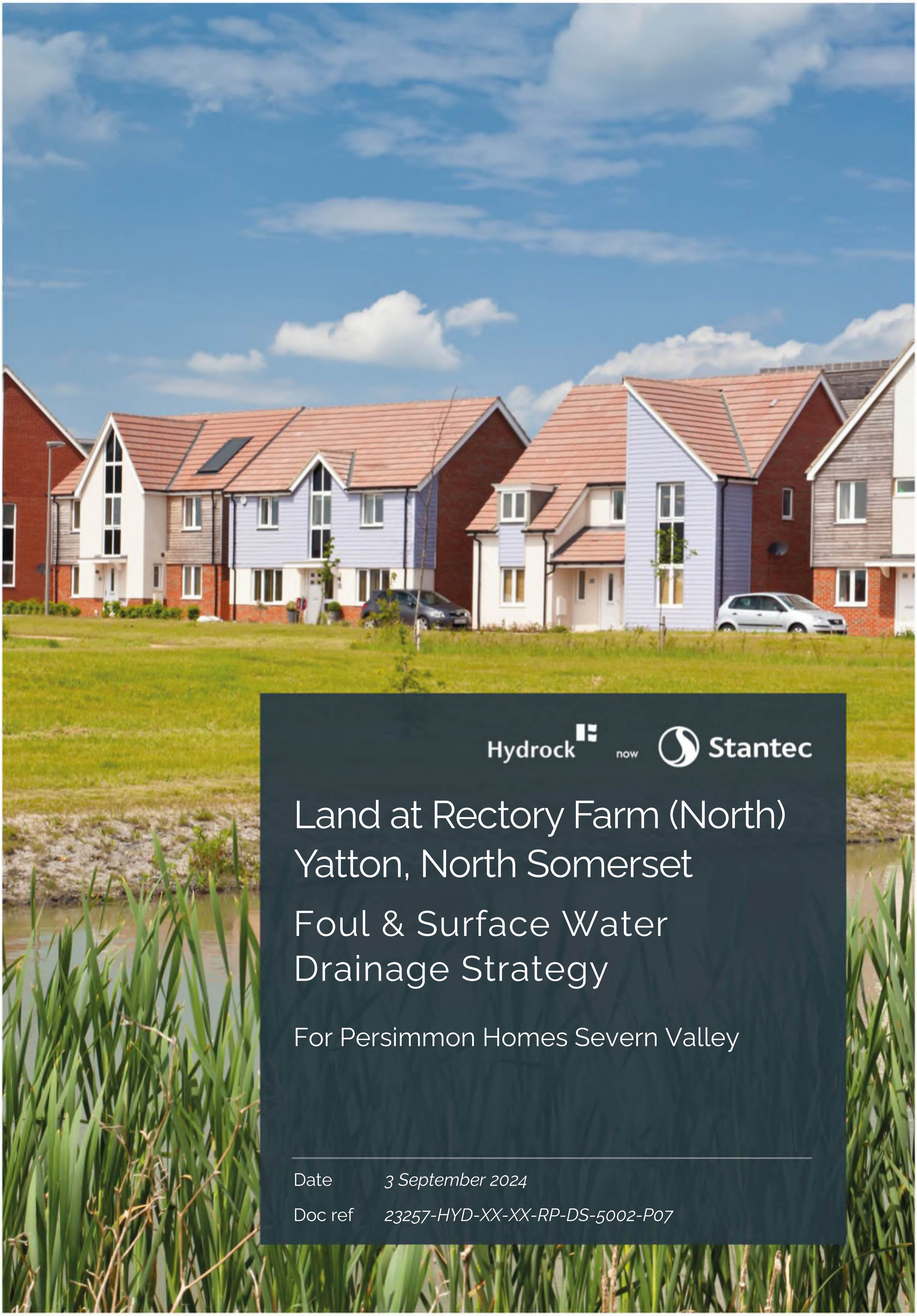

Hydrock now Stantec

Land at Rectory Farm (North) Yatton, North Somerset

Foul & Surface Water Drainage Strategy

For Persimmon Homes Severn Valley

Date *3 September 2024*

Doc ref *23257-HYD-XX-XX-RP-DS-5002-P07*

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1. Introduction

1.1 This report has been prepared by Hydrock Consultants Limited (Hydrock) on behalf of our client, Persimmon Homes Severn Valley, (PHSV). It supports a planning application – now at appeal (ref: APP/D0121/W/24/3343144) – for new development at Rectory Farm (North), Yatton. The application's description of development is for an "Outline planning application for the development of up to 190no. homes (including 50% affordable homes) to include flats and semi-detached, detached and terraced houses with a maximum height of 3 storeys at an average density of no more than 20 dwellings per net acre, 0.13ha of land reserved for Class E uses, allotments, car parking, earthworks to facilitate sustainable drainage systems, orchards, open space comprising circa 70% of the gross area including children's play with a minimum of 1no. LEAP and 2no. LAPS, bio-diversity net gain of a minimum of 20% in habitat units and 40% in hedgerow units, and all other ancillary infrastructure and enabling works with means of access from Shiners Elms for consideration. All other matters (means of access from Chescombe Road, internal access, layout, appearance and landscaping) reserved for subsequent approval. (Planning Application ref: 23/P/0664/OUT)"

1.2 This report will demonstrate that a Sustainable Drainage Strategy (SuDS) can be readily used to support the delivery of the above development and in accordance with the principles previously outlined (Hydrock report 23257-HYD-XX-XX-DR-D-2001 Revision 04, dated 16.03.2023) and which was then supplemented by a (Hydrock) Technical Note 23257-HYD- XX-XX-TN-D-0002 Revision 2 which received IDB approval 15.8.2023 (in Appendix G) as part of the original planning application. To further reinforce the previously approved position, this report will comment on relevant planning policy and other guidance, the design and other principles applied in the scheme's formulation alongside the key drainage considerations, and a scheme which in principle and subject to detailed design is acceptable in planning terms. In so doing, the report addresses and responds to the SuDS hierarchy policy.

1.3 This report presents two acceptable approaches to addressing surface water drainage - presented here as Option A and Option B; alongside a commentary on the suggested approach to foul water drainage, which remain in accordance with the agreed principles. In presenting two sustainable drainage options each which respond positively to the Environment Agency's acceptance (following helpful discussions and their recommendation) of a suitable, applicable ground level. Further, through Options A and B, there are variations or hybrid arrangements which will therefore work effectively through detailed design.

1.4 The site (as undeveloped) is inland, greater than 1 hectare in area and is located within Flood Zone 3 (High Risk). However, the site is shown to be afforded protection by coastal flood defences.

1.5 To address the relevant policy considerations, approach and techniques and methods applicable to each SuDS option, and in response to the requirements of the NPPF and LLFA, this report:

- Presents the relevant policy context in respect of development drainage solutions;
- Assesses whether the proposed development is appropriate in the suggested location in respect of drainage;

- » Considers overarching drainage design principles specifically in respect of the application of the Sustainable Drainage Systems (SuDS) hierarchy to develop a suitable drainage scheme for the development
- » Comments on the existing drainage, planning position/discussions on drainage matters and ground infiltration potential and identifies opportunities and constraints to facilitate a sustainable strategy for managing surface water for the proposed development;
- » Explores two options in detail for sustainable drainage, in compliance with the SuDS hierarchy:
  - Option A: Surface water drainage scheme utilising smaller catchments served largely by below ground cellular attenuation tanks and a gravity discharge of surface water to an outfall.
  - Option B: SuDS based scheme with surface water storage basins and pumps included to drain surface water to an outfall (assuming restriction on ground level raising).
  - At the detailed design/reserved matters stage, the drainage strategy to be submitted may follow the principles of Option A, Option B, or a variation which could incorporate elements of both Options, which this report has set out are deliverable. In all scenarios, this would be submitted for the Council's approval, with consultation with the LLFA and IDB.
- » To identify and explain the suitable points of connection for foul drainage.

Background

1.6 The planning application was submitted with a surface water and foul drainage strategy and flood risk study as below.

- » Report ref: 23257-HYD-XX-XX-RP-D-5002-P04 Foul and Surface Water Drainage Strategy dated 16 March 2023
- » Technical Note ref: 23257-HYD-XX-XX-TN-0002-P02 Response to IDB Comments dated 15th May 2023
- » Report ref: 23257-HYD-XX-XX-RP-FR-0002-P01 Flood Risk Assessment & Hydraulic Modelling Report.

1.7 Recent flood risk studies have also been undertaken in relation to the site as below:

- » Rappor Flood Risk Technical Note January 2024
- » Brookbanks (Ref: Land to North of Rectory Farm, Yatton – Flood Risk- Consultation Response Rv2, dated 2nd August 2023

1.8 This strategy allied to an outline planning application was agreeable to the North Somerset District Council (NSDC) in their role as the Lead Local Flood Authority (LLFA) and North Somerset Levels Internal Drainage Board (NSIDB). We have now been asked to provide clarity as to what changes are suggested to the strategy: and there is nothing changed to the foul; and associated with the surface water strategy, two options are presented.

1.9 The scheme submitted with the application and set within the Hydrock Foul and Surface Water Strategy, 16 March 2023, provided for surface water capture - managed through sustainable methods where possible. The scheme used on site attenuation combined with a restricted discharge to the rhyne network from three on-line attenuation basins. The discharge of the surface water was to be limited to 2l/s/ha rate as stipulated by the IDB. The drainage / SuDS system was to be designed to manage runoff for up to and including the 1 in 100 year event plus climate change allowance.

1.10 The development was split into -three surface water catchments and served by three attenuation basins. The basins were to be served by a positive piped system with flow controls to discharge off site by gravity at the IDB stipulated rate.

1.11 The surface water model was based (modelled) on the assumption that all outfalls are being surcharged to the 100 year plus climate change tidal flood level of 7.9mAOD. This had identified the need for a significant land raising across the site to facilitate a gravity connection. This level, has subsequently been reduced for the purposes of the scheme Options presented below.

1.12 Recent development with the flood modelling and EA discussions have resulted in the ground levels across the site being accepted as being lowered to 6.43mAOD to manage off-site flood risk, which subsequently required the details of the strategy to be reviewed. Accordingly, this current strategy presents two potential surface water drainage options, which will be guided by the SuDS principles and will remain in accordance with the agreed principles.

2. Existing Site Details & Proposed Development

2.1 Site Location

2.1.1 The site is located in the Somerset Levels on the southwestern outskirts of Yatton, bounded by the Strawberry Line (a disused railway line that is now a raised path for walkers and cyclists) to the west, agricultural fields laid to pasture to the north and a small commercial plot, and residential areas of Yatton to the east. Farm buildings belonging to Rectory Farm are immediately to the south of the site.

2.1.2 The gross site area is 13.654 ha.

2.1.3 The site address and Ordnance Survey Grid references are provided in Table 1, with the site location shown in Figure 1.

Table 1: Site Referencing Information

Site Referencing Information	
Site address	Land North of Rectory Farm, Chescombe Road, Yatton, Bristol, BS49 4BY
Grid reference	E. 342473, N. 165518 ST424655 / ST4247365518

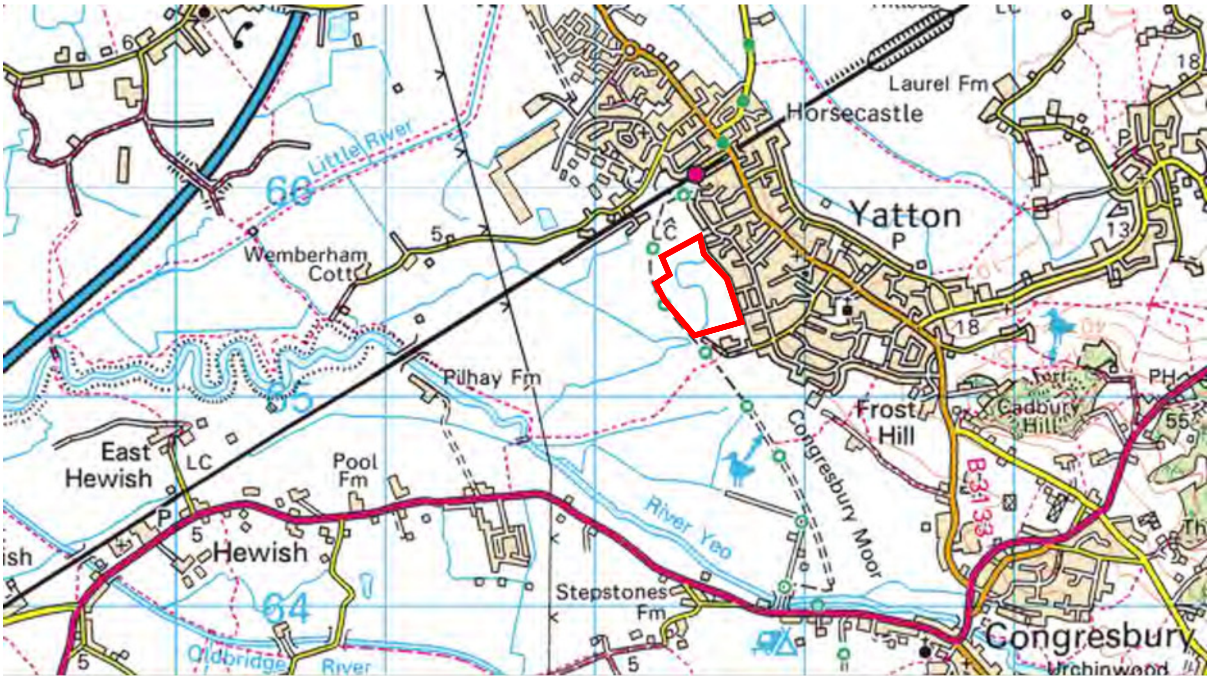

Figure 1: Location Plan

2.2 Proposed Development

2.2.1 The proposal is for the submission of an outline planning application for a residential development of up to 190 dwellings with associated access roads, parking, and open space. Land has also been set aside for potential Class E building use.

2.2.2 A copy of the Illustrative Masterplan is included in Appendix A.

2.3 Topography

2.3.1 A topographic survey was carried out by Hydrock in October 2022 and included both the site under consideration and the highways on the site frontages to the east and south.

2.3.2 The site is for all intents and purposes flat, with a general elevation ranging between 5.1m and 5.5m AOD. The ground rises to the eastern boundary where the level increases to 7.2m AOD in the south-east corner of the site, 6.6m AOD at the mid-point, and back down to 5.3m AOD in the north-east corner.

2.3.3 A number of interlinked rhynes cross the site conveying water from east to west.

2.3.4 A copy of the topographic survey is included in Appendix B.

3. Policy Framework

3.1.1 In preparing the drainage strategy, due consideration has been given to the policy framework against which SuDS strategies are prepared, implemented and managed. The Options presented individually respond to these strategies.

3.1.2 The development plan for North Somerset comprises:

- The North Somerset Core Strategy adopted January 2017
- North Somerset Sites and Policies Plan Part 1 adopted July 2016; and Part 2 adopted April 2018.

3.1.3 Other material considerations relevant to planning decisions and associated with drainage strategies are: NPPF and PPG and Non statutory technical standard for SuDS.

3.1.4 The adopted development plan polices relevant to formulating the scheme are discussed below.

3.1.5 North Somerset Council under their Development Management Policy (DMP) Part 1 (DM1: Flooding and drainage) aims to discourage inappropriate development in flood risk areas and to ensure that the impact of new development on flooding is fully taken into account. Applying the relevance of policy to drainage, the policy expects that all development that tends to increase the rate of discharge of surface water must consider its implications for the wider area. Sustainable drainage systems are expected for all major developments.

3.1.6 DMP Part 1 Policy DM 8 encourages the protection of ecosystem resources, to include water quality.

3.1.7 Core Strategy Policy CS2 requires the application of best practice in Sustainable Drainage Systems (SuDS) to reduce the impact of additional surface water run-off from new development. Such environmental infrastructure should be integrated into the design of the scheme and into landscaping features, and be easily maintained.

3.1.8 Core Strategy Policy CS3 with regards to water pollution states that Sustainable drainage systems (SuDS) are the preferred approach to dealing with surface water run-off. Planning for major developments should explore possibilities for SuDS, especially as part of multi-functional green infrastructure.

3.1.9 Policy CS3 further states that the development proposals within flood risk areas should incorporate appropriate mitigation measures which are themselves environmentally acceptable, e.g. SuDS.

3.1.10 In relevance to drainage, the NPPF Chapter 14, Paragraph 175 states that major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used 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.

3.1.11 NPPG advises that SuDS are designed to control surface water run off close to where it falls (an approach known as SuDS Management Train), combining a mixture of built and nature-based techniques to mimic natural drainage as closely as possible, and accounting for the predicted impacts of climate change. They provide benefits for water quantity, water quality, biodiversity and amenity. In doing so, sustainable drainage systems can also contribute to reducing the causes and impacts of flooding.

3.1.12 The Sewerage Sector Guidance – Appendix C states that:

surface water pumping stations should only be used where there is no other practicable sustainable method of surface water drainage and an adequate exceedance flood route is provided in the event of failure of the pumping station.'

To ensure that sewage flooding does not occur at, or upstream of, the pumping station during plant or power failure, additional storage should be provided.

3.1.13 Non statutory technical standard for SuDS (Policy S12) also states that pumping must only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.

3.1.14 In compliance with the above policy and guidance, a SuDS based scheme has been developed as an integrated approach to surface water design problems, which consider quality, quantity, amenity and biodiversity aspects equally as discussed in the following chapters.

4. Surface Water Drainage

4.1 Pre-Development

4.1.1 The site is currently undeveloped greenfield and is therefore assumed not to benefit from any existing surface water mains drainage. It should be noted that there may be some private and/or land drainage present however it is unlikely that these features will be recorded. Existing surface water runoff will infiltrate to ground until the natural capacity of the soils is exceeded whereafter overland flows will follow the natural topography of the land and discharge to the local rhyne network.

4.1.2 The site is crossed by an extensive rhyne network which discharge rainfall run-off from the site through culverts below the Strawberry Line cycle/footpath and ultimately out to the Congresbury Yeo.

4.1.3 Discussions have been held with the IDB to gain further knowledge of the workings of the rhyne systems and the extents of responsibilities for maintenance. The IDB has confirmed that a number of rhynes within the site are classed as being 'viewed' which are the primary routes by which water is removed from the land and field ditches to the Main Rivers. Viewed rhynes are maintained by the IDB on a regular or infrequent basis. The IDB undertakes consenting and enforcement powers on all rhynes.

4.1.4 The Viewed rhynes within the site boundary are named as Williams Rhyne and the Cookes Rhyne. A plan showing their location, as taken from the IDB website, is included in Appendix B. All other rhynes are classed as Ordinary Watercourses and are the responsibility of the landowner to maintain although both the IDB and the LLFA have powers to carry out work if a lack of maintenance adversely affects the Viewed rhynes.

4.1.5 Easement strips are required to all rhynes to allow access for maintenance. The standard requirements are 9m each side of a Viewed rhyne and 6m for Ordinary Watercourses. These are shown within Drawing 23257 HYD-XX-XX-DR-D-2005-P02 included in Appendix D.

4.1.6 The Wessex Water sewer mapping confirms that there are no public surface water sewers within the site boundary however, there are a number of outfalls from public sewers into the rhyne network along the eastern edge of the site. These sewers serve the existing residential development to the east. Copies of the sewer record plans are included in Appendix B.

4.2 Post-Development

4.2.1 The site lies within the responsibility of North Somerset Council as Lead Local Flood Authority (LLFA), and the North Somerset Levels Internal Drainage Board (IDB). Reference has been made to the following documents;

- West of England Sustainable Drainage Developer Guide dated March 2015
- National Planning Policy Framework – Section 14
- Creating Sustainable Places and Buildings in North Somerset
- North Somerset Council Core Strategy – Adopted April 2012
- Sites and Polices Plan Part 1 – Development Management Polices (Feb 2015)
- Somerset Drainage Boards Consortium Standing Advice for Major Developments

- North Somerset Levels IDB – Policy Statement and Standing Advice to Local Planning Authorities and Developers -Part – Advice and Guidance
- North Somerset Levels IDB Byelaws
- CIRIA C753 The SuDS Manual November 2015
- Non-Statutory Technical Standards for SuDS March 2015
- Sewerage Sector Guidance – Appendix C Design and Construction Guidance (The Code)

Drainage Hierarchy

4.2.2 In support of the drainage strategy options and in response to the Drainage Hierarchy a commentary is provided to each later in this report. By way of explanation here, in accordance with the National Planning Policy Framework (NPPF), surface water runoff from the proposed development is to be captured and managed utilising sustainable methods where possible. As such, the following surface water drainage management strategies will be assessed in direct relation to the site, based on preferential order in accordance with the NPPF, National Planning Policy Guidance (NPPG), Building Regulations and Sewerage Sector Guidance (SSG).

1. Infiltration
2. Discharge to local watercourse
3. Discharge to public surface water sewer
4. Discharge to public combined sewer

1. Infiltration

4.2.3 At the time of writing no intrusive ground investigation work has been undertaken.

4.2.4 A Geophysical Survey report has been completed by Headland Archaeology identifying the geology as being Tidal Flats deposits comprising clays and silts overlying bedrock of mudstone and halite stone.

4.2.5 In addition, a Preliminary Land Contamination and Geotechnical Risk Assessment has been carried out by Hamson Barron Smith, (report reference 23-12-113547/DSR1 dated December 2022), and concluded that soakaways are unlikely to be practical for the disposal of surface water runoff. An extract of the Executive Summary and Section 4 Environmental Setting, and Chapter 5 Geotechnical Assessment are attached in Appendix F.

4.2.6 Hydrock have previously undertaken a ground investigation for the adjacent Rectory Farm site immediately to the south. The findings concluded the following:

"With little to no superficial geology covering the majority of the site, especially the southern parcel and the nature of the underlaying geology (Mercia Mudstone Group) it can be inferred that the ground conditions are relatively impermeable and clayey resulting in little shallow groundwater. Any shallow ground water that is present is likely to drain south towards the Binhay Rhyne brook. As a result of the potentially low permeability of the subsurface the flux of water is likely to be small".

4.2.7 In view of the above findings, it is reasonable to assume that infiltration based drainage will not provide a suitable method of surface water discharge for this site.

2. Discharge to local watercourse

4.2.8 Following the drainage disposal hierarchy, the next option is to discharge into the watercourse (in this case, rhynes). As discussed in Section 4.1 above, there are several rhynes within and surrounding the site which are suitable for surface water discharge. Both surface water drainage proposals described within this report propose discharge into the existing rhynes.

4.2.9 Guidance as discussed under Section 3 suggests that all surface water discharge should be by gravity. The non statutory technical standard for SuDS (S12) advises that pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.

4.2.10 The drainage SuDS options presented set the principles that can be readily applied to this site in response to the aforementioned geology and the proposed maximum ground levels as informed by the Flood Risk Report by Rappor. As a response, two Options are presented: Option A which includes dividing the site area into small catchments with tanked storage and gravity drainage arrangements; or Option B which includes an above-ground attenuation with a series of surface water basins with pumping arrangements as required due to ground levels.

4.2.11 Both options utilise conventional SuDS measures and a surface water discharge into a local watercourse in line with the drainage hierarchy described above.

Proposed Drainage Strategies

4.2.12 As previously discussed, two surface water drainage strategies are being presented within this report, however both utilise the same principles with respect to surface water discharge.

4.2.13 The surface water discharge into the rhyne network will utilise a maximum discharge rate of 2l/s/ha as advised by the IDB. This proposed discharge rate is lower than the equivalent greenfield rate (QBAR of 4.1l/s/ha) from the site. For comparison, the pre-development greenfield runoff rates based on the proposed impermeable areas of 2.569 ha (discounting urban creep) and proposed discharge rates have been set out in Table 2 below. Note that the proposed discharge rates across all events are significantly lower than the equivalent greenfield rates, and as such represents betterment over the existing runoff situation across all events.

Table 2: Pre and Post Development Runoff Rates

	Greenfield Runoff Rate (l/s/ha)	Discharge at equivalent greenfield rate based on 2.569ha hard area (l/s)	Maximum Proposed Discharge Rate (l/s)	Comment
QBAR	4.1	10.5	-	-
Q1	3.2	8.2	5.1	38% reduction over existing rate
Q30	7.7	19.8	5.1	74% reduction over existing rate
Q100	9.8	25.1	5.1	80% reduction over existing rate

Q100+CC	-	-	5.1	80% reduction over existing 100yr greenfield rate

4.2.14 All surface water discharges into the existing rhynes will be set at 4.85mAOD as stipulated by the IDB.

4.2.15 Both proposals take into consideration discussions with the EA, supported by flood modelling works, which have led to the conclusion that land raising up to 6.43mAOD would be considered acceptable on flood risk grounds. The proposed ground level of 6.43m affords circa. 300mm freeboard above the 'undefended' 1:200year current tidal level of 6.12mAOD, which means the site would be protected under such event. Refer to flood risk reports for further details.

Option A - Gravity Solution

4.2.16 A gravity solution has been investigated for the development which requires dividing the site into nine surface water catchments, each with its own outfall to limit the distance from the head of run to the receiving rhynes to enable a gravity discharge.

4.2.17 As the site has been divided into much smaller catchments, managed surface water discharge at each outfall is relatively small, as shown on Table 3 below, to ensure the total discharge does not exceed the 2l/s/ha rate. Such an arrangement is workable and manageable and sets sensible principles against which a detailed surface water drainage scheme can be prepared responding to the reserved matters scheme.

Table 3: Option A - Catchment Summary & discharge rates

Catchment	Impermeable area (ha)	Impermeable Area +10% Urban Creep (ha)	Permissible Discharge Rate * (l/s)	Proposed Discharge Rate (l/s)
Orange	0.182	0.191	0.36	0.60
Yellow	0.644	0.679	1.29	0.60
Pink	0.205	0.216	0.41	0.60
Light Blue	0.364	0.384	0.73	0.60
Light Green	0.184	0.194	0.37	0.50
Purple	0.116	0.122	0.23	0.50
Dark blue	0.289	0.305	0.58	0.50
Dark green	0.230	0.243	0.46	0.50
Red	0.295	0.312	0.59	0.60
Total	**2.509**	**2.646**	**5.02**	**5.00**

4.2.18 Each catchment is designed to drain into the adjoining rhyne by gravity, which is an approach that reflects the originally submitted drainage strategy. Based on the current site layout, this approach utilises the use of below ground attenuation tanks for six of the surface water networks while remaining catchments utilise surface water basins. Refer to Hydrock drawing 23257-HYD-XX-XX-SK-D-2001 in Appendix C for details of attenuation volumes and sizes, and calculations provided in Appendix C. Division of the site into much smaller catchments mean that each catchment can only drain at a relatively small discharge rate to meet the IDB requirement. This will be achieved by utilising small orifice flow control devices. These devices will be maintained on a regular basis, as per the maintenance schedule discussed below.

4.2.19 In addition, it should be noted that private car parking areas could be designed to utilise tanked permeable paving which can provide some water treatment, and swales/rain gardens can be used in roadside verges to also improve water quality and keep drainage depths to a minimum. There may also be opportunities to revise the layout to accommodate further above ground SuDS at the reserved matters stage.

Option B - Pumped solution

4.2.20 Under this scheme, surface water will be managed using onsite SuDS (surface water storage basins, permeable paving, swales, water butts), and discharged into the adjoining rhynes at a restricted rate as advised by the IDB.

4.2.21 The development site has been split to drain into three separate surface water networks in order to minimise the number of crossings of the existing rhynes. The proposed SuDS basins will eventually discharge into the adjoining rhynes at 2l/s/ha as advised by the IDB.

4.2.22 Based on a finished ground level of 6.43mAOD, the upstream gravity network would require the bed level of Basin 1 to be 2.65mAOD when taking account of the required cover and falls along the piped drainage networks connecting to the basin. Basins 2 and 3 will require the bed levels to be set at 4.0m AOD. Due to the minimum outfall level stipulated by the IDB, Basins 1, 2 and 3 will not be able to drain into the rhynes by gravity. Therefore, a drainage scheme to include three pumps will lift surface water from the basins to the receiving rhynes based on a maximum on-site ground level of 6.43mAOD. This pumped drainage option is shown within Drawing 23257-HYD-XX-XX-DR-D-2006-P03 in Appendix D. The proposed strategy remains similar to the approved strategy, except due to the reduced ground levels, pumping is needed.

4.2.23 As the depths of the proposed surface water storage basins are guided by the invert of the incoming pipeworks, these are deeper and therefore will provide adequate storage over and above what is required for surface water management in the design storm event (1:100year with 45% climate change allowance as per the latest EA guidance). Such extra storage will function to mitigate residual flood risk associated with design exceedance and/or drainage failure. Refer to Table 4 below and calculations in Appendix C.

4.2.24 Owing to its depth, the design of Basin 1 will consider safety factors into account, such as safety fence around the edges and stepped or benched slopes etc in accordance with the CIRIA C753 The SuDS Manual, to ensure there is no danger to public using the open space.

4.2.25 Ground investigation report by Hamson Barron Smith suggested that groundwater levels are anticipated at 1.0 - 1.5mbgl as reflected by water levels within the rhynes. With ground levels at 5.0 - 5.50mAOD, groundwater will be at around 4.0m AOD, hence Basin 1 will extend into the groundwater table and mitigation measures (e.g. geogrid reinforcement or weighted down liner, drainage layer etc) will need to incorporated within the design of the basins to prevent groundwater ingress.

4.2.26 Discharge from each pond has been restricted to 2l/s/ha or a minimum pumped discharge of 1.5l/s to achieve a self-cleaning velocity within the rising main. The pump stations will lift the water from the basins and discharge to a manhole ('break chamber') which will then flow via gravity to a headwall outfall into the rhyne.

4.2.27 A summary of the impermeable areas and discharge rates are shown in Table 4 below and the catchment areas in Figure 3 below. The proposed discharge rates at the outfalls have been adjusted to achieve a minimum pumped rate of 1.5 l/s, however, the total discharge from the site will not exceed 5.1 l/s (at 2l/s/ha rate).

Table 4: Option B - Catchment Area Summary & Discharge Rates

Catchment Areas	Impermeable Area (ha)	Impermeable Area +10% Urban Creep (ha)	Permissible Discharge Rate * (l/s)	Proposed Discharge Rate (l/s)	Comment
Basin 1 (North) - A+B+D	1.179	1.244	2.4	1.8	Pump rates adjusted to achieve a minimum pumped rate 1.5l/s at each outfall
Basin 2 (Central) – C	0.369	0.406	0.7	1.5	
Basin 3 (South) – E	1.021	1.077	2.0	1.8	
Total	**2.569**	**2.893**	**5.1**	**5.1**	

** based on 2 l/s/ha and impermeable area of 2.569 without an urban creep*

4.2.28 A design summary for each attenuation basin for various scenarios is shown in Table 5 below. As the bed levels of the basins have been set by the proposed ground level (i.e. 6.43mAOD) and the fall required to achieve a gravity drainage for the incoming piped network, the basins cannot be made any shallower. This has resulted in the basins providing significantly greater storage than that required to manage the design storm event.

Table 5: Option B - Basins Design Summary

	Discharge Rate (l/s)	Basin Bed Level (mAOD)	Maximum Water Level (mAOD)	Bank Level (mAOD)	Storage Volume at design water level (m^3)	Emergency Storage at 125m^3/ha (m^3)	Maximum available storage up to the bank level (m^3)
Basin 1	1.8	2.65	4.18	6.15	1,400	155	5,450
Basin 2	1.5	4.0	5.53	6.1	510	72	1,000
Basin 3	1.8	4.0	5.3	6.15	1,105	135	2,320
Total	**5.1**				**3,015**	**362**	**8,770**

4.2.29 Additional storage will need to be provided within the site to cater for a pump or power failure situation. For surface water pumping stations, 125 m^3 of storage should be provided per hectare of impermeable surface draining to the pumping station (i.e., 15 minutes of rainfall at 50 mm per hour) (Sewerage Sector Guidance – Appendix C para. D5.5.3). Such storage can easily be accommodated within the freeboard available within each basin, as shown in Table 5.

4.2.30 However, it is to be noted that an appropriate maintenance regime will be set up to regularly maintain these pumps along with all other drainage / SuDS components as discussed below; as such risk of failure is low.

Option C: Hybrid Option (combined gravity and pumped solution)

4.2.31 Drawn from the above acceptable principles in respect of Option A and Option B, and through subsequent detailed design following any grant of outline planning permission a hybrid arrangement, working within the parameters of both of the Options would work to effectively deliver a surface water drainage system (alongside the foul system). Working to the agreed finished ground level of 6.43mAOD, a sustainable drainage arrangement utilising SuDS techniques which also incorporates tank storage, attenuation ponds and pumping can be drawn up alongside the detailed design layout for consideration and discharge through condition and/or Reserved Matters.

4.2.32 As part of the detailed design stage and as expected, further discussions with the LLFA and IDB as appropriate can help to refine such a hybrid option.

Surcharged Outfall Condition

4.2.33 The outfall levels are to be set above the summer penning level, at 4.85mAOD as advised by the IDB which will prevent surcharging of the surface water network. Refer to IDB response in Appendix G. Consequently, a surcharged condition at the outfall has not been modelled.

4.2.34 With regards to tidal locking, the area is defended for up to the 1:200year tidal flood event, and flood modelling has indicated it will take several hours for the peak tidal flood levels to reach the site location. Therefore, by the time peak tide reaches the site location to cause tide locking at the rhyne outfalls, the storm event would likely have passed and the basins would already be empty. As such, the model has not been tested for the tide locking situation; however, as shown in Table 3 above, all the basins have significant surplus capacity which can be mobilised at such times.

Exceedance Flow Routes

4.2.35 Exceedance flows will be routed along the onsite highways towards the basins and rhynes located within the site. Such flow routes are shown on Hydrock drawing no. 23257-HYD-XX-XX-DR-D-2004-P03 which is included in Appendix D.

Rhyne Crossings

4.2.36 The development layout requires crossing of the existing rhynes at several locations to construct the access roads and minor footways. These should be culverted with an adequately sized culverts in agreement with the IDB / LLFA. Note that these rhynes are already culverted in places with between 0.3 and 1.2m diameter pipes (refer to FRA Table 3).

Water Quality

4.2.37 The following mitigation measures will be put in place in order to offset any detrimental effects of the development on water quality on-site and within the catchment.

4.2.38 CIRIA document C753, chapter 26, recommends the use of the 'Simple Index Approach' for assessing the minimum water quality management requirements and this method has been used to check the suitability of the above proposals as follows;

(i) From table 26.2, residential roof runoff is classified as a 'very low' pollution hazard and residential roads as a 'low' hazard.

(ii) From Table 26.2, the following hazard indices are applicable for roofs:;

Total suspended solids	=	0.2
Metals	=	0.2
Hydrocarbons	=	0.05

and following hazard indices are applicable for residential roads;

Total suspended solids	=	0.5
Metals	=	0.4
Hydrocarbons	=	0.4

(iii) From Table 26.3, the indicative SuDS mitigation indices for an attenuation basin are as follows:

Total suspended solids	=	0.5
Metals	=	0.5
Hydrocarbons	=	0.6

(iii) From Table 26.3, the indicative SuDS mitigation indices for permeable paving is as follows:

Total suspended solids	=	0.7
Metals	=	0.6
Hydrocarbons	=	0.7

4.2.39 The above shows that a suitable level of treatment is provided in Option B as all flows pass through the attenuation basins. However, the cellular attenuation crates utilised in Option A do not have a SuDS mitigation indices and so requiring additional upstream water treatment measures or the use of a proprietary treatment system such as a Downstream Defender.

4.2.40 In both scenarios, permeable paving can be incorporated within private parking spaces which will add a further level of treatment and therefore increase the mitigation provided. All houses will be provided with water butts fitted with bypass units to convey roof water to storage and then on to the main drainage system when full. The use of rain gardens will be considered where the plot layouts will permit such features however this cannot be definitively detailed at the outline planning stage.

4.2.41 Oil interceptors can also be provided at each attenuation basin prior to discharge to the rhyne network. This is subject to further discussion with the IDB.

Operation and Maintenance

4.2.42 All surface water drainage will be located within adoptable highways or public open space areas.

4.2.43 The attenuation basins are located in publicly accessible areas with internal bank slopes of 1 in 4 to allow ready access for maintenance.

4.2.44 All IDB viewed rhynes and watercourses within the development area are retained and include maintenance strips of varying widths between 6m and 9m depending on requirements.

4.2.45 It is anticipated that all new surface water drainage sewers will be offered for adoption under a New Appointments and Variations (NAVS) such as IWNL, LEEP or ICOSA which allows developers and large business customers to choose their water and sewerage undertaker for a specific geographic area.

4.2.46 The attenuation basins and surface water pump stations will be maintained by a private Management Company. It may be possible for the adopting water authority to adopt the SuDS components under the SSG adoption framework. Both North Somerset Council or Somerset Council LLFA are not adopting SuDS features yet.

4.2.47 As noted in 4.1.6 above, there are a number of Wessex Water surface water outfalls along the western boundary of the site. These outfalls will be retained and will remain in accessible areas for future maintenance by the relevant authority.

4.2.48 Regular inspection and maintenance are important for the effective operation of SuDS systems as designed. Routine inspection and silt removal form the basis of any maintenance regime. Regular maintenance of SuDS should be carried out in line with the C753 The SuDS Manual or as per manufacturer's specification, as outlined in Tables below.

Table 6: Draft maintenance schedule for ponds

Maintenance Schedule	Required Action	Typical Frequency
Regular	Remove litter and debris	Monthly or as required
	Cut grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring – before nesting season, and autumn)
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Inspect marginal and bankside vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect inlets and forebay for silt accumulation	Half Yearly
	Check any penstocks and other mechanical devices	Half Yearly
	Tidy all dead growth before start of growing season	Annually
	Manage wetland plants	Annually
	Remove sediment from any forebay	Every 1 – 5 years or as required

Maintenance Schedule	Required Action	Typical Frequency
	Remove sediment and planting from one quadrant of the main body of ponds	Every 5 years
Occasional	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective treatment, this will only be required rarely, e.g. every 25-50 years
Remedial	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 inlets, outlets, and overflows	As required

Table 7: Draft maintenance schedule for permeable paving

Maintenance Schedule	Required Action	Typical Frequency*
Regular	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required
Occasional	Stabilise and mow contributing and adjacent areas	As required
	Weeds removal	As required
Remedial	Remedial work to any depressions, rutting or cracked or broken blocks considered detrimental to performance or a hazard to users	As required
	Rehabilitate surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required
Monitoring	Initial Inspection	Monthly for 3 months after installation
	Inspect for evidence of poor operation and/or weed growth	Three monthly, 48 hours after large storms in first six months
	Inspect silt accumulation rates	Annually
	Monitor inspection chambers	Annually

* Frequency of maintenance is dependent upon site specific circumstance and activities should be undertaken as necessary.

Table 8: Draft maintenance schedule for swales

Maintenance Schedule	Required Action	Typical Frequency
Regular	Remove litter and debris	Monthly or as required
	Mow grass	Monthly
	Manage nuisance vegetation and other plans	Monthly, and then as required
	Inspect inlets, outlets and overflows for blockages, silt accumulation, ponding or compaction	Monthly, or as required

Maintenance Schedule	Required Action	Typical Frequency
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
Occasional	Reseed areas of poor growth	As required or if bare soil exposed over 10%+ of swale treatment area
Remedial	Repair erosion or other damage	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Remove build-up of sediment and oils/petrol residues	As required

Table 9: Draft maintenance schedule for flow controls and catchpits

Maintenance Schedule	Required Action	Typical Frequency*
Regular	Inspect sump and benching in flow control chamber and note rate of sediment accumulation.	Three times a year or after significant rainfall events
	Inspect inlets, outlets and overflows for blockages.	Three times a year or after significant rainfall events
	Inspect pull cables in flow control chamber and any moving parts to ensure operational.	Three times a year or after significant rainfall events
	Observe condition of flow control chamber and carry out CCTV survey to check condition of pipes.	Every two years or if issues are identified.
Maintenance	Remove sediment and debris from sump	As required, based on inspection
	Grease moving parts in flow control chamber as appropriate	As required, based on inspection.
	Jet through pipelines	As required, based on inspection.
Remedial Action	Reconstruct inspection chamber structure	As required
	Replacement of flow control device and/or overflow pipe	As required
	Repair damaged joints in pipes or relay new pipes	As required
* Frequency of maintenance is dependent upon site specific circumstance and activities should be undertaken as necessary.		

Table 10: Draft maintenance schedule for open ditches

Maintenance Schedule	Required Action	Typical Frequency
Regular	Manage vegetation and remove nuisance plants	Every six months
	Inspect headwalls for blockages and silt accumulation, and clear if required	

Maintenance Schedule	Required Action	Typical Frequency
Occasional	Remove debris and litter from main channel and banks	As required
	Remove silt from headwalls	

5. Foul Water Drainage

5.1 Pre-Development

5.1.1 The site is currently undeveloped 'greenfield' and therefore there is no foul flow generated from the site.

5.1.2 The Wessex Water sewer mapping indicates that there are public foul sewers immediately to the east of the site serving the existing residential development. These sewers cross into the site at two locations on the eastern boundary, firstly to the north of Marsh Road and, secondly, in the extreme north-east corner of the site adjacent to Shiners Elms. Copies of the sewer record plans are included in Appendix B.

5.2 Post-Development

5.2.1 The proposed development is for up to 190 residential houses across the site plus an area of 0.30 ha set aside as land reserved for Class E uses.

5.2.2 The estimated peak flow for the residential development is 8.74 l/s for 190 units based on an allowance of 4,000 litres/dwelling/day in accordance with the recommendations of clause B3.1.1(b) of the Water UK Sewerage Sector Guidance - Appendix C.

5.2.3 The land set aside for Class E use has been assessed in accordance with the recommendations of clause B3.1.2(b) Sewerage Sector Guidance - Appendix C. The estimated peak flow assuming 0.5 l/s/ha and taking a peaking factor of x3 will be 0.22 l/s based on an area of 0.15 ha.

5.2.4 Due to the topography site, it will be necessary to pump part of the development area in order to discharge to the existing public sewer located on the eastern side of the site. It is proposed that two new pumping stations be provided on the western edge of the development area, one in the north-west corner of the site and a second midway along the eastern boundary. These locations may be adjusted at the detailed design stage to suit the finalised layout proposals but can be easily accommodated. The strategy remains unchanged to the originally approved drainage scheme. A copy of the proposed foul drainage layout is included in Appendix D.

5.2.5 It is anticipated that all new foul water drainage will be offered for adoption under a New Appointments and Variations (NAVS) such as IWNL, LEEP or ICOSA which allows developers and large business customers to choose their water and sewerage undertaker for a specific geographic area

5.2.6 A Pre-Development Enquiry has submitted to Wessex Water in order to determine the recommended points of connection and if any off-site reinforcement works are required. Wessex Water have confirmed that a connection should be made to the 450mm diameter foul sewer in the north-east corner of the site due to capacity issues further upstream.

5.2.7 A copy of the Wessex Water response is included in Appendix E; however, it should be noted that this refers to an earlier iteration of the scheme for 280 units. Wessex Water have been asked to review their advice in the light of the reduction off dwellings however they have confirmed that the principles of acceptable points of connection remain unchanged. A copy of this secondary confirmation is also included in Appendix E.

5.2.8 As noted in section 4.1.2 above, public foul sewers encroach within the development area in the north-east part of the site. These sewers will require diversion in order to accommodate the proposed site layout.

5.2.9 Any diversion work will be subject to discussion with Wessex Water and the requirements of Section 185 of the Water Industry Act 1991.

6. SUMMARY

6.1 This report demonstrates that that the proposed development can be suitably drained of surface water through the application of SuDS. Two deliverable approaches to drainage have been presented in accordance with the principles previously agreed. The two strategies respond to the lower level of ground raising agreed with the Environment Agency, in response to potential effects on flood levels. The detailed design of the drainage strategy would be submitted at the Reserved Matters stage, which would follow the principles of Option A, Option B, or a combination of the two approaches. As this is a matter of detailed design, in the context of an application/appeal for outline planning permission, the choice between these options does not need to be made now, but is instead for the discharge of reserved matters and/or any relevant conditions attached to the outline permission sought.

6.2 The Options presented follow the SuDS hierachy with surface water discharges into the adjoining rhynes, restricted at 2 l/s/ha. The recent flood modelling works and discussions with the EA have concluded that land can be raised up to 6.43mAOD before it starts increasing flood risk to offsite properties. Based on this agreed proposed ground level of 6.43mAOD and the IDB stipulated outfall level of the rhyne (4.85mAOD), two options have been explored either utilising smaller catchments (option A), or surface water pumps (option B). Both contain different types of SuDS which may be more or less favourable to the LLFA/IDB. As such, due to the differing benefits it may be more favourable to combine both approaches to enable some areas to drain via gravity, and others to utilise a surface water pump.

6.3 An adequately designed SuDS system will cater for the design exceedance and drainage / pump failure situation, and will ensure that the development does not exacerbate flood risk within the site or the local area.

6.4 With regards to foul drainage, as per the approved scheme, it is anticipated that foul water will need to be pumped and two pumping stations have been proposed in order to convey flows to the existing Wessex Water foul sewer located in the north-west corner of the site.

6.5 Regular maintenance of all the proposed drainage and SuDS components can ensure that the system as designed and as constructed work efficiently throughout the lifetime of the development.

6.6 Given the above, the proposals meet the requirements of the NPPF and relevant local and national guidance. We can confirm that through a sustainable drainage scheme being employed as explained in this document, in compliance with the paragraphs 173c and 175 of the NPPF, the proposed scheme:

- Takes account of LLFA and IDB discussions
- Incorporates SuDS
- Can be delivered and appropriately maintained
- Residual risks can be managed
- Can deliver functional improvements noting the scheme's response to ecology and environmental design benefits – considering the scheme layout.

APPENDIX A

DEVELOPMENT DETAILS

Illustrative Masterplan

Land at Rectory Farm (North), Yatton, North Somerset
Illustrative Masterplan

edp

- date **14 MARCH 2023** - drawing number **edp7842_d003g** - scale **1:1,250 @ A1** - drawn by **OSh** - checked **GHo** - QA **PDa**

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APPENDIX B

EXISTING SITE INFORMATION

Topographic Survey

Wessex Water Sewer Record Plans

IDB Drainage Plan

OS NORTH

Notes:
All dimensions, features and details are to be checked on site before the commencement of works. Efforts have been made to correctly identify and measure key features on site. Hydrock accept no responsibility or liability for inaccuracies, false or missing information within this drawing. Ditch levels have been captured from dip measurements without entering the watercourses and as such it is possible that there are anomalies hidden within the ditches which have been omitted - levels should be treated as indicative only.

LEVEL INFORMATION

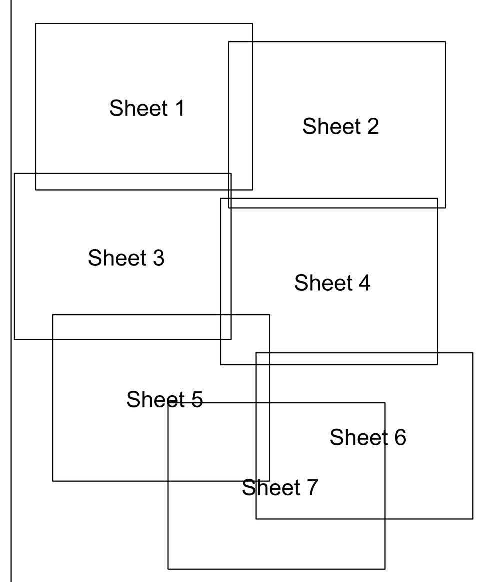
Heights in Metres
Datum : GPS controlled (OSGB36 -15)

COORDINATE INFORMATION

Values in Metres
All Coordinates are : Relative to Ordinance Survey National Grid - OSGB36(15) - Centered on ST01 E:342527.013 N:165447.040 E:5.339

Calculated scale factor: 1.0000000

SHEET LAYOUT - NOT TO SCALE



ABBREVIATIONS

General

(A)	Approximate	LB	Letter Box
Ave	Average	Ldr	Ladder
(AR)	Assumed Route	LP	Lamp Post
BB	Bottom Bank	MH	Manhole
BBn	Belisha Beacon	M	Marker
B	Bollard	Mon	Monument
Bin	Litter Bin	NB	Notice Board
Bldg	Building	o/h	Overhead
BL	Bed Level	o/l	Outline of
BTIC	BT Inspection Chamber		
Cab	Cabinet	Pav	Paviors
CE	Cable TV Entry Point	PGM	Permanent Ground Marker
CEK	Concrete Edging Kerb	PI	Pipe Into Ground
CI	Cable Into Ground	PKN	Parker Kalon Nail
CL	Cover Level	PM	Parking Meter
CM	Cable Marker	(R)	Records
Col	Column	RE	Rodding Eye
Conc	Concrete	RGL	Ridge Level
CP	Concrete Post	RL	Roof Level
CPS	Concrete Paving Slabs	RS	Road Sign
CT	Cable TV IC	RSJ	Reinforced Steel Joist
D	Duct	Rub	Rubble
d	Depth	RWC	Rain Water Channel
DF	Drinking Fountain	SA	Soakaway
Dil	Dilapidated	SB	Sign Board
DK	Drop Kerb	SD	Slot Drain
DM	Duct Marker	SEK	Stone Edging Kerb
Dn	Down	Shb	Shrub Bed
DP	Rainwater Down Pipe	SL	Soffit Level
Ea	Earth	SN	Sign
EC	Electricity Cable Outlet	SP	Soil Down Pipe
EIC	Electricity Inspection Chamber	Sub	Substation
EL	Eaves Level	SV	Stop Valve
EM	Electricity Meter	SVMK	Stop Valve Marker
EP	Electricity Pole	SVP	Soil Vent Pipe
ER	Earthing Rod	SWIC	Storm Water Inspection Chamber
ETL	Electricity Transmission Lines	SY	Stay
FB	Footbridge	Tac	Tactile Paving
FD	French Drain	Tar	Tarmac
FEsc	Fire Escape	TB	Top of Bank
FH	Fire Hydrant	TCB	Telephone Call Box
FHMK	Fire Hydrant Marker	TL	Threshold Level
FL	Floor Level	TLt	Traffic Light
Flb	Flower Bed	TP	Telegraph pole
Flp	Flag Pole	TPS	Textured Paving Slabs
Flt	Floodlight	TS	Tree Stump
FP	Footpath	TTL	Telephone Transmission Line
FWIC	Foul Water Inspection Chamber	u/g	Underground
Gbn	Gabions	Up	Up
GM	Gas Meter	UTR	Unable To Raise
GMK	Gas Marker	Veg	Vegetation
GP	Gate Post	VP	Vent Pipe
Gr	Grass	VT	Vent
GT	Grease Trap	w	Width
GV	Gas Valve	WL	Water Level
Gvl	Gravel	WM	Water Meter
GY	Gully	WMK	Water Meter Marker
h	Height	WO	Wash Out
Hc	Hardcore	WP	Wooden Peg
HN	Hilti Nail	WT	Water Tap
IC	Inspection Cover	VL	Unknown Valve
IL	Invert Level		
KO	Kerb Outlet		

Fences

AI	Angle Iron	EF	Electric Fence
CP	Concrete Post	IRF	Iron Railed Fence
MP	Metal Post	IWF	InterWoven Fence
WP	Wooden Post	MHR	Metal Hand Rail
		MPR	Metal Post & Rail Fence
Bar	Barrier	Pa	Closed Panel
BWF	Barbed Wire Fence	Pal	Pallisade
CB	Crash Barrier	RF	Railed Fence
CBF	Close Boarded Fence	Sec	Security Fence
ChP	Chestnut Paling	Tr	Trellis Fence
CIF	Corrugated Iron Fence	WMF	Wire Mesh Fence
CLF	Chain Link Fence	WPR	Wooden Post & Rail Fence

Walls

BL	Block	RW	Retaining Wall
B	Brick	W	Wall
C	Concrete		
DB	Devon Bank		
DS	Dry Stone		
S	Stone		

Rev	Date	Description	By	Ckd
A	05/10/22	Entire Site Sheet Added	PLS	JWH

Hydrock

Over Court Barns, Over Lane, Almondsbury, Bristol, BS32 4DF.
TEL: 01454 619 533 FAX: 01454 614 125 or visit
www.hydrock.com

Client:
PERSIMMON
SEVERN VALLEY

Project:
LAND AT RECTORY FARM
YATTON

Project Number: 23257

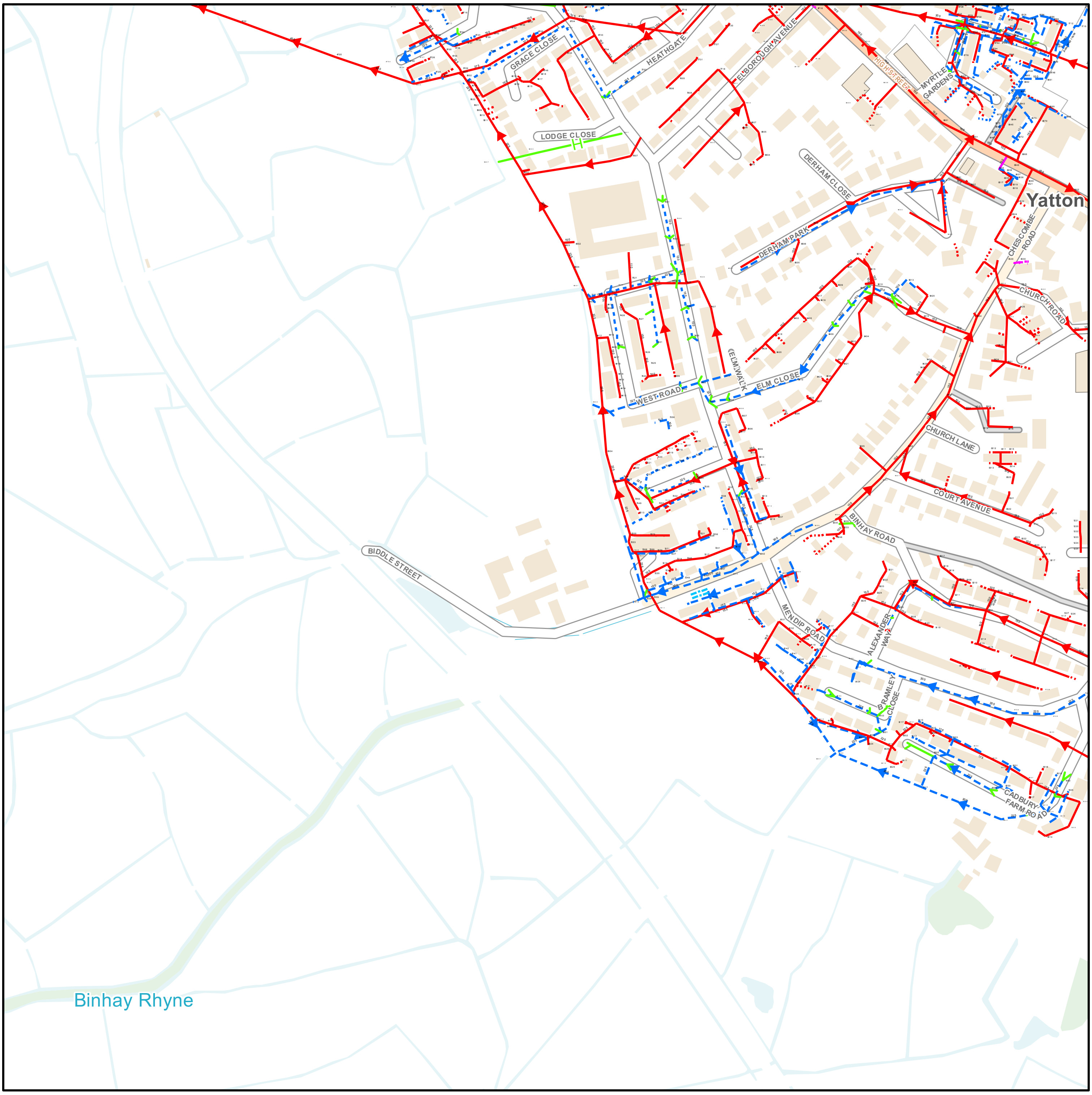
Drawing Title:
TOPOGRAPHICAL SURVEY
REVISION A

Drawn:	Checked:	Scale @ A0:	Drawn Date:	First Issue:
JWH	PLS	NOT TO SCALE	02/10/2022	02/10/2022

Drawing Status. INFORMATION

Drawing No. 23257-TS01 Sheet Entire Site

WWMAP2



WATER MAINS
- Distribution Main
- Washout Main
- Raw Water Main
- Abandoned Main
- Private Main

SITES
- Source
- Reservoir
- Pump
- Treatment Works

FITTINGS
- Valve - Open
- Valve - Closed
- Fire Hydrant
- Pressure Reducing Valve
- Meter

SEWERS	PUBLIC	PRIVATE	SECTION 104
Foul			
Surface			
Combined			
Abandoned			

OTHER WESSEX PIPES
- Rising Mains
- EDM Effluent Disposal
- Overflow
- S Syphon

NON-WESSEX / UNKNOWN
- Private Rising Mains
- CW Culverted Watercourse
- H Highway Drain
- ? Use Unknown
- SU Status Unknown

Colours generally indicate the use of the sewer/drain (i.e Red - Foul, Dark Blue - Surface, Magenta - Combined/Dual Use, Light Green - Highway Drain, Mid Green - Overflow) styles of line are shown on the key in sample/typical colours.

STRUCTURES
- Manhole - Foul
- Manhole - Surface
- Manhole - Combined
- Outfall
- Inlet
- LH Lamphole
- Bifurcation - Foul
- Bifurcation - Surface
- Bifurcation - Combined
- CSO Combined Sewage Overflow
- Pumping Station - Surface
- Pumping Stn - Foul/Combined
- Gully
- Vent Column
- Rodding Eye
- Catchpit
- FC Flushing Chamber
- SK Soakaway
- Non Return Valve
- X Washout
- Air Valve
- HB Hatch Box

OTHER STRUCTURES
- Chamber
- Attenuation Tank
- Tunnel
- Storage Tank
- Interceptor

Wessex Water a YTL company

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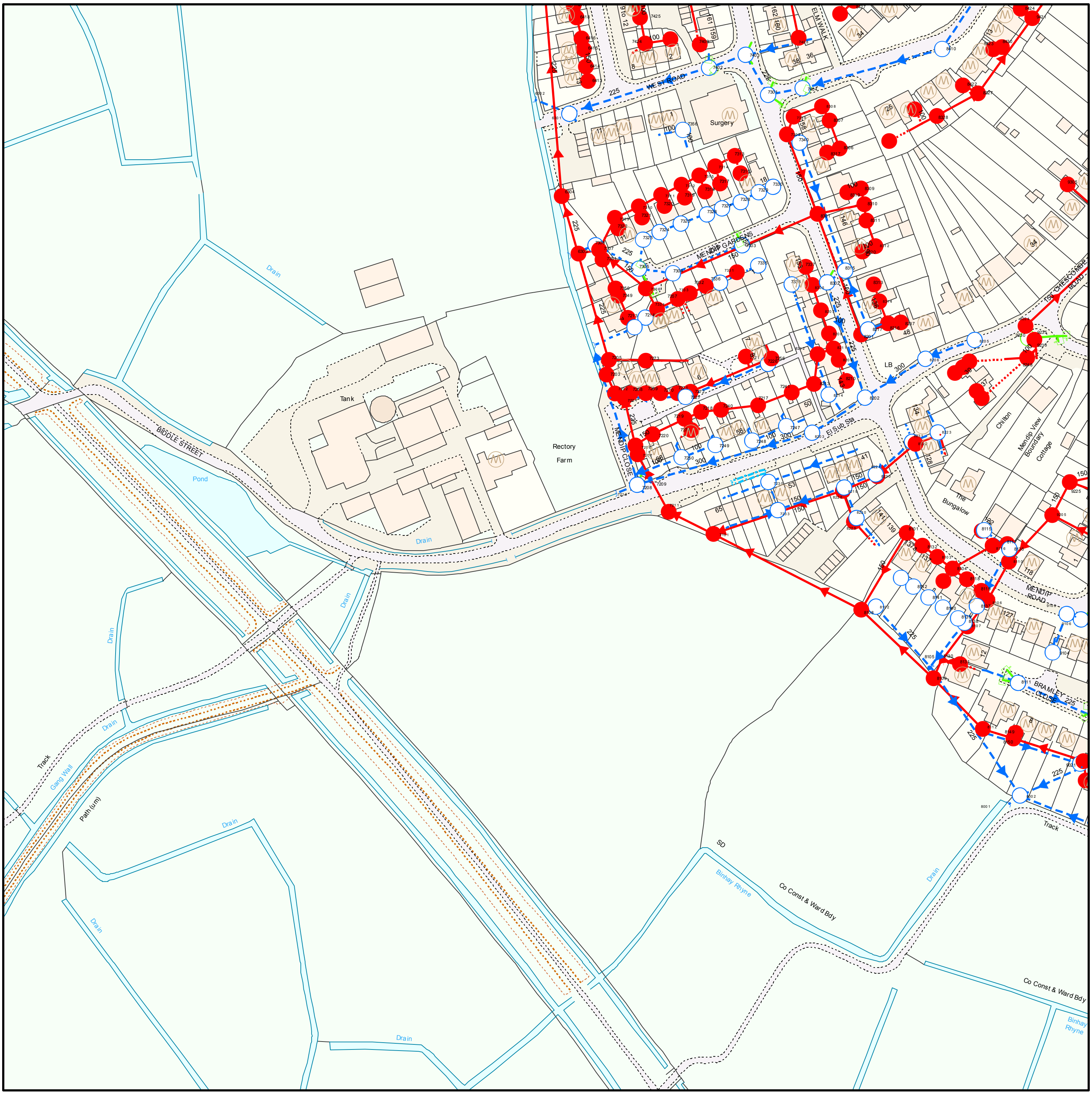
Scale: 1:5000
Centre: 342630, 165264

N E S W

WWMAP2



WATER MAINS
- Distribution Main
- Washout Main
- Raw Water Main
- Abandoned Main
- Private Main

SITES
- Source
- Reservoir
- Pump
- Treatment Works

FITTINGS
- Valve - Open
- Valve - Closed
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SEWERS	PUBLIC	PRIVATE	SECTION 104
Foul			
Surface			
Combined			
Abandoned			

OTHER WESSEX PIPES
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- Lamphole
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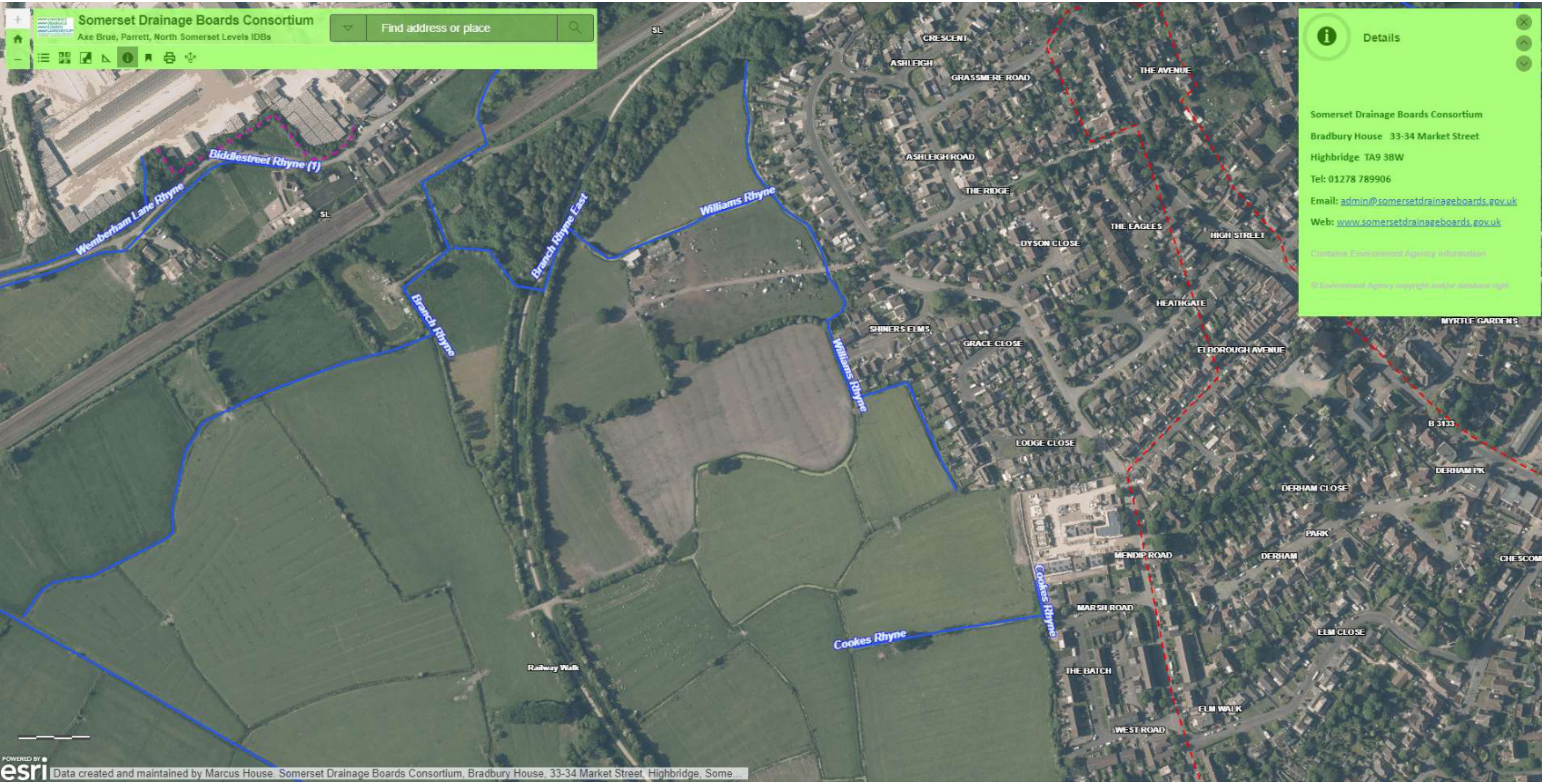
- Bifurcation - Surface
- Bifurcation - Combined
- Combined Sewage Overflow
- Pumping Station - Surface
- Pumping Stn - Foul/Combined
- Gully
- Vent Column
- Rodding Eye
- Catchpit
- Flushing Chamber
- Soakaway
- Non Return Valve
- Washout
- Air Valve
- Hatch Box

OTHER STRUCTURES
- Chamber
- Attenuation Tank
- Tunnel
- Storage Tank
- Interceptor

a YTL company

Date: 03/12/2020, 18:02:21
Scale: 1:2500
Centre: 342678, 165190



Somerset Drainage Boards Consortium
Axe Brue, Parrett, North Somerset Levels IDBs
Find address or place
Details
Somerset Drainage Boards Consortium
Bradbury House 33-34 Market Street
Highbridge TA9 3BW
Tel: 01278 789906
Email: admin@somersetdrainageboards.gov.uk
Web: www.somersetdrainageboards.gov.uk
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Biddlestreet Rhyne (1)
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Williams Rhyne
Branch Rhyne
Williams Rhyne
Cookes Rhyne
Cookes Rhyne
Railway Walk
SL
SL
CRESCENT
ASHLEIGH
GRASSMERE ROAD
THE AVENUE
ASHLEIGH ROAD
THE RIDGE
THE EAGLES
HIGH STREET
DYSON CLOSE
HEATHGATE
MYRTLE GARDENS
SHINERS ELMS
GRACE CLOSE
ELBOROUGH AVENUE
B 3133
LODGE CLOSE
DERHAM PK
DERHAM CLOSE
PARK
MENDIP ROAD
DERHAM
MARSH ROAD
ELM CLOSE
THE BATCH
ELM WALK
WEST ROAD
esri
Data created and maintained by Marcus House. Somerset Drainage Boards Consortium, Bradbury House, 33-34 Market Street, Highbridge, Some...

APPENDIX C

SURFACE WATER DRAINAGE CALCULATIONS

Greenfield Runoff Calculation

Option 1 Network Calculations (Gravity Option)

Option 2 Network Calculations (Pumped Option)

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	SAAR (mm)	815	Urban	0.000
Area (ha)	1.000	Soil	0.400	Region Number	Region 8

Results	**l/s**
QBAR Rural	4.1
QBAR Urban	4.1
Q100 years	9.8
Q1 year	3.2
Q30 years	7.7
Q100 years	9.8

Option 1 Network Calculations (Gravity Option)

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Orange

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	58
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Orange

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	8.757	0.450	19.5	0.031	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	28.151	0.115	244.8	0.073	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	7.093	0.029	244.6	0.033	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	7.930	0.032	247.8	0.010	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	5.251	0.021	250.0	0.045	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	9.258	0.038	243.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	5.880	0.031	0.0	0.0	0.0	1.76	13.8	4.2
S1.001	50.00	5.55	5.056	0.104	0.0	0.0	0.0	1.00	70.7	14.1
S2.000	50.00	5.12	4.970	0.033	0.0	0.0	0.0	1.00	70.7	4.5
S1.002	50.00	5.68	4.941	0.147	0.0	0.0	0.0	0.99	70.3	19.9
S1.003	50.00	5.77	4.909	0.191	0.0	0.0	0.0	0.99	70.0	25.9
S1.004	50.00	5.93	4.888	0.191	0.0	0.0	0.0	1.00	70.9	25.9

PIPELINE SCHEDULES for Orange

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	100	SPP	6.430	5.880	0.450	Open Manhole	1350
S1.001	o	300	S3	6.260	5.056	0.904	Open Manhole	1350
S2.000	o	300	STank	6.430	4.970	1.160	Open Manhole	1350
S1.002	o	300	S4	6.250	4.941	1.009	Open Manhole	1350
S1.003	o	300	S5	6.250	4.909	1.041	Open Manhole	1350
S1.004	o	300	SFC	6.250	4.888	1.062	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	8.757	19.5	S3	6.260	5.430	0.730	Open Manhole	1350
S1.001	28.151	244.8	S4	6.250	4.941	1.009	Open Manhole	1350
S2.000	7.093	244.6	S4	6.250	4.941	1.009	Open Manhole	1350
S1.002	7.930	247.8	S5	6.250	4.909	1.041	Open Manhole	1350
S1.003	5.251	250.0	SFC	6.250	4.888	1.062	Open Manhole	1350
S1.004	9.258	243.6	S	6.430	4.850	1.280	Open Manhole	0

Online Controls for Orange

Hydro-Brake® Optimum Manhole: SFC, DS/PN: S1.004, Volume (m^3): 2.2

Unit Reference	MD-SHE-0032-6000-1500-6000
Design Head (m)	1.500
Design Flow (l/s)	0.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	32
Invert Level (m)	4.888
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	0.6	Kick-Flo®	0.288	0.3
Flush-Flo™	0.144	0.3	Mean Flow over Head Range	-	0.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.3	1.200	0.5	3.000	0.8	7.000	1.2
0.200	0.3	1.400	0.6	3.500	0.9	7.500	1.2
0.300	0.3	1.600	0.6	4.000	0.9	8.000	1.3
0.400	0.3	1.800	0.6	4.500	1.0	8.500	1.3
0.500	0.4	2.000	0.7	5.000	1.0	9.000	1.3
0.600	0.4	2.200	0.7	5.500	1.1	9.500	1.4
0.800	0.5	2.400	0.7	6.000	1.1		
1.000	0.5	2.600	0.8	6.500	1.2		

Storage Structures for Orange

Porous Car Park Manhole: SPP, DS/PN: S1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	2.5
Membrane Percolation (mm/hr)	1000	Length (m)	30.0
Max Percolation (l/s)	20.8	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.880	Membrane Depth (mm)	0

Cellular Storage Manhole: STank, DS/PN: S2.000

Invert Level (m)	4.970	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m^2)**	**Inf. Area (m^2)**	**Depth (m)**	**Area (m^2)**	**Inf. Area (m^2)**
0.000	136.0	0.0	0.801	0.0	0.0
0.800	136.0	0.0			

Cellular Storage Manhole: SFC, DS/PN: S1.004

Invert Level (m)	4.887	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m^2)**	**Inf. Area (m^2)**	**Depth (m)**	**Area (m^2)**	**Inf. Area (m^2)**
0.000	90.0	0.0	0.801	0.0	0.0
0.800	90.0	0.0			

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Yellow

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	1999
Site Location	GB 341850 165500 ST 41850 65500
C (1km)	-0.028
D1 (1km)	0.362
D2 (1km)	0.381
D3 (1km)	0.330
E (1km)	0.295
F (1km)	2.426
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.900
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Yellow

- Indicates pipe length does not match coordinates
« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.000	19.162	0.375	51.1	0.016	5.00	0.0	0.600	o	100	Pipe/Conduit	
2.001	13.626	0.056	243.3	0.013	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	15.242	0.432	35.3	0.082	5.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.000	50.00	5.30	5.830	0.016	0.0	0.0	0.0	1.08	8.5	2.1
2.001	50.00	5.52	5.255	0.028	0.0	0.0	0.0	1.00	70.9	3.8
3.000	50.00	5.10	5.631	0.082	0.0	0.0	0.0	2.66	187.7	11.2

Network Design Table for Yellow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.002	36.612	0.149	245.7	0.068	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	24.515#	0.100	245.2	0.119	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	13.782	0.056	246.1	0.100	5.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	20.446	0.350	58.4	0.017	5.00	0.0	0.600	o	100	Pipe/Conduit	
5.001	8.397	0.107	78.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
4.001	46.021	0.095	484.4	0.053	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.002	19.490#	0.080	243.6	0.136	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	25.909	0.106	244.4	0.049	5.00	0.0	0.600	o	300	Pipe/Conduit	
6.001	13.859	0.057	243.1	0.026	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.002	16.225#	0.066	245.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.004	12.544	0.030	418.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
2.005	18.460	0.075	246.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.002	50.00	6.13	5.199	0.179	0.0	0.0	0.0	1.00	70.6	24.2
2.003	50.00	6.54	5.050	0.298	0.0	0.0	0.0	1.00	70.7	40.3
4.000	50.00	5.23	5.830	0.100	0.0	0.0	0.0	1.00	70.5	13.6
5.000	50.00	5.34	5.830	0.017	0.0	0.0	0.0	1.01	7.9	2.3
5.001	50.00	5.50	5.480	0.017	0.0	0.0	0.0	0.87	6.8	2.3
4.001	50.00	6.58	5.223	0.170	0.0	0.0	0.0	0.71	50.0	23.0
4.002	50.00	6.91	5.128	0.306	0.0	0.0	0.0	1.00	70.9	41.4
6.000	50.00	5.43	5.184	0.049	0.0	0.0	0.0	1.00	70.8	6.7
6.001	50.00	5.66	5.078	0.075	0.0	0.0	0.0	1.00	71.0	10.2
6.002	50.00	5.93	5.021	0.075	0.0	0.0	0.0	1.00	70.6	10.2
2.004	50.00	7.12	4.955	0.679	0.0	0.0	0.0	0.99	157.1	91.9
2.005	50.00	7.43	4.925	0.679	0.0	0.0	0.0	1.00	70.5«	91.9

PIPELINE SCHEDULES for Yellow

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.000	o	100	Swale	6.430	5.830	0.500	Junction	
2.001	o	300	Swale	6.430	5.255	0.875	Open Manhole	1350
3.000	o	300	PP	6.430	5.631	0.499	Open Manhole	1350
2.002	o	300	7	6.430	5.199	0.931	Open Manhole	1350
2.003	o	300	8	6.250	5.050	0.900	Open Manhole	1350
4.000	o	300	PP	6.430	5.830	0.300	Open Manhole	1350
5.000	o	100	Swale	6.430	5.830	0.500	Junction	
5.001	o	100	Swale	6.430	5.480	0.850	Open Manhole	1350
4.001	o	300	15	6.430	5.223	0.907	Open Manhole	1350
4.002	o	300	17	6.330	5.128	0.902	Open Manhole	1350
6.000	o	300	18	6.430	5.184	0.946	Open Manhole	1350
6.001	o	300	19	6.330	5.078	0.952	Open Manhole	1350
6.002	o	300	20	6.430	5.021	1.109	Open Manhole	1350
2.004	o	450	21	6.200	4.955	0.795	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.000	19.162	51.1	Swale	6.430	5.455	0.875	Open Manhole	1350
2.001	13.626	243.3	7	6.430	5.199	0.931	Open Manhole	1350
3.000	15.242	35.3	7	6.430	5.199	0.931	Open Manhole	1350
2.002	36.612	245.7	8	6.250	5.050	0.900	Open Manhole	1350
2.003	24.515#	245.2	21	6.200	4.950	0.950	Open Manhole	1350
4.000	13.782	246.1	15	6.430	5.774	0.356	Open Manhole	1350
5.000	20.446	58.4	Swale	6.430	5.480	0.850	Open Manhole	1350
5.001	8.397	78.5	15	6.430	5.373	0.957	Open Manhole	1350
4.001	46.021	484.4	17	6.330	5.128	0.902	Open Manhole	1350
4.002	19.490#	243.6	21	6.200	5.048	0.852	Open Manhole	1350
6.000	25.909	244.4	19	6.330	5.078	0.952	Open Manhole	1350
6.001	13.859	243.1	20	6.430	5.021	1.109	Open Manhole	1350
6.002	16.225#	245.8	21	6.200	4.955	0.945	Open Manhole	1350
2.004	12.544	418.1	22	6.200	4.925	0.825	Open Manhole	2100

PIPELINE SCHEDULES for Yellow

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.005	o	300	22	6.200	4.925	0.975	Open Manhole	2100

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.005	18.460	246.1	24	5.150	4.850	0.000	Open Manhole	0

Online Controls for Yellow

Hydro-Brake® Optimum Manhole: 22, DS/PN: 2.005, Volume (m³): 6.1

Unit Reference	MD-SHE-0038-8000-1500-8000
Design Head (m)	1.500
Design Flow (l/s)	0.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	38
Invert Level (m)	4.925
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	0.8	Kick-Flo®	0.337	0.4
Flush-Flo™	0.168	0.5	Mean Flow over Head Range	-	0.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.5	1.200	0.7	3.000	1.1	7.000	1.6
0.200	0.5	1.400	0.8	3.500	1.2	7.500	1.7
0.300	0.5	1.600	0.8	4.000	1.2	8.000	1.7
0.400	0.4	1.800	0.9	4.500	1.3	8.500	1.8
0.500	0.5	2.000	0.9	5.000	1.4	9.000	1.8
0.600	0.5	2.200	0.9	5.500	1.4	9.500	1.9
0.800	0.6	2.400	1.0	6.000	1.5		
1.000	0.7	2.600	1.0	6.500	1.6		

Storage Structures for Yellow

Tank or Pond Manhole: 21, DS/PN: 2.004

Invert Level (m) 4.955

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	577.0	1.245	1391.0

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pink

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	58
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pink

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	31.500	0.129	244.2	0.066	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	29.175	0.119	245.2	0.066	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	11.356	0.046	246.9	0.017	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.950	0.024	247.9	0.067	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	8.904	0.036	247.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.52	5.093	0.066	0.0	0.0	0.0	1.00	70.8	8.9
S2.000	50.00	5.49	5.076	0.066	0.0	0.0	0.0	1.00	70.7	9.0
S1.001	50.00	5.71	4.957	0.149	0.0	0.0	0.0	1.00	70.4	20.2
S1.002	50.00	5.81	4.911	0.216	0.0	0.0	0.0	0.99	70.3	29.2
S1.003	50.00	5.96	4.887	0.216	0.0	0.0	0.0	1.00	70.3	29.2

PIPELINE SCHEDULES for Pink

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	300	S1	6.300	5.093	0.907	Open Manhole	1350
S2.000	o	300	S2	6.300	5.076	0.924	Open Manhole	1350
S1.001	o	300	S2	6.250	4.957	0.993	Open Manhole	1350
S1.002	o	300	S3	6.250	4.911	1.039	Open Manhole	1350
S1.003	o	300	S4	6.250	4.887	1.063	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	31.500	244.2	S2	6.250	4.964	0.986	Open Manhole	1350
S2.000	29.175	245.2	S2	6.250	4.957	0.993	Open Manhole	1350
S1.001	11.356	246.9	S3	6.250	4.911	1.039	Open Manhole	1350
S1.002	5.950	247.9	S4	6.250	4.887	1.063	Open Manhole	1350
S1.003	8.904	247.3	S	6.430	4.851	1.279	Open Manhole	0

Online Controls for Pink

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 2.3

Unit Reference	MD-SHE-0034-5000-0800-5000
Design Head (m)	0.800
Design Flow (l/s)	0.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	34
Invert Level (m)	4.887
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	0.5	Kick-Flo®	0.303	0.3
Flush-Flo™	0.151	0.4	Mean Flow over Head Range	-	0.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.4	1.200	0.6	3.000	0.9	7.000	1.3
0.200	0.4	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.7	4.000	1.0	8.000	1.4
0.400	0.4	1.800	0.7	4.500	1.1	8.500	1.4
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.5
0.800	0.5	2.400	0.8	6.000	1.2		
1.000	0.6	2.600	0.8	6.500	1.3		

Storage Structures for Pink

Cellular Storage Manhole: S4, DS/PN: S1.003

Invert Level (m) 4.886 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	273.0	0.0	0.801	0.0	0.0
0.800	273.0	0.0			

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Light blue

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	58
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Light blue

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.969	0.618	17.7	0.184	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	20.194	0.082	246.3	0.034	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	14.223	0.058	245.2	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	7.845	0.032	245.2	0.048	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	17.590	0.072	244.3	0.013	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	3.360	0.014	240.0	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	18.442	0.075	245.9	0.018	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	5.830	0.184	0.0	0.0	0.0	2.40	42.5	24.9
S1.001	50.00	5.41	5.137	0.218	0.0	0.0	0.0	1.00	70.5	29.5
S1.002	50.00	5.65	5.055	0.259	0.0	0.0	0.0	1.00	70.7	35.0
S2.000	50.00	5.13	5.029	0.048	0.0	0.0	0.0	1.00	70.7	6.4
S1.003	50.00	5.94	4.997	0.320	0.0	0.0	0.0	1.00	70.8	43.3
S3.000	50.00	5.09	4.939	0.046	0.0	0.0	0.0	0.64	11.4	6.2
S1.004	50.00	5.31	4.775	0.000	0.5	0.0	0.0	1.00	70.6	0.5

PIPELINE SCHEDULES for Light blue

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	SPP	6.430	5.830	0.450	Open Manhole	1350
S1.001	o	300	S2	6.337	5.137	0.900	Open Manhole	1350
S1.002	o	300	S3	6.300	5.055	0.945	Open Manhole	1350
S2.000	o	300	S4	6.300	5.029	0.971	Open Manhole	1350
S1.003	o	300	S4	6.230	4.997	0.933	Open Manhole	1350
S3.000	o	150	S6	6.200	4.939	1.111	Open Manhole	1350
S1.004	o	300	S5	6.200	4.775	1.125	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	10.969	17.7	S2	6.337	5.212	0.975	Open Manhole	1350
S1.001	20.194	246.3	S3	6.300	5.055	0.945	Open Manhole	1350
S1.002	14.223	245.2	S4	6.230	4.997	0.933	Open Manhole	1350
S2.000	7.845	245.2	S4	6.230	4.997	0.933	Open Manhole	1350
S1.003	17.590	244.3	S5	6.200	4.925	0.975	Open Manhole	1350
S3.000	3.360	240.0	S5	6.200	4.925	1.125	Open Manhole	1350
S1.004	18.442	245.9	S	6.430	4.700	1.430	Open Manhole	0

Online Controls for Light blue

Hydro-Brake® Optimum Manhole: S5, DS/PN: S1.004, Volume (m³): 3.2

Unit Reference	MD-SHE-0034-5000-0800-5000
Design Head (m)	0.800
Design Flow (l/s)	0.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	34
Invert Level (m)	4.925
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	0.5	Kick-Flo®	0.303	0.3
Flush-Flo™	0.151	0.4	Mean Flow over Head Range	-	0.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.4	1.200	0.6	3.000	0.9	7.000	1.3
0.200	0.4	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.7	4.000	1.0	8.000	1.4
0.400	0.4	1.800	0.7	4.500	1.1	8.500	1.4
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.5
0.800	0.5	2.400	0.8	6.000	1.2		
1.000	0.6	2.600	0.8	6.500	1.3		

Storage Structures for Light blue

Porous Car Park Manhole: SPP, DS/PN: S1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	3.5
Membrane Percolation (mm/hr)	1000	Length (m)	60.0
Max Percolation (l/s)	58.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.830	Membrane Depth (mm)	0

Cellular Storage Manhole: S4, DS/PN: S2.000

Invert Level (m)	5.029	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	220.0	0.0	0.801	0.0	0.0
0.800	220.0	0.0			

Cellular Storage Manhole: S6, DS/PN: S3.000

Invert Level (m)	4.939	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	270.0	0.0	0.801	0.0	0.0
0.800	270.0	0.0			

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Light green

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	58
M5-60 (mm)	20.200	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Light green

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	20.679	0.084	246.2	0.057	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	18.250	0.074	246.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	10.515	0.043	244.5	0.023	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	13.551	0.055	246.4	0.066	5.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	16.274	0.066	246.6	0.048	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	15.807	0.065	243.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.35	5.117	0.057	0.0	0.0	0.0	1.00	70.5	7.8
S1.001	50.00	5.65	5.033	0.057	0.0	0.0	0.0	1.00	70.5	7.8
S1.002	50.00	5.83	4.959	0.080	0.0	0.0	0.0	1.00	70.8	10.8
S2.000	50.00	5.23	5.630	0.066	0.0	0.0	0.0	1.00	70.5	8.9
S3.000	50.00	5.27	4.982	0.048	0.0	0.0	0.0	1.00	70.5	6.5
S1.003	50.00	6.09	4.916	0.194	0.0	0.0	0.0	1.00	71.0	26.2

PIPELINE SCHEDULES for Light green

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	300	S1	6.330	5.117	0.913	Open Manhole	1350
S1.001	o	300	S2	6.300	5.033	0.967	Open Manhole	1350
S1.002	o	300	S3	6.250	4.959	0.991	Open Manhole	1350
S2.000	o	300	S4	6.430	5.630	0.500	Open Manhole	1350
S3.000	o	300	S5	6.330	4.982	1.048	Open Manhole	1350
S1.003	o	300	S4	6.330	4.916	1.114	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	20.679	246.2	S2	6.300	5.033	0.967	Open Manhole	1350
S1.001	18.250	246.6	S3	6.250	4.959	0.991	Open Manhole	1350
S1.002	10.515	244.5	S4	6.330	4.916	1.114	Open Manhole	1350
S2.000	13.551	246.4	S4	6.330	5.575	0.455	Open Manhole	1350
S3.000	16.274	246.6	S4	6.330	4.916	1.114	Open Manhole	1350
S1.003	15.807	243.2	S	6.430	4.851	1.279	Open Manhole	0

Online Controls for Light green

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 4.6

Unit Reference	MD-SHE-0031-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	0.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	31
Invert Level (m)	4.916
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	0.5	Kick-Flo®	0.275	0.3
Flush-Flo™	0.137	0.3	Mean Flow over Head Range	-	0.4

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.3	1.200	0.5	3.000	0.7	7.000	1.1
0.200	0.3	1.400	0.5	3.500	0.8	7.500	1.1
0.300	0.3	1.600	0.6	4.000	0.9	8.000	1.2
0.400	0.3	1.800	0.6	4.500	0.9	8.500	1.2
0.500	0.3	2.000	0.6	5.000	0.9	9.000	1.2
0.600	0.4	2.200	0.7	5.500	1.0	9.500	1.3
0.800	0.4	2.400	0.7	6.000	1.0		
1.000	0.5	2.600	0.7	6.500	1.1		

Storage Structures for Light green

Porous Car Park Manhole: S4, DS/PN: S2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	2.5
Membrane Percolation (mm/hr)	1000	Length (m)	50.0
Max Percolation (l/s)	34.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.630	Membrane Depth (mm)	0

Cellular Storage Manhole: S5, DS/PN: S3.000

Invert Level (m)	4.982	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	210.0	0.0	0.801	0.0	0.0
0.800	210.0	0.0			

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Purple

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	58
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Purple

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	25.100	0.102	246.1	0.034	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	14.958	0.061	245.2	0.051	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	6.211	0.025	248.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	8.567	0.035	244.8	0.037	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	13.619	0.056	243.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.42	5.130	0.034	0.0	0.0	0.0	1.00	70.5	4.6
1.001	50.00	5.67	5.028	0.085	0.0	0.0	0.0	1.00	70.7	11.5
1.002	50.00	5.77	4.967	0.085	0.0	0.0	0.0	0.99	70.2	11.5
1.003	50.00	5.92	4.942	0.122	0.0	0.0	0.0	1.00	70.7	16.5
1.004	50.00	6.14	4.907	0.122	0.0	0.0	0.0	1.00	71.0	16.5

PIPELINE SCHEDULES for Purple

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	1	6.330	5.130	0.900	Open Manhole	1350
1.001	o	300	2	6.300	5.028	0.972	Open Manhole	1350
1.002	o	300	3	6.300	4.967	1.033	Open Manhole	1350
1.003	o	300	4	6.300	4.942	1.058	Open Manhole	1350
1.004	o	300	5	6.300	4.907	1.093	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	25.100	246.1	2	6.300	5.028	0.972	Open Manhole	1350
1.001	14.958	245.2	3	6.300	4.967	1.033	Open Manhole	1350
1.002	6.211	248.4	4	6.300	4.942	1.058	Open Manhole	1350
1.003	8.567	244.8	5	6.300	4.907	1.093	Open Manhole	1350
1.004	13.619	243.2		6.430	4.851	1.279	Open Manhole	0

Online Controls for Purple

Hydro-Brake® Optimum Manhole: 5, DS/PN: 1.004, Volume (m³): 2.5

Unit Reference	MD-SHE-0029-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	0.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	29
Invert Level (m)	4.907
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.500	0.5	Kick-Flo®	0.262	0.2
Flush-Flo™	0.129	0.3	Mean Flow over Head Range	-	0.4

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.3	1.200	0.5	3.000	0.7	7.000	1.0
0.200	0.3	1.400	0.5	3.500	0.7	7.500	1.0
0.300	0.3	1.600	0.5	4.000	0.8	8.000	1.1
0.400	0.3	1.800	0.5	4.500	0.8	8.500	1.1
0.500	0.3	2.000	0.6	5.000	0.9	9.000	1.1
0.600	0.3	2.200	0.6	5.500	0.9	9.500	1.1
0.800	0.4	2.400	0.6	6.000	0.9		
1.000	0.4	2.600	0.6	6.500	1.0		

Storage Structures for Purple

Cellular Storage Manhole: 5, DS/PN: 1.004

Invert Level (m) 4.907 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	140.0	0.0	0.801	0.0	0.0
0.800	140.0	0.0			

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Dark blue

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	58
M5-60 (mm)	20.100	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Dark blue

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	29.327	0.059	497.1	0.103	5.00	0.0	0.600	o	525	Pipe/Conduit	
1.001	20.991	0.042	499.8	0.053	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.002	10.158	0.020	507.9	0.031	0.00	0.0	0.600	o	525	Pipe/Conduit	
2.000	30.150	0.060	502.5	0.064	5.00	0.0	0.600	o	525	Pipe/Conduit	
3.000	12.293	0.025	491.7	0.000	5.00	0.0	0.600	o	525	Pipe/Conduit	
3.001	37.263	0.075	500.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
3.002	22.975	0.046	499.5	0.075	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.003	13.740	0.027	508.9	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.49	4.998	0.103	0.0	0.0	0.0	1.00	216.0	14.0
1.001	50.00	5.84	4.939	0.156	0.0	0.0	0.0	1.00	215.4	21.1
1.002	50.00	6.01	4.897	0.187	0.0	0.0	0.0	0.99	213.7	25.3
2.000	50.00	5.51	4.937	0.064	0.0	0.0	0.0	0.99	214.8	8.7
3.000	50.00	5.20	5.023	0.000	0.0	0.0	0.0	1.00	217.2	0.0
3.001	50.00	5.83	4.998	0.000	0.0	0.0	0.0	0.99	215.4	0.0
3.002	50.00	6.21	4.923	0.075	0.0	0.0	0.0	1.00	215.5	10.1
1.003	50.00	5.23	4.877	0.000	0.6	0.0	0.0	0.99	213.5	0.6

PIPELINE SCHEDULES for Dark blue

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	525	1	6.430	4.998	0.907	Open Manhole	1500
1.001	o	525	2	6.380	4.939	0.916	Open Manhole	1500
1.002	o	525	3	6.330	4.897	0.908	Open Manhole	1500
2.000	o	525	4	6.380	4.937	0.918	Open Manhole	1500
3.000	o	525	5	6.430	5.023	0.882	Open Manhole	1500
3.001	o	525	6	6.430	4.998	0.907	Open Manhole	1500
3.002	o	525	7	6.380	4.923	0.932	Open Manhole	1500
1.003	o	525	8	6.330	4.877	0.928	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	29.327	497.1	2	6.380	4.939	0.916	Open Manhole	1500
1.001	20.991	499.8	3	6.330	4.897	0.908	Open Manhole	1500
1.002	10.158	507.9	8	6.330	4.877	0.928	Open Manhole	1500
2.000	30.150	502.5	8	6.330	4.877	0.928	Open Manhole	1500
3.000	12.293	491.7	6	6.430	4.998	0.907	Open Manhole	1500
3.001	37.263	500.0	7	6.380	4.923	0.932	Open Manhole	1500
3.002	22.975	499.5	8	6.330	4.877	0.928	Open Manhole	1500
1.003	13.740	508.9		6.430	4.850	1.055	Open Manhole	0

Online Controls for Dark blue

Hydro-Brake® Optimum Manhole: 8, DS/PN: 1.003, Volume (m³): 15.3

Unit Reference	MD-SHE-0032-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	0.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	32
Invert Level (m)	4.877
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	0.5	Kick-Flo®	0.288	0.3
Flush-Flo™	0.143	0.3	Mean Flow over Head Range	-	0.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.3	1.200	0.5	3.000	0.8	7.000	1.2
0.200	0.3	1.400	0.6	3.500	0.9	7.500	1.2
0.300	0.3	1.600	0.6	4.000	0.9	8.000	1.3
0.400	0.3	1.800	0.6	4.500	1.0	8.500	1.3
0.500	0.4	2.000	0.7	5.000	1.0	9.000	1.3
0.600	0.4	2.200	0.7	5.500	1.1	9.500	1.4
0.800	0.5	2.400	0.7	6.000	1.1		
1.000	0.5	2.600	0.8	6.500	1.2		

Storage Structures for Dark blue

Tank or Pond Manhole: 5, DS/PN: 3.000

Invert Level (m) 5.023

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	198.0	1.400	696.0

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Dark green

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	58
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Dark green

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.535	0.043	245.0	0.032	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	30.191	0.123	245.5	0.036	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	16.415	0.067	245.0	0.019	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	24.266	0.099	245.1	0.015	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	23.686	0.097	244.2	0.012	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	13.676	0.056	244.2	0.130	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	14.733	0.060	245.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.18	5.230	0.032	0.0	0.0	0.0	1.00	70.7	4.4
S1.001	50.00	5.68	5.187	0.068	0.0	0.0	0.0	1.00	70.6	9.3
S2.000	50.00	5.27	5.230	0.019	0.0	0.0	0.0	1.00	70.7	2.5
S2.001	50.00	5.68	5.163	0.033	0.0	0.0	0.0	1.00	70.7	4.5
S1.002	50.00	6.07	5.064	0.113	0.0	0.0	0.0	1.00	70.8	15.3
S1.003	50.00	6.30	4.967	0.243	0.0	0.0	0.0	1.00	70.8	32.9
S1.004	50.00	6.55	4.911	0.243	0.0	0.0	0.0	1.00	70.7	32.9

PIPELINE SCHEDULES for Dark green

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	300	S1	6.430	5.230	0.900	Open Manhole	1350
S1.001	o	300	S2	6.430	5.187	0.943	Open Manhole	1350
S2.000	o	300	S3	6.430	5.230	0.900	Open Manhole	1350
S2.001	o	300	S4	6.430	5.163	0.967	Open Manhole	1350
S1.002	o	300	S3	6.430	5.064	1.066	Open Manhole	1350
S1.003	o	300	S4	6.430	4.967	1.163	Open Manhole	1350
S1.004	o	300	S5	6.430	4.911	1.219	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	10.535	245.0	S2	6.430	5.187	0.943	Open Manhole	1350
S1.001	30.191	245.5	S3	6.430	5.064	1.066	Open Manhole	1350
S2.000	16.415	245.0	S4	6.430	5.163	0.967	Open Manhole	1350
S2.001	24.266	245.1	S3	6.430	5.064	1.066	Open Manhole	1350
S1.002	23.686	244.2	S4	6.430	4.967	1.163	Open Manhole	1350
S1.003	13.676	244.2	S5	6.430	4.911	1.219	Open Manhole	1350
S1.004	14.733	245.0	S	6.430	4.851	1.279	Open Manhole	0

Online Controls for Dark green

Hydro-Brake® Optimum Manhole: S5, DS/PN: S1.004, Volume (m³): 3.0

Unit Reference	MD-SHE-0030-5000-1300-5000
Design Head (m)	1.300
Design Flow (l/s)	0.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	30
Invert Level (m)	4.911
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.300	0.5	Kick-Flo®	0.272	0.3
Flush-Flo™	0.135	0.3	Mean Flow over Head Range	-	0.4

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.3	1.200	0.5	3.000	0.7	7.000	1.1
0.200	0.3	1.400	0.5	3.500	0.8	7.500	1.1
0.300	0.3	1.600	0.5	4.000	0.8	8.000	1.1
0.400	0.3	1.800	0.6	4.500	0.9	8.500	1.2
0.500	0.3	2.000	0.6	5.000	0.9	9.000	1.2
0.600	0.4	2.200	0.6	5.500	1.0	9.500	1.2
0.800	0.4	2.400	0.7	6.000	1.0		
1.000	0.4	2.600	0.7	6.500	1.0		

Storage Structures for Dark green

Cellular Storage Manhole: S5, DS/PN: S1.004

Invert Level (m) 4.911 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	320.0	0.0	0.801	0.0	0.0
0.800	320.0	0.0			

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Red

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	1999
Site Location	GB 341850 165500 ST 41850 65500
C (1km)	-0.028
D1 (1km)	0.362
D2 (1km)	0.381
D3 (1km)	0.330
E (1km)	0.295
F (1km)	2.426
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	58
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	0.900
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Red

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
20.000	13.435	0.055	244.3	0.054	5.00	0.0	0.600	o	300	Pipe/Conduit	🔒
21.000	30.667	0.125	245.3	0.040	5.00	0.0	0.600	o	300	Pipe/Conduit	🔒
20.001	22.601	0.092	245.7	0.031	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
20.002	16.800#	0.069	243.5	0.030	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
20.000	50.00	5.22	5.149	0.054	0.0	0.0	0.0	1.00	70.8	7.3
21.000	50.00	5.51	5.219	0.040	0.0	0.0	0.0	1.00	70.6	5.4
20.001	50.00	5.89	5.094	0.125	0.0	0.0	0.0	1.00	70.6	16.9
20.002	50.00	6.17	5.002	0.155	0.0	0.0	0.0	1.00	70.9	21.0

Network Design Table for Red

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
22.000	21.093	0.086	245.3	0.077	5.00	0.0	0.600	o	300	Pipe/Conduit	
22.001	9.136	0.037	245.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
22.002	49.689	0.099	501.9	0.079	0.00	0.0	0.600	o	300	Pipe/Conduit	
22.003	17.859	0.073	244.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
22.004	0.500#	0.002	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
20.003	9.620	0.019	506.3	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
20.004	15.575	0.064	243.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
22.000	50.00	5.35	5.230	0.077	0.0	0.0	0.0	1.00	70.6	10.4
22.001	50.00	5.50	5.144	0.077	0.0	0.0	0.0	1.00	70.7	10.4
22.002	50.00	6.70	5.107	0.157	0.0	0.0	0.0	0.70	49.1	21.2
22.003	50.00	6.99	5.007	0.157	0.0	0.0	0.0	1.00	70.7	21.2
22.004	50.00	7.00	4.934	0.157	0.0	0.0	0.0	0.99	70.0	21.2
20.003	50.00	7.16	4.933	0.311	0.0	0.0	0.0	0.99	214.0	42.2
20.004	50.00	7.42	4.914	0.311	0.0	0.0	0.0	1.00	70.9	42.2

PIPELINE SCHEDULES for Red

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
20.000	o	300	3	6.430	5.149	0.981	Open Manhole	1350
21.000	o	300	5	6.430	5.219	0.911	Open Manhole	1500
20.001	o	300	6	6.330	5.094	0.936	Open Manhole	1800
20.002	o	300	7	6.330	5.002	1.028	Open Manhole	1800
22.000	o	300	5	6.430	5.230	0.900	Open Manhole	1350
22.001	o	300	6	6.430	5.144	0.986	Open Manhole	1350
22.002	o	300	SwaleIn	6.100	5.107	0.693	Open Manhole	1200
22.003	o	300	SwaleOut	6.100	5.007	0.793	Open Manhole	1200
22.004	o	300	BasinIn	6.100	4.934	0.866	Open Manhole	1350
20.003	o	525	8	6.100	4.933	0.642	Open Manhole	1500
20.004	o	300	9(HB)	6.100	4.914	0.886	Open Manhole	2100

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
20.000	13.435	244.3	6	6.330	5.094	0.936	Open Manhole	1800
21.000	30.667	245.3	6	6.330	5.094	0.936	Open Manhole	1800
20.001	22.601	245.7	7	6.330	5.002	1.028	Open Manhole	1800
20.002	16.800#	243.5	8	6.100	4.933	0.867	Open Manhole	1500
22.000	21.093	245.3	6	6.430	5.144	0.986	Open Manhole	1350
22.001	9.136	245.0	SwaleIn	6.100	5.107	0.693	Open Manhole	1200
22.002	49.689	501.9	SwaleOut	6.100	5.008	0.792	Open Manhole	1200
22.003	17.859	244.6	BasinIn	6.100	4.934	0.866	Open Manhole	1350
22.004	0.500#	250.0	8	6.100	4.932	0.868	Open Manhole	1500
20.003	9.620	506.3	9(HB)	6.100	4.914	0.661	Open Manhole	2100
20.004	15.575	243.4	11	5.450	4.850	0.300	Open Manhole	0

Online Controls for Red

Hydro-Brake® Optimum Manhole: 9(HB), DS/PN: 20.004, Volume (m³): 5.8

Unit Reference	MD-SHE-0036-6000-1000-6000
Design Head (m)	1.000
Design Flow (l/s)	0.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	36
Invert Level (m)	4.914
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	0.6	Kick-Flo®	0.317	0.4
Flush-Flo™	0.156	0.4	Mean Flow over Head Range	-	0.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.4	1.200	0.6	3.000	1.0	7.000	1.4
0.200	0.4	1.400	0.7	3.500	1.0	7.500	1.5
0.300	0.4	1.600	0.7	4.000	1.1	8.000	1.5
0.400	0.4	1.800	0.8	4.500	1.2	8.500	1.6
0.500	0.4	2.000	0.8	5.000	1.2	9.000	1.6
0.600	0.5	2.200	0.9	5.500	1.3	9.500	1.7
0.800	0.5	2.400	0.9	6.000	1.3		
1.000	0.6	2.600	0.9	6.500	1.4		

Storage Structures for Red

Tank or Pond Manhole: SwaleIn, DS/PN: 22.002

Invert Level (m) 5.107

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	63.7	1.000	479.0

Tank or Pond Manhole: 8, DS/PN: 20.003

Invert Level (m) 4.933

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	166.0	1.168	580.0

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Red

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 341850 165500 ST 41850 65500
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
20.000	3	15 Winter	2	+0%	100/15 Summer				5.234
21.000	5	15 Winter	2	+0%	100/15 Summer				5.282
20.001	6	1440 Winter	2	+0%	30/1440 Winter				5.226
20.002	7	1440 Winter	2	+0%	30/240 Winter				5.226
22.000	5	15 Winter	2	+0%	100/240 Winter				5.320
22.001	6	15 Winter	2	+0%	100/120 Winter				5.239
22.002	SwaleIn	1440 Winter	2	+0%	100/60 Winter				5.226
22.003	SwaleOut	1440 Winter	2	+0%	30/240 Winter				5.226
22.004	BasinIn	1440 Winter	2	+0%	30/120 Summer				5.226
20.003	8	1440 Winter	2	+0%	100/120 Winter				5.226
20.004	9(HB)	1440 Winter	2	+0%	2/960 Winter				5.226

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
20.000	3	-0.215	0.000	0.14			8.2	OK	
21.000	5	-0.237	0.000	0.10			6.1	OK	
20.001	6	-0.168	0.000	0.02			1.2	OK	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Red

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
20.002	7	-0.076	0.000	0.02			1.5	OK	
22.000	5	-0.210	0.000	0.19			11.8	OK	
22.001	6	-0.205	0.000	0.22			11.9	OK	
22.002	SwaleIn	-0.181	0.000	0.03			1.4	OK	
22.003	SwaleOut	-0.081	0.000	0.02			1.3	OK	
22.004	BasinIn	-0.008	0.000	0.02			1.3	OK	
20.003	8	-0.232	0.000	0.00			0.6	OK	
20.004	9(HB)	0.012	0.000	0.01			0.4	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Red

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 341850 165500 ST 41850 65500
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
20.000	3	1440 Winter	30	+0%	100/15 Summer				5.404
21.000	5	1440 Winter	30	+0%	100/15 Summer				5.404
20.001	6	1440 Winter	30	+0%	30/1440 Winter				5.404
20.002	7	1440 Winter	30	+0%	30/240 Winter				5.404
22.000	5	1440 Winter	30	+0%	100/240 Winter				5.404
22.001	6	1440 Winter	30	+0%	100/120 Winter				5.404
22.002	SwaleIn	1440 Winter	30	+0%	100/60 Winter				5.404
22.003	SwaleOut	1440 Winter	30	+0%	30/240 Winter				5.404
22.004	BasinIn	1440 Winter	30	+0%	30/120 Summer				5.404
20.003	8	1440 Winter	30	+0%	100/120 Winter				5.404
20.004	9(HB)	1440 Winter	30	+0%	2/960 Winter				5.404

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
20.000	3	-0.045	0.000	0.02			0.9	OK	
21.000	5	-0.115	0.000	0.01			0.7	OK	
20.001	6	0.010	0.000	0.03			2.0	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Red

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
20.002	7	0.102	0.000	0.04			2.5	SURCHARGED	
22.000	5	-0.126	0.000	0.02			1.4	OK	
22.001	6	-0.040	0.000	0.02			1.3	OK	
22.002	SwaleIn	-0.003	0.000	0.04			1.7	OK	
22.003	SwaleOut	0.097	0.000	0.03			1.6	SURCHARGED	
22.004	BasinIn	0.170	0.000	0.02			1.5	SURCHARGED	
20.003	8	-0.054	0.000	0.01			0.6	OK	
20.004	9(HB)	0.190	0.000	0.01			0.4	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Red

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 341850 165500 ST 41850 65500
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
20.000	3	1440 Winter	100	+45%	100/15 Summer				5.696
21.000	5	1440 Winter	100	+45%	100/15 Summer				5.696
20.001	6	1440 Winter	100	+45%	30/1440 Winter				5.696
20.002	7	1440 Winter	100	+45%	30/240 Winter				5.696
22.000	5	1440 Winter	100	+45%	100/240 Winter				5.696
22.001	6	1440 Winter	100	+45%	100/120 Winter				5.696
22.002	SwaleIn	1440 Winter	100	+45%	100/60 Winter				5.696
22.003	SwaleOut	1440 Winter	100	+45%	30/240 Winter				5.696
22.004	BasinIn	1440 Winter	100	+45%	30/120 Summer				5.696
20.003	8	1440 Winter	100	+45%	100/120 Winter				5.696
20.004	9(HB)	1440 Winter	100	+45%	2/960 Winter				5.697

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
20.000	3	0.247	0.000	0.03			1.8	SURCHARGED	
21.000	5	0.177	0.000	0.02			1.3	SURCHARGED	
20.001	6	0.302	0.000	0.07			4.2	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Red

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
20.002	7	0.394	0.000	0.08			5.1	SURCHARGED	
22.000	5	0.166	0.000	0.04			2.6	SURCHARGED	
22.001	6	0.252	0.000	0.05			2.6	SURCHARGED	
22.002	SwaleIn	0.289	0.000	0.05			2.4	SURCHARGED	
22.003	SwaleOut	0.389	0.000	0.04			2.2	SURCHARGED	
22.004	BasinIn	0.462	0.000	0.04			2.1	SURCHARGED	
20.003	8	0.238	0.000	0.01			0.7	SURCHARGED	
20.004	9(HB)	0.483	0.000	0.01			0.5	SURCHARGED	

Option 2 Network Calculations (Pumped Option)

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	1999
Site Location	GB 341850 165500 ST 41850 65500
C (1km)	-0.028
D1 (1km)	0.362
D2 (1km)	0.381
D3 (1km)	0.330
E (1km)	0.295
F (1km)	2.426
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.900
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
10.000	44.200	0.184	240.2	0.081	5.00	0.0	0.600	o	300	Pipe/Conduit	
11.000	36.100	0.150	240.7	0.066	5.00	0.0	0.600	o	300	Pipe/Conduit	
10.001	13.800	0.034	410.0	0.026	0.00	0.0	0.600	o	450	Pipe/Conduit	
10.002	20.200	0.049	410.0	0.038	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
10.000	50.00	5.73	4.930	0.081	0.0	0.0	0.0	1.01	71.4	11.0
11.000	50.00	5.60	4.930	0.066	0.0	0.0	0.0	1.01	71.3	8.9
10.001	50.00	5.96	4.596	0.173	0.0	0.0	0.0	1.00	158.7	23.4
10.002	50.00	6.30	4.562	0.211	0.0	0.0	0.0	1.00	158.7	28.6

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
12.000	18.500	0.077	240.3	0.035	5.00	0.0	0.600	o	300	Pipe/Conduit	
12.001	28.200	0.190	148.5	0.052	0.00	0.0	0.600	o	300	Pipe/Conduit	
10.003	34.900	1.238	28.2	0.064	0.00	0.0	0.600	o	450	Pipe/Conduit	
13.000	18.200	0.076	239.5	0.033	5.00	0.0	0.600	o	300	Pipe/Conduit	
13.001	43.800	0.183	239.3	0.080	0.00	0.0	0.600	o	300	Pipe/Conduit	
13.002	18.000	1.246	14.4	0.033	0.00	0.0	0.600	o	300	Pipe/Conduit	
10.004	28.400	0.057	500.0	0.052	0.00	0.0	0.600	o	525	Pipe/Conduit	
10.005	22.700	0.045	500.0	0.042	0.00	0.0	0.600	o	525	Pipe/Conduit	
10.006	24.200	0.048	500.0	0.044	0.00	0.0	0.600	o	525	Pipe/Conduit	
14.000	30.500	1.656	18.4	0.056	5.00	0.0	0.600	o	300	Pipe/Conduit	
10.007	30.200	0.060	500.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
15.000	32.800	0.137	240.0	0.060	5.00	0.0	0.600	o	300	Pipe/Conduit	
15.001	22.800	1.580	14.4	0.042	0.00	0.0	0.600	o	300	Pipe/Conduit	
10.008	23.100	0.046	500.0	0.042	0.00	0.0	0.600	o	525	Pipe/Conduit	
10.009	21.800	0.044	500.0	0.041	0.00	0.0	0.600	o	525	Pipe/Conduit	
10.010	29.100	0.058	500.0	0.053	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
12.000	50.00	5.31	4.930	0.035	0.0	0.0	0.0	1.01	71.4	4.7
12.001	50.00	5.67	4.853	0.087	0.0	0.0	0.0	1.29	91.0	11.8
10.003	50.00	6.45	4.513	0.362	0.0	0.0	0.0	3.84	610.8	49.0
13.000	50.00	5.30	4.930	0.033	0.0	0.0	0.0	1.01	71.5	4.5
13.001	50.00	6.02	4.854	0.113	0.0	0.0	0.0	1.01	71.5	15.3
13.002	50.00	6.09	4.671	0.146	0.0	0.0	0.0	4.16	293.9	19.8
10.004	50.00	6.92	3.200	0.560	0.0	0.0	0.0	0.99	215.4	75.8
10.005	50.00	7.30	3.143	0.602	0.0	0.0	0.0	0.99	215.4	81.5
10.006	50.00	7.71	3.098	0.646	0.0	0.0	0.0	0.99	215.4	87.5
14.000	50.00	5.14	4.930	0.056	0.0	0.0	0.0	3.68	260.2	7.6
10.007	50.00	8.22	3.049	0.702	0.0	0.0	0.0	0.99	215.4	95.1
15.000	50.00	5.54	4.930	0.060	0.0	0.0	0.0	1.01	71.4	8.1
15.001	50.00	5.63	4.793	0.102	0.0	0.0	0.0	4.16	294.0	13.8
10.008	49.76	8.60	2.989	0.846	0.0	0.0	0.0	0.99	215.4	114.0
10.009	48.42	8.97	2.942	0.887	0.0	0.0	0.0	0.99	215.4	116.3
10.010	46.77	9.46	2.899	0.940	0.0	0.0	0.0	0.99	215.4	119.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
16.000	36.500	0.152	240.1	0.067	5.00	0.0	0.600	o	300	Pipe/Conduit	
16.001	29.300	0.122	240.2	0.054	0.00	0.0	0.600	o	300	Pipe/Conduit	
16.002	21.300	0.089	239.3	0.039	0.00	0.0	0.600	o	300	Pipe/Conduit	
16.003	12.800	1.501	8.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
10.011	23.400	0.047	500.0	0.043	0.00	0.0	0.600	o	525	Pipe/Conduit	
10.012	55.200	0.110	500.0	0.101	0.00	0.0	0.600	o	525	Pipe/Conduit	
10.013	17.000	0.070	242.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
10.014	16.600	-2.370	-7.0	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
10.015	14.100	0.100	141.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
16.000	50.00	5.60	4.930	0.067	0.0	0.0	0.0	1.01	71.4	9.1
16.001	50.00	6.09	4.778	0.121	0.0	0.0	0.0	1.01	71.4	16.4
16.002	50.00	6.44	4.656	0.160	0.0	0.0	0.0	1.01	71.5	21.7
16.003	50.00	6.48	4.567	0.160	0.0	0.0	0.0	5.42	382.8	21.7
10.011	45.53	9.85	2.841	1.143	0.0	0.0	0.0	0.99	215.4	141.0
10.012	42.93	10.77	2.794	1.244	0.0	0.0	0.0	0.99	215.4	144.6
10.013	42.36	10.99	2.650	1.244	0.0	0.0	0.0	1.30	206.8	144.6
10.014	34.57	14.97	2.580	1.244	0.0	0.0	0.0	0.07	0.5«	144.6
10.015	34.25	15.19	4.950	1.244	0.0	0.0	0.0	1.10	43.7«	144.6

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	6.430	1.500	Open Manhole	1350	10.000	4.930	300				
2	6.430	1.500	Open Manhole	1350	11.000	4.930	300				
3	6.430	1.834	Open Manhole	1800	10.001	4.596	450	10.000	4.746	300	
								11.000	4.780	300	34
4	6.430	1.868	Open Manhole	1800	10.002	4.562	450	10.001	4.562	450	
5	6.430	1.500	Open Manhole	1350	12.000	4.930	300				
6	6.430	1.577	Open Manhole	1350	12.001	4.853	300	12.000	4.853	300	
7	6.430	1.917	Open Manhole	1800	10.003	4.513	450	10.002	4.513	450	
								12.001	4.663	300	
8	6.430	1.500	Open Manhole	1350	13.000	4.930	300				
9	6.430	1.576	Open Manhole	1500	13.001	4.854	300	13.000	4.854	300	
10	6.430	1.759	Open Manhole	1350	13.002	4.671	300	13.001	4.671	300	
11	6.430	3.230	Open Manhole	1800	10.004	3.200	525	10.003	3.275	450	
								13.002	3.425	300	
12	6.430	3.287	Open Manhole	1800	10.005	3.143	525	10.004	3.143	525	
13	6.430	3.332	Open Manhole	1800	10.006	3.098	525	10.005	3.098	525	
14	6.430	1.500	Open Manhole	1350	14.000	4.930	300				
15	6.430	3.381	Open Manhole	1800	10.007	3.049	525	10.006	3.049	525	
								14.000	3.274	300	
16	6.430	1.500	Open Manhole	1500	15.000	4.930	300				
17	6.430	1.637	Open Manhole	1350	15.001	4.793	300	15.000	4.793	300	
18	6.430	3.441	Open Manhole	1800	10.008	2.989	525	10.007	2.989	525	
								15.001	3.214	300	
19	6.430	3.488	Open Manhole	1800	10.009	2.942	525	10.008	2.942	525	
20	6.430	3.531	Open Manhole	1800	10.010	2.899	525	10.009	2.899	525	
21	6.430	1.500	Open Manhole	1350	16.000	4.930	300				
22	6.430	1.652	Open Manhole	1350	16.001	4.778	300	16.000	4.778	300	
23	6.430	1.774	Open Manhole	1350	16.002	4.656	300	16.001	4.656	300	
24	6.430	1.863	Open Manhole	1350	16.003	4.567	300	16.002	4.567	300	
25	6.430	3.589	Open Manhole	1800	10.011	2.841	525	10.010	2.841	525	
								16.003	3.066	300	
26	6.430	3.636	Open Manhole	1800	10.012	2.794	525	10.011	2.794	525	
27	6.150	3.500	Open Manhole	1800	10.013	2.650	450	10.012	2.683	525	108
28	6.150	3.570	Open Manhole	2100	10.014	2.580	100	10.013	2.580	450	
29	6.150	1.200	Open Manhole	1350	10.015	4.950	225	10.014	4.950	100	
30	5.250	0.400	Open Manhole	0		OUTFALL		10.015	4.850	225	

No coordinates have been specified, layout information cannot be produced.

Online Controls for Storm

Pump Manhole: 28, DS/PN: 10.014, Volume (m³): 14.8

Invert Level (m) 2.580

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.200	1.8000	1.800	1.8000	3.400	1.8000	5.000	1.8000
0.400	1.8000	2.000	1.8000	3.600	1.8000	5.200	1.8000
0.600	1.8000	2.200	1.8000	3.800	1.8000	5.400	1.8000
0.800	1.8000	2.400	1.8000	4.000	1.8000	5.600	1.8000
1.000	1.8000	2.600	1.8000	4.200	1.8000	5.800	1.8000
1.200	1.8000	2.800	1.8000	4.400	1.8000	6.000	1.8000
1.400	1.8000	3.000	1.8000	4.600	1.8000		
1.600	1.8000	3.200	1.8000	4.800	1.8000		

Storage Structures for Storm

Tank or Pond Manhole: 27, DS/PN: 10.013

Invert Level (m) 2.650

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	535.0	3.500	2895.0

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 341850 165500 ST 41850 65500
C (1km)	-0.028
D1 (1km)	0.362
D2 (1km)	0.381
D3 (1km)	0.330
E (1km)	0.295
F (1km)	2.426
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
10.000	1	15 minute 1 year Winter I+0%	6.430	5.007	-0.223	0.000	0.15	0.104
11.000	2	15 minute 1 year Winter I+0%	6.430	5.000	-0.230	0.000	0.12	0.093
10.001	3	15 minute 1 year Winter I+0%	6.430	4.736	-0.310	0.000	0.20	0.356
10.002	4	15 minute 1 year Winter I+0%	6.430	4.695	-0.317	0.000	0.19	0.592
12.000	5	15 minute 1 year Winter I+0%	6.430	4.982	-0.248	0.000	0.07	0.068
12.001	6	15 minute 1 year Winter I+0%	6.430	4.922	-0.231	0.000	0.12	0.209
10.003	7	15 minute 1 year Winter I+0%	6.430	4.594	-0.369	0.000	0.07	0.361
13.000	8	15 minute 1 year Winter I+0%	6.430	4.985	-0.245	0.000	0.06	0.072
13.001	9	15 minute 1 year Winter I+0%	6.430	4.941	-0.213	0.000	0.18	0.296
13.002	10	15 minute 1 year Winter I+0%	6.430	4.719	-0.252	0.000	0.06	0.146
10.004	11	15 minute 1 year Winter I+0%	6.430	3.443	-0.282	0.000	0.33	0.714
10.005	12	15 minute 1 year Winter I+0%	6.430	3.395	-0.274	0.000	0.36	2.584
10.006	13	15 minute 1 year Winter I+0%	6.430	3.352	-0.271	0.000	0.36	2.198

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

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
10.000	1	4.660	10.0	OK
11.000	2	3.798	8.1	OK
10.001	3	9.954	20.6	OK
10.002	4	12.140	24.1	OK
12.000	5	2.014	4.2	OK
12.001	6	5.006	9.7	OK
10.003	7	20.828	39.6	OK
13.000	8	1.899	4.0	OK
13.001	9	6.501	12.0	OK
13.002	10	8.400	15.3	OK
10.004	11	32.220	58.9	OK
10.005	12	34.602	59.7	OK
10.006	13	37.043	61.1	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
14.000	14	15 minute 1 year Winter I+0%	6.430	4.964	-0.266	0.000	0.03	0.041
10.007	15	15 minute 1 year Winter I+0%	6.430	3.309	-0.265	0.000	0.34	2.389
15.000	16	15 minute 1 year Winter I+0%	6.430	4.997	-0.233	0.000	0.11	0.110
15.001	17	15 minute 1 year Winter I+0%	6.430	4.834	-0.259	0.000	0.04	0.122
10.008	18	15 minute 1 year Winter I+0%	6.430	3.261	-0.252	0.000	0.42	3.080
10.009	19	15 minute 1 year Winter I+0%	6.430	3.215	-0.252	0.000	0.44	2.477
10.010	20	15 minute 1 year Winter I+0%	6.430	3.166	-0.258	0.000	0.40	2.298
16.000	21	15 minute 1 year Winter I+0%	6.430	5.001	-0.229	0.000	0.12	0.094
16.001	22	15 minute 1 year Winter I+0%	6.430	4.871	-0.207	0.000	0.21	0.301
16.002	23	15 minute 1 year Winter I+0%	6.430	4.763	-0.193	0.000	0.27	0.359
16.003	24	15 minute 1 year Winter I+0%	6.430	4.613	-0.254	0.000	0.06	0.136
10.011	25	15 minute 1 year Winter I+0%	6.430	3.107	-0.258	0.000	0.49	2.885
10.012	26	2880 minute 1 year Winter I+0%	6.430	3.059	-0.260	0.000	0.04	2.404
10.013	27	2880 minute 1 year Winter I+0%	6.150	3.059	-0.041	0.000	0.01	262.788
10.014	28	2880 minute 1 year Winter I+0%	6.150	3.059	0.379	0.000	0.95	3.948
10.015	29	10080 minute 1 year Winter I+0%	6.150	4.981	-0.194	0.000	0.05	0.038

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
14.000	14	3.223	6.9	OK
10.007	15	40.076	62.0	OK
15.000	16	3.452	7.2	OK
15.001	17	5.869	11.6	OK
10.008	18	48.031	69.4	OK
10.009	19	50.038	70.3	OK
10.010	20	52.644	71.4	OK
16.000	21	3.855	8.1	OK
16.001	22	6.962	13.5	OK
16.002	23	9.206	17.3	OK
16.003	24	9.206	17.3	OK
10.011	25	63.726	81.4	OK
10.012	26	492.635	7.1	OK
10.013	27	490.729	2.0	OK
10.014	28	490.664	1.8	SURCHARGED
10.015	29	743.799	1.8	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 341850 165500 ST 41850 65500
C (1km)	-0.028
D1 (1km)	0.362
D2 (1km)	0.381
D3 (1km)	0.330
E (1km)	0.295
F (1km)	2.426
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
10.000	1	15 minute 30 year Winter I+0%	6.430	5.074	-0.156	0.000	0.45	0.199
11.000	2	15 minute 30 year Winter I+0%	6.430	5.059	-0.171	0.000	0.37	0.178
10.001	3	15 minute 30 year Winter I+0%	6.430	4.857	-0.189	0.000	0.62	1.121
10.002	4	15 minute 30 year Winter I+0%	6.430	4.814	-0.198	0.000	0.59	1.460
12.000	5	15 minute 30 year Winter I+0%	6.430	5.033	-0.197	0.000	0.21	0.140
12.001	6	15 minute 30 year Winter I+0%	6.430	4.988	-0.165	0.000	0.41	0.517
10.003	7	15 minute 30 year Winter I+0%	6.430	4.665	-0.298	0.000	0.25	0.919
13.000	8	15 minute 30 year Winter I+0%	6.430	5.055	-0.175	0.000	0.20	0.171
13.001	9	15 minute 30 year Winter I+0%	6.430	5.035	-0.119	0.000	0.64	0.850
13.002	10	15 minute 30 year Winter I+0%	6.430	4.767	-0.204	0.000	0.22	0.311
10.004	11	15 minute 30 year Winter I+0%	6.430	3.980	0.255	0.000	1.08	4.364
10.005	12	15 minute 30 year Winter I+0%	6.430	3.937	0.269	0.000	1.18	7.766
10.006	13	15 minute 30 year Winter I+0%	6.430	3.896	0.273	0.000	1.15	6.542

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
10.000	1	14.424	30.0	OK
11.000	2	11.753	24.6	OK
10.001	3	30.802	63.4	OK
10.002	4	37.570	75.2	OK
12.000	5	6.232	13.1	OK
12.001	6	15.491	33.6	OK
10.003	7	64.457	131.3	OK
13.000	8	5.876	12.4	OK
13.001	9	20.121	43.0	OK
13.002	10	25.997	55.0	OK
10.004	11	99.689	193.3	SURCHARGED
10.005	12	106.930	194.3	SURCHARGED
10.006	13	114.385	196.2	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
14.000	14	15 minute 30 year Winter I+0%	6.430	4.991	-0.239	0.000	0.09	0.080
10.007	15	15 minute 30 year Winter I+0%	6.430	3.848	0.274	0.000	1.10	7.389
15.000	16	15 minute 30 year Winter I+0%	6.430	5.053	-0.177	0.000	0.34	0.209
15.001	17	15 minute 30 year Winter I+0%	6.430	4.871	-0.222	0.000	0.15	0.248
10.008	18	15 minute 30 year Winter I+0%	6.430	3.784	0.270	0.000	1.35	8.553
10.009	19	15 minute 30 year Winter I+0%	6.430	3.711	0.243	0.000	1.42	6.553
10.010	20	15 minute 30 year Winter I+0%	6.430	3.640	0.216	0.000	1.27	6.204
16.000	21	15 minute 30 year Winter I+0%	6.430	5.060	-0.170	0.000	0.38	0.179
16.001	22	15 minute 30 year Winter I+0%	6.430	4.966	-0.112	0.000	0.70	1.115
16.002	23	15 minute 30 year Winter I+0%	6.430	4.884	-0.072	0.000	0.92	1.393
16.003	24	15 minute 30 year Winter I+0%	6.430	4.655	-0.212	0.000	0.19	0.278
10.011	25	15 minute 30 year Winter I+0%	6.430	3.545	0.179	0.000	1.61	7.860
10.012	26	2160 minute 30 year Winter I+0%	6.430	3.500	0.181	0.000	0.08	6.460
10.013	27	2160 minute 30 year Winter I+0%	6.150	3.500	0.400	0.000	0.02	630.540
10.014	28	2160 minute 30 year Winter I+0%	6.150	3.506	0.826	0.000	0.95	5.628
10.015	29	4320 minute 30 year Winter I+0%	6.150	4.981	-0.194	0.000	0.05	0.038

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
14.000	14	9.974	21.4	OK
10.007	15	123.654	199.1	SURCHARGED
15.000	16	10.684	22.4	OK
15.001	17	18.163	38.7	OK
10.008	18	147.954	224.2	SURCHARGED
10.009	19	153.625	226.4	SURCHARGED
10.010	20	160.970	227.6	SURCHARGED
16.000	21	11.931	24.9	OK
16.001	22	21.546	45.1	OK
16.002	23	28.490	57.9	OK
16.003	24	28.490	57.7	OK
10.011	25	194.320	269.5	SURCHARGED
10.012	26	823.986	15.0	SURCHARGED
10.013	27	440.574	3.2	SURCHARGED
10.014	28	435.494	1.8	SURCHARGED
10.015	29	866.891	1.8	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 341850 165500 ST 41850 65500
C (1km)	-0.028
D1 (1km)	0.362
D2 (1km)	0.381
D3 (1km)	0.330
E (1km)	0.295
F (1km)	2.426
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
10.000	1	15 minute 100 year Winter I+0%	6.430	5.116	-0.114	0.000	0.67	0.259
11.000	2	15 minute 100 year Winter I+0%	6.430	5.094	-0.136	0.000	0.56	0.228
10.001	3	15 minute 100 year Winter I+0%	6.430	5.056	0.010	0.000	0.90	4.940
10.002	4	15 minute 100 year Winter I+0%	6.430	5.044	0.032	0.000	0.86	3.043
12.000	5	15 minute 100 year Winter I+0%	6.430	5.064	-0.166	0.000	0.32	0.185
12.001	6	15 minute 100 year Winter I+0%	6.430	5.032	-0.121	0.000	0.61	0.792
10.003	7	15 minute 100 year Winter I+0%	6.430	5.009	0.046	0.000	0.35	5.670
13.000	8	15 minute 100 year Winter I+0%	6.430	5.122	-0.108	0.000	0.31	0.268
13.001	9	15 minute 100 year Winter I+0%	6.430	5.098	-0.056	0.000	0.96	1.247
13.002	10	15 minute 100 year Winter I+0%	6.430	4.841	-0.130	0.000	0.33	0.969
10.004	11	15 minute 100 year Winter I+0%	6.430	4.809	1.084	0.000	1.38	10.383
10.005	12	15 minute 100 year Winter I+0%	6.430	4.752	1.084	0.000	1.51	9.839
10.006	13	15 minute 100 year Winter I+0%	6.430	4.682	1.059	0.000	1.50	8.543

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
10.000	1	21.646	45.0	OK
11.000	2	17.638	36.8	OK
10.001	3	46.238	92.3	SURCHARGED
10.002	4	56.406	109.2	SURCHARGED
12.000	5	9.353	19.7	OK
12.001	6	23.251	50.5	OK
10.003	7	96.758	188.4	SURCHARGED
13.000	8	8.818	18.8	OK
13.001	9	30.193	64.3	OK
13.002	10	39.011	82.6	OK
10.004	11	149.518	246.6	SURCHARGED
10.005	12	160.054	248.3	SURCHARGED
10.006	13	170.653	256.7	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
14.000	14	15 minute 100 year Winter I+0%	6.430	5.003	-0.227	0.000	0.14	0.098
10.007	15	15 minute 100 year Winter I+0%	6.430	4.608	1.034	0.000	1.47	10.259
15.000	16	15 minute 100 year Winter I+0%	6.430	5.085	-0.145	0.000	0.51	0.266
15.001	17	15 minute 100 year Winter I+0%	6.430	4.891	-0.203	0.000	0.22	0.313
10.008	18	15 minute 100 year Winter I+0%	6.430	4.498	0.984	0.000	1.88	11.047
10.009	19	15 minute 100 year Winter I+0%	6.430	4.343	0.876	0.000	1.98	8.163
10.010	20	15 minute 100 year Winter I+0%	6.430	4.172	0.748	0.000	1.82	7.556
16.000	21	15 minute 100 year Winter I+0%	6.430	5.182	-0.048	0.000	0.55	0.354
16.001	22	15 minute 100 year Winter I+0%	6.430	5.126	0.048	0.000	0.96	2.650
16.002	23	15 minute 100 year Winter I+0%	6.430	5.008	0.052	0.000	1.29	2.305
16.003	24	15 minute 100 year Winter I+0%	6.430	4.672	-0.195	0.000	0.26	0.334
10.011	25	15 minute 100 year Winter I+0%	6.430	3.974	0.608	0.000	2.38	9.180
10.012	26	4320 minute 100 year Winter I+0%	6.430	3.725	0.407	0.000	0.06	7.034
10.013	27	4320 minute 100 year Winter I+0%	6.150	3.725	0.625	0.000	0.02	855.921
10.014	28	2880 minute 100 year Winter I+0%	6.150	3.753	1.073	0.000	0.95	6.495
10.015	29	4320 minute 100 year Winter I+0%	6.150	4.981	-0.194	0.000	0.05	0.038

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
14.000	14	14.967	32.1	OK
10.007	15	183.619	265.3	SURCHARGED
15.000	16	16.033	33.6	OK
15.001	17	27.255	58.2	OK
10.008	18	218.890	312.3	SURCHARGED
10.009	19	226.503	315.3	SURCHARGED
10.010	20	236.776	326.0	SURCHARGED
16.000	21	17.908	36.3	OK
16.001	22	32.340	62.2	SURCHARGED
16.002	23	42.759	80.7	SURCHARGED
16.003	24	42.759	81.2	OK
10.011	25	285.859	398.2	SURCHARGED
10.012	26	1228.561	12.0	SURCHARGED
10.013	27	884.280	3.1	SURCHARGED
10.014	28	588.092	1.8	SURCHARGED
10.015	29	878.906	1.8	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 341850 165500 ST 41850 65500
C (1km)	-0.028
D1 (1km)	0.362
D2 (1km)	0.381
D3 (1km)	0.330
E (1km)	0.295
F (1km)	2.426
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	45

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
10.000	1	15 minute 100 year Winter I+45%	6.430	6.304	1.074	0.000	0.90	1.959
11.000	2	15 minute 100 year Winter I+45%	6.430	6.298	1.068	0.000	0.75	1.951
10.001	3	15 minute 100 year Winter I+45%	6.430	6.211	1.165	0.000	0.93	9.550
10.002	4	15 minute 100 year Winter I+45%	6.430	6.181	1.168	0.000	0.88	6.014
12.000	5	15 minute 100 year Winter I+45%	6.430	6.272	1.042	0.000	0.41	1.914
12.001	6	15 minute 100 year Winter I+45%	6.430	6.255	1.102	0.000	0.78	3.212
10.003	7	15 minute 100 year Winter I+45%	6.430	6.140	1.177	0.000	0.41	8.937
13.000	8	15 minute 100 year Winter I+45%	6.430	6.180	0.950	0.000	0.40	1.783
13.001	9	15 minute 100 year Winter I+45%	6.430	6.164	1.010	0.000	1.29	3.492
13.002	10	15 minute 100 year Winter I+45%	6.430	6.035	1.064	0.000	0.38	4.941
10.004	11	15 minute 100 year Winter I+45%	6.430	5.834	2.109	0.000	1.46	13.115
10.005	12	15 minute 100 year Winter I+45%	6.430	5.717	2.049	0.000	1.66	12.296
10.006	13	15 minute 100 year Winter I+45%	6.430	5.591	1.968	0.000	1.68	10.857

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
10.000	1	31.344	59.8	FLOOD RISK
11.000	2	25.537	49.1	SURCHARGED
10.001	3	66.934	94.8	SURCHARGED
10.002	4	81.642	112.6	SURCHARGED
12.000	5	13.530	25.5	SURCHARGED
12.001	6	33.666	64.2	SURCHARGED
10.003	7	140.104	220.1	SURCHARGED
13.000	8	12.798	24.9	SURCHARGED
13.001	9	43.820	86.3	SURCHARGED
13.002	10	56.605	94.9	SURCHARGED
10.004	11	215.456	261.5	SURCHARGED
10.005	12	226.355	272.5	SURCHARGED
10.006	13	238.305	288.5	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
14.000	14	15 minute 100 year Winter I+45%	6.430	5.482	0.252	0.000	0.20	0.783
10.007	15	15 minute 100 year Winter I+45%	6.430	5.447	1.873	0.000	1.72	12.984
15.000	16	15 minute 100 year Winter I+45%	6.430	5.454	0.224	0.000	0.74	0.918
15.001	17	15 minute 100 year Winter I+45%	6.430	5.387	0.294	0.000	0.32	3.060
10.008	18	15 minute 100 year Winter I+45%	6.430	5.274	1.761	0.000	2.22	13.452
10.009	19	15 minute 100 year Winter I+45%	6.430	5.050	1.582	0.000	2.39	9.961
10.010	20	15 minute 100 year Winter I+45%	6.430	4.814	1.390	0.000	2.21	9.191
16.000	21	15 minute 100 year Winter I+45%	6.430	5.584	0.354	0.000	0.80	0.929
16.001	22	15 minute 100 year Winter I+45%	6.430	5.483	0.405	0.000	1.45	3.486
16.002	23	15 minute 100 year Winter I+45%	6.430	5.209	0.253	0.000	1.95	2.761
16.003	24	15 minute 100 year Winter I+45%	6.430	4.714	-0.153	0.000	0.40	0.625
10.011	25	15 minute 100 year Winter I+45%	6.430	4.543	1.177	0.000	3.04	10.925
10.012	26	7200 minute 100 year Winter I+45%	6.430	4.179	0.861	0.000	0.06	8.189
10.013	27	7200 minute 100 year Winter I+45%	6.150	4.179	1.079	0.000	0.01	1399.444
10.014	28	7200 minute 100 year Winter I+45%	6.150	4.173	1.493	0.000	0.95	7.971
10.015	29	15 minute 100 year Summer I+45%	6.150	4.981	-0.194	0.000	0.05	0.038

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
14.000	14	21.701	46.5	SURCHARGED
10.007	15	253.903	311.2	SURCHARGED
15.000	16	23.262	48.5	SURCHARGED
15.001	17	39.535	84.0	SURCHARGED
10.008	18	302.233	368.1	SURCHARGED
10.009	19	312.117	381.2	SURCHARGED
10.010	20	326.808	397.0	SURCHARGED
16.000	21	25.961	52.7	SURCHARGED
16.001	22	46.883	93.8	SURCHARGED
16.002	23	61.992	122.6	SURCHARGED
16.003	24	61.992	121.5	OK
10.011	25	398.101	509.7	SURCHARGED
10.012	26	1973.104	11.7	SURCHARGED
10.013	27	1491.373	2.3	SURCHARGED
10.014	28	1484.820	1.8	SURCHARGED
10.015	29	2.096	1.8	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	1999
Site Location	GB 341850 165500 ST 41850 65500
C (1km)	-0.028
D1 (1km)	0.362
D2 (1km)	0.381
D3 (1km)	0.330
E (1km)	0.295
F (1km)	2.426
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.900
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
20.000	17.100	0.071	240.8	0.066	4.00	0.0	0.600	o	300	Pipe/Conduit	
20.001	16.700	0.070	238.6	0.064	0.00	0.0	0.600	o	300	Pipe/Conduit	
20.002	13.400	0.088	152.3	0.049	0.00	0.0	0.600	o	300	Pipe/Conduit	
21.000	13.400	0.056	239.3	0.049	4.00	0.0	0.600	o	300	Pipe/Conduit	
21.001	41.400	0.173	239.3	0.175	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
20.000	50.00	4.28	4.930	0.066	0.0	0.0	0.0	1.01	71.3	8.9
20.001	50.00	4.56	4.859	0.130	0.0	0.0	0.0	1.01	71.6	17.6
20.002	50.00	4.73	4.789	0.179	0.0	0.0	0.0	1.27	89.9	24.2
21.000	50.00	4.22	4.930	0.049	0.0	0.0	0.0	1.01	71.5	6.6
21.001	50.00	4.81	4.799	0.224	0.0	0.0	0.0	1.17	128.9	30.3

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
20.003	22.600	0.045	500.0	0.091	0.00	0.0	0.600	o	525	Pipe/Conduit	
20.004	19.500	0.081	240.7	0.078	0.00	0.0	0.600	o	525	Pipe/Conduit	
20.005	10.300	0.050	206.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
20.006	7.300	-0.950	-7.7	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
20.007	8.400	0.050	168.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
20.003	50.00	5.19	4.476	0.494	0.0	0.0	0.0	0.99	215.4	66.9
20.004	50.00	5.42	4.431	0.572	0.0	0.0	0.0	1.44	311.6	77.5
20.005	50.00	5.57	4.000	0.572	0.0	0.0	0.0	1.09	77.2«	77.5
20.006	50.00	7.32	3.950	0.572	0.0	0.0	0.0	0.07	0.5«	77.5
20.007	50.00	7.46	4.900	0.572	0.0	0.0	0.0	1.01	40.0«	77.5

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
20.000	o	300	1	6.430	4.930	1.200	Open Manhole	1350
20.001	o	300	2	6.430	4.859	1.271	Open Manhole	1350
20.002	o	300	3	6.430	4.789	1.341	Open Manhole	1350
21.000	o	300	4	6.430	4.930	1.200	Open Manhole	1350
21.001	o	375	5	6.430	4.799	1.256	Open Manhole	1500
20.003	o	525	6	6.430	4.476	1.429	Open Manhole	1800
20.004	o	525	7	6.430	4.431	1.474	Open Manhole	1800
20.005	o	300	8	6.150	4.000	1.850	Open Manhole	1500
20.006	o	100	9	6.150	3.950	2.100	Open Manhole	2100
20.007	o	225	10	6.150	4.900	1.025	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
20.000	17.100	240.8	2	6.430	4.859	1.271	Open Manhole	1350
20.001	16.700	238.6	3	6.430	4.789	1.341	Open Manhole	1350
20.002	13.400	152.3	6	6.430	4.701	1.429	Open Manhole	1800
21.000	13.400	239.3	5	6.430	4.874	1.256	Open Manhole	1500
21.001	41.400	239.3	6	6.430	4.626	1.429	Open Manhole	1800
20.003	22.600	500.0	7	6.430	4.431	1.474	Open Manhole	1800
20.004	19.500	240.7	8	6.150	4.350	1.275	Open Manhole	1500
20.005	10.300	206.0	9	6.150	3.950	1.900	Open Manhole	2100
20.006	7.300	-7.7	10	6.150	4.900	1.150	Open Manhole	1350
20.007	8.400	168.0	11	5.450	4.850	0.375	Open Manhole	0

Online Controls for Storm

Pump Manhole: 9, DS/PN: 20.006, Volume (m³): 8.2

Invert Level (m) 3.950

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.200	1.5000	1.800	1.5000	3.400	1.5000	5.000	1.5000
0.400	1.5000	2.000	1.5000	3.600	1.5000	5.200	1.5000
0.600	1.5000	2.200	1.5000	3.800	1.5000	5.400	1.5000
0.800	1.5000	2.400	1.5000	4.000	1.5000	5.600	1.5000
1.000	1.5000	2.600	1.5000	4.200	1.5000	5.800	1.5000
1.200	1.5000	2.800	1.5000	4.400	1.5000	6.000	1.5000
1.400	1.5000	3.000	1.5000	4.600	1.5000		
1.600	1.5000	3.200	1.5000	4.800	1.5000		

Storage Structures for Storm

Tank or Pond Manhole: 8, DS/PN: 20.005

Invert Level (m) 4.000

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	98.0	2.150	990.0

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.362 F (1km) 2.426
FEH Rainfall Version 1999 D2 (1km) 0.381 Cv (Summer) 0.750
Site Location D3 (1km) 0.330 Cv (Winter) 0.840
C (1km) -0.028 E (1km) 0.295

Margin for Flood Risk Warning (mm) 130.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
20.000	1	15 minute 1 year Winter I+0%	6.430	5.009	-0.221	0.000	0.14	0.106
20.001	2	15 minute 1 year Winter I+0%	6.430	4.961	-0.198	0.000	0.25	0.314
20.002	3	15 minute 1 year Winter I+0%	6.430	4.896	-0.193	0.000	0.27	0.333
21.000	4	15 minute 1 year Winter I+0%	6.430	4.996	-0.234	0.000	0.11	0.087
21.001	5	15 minute 1 year Winter I+0%	6.430	4.916	-0.258	0.000	0.21	0.229
20.003	6	15 minute 1 year Winter I+0%	6.430	4.683	-0.318	0.000	0.33	0.569
20.004	7	15 minute 1 year Winter I+0%	6.430	4.610	-0.346	0.000	0.25	1.277
20.005	8	960 minute 1 year Winter I+0%	6.150	4.515	0.215	0.000	0.03	82.771
20.006	9	960 minute 1 year Winter I+0%	6.150	4.514	0.464	0.000	0.53	2.559
20.007	10	30 minute 1 year Winter I+0%	6.150	4.931	-0.194	0.000	0.05	0.038

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
20.000	1	3.798	8.7	OK
20.001	2	7.480	15.1	OK
20.002	3	10.299	20.3	OK
21.000	4	2.819	6.5	OK

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

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
21.001	5	12.888	24.3	OK
20.003	6	28.423	53.3	OK
20.004	7	32.910	61.0	OK
20.005	8	146.771	1.7	SURCHARGED
20.006	9	146.490	1.5	SURCHARGED
20.007	10	4.099	1.5	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.362 F (1km) 2.426
FEH Rainfall Version 1999 D2 (1km) 0.381 Cv (Summer) 0.750
Site Location D3 (1km) 0.330 Cv (Winter) 0.840
C (1km) -0.028 E (1km) 0.295

Margin for Flood Risk Warning (mm) 130.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
20.000	1	15 minute 30 year Winter I+0%	6.430	5.205	-0.025	0.000	0.43	0.386
20.001	2	15 minute 30 year Winter I+0%	6.430	5.164	0.005	0.000	0.83	1.460
20.002	3	15 minute 30 year Winter I+0%	6.430	5.093	0.004	0.000	0.91	1.430
21.000	4	15 minute 30 year Winter I+0%	6.430	5.099	-0.131	0.000	0.33	0.235
21.001	5	15 minute 30 year Winter I+0%	6.430	5.086	-0.088	0.000	0.74	1.016
20.003	6	15 minute 30 year Winter I+0%	6.430	5.001	0.000	0.000	1.05	5.478
20.004	7	1440 minute 30 year Winter I+0%	6.430	4.961	0.005	0.000	0.04	5.511
20.005	8	1440 minute 30 year Winter I+0%	6.150	4.960	0.660	0.000	0.03	220.934
20.006	9	1440 minute 30 year Winter I+0%	6.150	4.959	0.909	0.000	0.53	4.122
20.007	10	15 minute 30 year Winter I+0%	6.150	4.931	-0.194	0.000	0.05	0.038

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
20.000	1	11.753	26.4	OK
20.001	2	23.152	50.7	SURCHARGED
20.002	3	31.877	67.7	SURCHARGED
21.000	4	8.725	19.5	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
21.001	5	39.885	87.3	OK
20.003	6	87.728	171.9	SURCHARGED
20.004	7	348.185	9.8	SURCHARGED
20.005	8	247.549	1.7	SURCHARGED
20.006	9	244.724	1.5	SURCHARGED
20.007	10	2.053	1.5	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.362	F (1km)	2.426
FEH Rainfall Version	1999	D2 (1km)	0.381	Cv (Summer)	0.750
Site Location		D3 (1km)	0.330	Cv (Winter)	0.840
C (1km)	-0.028	E (1km)	0.295		

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
20.000	1	15 minute 100 year Winter I+0%	6.430	5.515	0.285	0.000	0.60	0.830
20.001	2	15 minute 100 year Winter I+0%	6.430	5.428	0.269	0.000	1.18	1.921
20.002	3	15 minute 100 year Winter I+0%	6.430	5.322	0.233	0.000	1.34	1.841
21.000	4	15 minute 100 year Winter I+0%	6.430	5.448	0.218	0.000	0.47	0.735
21.001	5	15 minute 100 year Summer I+0%	6.430	5.373	0.199	0.000	1.05	1.853
20.003	6	1440 minute 100 year Winter I+0%	6.430	5.167	0.166	0.000	0.07	6.942
20.004	7	1440 minute 100 year Winter I+0%	6.430	5.167	0.211	0.000	0.05	6.363
20.005	8	1440 minute 100 year Winter I+0%	6.150	5.167	0.867	0.000	0.03	308.595
20.006	9	1440 minute 100 year Winter I+0%	6.150	5.166	1.116	0.000	0.53	4.836
20.007	10	15 minute 100 year Winter I+0%	6.150	4.931	-0.194	0.000	0.05	0.038

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
20.000	1	17.633	36.7	SURCHARGED
20.001	2	34.738	72.3	SURCHARGED
20.002	3	47.831	99.5	SURCHARGED
21.000	4	13.093	27.7	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
21.001	5	53.441	123.9	SURCHARGED
20.003	6	383.802	10.9	SURCHARGED
20.004	7	440.280	12.2	SURCHARGED
20.005	8	251.864	1.8	SURCHARGED
20.006	9	248.036	1.5	SURCHARGED
20.007	10	2.116	1.5	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.362 F (1km) 2.426
FEH Rainfall Version 1999 D2 (1km) 0.381 Cv (Summer) 0.750
Site Location D3 (1km) 0.330 Cv (Winter) 0.840
C (1km) -0.028 E (1km) 0.295

Margin for Flood Risk Warning (mm) 130.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 100
Climate Change (%) 45

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
20.000	1	15 minute 100 year Winter I+45%	6.430	6.139	0.909	0.000	0.87	1.724
20.001	2	15 minute 100 year Winter I+45%	6.430	6.062	0.903	0.000	1.72	2.828
20.002	3	15 minute 100 year Winter I+45%	6.430	5.845	0.756	0.000	1.95	2.590
21.000	4	15 minute 100 year Winter I+45%	6.430	6.034	0.804	0.000	0.69	1.573
21.001	5	15 minute 100 year Winter I+45%	6.430	5.958	0.784	0.000	1.56	2.886
20.003	6	2160 minute 100 year Winter I+45%	6.430	5.534	0.533	0.000	0.07	7.905
20.004	7	2160 minute 100 year Winter I+45%	6.430	5.534	0.578	0.000	0.06	7.297
20.005	8	2160 minute 100 year Winter I+45%	6.150	5.533	1.233	0.000	0.03	511.138
20.006	9	2160 minute 100 year Winter I+45%	6.150	5.532	1.482	0.000	0.53	6.106
20.007	10	15 minute 100 year Winter I+45%	6.150	4.931	-0.194	0.000	0.05	0.038

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
20.000	1	25.574	53.0	SURCHARGED
20.001	2	50.190	104.9	SURCHARGED
20.002	3	68.695	144.3	SURCHARGED
21.000	4	18.985	40.7	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
21.001	5	86.509	183.6	SURCHARGED
20.003	6	609.471	12.0	SURCHARGED
20.004	7	701.134	13.7	SURCHARGED
20.005	8	381.518	1.7	SURCHARGED
20.006	9	376.589	1.5	SURCHARGED
20.007	10	2.167	1.5	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	1999
Site Location	GB 341850 165500 ST 41850 65500
C (1km)	-0.028
D1 (1km)	0.362
D2 (1km)	0.381
D3 (1km)	0.330
E (1km)	0.295
F (1km)	2.426
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.900
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	36.500	0.152	240.1	0.086	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	22.000	0.092	240.0	0.040	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	28.000	0.068	410.0	0.058	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.002	25.400	0.062	410.0	0.055	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.60	4.930	0.086	0.0	0.0	0.0	1.01	71.4	11.6
2.000	50.00	5.36	4.930	0.040	0.0	0.0	0.0	1.01	71.4	5.4
1.001	50.00	6.07	4.628	0.184	0.0	0.0	0.0	1.00	158.7	24.9
1.002	50.00	6.49	4.560	0.239	0.0	0.0	0.0	1.00	158.7	32.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
3.000	31.800	0.133	240.0	0.066	5.00	0.0	0.600	o	300	Pipe/Conduit	
3.001	10.100	0.150	67.4	0.022	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	36.600	0.073	500.0	0.076	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.004	28.500	0.057	500.0	0.059	0.00	0.0	0.600	o	525	Pipe/Conduit	
4.000	42.100	0.175	240.0	0.059	5.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	29.200	0.122	240.0	0.060	5.00	0.0	0.600	o	300	Pipe/Conduit	
4.001	28.200	0.069	410.0	0.056	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.002	27.100	0.070	388.2	0.056	0.00	0.0	0.600	o	450	Pipe/Conduit	
6.000	28.200	0.118	240.0	0.058	5.00	0.0	0.600	o	300	Pipe/Conduit	
6.001	13.800	0.197	70.2	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.003	23.300	0.057	410.0	0.049	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.004	37.200	0.091	410.0	0.077	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.005	18.600	0.045	410.0	0.039	0.00	0.0	0.600	o	450	Pipe/Conduit	
7.000	25.900	0.108	240.0	0.034	5.00	0.0	0.600	o	300	Pipe/Conduit	
7.001	13.900	0.058	240.0	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.002	20.500	0.085	240.0	0.069	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.000	50.00	5.52	4.930	0.066	0.0	0.0	0.0	1.01	71.4	8.9
3.001	50.00	5.61	4.798	0.088	0.0	0.0	0.0	1.92	135.5	11.9
1.003	50.00	7.11	4.423	0.403	0.0	0.0	0.0	0.99	215.4	54.6
1.004	50.00	7.58	4.350	0.462	0.0	0.0	0.0	0.99	215.4	62.6
4.000	50.00	5.69	4.930	0.059	0.0	0.0	0.0	1.01	71.4	8.0
5.000	50.00	5.48	4.930	0.060	0.0	0.0	0.0	1.01	71.4	8.1
4.001	50.00	6.17	4.605	0.175	0.0	0.0	0.0	1.00	158.7	23.7
4.002	50.00	6.61	4.536	0.231	0.0	0.0	0.0	1.03	163.1	31.3
6.000	50.00	5.47	4.930	0.058	0.0	0.0	0.0	1.01	71.4	7.9
6.001	50.00	5.59	4.813	0.087	0.0	0.0	0.0	1.88	132.8	11.8
4.003	50.00	6.99	4.466	0.367	0.0	0.0	0.0	1.00	158.7	49.7
4.004	50.00	7.62	4.409	0.444	0.0	0.0	0.0	1.00	158.7	60.1
4.005	50.00	7.93	4.318	0.483	0.0	0.0	0.0	1.00	158.7	65.4
7.000	50.00	5.43	4.930	0.034	0.0	0.0	0.0	1.01	71.4	4.6
7.001	50.00	5.66	4.822	0.063	0.0	0.0	0.0	1.01	71.4	8.5
7.002	50.00	5.99	4.764	0.132	0.0	0.0	0.0	1.01	71.4	17.9

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.005	12.100	0.050	242.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	11.700	-1.000	-11.7	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.007	11.700	0.100	117.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	50.00	8.13	4.000	1.077	0.0	0.0	0.0	1.01	71.1«	145.8
1.006	42.51	10.93	3.950	1.077	0.0	0.0	0.0	0.07	0.5«	145.8
1.007	42.10	11.10	4.950	1.077	0.0	0.0	0.0	1.21	48.0«	145.8

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	1	6.430	4.930	1.200	Open Manhole	1350
2.000	o	300	2	6.430	4.930	1.200	Open Manhole	1350
1.001	o	450	3	6.430	4.628	1.352	Open Manhole	1350
1.002	o	450	4	6.430	4.560	1.420	Open Manhole	1350
3.000	o	300	5	6.430	4.930	1.200	Open Manhole	1350
3.001	o	300	6	6.430	4.798	1.333	Open Manhole	1350
1.003	o	525	7	6.430	4.423	1.482	Open Manhole	1500
1.004	o	525	8	6.430	4.350	1.555	Open Manhole	1500
4.000	o	300	9	6.430	4.930	1.200	Open Manhole	1350
5.000	o	300	10	6.430	4.930	1.200	Open Manhole	1350
4.001	o	450	11	6.430	4.605	1.375	Open Manhole	1350
4.002	o	450	12	6.430	4.536	1.444	Open Manhole	1350
6.000	o	300	13	6.430	4.930	1.200	Open Manhole	1350
6.001	o	300	14	6.430	4.813	1.318	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	36.500	240.1	3	6.430	4.778	1.352	Open Manhole	1350
2.000	22.000	240.0	3	6.430	4.838	1.292	Open Manhole	1350
1.001	28.000	410.0	4	6.430	4.560	1.420	Open Manhole	1350
1.002	25.400	410.0	7	6.430	4.498	1.482	Open Manhole	1500
3.000	31.800	240.0	6	6.430	4.798	1.333	Open Manhole	1350
3.001	10.100	67.4	7	6.430	4.648	1.482	Open Manhole	1500
1.003	36.600	500.0	8	6.430	4.350	1.555	Open Manhole	1500
1.004	28.500	500.0	21	6.150	4.293	1.332	Open Manhole	1500
4.000	42.100	240.0	11	6.430	4.755	1.375	Open Manhole	1350
5.000	29.200	240.0	11	6.430	4.808	1.322	Open Manhole	1350
4.001	28.200	410.0	12	6.430	4.536	1.444	Open Manhole	1350
4.002	27.100	388.2	15	6.430	4.466	1.514	Open Manhole	1350
6.000	28.200	240.0	14	6.430	4.813	1.318	Open Manhole	1350
6.001	13.800	70.2	15	6.430	4.616	1.514	Open Manhole	1350

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
4.003	o	450	15	6.430	4.466	1.514	Open Manhole	1350
4.004	o	450	16	6.430	4.409	1.571	Open Manhole	1350
4.005	o	450	17	6.430	4.318	1.662	Open Manhole	1350
7.000	o	300	18	6.430	4.930	1.200	Open Manhole	1350
7.001	o	300	19	6.430	4.822	1.308	Open Manhole	1350
7.002	o	300	20	6.430	4.764	1.366	Open Manhole	1350
1.005	o	300	21	6.150	4.000	1.850	Open Manhole	1500
1.006	o	100	22	6.150	3.950	2.100	Open Manhole	2100
1.007	o	225	23	6.150	4.950	0.975	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
4.003	23.300	410.0	16	6.430	4.409	1.571	Open Manhole	1350
4.004	37.200	410.0	17	6.430	4.318	1.662	Open Manhole	1350
4.005	18.600	410.0	21	6.150	4.273	1.427	Open Manhole	1500
7.000	25.900	240.0	19	6.430	4.822	1.308	Open Manhole	1350
7.001	13.900	240.0	20	6.430	4.764	1.366	Open Manhole	1350
7.002	20.500	240.0	21	6.150	4.679	1.171	Open Manhole	1500
1.005	12.100	242.0	22	6.150	3.950	1.900	Open Manhole	2100
1.006	11.700	-11.7	23	6.150	4.950	1.100	Open Manhole	1350
1.007	11.700	117.0	24	5.150	4.850	0.075	Open Manhole	0

Online Controls for Storm

Pump Manhole: 22, DS/PN: 1.006, Volume (m³): 8.3

Invert Level (m) 3.950

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.200	1.8000	1.800	1.8000	3.400	1.8000	5.000	1.8000
0.400	1.8000	2.000	1.8000	3.600	1.8000	5.200	1.8000
0.600	1.8000	2.200	1.8000	3.800	1.8000	5.400	1.8000
0.800	1.8000	2.400	1.8000	4.000	1.8000	5.600	1.8000
1.000	1.8000	2.600	1.8000	4.200	1.8000	5.800	1.8000
1.200	1.8000	2.800	1.8000	4.400	1.8000	6.000	1.8000
1.400	1.8000	3.000	1.8000	4.600	1.8000		
1.600	1.8000	3.200	1.8000	4.800	1.8000		

Storage Structures for Storm

Tank or Pond Manhole: 21, DS/PN: 1.005

Invert Level (m) 4.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	450.0	2.150	1870.0

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.362 F (1km) 2.426
FEH Rainfall Version 1999 D2 (1km) 0.381 Cv (Summer) 0.750
Site Location D3 (1km) 0.330 Cv (Winter) 0.840
C (1km) -0.028 E (1km) 0.295

Margin for Flood Risk Warning (mm) 130.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
1.000	1	15 minute 1 year Winter I+0%	6.430	5.010	-0.220	0.000	0.16	0.108
2.000	2	15 minute 1 year Winter I+0%	6.430	4.986	-0.244	0.000	0.08	0.073
1.001	3	15 minute 1 year Winter I+0%	6.430	4.759	-0.319	0.000	0.16	0.190
1.002	4	15 minute 1 year Winter I+0%	6.430	4.695	-0.314	0.000	0.20	0.807
3.000	5	15 minute 1 year Winter I+0%	6.430	5.000	-0.230	0.000	0.12	0.094
3.001	6	15 minute 1 year Winter I+0%	6.430	4.863	-0.235	0.000	0.11	0.204
1.003	7	15 minute 1 year Winter I+0%	6.430	4.609	-0.339	0.000	0.23	0.705
1.004	8	15 minute 1 year Winter I+0%	6.430	4.532	-0.343	0.000	0.26	1.763
4.000	9	15 minute 1 year Winter I+0%	6.430	4.996	-0.234	0.000	0.11	0.087
5.000	10	15 minute 1 year Winter I+0%	6.430	4.997	-0.233	0.000	0.11	0.089
4.001	11	15 minute 1 year Winter I+0%	6.430	4.739	-0.315	0.000	0.15	0.197
4.002	12	15 minute 1 year Winter I+0%	6.430	4.689	-0.297	0.000	0.18	1.004
6.000	13	15 minute 1 year Winter I+0%	6.430	4.997	-0.233	0.000	0.11	0.088
6.001	14	15 minute 1 year Winter I+0%	6.430	4.874	-0.239	0.000	0.09	0.191
4.003	15	15 minute 1 year Winter I+0%	6.430	4.645	-0.271	0.000	0.28	1.268
4.004	16	15 minute 1 year Winter I+0%	6.430	4.589	-0.270	0.000	0.31	1.119
4.005	17	15 minute 1 year Winter I+0%	6.430	4.510	-0.259	0.000	0.38	1.831
7.000	18	15 minute 1 year Winter I+0%	6.430	4.980	-0.250	0.000	0.06	0.065
7.001	19	15 minute 1 year Winter I+0%	6.430	4.896	-0.226	0.000	0.12	0.233
7.002	20	15 minute 1 year Winter I+0%	6.430	4.861	-0.203	0.000	0.23	0.278

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

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	1	4.948	10.6	OK
2.000	2	2.301	4.9	OK
1.001	3	10.587	21.2	OK
1.002	4	13.751	26.1	OK
3.000	5	3.798	8.0	OK
3.001	6	5.063	10.3	OK
1.003	7	23.186	41.9	OK
1.004	8	26.577	46.7	OK
4.000	9	3.395	7.3	OK
5.000	10	3.452	7.3	OK
4.001	11	10.069	20.1	OK
4.002	12	13.291	24.5	OK
6.000	13	3.337	7.0	OK
6.001	14	5.006	10.1	OK
4.003	15	21.114	37.2	OK
4.004	16	25.537	42.9	OK
4.005	17	27.741	45.6	OK
7.000	18	1.956	4.1	OK
7.001	19	3.625	7.1	OK
7.002	20	7.595	14.2	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
1.005	21	2880 minute 1 year Winter I+0%	6.150	4.403	0.103	0.000	0.03	220.251
1.006	22	2880 minute 1 year Winter I+0%	6.150	4.401	0.351	0.000	0.80	2.306
1.007	23	60 minute 1 year Winter I+0%	6.150	4.980	-0.195	0.000	0.04	0.037

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.005	21	426.481	1.9	SURCHARGED
1.006	22	426.474	1.8	SURCHARGED
1.007	23	9.787	1.8	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.362 F (1km) 2.426
FEH Rainfall Version 1999 D2 (1km) 0.381 Cv (Summer) 0.750
Site Location D3 (1km) 0.330 Cv (Winter) 0.840
C (1km) -0.028 E (1km) 0.295

Margin for Flood Risk Warning (mm) 130.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
1.000	1	15 minute 30 year Winter I+0%	6.430	5.081	-0.149	0.000	0.49	0.208
2.000	2	15 minute 30 year Winter I+0%	6.430	5.030	-0.200	0.000	0.24	0.136
1.001	3	15 minute 30 year Winter I+0%	6.430	4.904	-0.174	0.000	0.50	0.871
1.002	4	15 minute 30 year Winter I+0%	6.430	4.858	-0.152	0.000	0.62	2.813
3.000	5	15 minute 30 year Winter I+0%	6.430	5.060	-0.170	0.000	0.38	0.179
3.001	6	15 minute 30 year Winter I+0%	6.430	4.920	-0.178	0.000	0.34	0.489
1.003	7	15 minute 30 year Winter I+0%	6.430	4.802	-0.146	0.000	0.73	3.018
1.004	8	2880 minute 30 year Winter I+0%	6.430	4.788	-0.087	0.000	0.03	6.608
4.000	9	15 minute 30 year Winter I+0%	6.430	5.073	-0.157	0.000	0.33	0.197
5.000	10	15 minute 30 year Winter I+0%	6.430	5.071	-0.159	0.000	0.35	0.194
4.001	11	15 minute 30 year Winter I+0%	6.430	5.054	0.000	0.000	0.43	3.858
4.002	12	15 minute 30 year Winter I+0%	6.430	4.986	0.000	0.000	0.50	4.523
6.000	13	15 minute 30 year Winter I+0%	6.430	5.052	-0.178	0.000	0.34	0.167
6.001	14	15 minute 30 year Winter I+0%	6.430	4.940	-0.172	0.000	0.30	0.527
4.003	15	15 minute 30 year Winter I+0%	6.430	4.916	0.000	0.000	0.84	4.945
4.004	16	15 minute 30 year Winter I+0%	6.430	4.858	-0.001	0.000	0.89	3.808
4.005	17	2880 minute 30 year Winter I+0%	6.430	4.788	0.019	0.000	0.04	6.017
7.000	18	15 minute 30 year Winter I+0%	6.430	5.033	-0.197	0.000	0.20	0.140
7.001	19	15 minute 30 year Winter I+0%	6.430	4.993	-0.129	0.000	0.41	0.854
7.002	20	15 minute 30 year Winter I+0%	6.430	4.972	-0.093	0.000	0.80	0.816

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	1	15.314	32.0	OK
2.000	2	7.123	15.0	OK
1.001	3	32.762	67.0	OK
1.002	4	42.555	82.1	OK
3.000	5	11.753	24.6	OK
3.001	6	15.670	33.0	OK
1.003	7	71.756	135.2	OK
1.004	8	344.040	4.8	OK
4.000	9	10.507	21.9	OK
5.000	10	10.685	22.4	OK
4.001	11	31.168	58.7	OK
4.002	12	41.155	69.2	OK
6.000	13	10.328	21.6	OK
6.001	14	15.492	32.7	OK
4.003	15	65.374	110.1	OK
4.004	16	79.080	124.7	OK
4.005	17	359.346	5.0	SURCHARGED
7.000	18	6.054	12.7	OK
7.001	19	11.217	24.0	OK
7.002	20	23.504	49.8	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
1.005	21	2880 minute 30 year Winter I+0%	6.150	4.788	0.488	0.000	0.03	516.073
1.006	22	2880 minute 30 year Winter I+0%	6.150	4.786	0.736	0.000	0.80	3.670
1.007	23	30 minute 30 year Summer I+0%	6.150	4.980	-0.195	0.000	0.04	0.037

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.005	21	576.586	2.0	SURCHARGED
1.006	22	574.238	1.8	SURCHARGED
1.007	23	4.935	1.8	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.362	F (1km)	2.426
FEH Rainfall Version	1999	D2 (1km)	0.381	Cv (Summer)	0.750
Site Location		D3 (1km)	0.330	Cv (Winter)	0.840
C (1km)	-0.028	E (1km)	0.295		

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
1.000	1	15 minute 100 year Winter I+0%	6.430	5.166	-0.064	0.000	0.71	0.331
2.000	2	15 minute 100 year Winter I+0%	6.430	5.117	-0.113	0.000	0.35	0.261
1.001	3	15 minute 100 year Summer I+0%	6.430	5.088	0.010	0.000	0.64	3.581
1.002	4	15 minute 100 year Winter I+0%	6.430	5.010	0.000	0.000	0.84	4.494
3.000	5	15 minute 100 year Winter I+0%	6.430	5.095	-0.135	0.000	0.57	0.229
3.001	6	15 minute 100 year Winter I+0%	6.430	4.988	-0.110	0.000	0.50	1.091
1.003	7	2880 minute 100 year Winter I+0%	6.430	4.975	0.027	0.000	0.03	5.073
1.004	8	2880 minute 100 year Winter I+0%	6.430	4.975	0.100	0.000	0.03	8.678
4.000	9	15 minute 100 year Winter I+0%	6.430	5.241	0.011	0.000	0.46	0.438
5.000	10	15 minute 100 year Winter I+0%	6.430	5.239	0.009	0.000	0.50	0.435
4.001	11	15 minute 100 year Winter I+0%	6.430	5.158	0.103	0.000	0.62	5.277
4.002	12	15 minute 100 year Winter I+0%	6.430	5.126	0.140	0.000	0.77	5.103
6.000	13	15 minute 100 year Winter I+0%	6.430	5.280	0.050	0.000	0.50	0.494
6.001	14	15 minute 100 year Winter I+0%	6.430	5.197	0.085	0.000	0.39	2.382
4.003	15	15 minute 100 year Winter I+0%	6.430	5.078	0.162	0.000	1.20	5.837
4.004	16	15 minute 100 year Winter I+0%	6.430	4.993	0.134	0.000	1.31	4.314
4.005	17	2880 minute 100 year Winter I+0%	6.430	4.975	0.206	0.000	0.05	6.634
7.000	18	15 minute 100 year Winter I+0%	6.430	5.191	-0.039	0.000	0.28	0.366
7.001	19	15 minute 100 year Winter I+0%	6.430	5.151	0.029	0.000	0.55	2.021
7.002	20	15 minute 100 year Winter I+0%	6.430	5.074	0.010	0.000	1.10	1.275

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	1	22.982	47.0	OK
2.000	2	10.691	22.3	OK
1.001	3	43.925	86.3	SURCHARGED
1.002	4	63.917	112.5	OK
3.000	5	17.636	36.9	OK
3.001	6	23.514	48.1	OK
1.003	7	374.874	5.4	SURCHARGED
1.004	8	425.742	5.9	SURCHARGED
4.000	9	15.768	30.8	SURCHARGED
5.000	10	16.036	32.2	SURCHARGED
4.001	11	46.735	84.1	SURCHARGED
4.002	12	61.698	106.3	SURCHARGED
6.000	13	15.498	32.1	SURCHARGED
6.001	14	23.247	42.3	SURCHARGED
4.003	15	97.939	157.7	SURCHARGED
4.004	16	118.187	183.2	SURCHARGED
4.005	17	443.358	6.0	SURCHARGED
7.000	18	9.084	18.1	OK
7.001	19	16.836	32.6	SURCHARGED
7.002	20	35.274	68.8	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
1.005	21	2880 minute 100 year Winter I+0%	6.150	4.975	0.675	0.000	0.04	689.021
1.006	22	2880 minute 100 year Winter I+0%	6.150	4.973	0.923	0.000	0.80	4.330
1.007	23	15 minute 100 year Winter I+0%	6.150	4.980	-0.195	0.000	0.04	0.037

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.005	21	585.804	2.1	SURCHARGED
1.006	22	582.580	1.8	SURCHARGED
1.007	23	2.280	1.8	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.362	F (1km)	2.426
FEH Rainfall Version	1999	D2 (1km)	0.381	Cv (Summer)	0.750
Site Location		D3 (1km)	0.330	Cv (Winter)	0.840
C (1km)	-0.028	E (1km)	0.295		

Margin for Flood Risk Warning (mm)	130.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	45

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
1.000	1	15 minute 100 year Winter I+45%	6.430	5.520	0.290	0.000	1.01	0.837
2.000	2	15 minute 100 year Winter I+45%	6.430	5.446	0.216	0.000	0.47	0.732
1.001	3	15 minute 100 year Winter I+45%	6.430	5.364	0.286	0.000	1.02	4.991
1.002	4	2880 minute 100 year Winter I+45%	6.430	5.351	0.341	0.000	0.04	5.364
3.000	5	15 minute 100 year Winter I+45%	6.430	5.396	0.166	0.000	0.77	0.660
3.001	6	2880 minute 100 year Winter I+45%	6.430	5.351	0.254	0.000	0.02	2.938
1.003	7	2880 minute 100 year Winter I+45%	6.430	5.351	0.403	0.000	0.04	6.058
1.004	8	2880 minute 100 year Winter I+45%	6.430	5.351	0.477	0.000	0.05	9.360
4.000	9	15 minute 100 year Winter I+45%	6.430	5.903	0.673	0.000	0.63	1.385
5.000	10	15 minute 100 year Winter I+45%	6.430	5.900	0.670	0.000	0.66	1.381
4.001	11	15 minute 100 year Winter I+45%	6.430	5.819	0.764	0.000	0.90	6.580
4.002	12	15 minute 100 year Winter I+45%	6.430	5.760	0.774	0.000	1.14	6.015
6.000	13	15 minute 100 year Winter I+45%	6.430	5.888	0.658	0.000	0.64	1.364
6.001	14	15 minute 100 year Winter I+45%	6.430	5.807	0.694	0.000	0.54	3.314
4.003	15	15 minute 100 year Winter I+45%	6.430	5.663	0.747	0.000	1.89	6.682
4.004	16	15 minute 100 year Winter I+45%	6.430	5.449	0.590	0.000	2.08	4.972
4.005	17	2880 minute 100 year Winter I+45%	6.430	5.352	0.583	0.000	0.08	7.173
7.000	18	15 minute 100 year Winter I+45%	6.430	5.407	0.177	0.000	0.44	0.676
7.001	19	2880 minute 100 year Winter I+45%	6.430	5.351	0.229	0.000	0.02	2.486
7.002	20	2880 minute 100 year Winter I+45%	6.430	5.351	0.287	0.000	0.04	1.720

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	1	33.323	66.8	SURCHARGED
2.000	2	15.503	29.8	SURCHARGED
1.001	3	71.265	137.4	SURCHARGED
1.002	4	314.688	4.7	SURCHARGED
3.000	5	25.575	50.5	SURCHARGED
3.001	6	116.969	1.7	SURCHARGED
1.003	7	528.930	8.0	SURCHARGED
1.004	8	599.886	9.2	SURCHARGED
4.000	9	22.856	42.1	SURCHARGED
5.000	10	23.245	42.9	SURCHARGED
4.001	11	67.713	121.7	SURCHARGED
4.002	12	88.864	158.2	SURCHARGED
6.000	13	22.466	41.4	SURCHARGED
6.001	14	33.701	59.8	SURCHARGED
4.003	15	140.227	249.3	SURCHARGED
4.004	16	168.252	291.6	SURCHARGED
4.005	17	625.358	9.6	SURCHARGED
7.000	18	13.173	27.9	SURCHARGED
7.001	19	83.533	1.2	SURCHARGED
7.002	20	175.690	2.6	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)
1.005	21	2880 minute 100 year Winter I+45%	6.150	5.351	1.051	0.000	0.03	1103.615
1.006	22	2880 minute 100 year Winter I+45%	6.150	5.350	1.300	0.000	0.80	5.635
1.007	23	15 minute 100 year Winter I+45%	6.150	4.980	-0.195	0.000	0.04	0.037

PN	US/MH Name	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.005	21	598.614	1.9	SURCHARGED
1.006	22	593.880	1.8	SURCHARGED
1.007	23	2.360	1.8	OK

APPENDIX D

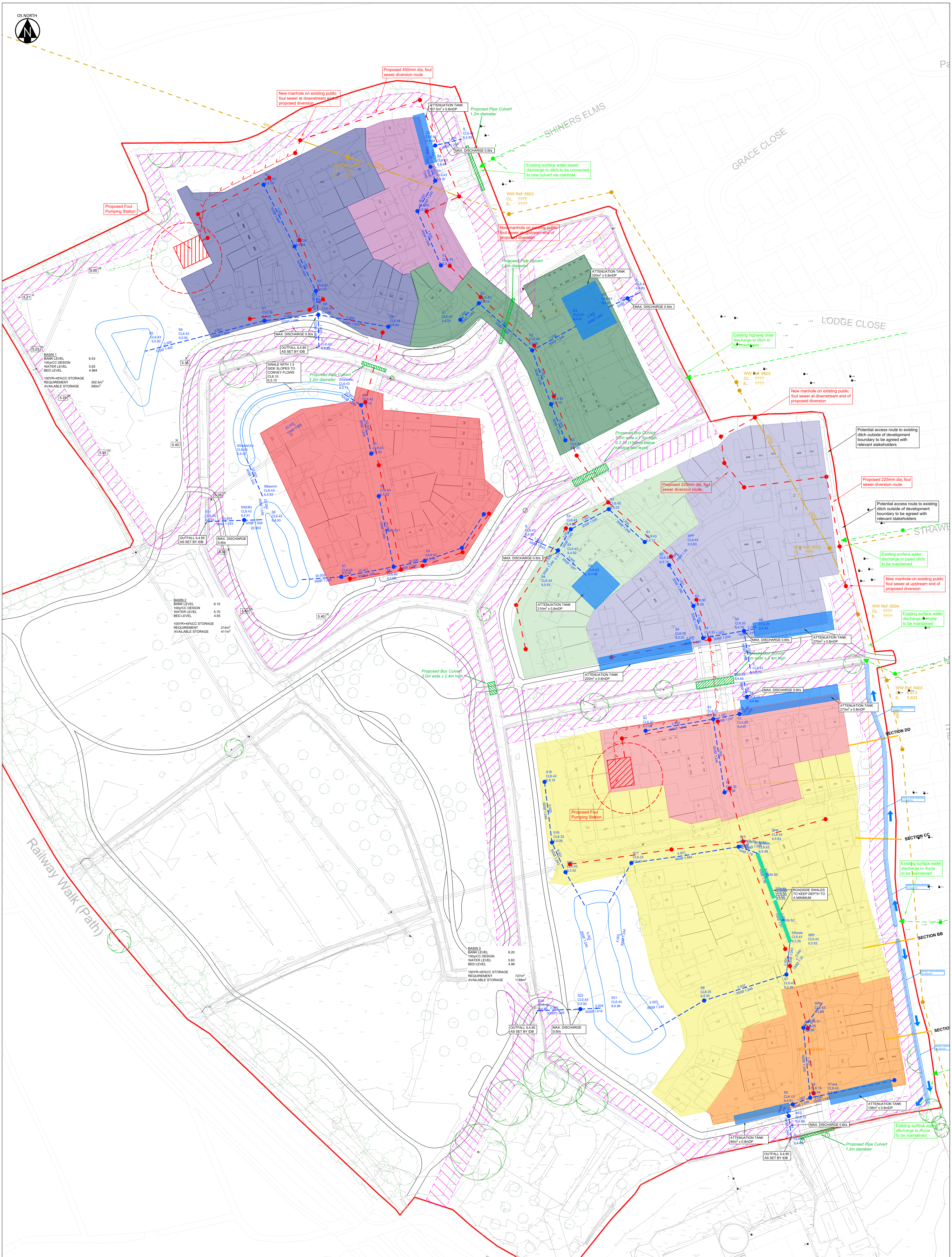
PROPOSED DRAINAGE STRATEGIES (DRAWINGS)

Drawing 23257-HYD-XX-XX-SK-D-2001-P02 Surface Water Drainage Strategy – Gravity Network

Drawing 23257-HYD-XX-XX-DR-D-2006-P03 Propose Drainage Strategy (Pumped Option)

Drawing 23257 HYD XX XX DR D 2002-P02 Existing Rhyne System & Related Works

Drawing 23257 HYD XX XX DR D 2004-P03 Post Development Surface Water Exceedance Flow Routes



Key

- Existing public foul water sewer
- Existing public surface water sewer
- Proposed surface water sewer
- Proposed foul water sewer
- Proposed foul rising main
- Proposed rhyne crossing culvert
- Proposed attenuation basin
- Proposed cellular tank
- Proposed foul pumping station with 15m standoff zone
- Existing public foul water sewer to be abandoned and diverted
- Existing ground levels to be retained
- Proposed rhyne easement strips

REVISIONS

Rev	Date	Description	By	Ckd	App
P02	02/09/24	Pipe details shown, minor updates	OD/NP	NP	JC
P01	29/08/24	DRAFT	OD	XX	XX

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CLIENT
PERSIMMON HOMES SEVERN VALLEY

PROJECT
LAND AT RECTORY FARM (NORTH)
YATTON, NORTH SOMERSET

TITLE
SURFACE WATER DRAINAGE STRATEGY - GRAVITY NETWORK

HYDROCK PROJECT NO. 23257-IOCB

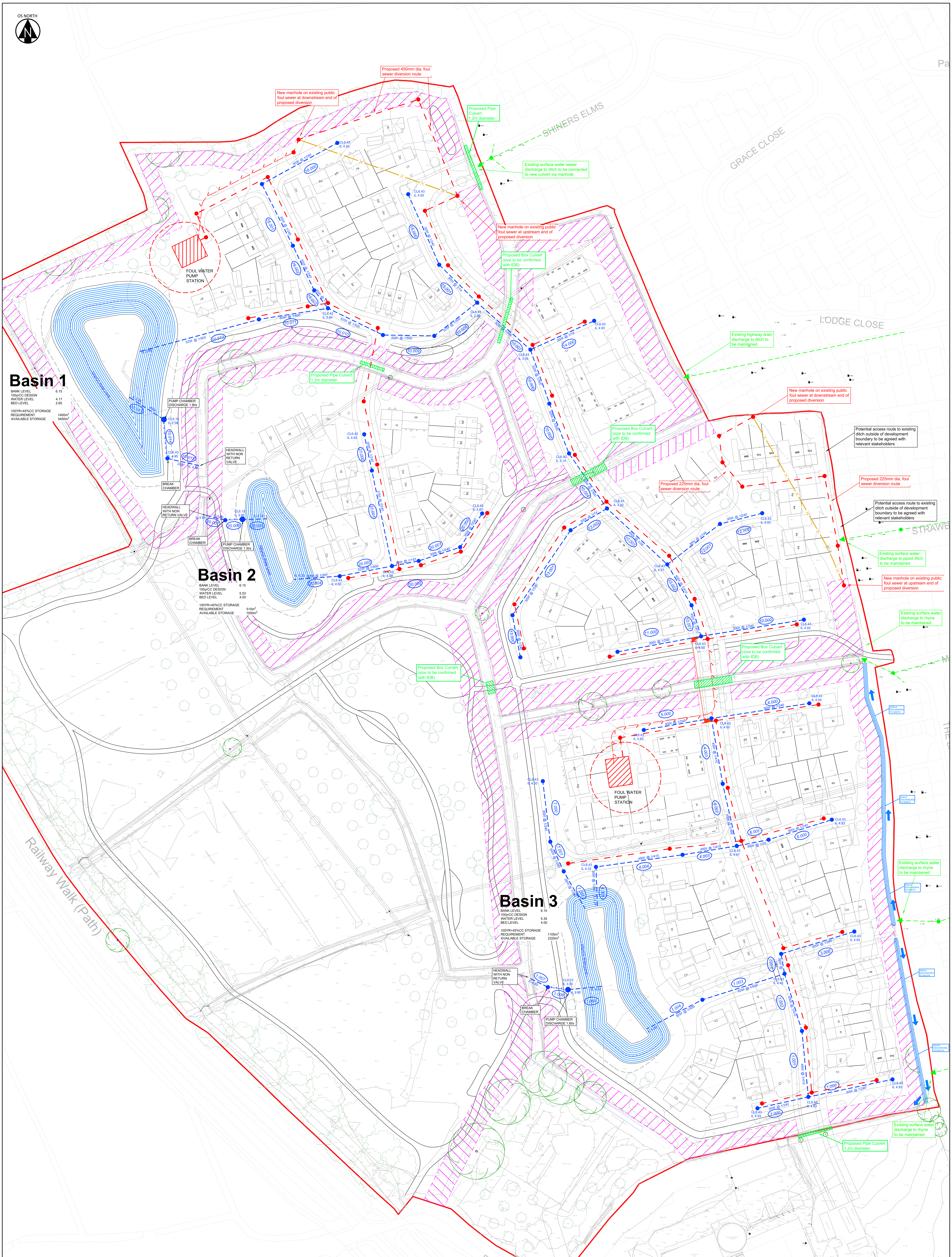
SCALE @ A0 1 : 500

STATUS DESCRIPTION FOR APPROVAL

STATUS S2

DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 23257-HYD-XX-XX-SK-D-2001

REVISION P02



Key

- Existing public foul water sewer
- Existing public surface water sewer
- Proposed surface water sewer
- Proposed foul water sewer
- Proposed foul rising main
- Proposed rhyne crossing culvert
- Proposed attenuation basin
- Proposed rhyne easement strips
- Proposed foul pumping station with 15m standoff zone
- Existing public foul water sewer to be abandoned and diverted
- Proposed surface water rising main

NOTES:

- Drainage based on maximum ground level of 6.43m as informed by flood risk modelling, and a minimum outfall level of 4.85m as advised by the IDB. Accordingly, surface water pumping will be needed.
- Drainage design based on an unsurcharged outfall condition, as the area is understood to be defended against tidal flood risk. Note that the outfall level is set above the rhyne penning level at 4.85m, i.e. 1m above the rhyne bed level.
- Minimum pump rate set at 1.5l/s to achieve a self cleansing velocity.
- Basin construction to incorporate mitigations against groundwater ingress.
- Drainage and levels are indicative only and is subject to detail design.
- Drainage subject to discussion with the LLFA and Internal Drainage Board.

REVISIONS

Rev	Date	Description	By	Ckd	App
P03	23/08/2024	Pump rates adjusted, basin design updated, notes updated	NP	OD	OD
P02	22/08/2024	Minor updates	NP	OD	OD
P01	21/08/2024	Issued for comment	NP	OD	OD

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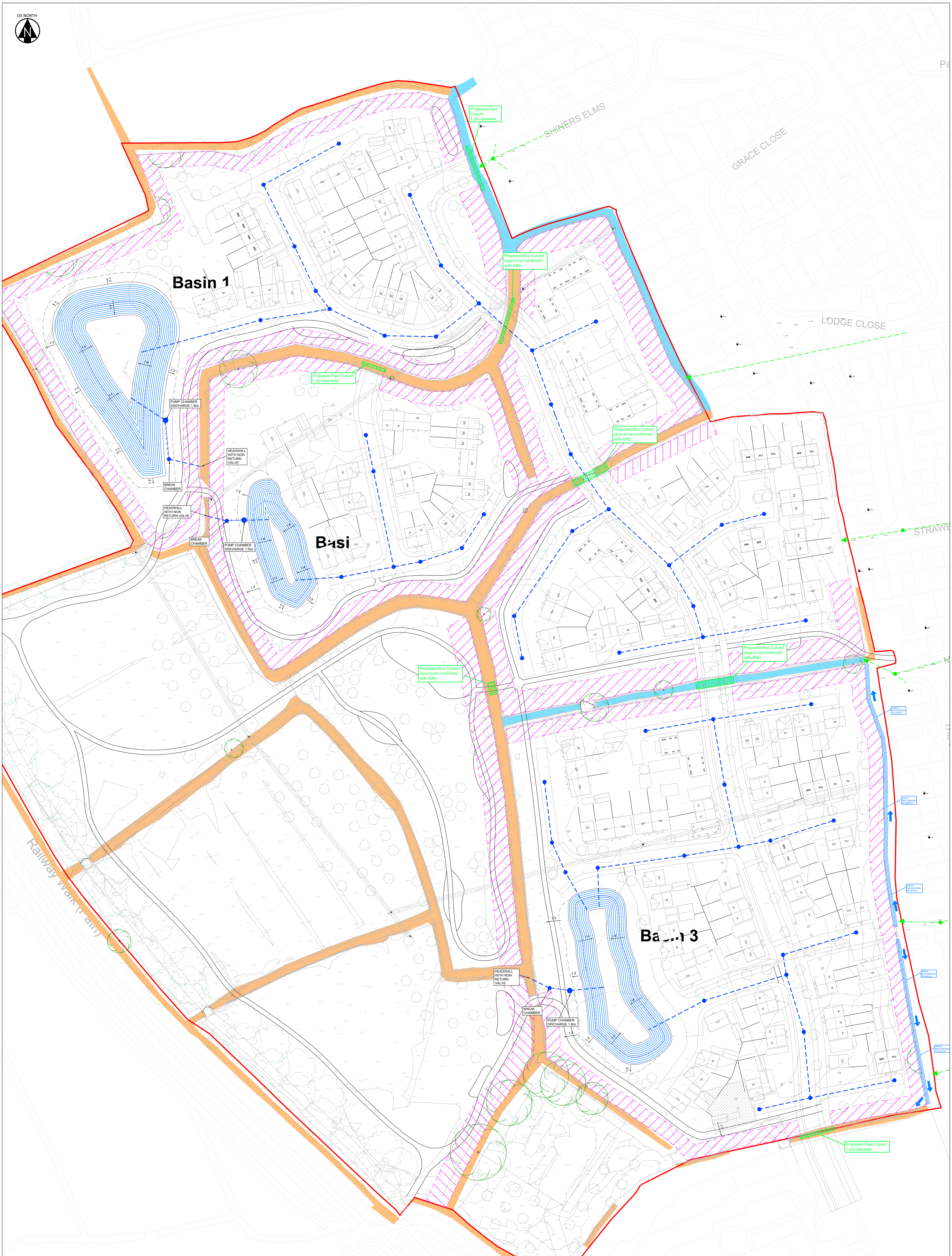
e: bristol@hydrock.com

CLIENT
PERSIMMON HOMES SEVERN VALLEY

PROJECT
LAND AT RECTORY FARM (NORTH)
YATTON, NORTH SOMERSET

TITLE
PROPOSED DRAINAGE STRATEGY
(PUMPED OPTION)

HYDROCK PROJECT NO. 23257-IOCB
SCALE @ A0 1 : 500
STATUS DESCRIPTION FOR INFORMATION
STATUS S2
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 23257-HYD-XX-XX-DR-D-2006
REVISION P03



Key

- Existing piped ditch/rhyne
- Existing public surface water sewer
- Proposed surface water sewer
- Proposed rhyne crossing culvert
- Proposed attenuation basin
- Proposed rhyne easement strips
- IDB Viewed Rhyne
- Ordinary Watercourse

REVISIONS

Rev	Date	Description	By	Ckd	App
P02	23/08/2024	Updated to show pumped drainage option	NP	JC	JC
P01	16/03/23	First Issue.	RJH		

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CLIENT
PERSIMMON HOMES SEVERN VALLEY

PROJECT
LAND AT RECTORY FARM (NORTH)
YATTON, NORTH SOMERSET

TITLE
EXISTING RHYNE SYSTEM AND RELATED WORKS

HYDROCK PROJECT NO. 23257-IOCB

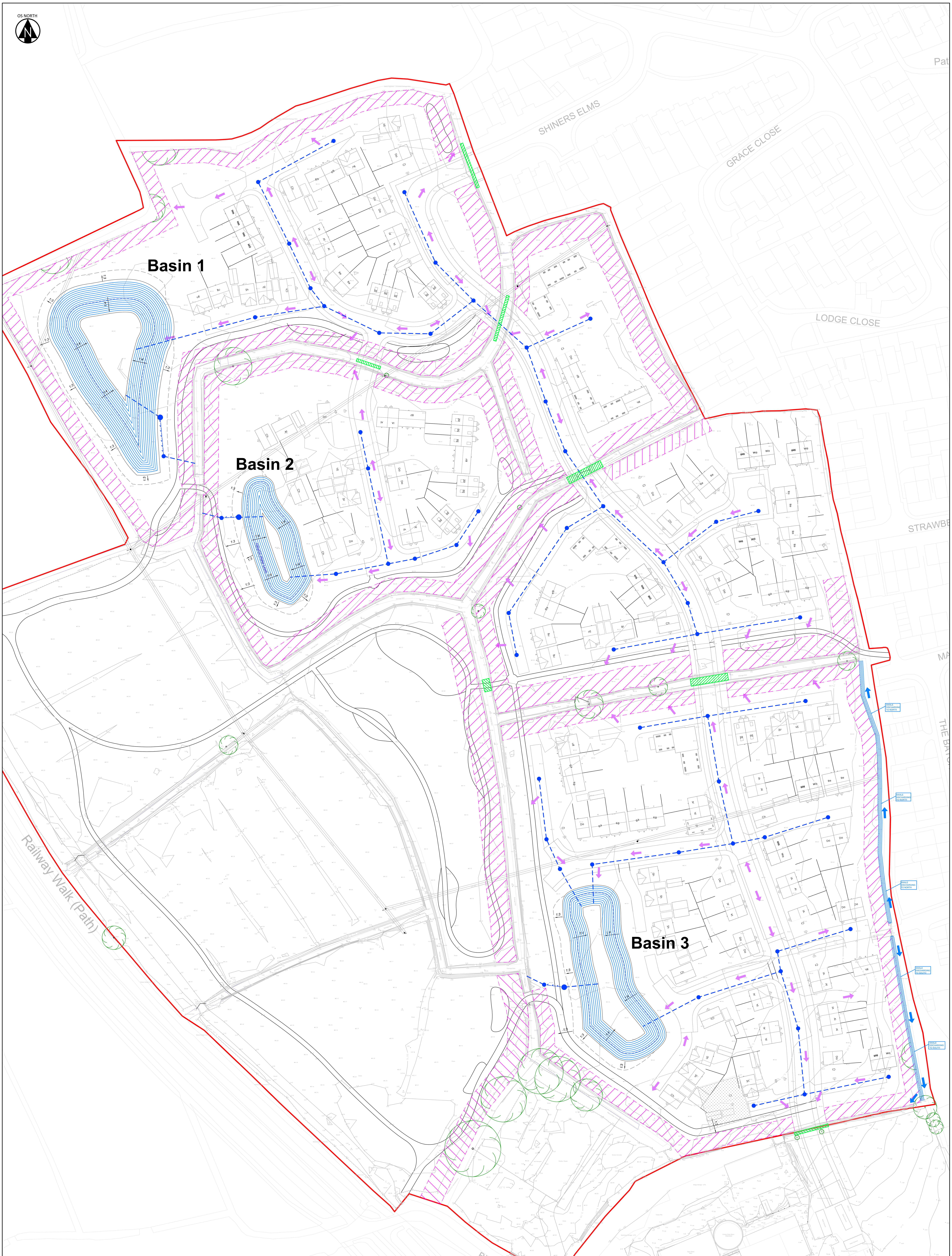
SCALE @ A0 1 : 500

STATUS DESCRIPTION FOR APPROVAL

STATUS S2

DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 23257-HYD-XX-XX-DR-D-2002

REVISION P02



Key

- Exceedance flow route
- Proposed surface water sewer
- Proposed rhyne crossing culvert
- Proposed attenuation basin
- Proposed rhyne easement strips

REVISIONS

Rev	Date	Description	By	Ckd	App
P03	22/08/2024	Updated with pumped drainage option	NP	JC	JC
P02	06/07/23	Rhyne easement strips amended.	RJH		
P01	16/03/23	First Issue.	RJH		

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CLIENT
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PROJECT
LAND AT RECTORY FARM (NORTH)
YATTON, NORTH SOMERSET

TITLE
POST-DEVELOPMENT SURFACE WATER EXCEEDANCE FLOW ROUTES

HYDROCK PROJECT NO. 23257-IOCB

SCALE @ A0 1 : 500

STATUS DESCRIPTION FOR APPROVAL

STATUS S2

DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 23257-HYD-XX-XX-DR-D-2004

REVISION P03

APPENDIX E

WESSEX WATER PRE-DEVELOPMENT ENQUIRY

Wessex Water Response

Richard Hughes

From:	Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Sent:	01 December 2022 15:28
To:	Richard Hughes
Subject:	WWRESP : ST46NW/ 47 - Rectory Farm, Chescombe Road, Yatton
Follow Up Flag:	Follow up
Flag Status:	Flagged
Categories:	Scanned by Gekko

Good afternoon Richard,

Re: 280 units at Rectory Farm, Chescombe Road, Yatton

Many thanks for your email on the subject site, Please note the requested comments below.

Foul drainage

Easements

Firstly, please note the attached maps, ensuing links and table below indicating the minimum stand-off distances for the public sewers crossing the site. Statutory easements must be maintained and are essential to accommodate the size of the excavation and the equipment required to repair, maintain and mitigate the risk of structural damage to buildings and property. Obstructions and restrictions such as front access wall structures with flights of steps, private enclosed gardens and plot boundary structures will not be acceptable within the statutory easement.

Depth to invert of sewer (m)	Sewer diameter/size						
	Not exceeding 225mm	226mm to 475mm	476mm to 724mm	725mm to 924mm	925mm to 1124mm	1125mm to 1399mm	1400 or greater
Less than 3m	3m	3m	3.5m	4m	5m	5m	5m
3 to 4	3m	3m	4m	5m	5m	5m	5m
4 to 5	4m	4m	5m	5m	6m	6.5m	6.5m
5 to 6	5m	5m	6m	6.5m	6.5m	6.5m	6.5m
6 to 7.5	6m	6m	6m	6.5m	6.5m	6.5m	6.5m
7.5 or greater	4m	4m	4m	5m	5m	5m	6m

- Section 104 /185 process link
- Wessex Water easements & Guidance

Foul point of connection

The proposed 280 units will warrant a connection to the nearest public foul 225 mm dia or bigger under our size-for-size policy. We note as part of our preliminary revision that Yatton is benchmarked for a broad distribution of 391 units in accordance with the spatial strategy and requirements for neighbourhood plan considerations. It is understood that Land at North End, Yatton Rugby Club/Moor Road, and Land north of Egret Drive are earmarked to provide the additional units which total up to 322 of the anticipated 391 aforementioned (*154 units, 160 units and 8 units respectively*).

A point of connection will be considered to an adequate point within the 450 mm dia public foul sewers crossing the north-eastern fringes of the site subject to planning consent (*which will dictate the final number of units, layout and method of conveyance*) and depending on when the site comes forward in relation to the aforementioned allocations. Capacity is generally limited within the catchment and capacity improvements will likely be required to support growth and upcoming developments; The developer/applicant is recommended to reengage with Wessex Water as the site progresses and details come forward.

For the existing and new development to operate sustainably, it is important that we meet the capacity requirements, ensuring that negative effects on residents, local communities, and the environment are avoided while still satisfying requirements for the approved/upcoming developments. Wessex Water will manage capacity improvements for upcoming sites through careful planning and programming for the best possible outcome in terms of risk, disruption, and cost, based on the phasing of upcoming sites. Some options we will consider may involve oversizing/ storage arrangements at the on-site pumping station should this be deemed more cost-effective /less disruptive from a catchment-wide approach.

We note future processes on site could result in the need for a Trade Effluent Consent. It is important to stress the importance of understanding the full details of any proposed commercial elements of the proposal as well as any establishments likely to generate trade effluent flows. Capacity Improvements to be managed by Wessex Water will include the predicted foul flows from any approved non-residential uses being of domestic type only. The applicant must contact Wessex Water with information should discharge of a non-domestic nature be approved.

Wessex Water recommends the installation of a properly maintained fat trap on all systems for catering establishments; We further recommend, in line with best practice for the disposal of Fats, Oils, and Grease, the collection of waste oil by a contractor, particularly to recycle. Failure to implement these recommendations may result in this and other properties suffering blocked drains, sewage flooding, and pollution of local watercourses nearby.

Pumping station requirements

Site topography and the proposal to pump via two pumping stations are noted at this stage; In addition to being built to adoptable standards, Wessex Water anticipates that matters on septicity, pump rates and times of operation, and easement of the onsite pumping station to the nearest residential dwelling (*15 m*) will be addressed as details come forward. Please note the further guidance links below.

- *Pumping station septicity control*
- *Wessex Water Pumping Station addendum*
- *Other sewerage connections - Wessex Water*

Manhole levels

To verify the actual levels and gradients of sewers and manholes, further on-site surveys should be conducted as the project progresses.

1. MH Reference ST4265 4705
   a. Cover Level 5.297
   b. Location IN FIELD 4067 REAR OF SHINERS ELMS
   c. Lowest Invert 3.637
   d. Depth 1.660

2. MH Reference ST4265 3702
   a. Cover Level 5.294
   b. Location IN FIELD 4178 OPP BARN
   c. Lowest Invert 3.474
   d. Depth 1.820

I hope the above is enough to proceed with the design. A review of the contents of this email will be required where 18 months or more have elapsed. In light of significant changes, any variations that are likely to impact the response (e.g. changes in drainage strategy, development numbers, or phasing) will need to be discussed with Wessex Water.

Kind regards

Teddy Takyi-Amuah

Planning Liaison / Wessex Water
Claverton Down Bath BA2 7WW

From: Richard Hughes <RichardHughes@hydrock.com>
Sent: 10 November 2022 11:35
To: Planning Liaison <planning.liaison@wessexwater.co.uk>
Subject: [Hydrock: 23257-IOCB] 23257-IOCB - Proposed Development at Yatton - Pre-Development Enquiry

[EXTERNAL EMAIL] DO NOT CLICK links or attachments unless you recognise the sender and know the content is safe.

Dear Sirs,

Please find attached an application for a Pre-Development capacity check for a proposed residential development at the above site on behalf of our Client, Persimmon Homes. A pre-application submission is also with the planning authority at this time.

For your information, it is intended that surface water will be disposed of to adjacent watercourses and therefore this application is purely for foul water. Due to topography we believe that most of the site will need to be pumped to the nearest Wessex Water foul sewer on the eastern boundary of the site.

Attached is a completed application form, site location details, and a copy of the indicative Land Budget Plan.

Should you require any further information or have any queries then please do not hesitate to contact us.

Richard Hughes Eng Tech MICE
Principal Engineer - Infrastructure

Make flexibility work: Hydrock promotes flexible working; if you get an email from me outside normal hours it is because I am sending it at a time convenient to me. I do not expect you to read or reply until normal office hours.

Hydrock
Over Court Barns, Over Lane, Almondsbury, Bristol BS32 4DF
Tel: +44 (0)1454 619 533 Ext: 2235
hydrock.com

Eight consecutive years in the '100 Best Large Companies to Work For' listing.

Richard Hughes

From: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Sent: 13 March 2023 09:00
To: Richard Hughes
Subject: RE: [Hydrock: 23257-IOCB] RE: WWRESP : ST46NW/ 47 - Rectory Farm, Chescombe Road, Yatton

Categories: Scanned by Gekko

Good morning Richard,

Re: ST46NW/ 47 - Rectory Farm, Chescombe Road, Yatton
Based on the reduction in numbers alone; I will inform that the comments from December remain the same. I hope this answers the questions raised.

Kind regards,

Teddy Amuah

From: Richard Hughes <RichardHughes@hydrock.com>
Sent: 09 March 2023 11:47
To: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Subject: [Hydrock: 23257-IOCB] RE: WWRESP : ST46NW/ 47 - Rectory Farm, Chescombe Road, Yatton

Good Morning Teddy,

We are hoping to be in a position to be able to submit the planning application for the above project in the next few weeks. Since your last email of the 1st December 2022, copy below, the layout has been significantly amended and we are now looking at a development of up to 190 residential dwellings, as opposed to the original 280 units, and approximately 0.3 ha of Class E building use.

As this is a significant reduction on the previous proposals I would be grateful if you advise me of any changes that this will have to your previous comments.

Many Thanks,

Richard

Richard Hughes Eng Tech MICE
Principal Engineer - Infrastructure

APPENDIX F

GEOTECHNCIAL INFORMATION

Extracts from Preliminary Land Contamination and Geotechnical Risk Assessment (Hamson Barron Smith, report reference 23-12-113547/DSR, dated December 2022), Hamson Barron Smith

Land at Yatton, Yatton
Preliminary Land Contamination and Geotechnical Risk Assessment

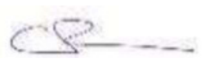
On behalf of Persimmon Homes Severn Valley

Report 23-12-113547/DSR1

December 2022

Report Issue Record

Project No.:	23-12-113547
Project Title:	Land at Yatton
Site Location:	Land north of Rectory Farm, Chescombe Road, Yatton
Client:	Persimmon Homes Severn Valley
Report Title:	Preliminary Land Contamination and Geotechnical Risk Assessment
Issue Date:	13 December 2022
Report No.:	23-12-113547/DSR1
Revision:	-

Prepared by	Written	Reviewed & Approved
Name	**Catherine Riley**	**Craig Roberts**
Signature		
Position	Senior Geo-Environmental Engineer	Technical Director

Template No and Name:		Version:	Date:
21861	Phase 1 Risk Assessment Report	3	December 2018

Contents

Appendices

Executive Summary

SITE INFORMATION	
Client	Persimmon Homes Severn Valley.
Site	Land at Yatton.
Location	Land north of Rectory Farm, Chescombe Road, Yatton, BS49 4EU (nearest). NGR 342478, 165551.
Approximate area	13.5Ha.
Topography	Elevation circa 5m OD.
Current land use	Farmland.
Proposed development	Low rise residential.

SITE SETTING	
Geology	Superficial deposits of Raised Tidal Flat Deposits (clay and silt) over Mercia Mudstone Group.
Radon	No radon protective measures are required.
Hydrogeology	Unproductive Strata over Secondary B Aquifer. The site does not lie in a Source Protection Zone.
Hydrology	Series of unnamed field drains running through and around the immediate vicinity of the site. Branch Rhyne lies c.150m north west and Biddle Street Rhyne lies c.150m south west. The closest main river is the Yeo which lies c.845m south west.
Landfill sites	No landfills located within 250m of the site.
History	Ordnance Survey plans show the site to have remained undeveloped to present day.
Previous site investigations	Hamson Barron Smith has not been made aware of any previous investigations which may have been undertaken at this site.
Anticipated ground conditions	Potentially soft clays. Shallow groundwater is anticipated.

GEOTECHNICAL	
Foundations	Shallow spread foundations may not be suitable depending on the depth and strength of the Tidal Flat deposits. Bearing capacity to be determined from site investigation.
Shrinkable soils	Soils are likely to be shrinkable.
Buried concrete	Significant concrete protection measures may be required.
Floor slabs	Suspended floor slab likely to be required.
Slope stability	Site and adjacent area are level and therefore no risks.
Pavement	CBR values likely to be adequate for road and car park construction.
Soakaways	Underlying geology unlikely to be suitable for soakaway drainage, subject to full scale testing to confirm and calculate infiltration rates.
Natural cavities	None expected.
Mining	None expected.
UXO	The preliminary UXO report was unable to rule out the risk of UXO and therefore it is therefore recommended that in advance of any intrusive works that further research in the form of a detail UXO Risk assessment be undertaken in accordance with CIRICA guidelines.

CONTAMINATION	
Human health	No significant risks identified.
Controlled waters	No significant risks identified.
Gas protection	Medium risk identified, depending on the presence of organic soils within the Tidal Flat deposits. No radon protective measures are required.
Water supply pipes	No significant risks identified, standard pipework may be suitable.

4 Environmental Setting

4.1 Geology

The 1:50,000 scale British Geological Survey (BGS) geological mapping indicates the site to be underlain by superficial deposits comprising Raised Tidal Flat Deposits (clay and silt) overlying the bedrock geology of Mercia Mudstone Group.

Tidal Flat Deposits, are deposited on extensive nearly horizontal marshy land in the intertidal zone that is alternately covered and uncovered by the rise and fall of the tide. They consist of unconsolidated sediment, mainly mud and/or sand. Normally a consolidated soft silty clay, with layers of sand, gravel and peat.

The Mercia Mudstone Group is described by the BGS as "*dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas. Thin beds of gypsum/anhydrite are widespread; thin sandstones are also present*".

There are no BGS records in the immediate vicinity of the site.

4.2 Soil Geochemistry

The BGS "Normal Background Concentrations of Contaminants in English Soils" included as part of the Groundsure report indicates the typical estimated concentrations of each determinant in topsoil in the locality of the site, as summarised in Table 1.

Table 1: Summary of BGS Estimated Soil Geochemistry

Determinant	Concentration Range (mg/kg)
Arsenic	15 – 25
Cadmium	<1.8
Chromium	60 – 90
Lead	<100
Nickel	15 – 30

4.3 Hydrogeology

The Environment Agency classifies the Tidal Flat Deposits to be Unproductive Strata. The underlying Mercia Mudstone Group at the site is a Secondary B Aquifer. The site does not lie within a Source Protection Zone. The nearest commercial groundwater abstraction (for general farming use) lies circa 905m north west of the site.

The depth to groundwater is unknown. However, the site comprises low lying land on the Somerset Levels and on site field drains have surface water at a depth of 1.0m to 1.5m bgl. Therefore, shallow groundwater is anticipated at the site.

Despite the shallow depth to groundwater, the likely low permeability of the superficial deposits would suggest that groundwater would be of low sensitivity to any potential on site sources of contamination.

4.4 Hydrology

A series of unnamed field drains run through and around the immediate vicinity of the site. Branch Rhyne lies c.150m north west and Biddle Street Rhyne lies c.150m south west. The closest main river is the Yeo which lies c.845m south west.

The proximity of the site to the surface water features would suggest that surface water is considered to be of high sensitivity to any potential on site sources of contamination.

4.5 Landfill Sites

No current or historical landfills are known to exist within 250m of the site. No evidence of buried biodegradable materials or other potential sources of ground gas were identified on the site. However, the site is underlain by Tidal Flat Deposits, which may contain organic rich soils. Consequently, the risks to end users from explosive or asphyxiating gases is considered medium.

4.6 Radon

The Groundsure report states that the site is in an area where the estimated probability of homes being above the action level of 200Bqm^{-3} is less than 1%. Therefore, no radon protective measures are required in the construction of new buildings. The Groundsure report is presented in Appendix D.

Confirmation of any protection measures should be agreed with the local authority building control and / or warranty provider.

4.7 Statutory Authority Records

A review of public registers contained within the Groundsure report has been undertaken. These entries relate to trade directories, pollution control registers, hazardous sites, enforcement notices etc. A summary of those that might be of relevance to the site is presented below, for full details of all entries, reference should be made to the Groundsure report in Appendix D.

- A former petrol filling station is listed at High Street, Yatton, approximately 400m to the north of the site boundary.
- There is a Pollution Incident recorded located circa 20m south of the site from August 2008; the incident involved waste materials including vehicle parts, tyres, metal waste, commercial waste, demolition waste and biodegradable materials, and is listed as having a Category 2 Significant Impact on land.

4.8 Sensitive Land Uses and Designated Areas

There are three Site of Special Scientific Interest (SSSI) located within 2km of the site including Biddle Street which is located on site / immediately west, Tickenham, Nailsea and Kenn Moors which are located circa 665m north east and Puxton Moor which is located circa 1.85km south west.

Cheddar Valley Railway Walk which is located on the western site boundary is listed as a Local Nature reserve (LNR).

4.9 Land Use History

The historical land uses of the site and its surrounding area have been established from superseded editions of Ordnance Survey maps and are detailed in Table 2.

Copies of the maps are included in Appendix C.

Table 2: Summary of Historical Maps

Date	On Site	Offsite
1883-1885	The site comprises a series of undeveloped agricultural fields.	The Great Western Railway forms the western boundary of the site. The generally surrounding land use is agriculture, with residential dwellings in the village of Yatton c.250m north east. A gas works lies 260m north west.

Date	On Site	Offsite
1902-1903	No significant changes are evident.	No significant changes are evident.
1931-1932	No significant changes are evident.	The gas works is no longer marked.
1960-1961-	No significant changes are evident.	No significant changes are evident.
1975-1979	No significant changes are evident.	By 1977 Rectory Farm has been constructed to the south with residential housing and a works present to the east.
1980-1988-	No significant changes are evident.	The former gas site is marked as a works and a gasholder is present on the site.
1991-1995	No significant changes are evident.	The works and gas holder to the north are no longer marked. The works to the east has been extended. A storage tank is marked in the farm.
2001-2003	No significant changes are evident.	No significant changes are evident.
2010	No significant changes are evident.	No significant changes are evident.
2022	No significant changes are evident.	No significant changes are evident.

4.9.1 Summary of Development History

On site

The site has remained as undeveloped agricultural land until the present date.

Off Site

The surrounding land use was typically undeveloped farmland becoming a mixture of agricultural land and residential properties. A gas works was present circa 260m north west from the 1800s until the 1930s. A works was present immediately east from the later 1970s; the site has recently been redeveloped by Woodstock Homes for residential apartments.

5 Geotechnical Assessment

The 1:50,000 scale British Geological Survey (BGS) geological mapping indicates the site to be underlain by superficial deposits comprising Tidal Flat Deposits (clay and silt) overlying the bedrock geology of Mercia Mudstone Group.

An assessment of potential geotechnical risks based on the information from the Groundsure Report and available geological information is presented in the following sections. The risks are summarised in Table 4. The Groundsure Report is reproduced in Appendix D.

5.1 Deep Made Ground

It is possible that some localised Made Ground will be present, resulting from the current use of the site e.g. demolition rubble place in the farm access. Deep Made Ground resulting from infilling or significant raising of levels is considered unlikely however.

5.2 Buried Structures

None are anticipated.

5.3 Compressible Soils

The Groundsure report states that the Compressible Ground risk at the site is “moderate”. Based on the expected superficial geology, compressible soils may be present.

5.4 Shrinking / Swelling Clay

The Groundsure report states that the Shrinking or Swelling Clay risk at the site is “low”. The near surface soils are anticipated to be clay and therefore are likely to be shrinkable.

5.5 Collapsible soils

The Groundsure report states that the Collapsible Ground risk at the site is “negligible” to “very low”. Based on the anticipated ground conditions, collapsible soils are not expected.

5.6 Aggressive Ground Conditions for Concrete

Based on the published geology, the anticipated soils are expected to contain significantly elevated concentrations of soluble sulphates or pyritic materials which may oxidise to form soluble sulphates.

5.7 Running Sands / Excavation Instability

The Groundsure report states that the Running Sand risk at the site is “moderate”. Based on the anticipated ground conditions, running sands may be present.

5.8 Groundwater

The site comprises low lying land on the Somerset Levels. On site field drains have surface water at a depth of 1.0m to 1.5m bgl and ponding of surface waters were noted across the site during the walkover. We therefore envisage that shallow groundwater will be present in the near surface superficial deposits.

5.9 Slope Stability

The Groundsure report states that the Landslide risk at the site is “very low”.

The site is topographically flat. Provided no significant alterations to the site’s topography are made no issues with stability are anticipated. Any proposed slopes or temporary cutting for retaining systems should be carefully assessed however.

5.10 Solution Features / Natural Cavities

The site is expected to be underlain by Tidal Flat Deposits (clay and silt) over mudstone of the Mercia Mudstone Group which are not prone to dissolution.

The Groundsure report states that the Ground Dissolution risk at the site is “negligible” and no solution features are recorded within 1km.

5.11 Underground Mining

A review of the Groundsure report and the historical maps indicates that there are no records of underground mining within 1km of the site. Consequently, the risks from underground mining within the site itself are considered to be negligible.

5.12 UXO Risk

An online check of freely available UXO risk maps https://zeticauxo.com/downloads-and-resources/risk-maps/) from Zetica indicated there is a Moderate risk of unknown UXO at the site. Therefore, a preliminary UXO risk assessment was obtained from 1st Line Defence, the report is presented in Appendix E.

The preliminary UXO confirmed the following.

- The site has not had a former military use. It is noted that the site was located approx. 6.2km from the closest Heavy Anti-Aircraft battery.
- The site is located within the Long Ashton Rural District which sustained an overall low density of bombing, with an average of 22.2 items dropped per 1,000 acres. In total 1,034 items of ordnance including 1004 high explosive (HE) bombs, 8 parachute mines, 16 oil bombs and 6 phosphorous bombs were recorded over an area of 45,515 acres.
- The report identified a refence to a bombing incident at Yatton Junction in October 1940. This lies circa 250m north of the site. The source spoke of a "stick" of eight bombs but refence to the location of the other 7 incidents were vague and could not be ascertained at the preliminary stage.
- There are no structures within the site boundary with which to attribute damage when comparing pre and post WWII OS mapping.

The report concluded that the location of the remaining seven incidents was vague and could not be ascertained at this preliminary stage. As the site is large and was undeveloped it is noted that had any of these incidents landed within the boundary, it is considered unlikely they would have been noted and subsequently investigated.

Given both this and the site’s relative proximity to the aforementioned Yatton Junction, it is considered necessary to conduct further research in regards to this incident, and whether it had an effect on the site.

The report therefore recommends that a detailed UXO report is commission ed to examine in detail the probability of encountering explosive ordnance during any proposed works at the site.

APPENDIX G

LLFA / IDB Response to Approved Strategy

NORTH SOMERSET LEVELS IDB
PART OF THE SOMERSET DRAINAGE BOARDS CONSORTIUM

BRADBURY HOUSE, 33-34 MARKET STREET
HIGHBRIDGE, SOMERSET, TA9 3BW
TEL: 01278 789906
EMAIL: planning@somersetdbs.co.uk

Our Ref: P-NS-004650 Your Ref: 23/P/0664/OUT Date: 10 May 2024

Development Management
Development and Environment
Post Point 15
North Somerset Council
Town Hall
Walliscote Grove Road
Weston-super-Mare
BS23 1UJ

Dear Sir or Madam

The Town & Country Planning Act 1990
The Town & Country Planning (Development Management Procedure) Order 2015

Proposal: Outline planning application for the development of up to 190no. homes (including 50% affordable homes), 0.13ha of land reserved for Class E uses, allotments, car parking, earthworks to facilitate sustainable drainage systems, open space and all other ancillary infrastructure and enabling works with means of access from Shiners Elms for consideration. All other matters (means of access from Chescombe Road, internal access, layout, appearance and landscaping) reserved for subsequent approval.

Location: Land To North Of Rectory Farm, Chescombe Road, Yatton
O.S. Grid reference: 342491 165515

Thank you for referring the above application.

The IDB has **no further comments** on the additional information provided for the planning application.

Our Surface water concerns was covered in the Foul and Surface water strategy (23257 HYD XX XX RP DS 5002 revision P04) and the technical note (ref 23257 HYD XX XX TN D 002 revision P02).

We would like our comments in our letter of the **15 August 2023** to be considered when determining the application.

Any email correspondence relating to this consultation response should be sent to planning@somersetdbs.co.uk

Yours Sincerely

Virginie Martin
Development Control Officer

SOMERSET DRAINAGE BOARDS CONSORTIUM
AXE BRUE, PARRETT & NORTH SOMERSET LEVELS
INTERNAL DRAINAGE BOARDS

BRADBURY HOUSE, 33-34 MARKET STREET
HIGHBRIDGE, SOMERSET, TA9 3BW
TEL: 01278 789906
FAX: 01278 792914
EMAIL: admin@somersetdbs.co.uk

Our Ref: P-NS-001505 Your Ref: 23/P/0664/OUT Date: 15 August 2023

Development Management
Development and Environment
Post Point 15
North Somerset Council
Town Hall
Walliscote Grove Road
Weston-super-Mare
BS23 1UJ

Dear Sir or Madam,

Thank you for referring the above application

With reference to the above planning application, provided the Local Planning Authority (LPA) is satisfied the requirements of the Sequential Test under the National Planning Policy Framework (NPPF) are met, the Board is able to remove its objection to the proposals but would like to recommend the following conditions to be included within the Decision Notice:

CONDITION:
The development permitted by this planning permission shall only be carried out in accordance with the approved Foul and Surface Water Drainage Strategy (ref 23257 HYD XX XX RP DS 5002 revision P04) and the technical note (ref 23257 HYD XX XX TN D 002 revision P02), and the following mitigation measures detailed within them:

1. Limiting the surface water run-off generated by the critical storm to 2 l/s/ha of impermeable area for all return periods including the 1 in 100 year plus climate change so that it will not exceed the run-off from the undeveloped site and not increase the risk of flooding off-site.
2. Provision of compensatory flood storage on site, for all return periods including the 1 in 100 year plus climate change
3. Maintenance and access route to be provided for all rhynes and ordinary watercourses on the site as per drawing 23257 HYD XX XX DR D 2005 revision P01
4. The discharge outfall from the attenuation ponds into the rhynes shall be set no lower than 4.85 m AOD.
5. There shall be no tree planting within 9m of any ordinary watercourses or viewed rhynes

REASON:

1. To prevent flooding by ensuring the post development surface water runoff from the site is no higher the pre development surface water.
2. To prevent flooding elsewhere by ensuring that compensatory storage of flood water is provided.
3. To ensure the structural integrity of existing rhynes can be maintained by the IDB thereby reducing the risk of flooding.
4. To enable the site surface water discharge above the summer penning level avoiding surcharge of the surface water network.
5. To secure IDB access for maintenance of the viewed rhynes thereby reducing the risk of flooding.

CONDITION:
The development hereby permitted shall not be commenced until such time as a scheme to deal with existing runoff from adjacent sites has been submitted to, and approved in writing by, the local planning authority.

1. Ensuring no interruption of existing surface water flow and drainage by the new development
2. Ensuring access is provided to the 9 m easement

The scheme shall be fully implemented and subsequently maintained, in accordance with the timing / phasing arrangements embodied within the scheme, or within any other period as may subsequently be agreed, in writing, by the local planning authority.

REASON:

1. To prevent flooding by ensuring the satisfactory disposal of surface water from the site.
2. To ensure the structural integrity of existing rhynes can be maintained by the IDB thereby reducing the risk of flooding.

The Board would request that the following informative is added to any permission that is granted:

Informative: The applicant is advised that, prior to works commencing on site, Land Drainage Consent is required under section 23 and 66 of the Land Drainage Act 1991 from the Internal Drainage Board for any construction in, or within, 9m of a watercourse and for the introduction of additional flow into a watercourse in the Board's District (or from the Environment Agency for an EA Main River).

There must be no interruption to the surface water drainage system of the surrounding land as a result of the operations on the site. Provisions must be made to ensure that all existing drainage systems continue to operate effectively and that riparian owners upstream and downstream of the site are not adversely affected.

Any email correspondence relating to this consultation response should be sent to planning@somersetdbs.co.uk

Yours Sincerely

[redacted]

Virginie Martin
Development Control Officer

cc. Mr R King, Operations Manager