AMENDED

Surface Water Management Strategy incorporating a Flood Risk Assessment

Land at Sanderling Way

Iwade

Sittingbourne

ME9 8TE

RMB Consultants (Civil Engineering) Ltd

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RMB Consultants (Civil Engineering) Ltd
39 Cossington Road
Canterbury
Kent
CT1 3HU

Tel 01227 472128
www.rmbconsultants.co.uk

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1. Background and Introduction

This Surface Water Management Strategy incorporating a Flood Risk Assessment accompanies a planning application for proposed residential development on land at Sanderling Way, Iwade, Sittingbourne, ME9 8TE.

A pre-application meeting was held with Kent County Council (KCC) as Lead Local Flood Authority. The approach taken within this report was discussed and agreed with KCC.

2. Development Location and Description

Development Location

The site is located to the north of Sanderling Way, Iwade, Figure 1. It is a greenfield site that is currently rough pasture and covers 4.4ha.

Figure 1. Site location plan.

Development Proposals

An outline planning application is being made for residential development for 60 dwellings. An illustrative layout for the proposed development is shown in Figure 2.

Figure 2. Proposed development.

3. Policy Background

The management of surface water across the development has to comply with the National Planning Policy Framework (NPPF) and local policy documents adopted by Swale Borough Council.

The National Planning Policy Framework

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced.

Chapter 14 Meeting the challenge of climate change, flooding and coastal change states:

Planning and flood risk

159. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

160. Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

161. All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

a) applying the sequential test and then, if necessary, the exception test as set out below;

b) safeguarding land from development that is required, or likely to be required, for current or future flood management;

c) using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and *d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.*

162. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

163. If it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3.

164. 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.

165. Both elements of the exception test should be satisfied for development to be allocated or permitted.

166. Where planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-making stage, or if more recent information about existing or potential flood risk should be taken into account.

167. 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 located 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.

168. Applications for some minor development and changes of use should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

169. 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.

Bearing Fruits 2031 The Swale Borough Council Local Plan

Swale Borough Council's Local Plan was adopted in July 2017.

Policy DM21 - Water, flooding and drainage states that:

When considering the water-related, flooding and drainage implications of development, development proposals will:

1. Accord with national planning policy and planning practice guidance;

2. Avoid inappropriate development in areas at risk of flooding and where development would increase flood risk elsewhere;

3. Provide site specific flood risk assessments, as required, carried out to the satisfaction of the Environment Agency and, if relevant, the Internal Drainage Board. These will, where necessary, include details of new flood alleviation and flood defence measures to be installed and maintained by the developer;

4. *Include, where possible, sustainable drainage systems to restrict runoff to an appropriate discharge rate, maintain or improve the quality of the receiving watercourse, to enhance biodiversity and amenity and increase the potential for grey water recycling. Drainage strategies (including surface water management schemes) for major developments should be carried out to the satisfaction of the Lead Local Flood Authority;*
5. *Integrate drainage measures within the planning and design of the project to ensure that the most sustainable option can be delivered, especially where, exceptionally, development is to be permitted in an area of flood risk;*
6. *Within areas at risk of flooding, submit a suitable flood warning and emergency plan that has been approved by the relevant emergency planning regime and, where appropriate, the emergency services;*
7. *Where necessary, demonstrate that adequate water supply and wastewater connection and treatment infrastructure is in place before construction commences and that these details have been approved by the appropriate water company and funded by the development where appropriate;*
8. *Ensure future unconstrained access to the existing and future sewerage and water supply infrastructure for maintenance and up-sizing purposes;*
9. *Make efficient use of water resources and protect the yield of local public water supplies. For new residential development, all homes to be designed to achieve a minimum water efficiency of 110 litres per person per day, in line with the Government's Housing Optional Technical Standard for water efficiency; and*
10. *Protect water quality, including safeguarding ground water source protection zones from pollution, to the satisfaction of the Environment Agency.*

The site is identified within the Local Plan as part of the proposed expansion of Iwade under Policy A17. The area covered by Policy A17 is shown on the Proposals Map, reproduced in Figure 3.

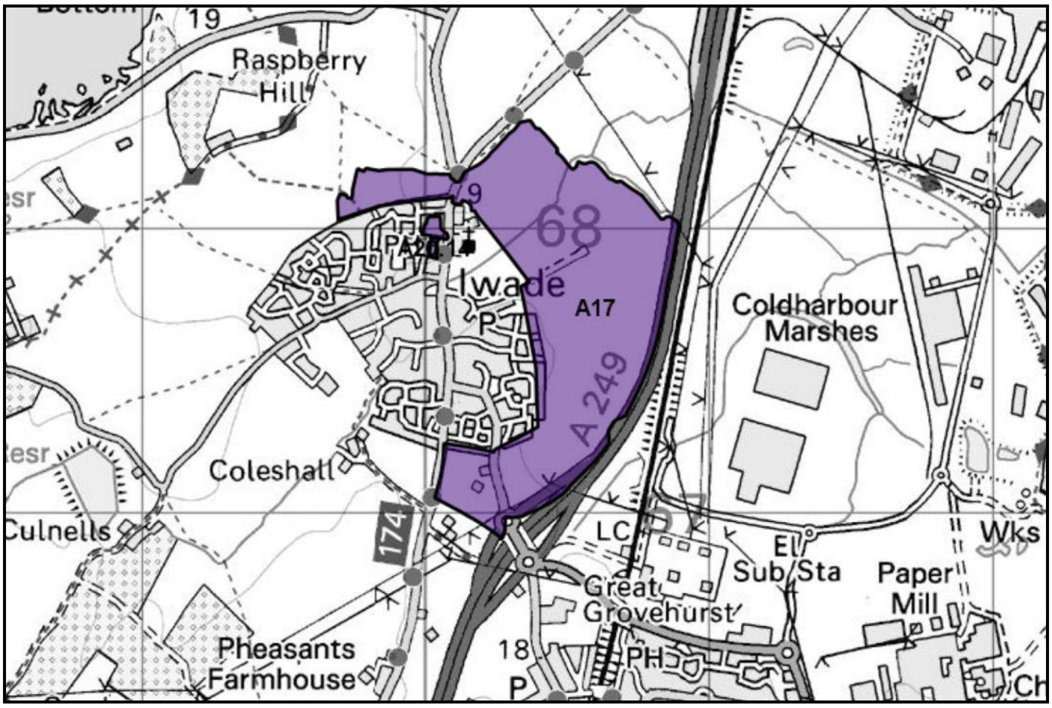


Figure 3. Policy A17.

Policy A17 includes the following concerning flood risk and sustainable drainage:

Planning permission will be granted for a minimum of 572 dwellings at Iwade, as shown on the Proposals Map, together with a new country park, landscape and ecological enhancements and community facilities. Landowners and developers will be required to co-ordinate on the preparation, consultation and approval of a Masterplan/development brief. The Masterplan/development brief and planning applications will:

3. *Submit a site flood risk assessment in accordance with Policy DM21 which shall additionally consider the sustainable drainage and land management measures that should be undertaken within the developed areas and open space.*

4. Site Characteristics

Topography - Contours have been derived from Lidar data, Figure 4. The site slopes from a high point to the southwest of 12.5mAOD (Above Ordnance Datum), northeast to a level of 6mAOD, at an average gradient of approximately 1 in 50. A detailed topographical survey has been carried out.

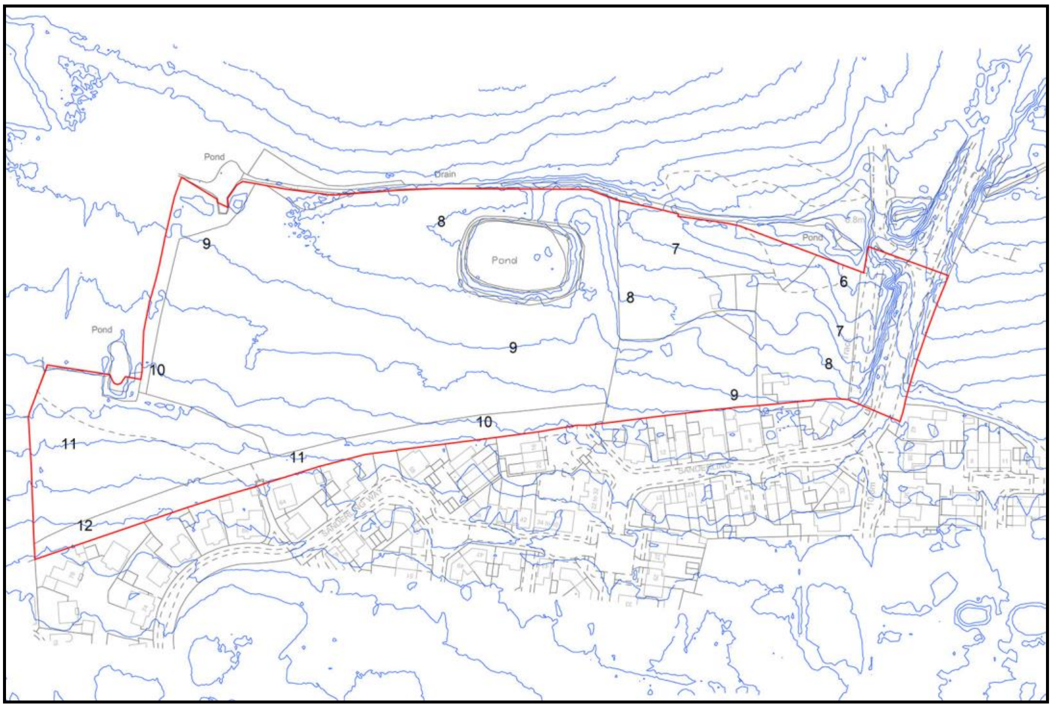


Figure 4. Local topography.

Geology and Soils - The bedrock geology consists of the London Clay Formation, clay and silt. There are no superficial deposits recorded at the site. Soils are classified as slowly permeable seasonally wet loamy and clayey soils with impeded drainage that drain to the local stream network. Boreholes in the area indicate a groundwater level of approximately 0 - 4mAOD.

Groundwater - The site lies outside any groundwater source protection zones. The London Clay is an unproductive strata as far as groundwater is concerned.

Infiltration Rates - Soakage testing has not been carried out at the site. London Clay deposits, and the nearby stream network indicate that infiltration rates are likely to be low and that a surface water drainage strategy based on a controlled discharge from the site to the local stream network is the most appropriate.

Existing Surface Water Drainage Patterns - The catchment characteristics for the site have been obtained from the Flood Estimation Handbook (FEH) Web Service. The site is part of a wider catchment that drains to the east, Figure 5. The FEH catchment descriptors are attached at Appendix A.

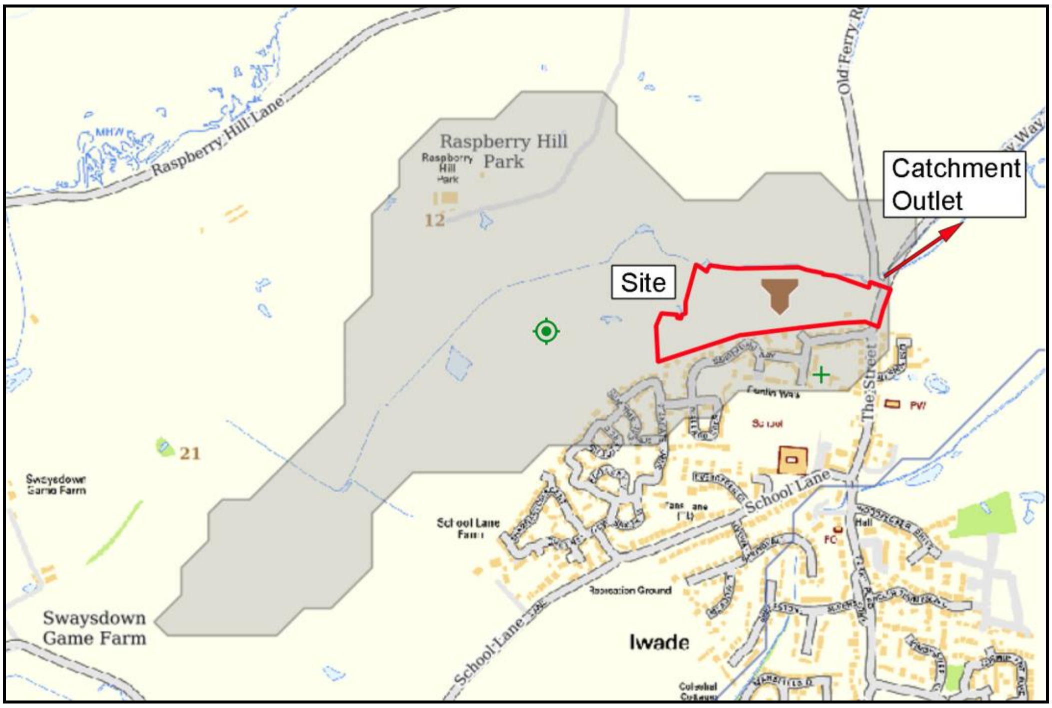


Figure 5. Local drainage catchment. (© Flood Estimation Handbook)

The catchment drains under Old Ferry Road via a 750mm diameter concrete pipe, Figure 6 and under Sheppey Way via a 600mm diameter pipe, Figure 7.

Figure 6. Concrete pipe under Old Ferry Road.

Figure 7. Concrete pipe under Sheppey Way.

Rainfall Data - Point rainfall data has been obtained from the FEH Web Service. The FEH 2022 XML rainfall data has been used in the surface water drainage design. This provides rainfall data for return periods greater than 2 years.

Sewer Record - The development along Sanderling Way is served by public foul sewers, Figure 8. These drain to the south. To the west of Sanderling Way the development is served by public surface water sewers. These drain to an attenuation pond west of the site. The public sewer record is attached at Appendix B.

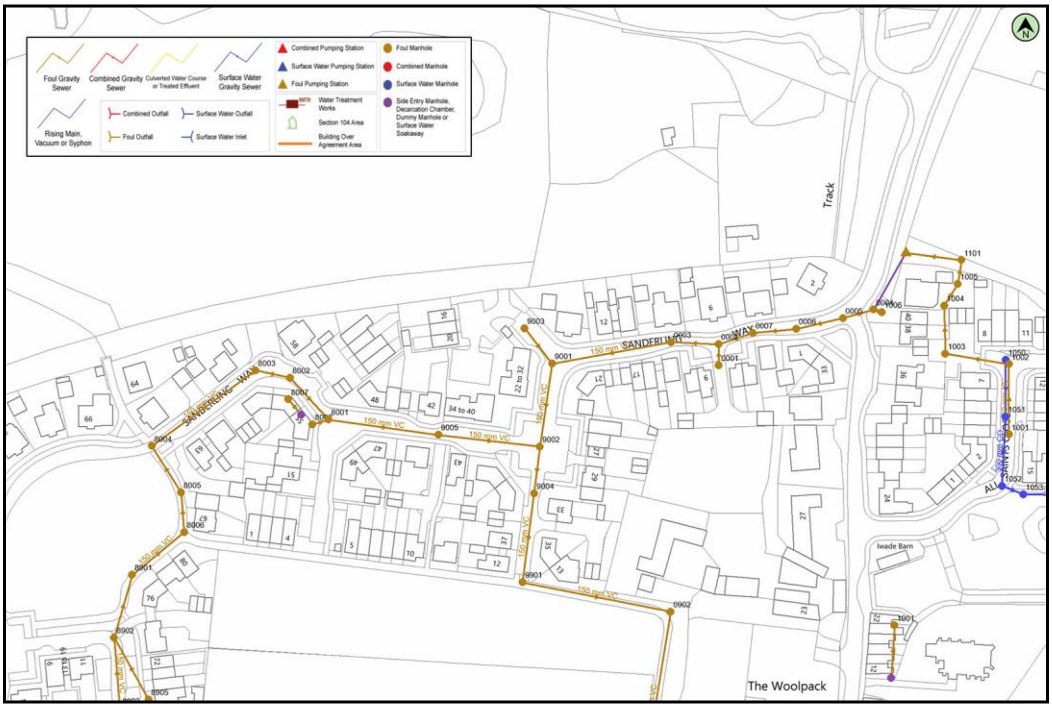


Figure 8. Public sewer record. (© Southern Water)

Existing On-site Drainage - A detention pond is located within the site boundary. This accepts water from the development along Sanderling Way and discharges to the watercourse at the northern boundary of the site.

The Sanderling Way development is served by surface water sewers although these are not shown on the public sewer record. The connection from the Sanderling Way development to the attenuation pond consists of a 750mm diameter pipe and is subject to a 10m easement, Figure 9.

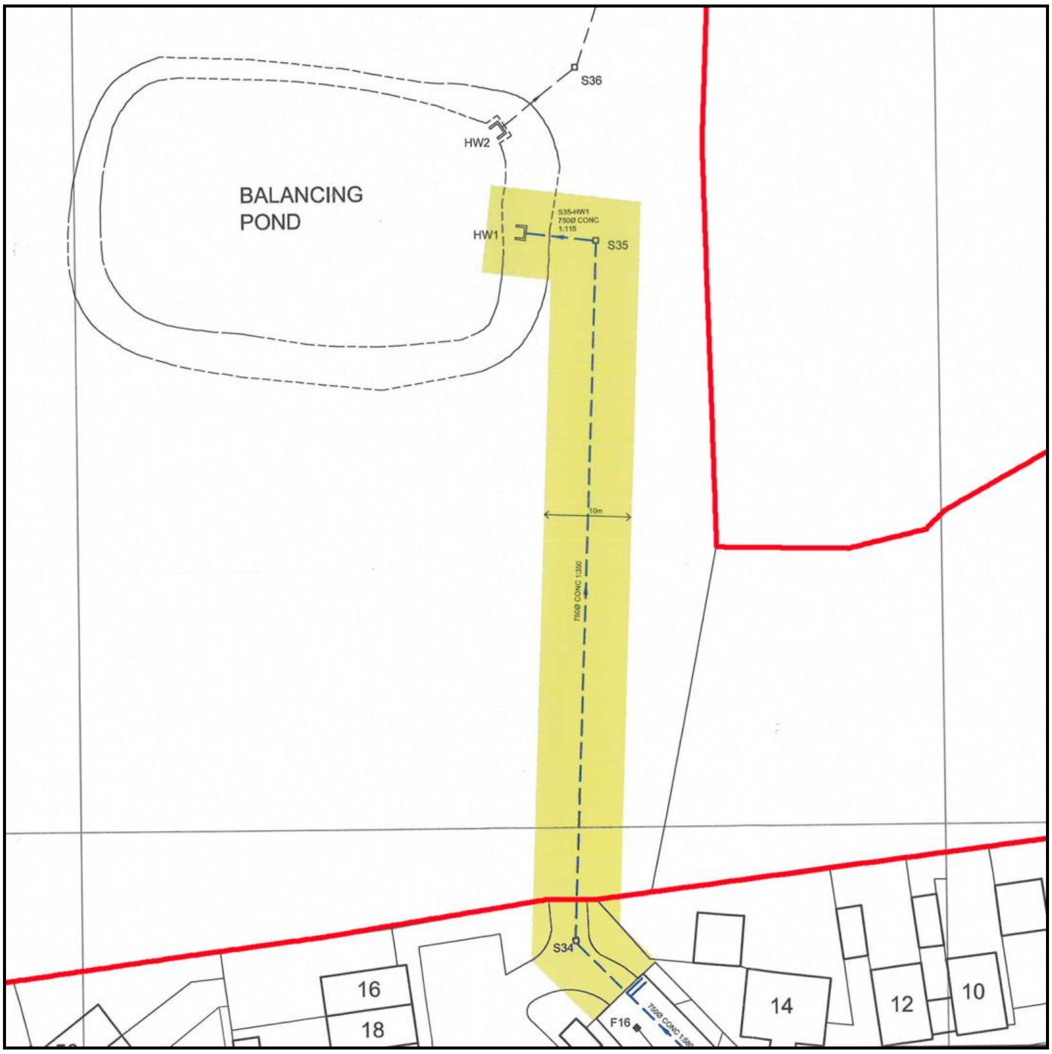


Figure 9. Existing surface water connection to the on-site attenuation pond, with the site edged red.

The illustrative development layout has been designed to accommodate the existing surface water connection to the on-site attenuation pond, Figure 10.

Figure 10. Existing surface water connection to the on-site attenuation pond overlaid on the illustrative development layout.

Greenfield runoff - The peak greenfield runoff rate for the critical storm duration has been calculated using the IH124 method from the greenfield runoff rate estimation tool published online by HR Wallingford at uksuds.com, Table 1. The SPR has been altered to 0.47 to reflect the FEH catchment descriptors.

Return Period	Runoff Rate Q l/s per ha.
QBar	3.8
1	3.2
30	8.7
100	12.1

Table 1. Greenfield runoff rate for the site.

5. Flood Risk Assessment

Fluvial Flood Risk - The NPPF states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change by applying the Sequential Test.

Flood zones are the starting point for the Sequential Test. These zones are a broad assessment of flood risk as given below.

Zone 1 Low Probability - land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Zone 2 Medium Probability - land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Zone 3a High Probability - land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3b The Functional Floodplain - land where water has to flow or be stored in times of flood, land which would flood with an annual probability of 1 in 20 (5%) of greater in any year or designed to flood in an extreme flood.

The site lies within flood zone 1, Figure 11, and has been allocated within the Local Plan. The site therefore passes the Sequential Test and is suitable for residential development.

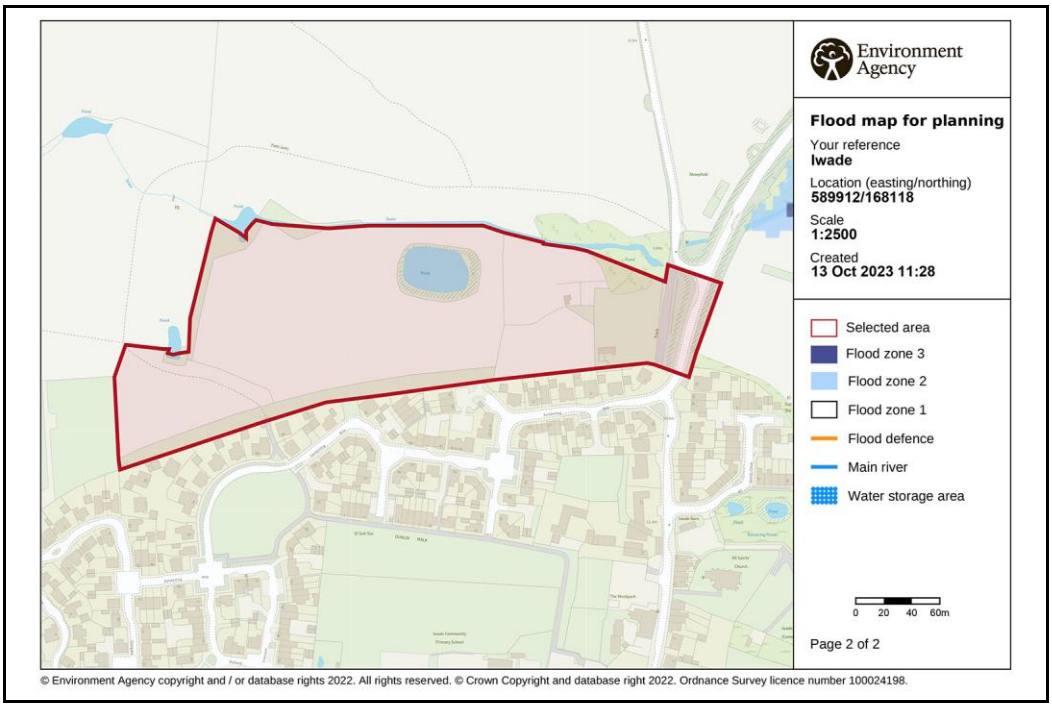


Figure 11. The Flood Map for Planning with the site edged red.

Surface Water - The Government has published surface water flood risk maps. These show that the majority of the site is at very low risk of surface water flooding with areas at low to medium risk, Figure 12. The definition of each category is given below:

Very Low (white) a chance of flooding of less than 1 in 1000 (0.1%)
Low (pale blue) a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%)
Medium (mid blue) a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%)
High (dark blue) a chance of flooding of greater than 1 in 30 (3.3%)

The depth of water associated with the low, medium and high risk events is shown in Figures 13 to 15. The definition of each colour is given below:

Below 300mm (light blue)
300-900mm (medium blue)
Over 900mm (dark blue)

The surface water flood maps also give an indication of velocity and direction of flow, Figure 16. The definition of each colour is given below:

Over 0.25 m/s (dark blue)
Less than 0.25 m/s (light blue)

The arrows indicate the direction of flow.

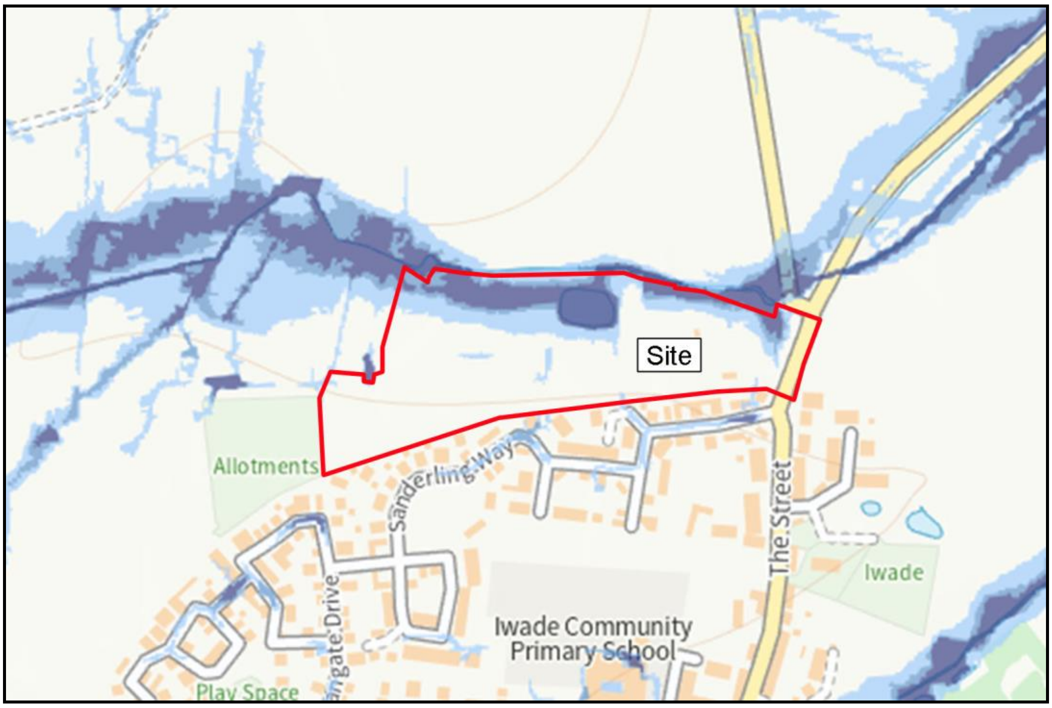


Figure 12. Surface water flood map with the site edged red.

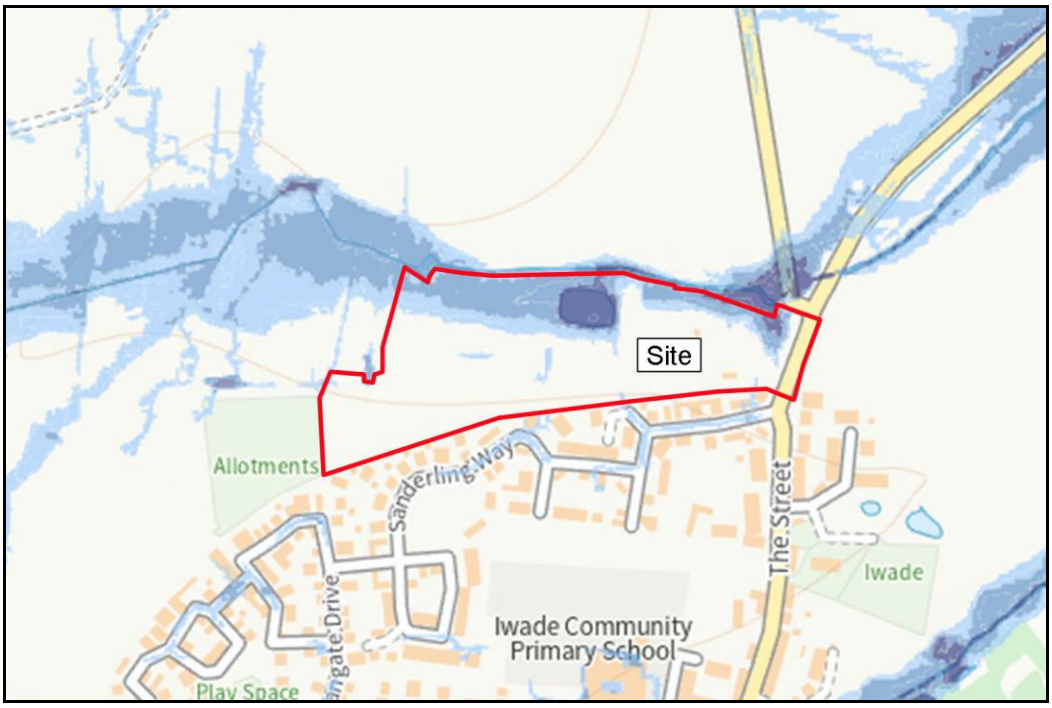


Figure 13. Surface water flood depth map for the low risk flood event with the site edged red.

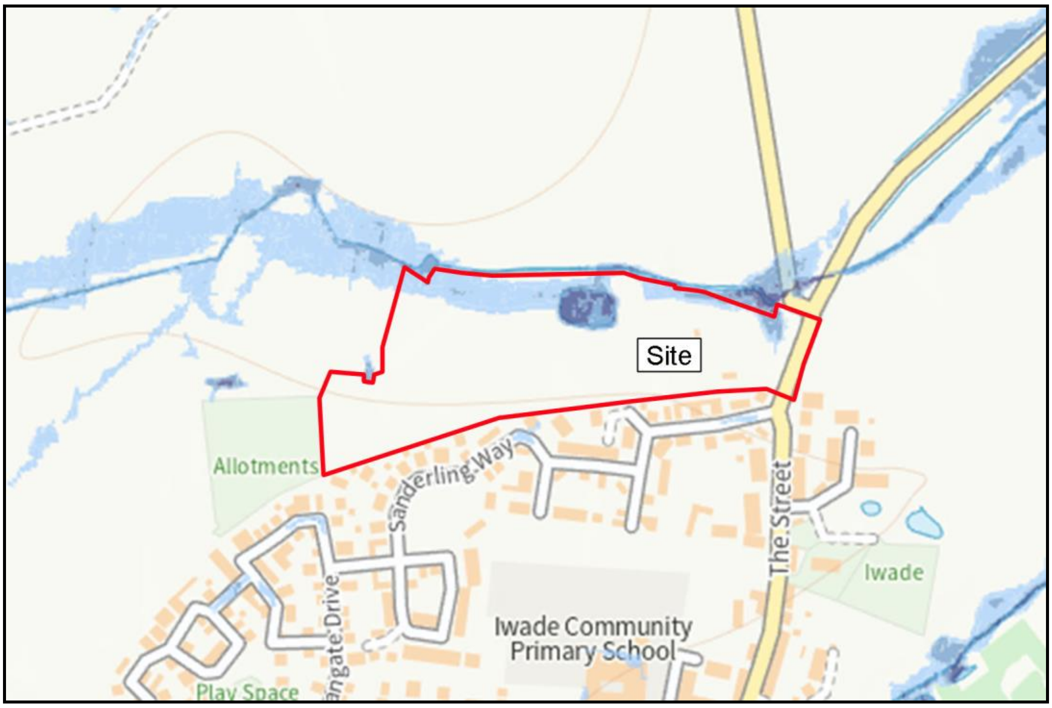


Figure 14. Surface water flood depth map for the medium risk flood event with the site edged red.

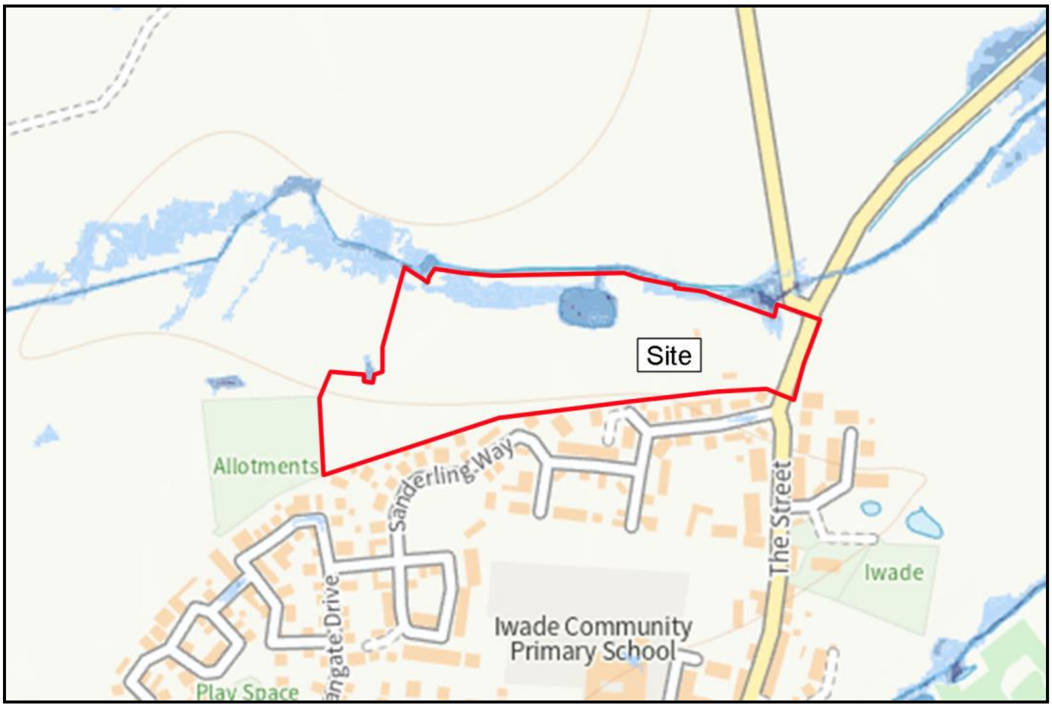


Figure 15. Surface water flood depth map for the high risk flood event with the site edged red.

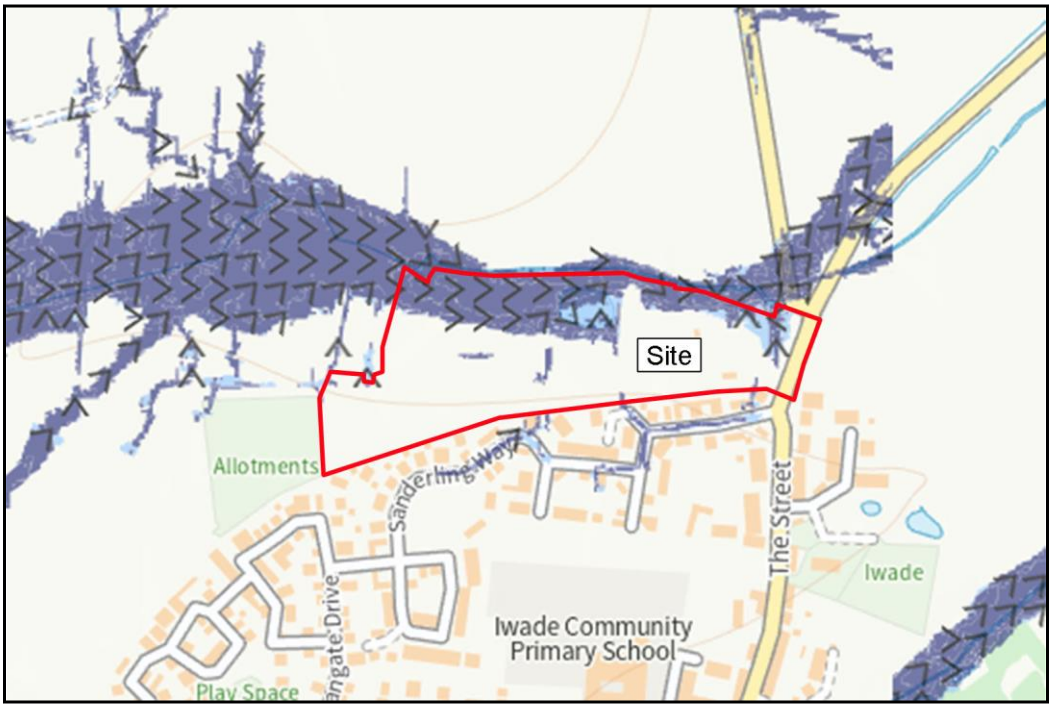


Figure 16. Surface water flood velocity map for the low risk of flooding category with the site edged red.

The southern part of the site is at very low risk of surface water flooding. There is a surface water flow path running west to east across the northern part of the site. This is at high to low risk of flooding. The depth of flooding under the high and medium risk events is less than 300mm except for surface water collecting within the existing pond. Under the low risk event the depth of flooding increases to 0 - 900mm. The velocity map confirms the general direction of flow from west to east. This follows the line of the existing watercourse but is south of it.

Groundwater Flood Risk - Swale Borough Council's Strategic Flood Risk Assessment indicates that the area is not at risk of groundwater flooding.

The site is underlain by the unproductive London Clay Formation. Boreholes in the area indicate a groundwater level of approximately 0 - 4mAOD, 2 - 6m below the lowest site level. Rising groundwater would flow eastwards towards lower lying land.

The risk of groundwater flooding at the site is therefore considered to be very low.

Infrastructure Flood Risk - The existing attenuation pond is within the site boundary and fed by a 750mm pipe running through the site. The illustrative layout has positioned development away from the pond and the pipe. Any flooding resulting from these elements would flow north to the existing stream network and not affect the proposed development.

The site does not lie within an area at risk of flooding following the failure of reservoirs, Figure 17.

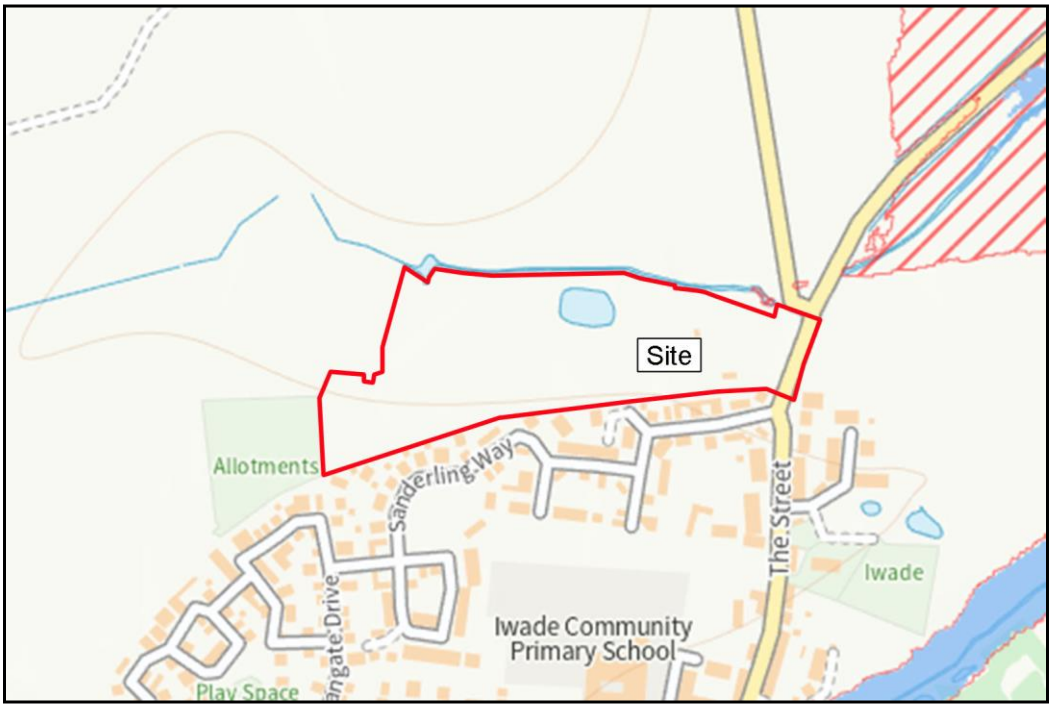


Figure 17. Reservoir flood risk map with the site edged red.

The risk of infrastructure flooding affecting the development is low.

The site lies within flood zone 1 and has been allocated within the Local Plan. The site therefore passes the Sequential Test and is suitable for residential development. The greatest risk of flooding is from surface water, this is discussed in more detail in Chapter 6 Surface Water Flood Risk and Mitigation.

6. Surface Water Flood Risk and Mitigation

The surface water flood risk data is available as a GIS dataset. The modelled low and medium risk events have been overlaid on the illustrative layout, Figures 18 and 19.

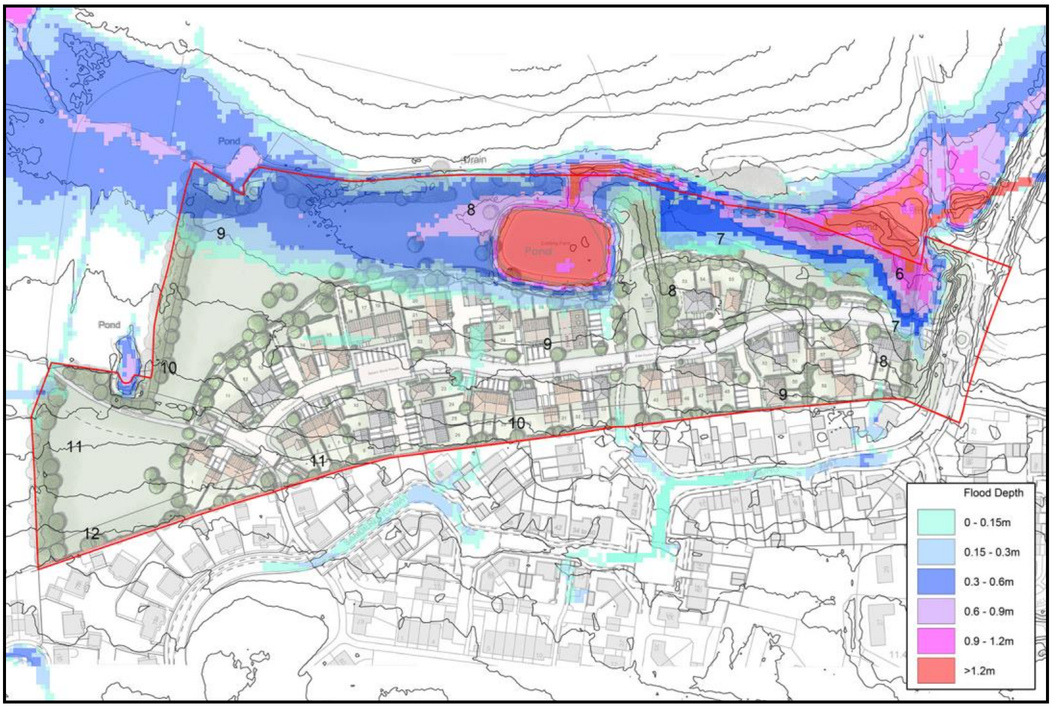


Figure 18. Low risk surface water flood depths overlaid on the proposed layout.

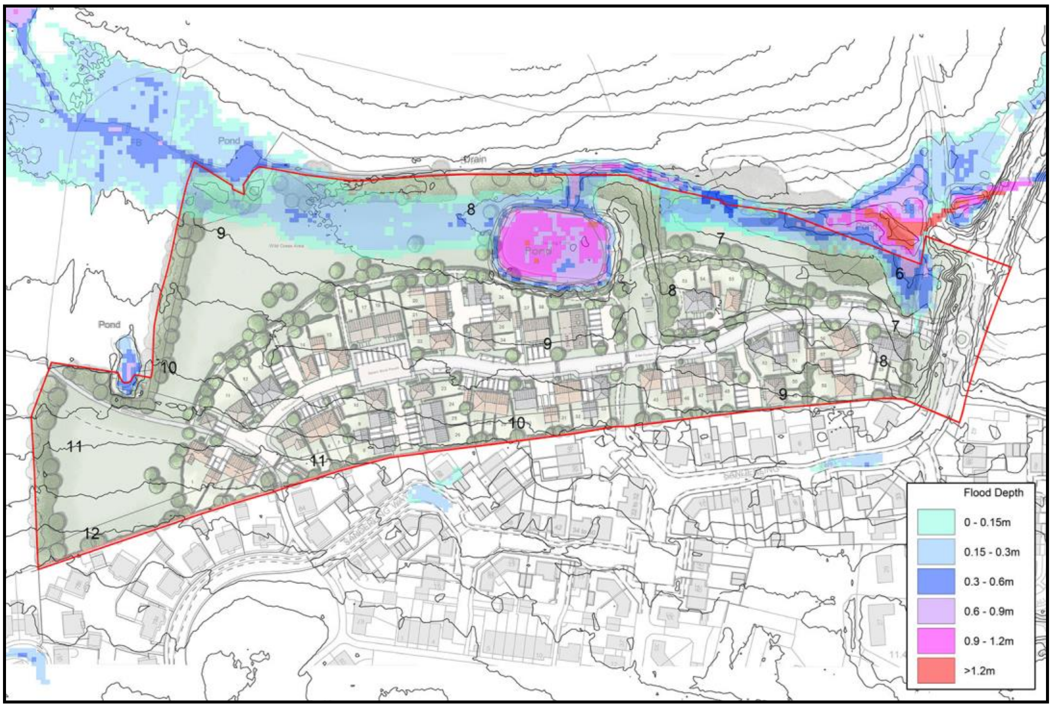


Figure 19. Medium risk surface water flood depths overlaid on the proposed layout.

The modelling carried out to produce the surface water flood maps, by necessity, makes broad assumptions. Structures, such as bridges, culverts and weirs, and flood risk management infrastructure, such as defences, are not always represented.

Inspection of the surface water flood maps suggests that the piped connection under Old Ferry Road and Sheppey Way is modelled in some way however the ditch running along the northern boundary of the site is not until after the attenuation pond within the site.

Inspection of contours generated from Lidar data shows that this ditch is not picked up by the survey. This means that an overland flow path is created between the pond at the northwest corner of the site and the attenuation pond at the centre of the site, Figure 20.

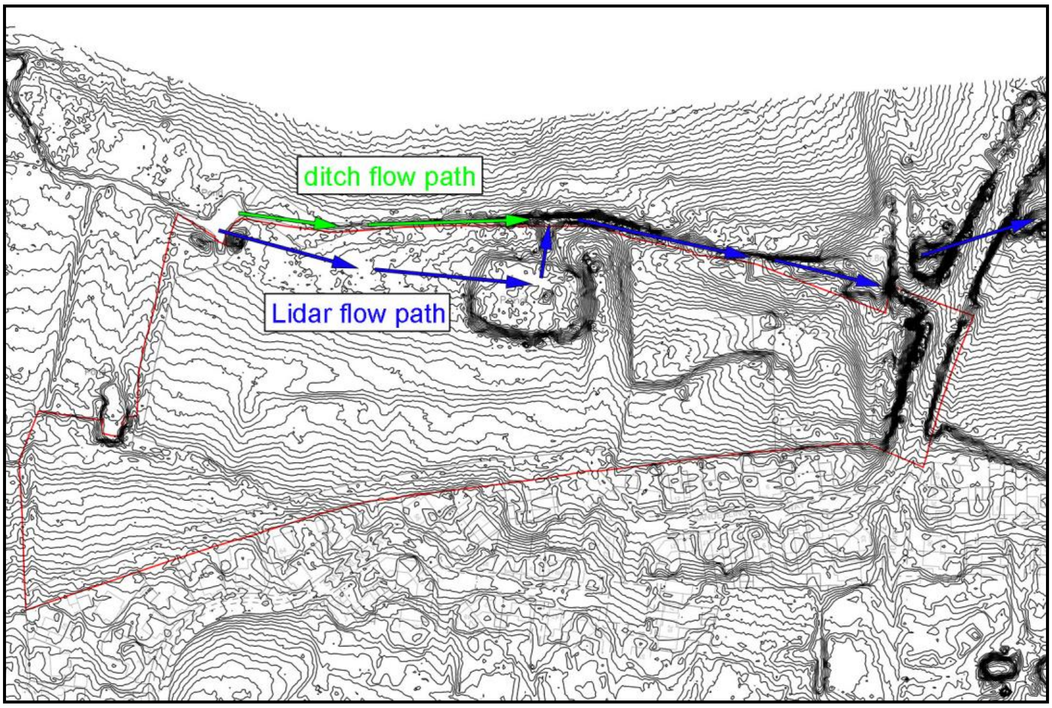


Figure 20. Surface water flow paths.

Conveyance of surface water flooding through the site has been modelled to determine the impact of surface water flooding on any proposed development. The following data have been used:

1. An input hydrograph has been generated using The Revitalised Flood Hydrograph modelling tool (ReFH2).
2. Pipe diameters were measured during a site visit.
3. The topographical survey has been used to determine ditch cross sections.
4. The volume of storage required to accommodate flows given current site constraints has been determine using Micro Drainage Source Control software.
5. The volume available has been determined using contours generated from Lidar data.

Following a pre-application meeting with KCC the catchment area has been increased to allow for connections from the development to the south of the site. The increased catchment has been based on Lidar contours and is shown in Figure 21.

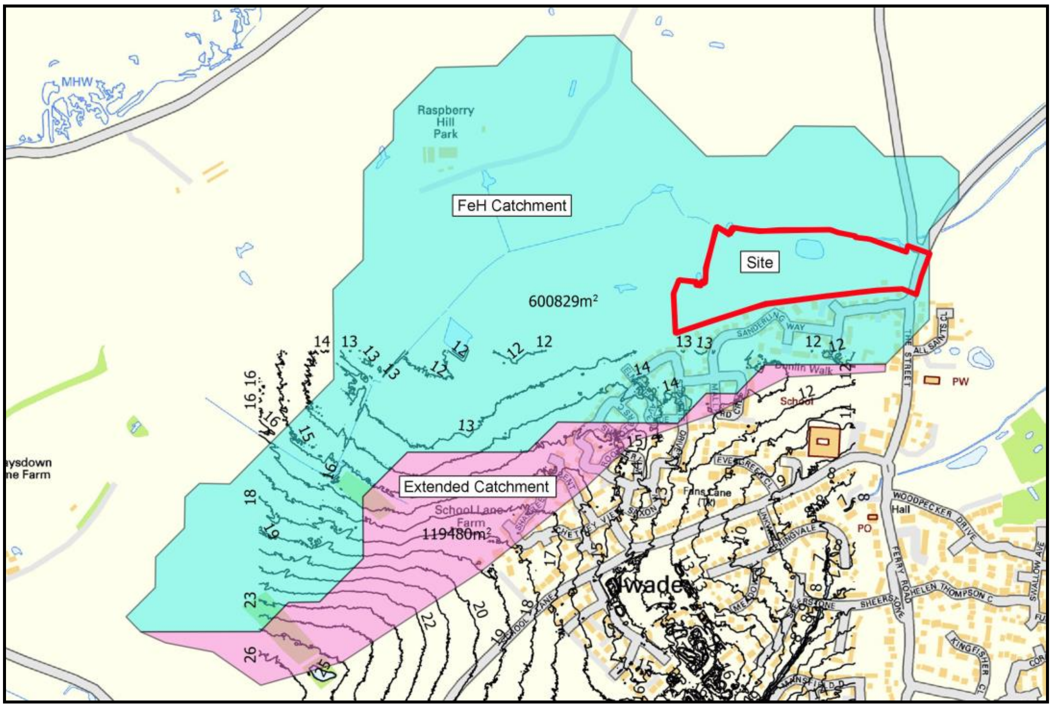


Figure 21. Increased local drainage catchment.

Hydrographs have been generated for various storm return periods using ReFH2 and the FEH22 model. The peak flow at the outlet of the catchment for various return periods is shown in Table 2.

Return Period (year)	Peak Flow (m^3/s)	
	Winter	Summer
1	0.28	0.33
2	0.31	0.37
5	0.42	0.51
30	0.65	0.82
100	0.89	1.16
100+34%	1.22	1.64
100+67%	1.57	2.17
1000	1.62	2.25

Table 2. Peak flows from ReFH2.

Inspection of the topography identifies three possible throttles within the catchment that could influence flood risk at the site:

1. Old Ferry Road and Sheppey Way create barriers to the natural flow path with flow restricted through the concrete pipes under both roads.
2. A narrowing of the topography between the existing pond within the site and the flow path to the east.
3. An inadequate ditch outlet from the existing pond at the northwest corner of the site which leads to overland flow during extreme events.

The location of these throttles is shown in Figure 22.

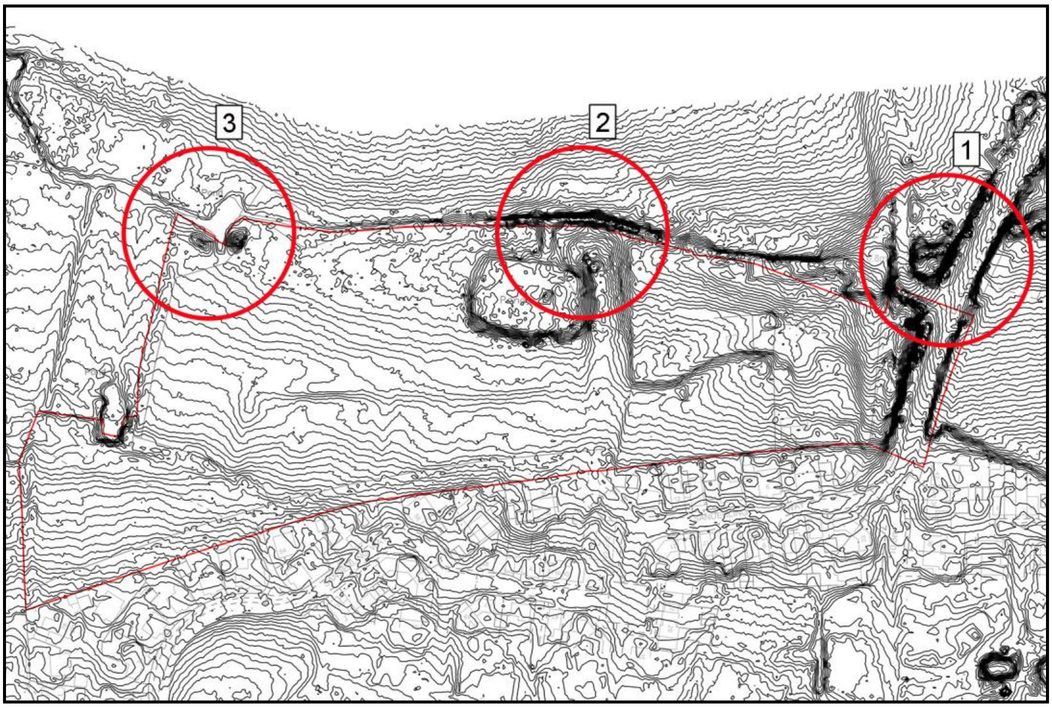


Figure 22. Surface water drainage throttles.

Old Ferry Road/Sheppey Way - The lowest crest level of Old Ferry Road is at 6.4mAOD. Sheppey Way is higher than the land to either side. Water weiring over Old Sheppey Way is retained west of Sheppey Way until a level of 6.6 - 6.7mAOD is reached when a flow path to the north, on the western side of Sheppey Way, is opened up. The land to the northwest is lower and does not provide any restriction to flows.

A simplified model has been used to determine the water level west of Old Ferry Road/Sheppey Way. The parameters used in the model are shown in Table 3. The model output is shown in Appendix C.

Parameter	Value
Minimum Outlet	0.6m diameter pipe with an invert level of 4.8mAOD
Blockage Allowance	Assumed to be 50% blocked resulting in an outlet pipe diameter of 0.4m
Overflow	Weir with a crest level of 6.7mAOD and a width of 10m
Storm Event	1 in 100 year summer + 67% allowance for climate change
Maximum water level	6.940mAOD

Table 3. Simplified model parameters for Old Ferry Road/Sheppey Way.

The 6.9mAOD contour derived from Lidar data is shown in Figure 23. The extent of flooding is does not impact on the development site.

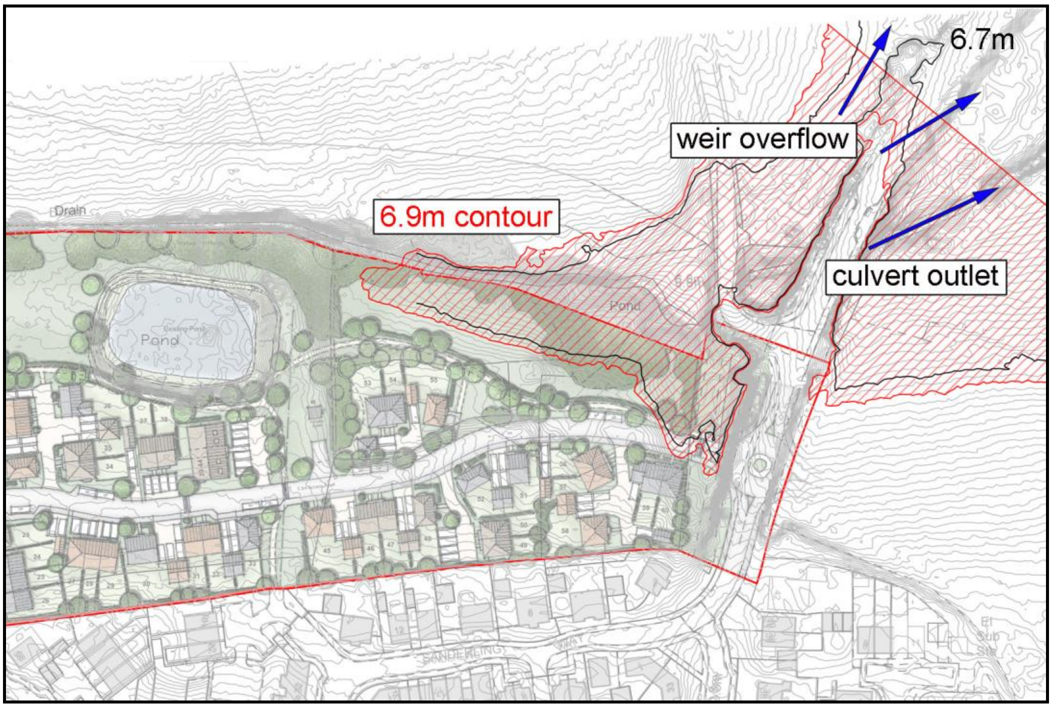


Figure 23. Potential flooding around Old Ferry Road/Sheppey Way.

The model underestimates the outflow from the basin to the north as it assumes a fixed width weir and crest level. In reality as the water level rises the outflow increases. The model demonstrates that the restrictions around Old Ferry Road and Sheppey Way do not affect the development site.

Existing Pond within the Site - The pond has a piped outlet. This has been ignored for the purposes of this modelling. The outlet is the ditch running west to east. The ditch has a typical cross section of $1.5m^3$ near the pond. An equivalent discharge is obtained from a 0.7m diameter pipe. Water weiring out of the pond is constrained by the topography and a weir level of 8.0m and width of 12m is assumed. To the east of the pond the land falls away towards Old Ferry Road.

A simplified model has been used to determine the water level west of the pond. The parameters used in the model are shown in Table 4. The model output is shown in Appendix D.

Parameter	Value
Minimum Outlet	0.7m diameter pipe with an invert level of 7.2mAOD
Blockage Allowance	Assumed to be 50% blocked resulting in an outlet pipe diameter of 0.5m
Overflow	Weir with a crest level of 8.0mAOD and a width of 12m
Storm Event	1 in 100 year summer + 67% allowance for climate change
Maximum water level	8.214mAOD

Table 4. Simplified model parameters for the existing pond.

The 8.2mAOD contour derived from Lidar data is shown in Figure 24. The extent of flooding is does not impact on the development site.

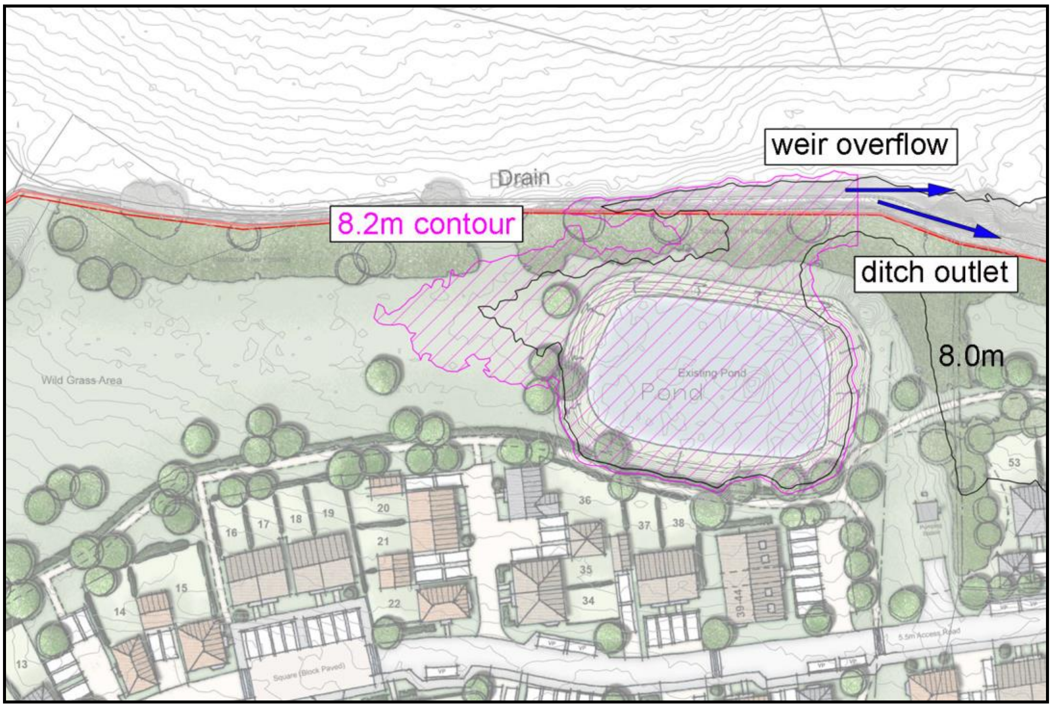


Figure 24. Potential flooding around the existing pond.

Existing Pond at the Northwest Corner of the Site - The pond has a ditch outlet although this is shallow and at a relatively high level, Figure 25. By inspection the ditch outlet is insufficient to accommodate flows from extreme flood events. This results in the overland flow shown in the surface water flood map modelling. Once the water arrives at the existing pond at the centre of the site it flows eastwards as shown above.

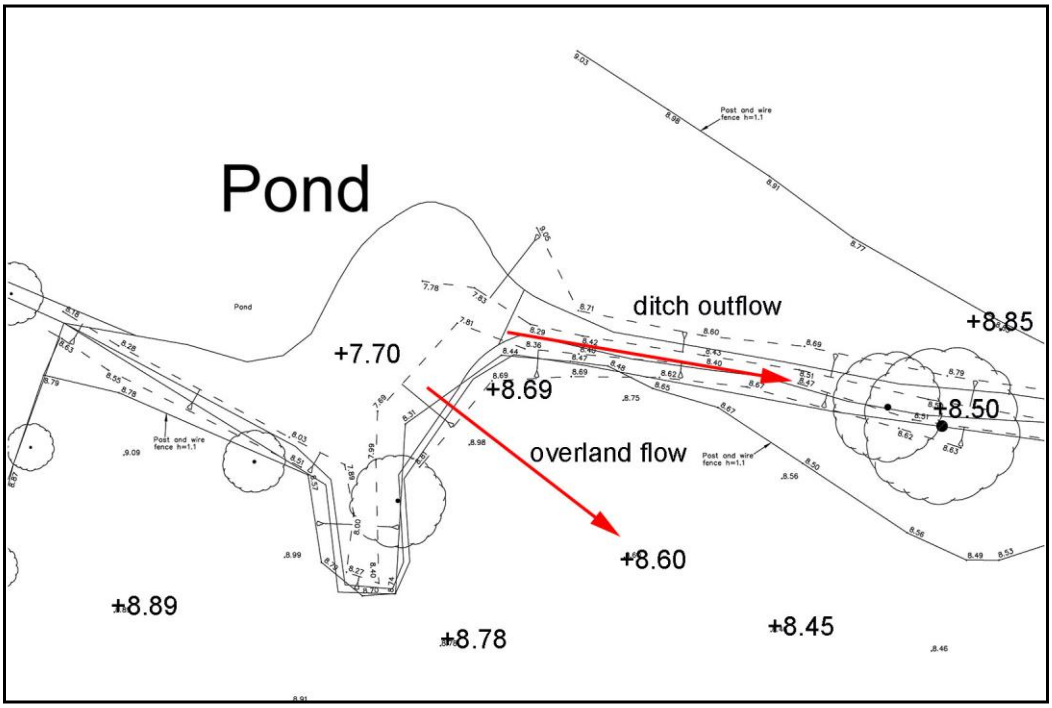


Figure 25. Levels around existing northwest pond.

Based on the above the maximum 1 in 100 year + 67% allowance for climate change flood level at the existing pond is 8.2mAOD. The illustrative layout has been designed to have all built development at least 300mm above this level. All built development is outside the extent of the modelled medium risk surface water flood event. Only two properties are within the extent of the modelled low risk surface water flood modelling. These will have minimum finished floor levels of 8.5mAOD and be at least 300mm above the maximum flood level, calculated above, of 8.2mAOD.

Surface water storage features are all located outside the extent of the modelled medium risk surface water flood event and above the modelled flood levels of 8.2mAOD at the existing pond and 6.9mAOD at the culvert under Old Ferry Road/Sheppey Way, Figure 26.

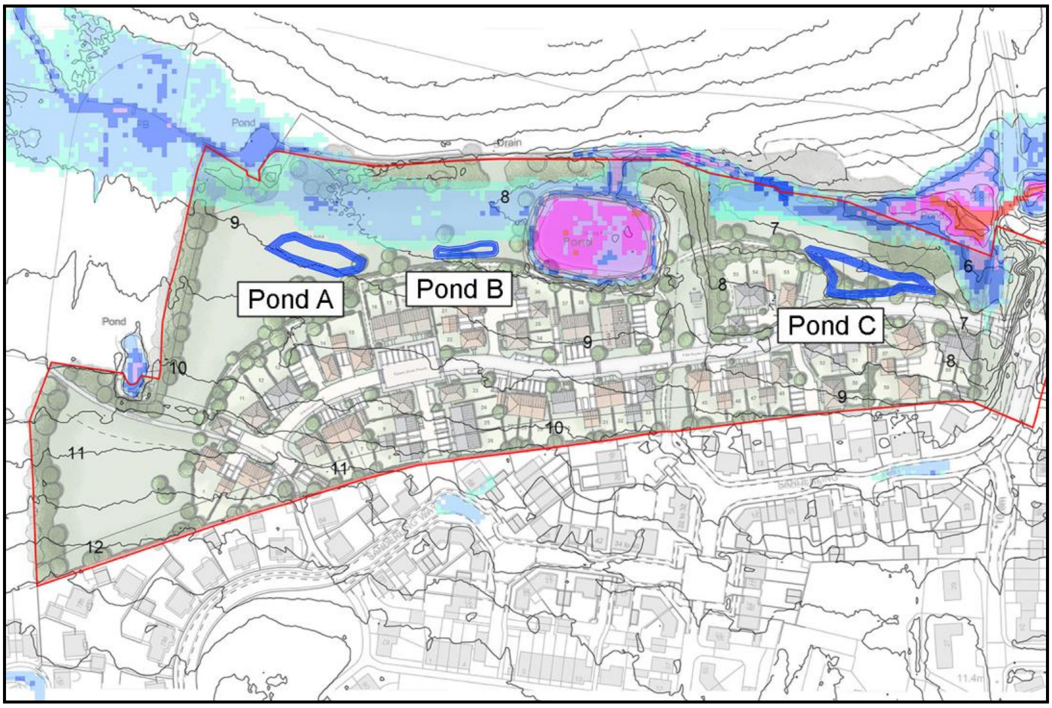


Figure 26. Proposed surface water storage areas.

To maximise the area available for surface water features to serve the proposed development it is proposed to formalise the overland flow path from the north west pond to the central attenuation pond. There are three mechanisms by which this conveyance can be achieved:

1. Clear out and deepen the existing ditch running along the northern boundary.
2. Provide a new ditch/swale between the two ponds.
3. Provide a shallow bund to divert overland flows from the upper to the lower pond and to constrain these flows.

Clearing out the existing ditch is discounted for the purposes of this assessment in order to demonstrate that conveyance can be achieved with minimal disturbance to the existing ditch.

A swale is proposed across the grassed area between the proposed built development and the existing ditch on the northern boundary. This swale will accommodate more frequent flood events, up to the 5 year event. Events greater than the 1 in 5 year event will lead to flow outside the swale channel. This overflow flow will be accommodated by construction a bund between the swale and the proposed development.

The location of the swale and the bund are shown in Figure 27.

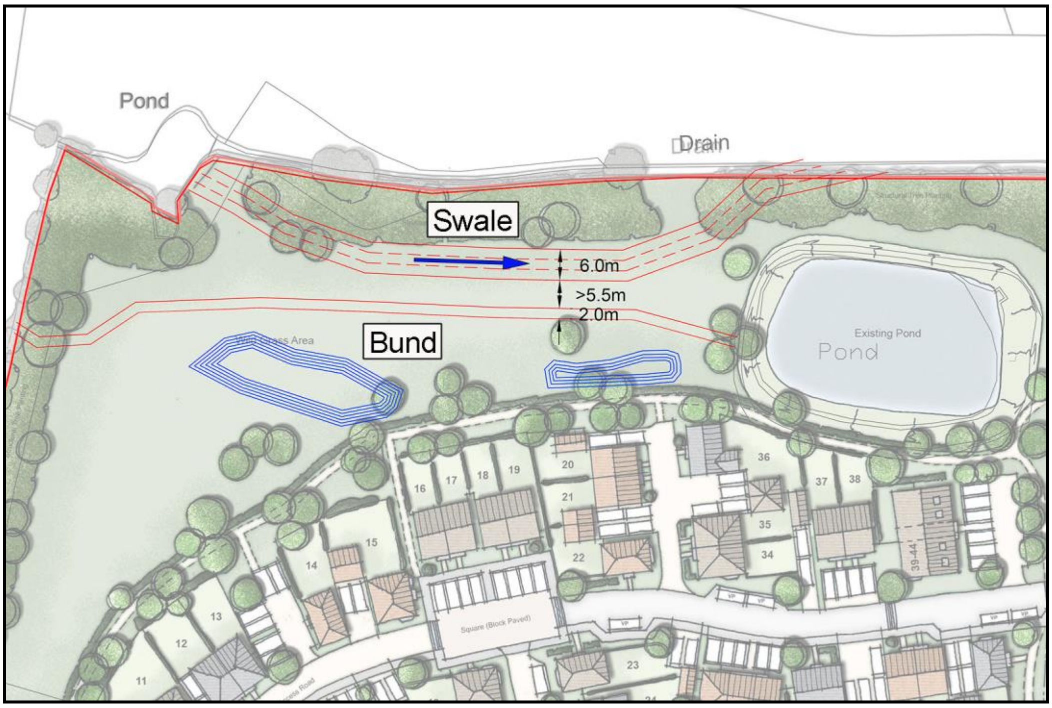


Figure 27. Location of the proposed swale and bund.

The characteristics of the swale and bunded area are detailed in Table 5.

Parameter	Swale Channel	Overland flow	Total Flow
Base width	2m	17m	
Depth	0.5m	0.35m	
Side slope	1 in 4	1 in 4	
Top width	6m	19.8m	
Manning's constant	0.08	0.08	
Gradient	1 in 217	1 in 217	
Discharge Capacity	0.80m^3	2.57m^3	3.37m^3

Table 5. Proposed swale and overland flow parameters.

The total capacity of the swale with bunded area is 3.37m^3. This is greater than the maximum catchment flow under the 1 in 100 year rainfall event with an increase of 67% to allow for climate change of 2.25m^3.

The design is robust as the overland flow area is wider than modelled and the flow into the swale is overestimated as it assumes flows from the whole of the extended catchment discharges to the head of the swale whereas in reality parts will discharge to the existing attenuation pond and to areas downstream of the swale.

The development parcel will be to the south of the bund line. The surface water management structures will be placed between the development and the proposed bund.

7. Climate Change

The impact of climate change will be to reduce the standard of protection provided by current defences with time and increase the risk of flooding in undefended areas.

The current climate change guidance for river flows and rainfall provide a range of increases based on percentiles. For peak river flows three allowances are defined:

- central allowance is based on the 50th percentile
- higher central is based on the 70th percentile
- upper end is based on the 90th percentile

The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it.

The allowances for the North Kent Management Catchment are shown in Table 6.

Allowance	**2020s**	**2050s**	**2080s**
Central	10%	9%	22%
Higher central	15%	17%	34%
Upper end	28%	36%	67%

Table 6. Peak river flow allowances for the North Kent Management Catchment.

The upper end allowance of 67% has been used in this report for robustness.

Peak rainfall climate change allowances are also provided by management catchment. The peak rainfall allowances for the 2050s and 2070s are shown in Table 7.

Annual Exceedance Event	**Central Allowance**		**Upper End Allowance**	
	2050s	**2070s**	**2050s**	**2070s**
3.3%	20%	20%	40%	40%
1%	20%	20%	45%	40%

Table 7. Peak rainfall allowances for the North Kent Management Catchment.

The Planning Practice Guidance suggests that flood risk assessments and strategic flood risk assessments should assess both the Central and Upper End allowances to understand the range of impact. The surface water management strategy includes an increase of 45% in peak rainfall intensity for the calculation of storage requirements.

8. Detailed Development Proposals

The proposed development consists of 60 dwellings. The development area is 4.4ha. Analysis of the illustrative layout indicates that potential impermeable surfaces will cover approximately 9,810m^2, consisting of 4,000m^2 of roof and 5,810m^2 of paving, Figure 28.

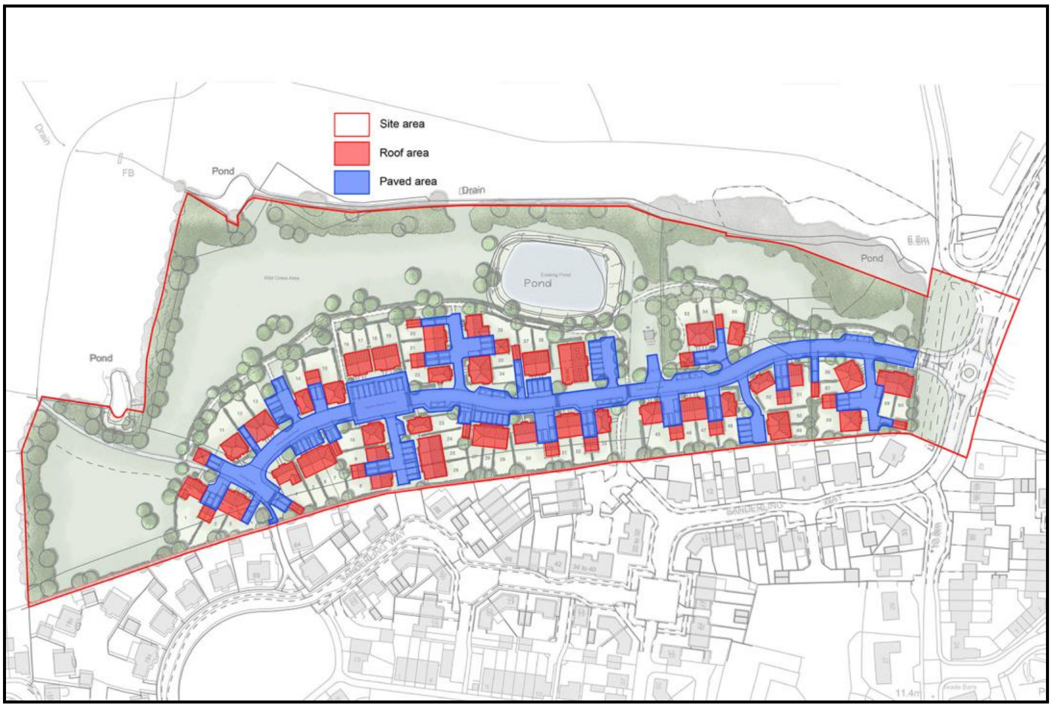


Figure 28. Proposed impermeable areas.

The peak rate of runoff and volume of runoff for the critical storm duration for the existing and proposed site is shown in Table 8.

Storm Return Period (years)	Peak Runoff (Q l/s)		Volume of Runoff 360 minute duration storm (m^3)	
	Existing Greenfield (9,810m^2)	Proposed (9,810m^2)	Existing Greenfield (9,810m^2)	Proposed (9,810m^2)
2	3.8	131	107	203
30	8.5	343	251	438
100	11.9	441	365	604
100 + 20%	14.2	531	438	724
100 + 45%	17.2	642	530	874

Table 8. Peak rate of runoff and volume of runoff from the existing and proposed site.

9. Surface Water Management Strategy

Overview

The surface water management strategy is to provide attenuation for surface water runoff within the site with a controlled discharge to the existing ditch running along the northern site boundary. The existing attenuation pond serving the Sanderling Way development will be retained but will not be used for attenuation from the proposed development.

Drainage Elements

The appropriateness of different SuDS is considered in Table 9.

SuDS Type	Appropriate to site	Comment
Permeable paving (Infiltration)	No	London Clay is unlikely to support infiltration
Permeable paving (Attenuation)	Yes	Permeable paved areas can be used to attenuate runoff from the development
Green roof	No	Traditional pitched roofs are likely to be proposed to match adjacent development
Filter strips	No	Insufficient space within the development
Swales	No	The topography means the drainage along the northern edge of the development is too deep to utilise swales.
Infiltration devices	No	London Clay is unlikely to support infiltration
Filter drains	No	London Clay is unlikely to support infiltration
Infiltration basin	No	London Clay is unlikely to support infiltration
Detention basin	Yes	Detention basins can be used for storage along the northern boundary of the proposed development
Wet pond	Yes	Wet ponds can be used for storage along the northern boundary of the proposed development
On/offline storage	Yes	Appropriate if additional attenuation required

Table 9. SuDS suitability for development.

The following drainage elements are identified as being the most appropriate to the site:

- water butts
- permeable paving (attenuation)
- detention basins
- wet ponds

- piped systems/storage

Water Butts - Water butts act as source control devices intercepting rainfall early in the management train. Water butts will be provided on all residential units. It is recognised that water butts may be full during critical rainfall conditions and not provide storage.

Permeable Paving (Attenuation) - Permeable paving allows water to infiltrate through the surface into a coarse graded sub-base which can store runoff. The base of the pavement is assumed to be lined. For the sub-base storage to operate effectively the system requires flow controls. These are generally small orifice plates in a control chamber and can be very small, minimum 20mm, because the risk of blockage is low since the water has been filtered through the sub-base. The frequency of runoff from permeable paving is significantly reduced when compared to gully and pipe systems draining impermeable surfaces. Permeable paving acts as interception storage and runoff typically does not occur from permeable paving for rainfall events up to 5mm even without infiltration, due to evaporation.

Detention Ponds - Detention ponds are depressions that are usually dry but can accommodate water during extreme rainfall events. They provide temporary storage for storm water runoff.

Wet Ponds - Wet ponds are basins that have a permanent pool of water. They provide temporary storage for additional storm water runoff above the permanent water level.

No distinction is made, in this surface water management strategy, between detention ponds and wet ponds. The strategy considers the volume of storage required either within detention ponds or above the permanent water level in wet ponds.

Piped Systems/Storage - Pipes can be used for connections between SuDS elements. Additional storage can be provided using cellular storage crate systems if required.

Surface Water Management Strategy

The site is underlaid by London Clay with no superficial deposits. Infiltration to ground is not feasible.

There is an open watercourse along the northern boundary of the site and runoff from the existing site discharges to this.

A surface water management strategy based on attenuated discharge to the watercourse is proposed. Storage will be provided by detention ponds with the outflow limited by using vortex control manholes.

The surface water drainage strategy has been analysed using FLOW software published by Causeway. The surface water drainage strategy parameters and calculations are attached at Appendix E.

An illustrative surface water drainage layout is shown on the following drawings attached at Appendix F.

789/DSOA	Illustrative Drainage Layout Overview
789/DS01A	Illustrative Drainage Layout (Sheet 1 of 3)
789/DS02A	Illustrative Drainage Layout (Sheet 2 of 3)
789/DS03A	Illustrative Drainage Layout (Sheet 3 of 3)

The strategy has been designed based on no above ground flooding under the 1 in 100 year rainfall event with an allowance of 45% for climate change.

The runoff from the proposed site is significantly reduced when compared to the existing greenfield site, Table 10.

Storm Return Period (years)	**Peak Runoff (Q l/s)**		
	Existing ($9{,}810m^2$)	**Proposed ($9{,}810m^2$)**	**Proposed (with mitigation)**
2	3.8	131	3.8
30	8.5	343	3.8
100	11.9	441	3.8
100 + 25%	14.2	531	4.1
100 + 40%	17.2	642	4.4

Table 10. Percentage reduction in peak runoff.

A SUDS Management and Maintenance Plan is attached at Appendix G.

The proposed surface water management strategy limits runoff from the site to less than greenfield runoff rates under all storm events up to the 1 in 100 year event plus a 45% allowance for climate change.

Exceedance event flow paths will be to the northwest towards the existing ditch. The exceedance event flow paths for the site are shown on the following drawing attached at Appendix F.

789/DSOA Illustrative Drainage Layout Overview

A summary of the surface water drainage strategy is shown at Appendix H.

10. Water Quality

Runoff discharges to local watercourse network which discharges to The Swale, northeast of the site.

The SuDS Manual gives the following as standards of good practice for water quality:

Water quality standard 1: Prevent runoff from the site to receiving surface waters for the majority of small rainfall events.

No runoff should be discharged from the site to receiving surface waters or sewers for the majority of small (eg < 5 mm) rainfall events. This is termed Interception.

Water quality standard 2: Treat runoff to prevent negative impacts on the receiving water quality.

Runoff should be adequately treated to protect the receiving water body from:

1. Short-term acute pollution that may result from accidental spills or temporary high pollution loadings within the catchment area.
2. Long-term chronic pollution from the spectrum of runoff pollutant sources within the urban environment.

Water Quality Standard 1 - Interception

The detention basins will act as interception storage. Although the analysis above assumes that all surface water runoff is discharged from the site, in reality runoff from smaller events will be retained within the detention basins, maximising evaporation and transpiration. Runoff from rainfall events up to 5mm is unlikely to discharge from the site. The proposed strategy therefore meets the interception standard.

Water Quality Standard 2 - Treatment

The extent of treatment required depends on the land use, the level of pollution prevention in the catchment and for groundwater the natural protection afforded by underlying soil layers. High hazard sites will have a higher potential pollution load and higher potential maximum pollution concentrations. They therefore tend to require more treatment than low hazard sites in order to deliver discharges of an acceptable quality.

The SuDS Manual sets out minimum water quality management requirements for discharges to receiving surface waters and groundwater for various land use types, Table 11. The site consists of two land use types:

1. Roofs to houses classed as *residential roofs*, very low pollution hazard.
2. The access road and parking areas classed as *property driveways/low traffic roads*, low pollution hazard.

Land use	**Pollution hazard level**	**Requirements for discharge to:**	
		surface waters	groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (eg cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (eg schools, offices)	Low	Simple index approach Note: extra measures may be required for discharges to protected resources	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	Simple index approach Note: extra measures may be required for discharges to protected resources	In England and Wales, Risk Screening must be undertaken first to determine whether consultation with the environmental regulator is required.
Trunk roads and motorways	High	Follow the guidance and risk assessment process set out in HA (2009)	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels are to be delivered, handled, stored, used or manufactured, industrial sites	High	Discharges may require an environmental licence or permit. Obtain pre-permitting advice from the environmental regulator. Risk assessment is likely to be required.	
Note 1. Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan. Note 2. Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water. Note 3. Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.			

Table 11. Water quality requirements for discharge to surface waters and groundwater.

For each land use type a simple index approach is appropriate which involves the following steps:

1. Allocate suitable pollution hazard indices for the proposed land use, Table 12.
2. Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index, Table 13.
3. Where the discharge is to protected surface waters or groundwater, consider the need for a more precautionary approach.

Land Use	Pollution hazard level	Total suspended solids	Metals	Hydro-carbons
Residential Roofs	Very low	0.2	0.2	0.05
Other roofs (commercial/industrial)	Low	0.3	0.2[1]	0.05
Individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change (eg schools, offices) <300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites, sites where chemicals and fuels are to be delivered, handled, stored, used or manufactured, industrial sites, trunk roads and motorways[2]	High	0.8[3]	0.8[3]	0.9[3]
Note 1. Up to 0.8 where there is potential for metals to leach from the roof. Note 2. Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009) Note 3. These should only be used if considered appropriate as part of a detailed risk assessment.				

Table 12. Pollution hazard indices for different land use classifications.

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index, for each contaminant type, that equals or exceeds the pollution hazard index, for each contaminant type. Where the mitigation index of an individual component is insufficient, two components, or more, in series will be required. A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components.

Type of SuDS component	Total suspended solids	Metals	Hydro-carbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[1]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention pond	0.5	0.5	0.5
Pond	0.7[2]	0.7	0.5
Wetland[3]	0.8[2]	0.8	0.8
Proprietary treatment system	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		
Note 1. Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan. Note 2. Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water. Note 3. Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.			

Table 13. Indicative SuDS mitigation indices for discharge to surface waters.

For residential roofs the removal of gross solids and sediments only is required. Silt traps and filters will form part of the detailed drainage system to remove solids and sediments. Further treatment is provided within the detention basins. For the access road and parking areas the detention basins proposed provide a total pollution mitigation index equal or greater than the pollution hazard index for all pollutants, Table 14.

All runoff from the site will therefore receive an appropriate level of water quality treatment.

Indices	Total suspended solids	Metals	Hydro-carbons
Residential roofs			
Maximum hazard index	0.2	0.2	0.05
SuDS mitigation index (detention basin)	0.5	0.5	0.5
Appropriate treatment	✓	✓	✓
Access road/parking areas			
Maximum hazard index	0.5	0.4	0.4
SuDS mitigation index (detention basin)	0.5	0.5	0.5
Appropriate treatment	✓	✓	✓

Table 14. Pollution hazard indices and SuDS mitigation indices for the development.

11. Conclusion

This Surface Water Management Strategy incorporating a Flood Risk Assessment accompanies a planning application for proposed residential development on land at Sanderling Way, Iwade, Sittingbourne, ME9 8TE.

A pre-application meeting was held with Kent County Council KCC as Lead Local Flood Authority. The approach taken within this report was discussed and agreed with KCC.

The site is located to the north of Sanderling Way, Iwade. It is a greenfield site that is currently rough pasture and covers 4.4ha.

An outline planning application is being made for residential development for 60 dwellings. An illustrative layout for the proposed development has been produced.

The site lies within flood zone 1 and has been allocated within the Local Plan. The site therefore passes the Sequential Test and is suitable for residential development. The greatest risk of flooding is from surface water.

A swale is proposed across the grassed area between the proposed built development and the existing ditch on the northern boundary. This swale will accommodate more frequent flood events, up to the 5 year event. Events greater than the 1 in 5 year event will lead to flow outside the swale channel. This overflow flow will be accommodated by construction a bund between the swale and the proposed development. The development parcel will be to the south of the bund line. The surface water management structures will be placed between the development and the proposed bund.

Analysis of the illustrative layout indicates that potential impermeable surfaces will cover approximately 9,810m^2, consisting of 4,000m^2 of roof and 5,810m^2 of paving.

The surface water management strategy is to provide attenuation for surface water runoff within the site with a controlled discharge to the existing ditch running along the northern site boundary. The existing attenuation pond serving the Sanderling Way development will be retained but will not be used for attenuation from the proposed development.

The proposed surface water management strategy limits runoff from the site to less than greenfield runoff rates under all storm events up to the 1 in 100 year event plus a 45% allowance for climate change. Exceedance event flow paths will be to the northwest towards the existing ditch.

The detention basins will act as interception storage. Runoff from rainfall events up to 5mm is unlikely to discharge from the site. The proposed strategy therefore meets the interception water quality standard. For residential roofs the removal of gross solids and sediments only is required. Silt traps and filters will form part of the detailed drainage system to remove solids and sediments. Further treatment is provided within the detention basins. For the access road and parking areas the detention basins proposed provide a total pollution mitigation index equal or greater than the pollution hazard index for all pollutants. All runoff from the site will therefore receive an appropriate level of water quality treatment as recommended within the SuDS Manual.

The proposed development is considered acceptable from a surface water management and flood risk perspective.

Appendix A - FEH Catchment Descriptors

VERSION	"FEH CD-ROM"	Version	3	exported a	14:45:04	GMT	Fri	19-Jan-18
CATCHMENT	GB	590150	168300	TQ 90150 68300				
CENTROID	GB	589495	168080	TQ 89495 68080				
AREA	0.6025							
ALTBAR	15							
ASPBAR	67							
ASPVAR	0.75							
BFIHOST	0.255							
DPLBAR	0.8							
DPSBAR	11.1							
FARL	1							
FPEXT	0.1701							
FPDBAR	0.627							
FPLOC	0.548							
LDP	1.72							
PROPWET	0.21							
RMED-1H	12.2							
RMED-1D	30.5							
RMED-2D	37.2							
SAAR	573							
SAAR4170	575							
SPRHOST	47.04							
URBCONC1990	0.5							
URBEXT1990	0.0124							
URBLOC1990	1.222							
URBCONC2000	0.143							
URBEXT2000	0.0124							
URBLOC2000	0.182							
C	-0.02461							
D1	0.2993							
D2	0.36536							
D3	0.25737							
E	0.31366							
F	2.54894							
C(1 km)	-0.025							
D1(1 km)	0.301							
D2(1 km)	0.366							
D3(1 km)	0.258							
E(1 km)	0.314							
F(1 km)	2.546							

Appendix B - Public Sewer Record

(c) Crown copyright and database rights 2023 Ordnance Survey 100031673	Date: 09/10/23	Scale: 1:1250	Map Centre: 589916,168064	Data updated: 21/08/23	Our Ref: 1292309 - 2	Wastewater Plan A3

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2023 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer
Combined Gravity Sewer
Culverted Water Course or Treated Effluent
Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon
Combined Outfall
Surface Water Outfall
Foul Outfall
Surface Water Inlet
Combined Pumping Station
Surface Water Pumping Station
Foul Pumping Station
Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway

robert.beck@rmbconsultants.co.uk

Iwade

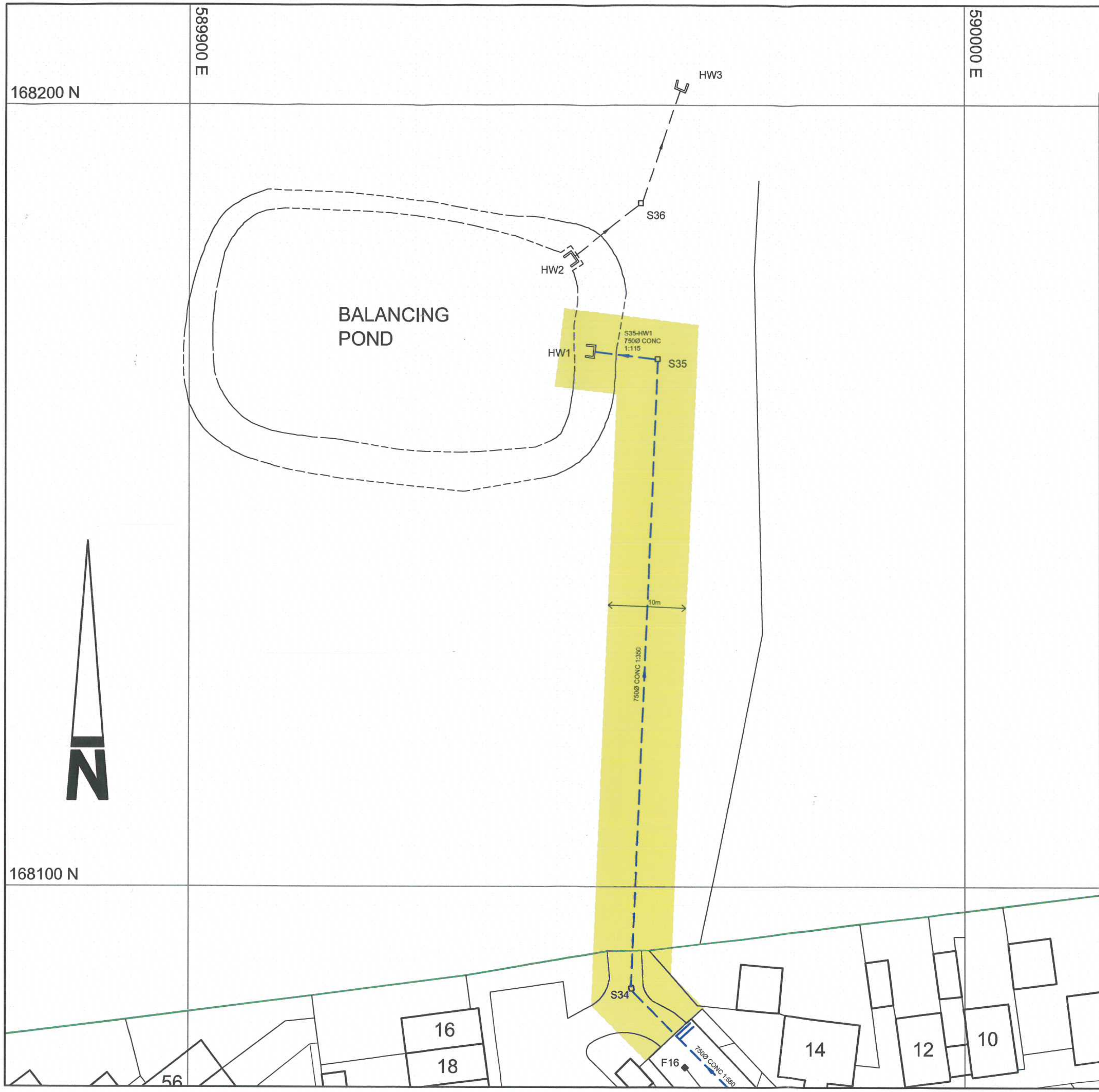
WATER for LIFE

from Southern Water.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0001	F	10.05	9.15	
0002	F	9.92	7.90	
0003	F	10.02	7.71	
0004	F	10.26	8.75	
0005	F	10.04	8.25	
0006	F	9.73	8.13	
0007	F	9.77	8.01	
0902	F	12.04	6.28	
1001	F	0.00	0.00	
1002	F	0.00	0.00	
1003	F	0.00	0.00	
1004	F	0.00	0.00	
1005	F	0.00	0.00	
1006	F	0.00	0.00	
1101	F	0.00	0.00	
1901	F	0.00	0.00	
7901	F	13.24	12.10	
7902	F	13.68	1.86	
8001	F	11.37	8.80	
8002	F	11.13	8.94	
8003	F	11.28	9.03	
8004	F	12.03	9.36	
8005	F	12.49	9.50	
8006	F	12.73	9.62	
8007	F	0.00	0.00	
8008	F	0.00	0.00	
8901	F	12.97	9.81	
8902	F	13.35	10.00	
8903	F	13.04	10.19	
8905	F	0.00	0.00	
9001	F	10.36	7.38	
9002	F	11.25	7.13	
9003	F	10.10	7.60	
9004	F	11.48	7.01	
9005	F	11.53	8.51	
9901	F	11.98	6.76	
1050	S	10.22	8.37	
1051	S	10.75	8.25	
1052	S	11.07	8.10	
1053	S	10.96	8.04	
6953	S	13.13	11.59	
6954	S	13.22	11.50	
7951	S	13.64	11.98	
7952	S	13.21	11.73	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert



NOTES:

1. GRID IS NATIONAL GRID.
2. BACKGROUND INFORMATION TAKEN FROM ORDNANCE SURVEY DIGITAL DATA.

KEY:

SEWER EASEMENT

Rev	Revision Details	Date
1	Amendments made at request of Southern Water.	14/01/09

MILTON KEYNES SURVEYS LTD
Land & Building Surveys * 3D Laser Scanning * CAD Bureau
Datum House
41 Burners Lane South
Kiln Farm
Milton Keynes
MK11 3HA
Tel : 01908 565561
Fax : 01908 261030
E-mail : mail@mksurveys.co.uk
Web : www.mksurveys.co.uk

TDS (Southern) Ltd
Knight House
Farren Court
The Street
Cowfold
West Sussex
RH13 8BP
Tel 01403 864450
Fax 01403 864480

Client : BARRATT

Sewer Easement Plan :

Sanderling Way
Iwade
Kent

Dwg Number :	Sheet Number :	Revision :
13024_SE	-	1

Scale :	Date :	Surveyed By :
1 : 500 @ A3	December 2008	MKS

Appendix C - Old Ferry Road/Sheppey Way Throttle Analysis

Summary of Results for Input Hydrograph

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
Input Hydrograph	6.940	1.940	448.9	1696.6	2145.6	3600.3	Flood Risk

Storm Event	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
Input Hydrograph	0.0	86381.9	43294.3	540

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
30	22.8	810	1246.4	1590	137.3	2370	84.6	3150	52.1	3930	32.1
60	27.3	840	1152.4	1620	134.7	2400	83.0	3180	51.2	3960	31.5
90	36.5	870	1066.7	1650	132.2	2430	81.5	3210	50.2	3990	30.9
120	52.4	900	986.7	1680	129.8	2460	80.0	3240	49.3	4020	30.4
150	77.9	930	910.8	1710	127.4	2490	78.5	3270	48.4	4050	29.8
180	118.1	960	837.7	1740	125.1	2520	77.1	3300	47.5	4080	29.3
210	182.9	990	766.7	1770	122.8	2550	75.6	3330	46.6	4110	28.7
240	297.2	1020	697.1	1800	120.5	2580	74.3	3360	45.8	4140	28.2
270	465.6	1050	628.1	1830	118.3	2610	72.9	3390	44.9	4170	27.7
300	667.1	1080	559.7	1860	116.1	2640	71.5	3420	44.1	4200	27.2
330	887.4	1110	492.4	1890	113.9	2670	70.2	3450	43.3	4230	26.7
360	1118.4	1140	426.8	1920	111.8	2700	68.9	3480	42.5	4260	26.2
390	1353.0	1170	364.0	1950	109.8	2730	67.6	3510	41.7	4290	25.7
420	1584.3	1200	305.9	1980	107.8	2760	66.4	3540	40.9	4320	25.2
450	1803.2	1230	256.8	2010	105.8	2790	65.2	3570	40.2	4350	24.8
480	1993.1	1260	222.8	2040	103.8	2820	64.0	3600	39.4	4380	24.3
510	2121.4	1290	199.2	2070	101.9	2850	62.8	3630	38.7	4410	23.8
540	2157.4	1320	182.2	2100	100.0	2880	61.6	3660	38.0	4440	23.4
570	2133.4	1350	169.9	2130	98.2	2910	60.5	3690	37.3	4470	23.0
600	2070.3	1380	161.2	2160	96.4	2940	59.4	3720	36.6	4500	22.6
630	1979.7	1410	155.0	2190	94.6	2970	58.3	3750	35.9	4530	22.1
660	1869.7	1440	150.8	2220	92.8	3000	57.2	3780	35.3		
690	1746.1	1470	147.9	2250	91.1	3030	56.2	3810	34.6		
720	1613.8	1500	145.1	2280	89.4	3060	55.1	3840	34.0		
750	1479.3	1530	142.5	2310	87.8	3090	54.1	3870	33.3		
780	1353.8	1560	139.8	2340	86.2	3120	53.1	3900	32.7		

Model Details

Storage is Online Cover Level (m) 7.100

Tank or Pond Structure

Invert Level (m) 5.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	50.0	1.400	2150.0	2.800	0.0	4.200	0.0
0.200	170.0	1.600	4310.0	3.000	0.0	4.400	0.0
0.400	280.0	1.800	5800.0	3.200	0.0	4.600	0.0
0.600	550.0	2.000	7180.0	3.400	0.0	4.800	0.0
0.800	710.0	2.100	7920.0	3.600	0.0	5.000	0.0
1.000	1030.0	2.400	0.0	3.800	0.0		
1.200	1580.0	2.600	0.0	4.000	0.0		

Pipe Outflow Control

Diameter (m)	0.400	Entry Loss Coefficient	0.500
Slope (1:X)	50.0	Coefficient of Contraction	0.600
Length (m)	30.000	Upstream Invert Level (m)	4.800
Roughness k (mm)	1.500		

Weir Overflow Control

Discharge Coef 0.460 Width (m) 10.000 Invert Level (m) 6.700

Appendix D - Existing Pond Throttle Analysis

Summary of Results for Input Hydrograph

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
Input Hydrograph	8.214	1.014	447.2	1708.6	2155.8	1043.4	O K

Storm Event	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
Input Hydrograph	0.0	86377.8	45614.8	540

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
30	22.8	810	1246.4	1590	137.3	2370	84.6	3150	52.1	3930	32.1
60	27.3	840	1152.4	1620	134.7	2400	83.0	3180	51.2	3960	31.5
90	36.5	870	1066.7	1650	132.2	2430	81.5	3210	50.2	3990	30.9
120	52.4	900	986.7	1680	129.8	2460	80.0	3240	49.3	4020	30.4
150	77.9	930	910.8	1710	127.4	2490	78.5	3270	48.4	4050	29.8
180	118.1	960	837.7	1740	125.1	2520	77.1	3300	47.5	4080	29.3
210	182.9	990	766.7	1770	122.8	2550	75.6	3330	46.6	4110	28.7
240	297.2	1020	697.1	1800	120.5	2580	74.3	3360	45.8	4140	28.2
270	465.6	1050	628.1	1830	118.3	2610	72.9	3390	44.9	4170	27.7
300	667.1	1080	559.7	1860	116.1	2640	71.5	3420	44.1	4200	27.2
330	887.4	1110	492.4	1890	113.9	2670	70.2	3450	43.3	4230	26.7
360	1118.4	1140	426.8	1920	111.8	2700	68.9	3480	42.5	4260	26.2
390	1353.0	1170	364.0	1950	109.8	2730	67.6	3510	41.7	4290	25.7
420	1584.3	1200	305.9	1980	107.8	2760	66.4	3540	40.9	4320	25.2
450	1803.2	1230	256.8	2010	105.8	2790	65.2	3570	40.2	4350	24.8
480	1993.1	1260	222.8	2040	103.8	2820	64.0	3600	39.4	4380	24.3
510	2121.4	1290	199.2	2070	101.9	2850	62.8	3630	38.7	4410	23.8
540	2157.4	1320	182.2	2100	100.0	2880	61.6	3660	38.0	4440	23.4
570	2133.4	1350	169.9	2130	98.2	2910	60.5	3690	37.3	4470	23.0
600	2070.3	1380	161.2	2160	96.4	2940	59.4	3720	36.6	4500	22.6
630	1979.7	1410	155.0	2190	94.6	2970	58.3	3750	35.9	4530	22.1
660	1869.7	1440	150.8	2220	92.8	3000	57.2	3780	35.3		
690	1746.1	1470	147.9	2250	91.1	3030	56.2	3810	34.6		
720	1613.8	1500	145.1	2280	89.4	3060	55.1	3840	34.0		
750	1479.3	1530	142.5	2310	87.8	3090	54.1	3870	33.3		
780	1353.8	1560	139.8	2340	86.2	3120	53.1	3900	32.7		

Model Details

Storage is Online Cover Level (m) 9.000

Tank or Pond Structure

Invert Level (m) 7.200

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	1.400	5670.0	2.800	0.0	4.200	0.0
0.200	0.0	1.600	8270.0	3.000	0.0	4.400	0.0
0.400	0.0	1.800	14750.0	3.200	0.0	4.600	0.0
0.600	1810.0	2.000	0.0	3.400	0.0	4.800	0.0
0.800	2110.0	2.200	0.0	3.600	0.0	5.000	0.0
1.000	2820.0	2.400	0.0	3.800	0.0		
1.200	3990.0	2.600	0.0	4.000	0.0		

Pipe Outflow Control

Diameter (m)	0.500	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	30.000	Upstream Invert Level (m)	7.200
Roughness k (mm)	1.500		

Weir Overflow Control

Discharge Coef 0.460 Width (m) 12.000 Invert Level (m) 8.000

Appendix E - Surface Water Strategy Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	5	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	2.000
CV	0.750	Preferred Cover Depth (m)	0.900
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
14		5.00	9.100	1200	589828.088	168165.077	1.645
20		5.00	8.450	1200	589879.939	168169.652	1.450
21			8.300	1200	589879.899	168171.652	1.367
22			8.100	1200	589908.423	168196.806	1.547
38		5.00	8.000	1200	590036.949	168161.153	1.700
39			6.000	1200	590043.077	168176.888	0.746
39_OUT			6.000	1200	590046.506	168179.605	0.790
23	0.079	5.00	9.550	1200	589913.237	168117.869	1.125
24		5.00	9.050	1200	589952.076	168137.062	1.125
25	0.095	5.00	9.350	1200	589953.834	168122.916	1.642
26	0.066	5.00	9.000	1200	589997.533	168128.349	1.552
27	0.034	5.00	8.700	1200	589999.622	168139.374	1.125
28	0.007	5.00	8.900	1200	590003.568	168131.298	1.490
29	0.024	5.00	9.050	1200	590016.061	168109.934	1.050
30	0.013	5.00	8.750	1200	590010.534	168125.014	1.050
31			8.800	1200	590006.713	168132.834	1.405
32	0.037	5.00	8.300	1200	590024.276	168141.417	1.200
33	0.013	5.00	8.450	1200	590066.376	168115.154	1.050
34	0.023	5.00	8.620	1200	590077.445	168140.012	1.050
35	0.039	5.00	8.410	1200	590064.119	168141.359	1.271
36	0.041	5.00	8.210	1350	590049.726	168142.813	1.890
37			8.000	1350	590049.452	168147.806	1.698
1	0.088	5.00	10.800	1200	589792.591	168087.500	1.425
2	0.084	5.00	10.000	1200	589815.850	168108.453	1.425
3	0.006	5.00	9.700	1200	589803.838	168134.056	1.292
4			9.600	1200	589801.714	168138.583	1.747
5			9.100	1200	589811.622	168158.238	1.643
6	0.064	5.00	10.300	1200	589859.868	168088.469	1.425
7	0.032	5.00	9.700	1200	589854.438	168117.900	1.425
8	0.002	5.00	9.950	1200	589827.018	168112.841	1.350
9			9.800	1200	589837.982	168114.864	1.400
10	0.047	5.00	9.700	1200	589842.292	168117.398	1.497
11	0.011	5.00	9.450	1200	589835.990	168128.116	1.321
12	0.021	5.00	9.050	1200	589831.313	168151.827	1.515
13			9.000	1200	589830.345	168156.732	1.543
15	0.014	5.00	9.500	1200	589903.354	168118.266	1.350
16	0.006	5.00	9.500	1200	589869.853	168121.218	1.350
17	0.107	5.00	9.450	1200	589885.417	168122.926	1.560
18	0.027	5.00	8.500	1200	589881.545	168158.218	1.271
19			8.450	1200	589881.000	168163.189	1.449

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	14	21	52.227	0.600	7.455	6.933	0.522	100.1	100	6.13	73.5
2.000	20	21	2.000	0.600	7.000	6.933	0.067	29.9	150	5.02	80.1
1.001	21	22	38.031	0.600	6.933	6.553	0.380	100.1	150	6.76	70.2
1.002	22	39	136.119	0.600	6.553	5.254	1.299	104.8	150	9.08	60.4
3.000	38	39	16.886	0.600	6.300	5.254	1.046	16.1	150	5.11	79.6
1.003	39	39_OUT	4.375	0.600	5.254	5.210	0.044	99.4	150	9.15	60.1
4.000	23	25	40.910	0.600	8.425	7.783	0.642	63.7	225	5.42	77.7
5.000	24	25	14.255	0.600	7.925	7.783	0.142	100.4	225	5.18	79.1
4.001	25	26	44.035	0.600	7.708	7.448	0.260	169.4	300	6.02	74.1
4.002	26	28	6.717	0.600	7.448	7.410	0.038	176.8	300	6.12	73.6
6.000	27	28	8.988	0.600	7.575	7.485	0.090	99.9	225	5.11	79.6
4.003	28	31	3.500	0.600	7.410	7.395	0.015	233.3	300	6.18	73.3
7.000	29	30	16.061	0.600	8.000	7.700	0.300	53.5	150	5.19	79.1
7.001	30	31	8.704	0.600	7.700	7.545	0.155	56.2	150	5.30	78.4
4.004	31	32	19.548	0.600	7.395	7.100	0.295	66.3	300	6.34	72.4
4.005	32	36	25.488	0.600	7.100	6.845	0.255	100.0	300	6.62	71.0
8.000	33	35	26.302	0.600	7.400	7.139	0.261	100.8	150	5.44	77.6
9.000	34	35	13.394	0.600	7.570	7.139	0.431	31.1	150	5.12	79.5
8.001	35	36	14.466	0.600	7.139	6.995	0.144	100.5	150	5.68	76.2
4.006	36	37	5.001	0.600	6.770	6.750	0.020	250.0	375	6.69	70.6
10.000	1	2	31.305	0.600	9.375	8.575	0.800	39.1	225	5.25	78.7
10.001	2	3	28.281	0.600	8.575	8.408	0.167	169.3	225	5.72	75.9
10.002	3	4	5.001	0.600	8.408	8.378	0.030	166.7	225	5.80	75.4
10.003	4	5	22.011	0.600	8.303	8.209	0.094	234.2	300	6.16	73.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.768	6.0	0.0	1.545	1.267	0.000	0.0	0	0.000
2.000	1.849	32.7	0.0	1.300	1.217	0.000	0.0	0	0.000
1.001	1.004	17.7	0.0	1.217	1.397	0.000	0.0	0	0.000
1.002	0.981	17.3	0.0	1.397	0.596	0.000	0.0	0	0.000
3.000	2.519	44.5	0.0	1.550	0.596	0.000	0.0	0	0.000
1.003	1.008	17.8	0.0	0.596	0.640	0.000	0.0	0	0.000
4.000	1.641	65.2	16.7	0.900	1.342	0.079	0.0	78	1.382
5.000	1.305	51.9	0.0	0.900	1.342	0.000	0.0	0	0.000
4.001	1.205	85.2	35.0	1.342	1.252	0.174	0.0	134	1.148
4.002	1.179	83.4	47.9	1.252	1.190	0.240	0.0	163	1.219
6.000	1.308	52.0	7.4	0.900	1.190	0.034	0.0	57	0.928
4.003	1.025	72.4	55.9	1.190	1.105	0.281	0.0	198	1.127
7.000	1.378	24.3	5.1	0.900	0.900	0.024	0.0	47	1.093
7.001	1.345	23.8	7.8	0.900	1.105	0.037	0.0	59	1.204
4.004	1.934	136.7	62.4	1.105	0.900	0.318	0.0	142	1.891
4.005	1.572	111.1	68.4	0.900	1.065	0.355	0.0	170	1.650
8.000	1.001	17.7	2.8	0.900	1.121	0.013	0.0	40	0.731
9.000	1.812	32.0	4.9	0.900	1.121	0.023	0.0	40	1.315
8.001	1.002	17.7	15.4	1.121	1.065	0.075	0.0	109	1.127
4.006	1.141	126.0	90.2	1.065	0.875	0.471	0.0	235	1.237
10.000	2.097	83.4	18.8	1.200	1.200	0.088	0.0	73	1.704
10.001	1.002	39.8	35.3	1.200	1.067	0.172	0.0	166	1.128
10.002	1.010	40.1	36.3	1.067	0.997	0.178	0.0	168	1.139
10.003	1.023	72.3	35.4	0.997	0.591	0.178	0.0	148	1.017

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
11.000	6	7	29.928	0.600	8.875	8.275	0.600	49.9	225	5.27	78.6
11.001	7	10	12.156	0.600	8.275	8.203	0.072	168.8	225	5.47	77.4
12.000	8	9	11.149	0.600	8.600	8.400	0.200	55.7	150	5.14	79.4
12.001	9	10	5.000	0.600	8.400	8.278	0.122	41.0	150	5.19	79.1
11.002	10	11	12.433	0.600	8.203	8.129	0.074	168.0	225	5.68	76.2
11.003	11	12	24.168	0.600	8.129	7.985	0.144	167.8	225	6.08	73.8
11.004	12	13	5.000	0.600	7.985	7.955	0.030	166.7	225	6.16	73.4
13.000	15	17	18.532	0.600	8.150	7.965	0.185	100.2	150	5.31	78.4
14.000	16	17	15.657	0.600	8.150	7.965	0.185	84.6	150	5.24	78.8
13.001	17	18	35.504	0.600	7.890	7.679	0.211	168.3	225	5.90	74.9
13.002	18	19	5.001	0.600	7.679	7.649	0.030	166.7	225	5.98	74.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
11.000	1.856	73.8	13.6	1.200	1.200	0.064	0.0	65	1.428
11.001	1.003	39.9	20.1	1.200	1.272	0.096	0.0	113	1.005
12.000	1.350	23.9	0.4	1.200	1.250	0.002	0.0	14	0.507
12.001	1.576	27.9	0.4	1.250	1.272	0.002	0.0	13	0.559
11.002	1.006	40.0	29.9	1.272	1.096	0.145	0.0	145	1.100
11.003	1.006	40.0	31.2	1.096	0.840	0.156	0.0	150	1.110
11.004	1.010	40.1	35.3	0.840	0.820	0.177	0.0	164	1.135
13.000	1.004	17.7	3.0	1.200	1.335	0.014	0.0	42	0.751
14.000	1.093	19.3	1.3	1.200	1.335	0.006	0.0	27	0.627
13.001	1.005	40.0	25.9	1.335	0.596	0.128	0.0	132	1.068
13.002	1.010	40.1	31.2	0.596	0.576	0.155	0.0	150	1.113

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	52.227	100.1	100	Circular	9.100	7.455	1.545	8.300	6.933	1.267
2.000	2.000	29.9	150	Circular	8.450	7.000	1.300	8.300	6.933	1.217
1.001	38.031	100.1	150	Circular	8.300	6.933	1.217	8.100	6.553	1.397
1.002	136.119	104.8	150	Circular	8.100	6.553	1.397	6.000	5.254	0.596
3.000	16.886	16.1	150	Circular	8.000	6.300	1.550	6.000	5.254	0.596
1.003	4.375	99.4	150	Circular	6.000	5.254	0.596	6.000	5.210	0.640
4.000	40.910	63.7	225	Circular	9.550	8.425	0.900	9.350	7.783	1.342
5.000	14.255	100.4	225	Circular	9.050	7.925	0.900	9.350	7.783	1.342
4.001	44.035	169.4	300	Circular	9.350	7.708	1.342	9.000	7.448	1.252

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	14	1200	Manhole	Adoptable	21	1200	Manhole	Adoptable
2.000	20	1200	Manhole	Adoptable	21	1200	Manhole	Adoptable
1.001	21	1200	Manhole	Adoptable	22	1200	Manhole	Adoptable
1.002	22	1200	Manhole	Adoptable	39	1200	Manhole	Adoptable
3.000	38	1200	Manhole	Adoptable	39	1200	Manhole	Adoptable
1.003	39	1200	Manhole	Adoptable	39_OUT	1200	Manhole	Adoptable
4.000	23	1200	Manhole	Adoptable	25	1200	Manhole	Adoptable
5.000	24	1200	Manhole	Adoptable	25	1200	Manhole	Adoptable
4.001	25	1200	Manhole	Adoptable	26	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.002	6.717	176.8	300	Circular	9.000	7.448	1.252	8.900	7.410	1.190
6.000	8.988	99.9	225	Circular	8.700	7.575	0.900	8.900	7.485	1.190
4.003	3.500	233.3	300	Circular	8.900	7.410	1.190	8.800	7.395	1.105
7.000	16.061	53.5	150	Circular	9.050	8.000	0.900	8.750	7.700	0.900
7.001	8.704	56.2	150	Circular	8.750	7.700	0.900	8.800	7.545	1.105
4.004	19.548	66.3	300	Circular	8.800	7.395	1.105	8.300	7.100	0.900
4.005	25.488	100.0	300	Circular	8.300	7.100	0.900	8.210	6.845	1.065
8.000	26.302	100.8	150	Circular	8.450	7.400	0.900	8.410	7.139	1.121
9.000	13.394	31.1	150	Circular	8.620	7.570	0.900	8.410	7.139	1.121
8.001	14.466	100.5	150	Circular	8.410	7.139	1.121	8.210	6.995	1.065
4.006	5.001	250.0	375	Circular	8.210	6.770	1.065	8.000	6.750	0.875
10.000	31.305	39.1	225	Circular	10.800	9.375	1.200	10.000	8.575	1.200
10.001	28.281	169.3	225	Circular	10.000	8.575	1.200	9.700	8.408	1.067
10.002	5.001	166.7	225	Circular	9.700	8.408	1.067	9.600	8.378	0.997
10.003	22.011	234.2	300	Circular	9.600	8.303	0.997	9.100	8.209	0.591
11.000	29.928	49.9	225	Circular	10.300	8.875	1.200	9.700	8.275	1.200
11.001	12.156	168.8	225	Circular	9.700	8.275	1.200	9.700	8.203	1.272
12.000	11.149	55.7	150	Circular	9.950	8.600	1.200	9.800	8.400	1.250
12.001	5.000	41.0	150	Circular	9.800	8.400	1.250	9.700	8.278	1.272
11.002	12.433	168.0	225	Circular	9.700	8.203	1.272	9.450	8.129	1.096
11.003	24.168	167.8	225	Circular	9.450	8.129	1.096	9.050	7.985	0.840
11.004	5.000	166.7	225	Circular	9.050	7.985	0.840	9.000	7.955	0.820
13.000	18.532	100.2	150	Circular	9.500	8.150	1.200	9.450	7.965	1.335
14.000	15.657	84.6	150	Circular	9.500	8.150	1.200	9.450	7.965	1.335
13.001	35.504	168.3	225	Circular	9.450	7.890	1.335	8.500	7.679	0.596

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
4.002	26	1200	Manhole	Adoptable	28	1200	Manhole	Adoptable
6.000	27	1200	Manhole	Adoptable	28	1200	Manhole	Adoptable
4.003	28	1200	Manhole	Adoptable	31	1200	Manhole	Adoptable
7.000	29	1200	Manhole	Adoptable	30	1200	Manhole	Adoptable
7.001	30	1200	Manhole	Adoptable	31	1200	Manhole	Adoptable
4.004	31	1200	Manhole	Adoptable	32	1200	Manhole	Adoptable
4.005	32	1200	Manhole	Adoptable	36	1350	Manhole	Adoptable
8.000	33	1200	Manhole	Adoptable	35	1200	Manhole	Adoptable
9.000	34	1200	Manhole	Adoptable	35	1200	Manhole	Adoptable
8.001	35	1200	Manhole	Adoptable	36	1350	Manhole	Adoptable
4.006	36	1350	Manhole	Adoptable	37	1350	Manhole	Adoptable
10.000	1	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
10.001	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
10.002	3	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
10.003	4	1200	Manhole	Adoptable	5	1200	Manhole	Adoptable
11.000	6	1200	Manhole	Adoptable	7	1200	Manhole	Adoptable
11.001	7	1200	Manhole	Adoptable	10	1200	Manhole	Adoptable
12.000	8	1200	Manhole	Adoptable	9	1200	Manhole	Adoptable
12.001	9	1200	Manhole	Adoptable	10	1200	Manhole	Adoptable
11.002	10	1200	Manhole	Adoptable	11	1200	Manhole	Adoptable
11.003	11	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
11.004	12	1200	Manhole	Adoptable	13	1200	Manhole	Adoptable
13.000	15	1200	Manhole	Adoptable	17	1200	Manhole	Adoptable
14.000	16	1200	Manhole	Adoptable	17	1200	Manhole	Adoptable
13.001	17	1200	Manhole	Adoptable	18	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
13.002	5.001	166.7	225	Circular	8.500	7.679	0.596	8.450	7.649	0.576

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
13.002	18	1200	Manhole	Adoptable	19	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
14	589828.088	168165.077	9.100	1.645	1200	0	1.000	7.455	100
20	589879.939	168169.652	8.450	1.450	1200	0	2.000	7.000	150
21	589879.899	168171.652	8.300	1.367	1200	1	2.000	6.933	150
						2	1.000	6.933	100
						0	1.001	6.933	150
22	589908.423	168196.806	8.100	1.547	1200	1	1.001	6.553	150
						0	1.002	6.553	150
38	590036.949	168161.153	8.000	1.700	1200	0	3.000	6.300	150
39	590043.077	168176.888	6.000	0.746	1200	1	3.000	5.254	150
						2	1.002	5.254	150
						0	1.003	5.254	150
39_OUT	590046.506	168179.605	6.000	0.790	1200	1	1.003	5.210	150
23	589913.237	168117.869	9.550	1.125	1200	0	4.000	8.425	225
24	589952.076	168137.062	9.050	1.125	1200	0	5.000	7.925	225
25	589953.834	168122.916	9.350	1.642	1200	1	5.000	7.783	225
						2	4.000	7.783	225
						0	4.001	7.708	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
26	589997.533	168128.349	9.000	1.552	1200	1	4.001	7.448	300
						0	4.002	7.448	300
27	589999.622	168139.374	8.700	1.125	1200	0	6.000	7.575	225
28	590003.568	168131.298	8.900	1.490	1200	1	6.000	7.485	225
						2	4.002	7.410	300
						0	4.003	7.410	300
29	590016.061	168109.934	9.050	1.050	1200	0	7.000	8.000	150
30	590010.534	168125.014	8.750	1.050	1200	1	7.000	7.700	150
						0	7.001	7.700	150
31	590006.713	168132.834	8.800	1.405	1200	1	7.001	7.545	150
						2	4.003	7.395	300
						0	4.004	7.395	300
32	590024.276	168141.417	8.300	1.200	1200	1	4.004	7.100	300
						0	4.005	7.100	300
33	590066.376	168115.154	8.450	1.050	1200	0	8.000	7.400	150
34	590077.445	168140.012	8.620	1.050	1200	0	9.000	7.570	150
35	590064.119	168141.359	8.410	1.271	1200	1	9.000	7.139	150
						2	8.000	7.139	150
						0	8.001	7.139	150
36	590049.726	168142.813	8.210	1.890	1350	1	8.001	6.995	150
						2	4.005	6.845	300
						0	4.006	6.770	375
37	590049.452	168147.806	8.000	1.698	1350	1	4.006	6.750	375
1	589792.591	168087.500	10.800	1.425	1200	0	10.000	9.375	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
2	589815.850	168108.453	10.000	1.425	1200	1	10.000	8.575	225
						0	10.001	8.575	225
3	589803.838	168134.056	9.700	1.292	1200	1	10.001	8.408	225
						0	10.002	8.408	225
4	589801.714	168138.583	9.600	1.747	1200	1	10.002	8.378	225
						0	10.003	8.303	300
5	589811.622	168158.238	9.100	1.643	1200	1	10.003	8.209	300
6	589859.868	168088.469	10.300	1.425	1200	0	11.000	8.875	225
7	589854.438	168117.900	9.700	1.425	1200	1	11.000	8.275	225
						0	11.001	8.275	225
8	589827.018	168112.841	9.950	1.350	1200	0	12.000	8.600	150
9	589837.982	168114.864	9.800	1.400	1200	1	12.000	8.400	150
						0	12.001	8.400	150
10	589842.292	168117.398	9.700	1.497	1200	1	12.001	8.278	150
						2	11.001	8.203	225
						0	11.002	8.203	225
11	589835.990	168128.116	9.450	1.321	1200	1	11.002	8.129	225
						0	11.003	8.129	225
12	589831.313	168151.827	9.050	1.515	1200	1	11.003	7.985	225
						0	11.004	7.985	225
13	589830.345	168156.732	9.000	1.543	1200	1	11.004	7.955	225
15	589903.354	168118.266	9.500	1.350	1200	0	13.000	8.150	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
16	589869.853	168121.218	9.500	1.350	1200				
						0	14.000	8.150	150
17	589885.417	168122.926	9.450	1.560	1200	1	14.000	7.965	150
						2	13.000	7.965	150
						0	13.001	7.890	225
18	589881.545	168158.218	8.500	1.271	1200	1	13.001	7.679	225
						0	13.002	7.679	225
19	589881.000	168163.189	8.450	1.449	1200	1	13.002	7.649	225

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m^3/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	2880	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	20	0	0
100	45	0	0

Node 14 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	7.455	Product Number	CTL-SHE-0047-1000-1000-1000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.0	Min Node Diameter (mm)	1200

Node 20 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	7.000	Product Number	CTL-SHE-0051-1000-0650-1000
Design Depth (m)	0.650	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.0	Min Node Diameter (mm)	1200

Node 38 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	6.300	Product Number	CTL-SHE-0067-2000-1000-2000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 14 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	18.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	7.455	Main Channel Slope (1:X)	9999.0
Safety Factor	2.0	Time to half empty (mins)	1980	Main Channel n	0.300

Inlets

5	13

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	167.0	0.0	0.600	306.0	0.0	1.200	412.0	0.0
0.200	211.0	0.0	0.800	358.0	0.0	1.400	412.0	0.0
0.400	257.0	0.0	1.000	412.0	0.0	1.645	412.0	0.0

Node 20 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	6.600
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	7.000	Main Channel Slope (1:X)	9999.0
Safety Factor	2.0	Time to half empty (mins)	570	Main Channel n	0.030

Inlets

19

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	34.0	0.0	0.200	64.0	0.0	0.400	96.0	0.0	0.650	140.0	0.0

Node 38 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	18.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	6.300	Main Channel Slope (1:X)	9999.0
Safety Factor	2.0	Time to half empty (mins)	660	Main Channel n	0.030

Inlets

37

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	219.0	0.0	0.400	345.0	0.0	0.800	487.0	0.0
0.200	280.0	0.0	0.600	415.0	0.0	1.000	563.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	14	585	7.759	0.304	3.4	0.3444	0.0000	SURCHARGED
240 minute winter	20	196	7.298	0.298	2.9	0.3372	0.0000	SURCHARGED
960 minute summer	21	555	6.966	0.033	1.8	0.0369	0.0000	OK
240 minute summer	22	296	6.586	0.033	1.8	0.0371	0.0000	OK
360 minute winter	38	336	6.567	0.267	6.5	0.3022	0.0000	SURCHARGED
720 minute winter	39	555	5.305	0.051	3.8	0.0573	0.0000	OK
720 minute winter	39_OUT	555	5.257	0.047	3.8	0.0000	0.0000	OK
15 minute winter	23	10	8.484	0.059	10.0	0.1502	0.0000	OK
15 minute summer	24	1	7.925	0.000	0.0	0.0000	0.0000	OK
15 minute winter	25	11	7.809	0.101	21.5	0.2300	0.0000	OK
15 minute winter	26	11	7.594	0.146	29.0	0.2886	0.0000	OK
15 minute winter	27	10	7.619	0.044	4.3	0.0763	0.0000	OK
15 minute winter	28	11	7.555	0.145	33.9	0.1782	0.0000	OK
15 minute winter	29	10	8.035	0.035	3.0	0.0557	0.0000	OK
15 minute winter	30	10	7.746	0.046	4.5	0.0635	0.0000	OK
15 minute winter	31	11	7.508	0.113	38.4	0.1281	0.0000	OK
15 minute winter	32	11	7.236	0.136	42.8	0.2373	0.0000	OK
15 minute winter	33	10	7.431	0.031	1.7	0.0427	0.0000	OK
15 minute winter	34	10	7.600	0.030	2.8	0.0467	0.0000	OK
15 minute winter	35	11	7.219	0.080	9.2	0.1388	0.0000	OK
15 minute winter	36	11	6.967	0.197	56.3	0.3952	0.0000	OK
360 minute winter	37	336	6.567	0.265	11.2	0.3794	0.0000	OK
15 minute winter	1	10	9.430	0.055	11.1	0.1298	0.0000	OK
15 minute winter	2	11	8.695	0.120	21.4	0.2758	0.0000	OK
15 minute winter	3	11	8.540	0.132	21.7	0.1613	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute winter	14	1.000	21	0.8	0.573	0.137	0.0977	
240 minute winter	20	2.000	21	1.0	0.522	0.031	0.0040	
960 minute summer	21	1.001	22	1.8	0.645	0.103	0.1078	
240 minute summer	22	1.002	39	1.8	0.463	0.105	0.5471	
360 minute winter	38	3.000	39	1.9	0.650	0.044	0.0570	
720 minute winter	39	1.003	39_OUT	3.8	0.759	0.211	0.0216	235.8
15 minute winter	23	4.000	25	9.6	1.176	0.148	0.3356	
15 minute summer	24	5.000	25	0.0	0.000	0.000	0.0154	
15 minute winter	25	4.001	26	21.1	0.783	0.248	1.2023	
15 minute winter	26	4.002	28	29.0	0.858	0.348	0.2273	
15 minute winter	27	6.000	28	4.3	0.696	0.083	0.0706	
15 minute winter	28	4.003	31	33.9	1.169	0.468	0.1017	
15 minute winter	29	7.000	30	2.9	0.764	0.121	0.0622	
15 minute winter	30	7.001	31	4.4	1.001	0.187	0.0386	
15 minute winter	31	4.004	32	38.4	1.391	0.281	0.5399	
15 minute winter	32	4.005	36	42.4	1.431	0.381	0.7557	
15 minute winter	33	8.000	35	1.6	0.282	0.093	0.1594	
15 minute winter	34	9.000	35	2.8	0.497	0.087	0.0802	
15 minute winter	35	8.001	36	9.0	0.982	0.511	0.1334	
15 minute winter	36	4.006	37	56.1	1.041	0.445	0.2696	
360 minute winter	37	Flow through pond	38	6.5	0.018	0.001	69.3054	
15 minute winter	1	10.000	2	10.9	0.770	0.131	0.4522	
15 minute winter	2	10.001	3	21.0	0.924	0.528	0.6449	
15 minute winter	3	10.002	4	21.8	0.968	0.542	0.1125	

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	4	11	8.420	0.117	21.8	0.1325	0.0000	OK
600 minute winter	5	585	7.767	0.310	6.4	0.3508	0.0000	OK
15 minute winter	6	10	8.924	0.049	8.0	0.1004	0.0000	OK
15 minute winter	7	11	8.363	0.088	11.9	0.1393	0.0000	OK
15 minute summer	8	10	8.610	0.010	0.2	0.0118	0.0000	OK
15 minute summer	9	12	8.409	0.009	0.2	0.0104	0.0000	OK
15 minute winter	10	11	8.316	0.113	17.6	0.1990	0.0000	OK
15 minute winter	11	11	8.242	0.113	18.9	0.1465	0.0000	OK
15 minute winter	12	11	8.115	0.130	21.5	0.1998	0.0000	OK
600 minute winter	13	570	7.763	0.306	2.8	0.3461	0.0000	OK
15 minute winter	15	11	8.182	0.032	1.8	0.0431	0.0000	OK
15 minute winter	16	10	8.170	0.020	0.8	0.0248	0.0000	OK
15 minute winter	17	10	7.988	0.098	16.0	0.2457	0.0000	OK
15 minute winter	18	11	7.800	0.121	19.0	0.2160	0.0000	OK
240 minute winter	19	196	7.298	0.297	4.7	0.3360	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	4	10.003	5	21.5	0.880	0.298	0.5402	
600 minute winter	5	Flow through pond	14	3.4	0.005	0.004	60.9072	
15 minute winter	6	11.000	7	7.9	0.773	0.107	0.3114	
15 minute winter	7	11.001	10	11.7	0.681	0.293	0.2092	
15 minute summer	8	12.000	9	0.2	0.449	0.008	0.0052	
15 minute summer	9	12.001	10	0.2	0.407	0.007	0.0089	
15 minute winter	10	11.002	11	17.6	0.884	0.441	0.2480	
15 minute winter	11	11.003	12	19.0	0.869	0.475	0.5286	
15 minute winter	12	11.004	13	21.3	0.963	0.531	0.1108	
600 minute winter	13	Flow through pond	14	3.4	0.005	0.004	60.9072	
15 minute winter	15	13.000	17	1.7	0.636	0.098	0.0506	
15 minute winter	16	14.000	17	0.8	0.507	0.039	0.0244	
15 minute winter	17	13.001	18	15.6	0.829	0.390	0.6733	
15 minute winter	18	13.002	19	19.0	0.938	0.473	0.1012	
240 minute winter	19	Flow through pond	20	2.9	0.016	0.000	16.8186	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	14	1380	8.109	0.654	6.2	0.7398	0.0000	SURCHARGED
360 minute winter	20	352	7.602	0.602	4.4	0.6812	0.0000	SURCHARGED
15 minute summer	21	16	6.966	0.033	1.8	0.0373	0.0000	OK
15 minute winter	22	228	6.586	0.033	1.8	0.0371	0.0000	OK
720 minute winter	38	705	6.884	0.584	8.1	0.6608	0.0000	SURCHARGED
960 minute summer	39	465	5.305	0.051	3.8	0.0573	0.0000	OK
960 minute summer	39_OUT	465	5.257	0.047	3.8	0.0000	0.0000	OK
15 minute winter	23	10	8.528	0.103	27.2	0.2620	0.0000	OK
15 minute summer	24	1	7.925	0.000	0.0	0.0000	0.0000	OK
15 minute winter	25	11	7.886	0.178	59.3	0.4077	0.0000	OK
15 minute winter	26	11	7.782	0.334	79.9	0.6619	0.0000	SURCHARGED
15 minute winter	27	11	7.718	0.143	11.7	0.2485	0.0000	OK
15 minute winter	28	11	7.717	0.307	90.7	0.3772	0.0000	SURCHARGED
15 minute winter	29	10	8.059	0.059	8.1	0.0935	0.0000	OK
15 minute winter	30	10	7.783	0.083	12.4	0.1147	0.0000	OK
15 minute winter	31	11	7.633	0.238	102.4	0.2689	0.0000	OK
15 minute winter	32	11	7.460	0.360	112.7	0.6305	0.0000	SURCHARGED
15 minute winter	33	10	7.451	0.051	4.6	0.0713	0.0000	OK
15 minute winter	34	10	7.620	0.050	7.8	0.0785	0.0000	OK
15 minute winter	35	11	7.431	0.292	25.5	0.5068	0.0000	SURCHARGED
15 minute winter	36	11	7.134	0.364	148.8	0.7298	0.0000	OK
720 minute winter	37	705	6.884	0.582	14.2	0.8332	0.0000	OK
15 minute winter	1	10	9.468	0.093	30.2	0.2192	0.0000	OK
15 minute winter	2	11	9.079	0.504	58.6	1.1631	0.0000	SURCHARGED
15 minute winter	3	11	8.697	0.289	57.0	0.3536	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	14	1.000	21	0.8	0.577	0.137	0.0976	
360 minute winter	20	2.000	21	1.0	0.523	0.031	0.0040	
15 minute summer	21	1.001	22	1.8	0.699	0.103	0.1077	
15 minute winter	22	1.002	39	1.8	0.462	0.105	0.5463	
720 minute winter	38	3.000	39	2.0	0.714	0.044	0.0571	
960 minute summer	39	1.003	39_OUT	3.8	0.760	0.211	0.0216	471.4
15 minute winter	23	4.000	25	26.9	1.522	0.412	0.7218	
15 minute summer	24	5.000	25	0.0	0.000	0.000	0.1192	
15 minute winter	25	4.001	26	57.7	0.951	0.678	2.5115	
15 minute winter	26	4.002	28	78.1	1.110	0.937	0.4730	
15 minute winter	27	6.000	28	10.8	0.677	0.207	0.2983	
15 minute winter	28	4.003	31	90.3	1.390	1.247	0.2280	
15 minute winter	29	7.000	30	8.0	0.972	0.329	0.1325	
15 minute winter	30	7.001	31	12.2	1.284	0.513	0.0895	
15 minute winter	31	4.004	32	100.7	1.574	0.737	1.2736	
15 minute winter	32	4.005	36	112.2	1.602	1.010	1.7840	
15 minute winter	33	8.000	35	4.5	0.331	0.254	0.3018	
15 minute winter	34	9.000	35	7.7	0.580	0.241	0.1525	
15 minute winter	35	8.001	36	23.2	1.319	1.311	0.2503	
15 minute winter	36	4.006	37	148.3	1.465	1.176	0.4973	
720 minute winter	37	Flow through pond	38	8.1	0.019	0.001	181.5946	
15 minute winter	1	10.000	2	29.9	0.928	0.359	0.8635	
15 minute winter	2	10.001	3	55.1	1.384	1.382	1.1248	
15 minute winter	3	10.002	4	56.8	1.434	1.416	0.1913	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	4	11	8.515	0.212	56.8	0.2397	0.0000	OK
1440 minute winter	5	1380	8.115	0.658	3.7	0.7441	0.0000	OK
15 minute winter	6	10	8.958	0.083	22.0	0.1689	0.0000	OK
15 minute winter	7	12	8.633	0.358	32.7	0.5651	0.0000	SURCHARGED
15 minute winter	8	10	8.617	0.017	0.7	0.0201	0.0000	OK
15 minute winter	9	12	8.586	0.186	3.8	0.2105	0.0000	SURCHARGED
15 minute winter	10	12	8.585	0.382	43.5	0.6722	0.0000	SURCHARGED
15 minute winter	11	12	8.472	0.343	45.1	0.4450	0.0000	SURCHARGED
15 minute winter	12	12	8.246	0.261	51.1	0.4004	0.0000	SURCHARGED
1440 minute winter	13	1380	8.109	0.652	4.9	0.7378	0.0000	OK
15 minute winter	15	10	8.203	0.053	4.9	0.0715	0.0000	OK
15 minute winter	16	10	8.183	0.033	2.1	0.0405	0.0000	OK
15 minute winter	17	11	8.181	0.291	43.8	0.7289	0.0000	SURCHARGED
15 minute winter	18	11	7.929	0.250	48.9	0.4481	0.0000	SURCHARGED
360 minute winter	19	352	7.602	0.601	7.8	0.6801	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	4	10.003	5	56.2	1.145	0.778	1.0853	
1440 minute winter	5	Flow through pond	14	6.2	0.005	0.008	157.6928	
15 minute winter	6	11.000	7	21.8	0.907	0.295	0.7948	
15 minute winter	7	11.001	10	28.2	0.737	0.708	0.4835	
15 minute winter	8	12.000	9	0.7	0.584	0.028	0.1042	
15 minute winter	9	12.001	10	3.5	0.414	0.125	0.0880	
15 minute winter	10	11.002	11	42.1	1.058	1.052	0.4945	
15 minute winter	11	11.003	12	45.4	1.141	1.134	0.9612	
15 minute winter	12	11.004	13	51.3	1.301	1.277	0.1881	
1440 minute winter	13	Flow through pond	14	6.2	0.005	0.008	157.6928	
15 minute winter	15	13.000	17	4.8	0.625	0.272	0.2150	
15 minute winter	16	14.000	17	2.1	0.517	0.107	0.1603	
15 minute winter	17	13.001	18	40.2	1.012	1.007	1.4120	
15 minute winter	18	13.002	19	48.7	1.243	1.214	0.1863	
360 minute winter	19	Flow through pond	20	4.4	0.008	0.001	48.7873	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	14	1410	8.361	0.906	5.0	1.0251	0.0000	SURCHARGED
960 minute winter	20	765	7.782	0.782	3.2	0.8847	0.0000	SURCHARGED
960 minute winter	21	915	6.967	0.034	2.0	0.0387	0.0000	OK
960 minute winter	22	915	6.587	0.034	2.0	0.0389	0.0000	OK
1440 minute winter	38	1380	7.134	0.834	7.1	0.9435	0.0000	SURCHARGED
960 minute winter	39	930	5.305	0.051	3.8	0.0577	0.0000	OK
960 minute winter	39_OUT	930	5.257	0.047	3.8	0.0000	0.0000	OK
15 minute winter	23	10	8.540	0.115	34.6	0.2920	0.0000	OK
15 minute winter	24	12	8.187	0.262	4.1	0.2965	0.0000	SURCHARGED
15 minute winter	25	12	8.173	0.465	75.6	1.0636	0.0000	SURCHARGED
15 minute winter	26	12	8.013	0.565	88.8	1.1201	0.0000	SURCHARGED
15 minute winter	27	12	7.942	0.367	14.9	0.6386	0.0000	SURCHARGED
15 minute winter	28	12	7.935	0.525	99.3	0.6443	0.0000	SURCHARGED
15 minute winter	29	10	8.068	0.068	10.3	0.1069	0.0000	OK
15 minute winter	30	12	7.916	0.216	15.8	0.2975	0.0000	SURCHARGED
15 minute winter	31	12	7.855	0.460	112.0	0.5205	0.0000	SURCHARGED
15 minute winter	32	12	7.583	0.483	124.8	0.8445	0.0000	SURCHARGED
15 minute winter	33	12	7.627	0.227	5.8	0.3147	0.0000	SURCHARGED
15 minute winter	34	12	7.629	0.059	9.9	0.0923	0.0000	OK
15 minute winter	35	12	7.601	0.462	30.2	0.8023	0.0000	SURCHARGED
15 minute winter	36	12	7.169	0.399	166.4	0.8003	0.0000	SURCHARGED
1440 minute winter	37	1380	7.134	0.832	12.4	1.1910	0.0000	OK
15 minute winter	1	11	9.508	0.133	38.5	0.3154	0.0000	OK
15 minute winter	2	11	9.353	0.778	72.5	1.7934	0.0000	SURCHARGED
15 minute winter	3	11	8.768	0.360	70.5	0.4403	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	14	1.000	21	0.9	0.577	0.157	0.1052	
960 minute winter	20	2.000	21	1.1	0.514	0.033	0.0043	
960 minute winter	21	1.001	22	2.0	0.662	0.113	0.1151	
960 minute winter	22	1.002	39	2.0	0.486	0.116	0.5662	
1440 minute winter	38	3.000	39	2.0	0.710	0.044	0.0571	
960 minute winter	39	1.003	39_OUT	3.8	0.762	0.214	0.0219	679.0
15 minute winter	23	4.000	25	34.2	1.530	0.525	1.2192	
15 minute winter	24	5.000	25	4.4	0.252	0.085	0.5669	
15 minute winter	25	4.001	26	62.3	0.964	0.732	3.1009	
15 minute winter	26	4.002	28	85.4	1.212	1.024	0.4730	
15 minute winter	27	6.000	28	13.1	0.725	0.252	0.3575	
15 minute winter	28	4.003	31	99.4	1.440	1.372	0.2465	
15 minute winter	29	7.000	30	10.2	1.011	0.419	0.2014	
15 minute winter	30	7.001	31	14.0	1.318	0.589	0.1532	
15 minute winter	31	4.004	32	112.1	1.591	0.820	1.3766	
15 minute winter	32	4.005	36	124.9	1.773	1.124	1.7948	
15 minute winter	33	8.000	35	7.2	0.487	0.407	0.4630	
15 minute winter	34	9.000	35	9.8	0.703	0.307	0.1610	
15 minute winter	35	8.001	36	27.4	1.558	1.548	0.2547	
15 minute winter	36	4.006	37	166.6	1.557	1.322	0.5121	
1440 minute winter	37	Flow through pond	38	7.1	0.014	0.001	295.1008	
15 minute winter	1	10.000	2	35.9	1.065	0.431	1.0058	
15 minute winter	2	10.001	3	68.1	1.712	1.709	1.1248	
15 minute winter	3	10.002	4	70.3	1.768	1.751	0.1958	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	4	12	8.553	0.250	70.3	0.2833	0.0000	OK
1440 minute winter	5	1410	8.362	0.905	4.7	1.0235	0.0000	OK
15 minute winter	6	10	8.970	0.095	27.9	0.1924	0.0000	OK
15 minute winter	7	12	8.885	0.610	41.5	0.9627	0.0000	SURCHARGED
15 minute winter	8	12	8.817	0.217	4.1	0.2516	0.0000	SURCHARGED
15 minute winter	9	12	8.815	0.415	6.6	0.4689	0.0000	SURCHARGED
15 minute winter	10	12	8.812	0.609	54.7	1.0720	0.0000	SURCHARGED
15 minute winter	11	12	8.641	0.512	55.4	0.6649	0.0000	SURCHARGED
2160 minute winter	12	2100	8.362	0.377	3.3	0.5780	0.0000	SURCHARGED
1440 minute winter	13	1440	8.362	0.905	4.7	1.0241	0.0000	OK
15 minute winter	15	11	8.373	0.223	6.2	0.2995	0.0000	SURCHARGED
15 minute winter	16	11	8.361	0.211	2.7	0.2583	0.0000	SURCHARGED
15 minute winter	17	11	8.361	0.471	52.1	1.1816	0.0000	SURCHARGED
15 minute winter	18	11	7.984	0.305	60.3	0.5451	0.0000	SURCHARGED
960 minute winter	19	765	7.782	0.781	5.5	0.8836	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	4	10.003	5	70.2	1.219	0.971	1.2615	
1440 minute winter	5	Flow through pond	14	5.0	0.006	0.007	246.7404	
15 minute winter	6	11.000	7	27.6	0.910	0.375	0.8327	
15 minute winter	7	11.001	10	35.3	0.887	0.884	0.4835	
15 minute winter	8	12.000	9	4.2	0.624	0.176	0.1963	
15 minute winter	9	12.001	10	7.3	0.413	0.261	0.0880	
15 minute winter	10	11.002	11	51.6	1.297	1.290	0.4945	
15 minute winter	11	11.003	12	55.4	1.393	1.384	0.9612	
2160 minute winter	12	11.004	13	3.3	0.591	0.082	0.1989	
1440 minute winter	13	Flow through pond	14	5.0	0.006	0.007	246.7404	
15 minute winter	15	13.000	17	7.1	0.638	0.401	0.3263	
15 minute winter	16	14.000	17	5.1	0.499	0.266	0.2756	
15 minute winter	17	13.001	18	49.2	1.238	1.232	1.4120	
15 minute winter	18	13.002	19	59.9	1.507	1.491	0.1927	
960 minute winter	19	Flow through pond	20	3.2	0.015	0.001	73.7508	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	14	1410	8.510	1.055	5.9	1.1930	0.0000	SURCHARGED
960 minute winter	20	780	7.919	0.919	3.7	1.0391	0.0000	SURCHARGED
1440 minute winter	21	1260	6.968	0.035	2.2	0.0401	0.0000	OK
1440 minute winter	22	1260	6.589	0.036	2.2	0.0403	0.0000	OK
1440 minute winter	38	1380	7.271	0.971	8.2	1.0987	0.0000	SURCHARGED
1440 minute winter	39	1350	5.307	0.053	4.1	0.0602	0.0000	OK
1440 minute winter	39_OUT	1350	5.259	0.049	4.1	0.0000	0.0000	OK
15 minute winter	23	12	8.684	0.259	41.6	0.6574	0.0000	SURCHARGED
15 minute winter	24	12	8.520	0.595	3.6	0.6725	0.0000	SURCHARGED
15 minute winter	25	12	8.506	0.798	89.3	1.8246	0.0000	SURCHARGED
15 minute winter	26	12	8.310	0.862	101.5	1.7087	0.0000	SURCHARGED
15 minute winter	27	12	8.219	0.644	17.9	1.1196	0.0000	SURCHARGED
15 minute winter	28	12	8.209	0.799	114.8	0.9810	0.0000	SURCHARGED
15 minute winter	29	12	8.223	0.223	12.4	0.3531	0.0000	SURCHARGED
15 minute winter	30	12	8.174	0.474	19.0	0.6533	0.0000	SURCHARGED
15 minute winter	31	12	8.105	0.710	127.1	0.8031	0.0000	SURCHARGED
15 minute winter	32	12	7.754	0.654	142.3	1.1454	0.0000	SURCHARGED
15 minute winter	33	12	7.810	0.410	7.0	0.5679	0.0000	SURCHARGED
15 minute winter	34	12	7.826	0.256	11.9	0.4004	0.0000	SURCHARGED
15 minute winter	35	12	7.777	0.638	32.8	1.1087	0.0000	SURCHARGED
1440 minute winter	36	1380	7.271	0.501	14.8	1.0064	0.0000	SURCHARGED
1440 minute winter	37	1380	7.271	0.969	14.7	1.3873	0.0000	OK
15 minute winter	1	11	9.807	0.432	46.1	1.0221	0.0000	SURCHARGED
15 minute winter	2	11	9.589	1.014	80.9	2.3394	0.0000	SURCHARGED
15 minute winter	3	11	8.823	0.415	80.7	0.5077	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	14	1.000	21	1.0	0.588	0.168	0.1109	
960 minute winter	20	2.000	21	1.2	0.523	0.035	0.0045	
1440 minute winter	21	1.001	22	2.2	0.675	0.121	0.1212	
1440 minute winter	22	1.002	39	2.2	0.494	0.124	0.5978	
1440 minute winter	38	3.000	39	2.0	0.705	0.044	0.0602	
1440 minute winter	39	1.003	39_OUT	4.1	0.777	0.231	0.0231	845.4
15 minute winter	23	4.000	25	39.6	1.544	0.606	1.6270	
15 minute winter	24	5.000	25	10.7	0.337	0.206	0.5669	
15 minute winter	25	4.001	26	69.1	0.981	0.811	3.1009	
15 minute winter	26	4.002	28	97.9	1.390	1.174	0.4730	
15 minute winter	27	6.000	28	13.7	0.679	0.264	0.3575	
15 minute winter	28	4.003	31	113.8	1.616	1.571	0.2465	
15 minute winter	29	7.000	30	12.2	1.013	0.503	0.2828	
15 minute winter	30	7.001	31	15.8	1.301	0.667	0.1532	
15 minute winter	31	4.004	32	127.1	1.805	0.929	1.3766	
15 minute winter	32	4.005	36	142.3	2.021	1.281	1.7948	
15 minute winter	33	8.000	35	8.1	0.494	0.460	0.4630	
15 minute winter	34	9.000	35	11.0	0.772	0.342	0.2358	
15 minute winter	35	8.001	36	31.3	1.778	1.767	0.2547	
1440 minute winter	36	4.006	37	14.7	0.724	0.117	0.5516	
1440 minute winter	37	Flow through pond	38	8.2	0.015	0.001	367.4356	
15 minute winter	1	10.000	2	40.1	1.077	0.480	1.2450	
15 minute winter	2	10.001	3	77.8	1.957	1.954	1.1248	
15 minute winter	3	10.002	4	80.5	2.023	2.004	0.1979	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	4	12	8.596	0.293	80.5	0.3312	0.0000	OK
1440 minute winter	5	1410	8.512	1.055	5.6	1.1929	0.0000	OK
15 minute winter	6	12	9.193	0.318	33.5	0.6454	0.0000	SURCHARGED
15 minute winter	7	12	9.101	0.826	46.4	1.3033	0.0000	SURCHARGED
15 minute winter	8	12	9.011	0.411	3.0	0.4759	0.0000	SURCHARGED
15 minute winter	9	12	9.006	0.606	5.4	0.6856	0.0000	SURCHARGED
15 minute winter	10	12	9.003	0.800	62.7	1.4069	0.0000	SURCHARGED
15 minute winter	11	12	8.783	0.654	62.9	0.8488	0.0000	SURCHARGED
1440 minute winter	12	1410	8.512	0.527	5.6	0.8072	0.0000	SURCHARGED
1440 minute winter	13	1410	8.512	1.056	5.5	1.1940	0.0000	OK
15 minute winter	15	11	8.594	0.444	7.4	0.5954	0.0000	SURCHARGED
15 minute winter	16	11	8.574	0.424	5.9	0.5180	0.0000	SURCHARGED
15 minute winter	17	11	8.570	0.680	61.2	1.7051	0.0000	SURCHARGED
15 minute winter	18	11	8.043	0.364	71.5	0.6522	0.0000	SURCHARGED
960 minute winter	19	780	7.918	0.918	6.5	1.0380	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	4	10.003	5	80.9	1.257	1.118	1.3855	
1440 minute winter	5	Flow through pond	14	5.9	0.006	0.008	306.5992	
15 minute winter	6	11.000	7	30.8	0.932	0.417	1.1903	
15 minute winter	7	11.001	10	39.7	0.998	0.995	0.4835	
15 minute winter	8	12.000	9	4.5	0.591	0.188	0.1963	
15 minute winter	9	12.001	10	8.1	0.458	0.289	0.0880	
15 minute winter	10	11.002	11	58.4	1.468	1.460	0.4945	
15 minute winter	11	11.003	12	62.6	1.575	1.566	0.9612	
1440 minute winter	12	11.004	13	5.5	0.661	0.136	0.1989	
1440 minute winter	13	Flow through pond	14	5.9	0.006	0.008	306.5992	
15 minute winter	15	13.000	17	8.2	0.625	0.461	0.3263	
15 minute winter	16	14.000	17	6.2	0.478	0.323	0.2756	
15 minute winter	17	13.001	18	58.2	1.464	1.457	1.4120	
15 minute winter	18	13.002	19	71.1	1.788	1.771	0.1959	
960 minute winter	19	Flow through pond	20	3.7	0.015	0.001	92.8613	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	14	2100	8.698	1.243	5.3	1.4055	0.0000	SURCHARGED
960 minute winter	20	900	8.101	1.101	4.5	1.2454	0.0000	SURCHARGED
1440 minute winter	21	1350	6.970	0.037	2.3	0.0417	0.0000	OK
1440 minute winter	22	1350	6.590	0.037	2.3	0.0418	0.0000	OK
1440 minute winter	38	1410	7.441	1.141	9.7	1.2907	0.0000	SURCHARGED
1440 minute winter	39	1380	5.309	0.055	4.4	0.0628	0.0000	OK
1440 minute winter	39_OUT	1380	5.261	0.051	4.4	0.0000	0.0000	OK
15 minute winter	23	12	9.260	0.835	50.2	2.1223	0.0000	FLOOD RISK
15 minute winter	24	12	9.011	1.086	9.4	1.2286	0.0000	FLOOD RISK
15 minute winter	25	12	9.013	1.305	100.5	2.9830	0.0000	SURCHARGED
15 minute winter	26	12	8.724	1.276	119.4	2.5282	0.0000	FLOOD RISK
15 minute winter	27	12	8.596	1.021	21.6	1.7745	0.0000	FLOOD RISK
15 minute winter	28	12	8.584	1.174	132.9	1.4401	0.0000	SURCHARGED
15 minute winter	29	13	8.591	0.591	15.0	0.9343	0.0000	SURCHARGED
15 minute winter	30	13	8.524	0.824	21.0	1.1350	0.0000	FLOOD RISK
15 minute winter	31	12	8.443	1.048	146.4	1.1849	0.0000	SURCHARGED
15 minute winter	32	12	7.982	0.882	163.9	1.5428	0.0000	SURCHARGED
15 minute winter	33	12	8.077	0.677	8.5	0.9380	0.0000	SURCHARGED
15 minute winter	34	12	8.102	0.532	14.4	0.8309	0.0000	SURCHARGED
15 minute winter	35	12	8.035	0.896	38.6	1.5571	0.0000	SURCHARGED
1440 minute winter	36	1410	7.441	0.671	18.0	1.3472	0.0000	SURCHARGED
1440 minute winter	37	1410	7.441	1.139	17.7	1.6302	0.0000	OK
15 minute winter	1	12	10.295	0.920	55.8	2.1777	0.0000	SURCHARGED
15 minute winter	2	12	9.996	1.421	95.8	3.2761	0.0000	FLOOD RISK
15 minute winter	3	12	8.967	0.559	94.0	0.6831	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute winter	14	1.000	21	1.1	0.602	0.181	0.1161	
960 minute winter	20	2.000	21	1.3	0.535	0.038	0.0048	
1440 minute winter	21	1.001	22	2.3	0.690	0.131	0.1278	
1440 minute winter	22	1.002	39	2.3	0.504	0.134	0.6322	
1440 minute winter	38	3.000	39	2.1	0.679	0.047	0.0637	
1440 minute winter	39	1.003	39_OUT	4.4	0.792	0.249	0.0244	909.5
15 minute winter	23	4.000	25	44.0	1.496	0.674	1.6270	
15 minute winter	24	5.000	25	-9.4	0.303	-0.180	0.5669	
15 minute winter	25	4.001	26	82.6	1.173	0.970	3.1009	
15 minute winter	26	4.002	28	113.8	1.616	1.365	0.4730	
15 minute winter	27	6.000	28	15.6	0.715	0.301	0.3575	
15 minute winter	28	4.003	31	131.9	1.874	1.821	0.2465	
15 minute winter	29	7.000	30	13.3	1.042	0.546	0.2828	
15 minute winter	30	7.001	31	18.3	1.261	0.770	0.1532	
15 minute winter	31	4.004	32	146.7	2.084	1.073	1.3766	
15 minute winter	32	4.005	36	163.3	2.320	1.470	1.7948	
15 minute winter	33	8.000	35	7.8	0.451	0.439	0.4630	
15 minute winter	34	9.000	35	11.2	0.763	0.348	0.2358	
15 minute winter	35	8.001	36	36.5	2.074	2.062	0.2547	
1440 minute winter	36	4.006	37	17.7	0.730	0.141	0.5516	
1440 minute winter	37	Flow through pond	38	9.7	0.017	0.001	462.7443	
15 minute winter	1	10.000	2	47.1	1.185	0.565	1.2450	
15 minute winter	2	10.001	3	90.5	2.276	2.273	1.1248	
15 minute winter	3	10.002	4	93.6	2.354	2.332	0.1989	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	4	2100	8.699	0.396	4.9	0.4483	0.0000	SURCHARGED
2160 minute winter	5	2100	8.704	1.247	6.9	1.4102	0.0000	OK
15 minute winter	6	12	9.579	0.704	40.5	1.4291	0.0000	SURCHARGED
15 minute winter	7	12	9.451	1.176	51.5	1.8560	0.0000	FLOOD RISK
15 minute winter	8	12	9.320	0.720	6.7	0.8341	0.0000	SURCHARGED
15 minute winter	9	12	9.317	0.917	11.2	1.0375	0.0000	SURCHARGED
15 minute winter	10	12	9.315	1.112	75.1	1.9562	0.0000	SURCHARGED
15 minute winter	11	12	9.013	0.884	73.9	1.1475	0.0000	SURCHARGED
2160 minute winter	12	2100	8.698	0.713	4.9	1.0923	0.0000	SURCHARGED
2160 minute winter	13	2100	8.699	1.242	4.8	1.4048	0.0000	OK
15 minute winter	15	12	8.901	0.751	9.0	1.0069	0.0000	SURCHARGED
15 minute winter	16	12	8.862	0.712	7.6	0.8705	0.0000	SURCHARGED
15 minute winter	17	11	8.852	0.962	72.2	2.4149	0.0000	SURCHARGED
15 minute winter	18	11	8.118	0.439	84.9	0.7865	0.0000	SURCHARGED
960 minute winter	19	900	8.101	1.100	7.9	1.2443	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute winter	4	10.003	5	4.9	0.585	0.068	1.5500	
2160 minute winter	5	Flow through pond	14	5.3	0.006	0.007	384.0313	
15 minute winter	6	11.000	7	32.5	0.921	0.440	1.1903	
15 minute winter	7	11.001	10	47.1	1.186	1.182	0.4835	
15 minute winter	8	12.000	9	-5.6	0.614	-0.236	0.1963	
15 minute winter	9	12.001	10	-11.2	-0.637	-0.402	0.0880	
15 minute winter	10	11.002	11	68.4	1.721	1.712	0.4945	
15 minute winter	11	11.003	12	73.3	1.844	1.833	0.9612	
2160 minute winter	12	11.004	13	4.8	0.604	0.119	0.1989	
2160 minute winter	13	Flow through pond	14	5.3	0.006	0.007	384.0313	
15 minute winter	15	13.000	17	9.8	0.635	0.554	0.3263	
15 minute winter	16	14.000	17	7.3	0.491	0.376	0.2756	
15 minute winter	17	13.001	18	69.4	1.744	1.736	1.4120	
15 minute winter	18	13.002	19	84.5	2.124	2.105	0.1969	
960 minute winter	19	Flow through pond	20	4.5	0.017	0.001	118.3995	

Appendix F - Illustrative Drainage Layout

Sanderling Way

Notes:

Please report all discrepancies, errors and omissions.

Verify all dimensions on site before commencing any work on site or preparing shop drawings.

All materials, components and workmanship are to comply with the relevant British Standards, Codes of Practice, and appropriate manufacturers recommendations that from time to time shall apply.

For all specialist work, see relevant drawings.

Key

- Public foul sewer
- Foul drainage
- Foul drainage pumped
- SW drainage
- Exceedance event flow paths

Levels based on topographical survey carried out by others and assumptions concerning proposed levels.

NOT FOR CONSTRUCTION

Rev A. Revised Layout. 05/12/23.

N

0 5 10m

RMB
39 Cossington Road Canterbury Kent CT1 3HU
Tel/Fax: 01227 472128 • Mobile: 07886 185705
www.rmbconsultants.co.uk • robert.beck@rmbconsultants.co.uk

client	Sanderling Way
project	Sanderling Way Iwade ME9 8TE
drawing	Illustrative Drainage Layout Overview
scale	1:200 @ A1
drawing no.	789/DSOA
date	October 2023
drawn by	RB

Illustrative Drainage Layout Overview
Sanderling Way, Iwade, ME9 8TE

Pond A	
Depth (m)	Area (m²)
0.0	167
0.2	211
0.4	257
0.6	306
0.8	358
1.0	412
1.645	412

Pond A		
Event (year)	Level (m)	Depth (m)
2	7.756	0.301
30	8.103	0.648
100	8.355	0.900
100+20%	8.503	1.048
100+45%	8.689	1.234

Pond A
Cover level 9.100
Invert level 7.455

Pond A	
Depth (m)	Area (m²)
0.0	34
0.2	64
0.4	96
0.6	140
1.45	140

Pond B		
Event (year)	Level (m)	Depth (m)
2	7.299	0.299
30	7.603	0.603
100	7.783	0.783
100+20%	7.919	0.919
100+45%	8.102	1.102

Pond B
Cover level 8.450
Invert level 7.000

Notes:

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Key

- Public foul sewer
- Foul drainage
- Foul drainage pumped
- SW drainage
- F1.000 / 150, 100 / 10.000m — Reference / Diameter, Gradient / Length

Levels based on topographical survey carried out by others and assumptions concerning proposed levels.

NOT FOR CONSTRUCTION

Rev A. Revised Layout. 05/12/23.

N

0 5 10m

RMB
39 Cossington Road Canterbury Kent CT1 3HU
Tel/Fax: 01227 472128 • Mobile: 07886 185705
www.rmbconsultants.co.uk • robert.beck@rmbconsultants.co.uk

client	Sanderling Way
project	Sanderling Way, Iwade, ME9 8TE
drawing	Illustrative Drainage Layout (Sheet 1 of 3)
scale	1:200 @ A1
drawing no.	789/DS01A
date	October 2023
drawn by	RB

Illustrative Drainage Layout (Sheet 1 of 3)
Sanderling Way, Iwade, ME9 8TE

Sanderling Way

nd A	
	Area (m²)
	34
	64
	96
	140
	140

Pond B		
Event (year)	Level (m)	Depth (m)
2	7.299	0.299
30	7.603	0.603
100	7.783	0.783
100+20%	7.919	0.919
100+45%	8.102	1.102

Pond B
Cover level 8.450
Invert level 7.000

Pond C	
Depth (m)	Area (m²)
0.0	219
0.2	280
0.4	345
0.6	415
0.8	487
1.0	563
1.7	563

Pond C	
Event (year)	Level (m)
2	6.560
30	6.871
100	7.117
100+20%	7.251
100+45%	7.410

Pond C
Cover level 8.000
Invert level 6.300

Notes:

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Key

Public foul sewer

Foul drainage

Foul drainage pumped

SW drainage

F1.000 / 150
100 / 10.000m
Reference / Diameter
Gradient / Length

Levels based on topographical survey carried out by others and assumptions concerning proposed levels.

NOT FOR CONSTRUCTION

Rev A. Revised Layout. 05/12/23.

N

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RMB
39 Cossington Road Canterbury Kent CT1 3HU
Tel/Fax: 01227 472128 • Mobile: 07886 185705
www.rmbconsultants.co.uk • robert.beck@rmbconsultants.co.uk

client: Sanderling Way	project: Sanderling Way Iwade ME9 8TE	drawing: Illustrative Drainage Layout (Sheet 2 of 3)	
		scale: 1:200 @ A1	drawing no. 789/DS02A
		date: October 2023	drawn by: RB

Illustrative Drainage Layout (Sheet 2 of 3)
Sanderling Way, Iwade, ME9 8TE

Pond C	
Depth (m)	Area (m²)
0.0	219
0.2	280
0.4	345
0.6	415
0.8	487
1.0	563
1.7	563

Pond C		
Event (year)	Level (m)	Depth (m)
2	6.560	0.260
30	6.871	0.571
100	7.117	0.817
100+20%	7.251	0.951
100+45%	7.410	1.110

Pond C
Cover level 8.000
Invert level 6.300

Notes:

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Key

- Public foul sewer
- Foul drainage
- Foul drainage pumped
- SW drainage
- F1.000 / 150 100 / 10.000m — Reference / Diameter Gradient / Length

Levels based on topographical survey carried out by others and assumptions concerning proposed levels.

NOT FOR CONSTRUCTION

Rev A. Revised Layout. 05/12/23.

N

0 5 10m

RMB
39 Cossington Road Canterbury Kent CT1 3HU
Tel/Fax: 01227 472128 • Mobile: 07886 185705
www.rmbconsultants.co.uk • robert.beck@rmbconsultants.co.uk

client	Sanderling Way	project	Sanderling Way Iwade ME9 8TE
drawing	Illustrative Drainage Layout (Sheet 3 of 3)		
scale	1:200 @ A1	drawing no.	789/DS03A
date	October 2023	drawn by	RB

Appendix G - SUDS Management and Maintenance Plan

Land at Sanderling Way, Iwade, Sittingbourne, ME9 8TE

Sustainable Urban Drainage Systems Management and Maintenance Plan

1. Introduction

This Sustainable Urban Drainage Systems (SuDS) Management and Maintenance Plan has been produced for SuDS elements at land at Sanderling Way, Iwade, Sittingbourne, ME9 8TE.

The following SuDS elements are proposed within the development.

- Attenuation pond/ Detention pond
- Ditch
- Swale
- Control structures

2. Management

A management company will be responsible for the maintenance of the drainage structures.

3. Maintenance

The following maintenance plans will be put in place for each of the SuDS elements present within the development.

Attenuation Pond/Detention Pond

Element	**Attenuation Pond**	
Maintenance Issues	Debris or vegetation blocking inlet and outlet structures. Damage to pond structure.	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular	Inspect inlets and outlets and pond structure.	Monthly for first six months then quarterly
	Remove debris from ponds.	As required.
	Cut back vegetation.	Every six months or as required.
Remedial Work	Repair pond structures and repair or replace inlet and outlet structures.	As required

Ditch

SUDS Element	Ditch	
Maintenance Issues	Erosion, siltation and excessive vegetation growth	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular	Vegetation removal Tree and hedge trimming	As required
	Inspect and clear inlets and outlets	Quarterly
Occasional tasks	Remove leaf accumulation and dead vegetation	Annually in the autumn
Remedial Work	Repair erosion, level uneven surfaces or damage by re-turfing or seeding	As required
	Remove silt and spread locally outside design profile and reinstate surface	As required
	Repair inlets and outlets	As required

Swale

Element	Swale	
Maintenance Issues	Erosion, siltation and excessive vegetation growth.	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular	Inspect and repair swale profile and check dams.	Every six months.
	Grass cutting/grazing.	As required.
	Litter and debris removal from site.	Every six months.
Remedial Work	Repair erosion, level uneven surfaces or damage by re-profiling and seeding.	As required.
	Remove excessive silt and spread locally outside design profile and reinstate surface.	As required.
	Repair check dam structures to design detail.	As required.

Control Structures

SUDS Element	Control Structures	
Maintenance Issues	Debris blocking control structures.	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular	Inspect chamber and remove any debris from control device.	Quarterly and following heavy rainfall
	Debris removal from gutters.	Annually in autumn after leaf fall
	Remove sediment from silt traps.	Annually or as required
Remedial Work	Repair or replace control device if it is damaged.	As required

Appendix H - Surface Water Drainage Summary

Drainage Strategy Summary

Kent County Council
kent.gov.uk

1. Site details	
Site/development name	Land at Sanderling Way
Address including post code	Sanderling Way Iwade Sittingbourne ME9 8TE
Grid reference	E 589857 N 168115
LPA reference	n/a
Type of application	Outline ☒ Full ☐ Discharge of Conditions ☐ Other ☐
Site condition	Greenfield ☒ Brownfield ☐

2. Existing drainage				**Document/Plan where information is stated:**
Total site area (ha)	4.4			Surface Water Management Strategy incorporating a Flood Risk Assessment
Impermeable area (ha)	0.00			
Final discharge location	Infiltration ☐ Watercourse ☒ Sewer ☐ Tidal reach/sea ☐			
Greenfield discharge rate (l/s) for existing site area	QBAR (l/s)	3.8	per ha	Surface Water Management Strategy incorporating a Flood Risk Assessment
	1 in 1 year (l/s)	3.2		
	1 in 30 year (l/s)	8.7		
	1 in 100 year (l/s)	12.1		

3. Proposed drainage areas			**Document/Plan where information is stated:**
Impermeable area (ha)	Roof	0.400	Surface Water Management Strategy incorporating a Flood Risk Assessment
	Highway/road	0.581	
	Other paved areas		
	Total	0.981	
Permeable area (ha)	Open space	3.419	
	Other permeable areas		
	Total	4.400	
Final discharge location	Infiltration ☐ Infiltration rate ____________m/s Watercourse ☒ Sewer ☐ Tidal reach/sea ☐		Surface Water Management Strategy incorporating a Flood Risk Assessment
Climate change allowance included in design	20% ☐ 30% ☐ 45% ☒		

4. Post-Development Discharge rates, without mitigation			**Document/Plan where information is stated:**
Developed discharge rates (l/s)	1 in 2 year	131	Surface Water Management Strategy incorporating a Flood Risk Assessment
	1 in 30 year	343	
	1 in 100 year	441	
	1 in 100 year + CC	642	

5. Post-Development Discharge rates, with mitigation			**Document/Plan where information is stated:**
Describe development drainage strategy in general terms: Detention basins provide storage with controls to limit discharge from the site to greenfiled runoff rates to existing watercourse.			Surface Water Management Strategy incorporating a Flood Risk Assessment
(a) No control required, all flows infiltrating		☐	
(b) Controlled developed discharge rates (l/s)	1 in 2 year	3.8	Surface Water Management Strategy incorporating a Flood Risk Assessment
	1 in 30 year	3.8	
	1 in 100 year	3.8	
	1 in 100 year + CC	4.4	

6. Discharge Volumes			**Document/Plan where information is stated:**
	Existing volume (m^3)	Proposed volume (m^3)	Surface Water Management Strategy incorporating a Flood Risk Assessment
1 in 2 year	107	203	
1 in 30 year	251	438	
1 in 100 year	365	604	
1 in 100 year + CC	530	874	

All information presented above should be contained within the attached Flood Risk Assessment, Drainage Strategy or Statement and be substantiated through plans and appropriate calculations.

Form completed by	Robert Beck
Qualifications	Chartered Civil Engineer
Company	RMB Consultants (Civil Engineering) Ltd
Telephone	01227 472128
Email	robert.beck@rmbconsultants.co.uk
On behalf of (client's details)	
Date	05/12/23