Flood Risk Assessment

Bury CSO BRY0021

Bethell Construction Ltd

12 June 2024

The Power of Commitment

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Executive summary

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.2 and the assumptions and qualifications contained throughout the report.

This Flood Risk Assessment (FRA) has been prepared in accordance with requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. The FRA has been produced on behalf of Bethell Construction Ltd for the proposed development of a new CSO chamber and outfall route to the River Roch.

The Environment Agency (EA) Flood Map for Planning (FMfP) shows the southern part of the site is in Flood Zone 3. This is defined as an area which has an annual risk of fluvial flooding of greater than 1% (1% Annual Exceedance Probability, or AEP) and is commonly described as being at high risk from flooding.

The area of the CSO chamber and associated infrastructure is at risk from pluvial flooding during the low risk (0.1% AEP) event. During this event, depths are mapped as being less than 150mm. The EA Risk of Flooding from Surface Water (RoFSW) maps represent a worst-case scenario, wherein all drainage in and around the site is at capacity and cannot drain rainfall landing on the site. In addition, the RoFSW mapping makes no allowance for existing drainage networks intended to manage the risk of surface water pooling. The construction of the underground pipe will not be impacted by pluvial flows.

It is concluded that the proposed development site location is at a low risk of flooding from groundwater, sewer, tidal and reservoir sources.

No resistance or resilience measures are required as there are no proposed buildings.

Due to the ‘water-compatible’ nature of the development, it is considered that neither the Sequential Test nor the Exception Test are required in support of the development. Overall, the proposed development is considered appropriate for the site and there will be no increase in flood risk to the site or surrounding area because of the development.

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1. Introduction

1.1 Purpose of this report

The aim of this report is to evaluate the current proposals regarding flood risk and identify potential flood risk to and from the development site.

GHD have therefore undertaken an assessment of the development potential of the site with regards to flood risk in line with the National Planning Policy Framework (NPPF) and Flood Risk and Coastal Change Planning Practice Guidance (PPG).

1.2 Scope and limitations

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

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

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

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

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

2. Relevant Legislation

2.1 National Planning Policy Framework

The National Planning Policy Framework sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed.

Paragraph 159 of the NPPF states “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.” A risk-based approach should be adopted at all levels of planning. Applying the source pathway-receptor model to planning for development in areas of flood risk requires:

- a strategic approach which avoids adding to the causes or “sources” of flood risk, by such means as avoiding inappropriate development in flood risk areas and minimising run-off from new development onto adjacent and other downstream areas, and into the respective river systems;
- managing flood “pathways” to reduce the likelihood of flooding by ensuring that the design and location of the development maximises:
    - the use of SuDS;
    - takes account of its susceptibility to flooding;
    - the performance and processes of river/coastal systems;
    - appropriate flood defence infrastructure,
    - likely routes and storage of floodwater and its influence on flood risk downstream;
- and reducing the adverse consequences of flooding on the “receptors” (i.e., people, property, infrastructure, habitats and statutory sites) by avoiding inappropriate development in areas at risk of flooding.

An FRA should be carried out to the appropriate degree at all levels of the planning process, to assess the risks of all forms of flooding to and from development taking climate change into account. **The Sequential Test is not required for this development as it is classed as a ‘water-compatible development’ (refer to Table 2) and is located within Flood Zone 3 (refer to Table 1).**

In areas at risk of river or sea flooding, preference should be given to locating new development in Flood Zone 1. If there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3. Within each Flood Zone new development should be directed to sites at the lowest probability of flooding from all sources.

Flood risk has been categorised as High, Medium and Low based on the probability of inundation. Extracts from Tables 1, 2 and 3 of the Flood Risk and Coastal Change PPG are provided in Tables 1 to 3.

Table 1 Flood Zone Definitions

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probabilities of river or sea flooding. (Shown as ‘clear’ on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Where required an Exception Test must be passed in order for developments of that nature to be justified within the Flood Zone. For the Exception Test to be passed the following must be demonstrated:

- the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- 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.

The site is located partially within Flood Zone 3 and is classified as 'water-compatible development' and as such <u>the Exception Test is not required</u>.

Table 2 Flood risk vulnerability classification

Essential infrastructure
- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. - Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. - Wind turbines.
Highly vulnerable
- Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. - Emergency dispersal points. - Basement dwellings. - Caravans, mobile homes and park homes intended for permanent residential use. - Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More vulnerable
- Hospitals - Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. - Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. - Non–residential uses for health services, nurseries and educational establishments. - Landfill* and sites used for waste management facilities for hazardous waste. - Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less vulnerable
- Police, ambulance and fire stations which are not required to be operational during flooding. - Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. - Land and buildings used for agriculture and forestry. - Waste treatment (except landfill* and hazardous waste facilities). - Minerals working and processing (except for sand and gravel working). - Water treatment works which do not need to remain operational during times of flood. - Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
Water-compatible development
- Flood control infrastructure. - Water transmission infrastructure and pumping stations. - Sewage transmission infrastructure and pumping stations. - Sand and gravel working. - Docks, marinas and wharves. - Navigation facilities.

- Ministry of Defence defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water-based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

The development is categorised as "water-compatible development" and therefore is suitable within any Flood Zone.

Table 3 Flood risk vulnerability and flood zone 'compatibility'

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×
Extract from the Flood Risk and Coastal Change Planning Practice Guidance **Key:** ✓ Development is appropriate. × Development should not be permitted.						

Summary

The development is classified as being 'water-compatible development' and in accordance with the NPPF PPG and is located within Flood Zone 3. This means that neither the Sequential Test nor the Exception Test is required.

2.2 Local Planning Policy

Bury Council identify on their website that they are *"currently in the process of preparing a new Local Plan that will guide future development in the borough".*

Furthermore:

> *"Together with the Places for Everyone (PfE) joint development plan, the Local Plan will form a key part of Bury's overall development plan and, once adopted, these documents will both be used as the basis for determining future proposals for the next 20 years or so.*
>
> *Whereas the PfE will deal with strategic planning matters that are of significance across the Joint Plan area (such as identifying future levels of housing and employment growth), Bury's Local Plan will contain a range of locally-specific planning policies and identify local sites where development should be built as well as areas where development should be restricted or controlled.*
>
> *Work on the PfE is currently on-going and it is expected that a revised draft of this document will be subject to consultation shortly."*

The current published local plan relating to flood risk is titled "*Bury Local Plan, Topic Paper 6, Flood Risk*", dated October 2018. This summarises the various sources of flood risk and known areas in the Council area where these are most likely. No specific mention of the site is included in the plan.

2.3 Strategic Flood Risk Assessment (SFRA)

The Level 1 Strategic Flood Risk Assessment for Greater Manchester – Update (March 2019) provides an update to the earlier SFRA (August 2018) to account for updates to the Greater Manchester Spatial Framework (GMSF) allocations and each of the ten Greater Manchester (GM) district council's land supply sites for housing, office space and industrial and warehousing space.

Greater Manchester Combined Authority (GMCA) is acting on behalf of each of the ten councils; these are all designated Lead Local Flood Authorities (LLFA) as well as Local Planning Authorities (LPA's).

In August 2014, the ten LPA's in Greater Manchester agreed to prepare a joint Development Plan Document to set out the approach to housing and employment growth for the next 20 years. This is known as the GMSF (2019).

The SFRA, and its update, is required to:

- initiate the sequential risk-based approach to the allocation of land for development and
- identify whether application of the Exception Test is likely to be necessary using the most up-to-date information and guidance.

This will help to inform and provide the evidence base for the GMSF and each individual council's local plan.

The SFRA discusses flood risk in Bury, with the focus being on the risk posed from the River Irwell. No specific mention is made to the area of the proposed development or the commercial area that it is in proximity to.

The River Roch is discussed only a few times, with the main area of risk posed from this watercourse being identified as Rochdale Town Centre, c.8km to the north east. The SFRA states "*The River Roch is shown to come out of bank through much of the Town Centre and also upstream in the town of Littleborough.*"

It is noted that in all of Greater Manchester Bury has the lowest number of recorded historic surface water flooding incidents.

3. Development Site

3.1 Existing Site Arrangements

The site is currently occupied by a CSO that discharges into Barn Brook (a tributary of the River Roch) immediately to the north of a railway line. The current CSO is located on private land and is often covered by heavy stockpiled material. The current outfall from the CSO flows east to the location shown in Figure 1. It is proposed that the new CSO would be sited in the open car park land west of the existing location and would discharge directly into the River Roch, see Section 3.4 for details.

The current CSO and its outfall are situated between James Street and School Street, north of the railway. Levels in this area fall from west to east, varying between 86m AOD and 82m AOD. See section 3.2 for details and levels in the area of the proposed outfall.

The approximate locations of the CSO and its proposed outfall route are shown in Figure 1.

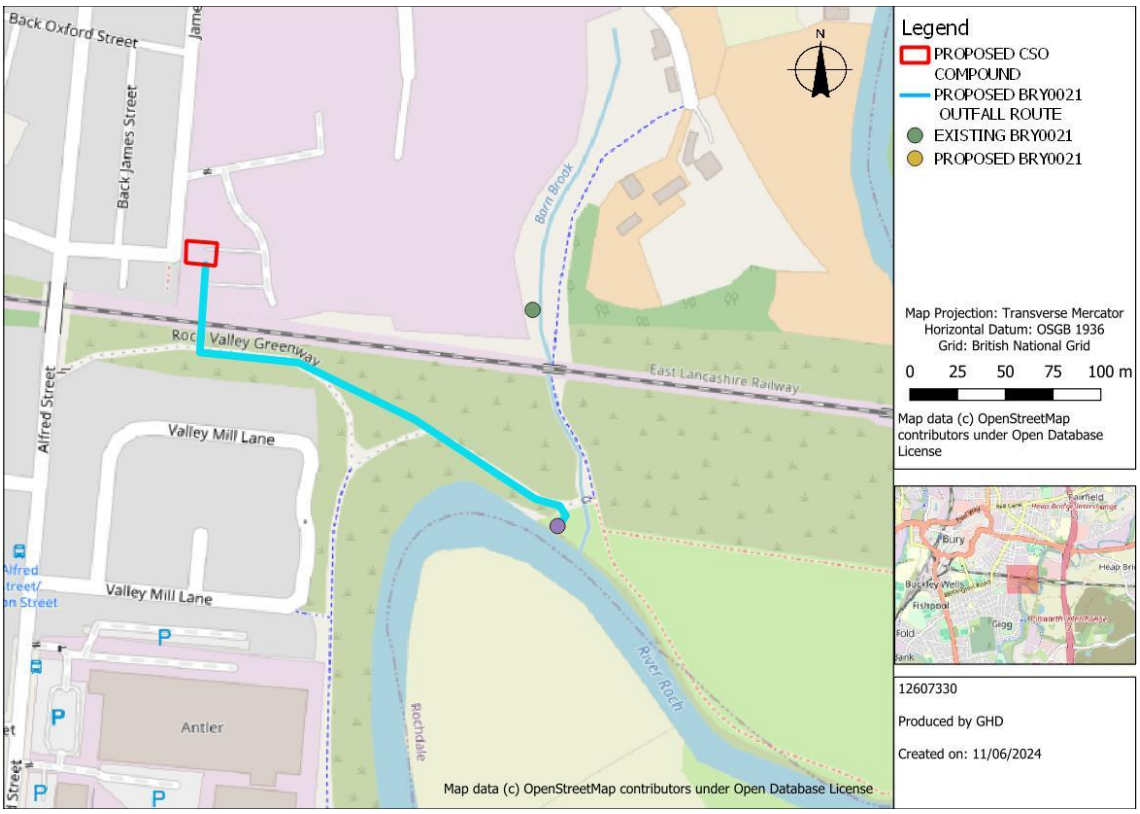

Figure 1 - Site Location Overview

Table 4 presents the key details for the site:

Table 4 Key site details

Site Location	Land east of James Street, Bury
Approximate Site area (hectares)	NA
National grid reference	SD 81291 10202
Nearest Postcode	BL9 7EG
Existing land use	Commercial (CSO), greenspace (proposed new pipe route and outfall)
Local Planning Authority	Bury Council
Lead Local Flood Authority	Bury Council

3.2 Existing Site Levels

A topographic survey of the existing CSO location and the land along the route of the outfall pipe was carried out by Atlantic Geomatics in October 2021. Ground levels around the CSO chamber are approximately 86.2m AOD. The position of the existing outfall (north of the railway line) has ground levels of approx. 72.6m AOD. Levels around the new outfall are approximately 70m AOD.

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

3.3 Relevant Watercourses and Site Features

To understand the risk of flooding occurring from nearby watercourses, a review of the available mapping was undertaken.

The River Roch is the nearest EA main river to the site location. This watercourse flows from east to west past the outfall site, navigating a meander in the river as it does so. As it flows past the proposed outfall location, the catchment of the River Roch is approximately 164km^2 (Flood Estimation Handbook Web Service, 2023).

South of School Street there is another watercourse, the Barn Brook, which is a tributary of the River Roch, located upstream of the proposed CSO outfall. This watercourse is the receiving waterbody of the current CSO outfall. The catchment of this watercourse is not marked on available mapping, but historic mapping does indicate a heavily urbanised catchment draining to this watercourse.

There are no other mapped watercourses in proximity to the site location.

3.4 Proposed Development Description

This FRA relates to asset reference number BRY0021, as specified by the client. This is a new CSO chamber with a new outfall route and outfall headwall.

At present, the BRY0021 CSO discharges during high rainfall events into Barn Brook (a tributary of the River Roch) immediately to the north of a railway line. No regular discharge is issued from the CSO. It is proposed that the new CSO site would discharge during high rainfall events via a new CSO and outfall structure directly into the River Roch.

The existing CSO chamber is located in the scrap yard immediately west of the Barn Brook, the new CSO chamber would be located further west in the open car park. This new location allows greater access for future maintenance compared to the current location. To support this new CSO chamber, a new outfall to the River Roch will be created. This will involve laying a new outfall pipe under the railway to the river, as illustrated in Figure 1.

The proposed CSO outfall location was originally on the bend in the River Roch, and then moved part way towards the Barn Brook tributary. The location of the outfall has been revised for a third time following a review of the initial proposed outfall location conducted by HYDRO-MORPH in July 2023 as part of a Geomorphological Assessment Addendum. This review included a review of the previous Geomorphological Assessment completed by United Utilities in 2022.

The initial proposed CSO outfall location was identified in the study as being situation in an area with steep and rapid flows, with the highest flow occurring on the outside bend of the river. This posed a risk of outfall undercutting or blockage, as the 2022 assessment noted active erosion on the outside bend of the River Roch, but the discharge from the outfall was unlikely to increase the localised erosion due to the small volume/ rate of flow compared to the receiving River Roch.

Following the findings of the assessment, a site visit was undertaken with the Environmental Agency during which the revised outfall location was agreed upon. The new proposed outfall location is further upstream than either of the two previous locations, and at a lower elevation. This location is approximately 15m downstream of the Barn Brook confluence. This location was chosen to better manage the risk of erosion and has been agreed upon by the client. Figure 2 shows a view of the previous outfall location. No photographs of the proposed outfall location were collected during the site visit due to limited safe access.

Figure 2 - ***View of the River Roch looking downstream. The original outfall location is indicated by the orange star. The riverbed appears to be relatively steep (forming a riffle) near the proposed outfall location and the curvature of the bend directs the highest velocity flows to the outside bend (as shown by the blue arrow). There is also evidence of active erosion along the upper face of the riverbank upstream of the Barn Brook (white arrow). Source: HYDRO-MORPH, July 2023.***

The new location further upstream is in an area where the channel is straighter and the velocity near the bank appears lower, as indicated by the smoother water surface. The updated outfall site is approximately 15m downstream of the Barn Brook confluence. This location is an improvement compared to the previously proposed site, as it has historically not been subjected to riverbank migration effects, according to the HYDRO-MORPH report. This suggests a stable bank with fewer forces acting on this area from the River Roch. The channel adjustment over time has been confined to a length upstream of the Barn Brook tributary, reinforcing the stability of the new site.

Plans showing the proposed arrangement of BRY0021 at its latest location are included as Appendix B.

3.5 Historic Site Information

Historical maps for the site and surrounding area have been examined from 1885 to present day to identify changes in the area which many be relevant to flood risk.

The earliest mapping (1885) shows the River Roch in its current day alignment but with less development surrounding the river channel. Upstream of this location the M66 is not present, but the Liverpool, Bolton and Bury railway line to the south is marked.

By 1888, maps show upstream of the site that the M66 is still missing but there is a weir marked in the channel as well as ‘Water Fold Mill’, both of which are assumed to influence the flow of the River Roch as it passes downstream towards the site, but both which have now been removed. Immediately to the south of the railway, on the east of the River Roch, a sewerage works is marked (Heywood Corporation) which is no longer shown on current maps.

On the 1892 25 Inch mapping, the same upstream features and sewerage works are marked, but the Barn Brook channel is more clearly defined and is open much further upstream than it is currently. The Barn Brook is also fed partly by a reservoir located adjacent to Fustain Mill, at the corner of School Street and Hurst Street.

By the 1900s mapping, much of the commercial and residential areas west of the site have been developed similar to current extents, the reservoir feeding the Barn Brook remains, as does the sewerage works and Water Fold Mill/weir. The site of the new CSO is still marked as recreation ground with no substantial changes in land use over its mapped lifetime.

By 1949 mapping, the mill and weir upstream are no longer marked but the sewerage works to the east remains. There are no later maps of the site area. The route and width of the River Roch remains consistent over the mapped time period indicating no substantial changes in flow regime that would influence flood risk to the area.

Historic aerial imagery from the year 2000 shows the M66 to have been constructed, and that work have started on the industrial area on the opposite side of the river to the new CSO outfall.

Over the 115 years of mapping there have been a number of changes to the river channel and its surrounding land uses, however these are unlikely to have substantially affected the flow regime of the channel in proximity to the CSO and its outfall.

4. Sources of Flood Risk Information

4.1 Environment Agency (EA)

The Environment Agency (EA) Flood Map for Planning (Figure 3) shows the proposed outfall location for the new combined CSO (BRY0021) is in Flood Zone 3. This means that the outfall site is at risk from fluvial flooding during events with greater than a 1% (1 in 100 year) Annual Exceedance Probability (AEP). The CSO infrastructure within the hard standing area east of James Street is elevated compared to the outfall and in an area of Flood Zone 1.

Figure 3 - Extract from EA Flood Map for Planning

Pluvial flooding can occur during prolonged rainfall events when soil infiltration or drainage infrastructure capacities are overwhelmed, causing an accumulation of surface water, generating overland flow pathways.

Figure 4 shows the EA's Risk of Flooding from Surface Water Map (RoFSW) and indicates the potential flooding which could occur when rainwater does not drain away through the existing piped/normal drainage systems or infiltrate into the ground. It shows the areas of the proposed outfall is at risk of surface water flooding for all events from the 3.3% AEP (1 in 30 year) to the 0.1% AEP (1 in 1000 year).

A more detailed evaluation of the risk to the site from pluvial flooding is presented in Section 5.4.

Figure 4 - EA Risk of Flooding from Surface Water Map

EA mapping shows there are no historical flood events within the vicinity of the site, with the closest mapped extent located on the opposite side of the M66, over 1.3km upstream.

Although unlikely, due to the tightly regulated nature and regular inspection frequency, reservoirs and other such large waterbodies could overtop or breach their structures, leading to rapid inundation of downstream locations.

The EA's risk of flooding from reservoirs (Figure 5) shows the proposed CSO outfall location to be within the maximum reservoir flood extent on both wet and dry days.

Due to the nature of the proposed structure and it serving as an outfall for a system that is at a higher elevation and placed underground, there is a low overall risk of permanent damage of impact on CSO operation from this source of flooding.

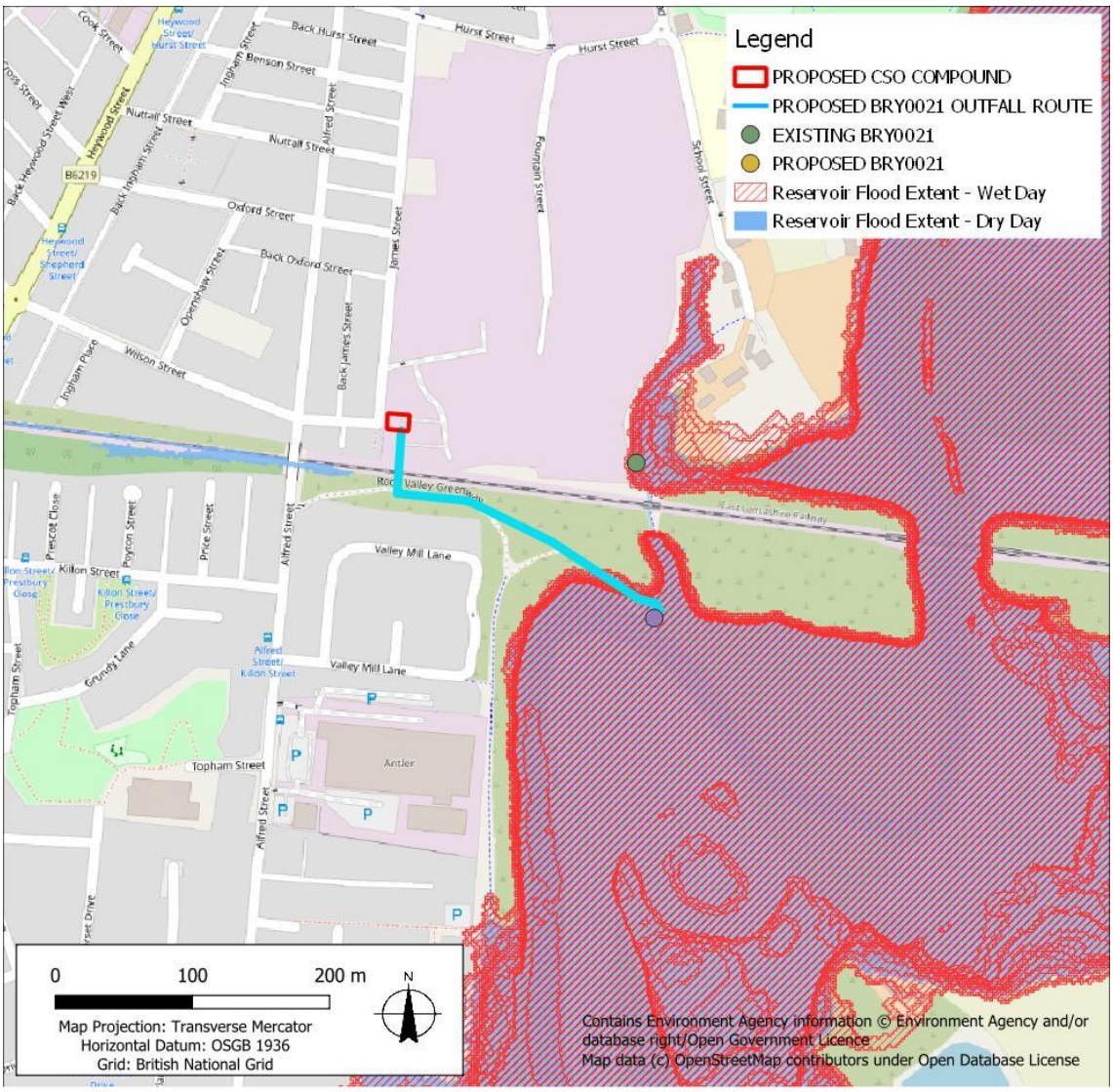

Figure 5 - Extract from EA Reservoir Flood Extent Map

4.2 Strategic Flood Risk Assessment (SFRA)

The Level 1 Strategic Flood Risk Assessment for Greater Manchester – Update (March 2019) discusses flood risk to the area of Bury, with the focus being on the risk posed from the River Irwell. No specific mention is made to the area of the proposed development or the open green space south of railway line that it is in proximity to.

The River Roch is discussed only a few times, with the main area of risk posed from this watercourse being identified as Rochdale Town Centre, c.8km to the north east. The SFRA states "*The River Roch is shown to come out of bank through much of the Town Centre and also upstream in the town of Littleborough*".

It is noted that in all of Greater Manchester, Bury has the lowest number of recorded historic surface water flooding incidents.

There was no specific mention of the site area including the SFRA and no site-specific flood risk information was available for the site within the SFRA.

4.3 Sewerage Company

Sewer flooding can occur when the capacity of the pipe infrastructure is exceeded by high flows, if the downstream sewerage system becomes surcharged, or as a result of a reduction in capacity due to blockage. These individually, and collectively, can lead to sewers flooding onto the surrounding surface through surcharge of manholes and gullies.

United Utilities, the sewerage operator in the region, is required by OFWAT to maintain a record of flooding incidents due to hydraulic capacity problems on the sewerage network. Following investigations to determine the cause and risk of flooding, properties are placed on the appropriate register depending on risk.

United Utilities have been contacted to determine whether they hold any historical records of flooding. United Utilities Developer Services responded by email, confirming they:

> *" …have no current record of sewer flooding within the vicinity of the proposed development.*
>
> *Please note that United Utilities Water Limited (UUW) can only record and check flooding events which are reported to us and we have to comply with our Regulators instructions on the qualification of flooding events to place on the register.*
>
> *Our response does not include:*
>
> - *any sewer flooding events caused by blockages or collapses which are the result of third party actions, natural events or other actions over which UUW has no control and not a facet of sewer capacity; or*
> - *any historical sewer flooding events that have been removed from the register as a result of investment in our infrastructure."*

4.4 Local Council

Bury Metropolitan Borough Council (BMBC) is the local planning authority for the area of the development. BMBC have been contacted to determine whether they hold any historical records of flooding for the site.

A review of freely available information from the BMBC website was carried out to determine if there were any records of historical flooding at nearby developments. The BMBC website does not contain any additional information on Flood Risk relevant to the site.

4.5 Lead Local Flood Authority (LLFA)

Bury Metropolitan Borough Council (BMBC) is the LLFA for the site location. An enquiry was sent to BMBC, the response of which is discussed in Section 4.4.

5. Sources of Potential Flood Risk

5.1 Fluvial (Rivers)

5.1.1 Present Day Risk

Extreme fluvial flood events have the potential to cause rapid inundation of properties, whilst posing a threat to the welfare of local residents, alongside potentially preventing emergency access to properties and essential infrastructure.

The EA's Flood Map for Planning (FMfP) shows the proposed CSO outfall location is in Flood Zone 3. This is defined as an area of fluvial flooding of greater than 1% AEP (Annual Exceedance Probability).

The CSO outfall is only a small part of the proposed development, with the CSO chamber, weir, other manholes and connecting pipework being located in areas of higher elevation, under the hard standing areas north of the railway line. The CSO outfall and its associated headwall structure will be the only above ground elements of the system subject to inundation by flood waters.

River Roch

In response to a Product 4 request, the EA provided modelled water levels and flows for a series of nodes along the River Roch (Figure 6) and the Barn Brook (as part of the Gipsey Brook model). The EA also confirmed as part of the same email that they held no records of flooding at the site location.

Peak flood levels (m AOD) from the nodes during a series of different return period events are provided in Table 6. The node most relevant to the site from the Product 4 response is '2' shown in Figure 6, otherwise known as ROCH01_04407. This is located approximately 90m upstream of the proposed outfall location.

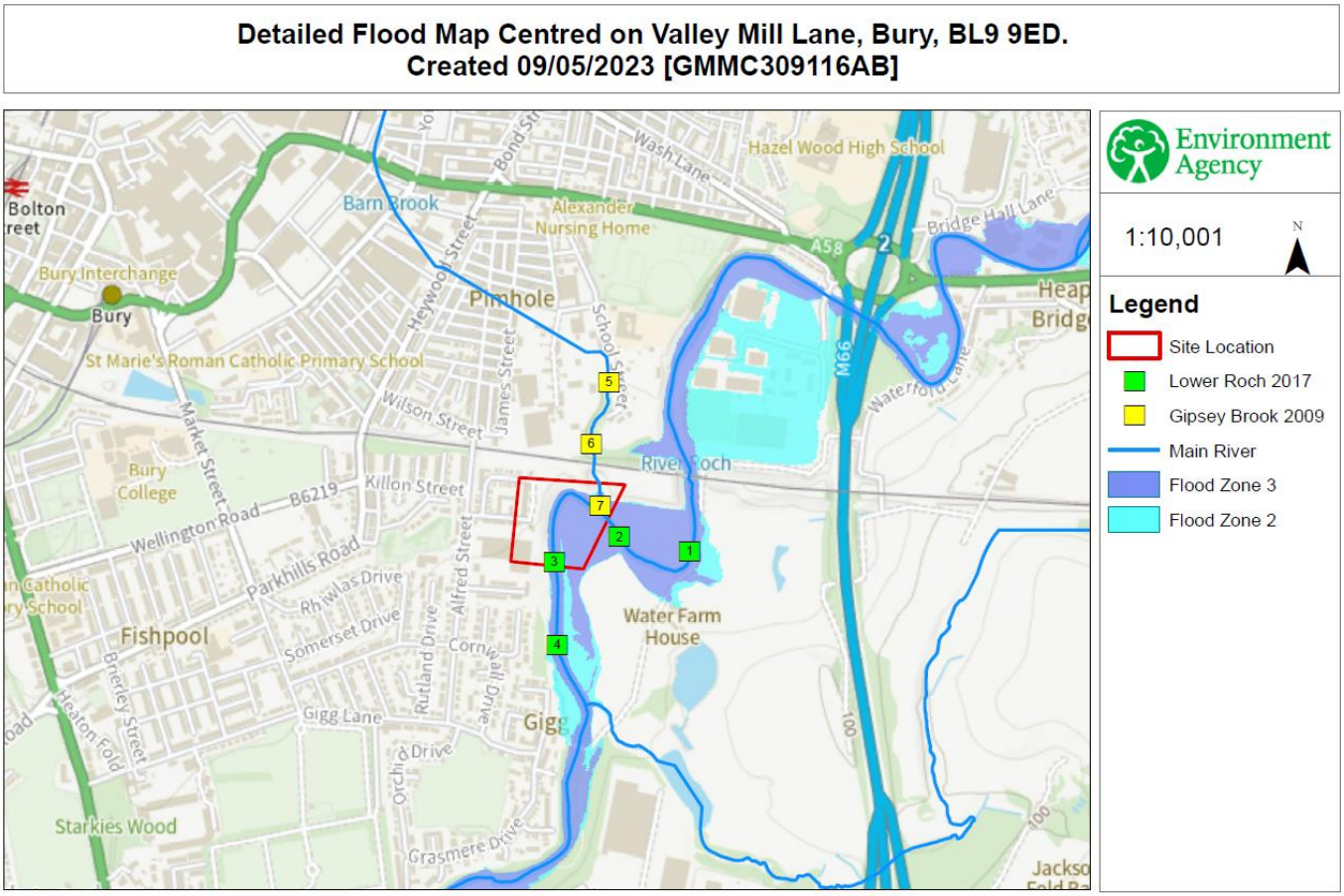

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Figure 6 - Extract of EA flood map and model node locations

The flood data provided by the EA includes two datasets for flood levels and flows, undefended and defended. A review of these two datasets shows that the defended peak flood levels are generally 150mm or more, higher than the undefended levels. To provide a conservative assessment of risk the defended levels have been used, as the undefended event would require all the flood defences upstream on the River Roch to have been removed or failed. Given the urban areas that the River Roch flows through, and the impact that removing the flood defences would have on the public, it is considered unlikely that the undefended scenario would in reality occur over the lifetime of the CSO. Therefore, the defended flood levels provide a more representative understanding of peak water levels.

Table 5 Flood levels (m AOD) for a range of Return Period Events at location 2, node ROCH01_04407

AEP (1 in X year)	Undefended level (mAOD)	Undefended flows (m^3/s)	Defended level (mAOD)	Defended flows (m^3/s)
50 % AEP (1 in 2 year)	71.37	57.9	71.56	57.9
20 % AEP (1 in 5 year)	71.65	73.89	71.83	73.9
10 % AEP (1 in 10 year)	71.83	85.88	72.01	85.88
5 % AEP (1 in 20 year)	72.03	98.31	72.21	98.34
4 % AEP (1 in 25 year)	72.11	102.54	72.29	102.58
2 % AEP (1 in 50 year)	72.37	117.36	72.52	117.42
1.33 % AEP (1 in 75 year)	72.46	132.42	72.61	128.74
1 % AEP (1 in 100 year)	72.46	135.69	72.62	134.58
0.5 % AEP (1 in 200 year)	72.46	156.17	72.8	156.21
0.1 % AEP (1 in 1000 year)	72.99	207.24	73.1	204.44

During the three design storm events (1 in 10, 30 and 100 years) considered in the sewer design carried out by others, the peak flood level varies between 72.01m AOD and 72.62m AOD, a range of 610mm.

Whilst the Product 4 data provides a reasonable understanding of flood risk at the proposed site location due to the distance of the nearest node to the proposed site it is possible that there is some variability in peak water level between the two locations. To reduce this uncertainty a Product 7 request was made to the Environment Agency (EA) for the model data used to inform the above-mentioned Product 4 to understand if any closer nodes existed. This request identified a river node closer to the new proposed outfall location, which is more appropriate for this assessment of flood levels. The node reference is ROCH01_04299 and is 15m downstream of the proposed outfall location.

Peak flood levels for this cross section for the defended scenario are given below in Table 6.

Table 6 Flood levels (m AOD) for a range of Return Period Events at ROCH01_04299

AEP (1 in X year)	Defended level (mAOD)
50 % AEP (1 in 2 year)	71.37
20 % AEP (1 in 5 year)	71.65
10 % AEP (1 in 10 year)	71.83
5 % AEP (1 in 20 year)	72.03
4 % AEP (1 in 25 year)	72.11
3.3 % AEP (1 in 30 year)	72.18
2 % AEP (1 in 50 year)	72.37
1.33 % AEP (1 in 75 year)	72.45
1 % AEP (1 in 100 year)	72.47
0.5 % AEP (1 in 200 year)	72.66
0.1 % AEP (1 in 1000 year)	72.98

Based on current designs, the invert level of the outfall and the chamber immediately upstream of the outfall position will be equal to the 50th percentile exceedance as define by Atkins Memo 'Roch Flow Exceedance for Bury CSO' dated 18th December 2023. This level is shown on the included drawings in Appendix B.

To manage the risk of raised river levels resulting in surcharge of upstream manholes the upstream manhole will have the cover level set above the defended 1:30 year flood level (72.18m AOD) to ensure that any raised flood levels do not cause flooding via surcharge of the outlet pipe. During larger events, the peak flood level will exceed the ground level and any surcharge flows through the cover will be mixed with raised flood waters in the River Roch.

The outfall pipe, with an invert level of 69.17m, will utilise a 750mm diameter pipe (with safety grill), meaning that for all design flood events, 1 in 2 year and greater, the outfall will be submerged.

The upstream end of the CSO outfall pipe has an invert level of 80.86m AOD, placing this over 6m above the 0.1% AEP flood event, thereby ensuring the raised river level would not inundate the CSO chamber.

The risk of flooding from the River Roch to the CSO outfall, which is a water compatible structure suitably protected from erosion, and the upstream CSO infrastructure, with its raised levels, is low.

River Roch velocity

In order to better understand the risk of erosion to the area of the outfall the model data was reviewed to understand the average velocity in the river at the peak of the flood event. These are shown in Table 7.

The outfall is at the edge of the channel and so velocity in this area is typically considered to be less than the average values stated below. The model shows that velocity does not pass 1.5m/s for all events. Whilst not tabulated the larger events are also limited in the model to less than 1.5m/s. Further discussion on the measures to manage erosion to the outfall are provided below in Section 5.3.

Table 7 In channel peak velocity at node ref. ROCH01_04299

Return period (years)	Peak velocity at ROCH01_04299 (m/s)
1:2	1.25
1:10	1.39
1:20	1.41
1:30	1.42
1:50	1.42

Barn Brook

The EA, in their P4 response, also provided modelled water levels and flows for the Barn Brook. These are based on the 2009 model of the Gipsey Brook and are summarised in Table 6. Unlike the River Roch the EA did not provide the model data for this watercourse.

There are no flood defences along the Barn Brook, so only one set of levels are provided, Table 8. These show that peak flood levels determined by this model, at the confluence with the River Roch, are lower than the more up to date River Roch model.

As the outfall will be located on the banks of the River Roch, the risk to the outfall has been assessed based on the more up to date modelling completed for this watercourse, as discussed above.

Table 8 Barn Brook flood levels

AEP (1 in X year)	Node 6 level (mAOD)	Node 6 flows (m^3/s)	Node 7 level (mAOD)	Node 7 flows (m^3/s)
5 % AEP (1 in 20 year)	73	2.04	71.81	2.04
1 % AEP (1 in 100 year)	73.1	2.75	71.98	2.75
0.1 % AEP (1 in 1000 year)	74.29	4.32	72.24	4.31

A copy of the EA Product 4 response is provided in Appendix C.

5.1.2 Future Risk (Climate Change)

The EA guidance document 'Flood risk assessments: climate change allowances' was release in February 2016 and included statistical increases in peak fluvial flows by river basin district and allowance categories based on epochs and development vulnerability classification.

The EA have subsequently updated the guidance on climate change in July 2021, stating that UKCP18 projections have been used to update the peak river flow allowances. Allowance have also been based on management catchments instead of river basin districts. The other major change in July 2021 involved a change in the guidance on how to apply peak river flow allowances. It is now specified that the central allowance is used for all assessments except for essential infrastructure, where the higher central allowance is used. Consequently, EA mapping was examined for the site, based on a 50-year design standard and the climate change allowance period that is to be considered is the 2050s (2040 to 2069). The Irwell Management Catchment peak river flow allowances for this period is 19% on the basis that the proposed development is not going to be impacted by flood extents and is classified as a *'water-compatible development'*.

The flood levels provided by the EA included a range of climate change allowances. A 30% uplift in flows has been applied to the 1% AEP and 0.1% AEP events resulting in a water level increase of 300mm and 390mm respectively. These are shown in Table 9.

Table 9 Climate change flood levels (m AOD) for a range of Return Period Events at node ROCH01_04299

AEP (1 in X year)	Defended level (mAOD)
1 % AEP (1 in 100 year) + 30% increase in flow	72.77
1 % AEP (1 in 100 year) + 35% increase in flow	72.81
1 % AEP (1 in 100 year) + 70% increase in flow	73.12
0.1 % AEP (1 in 1000 year) + 30% increase in flow	73.37

Given that the proposed CSO and outfall pipe is underground, except for the outfall headwall, and the CSO chamber is over 6m above the 0.1% AEP event with a 30% increase flows for climate change, the risk posed by an increase in flows due to climate change is low.

Due to the outfall being at the edge of the river channel, the minor uplift in peak water levels of up to 300-390mm is unlikely to substantially increase the impact on flood risk to the outfall that is already submerged at smaller design return periods.

Equally velocity of the flows at the edge of the flood water is unlikely to be dramatically affected by the uplift in flows. The erosion potential around the outfall and associated riprap/rock armour is therefore unlikely to be substantially increased as a result of climate change.

Barn Brook

Table 10 Barn Brook flood levels with an allowance for climate change

AEP (1 in X year)	Node 6 level (mAOD)	Node 6 flows (m^3/s)	Node 7 level (mAOD)	Node 7 flows (m^3/s)
1 % AEP (1 in 100 year) + 35% increase in flow	73.23	3.71	72.14	3.7
1 % AEP (1 in 100 year) + 70% increase in flow	73.36	4.68	72.28	4.68

As identified in Section 5.1.1. there is a difference in peak water levels between the River Roch model and the model used to derive the Barn Brook peak water levels. As the River Roch model is newer, and the outfall will be on the banks of the River Roch the risk from this source has been assessed based on the levels in Table 9.

The CSO itself will add nominal flows to the watercourse, with any increase due to climate change far exceed the impact of CSO flows, for further details see Section 5.2.

5.2 River Roch and CSO flow interaction

To understand the influence of the CSO flows on peak river levels a review of flows from both systems was undertaken.

The model of sewer network, including the new CSO, was provided by others as part of wider detailed design work. Interrogating this model showed that during the 1% AEP with climate change scenario for the critical storm duration (60 minute) the peak flow from BRY0021 is 1.1m^3/s. This is 0.8% of the flow in the River Roch during the 1% AEP, and even less after an increase in flows as a result of climate change. Overall, the flows from the CSO will have no measurable impact on peak flood level and will not result in an increase in flood risk elsewhere.

This conclusion is supported by hydraulic modelling carried out by Atkins in December 2021. Atkins were appointed by United Utilities to carry out computational hydraulic modelling for the River Roch to establish the impact of changes in outfall rates from 3no. combined sewer outfalls.

Atkins report (reference 5209508-001 | River_Roch_Modelling_Technical_Summary_v1_4) identifies that CSO flows will increase compared to the existing scenario, between 9 and 24% depending on the storm return period. Regardless of this, the peak flood level in the River Roch remains within 10mm of current levels during a coincident peak event, and that during offset peaks there is a localised 40mm increase in water level at the CSO. The report concludes that overall, the CSOs will have no measurable effect on peak flood levels in the River Roch.

5.3 Outfall and channel erosion protection measures

The outfall and channel erosion protection measures were discussed in length in the CSO outfall and River Roch bank protection design conducted by GHD in May 2024. It is advised by the Environment Agency that the outfall structure needs to be close to the river with appropriate bank protection, including measures to manage bed scour at the interface between the headwall and the riverbed to limit the risk of undercutting due to localised bank erosion. Vegetation around the outfall site should be preserved or reinstated to help bind the soils and limit erosion during flooding events.

To manage erosion risk, riprap (rock armour) should be used to create a hard interface between the headwall and existing ground levels. The new outfall location is closer to the River Roch and at a lower elevation than previously proposed, with the invert of the outfall pipe flush with the riverbed level and the headwall on the channel edge.

The new CSO outfall pipe is to be located as close to the River Roch channel as possible to reduce the risk of erosion to the bank, and to promote a better mixing of any CSO flows with the river. As the outfall will be at levels almost equal to the river bed level, there is no need for a reinforced channel to convey flows from the headwall apron to the channel across an area of intervening river bank. Instead, rock armour (riprap) will be required around the headwall to limit risk of erosion to the structure and the ground around it that provides its footing.

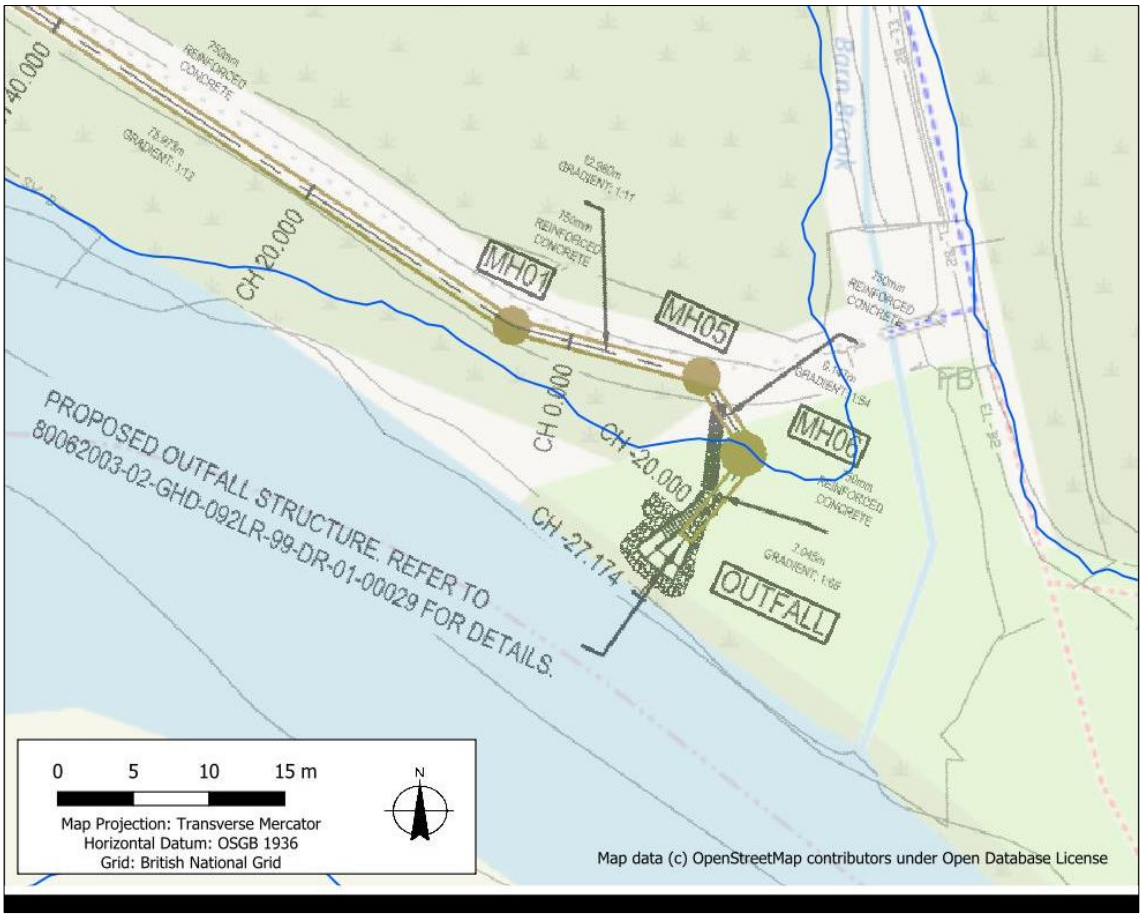


Figure 7 - Plan view of proposed new location for outfall. Outlet of CSO with riprap shown, as is Barn Brook based on OSM basemap. The blue contour is the 72.2m AOD level above which the upstream manhole should be raised.

Figure 7 shows the proposed outfall location, and the EA model data indicates that during a 50% AEP (1 in 2 year) flood event, the peak flood level is 71.37m AOD, submerging the outfall pipe by over 1m. This depth helps dissipate the energy of the CSO flows, limiting erosion impact in the River Roch channel.

Riprap, as shown, should be placed around the headwall to prevent erosion, with a median diameter of 300mm to ensure stability against peak velocities, including climate change allowances. A non-woven geotextile liner should be used under the riprap to limit soil migration, with a rock depth of at least 450mm. The edges of the riprap should be set into the slope and planted with native vegetation to manage erosion risks.

5.4 Infrastructure Failure

5.4.1 Defence Infrastructure

Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding.

EA Mapping show the nearest upstream EA flood defence to be in Rochdale, over 7.5km to the north east. There are no mapped flood defences less than 10km downstream, and as such, the risk to the site from a failure of a flood defence is low.

5.4.2 Conveyance Infrastructure

The failure of conveyance infrastructure such as culverts or bridges could increase the risk of flooding in the study area but due to the outfall pipe, and upstream infrastructure being underground there is no risk of flooding from this source to the development proposals.

5.5 Pluvial (Surface Water)

The EA's Risk of Flooding from Surface Water map (RoFSW) shows the area of the outfall, in the River Roch channel, to be at a low, medium and high risk from surface water flooding (Figure 4). This means that parts of the site are identified as being at risk from flooding for all events from the 3.3% AEP (1 in 30 year) rainfall event up to the 0.1% AEP (1 in 1000 year).

The area of the new CSO chamber and associated below ground infrastructure is located within the site boundary as shown in Figure 4. EA mapping shows the wider area to be at risk of flooding, with flows originating from the west and flowing east towards the Barn Brook. Detailed mapping provided by the EA shows that the site boundary is out with the extent of flooding during the high and medium risk events. The risk is posed only from the 0.1% AEP (low risk) event. During this low risk event, flood depths in and adjacent to the site boundary are less than 150mm, indicating a shallow flow route for water rather than any areas of substantial pooling.

The CSO will be below ground, although not sealed directly from overland flows due to the requirement to have vented covers. As flood depths during the low risk event is less than 150mm consideration should be given to providing an upstand around the CSO site compound boundary or specifically the vented covers to manage the residual risk from this source. With these mitigation measures in place the risk posed from this source is low. During construction measures should be taken to ensure surface water runoff from this source do not enter the excavations.

The route of the pipe is largely in areas of low risk. The exception is immediately south of the railway line. As with the CSO chamber, the pipe will be below ground and so there is a low risk from this source, but management of the risk will be required during the construction phase.

Post construction, with ground levels returned to existing, there will be no change in risk because of the development.

The site boundary is currently surfaced with hard standing, post construction the same area will be surfaced with hard standing. Overall, there is no change in the total area of hard standing ensuring no increase in runoff rates or volumes of surface water compared to the existing scenario.

Due to the development of the outfall (except for the headwall structure), being placed underground, there is no risk of surface water flooding to the development.

5.6 Coastal / Tidal

The River Roch is not understood by GHD to be tidally influenced meaning there is a very low risk from this source.

5.7 Sewer Flooding

The development is for improvements to the sewer network to better manage the risk of exceedance flows in excess of the design flows downstream. The CSO provides a "pressure break" in the system and will, post construction, reduce flood risk to the wider area from this source.

The site, by its nature is at risk from sewer flooding as it will convey excess flows out of the sewer network and discharge them to the River Roch.

5.8 Ground Water

Soilscapes mapping describes three different soil types across the CSO chamber and outfall route position. These are summarised below:

- CSO chamber: Freely draining slightly acid loamy soils that are freely draining
- Pipe route: Slowly permeable seasonally wet acid loamy and clayey soils with impeded drainage
- Outfall: Naturally wet very acid sandy and loamy soils

The British Geological Survey (BGS) online mapping describes the site to be underlain by various superficial deposits and bedrock geology across the route*:*

- CSO chamber: Superficial deposits of Glaciofluvial Deposits, Devensian - Sand and gravel, and bedrock geology of Pennine Lower Coal Measures Formation - Mudstone, siltstone, and sandstone.
- Pipe route: Superficial deposits of Till, Devensian – Diamicton and bedrock geology of Pennine Lower Coal Measures Formation - Mudstone, siltstone, and sandstone.
- Outfall: Superficial deposits of Alluvium - Clay, silt, sand and gravel and bedrock geology of Pennine Lower Coal Measures Formation - Mudstone, siltstone, and sandstone.

BGS borehole records include one record in the area of the proposed CSO chamber, but none along the pipe route or near the outfall. The borehole near the proposed CSO chamber (ref. SD81SW22) was sampled in 1924 as part of the Bury Sewer Scheme. This record details four boreholes, none of which record groundwater. Generally, the boreholes were drilled to 10m BGL and records show the ground contains elements of clay at all four locations.

Given the proximity to the watercourse, and the excavations that will take place to create the CSO chamber, there is a risk of groundwater emergence during the construction phase. Post construction, with the ground returned to existing levels the risk of groundwater emergence is low. Overall, the risk to the development from groundwater is low.

5.9 Artificial Water Bodies (Reservoir)

Reservoirs, canals, and other artificial water bodies have the potential to hold a large volume of water, often above ground level. Should the containment of these waterbodies fail (e.g., due to breach or overtopping) there could be a sudden release of deep fast-moving water with little warning able to be provided. However, due to regular maintenance and careful monitoring there is a low risk posed from such an event.

There are 10 reservoirs upstream of the site location that contribute to the mapped flood risk extent from this source.

The EA's risk of flooding from reservoirs (Figure 5) shows the outfall location falls within the maximum reservoir flood extent on wet and dry days, but the area of the proposed CSO chamber and the pipe route is raised above the maximum flood extent. Reservoir flooding is extremely unlikely to occur due to the regular maintenance and monitoring of these assets under the Reservoirs Act 1975.

Thus, the site considered to be at low risk from this source of flooding.

6. Mitigation

6.1 Finished Floor Levels (FFL)

There are no proposed buildings being constructed as part of the works and so the requirement to consider finished floor levels is not required. Any kiosk, or similar, associated with the CSO chamber should be raised a minimum of 150mm above adjacent finished ground level to manage the risk from surface water (pluvial) flooding.

6.2 Flood Resistance Measures

Flood resistance refers to measures to construct a building to prevent floodwater entering and damaging its fabric or structure. Due to the proposed development being a below ground pipe system, this measure is not necessary.

6.3 Flood Resilience Measures

Flood resilience measures can be used to limit the impact of flooding to a building or structure, and reduce the time taken to clean up and return to operation after a flood. The use of flood resilience measures is not required due the development being an installation of underground pipes.

6.4 Safe Access/Egress

Safe access and egress are not required for the proposed development.

6.5 Floodplain Compensation

Floodplain compensation is not required as the proposed pipe is being placed underground and so will not displace flood waters. The outfall headwall, on the north bank of the River Roch, will be subject to flooding. The volume of the headwall structure beyond the existing bank profile will be kept to a minimum and overall will not result in any measurable loss in floodplain storage. As such no floodplain compensation is required in support of the development.

7. Development Potential

The southern extent of the site area is located within Flood Zone 3, meaning the area is at risk from fluvial flooding during events with greater than a 1% AEP. As there are no buildings or above ground structures, except for a new outfall headwall, the impact on the proposals are minimal.

In line with the information set out in the Flood Risk and Coastal Change Planning Practice guidelines, it was not deemed necessary to perform the Sequential Test or the Exception Test. Due to the site being classified as a 'water-compatible development', the level of flood risk classification is dismissed, and development should be permitted.

Therefore, it is concluded that the site is suitable for the proposed development.

8. Conclusion

This FRA has been prepared in accordance with requirements set out in the NPPF and the associated Planning Practice Guidance. The FRA has been produced on behalf of Bethell Construction Ltd for the proposed below ground CSO, pipeline and outfall for a new CSO discharging flows to the River Roch.

The Environment Agency (EA) Flood Map for Planning (FMfP) shows the southern extent of the study area is in Flood Zone 3. This is defined as an area which has an annual risk of fluvial flooding of greater than 1% AEP (Annual Exceedance Probability).

The site is shown to be at risk from pluvial flooding around the outfall as well as in the area of the new CSO chamber. The CSO chamber and associated kiosk on the area of hard standing east of James Street, is at risk during the low risk (0.1% AEP) pluvial flood event. During this low-risk event, the depth of flooding is less than 150mm. The CSO will be below ground, although not sealed directly from overland flows due to the requirement to have vented covers. As flood depths during the low-risk event is less than 150mm consideration should be given to providing an upstand around the CSO site boundary or specifically the vented covers to manage the residual risk from this source. The EA's RoFSW maps represent a worst-case scenario, where all drainage in and around the site is at capacity and cannot drain. Due to the construction of the pipe being placed underground, pluvial flooding is not a risk to the site.

The site boundary is currently surfaced with hard standing, post construction the same area will be surfaced with hard standing. Overall, there is no change in the total area of hard standing ensuring no increase in runoff rates or volumes of surface water compared to the existing scenario.

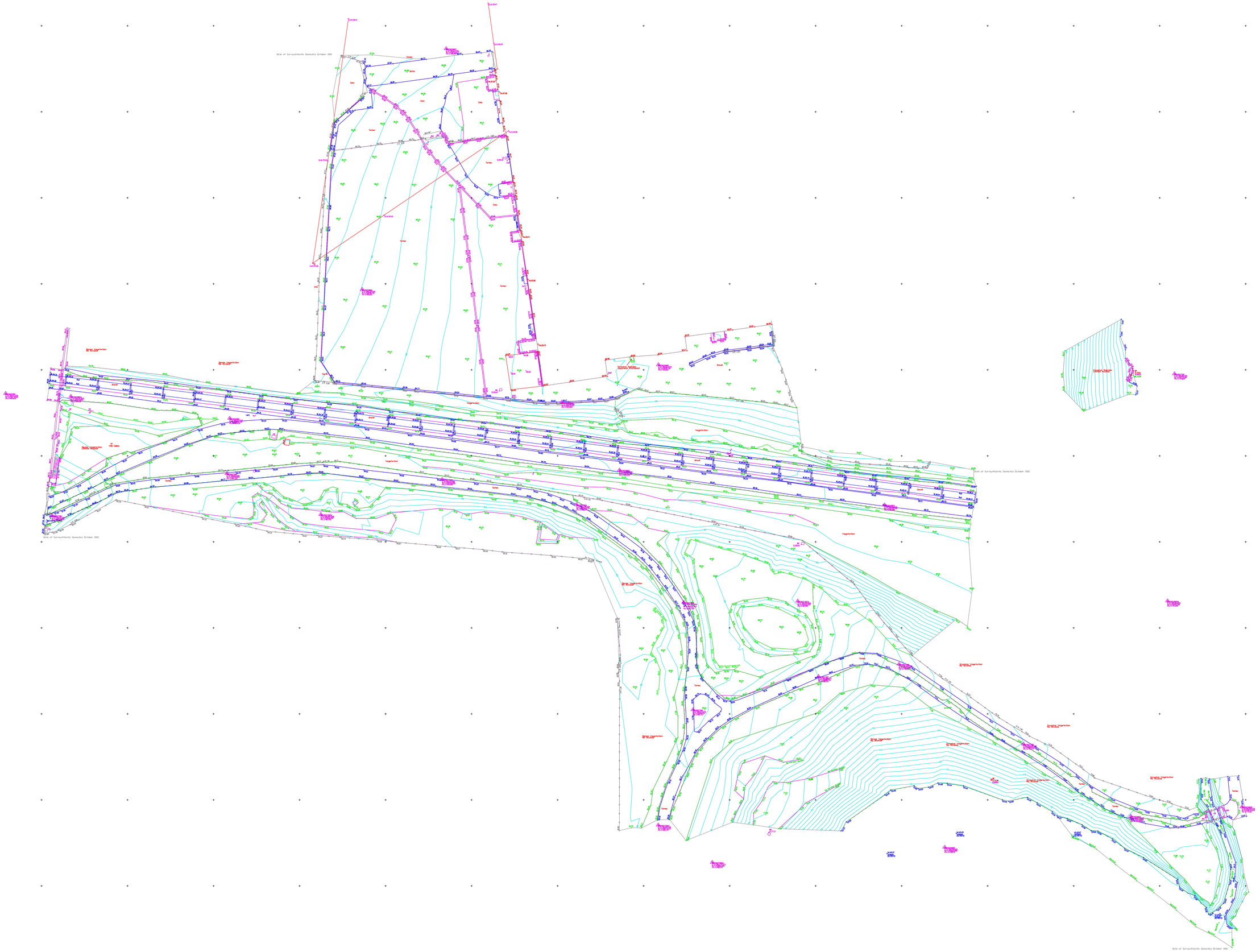
The outfall is located in proximity to the River Roch and will, by design, be at a greater risk of flooding. The creation of an outfall structure on the banks of the River Roch will not result in any measurable loss in floodplain storage. As such, no floodplain compensation is required in support of the development.

It can be concluded from other available sources of information that the proposed development area is at a low risk of flooding from groundwater, sewer, tidal and reservoir sources.

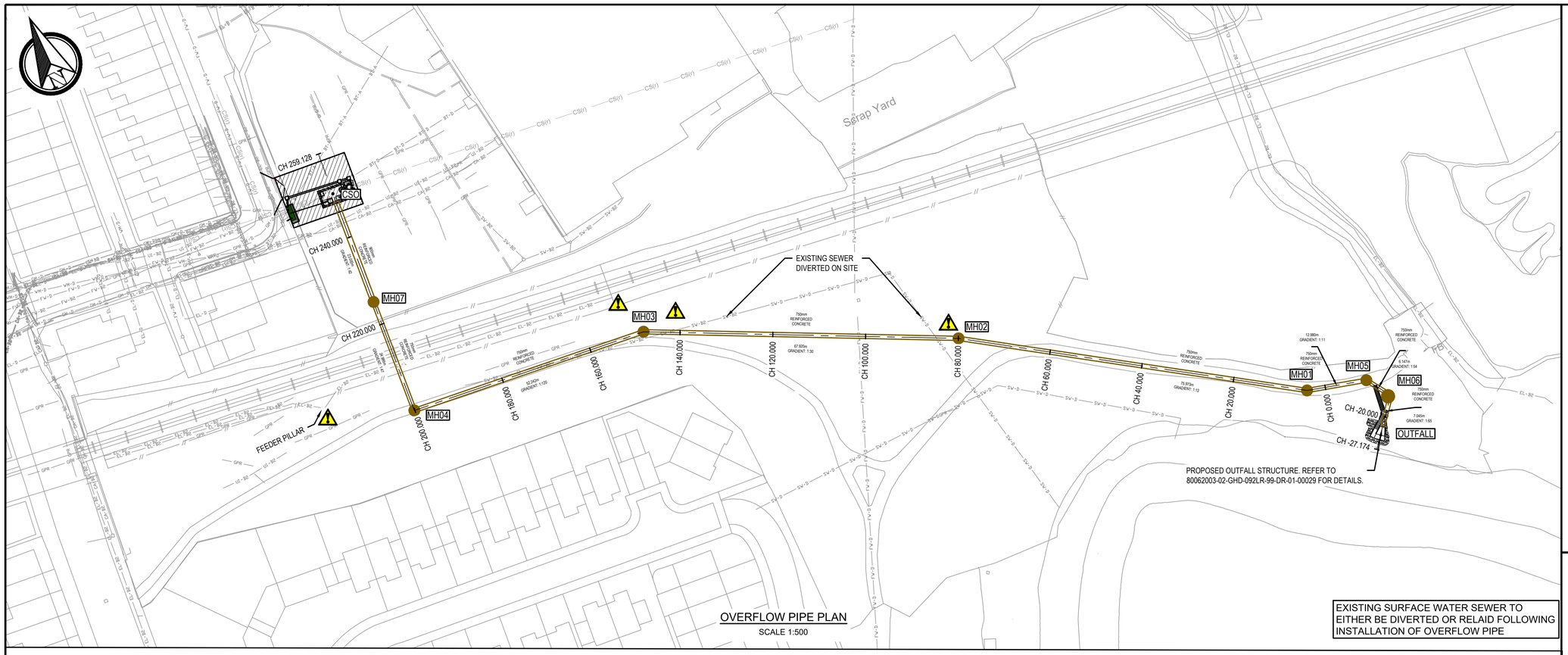
No resistance or resilience measures are required due to there being no buildings within the development area/corridor.

As the proposed development is classified as a 'water-compatible development', neither the Sequential Test or the Exception Test are required in support of the development and there will be no increase in flood risk to the site or surrounding area because of the development.

Appendix A – Topographic Survey


Date of Survey:Atlantic Geomatics October 2021
Vegetation
Turnpike
Cons
Grass
Gravel
Asphalt
Water

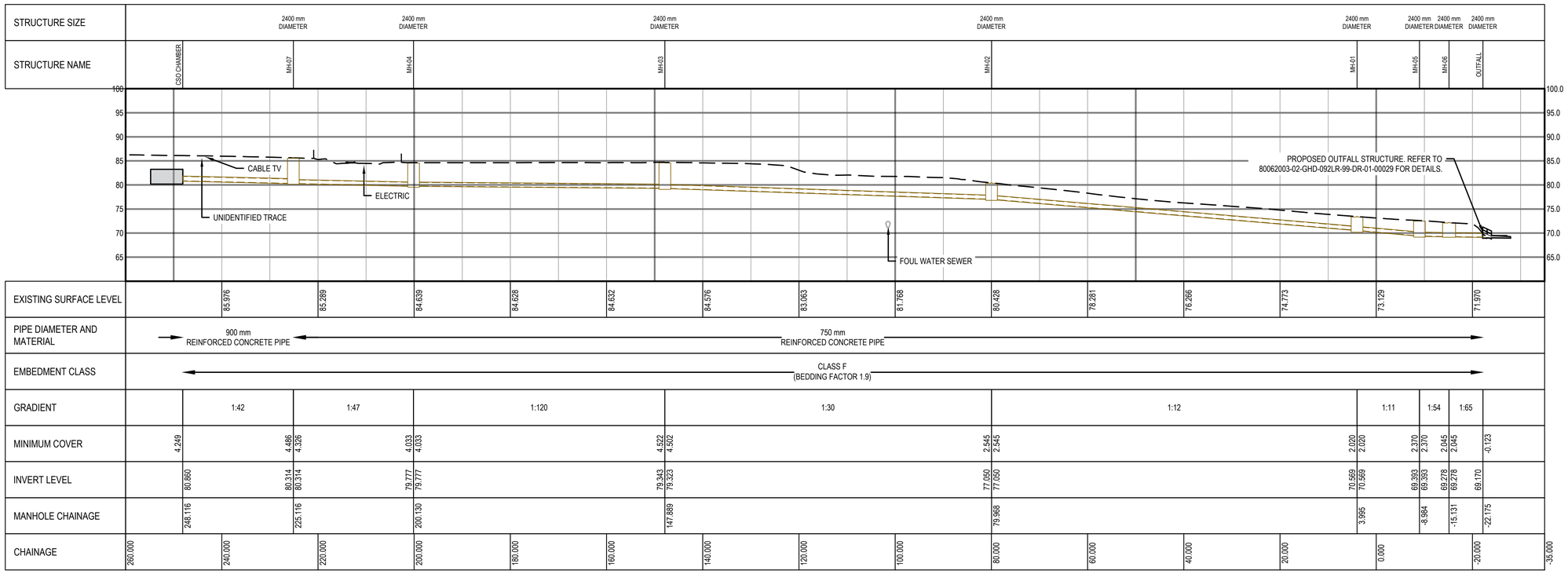
Appendix B – Proposed layout plans



OVERFLOW PIPE PLAN

SCALE 1:500

EXISTING SURFACE WATER SEWER TO EITHER BE DIVERTED OR RELAID FOLLOWING INSTALLATION OF OVERFLOW PIPE



OVERFLOW PIPE LONGITUDINAL SECTION

SCALE 1:500

0 5 10 15 20 25m

SCALE 1:500 AT ORIGINAL SIZE

HEALTH & SAFETY

SITE HAZARDS

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

CONSTRUCTION

1. UNCHARTERED SERVICES.
2. WORKING ADJACENT CAR DEALERSHIP AND PUBLIC ROAD.
3. HEIGHT RESTRICTIONS ON PLANT PASSING AND WORKING BENEATH OVERHEAD CABLES.
4. TEMPORARY OVERPUMPING REQUIRED DURING ONLINE CSO CONSTRUCTION.
5. EXISTING BELOW GROUND SERVICES TO BE DIVERTED AS REQUIRED AND/OR ADEQUATELY SUPPORTED DURING EXCAVATION WORKS.
6. WORKING ADJACENT DEEP WATER.
7. WORKING IN CLOSE PROXIMITY TO RAILWAY LINE.
8. WORKING IN CLOSE PROXIMITY TO RAILWAY FEEDER PILLAR AND RAILWAY ELECTRICAL CABLES
9. CROSSING EXISTING SURFACE WATER SEWER WITH NEW FOUL WATER SEWER

MAINTENANCE/CLEANING

1. CONFINED SPACE
2. WORKING ADJACENT DEEP WATER

DECOMMISSIONING/DEMOLITION

NO SIGNIFICANT RISK

NOTES:

1. ALL DIMENSIONS ARE IN METRES AND ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM UNLESS SHOWN OTHERWISE.
2. DO NOT SCALE FROM THIS DRAWING.
3. ALL DIMENSIONS AND LEVELS CHECKED ON SITE AND ANY DISCREPANCIES.
4. THIS DOCUMENT IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT PROJECT STANDARDS AND SPECIFICATIONS.
5. FOR MH SETTING OUT POINTS REFER TO MANHOLE SCHEDULE 80062003-02-GHD-092LR-99-DR-01-00032.

THIS DRAWING IS TO BE REPRODUCED IN COLOUR.

CURRENT ISSUE INFORMATION

UPDATED IN LINE WITH CLIENT COMMENTS

VERSION	AUTH	CHKD	REVD	REASON FOR ISSUE	DATE
P06	JK	WM	PB	FOR CONSTRUCTION APPROVAL	05.06.24

SUITABILITY CODE	SUITABILITY DESCRIPTION
S4	ISSUED FOR CONSTRUCTION APPROVAL

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United Utilities Water for the North West

BRY0021 AESTHETIC SCREENING

BURY AESTHETIC SCREENS

PLAN AND LONGITUDINAL SECTION - OVERFLOW PIPE

SCALE	SHEET SIZE
AS INDICATED	A1

DRAWING NUMBER	REVISION
80062003-02-GHD-092LR-99-DR-01-00019	P06

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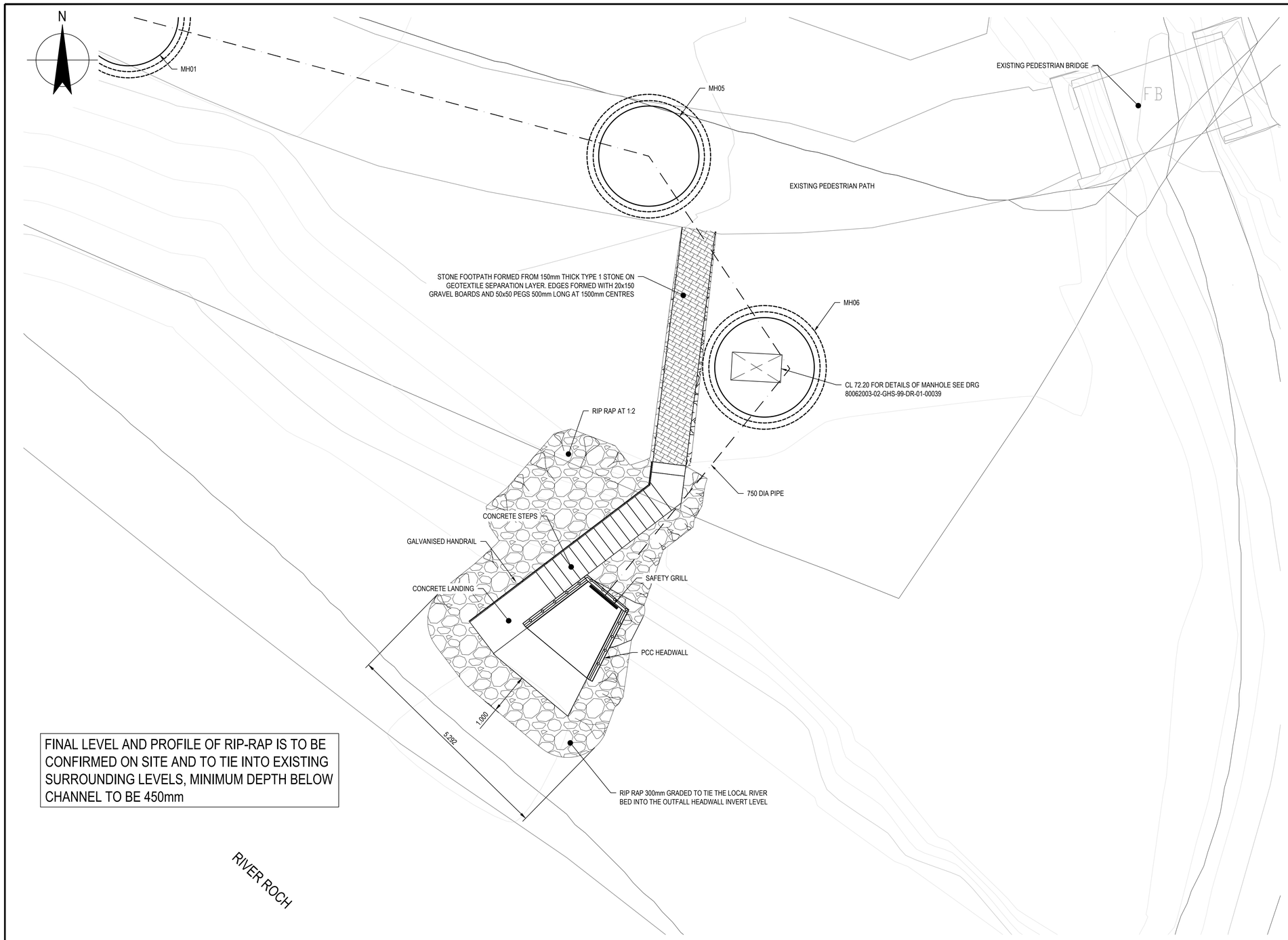

FINAL LEVEL AND PROFILE OF RIP-RAP IS TO BE CONFIRMED ON SITE AND TO TIE INTO EXISTING SURROUNDING LEVELS, MINIMUM DEPTH BELOW CHANNEL TO BE 450mm

0 0.5 1.0 1.5 2.0 2.5m

SCALE 1:50 AT ORIGINAL SIZE

HEALTH & SAFETY

SITE HAZARDS

1. UNCHARTERED SERVICES
2. WORKING ADJACENT DEEP WATER
3. WORKING ADJACENT TO STEEP SLOPE ABOVE FAST FLOWING WATER
4. WORK IN THE RIVER ROCH

GENERAL NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN MILLIMETRES (mm) & ALL LEVELS ARE IN METRES (m) AOD, UNLESS STATED OTHERWISE.
3. ALL DIMENSIONS & LEVELS TO BE CHECKED ON SITE AND ANY DISCREPANCIES SHOULD BE REPORTED TO GHD
4. THIS DOCUMENT IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT PROJECT STANDARDS AND SPECIFICATIONS.

CONCRETE:

1. CONCRETE PROVIDED IN ACCORDANCE WITH THE REQUIREMENTS OF BS EN 206:2013
2. CONCRETE GRADES PROVIDED IN ACCORDANCE WITH THE RECOMMENDATIONS OF BS8500-1:2015 :-

STRUCTURAL CONCRETE
a. COMPRESSIVE STRENGTH CLASS - C28/35
b. DESIGN CHEMICAL CLASS (DC-CLASS) - DC-3
c. MAXIMUM WATER CEMENT RATIO - 0.45
d. MINIMUM CEMENT CONTENT - 340 kg/m3
e. ALLOWABLE CEMENT COMBINATION TYPES - CEM1
f. AGG. CO-EFFICIENT OF THERMAL EXPANSION - 12
g. MAX AGGREGATE SIZE - 20mm

BENCHING/BLINDING
CONCRETE DESIGNATION - GEN3
CONCRETE ROADS/PATHS
CONCRETE DESIGNATION - PAV2

THE CONTRACTOR SHOULD PROPOSE CONCRETE CONSISTENCE CLASS FOR REVIEW BY GHD

CONCRETE MIX DESIGNS SHOULD BE PROVIDED BY THE SUPPLIER FOR REVIEW BY GHD

3. ALL EXPOSED VERTICAL AND HORIZONTAL ARRISES FINISHED WITH A 25 x 25mm CHAMFER, EXTENDING TO 150mm BELOW FINISHED GROUND LEVEL, EXCEPT FOR:
   - WEIR TOPS
   - STAIR NOSINGS
   - HORIZONTAL ARISE ABUTTING FLOORING, COVERS OR STAIR HEADS
   - WHERE THE CONCRETE FORMS A STEP ON AN ACCESS ROUTE.
4. SURFACES EXPOSED IN THE COMPLETED WORKS SHALL RECEIVE A FAIR WORKED FINISH. ALL OTHER STRUCTURAL CONCRETE SURFACES SHALL RECEIVE A FAIR FINISH.
5. UNLESS SHOWN OTHERWISE ON THE DRAWINGS, NOMINAL COVER SHALL BE:

a. 40mm GENERALLY
b. 50mm FOR CONCRETE CAST AGAINST BLINDING;
c. 75mm FOR CONCRETE CAST AGAINST SOIL; AND

6. ALL REINFORCEMENT HAS A MINIMUM LAP OF 53 x DIA OF SMALLER BAR IN LAP
7. REMOVAL OF FORMWORK:

MINIMUM CONCRETE STRENGTH GAIN OF 10N/mm² TO BE ACHIEVED PRIOR TO STRIKING FORMWORK. TEST CUBE RESULTS REQUIRED TO DEMONSTRATE STRENGTH GAIN HAS BEEN ACHIEVED

8. CONCRETE CONSTRUCTION SHOULD BE CARRIED OUT IN ACCORDANCE WITH THE RECOMMENDATIONS OF BS EN 13670:2009 EXECUTION OF CONCRETE STRUCTURES.
9. MANHOLE CONSTRUCTION TO BE IN ACCORDANCE WITH UU STANDARD DETAILS STND/01/001 AND 013.

CURRENT ISSUE CONSTRUCTION

VERSION	AUTH	CHKD	REVD	REASON FOR ISSUE	DATE
C05	JK	WM	MS	FOR CONSTRUCTION	14.05.24

SUITABILITY CODE	SUITABILITY DESCRIPTION
A	ISSUED FOR CONSTRUCTION

GHD
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Water for the North West

BRY0021 AESTHETIC SCREENING

BURY AESTHETIC SCREENS

OUTFALL GENERAL ARRANGEMENT

PLAN

SCALE 1:50m

SHEET SIZE A1

DRAWING NUMBER 80062003-02-GHD-092LR-99-DR-01-00029

REVISION C05

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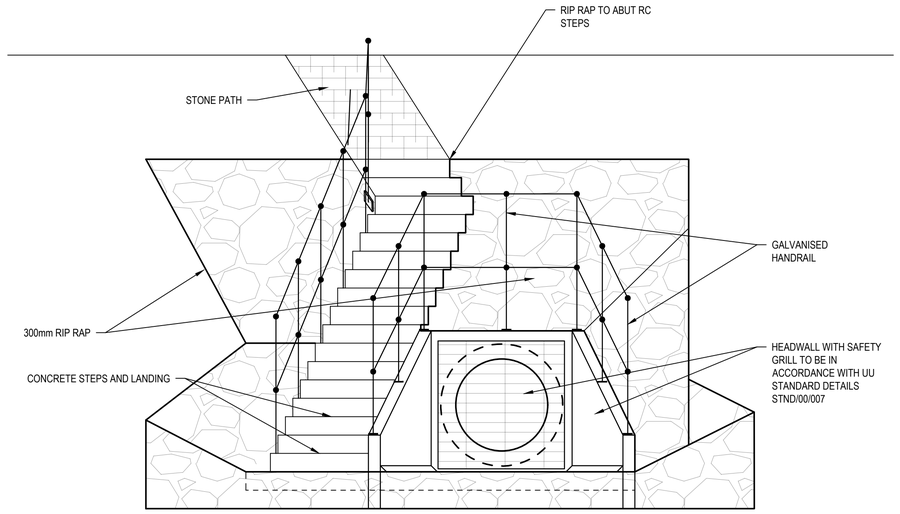
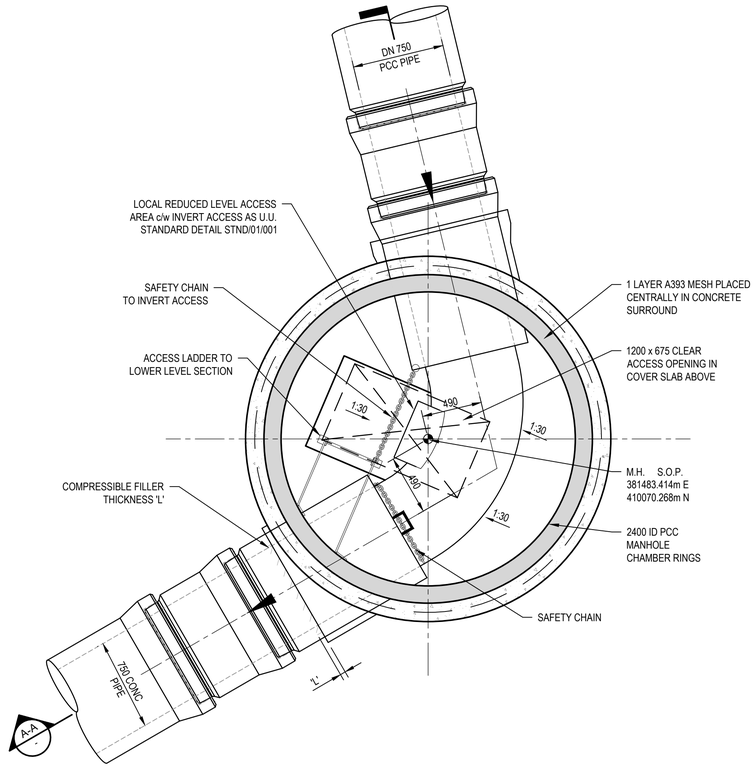


ELEVATION ON OUTFALL STRUCTURE

SCALE 1:25



PLAN ON MANHOLE 06

SCALE 1:25

HEALTH & SAFETY

SITE HAZARDS

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CONCRETE DESIGNATION - GEN3
CONCRETE ROADS/PATHS
CONCRETE DESIGNATION - PAV2

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CURRENT ISSUE INFORMATION

VERSION	AUTH	CHKD	REVD	REASON FOR ISSUE	DATE
C02	JK	WM	MS	ISSUED FOR CONSTRUCTION	08.05.23

SUITABILITY CODE	SUITABILITY DESCRIPTION
A	ISSUED FOR CONSTRUCTION

GHD
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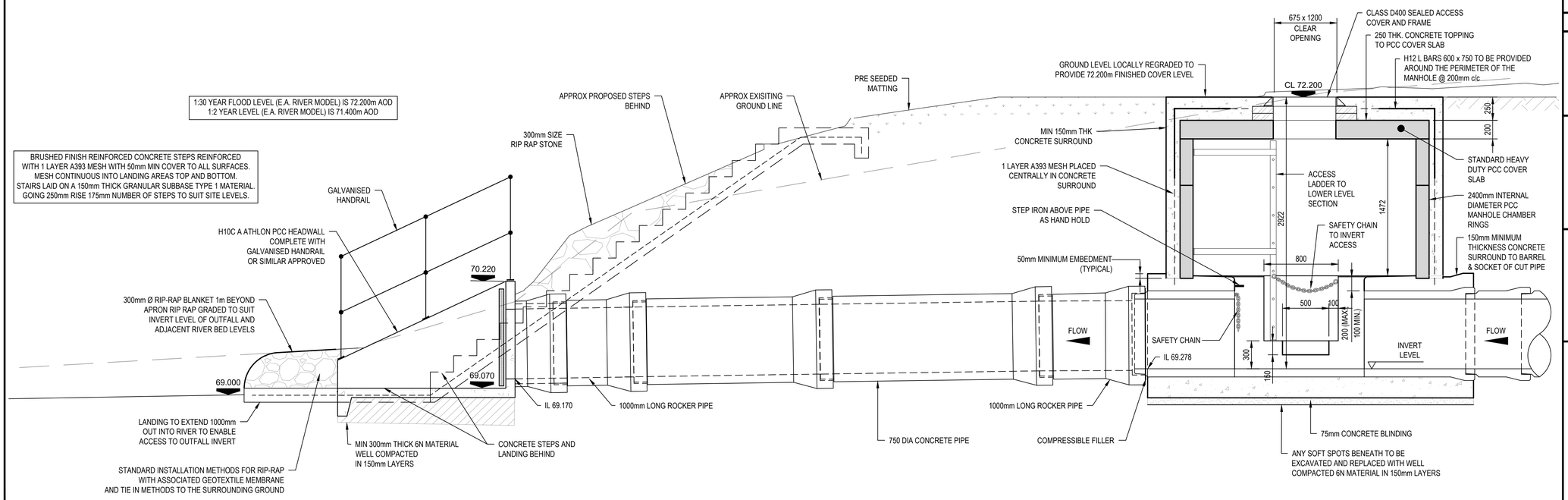
United Utilities Water for the North West



SECTION A-A OUTFALL STRUCTURE

SCALE 1:25

0 250 500 750 1000 1250mm
SCALE 1:25 AT ORIGINAL SIZE

BRY0021 AESTHETIC SCREENING

BURY AESTHETIC SCREENS

OUTFALL GENERAL ARRANGEMENT

SECTIONS

SCALE	SHEET SIZE
1:25mm	A1
DRAWING NUMBER: 80062003-02-GHD-092LR-99-DR-01-00039	REVISION: C02

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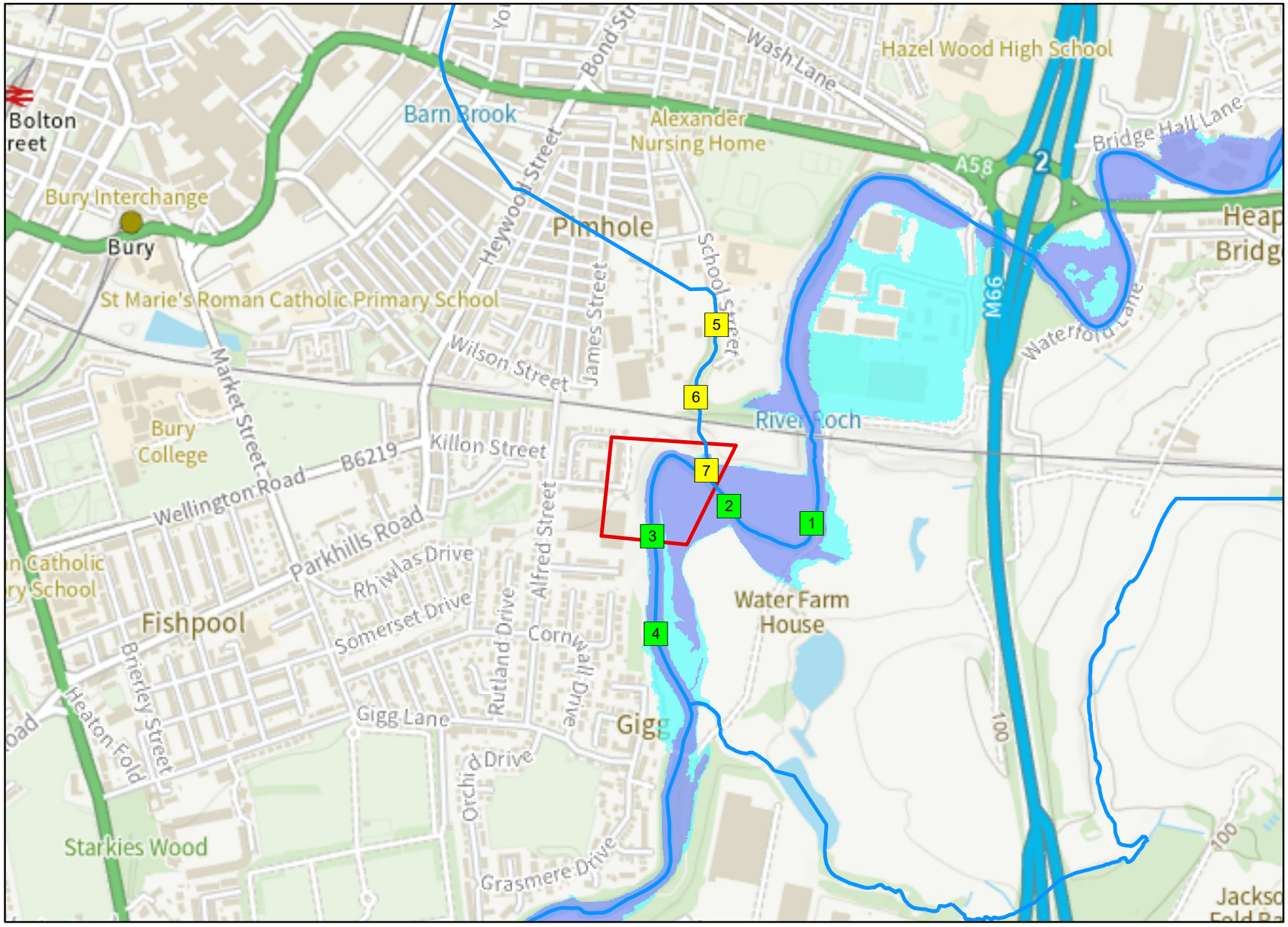
Appendix C – EA Product 4 response

Detailed Flood Map Centred on Valley Mill Lane, Bury, BL9 9ED.
Created 09/05/2023 [GMMC309116AB]



Environment Agency

1:10,001

N

Legend

- Site Location
- Lower Roch 2017
- Gipsey Brook 2009
- Main River
- Flood Zone 3
- Flood Zone 2

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					Undefended																Defended															
Map Reference	Model Node Reference	Easting	Northing	Data	50 % AEP (1 in 2 year)	20 % AEP (1 in 5 year)	10 % AEP (1 in 10 year)	5 % AEP (1 in 20 year)	4 % AEP (1 in 25 year)	2 % AEP (1 in 50 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	0.5 % AEP (1 in 200 year)	0.1 % AEP (1 in 1000 year)	0.1 % AEP (1 in 1000 year) + 35% increase in flow	50 % AEP (1 in 2 year)	20 % AEP (1 in 5 year)	10 % AEP (1 in 10 year)	5 % AEP (1 in 20 year)	4 % AEP (1 in 25 year)	2 % AEP (1 in 50 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 30% increase in flow	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	0.5 % AEP (1 in 200 year)	0.1 % AEP (1 in 1000 year)	0.1 % AEP (1 in 1000 year) + 30% increase in flow
1	ROCH01_04615	381685	409955	Modelled Water Level (m aodN)	71.79	72.09	72.29	72.50	72.57	72.74	72.81	72.83	73.10	73.15	73.43	72.81	73.30	73.65	71.88	72.18	72.38	72.63	72.68	72.83	72.91	72.95	73.20	73.24	73.50	73.10	73.38	73.73
				Modelled Flow (cumecs)	57.90	73.90	85.88	98.39	102.67	117.53	127.66	133.32	173.24	181.21	229.71	156.28	207.42	269.18	57.90	73.90	85.89	98.43	102.72	117.59	126.77	134.85	173.27	180.26	227.04	156.31	204.51	268.42
2	ROCH01_04407	381533	409985	Modelled Water Level (m aodN)	71.37	71.65	71.83	72.03	72.11	72.37	72.46	72.46	72.77	72.82	73.14	72.46	72.99	73.38	71.54	71.83	72.01	72.21	72.29	72.52	72.61	72.62	72.90	72.95	73.24	72.80	73.10	73.48
				Modelled Flow (cumecs)	57.90	73.89	85.88	98.31	102.54	117.36	132.42	135.69	173.13	181.12	229.50	156.17	207.24	269.00	57.90	73.90	85.88	98.34	102.58	117.42	128.74	134.58	173.16	180.16	226.86	156.21	204.44	268.18
3	ROCH01_04099	381391	409932	Modelled Water Level (m aodN)	70.44	70.72	70.90	71.09	71.15	71.36	71.54	71.61	72.06	72.13	72.55	71.54	72.37	72.83	70.65	70.94	71.13	71.32	71.38	71.62	71.77	71.87	72.29	72.35	72.74	72.12	72.56	73.03
				Modelled Flow (cumecs)	57.89	73.89	85.87	98.30	102.52	117.32	129.47	132.90	173.01	181.00	229.33	156.05	207.08	268.89	57.89	73.89	85.87	98.31	102.53	117.32	130.18	134.27	173.03	180.02	226.64	156.07	204.34	267.96
4	ROCH01_03919	381398	409752	Modelled Water Level (m aodN)	69.92	70.21	70.40	70.59	70.65	70.86	71.01	71.07	71.59	71.71	72.29	71.01	72.05	72.62	70.25	70.53	70.72	70.91	70.97	71.17	71.33	71.42	71.91	71.99	72.44	71.71	72.24	72.75
				Modelled Flow (cumecs)	57.89	73.88	85.87	98.30	102.52	117.31	128.63	132.88	172.85	180.15	216.60	155.68	200.70	246.22	57.88	73.88	85.87	98.30	102.52	117.31	128.91	134.25	172.96	179.97	226.50	156.01	204.30	267.48

Model data taken from Lower Roch 2017
AEP - Annual Exceedence Probability
m aodN - metres above ordnance datum Newlyn
cumecs - cubic metres per second

Notes: *Climate Change Scenario - 30%, 35% and 70% increases in flow calculated for the 2080's (2070 - 2115). Please see https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances for more information regarding the new climate change guidance. The location of the site and the type (vulnerability) of development determine the climate change allowances to consider in any flood risk assessment.

					Undefended				
Map Reference	Model Node Reference	Easting	Northing	Data	5 % AEP (1 in 20 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	0.1 % AEP (1 in 1000 year)
5	ea013_Model_GIPS01_02878	381511	410323	Modelled Water Level (m aodN)	75.71	75.83	75.98	76.10	76.06
				Modelled Flow (cumecs)	2.04	2.75	3.71	4.68	4.32
6	ea013_Model_GIPS01_01351	381472	410187	Modelled Water Level (m aodN)	73.00	73.10	73.23	73.36	74.29
				Modelled Flow (cumecs)	2.04	2.75	3.71	4.68	4.32
7	ea013_Model_GIPS01_0000	381493	410052	Modelled Water Level (m aodN)	71.81	71.98	72.14	72.28	72.24
				Modelled Flow (cumecs)	2.04	2.75	3.70	4.68	4.31

Model data taken from Gipsey Brook 2009
AEP - Annual Exceedence Probability
m aodN - metres above ordnance datum Newlyn
cumecs - cubic metres per second

Notes: *Climate Change Scenario - 35% and 70% increases in flow calculated for the 2080's (2070 - 2115). Please see https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances for more information regarding the new climate change guidance. The location of the site and the type (vulnerability) of development determine the climate change allowances to consider in any flood risk assessment.

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The Power of Commitment