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S4.P01	25/08/2023	17	First Issue	KK	KJ	RH
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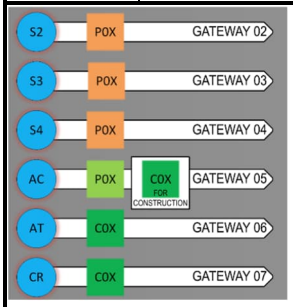

Fig. 1 YWS Spec: YEBPR AIN MFN ENG IN Z 0001 AP.A03 SUITABILITY CODES

YWS Status / Revision Codes:

The *Revision* number is to increase for any amendment to a document/drawing

OR

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Gateway 2 *(Develop Solution Phase)*
Feasibility Design
For Investigation Funding Approval (Pre-Tender)
Status: S2 (YWS Gateway 2) / Revision: P0*

Gateway 3 *(Develop Solution Phase)*
Outline Design
Business Case Approval
Status: S3 (YWS Gateway 3) / Revision: P0*

Gateway 4 *(Design Phase)*
Tender Design
Development Phase Funding Approval
Status: S4 (YWS Gateway 4) / Revision: P0*

Gateway 5 *(Design Phase)*
Detailed Design
Design Acceptance - Issued for Approval
Status: AC (YWS Gateway 5) / Revision: P0*

Once the Design has been Accepted i.e., Approved for Construction
Construction Phase
Status: AC (YWS Gateway 5) / Revision: C0*

Gateway 6 *(Commissioning Phase)*
Permission to Commission
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Gateway 7 *(Commission Phase)*
As-Builts
Acceptance of Take-Over
Status: CR (YWS Gateway 7) / Revision: C0*

Hold Record

Specify any Holds within the document.

Hold No.	Section	Description of Hold
<1>		

Revision Tracking

Specify significant change from previous revisions of the document. (From initial onwards)

Rev.	Section	Description of Change
S4.P01	All	First Issue
S4.P02	All	Incorporate YW and TDC comments
S4.P03	All	Planning Policy Context and Sequential Test Added
S4.P04	All	Planning team (Arup) comments

TECHNICAL NOTE: BOLTON UPON DEARNE STW FLOOD RISK ASSESSMENT

1. Introduction

PURPOSE

WSP has been commissioned by Tilbury Douglas Construction Ltd to provide a Flood Risk Assessment (FRA) to support a planning application for a proposed Ferric Dosing Kiosk at Yorkshire Water's (YW's) Bolton upon Dearne Sewage Treatment Works (STW), South Yorkshire.

The purpose of the FRA is to assess flood risk to the proposed new infrastructure from all sources. Suggestions are made for design mitigation measures to manage flood risk throughout the lifetime of development.

This FRA assesses flood risks from external sources and on defining mitigation measures to ensure that the proposed infrastructure upgrades are safe from flooding to an appropriate standard. YW's design standard for flood protection for new assets is the 0.5% annual exceedance probability (AEP) event, plus an appropriate allowance for climate change[1]

DATA SOURCES

Table 1 Sources of data and information

Data	Source	Purpose
LiDAR	Environmental Agency, LiDAR DTM 1m, 2022 https://environment.data.gov.uk/defradatadownload/?mode=survey	Topography of site.
Flood map for planning	https://flood-map-for-planning.service.gov.uk/ accessed 22/06/2023	For assessment of fluvial and tidal flood risk.
Risk of Flooding From surface Water (RoFSW) Mapping	https://flood-map-for-planning.service.gov.uk/ accessed 22/06/2023	For assessment of surface water flood risk.
Flood risk from Reservoirs mapping	https://flood-map-for-planning.service.gov.uk/ accessed 22/06/2023	For assessing reservoir flood risk.
EA Flood risk assessment data (previously known as product 4)	Flood Risk Assessment Data, Environmental Agency Customer reference number: X25XG8NYRPDB	Information on sources of flooding at the site
Geological Mapping	https://geologyviewer.bgs.ac.uk/?_ga=2.17902271.702420951.1687424783-1876513824.1687424783	To characterise the underlying geology and

[1]https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall

	accessed 22/06/2023	inform the assessment of groundwater flood risk.
Soils mapping	https://www.landis.org.uk/soilscapes/ accessed 22/06/2023	To characterise the underlying soil type.
Aerial Imagery	Google Earth Pro	To assess location and the site.
Climate Change Allowance	https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall accessed 22/06/2023	Climate change allowances for new development.
Site Layout	Bolton upon Dearne STW Site layout Drawing number: BOL10-TDC-WWT-WWT-DR-C-0571 S4.P03	Details of the proposed development and locations onsite.
Aquifer Designations	https://magic.defra.gov.uk/ accessed 22/06/2023	Determine the aquifer at the site.
Barnsley Local Policy	Barnsley Local Plan - Local Plan (barnsley.gov.uk) accessed 22/06/2023	Details the criteria and requirements for new developments

DOCUMENT STRUCTURE

This technical note is structured as follows:

- Section 2 identifies the key planning policy documents relevant to the FRA
- Section 3 provides an overview of the site, including the location, topography, hydrology, geology, and the proposed development;
- Section 4 reviews the potential flood risks to new infrastructure at the site;
- Section 5 sets out the proposed mitigation to address the risks identified;
- Section 6 sets out how the specific planning requirements have been addressed, including the Sequential and Exception Tests; and
- Section 7 presents the conclusions and recommendations.
-

The following figures are presented at the end of the technical note:

- Figure 1. Site location and Topography
- Figure 2 River Dearne- Aerial image
- Figure 3A Layout of STW- Site Layout
- Figure 3B Layout of STW- Chemical Area
- Figure 3C Layout of STW- Sludge Area
- Figure 4 Fluvial Flood
- Figure 5 Flood Risk from rivers and sea
- Figure 6 Flood Risk from surface water
- Figure 7 Flood risk from reservoirs
- Figure 8 EA risk of flooding from rivers and sea overlying LiDAR data

2. Planning Policy Context

The purpose of this section is to identify the key planning policy documents that define the scope of this FRA assessment. The section is structured in a hierarchical order, from national policy down to local guidance.

- National Planning Policy Framework Section 14 – Meeting the challenge of climate change, flooding and coastal change[2]
- Provides guidance and approach to mitigating climate change to ensure future resilience of communities and infrastructure
- NPPF Planning Practice Guidance on Flood Risk and Coastal Change (technical guidance on how the policies in Section 14 of NPPF should be implemented)[3]
- Provides technical guidance on how the policies in Section 14 of NPPF should be implemented and advises how to take account of and address the risks associated with flooding and coastal change in the planning process
- EA guidance on climate change allowances for FRA[4]
- Provides guidance for climate change allowance preparing strategic flood risk assessments and for developers preparing flood risk assessments for planning applications, and development consent orders for nationally significant infrastructure projects
- Strategic Flood Risk Assessment[5] – Barnsley Council
- Provides strategic flood risk guidance and advice to planners and developers to help them better understand flood risk and planning related issues
- Planning Policy Statement 25 (PPS25) Development and Flood Risk has been developed to underpin decisions relating to future development (including urban regeneration) within areas that are subject to flood risk
- Local Policy[6]- Barnsley Council, 2019
- Policy CC3 and CC4 set out some specific flood risk and sustainable drainage systems criteria and requirements.
- The local policy CC3 states that it is important all new developments are located and designed to reduce the risk of flooding to the development itself and settlements downstream and provides resilience to protect against increased risk of flooding in the future. Expecting all development proposals on brownfield sites to reduce surface water run-off by at least 30% and development on greenfield sites to maintain or reduce existing run-off rates requiring development proposals to use Sustainable Drainage Systems (SuDS) in accordance with policy CC4.

3. Site Location and Development Proposal

LOCATION

Bolton upon Dearne STW is located in the southeast part of the village in South Yorkshire. The site covers an area of ~3ha. The coordinates of the centre of the site are 445880, 402172 and the nearest identifiable postcode is S63 8NX. The site location is shown in Figure 1. The proposed Ferric Dosing Kiosk will be situated within the existing site.

The STW is bounded on the west by a railway and is accessible via an underpass beneath it. The River Dearne flows from southwest to northeast along the STW's southern boundary. To the east, it is bounded by Lowfield Lakes (a series of fishing ponds) and to the north by open fields. An area of low bushes and trees surrounds the site from north, west and south.

[2] National Planning Policy Framework - 14. Meeting the challenge of climate change, flooding and coastal change - Guidance - GOV.UK (www.gov.uk)
[3] Flood risk and coastal change - GOV.UK (www.gov.uk)
[4] Flood risk assessments: climate change allowances - GOV.UK (www.gov.uk)
[5] Barnsley Strategic Flood Risk Assessment Level 1 Report
[6] Local Plan (barnsley.gov.uk)

TOPOGRAPHY

The site is partially located on the floodplain of the adjacent River Dearne. EA LiDAR data show a gradual slope across the site from approximately 18.6 mAOD at the northern boundary to approximately 16.1 mAOD at the southern boundary of the site close to the River Dearne. The bank of the River Dearne has a crest level of 17.2 mAOD. The elevation in west-east direction is predominantly flat, gently sloping towards the eastern boundary.

HYDROLOGY

The site is in close proximity to the River Dearne. On the south side, the distance from the site boundary to the top of the river bank ranges from 4m to 13m. The closest station measuring flow is Adwick[7]. The station is located approximately 2.5 km downstream of the site. Another station, located upstream of the site, is Bolton Bridge. At this station the level of the River Dearne is measured. Approximately 6km downstream of the site, the river Dearne flows into River Don. According to the flood map, a flood defence structure of the River Dearne is located approximately 300m downstream of the STW.

The areal imagery obtained by Google Earth, for 2022 and 2003 does not show significant change in the channel (Figure 2).

A site walkover downstream of the site was undertaken, to confirm the presence and orientation of flood defence structures on the River Dearne.

GEOLOGY, SOILS AND GROUNDWATER

The British Geological Survey GeoIndex Onshore map[8] shows that solid geology beneath the site is Pennine Middle Coal Measures Formation indicating the existence of mudstone, siltstone and sandstone. Near the River Dearne the geology shows presence of superficial alluvium deposits of clay, silt, sand and gravel. According to the data obtained from Landis Soilscapes[9] part of the site is underlain by slowly permeable seasonally wet acid loamy and clayey soils. The part closer to the river is characterized as loamy and clayey floodplain soils with naturally high groundwater.
DEFRA Magic Maps[10] illustrates that the bedrock geology beneath the site is classified as 'Secondary A' aquifer, which "comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers". The superficial geology is also classified as 'Secondary A'.

PROPOSED STW UPGRADE

The application seeks planning permission for a proposed Ferric Dosing Kiosk, which is required to meet the requirements of an Environment Agency discharge consent. This is shown in Figure 3

4. Flood Risk Assessment

FLOOD RISK OVERVIEW

Table: Flood Risk Screening

Type of flood	Risk	Comment
Fluvial	Medium	The area of the site at the location of the proposed Ferric Dosing Kiosk is in Flood Zone 2, which covers most of the existing STW. This

[7] Hydrology Data Explorer - Station
[8] BGS Geology Viewer - British Geological Survey
[9] Soilscapes soil types viewer - Cranfield Environment Centre. Cranfield University (landis.org.uk)
[10] Magic Map Application (defra.gov.uk)

		indicates that a likelihood of fluvial flooding of between 1% and 0.1% AEP[11]. The max stage at the node closest to the site for 1% AEP is 16mAOD, and for 0.1% AEP is 17.14mAOD. When considering climate change (1%AEP+30% and 0.1%AEP+20%), the stages in this case are 16.67mAOD and 17.6mAOD respectively. The proposed Ferric Dosing Kiosk is located in Flood Zone 2. It should be noted that the EA Flood Zones do not fully align with the topography of the site, however available information suggests that the low-lying areas of the site may be at risk of flooding. The presence of alluvial superficial deposits within the site also suggests that it is at least partially located in the floodplain of River Dearne.
Surface water	Medium	EA surface water flood risk data indicates that the western boundary where the proposed Ferric Dosing Kiosk is located is at medium risk of flooding[12]. This means that the areas of the site withing Flood Zone 2, have a chance of flooding of between 1% and 3.3% each year. In this case, the mapped surface water and fluvial flood extents closely coincide and are both representative of the fluvial flood risk from the adjacent River Dearne. No other, separate surface water runoff pathways have been identified in or near the STW site.
Groundwater	Medium	According to the information presented in section 2 of this document, the site is underlain by of mudstone, siltstone and sandstone. The information presented in section 2.4 suggests that the presence of alluvium closer to the River Dearne indicates naturally high groundwater. Although groundwater may emerge in the lowermost parts of the site during extreme high groundwater level conditions, this is likely to occur within the fluvial floodplain and coincide with fluvial flooding. It is therefore considered a secondary risk to the fluvial flood risk.
Reservoirs	Low	There is a potential risk of reservoir flooding when there is also flooding from rivers. The nearest upstream reservoir is Elsecar. Flooding from reservoirs is extremely unlikely (with reservoirs managed and regulated under the Reservoirs Act) and is a prediction of a credible worst-case scenario, it's unlikely that any actual flood would be this large.
Sewers	Low	There is a potential risk of flooding of the site from sewerage inflows from the upstream sewer catchment. Flow modelling has not been carried out for the site. Any inlet overflow is expected to drain back into the works via manholes or be retained on site.

[11] https://flood-map-for-planning.service.gov.uk/
[12] Check the long term flood risk for an area in England - GOV.UK (www.gov.uk)

ASSESSMENT OF FLOOD RISK

The application site is located within Flood Zone 2, which is an area with a medium probability of flooding. This means in any year; the site has between a 0.1% to 1% chance of flooding from rivers. This is illustrated on Figure 4 below with an indicative area for the application site marked in red.

The main source of flood risk to the site derives from the River Dearne, located along the southern boundary of the STW. The new proposed developments are situated in the lowest lying areas of the site. The proposed Ferric Dosing Kiosk, on the western side of the site is within the borders of Flood Zone 2. This is shown if on Figure 4.

A flood defence is located approximately 300m downstream of the site. This flood defence does not have any effect on the site.

EA flood risk assessment data (previously known as Product 4 data), based on modelled outputs from Middle and Lower Don - Don Dearne Catchment (2018), shows that ~20% of the site would be impacted by 0.1% AEP (no defences scenario) and 1.0% AEP (+20%) (defences plus climate change) flood extents.

It should be noted that the mapped flood risk extents do not align well with the LiDAR topography data. Figure 8 shows overlapping of LiDAR terrain data with EA risk of flooding from rivers and sea, suggesting that in some areas the flood extend does not follow the terrain contours (isohypsis). It is likely that the EA flood extends are based on previous, coarser terrain data. A discrepancy is also noticeable in defining the Flood Zones, where a part of the site is intersected with a Water Storage Area, which as above does not appear to factor in the existing development location. However, in the Flood risk assessment data obtained from the Environmental Agency, the area outlined for the proposed development is classified as Flood Zone 2.

The Surface Water Flood map is shown in Figure 6. The extent of the flood follows the lowest lying part of the site, such as roads and the southern parts of the site. The surface water mapping in this case, effectively represents the flood risk from the River Dearne. There is no separate surface flood risk to the site apart from the River Dearne.

The access road to the site enters the STW in the west, crossing under the railway. This indicates that the road is prone to flooding due to its lower elevation in this area (with west to east incline).

Aerial imagery does not show significant change in the riverbed. A comparison between the site in 2003 and latest 2022 imagery is shown in Figure 2. The channel is in relatively good condition.

FERRIC DOSING KIOSK VULNERABILITY

From the flood maps it is evident that proposed Ferric Dosing Kiosk, located in the western part of the site, near the access road, is in the extent of Flood Zone 2.

The proposed Ferric Dosing Kiosk is impacted by the River Dearne as a source of flooding but is located towards the edge of the floodplain. However, the ferric dosing kiosk will be located on a reinforced concrete slab, the ground level in this area is ~600 above the adjacent site access road, which at 17.3 mAOD which is in line with the stage of a 0.5% AEP+ climate change flood event.

Based on the available data and the existing and proposed ground levels, no flood risk is considered at this location.

SITE VULNERABILITY

In the low-lying parts of the site, the soils are described as naturally wet meaning that the groundwater levels are high, which increases the risk of groundwater flooding.

Even though groundwater flooding is considered a secondary source of flood risk to the site compared to the fluvial flood risk from River Dearne, it is likely that groundwater will be encountered at shallow depth in the lower lying parts of the site.

Even though groundwater flooding is considered a secondary source of flood risk to the site compared to the fluvial flood risk from River Dearne, it is likely that groundwater will be encountered at shallow depth in the lower lying parts of the site. This should be taken into account when planning excavations and designing sub-surface structures / connections.

As a result of the potential flood risk to the site, potential mitigation options for this development are suggested below.

5. Managing Risk Onsite

FLOOD RISK MITIGATION

According to the Yorkshire Water design standard the assets should be resilient against a pluvial, fluvial or tidal event with a 0.5% AEP plus climate change and freeboard allowance. The climate change allowance of 30% is set to reflect the lifetime of the developments according to the type of infrastructure (central climate change allocation for 2080s). The EA flood risk assessment data doesn't provide data for 0.5AEP + 30% climate change event, thus the level of 17.3mAOD for this event was obtained by interpolation. This is higher than the 1 in 100-year event plus climate change mandated by the National Planning Practice Guidance.

Flood risk mitigation measures are recommended based in the best available information, as there is a lack of existing data to precisely define a flood level for a design event. Additional site-specific flood modelling was not considered to be required given the relatively limited flood risk, and small-scale of the proposed works at this site.

The ferric dosing Kiosk is shown on Figure 1. It consists of an enclosed kiosk, housing process plant, of approximate dimensions 3.1m x 5.0m x 3m high. To mitigate the risk of flooding onsite, the following measures are recommended:

- The coagulant area consisting of ferric dosing kiosk and chemical storage tank are located in the western part of the site. The ground level ground adjacent to the coagulant area is 17.300 mAOD which is in line with the stage of a 0.5% AEP+ climate change flood event. The chemical storage tank is mounted on a reinforced concrete plinth at 19.150mAOD. The dosing kiosk is located on a concrete slab at 18.000mAOD, therefore both providing a suitable freeboard of above the relevant climate change flood level.
- In accordance with SuDS best practice, any new impermeable surfaces (e.g. kiosk, dosing unit slabs) should preferably drain to the ground or collected by the onsite drainage network. Given the relatively small area of new proposed development (250m²) and its location, this should be achievable.

6. Project Specific Planning Policy Requirements

THE SEQUENTIAL TEST

The PPG recommends that the Sequential Test is applied at all stages of planning to direct new developments to areas with the lowest probability of flooding. According to the NPPF if there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development (NPPF Annex 3 and PPG Table 2) 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 where practicable.

There is a need to locate the Ferric Dosing Kiosk within the YW site, which is entirely within Flood Zones 2 and 3. The kiosk is proposed within an area of Flood Zone 2 and therefore there are no suitable locations within an area at lower risk of flooding. Furthermore, the development proposal is for a 'Water Compatible' use to be developed on the site. Water Compatible developments are appropriate in all flood zones due to their nature. The requirements of the project design along with consideration of other environmental and engineering constraints has meant that it was not possible to avoid development in an area of flood risk. As such the development passes the sequential test.

In line with the PPG Table 2, Water Compatible developments are not required to be satisfy the Exception Test if located in Flood Zone 2 and Flood Zone 3a. However, based on the nature of the proposal the criteria of the Exception Test would be satisfied as, the new development will provide needed infrastructural improvements to meet phosphorus targets under the WINEP initiative, by December 2024. The proposal will have a major positive effect on the quality of water to be discharged to the River Dearne, thus improve the quality of water pollution treatment and mitigation capabilities and by extension, improve the environmental, social, and economic conditions of the area.

Given that the YW's design standard for flood protection for new assets is higher than the 1 in 100-year event plus climate change mandated by the National Planning Practice Guidance, the new developments can be considered as safe throughout their lifetime.

LOCAL POLICY COMPLIANCE

The proposed development is required to be positioned on-site (which is in Flood Zone 2) to help existing wastewater treatment facilities accommodate the increase in generated sludge on site.

The development is part of 'water and sewage transmission infrastructure and pumping' as defined in Appendix A.2, Table B-2 from the Strategic flood Risk Assessment Level 1 Report, the proposal is considered to fall within the category of 'water compatible development'. Therefore, can be positioned in areas under Flood Zone 2 according to section 4.6. Flood Risk Vulnerability Classification from within the same report. The proposed development therefore complies with section 19.8- Policy CC3 from the Adopted Local Plan.

The water compatible nature of the development requires its location within Flood Zone 2. The proposed development is set back from the top of the riverbank of River Dearne by 120m to 130m. Mitigation measures have been incorporated into the design to ensure that the sensitive equipment / housing lies above the design flood levels. This complies with part 19.7 and 19.14 from Policy CC3 and section 3.4.1 from the Strategic Flood Risk Assessment which requires the proposal to be located where there is the lowest probability of flooding and that uses with higher vulnerability are located on parts of the site with the lowest probability of flooding.

7. Conclusions and Recommendations

This report has the following conclusions:

- The proposed new development is situated in Flood Zone 2, associated with River Dearne.
- The topography does not conform well with the Flood Zone extent, but information shows that the site is likely to be at risk of flooding from the River Dearne.
- Surface flood risk indicates a low possibility of flooding.
- There are no below ground structures proposed as part of the planning application
- The proposed ferric dosing kiosk is located on a concrete slab at 18.000mAOD, therefore providing a suitable freeboard of above the relevant climate change flood level

The following recommendations have been made to increase the flood risk resilience of the new developments:

- Maintain a minimum of 600mm freeboard for the proposed kiosk above 17.300 mAOD, which is in line with the stage of a 0.5% AEP+ climate change flood event.
- Infiltration SuDS should preferably be incorporated for all new impermeable surfaces, subject to confirmation of sufficient infiltration capacity / consideration of polluants. Where this is not viable, surface water drainage should be collected by the onsite drainage network.

Figure 1. Site location and Topography

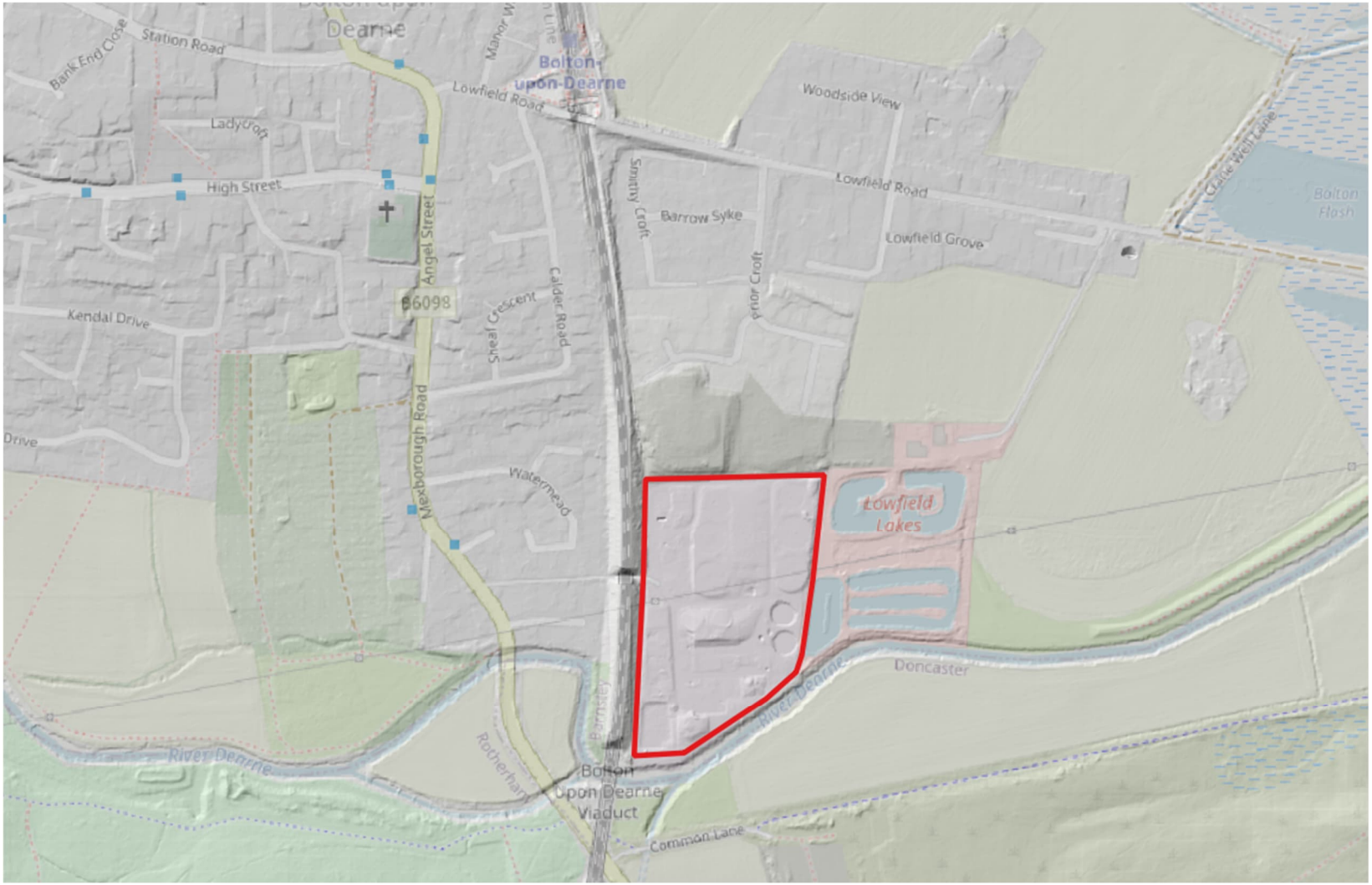


Figure 2 River Dearne- Aerial image

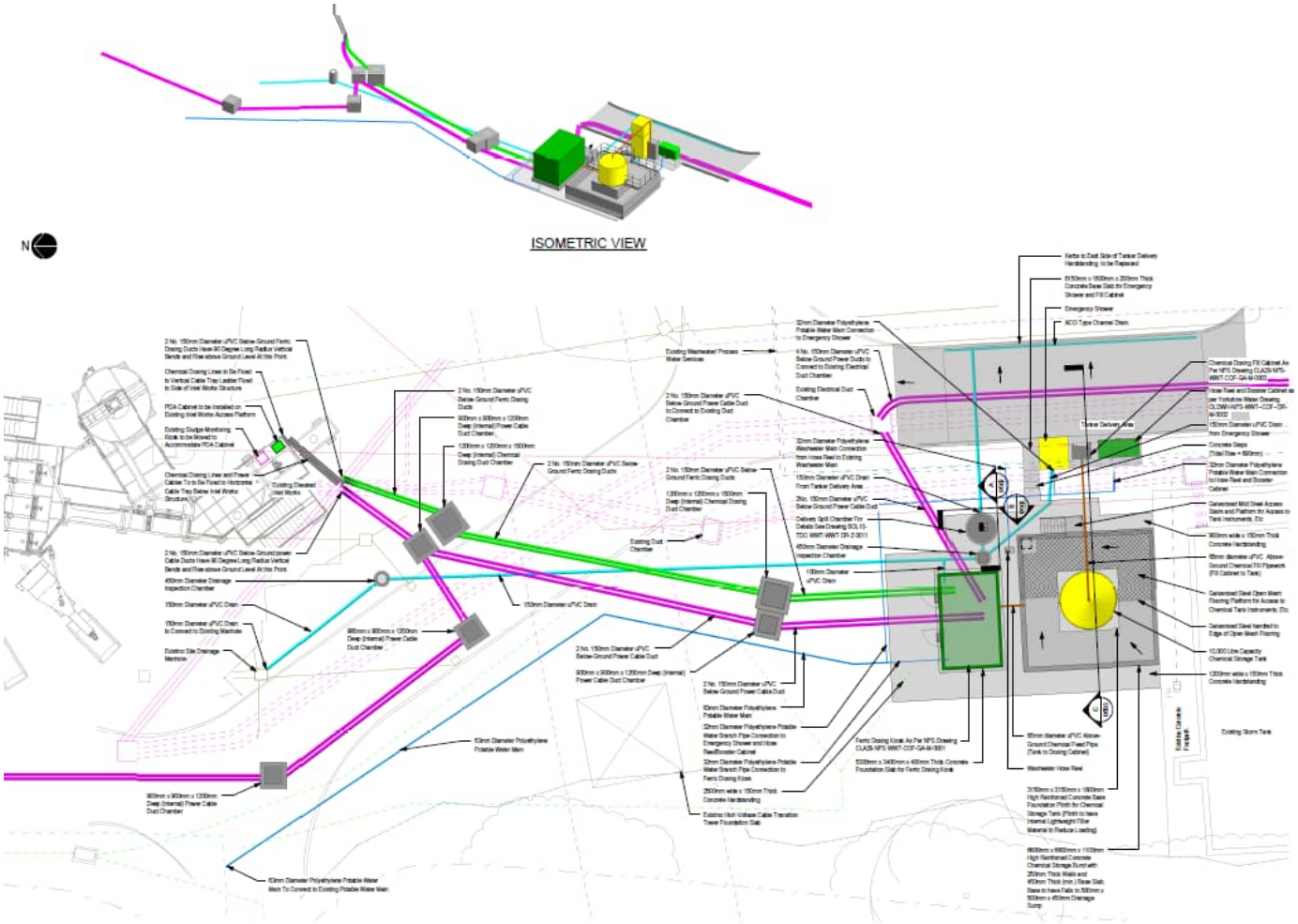
2022

2003

Figure 3A Layout of STW[13]- Site Layout

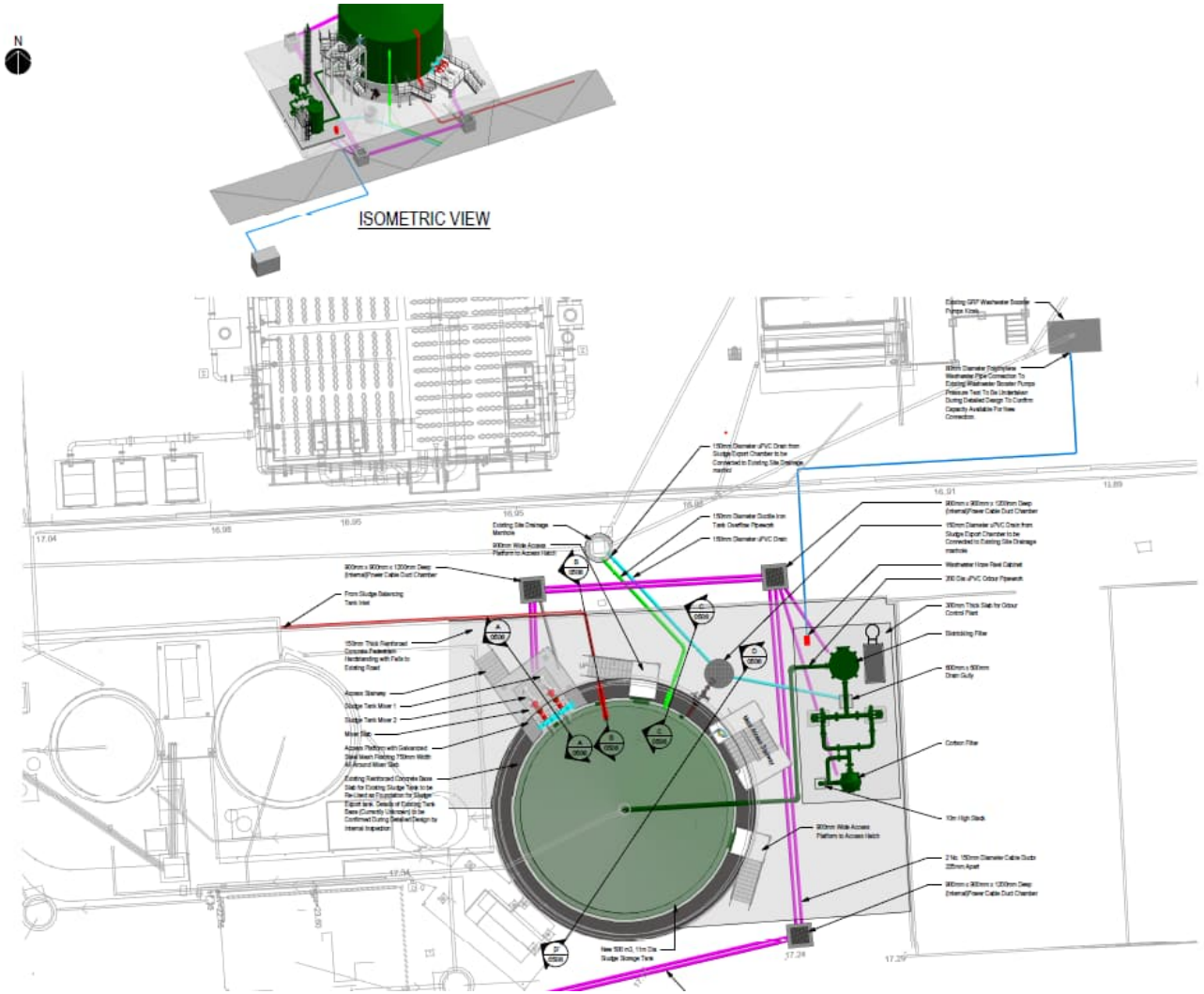
[8] BOL10-TDC-WWT-WWT-DR-C-0571 S4.P04

Figure 4B Layout of STW[14]- Chemical Area



[9] BOL10-TDC-WWT-WWT-DR-C-0501 S4.P02

Figure 5C Layout of STW[15]- Sludge Area



[1] BOL10-TDC-WWT-WWT-DR-C-0505 S4.P02

Figure 6 Fluvial Flood

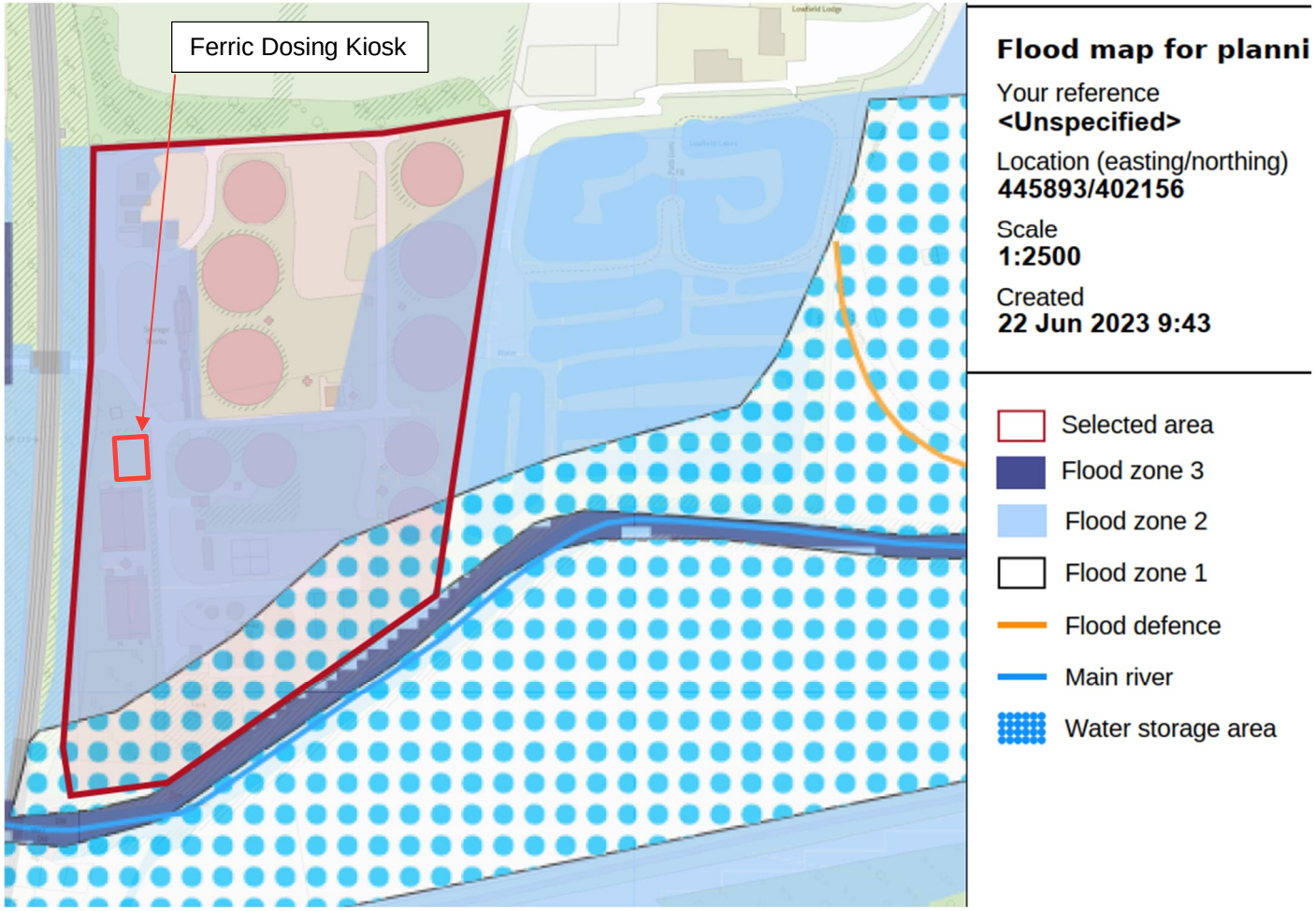


Figure 7 Flood Risk from rivers and sea

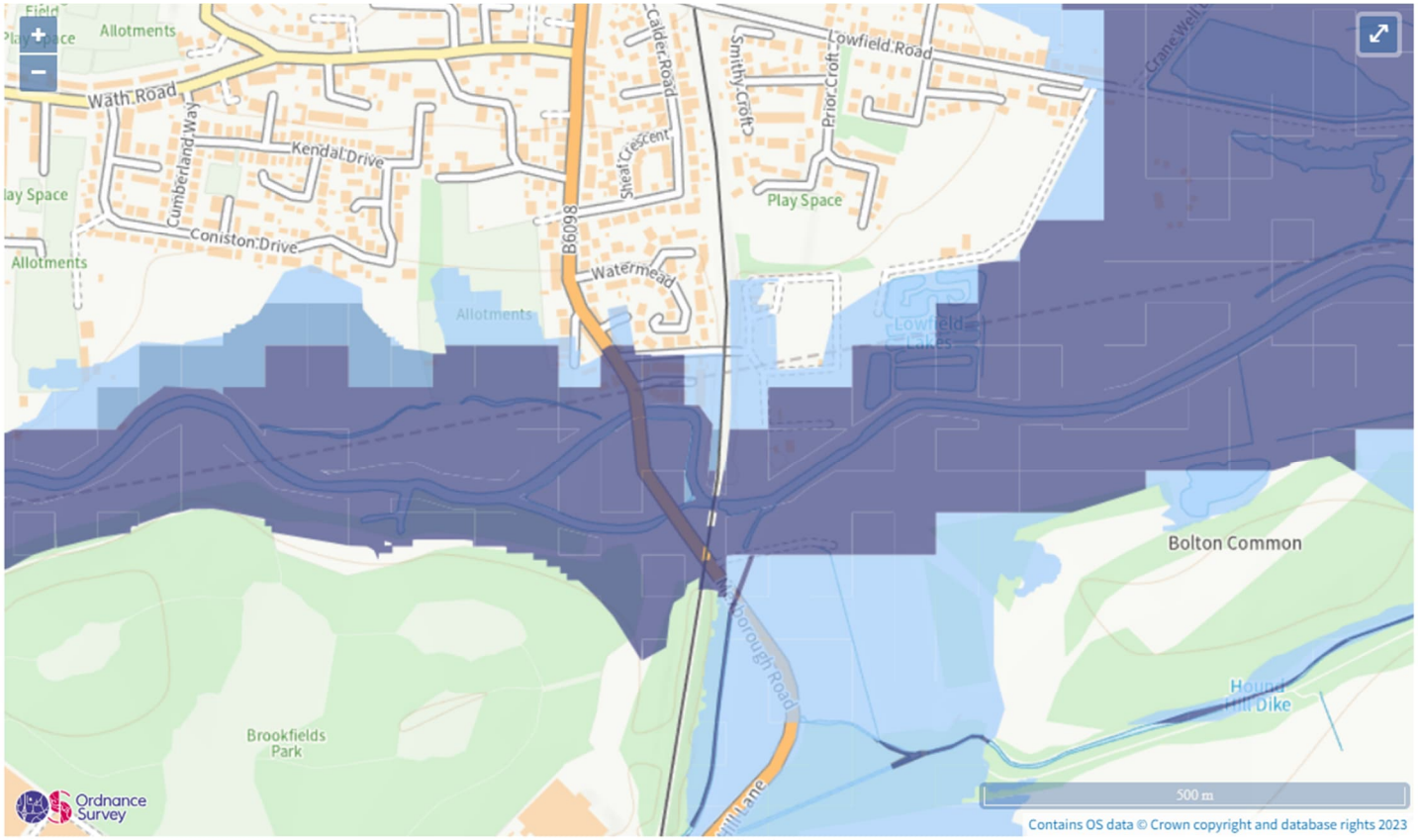
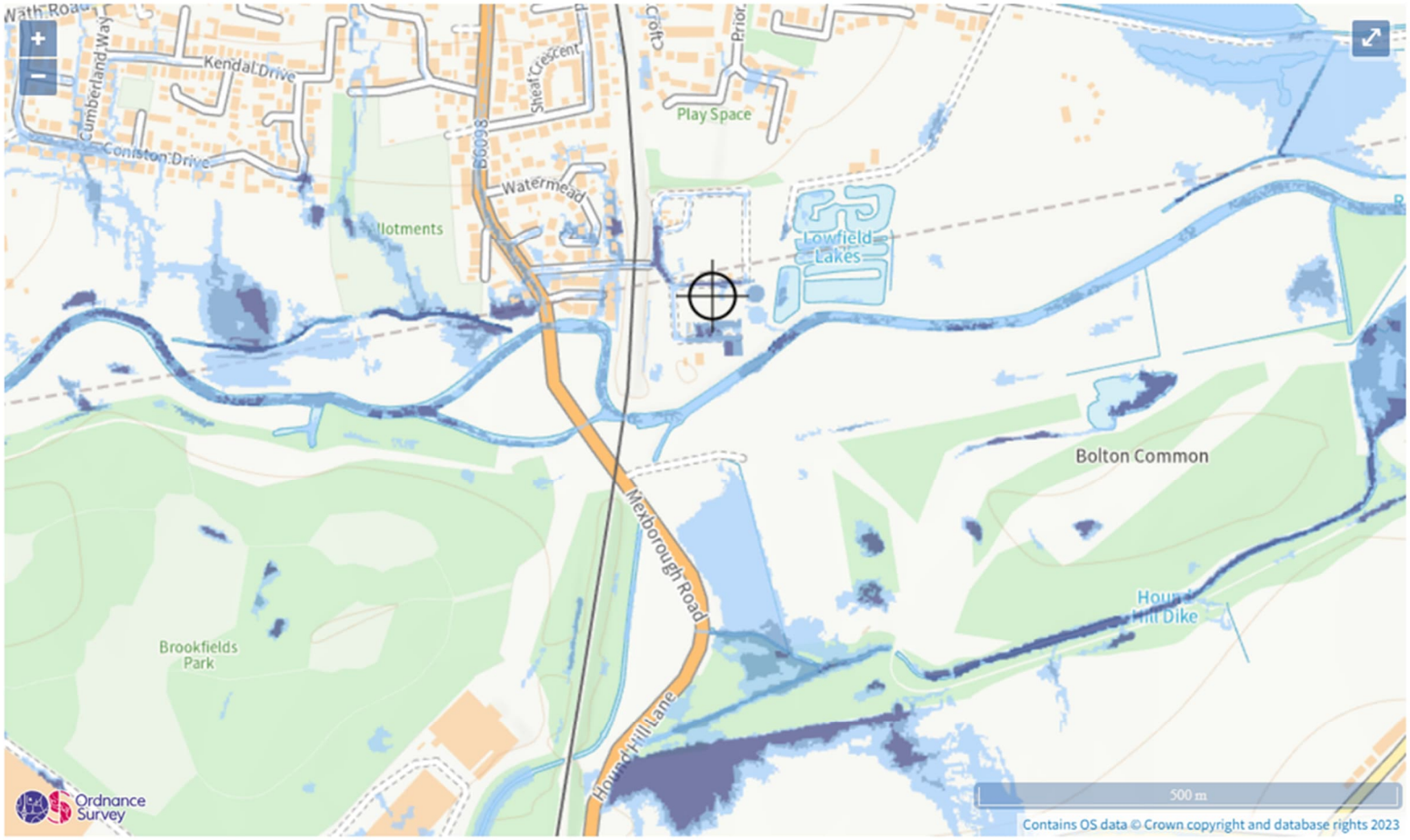


Figure 8 Flood Risk from surface water



Extent of flooding from surface water

High Medium Low Very low Location you selected

Figure 9 Flood risk from reservoirs

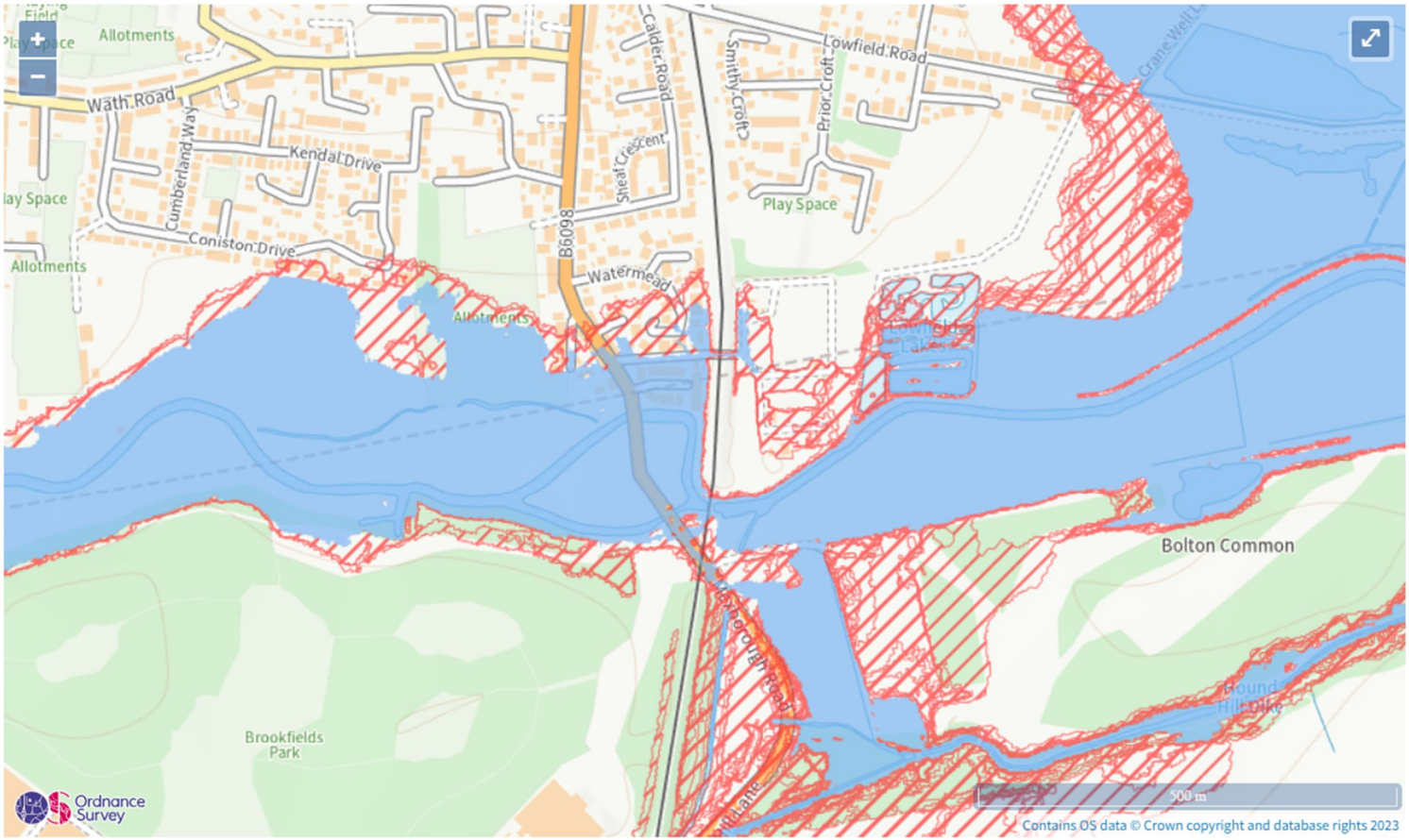
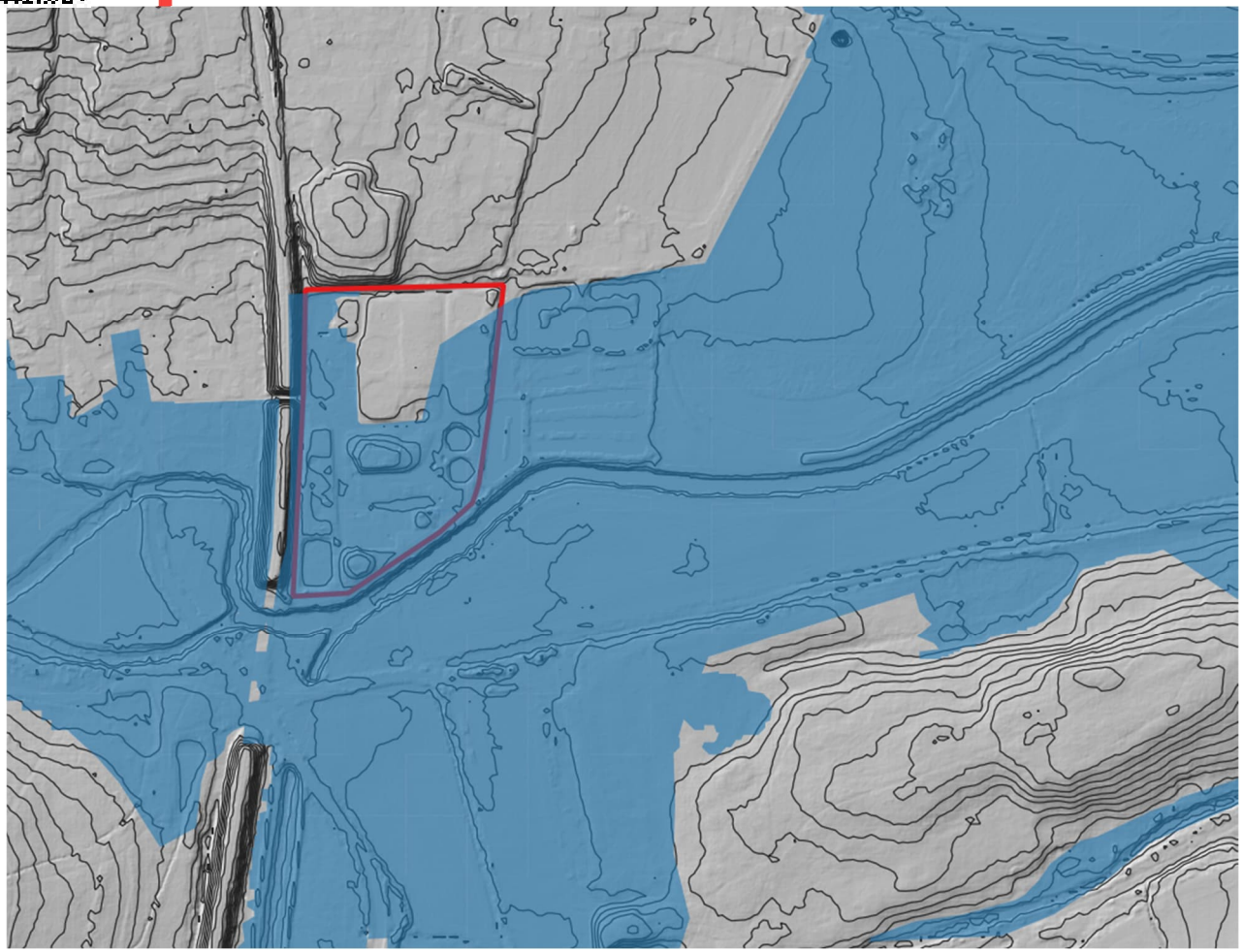


Figure 10 EA risk of flooding from rivers and sea overlying LiDAR data



February 2024
Document number: BOL10-TDC-WWT-WWT-RP-Z-0740 S4.P04

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Approved by

.....
Richard Home

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Management systems

This document has been produced in full compliance with our management systems, which have been certified to ISO 9001, ISO 14001 and ISO 45001 by Lloyd's Register.

Document revisions

No.	Details	Date
1	Version P01	24/08/2023
2	Version P02	13/09/2023
3	Version P03	15/12/2023
4	Version P04	07/02/2024