JNP GROUP

CONSULTING ENGINEERS

Flood Risk Assessment and Drainage Strategy

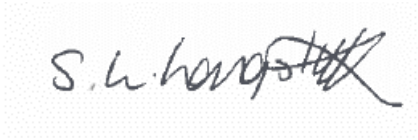
Project: Land at 894 Huddersfield Road
Mirfield

Client: Robert Halstead Chartered Surveyors & Town Planners

Reference: S11674-JNP-XX-XX-RP-C-0001 P01

Date: May 2022

DOCUMENT CONTROL SHEET



Prepared by……
Sarah Longstaff
BSc (Hons) MSc FGS
Principal Hydrogeologist

Approved by……
Lee Carl
BSc (Hons) MSc CEng MICE
Principal Civil Engineer

FOR AND ON BEHALF OF JNP GROUP
Date: August 2022

Document Issue Record

Rev	Date	Description	Prepared	Checked	Approved
P01	26/05/22	First Issue	SLL	SH	LC
P02	05/08/22	Amended pond layout	SLL	SH	SLL

Contents

1 INTRODUCTION

1.1 Terms of Reference

1.1.1 JNP Group has been commissioned by Robert Halstead Chartered Surveyors & Town Planners to prepare a flood risk assessment for the proposed residential development of 'Land at 894 Huddersfield Road, Mirfield' (the site).

1.1.2 This report assesses flood risk at the development site from all potential sources and describes the measures adopted in the master planning process to manage such risks. It has been prepared in compliance with current policies and best practices.

1.1.3 This report reviews the surface and foul water drainage hierarchy and proposes a site drainage strategy. It describes the surface water drainage system and identifies management and maintenance tasks for the system. It also outlines a surface water construction management plan.

1.2 Policy Framework and Key Stakeholders

1.2.1 The *National Planning Policy Framework* (NPPF) (February 2019) 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.

1.2.2 In areas at risk of flooding or for sites of one hectare (ha) or more, developers must undertake a site-specific flood risk assessment to accompany applications for planning permission (or prior approval for certain types of permitted development).

1.2.3 In decision-taking, local planning authorities must ensure a sequential approach to site selection and master planning is followed so that development is, as far as reasonably possible, located where the risk of flooding (from all sources) is lowest, taking account of climate change and the vulnerability of future uses to flood risk.

1.2.4 Where development needs to be in locations where there is a risk of flooding, local planning authorities and developers must ensure development is appropriately flood resilient and resistant, safe for its users for the development's lifetime, and will not increase flood risk elsewhere.

1.2.5 The Environment Agency (EA) is a statutory consultee on applications where there is a risk of flooding from the sea or main rivers.

1.2.6 Lead local flood authorities (unitary authorities or county councils) are responsible for managing local flood risk from ordinary watercourses, surface water or groundwater, and for preparing local flood risk management strategies. Local planning authorities work with lead local flood authorities to ensure local planning policies are compatible with the local flood risk management strategy.

1.2.7 Kirklees Council (KC) is the lead local flood authority (LLFA) and its strategy for managing local flood risk is set out in Kirklees Local Flood Risk Management Strategy (2012) and West Yorkshire Combined Authority SuDS Guidance .

1.2.8 KC is also the local planning authority (LPA) and its policies on flood risk management are set out in Local Plan (2019).

1.2.9 Where relevant, local planning authorities and developers must also take advice from:

- Internal drainage boards; to identify the scope of their interests.
- Sewerage undertakers; to ensure they can assess the impact of new development on their assets and plan any required improvements. Yorkshire Water (YW) is the local sewerage undertaker.
- Reservoir undertakers; to avoid an intensification of development within areas at risk from reservoir failure and ensure they can assess the cost implications of any reservoir safety improvements required due to change in land use downstream of their assets.
- Navigation authorities; in relation to developments adjacent to, or which discharge into, canals (especially where these are impounded above natural ground level).

1.3 Sources of Information

1.3.1 This flood risk assessment has been based on the following sources of information:

- Bespoke topographic survey undertaken by Land Surveys (6683/1) in July 2008;
- British Geological Survey's *Geoindex Tool*;

  (*http://mapapps2.bgs.ac.uk/geoindex/home.html)*
- DEFRA / EA's aquifer and source protection data

  (*https://magic.defra.gov.uk/MagicMap.aspx*)
- EA's Flood Map for Planning;

  (*https://flood-map-for-planning.service.gov.uk/*)
- EA's Long Term Flood Risk Information;

  (*https://flood-warning-information.service.gov.uk/long-term-flood-risk/map*)
- Calder Catchment Strategic Flood Risk Assessment (2016);
- KC's Preliminary Flood Risk Assessment (2009);
- KC's Surface Water management Plan (2011);
- EA's detailed flood risk information (Products 4);
- Further investigation of land at the former Swan Inn, Huddersfield Road, Mirfield, G&M Consulting Ref. C376/02/GS, September 2021;
- YW's Asset Location Plan.

2 DEVELOPMENT SITE

2.1 Location

2.1.1 The site is located off the A644 Huddersfield Road, approximately 1.5 km east of the centre of Mirfield (Figure 2.1, Table 2.1). The site is undeveloped land adjacent to 894 Huddersfield Road, which is a residential property.

Figure 2.1: Site Location

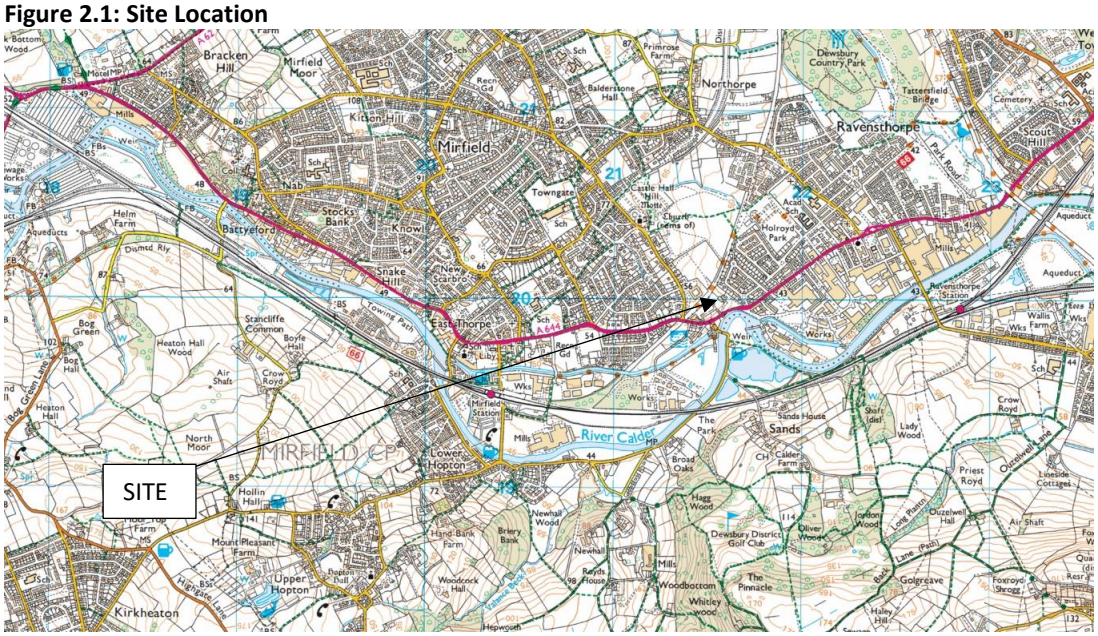


Table 2.1: Site Location

OS X	OS Y	Site Area (ha)	Nearest Postcode
421568	419973	0.75	WF14 9HS

2.1.2 The surrounding land uses are summarised in the following table.

Table 2.2: Surrounding Land Use

Direction	Land Use
North	Apartment block, field
East	Residential properties
South	Huddersfield Road, River Calder
West	Residential properties, former Swan Inn.

2.2 Topography

2.2.1 The available topographical information (Appendix A) shows that ground levels within the development slope from north west to south east, falling from c. 51.5 m above Ordnance Datum (aOD) and 43.1 m aOD. Huddersfield Road to the south is at a slightly higher elevation than the site.

2.3 Geology

2.3.1 The geology of the site has been determined by reference to the 1:50,000 scale British Geological Survey (BGS) online Geoindex Tool http://mapapps2.bgs.ac.uk/geoindex/home.html

2.3.2 No artificial or made ground is indicated to be present underlying the site. Superficial deposits are also absent from beneath the site although Alluvium is indicated to be present immediately to the south east of the site.

2.3.3 The underlying geology is indicated to be Pennine Lower Coal Measures. The BGS describe these as:

"Interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part."

2.3.4 There is a north west to south east rending fault denoted close the south western site boundary. Pennine Lower Coal Measures outcrop to the west of the fault.

2.3.5 JNP Group have consulted online borehole records held by the BGS. There are no borehole records close to the site.

2.3.6 A Phase II Ground Investigation has been undertaken at the former Swan Inn site, c. 100m to the south west and in a geologically comparable location. Trial pits determined 0.3m to 0.7m of made ground overlying Coal Measures. The latter were clay or siltstone with a 0.2m to 0.45m thick coal seam between 0.3m and 2.0m below ground level (bgl). Groundwater was not noted in any of the pits which extended between 1.0m and 2.8m bgl.

2.3.7 The EA's website indicates that the site is underlain by a Secondary A Aquifer. The aquifer status refers to the Pennine Lower Coal Measures Formation. The Alluvium is also classified as a Secondary A Aquifer.

2.3.8 The Environment Agency define a Secondary-A Aquifer as:

"Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers."

2.3.9 The site's proximity to groundwater Source Protection Zones (SPZs) was determined by reference to the Environment Agency's website. The site is not located close to or within a SPZ.

2.3.10 Based on the available geological and hydrogeological information, namely bedrock lithology, infiltration drainage is deemed unfeasible at the development site.

2.4 Hydrology

2.4.1 The nearest surface water feature is located c. 10m to the south of the site. This is the River Calder which flows west to east in a meandering channel immediately to the south of Huddersfield Road. The river is classified as a main river.

2.4.2 A branch of the Calder and Hebble Navigation discharges into the river just upstream of the site and another branch separates from the river just downstream of the site.

2.4.3 Based on the available hydrological information, discharge to a surface watercourse is deemed feasible although logistical considerations associated with crossing the road need consideration.

3 PROPOSED DEVELOPMENT

3.1.1 The proposed development (Figure 3.1 and Appendix B) comprises 0.75 ha of residential development, including 0.27 ha of hard paved / impermeable surfaces (e.g. roofs, roads, driveways, parking areas, etc.) and 0.48 ha of soft paved / permeable surfaces (e.g. gardens, green corridors, public open spaces, etc.).

3.1.2 Under Table 2 of the *Flood Risk and Coastal Change Guidance* (March 2014), the proposed residential development is classified as more vulnerable.

Figure 3.1: Proposed Development

4 FLOOD RISK ASSESSMENT

4.1 Overview

4.1.1 All potential sources of flood risk at the development site have been assessed based on the information listed in Section 2 and are summarised in Table 4.1. The key sources of flood risk to the proposed development are further described in the ensuing sections.

Table 4.1: Potential Sources of Flood Risk

Source	Flood Risk
Coastal	*No risk, site c. 45m aOD.*
Fluvial	Low risk, mostly flood zone 1, small area in south east is flood zone 2.
Surface Water	Very low risk in general, but low to high risk in south east.
Groundwater	SFRA indicates >75% risk of emergence in south or <25% risk of groundwater emergence in north.
Sewers	*Low risk. No public sewers crossing the site.*
Infrastructure Failure	Very low risk in general but some risk in south east when there is also flooding from rivers.

4.2 Climate Change

4.2.1 The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account.

4.2.2 In accordance with the EA's guidance Flood Risk Assessment: Climate Change Allowances (July 2021), the proposed development with anticipated life span into the 2080's (2070 to 2115) must take account of the following allowances. The guidance indicates that for a more vulnerable development in Flood Zone 2, the central allowance should be used.

- Peak River Flows (Aire and Calder Management Catchment)
  - Central 23%
- Peak Rainfall Intensity
  - Upper End 40%

4.3 Fluvial Flood Risk

4.3.1 Fluvial flooding occurs when a catchment area receives greater than usual amounts of water (e.g. rainfall or snow melt). When the converging runoff exceeds the conveyance capacity of the receiving channel, water spills onto the surrounding floodplains and fluvial flooding occurs.

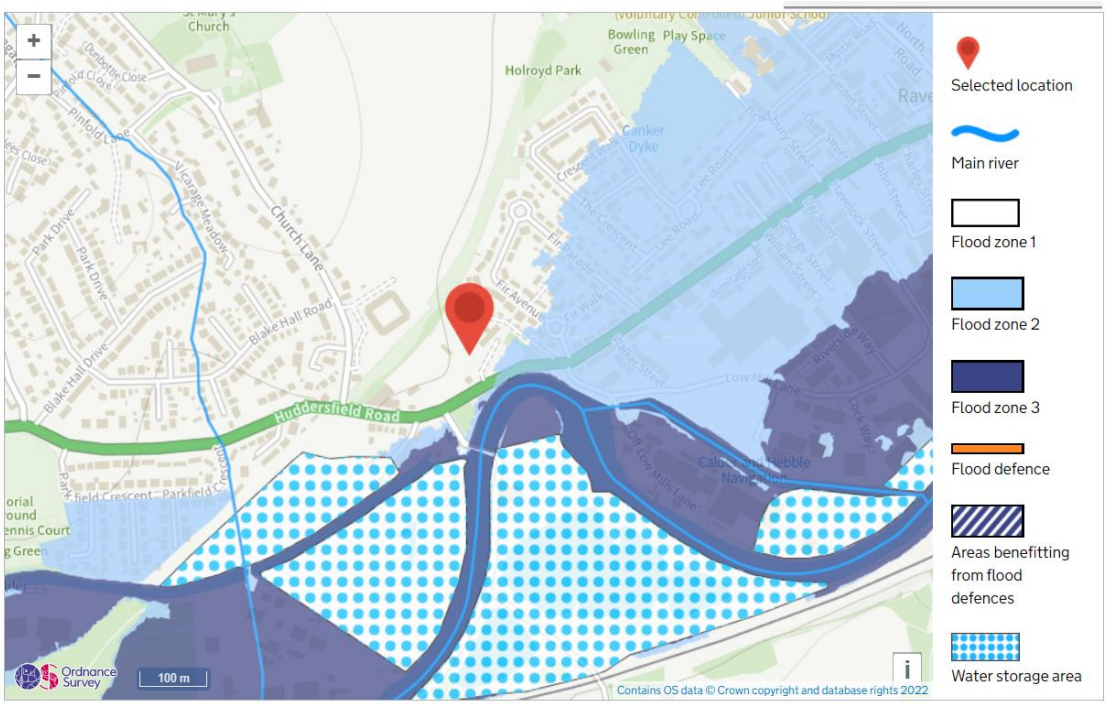
4.3.2 Fluvial flooding usually occurs hours or days after heavy and / or prolonged rainfall and its effects often last several hours or days.

4.3.3 Besides posing a direct flood risk to floodplain areas, high water levels in watercourses can exacerbate other sources of flood risk by surcharging / locking outfalls, thus preventing the normal discharge of flows or even back flowing into tributary drainage systems.

4.3.4 In accordance with the EA's *Flood Map for Planning* (Figure 4.1 and Appendix C), most of the development site is in Flood Zone 1 (0.1% AEP). However, a small area in the south east is in Flood Zone 2 (0.1% to 1% AEP).

4.3.5 The site does not benefit from formal flood defences.

Figure 4.1: Flood Map for Planning



4.3.6 The EA's historic flood outlines (Appendix C) show that none of the site has flooded since 2000 although the river channel to the south of the road, and flood plain to the south of the river have flooded during this period

4.3.7 Detailed modelling undertaken for the EA, established maximum fluvial flood levels as follows. The data did not include a scenario including a climate change allowance.

Table 4.2 Modelled Fluvial Flood Levels (m aOD)

Node	Defended	Undefended
	1 in 100	1 in 100
5 (upstream of site)	42.62	42.62
6 (south of site, close to south east boundary)	42.48	42.48

4.3.8 A stage discharge analysis has been undertaken using the EA data to assess the impact of increased river flows resulting from climate change. The analyses are included in Appendix D and the results summarised as follows.

Table 4.3 Flood Levels for 1 in 100 Year Event Including 23% Increased Flow Resulting from Climate Change (m aOD)

Node	Defended	Undefended
	1 in 100 + CC	1 in 100 + CC
5 (upstream of site)	42.72	42.64
6 (south of site, close to south east boundary)	42.71	42.63

4.3.9 The management measures proposed to deal with the design flood level of 42.72 m aOD (1 in 100 year + climate change) are described in Section 5.

4.4 Surface Water Flood Risk

4.4.1 Surface water flooding is a description for excessive overland flows that have yet to enter a natural or manmade receptor (e.g. aquifer, watercourse or sewer). Surface water flooding also occurs when the amount of runoff exceeds the capacity of the collecting system and spills onto overland flow routes.

4.4.2 Surface water flooding is usually the result of very intense, short lived rainfall events, but can also occur during milder, longer lived rainfall events, when collecting systems are at capacity or the ground is saturated. It often results in the inundation of low points in the terrain.

4.4.3 In accordance with the EA's *Long Term Flood Risk Information* (Figure 4.2), the development site is mostly at very low (< 0.1% AEP) risk of surface water flooding. However, a small area in the south east is at low (0.1% to 1.0% AEP), medium (1.0% to 3.3% AEP) and high (> 3.3% AEP) risk of surface water flooding.

Figure 4.2: Flood Risk from Surface Water

4.4.4 Flood waters may be between 300mm and 900mm in depth and are mostly flowing at less than 0.25 m/s towards the east.

4.4.5 The management measures proposed to deal with existing surface water flooding and the risk of surface water flooding from runoff generated within the development site will be described in Section 5.

4.5 Groundwater Flood Risk

4.5.1 Groundwater flooding occurs when the level of water filling the pores and / or cracks in the underlying soil and / or rock (i.e. water table) rises and emerges on the surface. The level of the water table varies seasonally and depends upon long term rainfall, thickness and porosity of the underlying strata and groundwater abstraction.

4.5.2 Groundwater flooding is most common in areas where the underlying bedrock and superficial deposits are very porous, but it can also happen at locations where superficial layers of sand or gravel overlay impermeable bedrock.

4.5.3 Groundwater flooding usually occurs after days or weeks of prolonged rainfall and often lasts for days or weeks, as subsiding of the water table can be a very slow process.

4.5.4 Besides posing a direct flood risk to developments (particularly basements), high water table levels can exacerbate other sources of flood risk by preventing infiltration and / or leaking into drainage systems.

4.5.5 In accordance with KC's SFRA, the southern part of the development site is in an area with a greater than 75% risk of groundwater emergence and the northern part is in an area with a less than 25% risk of groundwater emergence; this is the proportion of the 1km grid square in which the site is located, where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring.

4.5.6 Near a river, groundwater often discharges to the river, providing baseflow, which maintains the river flow during dry spells. The high risk of groundwater emergence is located along the route of the Calder and reflects that this is a likely discharge zone. The lower designation most probably reflects the situation on slightly higher ground away from the river.

4.5.7 The ground investigation undertaken to the west did not encounter groundwater within 2.8m of the surface.

4.5.8 Considering the above, the risk of groundwater flooding is considered to be low.

4.6 Infrastructure Failure Flood Risk

4.6.1 Infrastructure failure flooding occurs when a feature holding water above natural ground levels (e.g. reservoir or canal) is overtopped or breached. Infrastructure failure flooding is usually the result of extreme events in excess of the high standards of protection usually considered in the design of such structures (namely reservoirs).

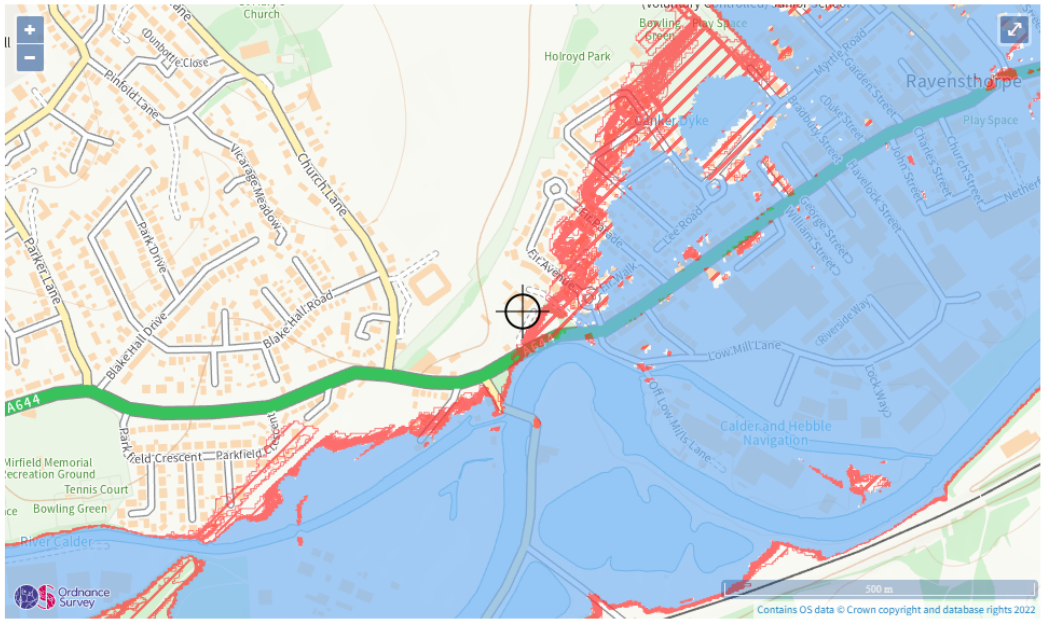
4.6.2 In accordance with the EA's *Long Term Flood Risk Information* (Figure 4.3), the development site is at risk of flooding from failure of several reservoirs in the Pennines to the west.

4.6.3 Reservoir failures are extremely rare in the UK, as the *Reservoir Act* ensures strict inspection and maintenance of all structures above a certain threshold. Structures under the *Reservoir Act* are also covered by comprehensive emergency plans and warning systems developed in liaison with the relevant civil protection authorities to ensure populations potentially at risk can be safely evacuated in critical situations.

4.6.4 The development site is also located close to the Calder and Hebble Navigation.

4.6.5 Canal failures are rare in the UK, as the Canal and River Trust regularly inspects and repairs structures and constantly monitors water levels and manages excess water in a number of passive and active ways (e.g. weirs, sluices, locks, restricted navigation, etc.).

Figure 4.3: Flood Risk from Reservoirs



Maximum extent of flooding from reservoirs:

when river levels are normal | when there is also flooding from rivers | Location you selected

4.6.6 Flood risk from infrastructure failure is mostly managed off-site by the competent authorities. The residual risk to the site is deemed low / negligible and adequately managed by measures proposed to deal with other sources of flooding.

5 FLOOD RISK MANAGEMENT

5.1 Sequential and Exception Tests

5.1.1 The sequential, risk-based approach to the location of development is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim is to keep development out of medium and high flood risk areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible.

5.1.2 Application of the sequential approach in the master planning process, in particular application of the *Sequential Test*, helps ensure that development can be safely and sustainably delivered, and developers do not waste resources promoting proposals which are inappropriate on flood risk grounds.

5.1.3 The *Sequential Test* ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The aim is to steer new development to Flood Zone 1 (areas with a low probability of sea or river flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of sea or river flooding), applying the *Exception Test* if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of sea or river flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the *Exception Test* if required.

5.1.4 Table 2 of the *Flood Risk and Coastal Change Guidance* categorises different types of uses and development according to their vulnerability to flood risk. Table 3 of the *Flood Risk and Coastal Change Guidance* (Table 5.1) maps these vulnerability classes against flood zones to indicate where development is appropriate and where it should not be permitted.

Table 5.1: Flood Risk Vulnerability and Flood Zone Compatibility

Flood Zone	Flood Risk Vulnerability				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test	✓	✓	✓
Zone 3a	Exception Test	×	Exception Test	✓	✓
Zone 3b	Exception Test	×	×	×	✓

Key:
✓ Development is appropriate
× Development should not be permitted

5.1.5 The site is located mostly in Flood Zone 1 and at no significant risk of flooding from any potential source. Development on the site is proposed for the north and west, thus

following a sequential approach to steer development away from flood risk. The Exception Test is not required for more vulnerable development in Flood Zones 1 and 2.

5.2 Fluvial Flood Risk

5.2.1 The following fluvial flood risk management measures have been incorporated in the proposed development's master plan:

- The proposed development should be located so FFLs are above the design flood level of 42.72 m aOD. The minimum FFL is 46.3m aOD.

5.2.2 The development site is in an area covered by the EA's flood warning system, which should allow users enough time to deploy flood defences and / or evacuate the site before accesses become impassable.

5.2.3 In the event of a more extreme flood, safe refuge will be provided in the upper floors of buildings without a permanent safe access / egress route.

5.3 Surface Water Flood Risk

5.3.1 The following surface water flood risk management measures have been incorporated in the proposed development's master plan:

- Vulnerable development should be set at least 300 mm above external ground levels.
- Ground levels which will be designed to safely route overland flows away from buildings, using less vulnerable parts of the proposed development such as public open spaces, parking areas and roads to convey and attenuate overland flows. Overland flow will remain similar to that pre-development.

6 SURFACE WATER DRAINAGE STRATEGY

6.1 Existing Drainage (Greenfield Runoff)

6.1.1 The undeveloped (greenfield) development site does not benefit from a formal surface water drainage system. Runoff generated within the site is expected to infiltrate into the ground or flow overland towards the south.

6.1.2 Greenfield and existing runoff rates of 1.8 l/s/ha (100% AEP), 2.0 l/s/ha (Q_{BAR}), 3.60 l/s/ha (3.3% AEP) and 4.2 l/s/ha (1.0% AEP) have been established for the development site using the *IH124* methodology with *ICP SuDS* correction for small catchments (Appendix E).

6.2 Hierarchy for Surface Water Disposal

6.2.1 The National Standards for Sustainable Drainage Systems (Defra, 2011) state that the following options must be considered in accordance with the hierarchy for surface water disposal:

Discharge to Ground (Infiltration)

6.2.2 Based on the available geologic and hydrogeological information (Section 3), infiltration drainage is deemed unfeasible at the development site.

Discharge to Surface Water Body

6.2.3 The River Calder is located close to the south of the site. Discharge to the river is considered feasible. However, Huddersfield Road is located between the site and the river which may present logistical difficulties in forming a new outfall to the river, considering both the impact of constructing an outfall and the existing services in the road. For the purposes of this strategy, and to follow the hierarchy, this option is considered to be achievable.

Discharge to Sewer

6.2.4 There are private surface water sewers to the south east and south west of the site, which discharge to the River Calder close to the site. However, Yorkshire Water have not provided details of the invert levels to enable assessment of whether gravity discharge to the sewers is achievable.

6.2.5 Should a direct crossing of Huddersfield Road and discharge to the River Calder not be feasible. utilising these sewers as a short conveyance route to the river may be preferable subject to suitable invert levels a consent to connect.

6.3 Proposed Drainage Strategy

6.3.1 The proposed surface water drainage strategy has been designed in accordance with the *DCG* and / or *Building Regulations Part H* and in compliance with the *NPPF*, local requirements and current best practices[1], to collect, convey and attenuate runoff from all impermeable areas (0.27 ha) before discharging into the River Calder.

[1] e.g. *Non-Statutory Technical Standards for Sustainable Drainage Systems* (March 2015) and *The SuDS Manual* (2015).

6.3.2 Given the unfeasibility of infiltration drainage, the volume of runoff leaving the proposed development cannot be reduced to zero and the excess volume must be discharged at a low rate that will not pose a flood risk downstream of the site. The proposed drainage strategy has been designed to limit discharge to 2.5 l/s which is a practical minimum rate.

6.3.3 The proposed drainage strategy (Appendix F) has been designed so that:

- flooding does not occur on any part of the site for all events up to 3.3% AEP (1 in 30 years);
- flooding does not occur in any part of a building or utility plant susceptible to water for all events up to 1.0% AEP (1 in 100 years) + 30% climate change allowance.

6.3.4 The performance of the proposed surface water drainage strategy has been tested for storm events with 100.0% AEP, 3.3% AEP and 1.0% AEP + 40% climate change and durations of 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640 and 10080 minutes.

6.3.5 The results of the simulations are included in Appendix G and demonstrate how the proposed surface water drainage strategy can manage surface water flood risk at the development site without increasing flood risk elsewhere for storm events up to the 1.0% AEP + 30% climate change allowance.

6.4 Sustainable Drainage Systems (SuDS)

6.4.1 In accordance with the *NPPF*, (major) developments should incorporate sustainable drainage systems (SuDS) unless there is clear evidence that this would be inappropriate. In addition to water quantity control, SuDS should consider opportunities to provide water quality and amenity / biodiversity benefits (i.e. multifunctionality approach).

6.4.2 While the proposed drainage strategy is largely reliant on a detention basin to manage runoff quantity, Table 6.1 shortlists other SuDS deemed compatible with the site's characteristics and which inclusion in the proposed development must be continuously assessed as the design progresses.

6.4.3 It is important to note the need to remove silt from runoff prior to discharge into SUDS features. SuDS such as filter drains, swales, bioretention systems and pervious pavements are sustainable alternatives to proprietary treatment systems otherwise required to manage silt.

Table 6.1: Sustainable Drainage Systems (SuDS)

SuDS Component	Description and Opportunities
Green / Blue Roofs	Green roofs are areas of living vegetation installed on the top of buildings for a range of reasons including visual benefit, ecological value, enhanced building performance and reduction of surface water runoff. A blue roof is a roof designed explicitly to store water for use within the building (rainwater harvesting) or controlled discharge. Green roofs that include reservoir storage zones beneath the growing medium could also be considered blue roofs. Green roofs can improve the thermal performance of buildings, help combat the urban heat island effect and contribute to improved air quality. Through evapotranspiration, green roofs can reduce peak flow rates to a site drainage system (principally for small and medium-sized events) but are unlikely to a have a significant impact on downstream attenuation storage requirements. Blue roofs can be designed to provide significant attenuation (and evapotranspiration). Pitched roofs are proposed for the properties, but if any flat roofs are included in the dwellings or garages, green roofs may be accommodated.
Filter Drains/Strips	Filter drains are trenches filled with stone/gravel that create temporary subsurface storage for the filtration, attenuation and conveyance of surface water runoff. Ideally, filter drains receive lateral inflow from adjacent impermeable surfaces pre-treated over a filter strip. Filter drains can help manage peak flows by naturally limiting rates of conveyance through the filter medium and by providing attenuation storage when the rate of flow at the outlet is controlled. Filter drains can be effectively incorporated into the landscape and public open spaces and can have minimal land-take requirements. The use of filter drains is typically restricted to flat sites (unless placed parallel to contours). Filter drains are best located adjacent to (small) impermeable surfaces such as car parks and roads / highways.
Pervious Pavements	Pervious pavements provide a pavement suitable for pedestrian and / or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying structural layers. The water is temporarily stored beneath the overlying surface before use, infiltration to the ground or controlled discharge downstream. Pervious pavements help reduce flow rates from a site by providing attenuation storage. A flow control structure is required to constrain the rate of water discharged from the sub-base via an outlet pipe. Pervious pavement drainage has been shown to have decreased concentrations of a range of surface water pollutants, including heavy metals, oil and grease, sediment and some nutrients. Pervious pavements are typically built as an alternative to impermeable surfaces and therefore require no extra development space for their construction. Consideration should be given to their use in the parking bays and / or internal road.

SuDS Component	Description and Opportunities
Detention Basins	Detention basins are landscaped depressions that are normally dry expect during and immediately following storm events. They can be on-line components where surface runoff from regular events is routed through the basin or off-line components into which runoff is diverted once flows reach a specific threshold. Detention basins can be vegetated depressions (providing treatment in on-line components) or hard landscaped storage areas. Off-line basins will normally have an alternative principal use (e.g. amenity or recreational facility or urban (hard) landscaping). A basin is proposed in the POS in the south of the site.

6.5 Exceedance Events

6.5.1 Plot levels are set at least 300 mm above external ground levels and external ground levels have been designed to safely route overland flows away from buildings using the less vulnerable parts of the proposed development such as public open spaces, parking areas and roads to convey and store overland flows.

6.5.2 Overland flows resulting from exceedance events are expected to leave the developed site to the north east or south as currently occurs (i.e. pre-development conditions), without posing any increased flood risk on site or elsewhere. The proposed overland flood routing plan is included in Appendix H.

6.6 Water Quality Management

6.6.1 The suitability of the proposed drainage strategy to manage the development's pollution risk has been assessed using the simple index approach in *The SuDS Manual* (2015), as summarized in Table 6.2.

Table 6.2: Surface Water Quality Management (Simple Index Approach)

Runoff Route / Treatment Train				
Land Use / SuDS	Hazard Level	TSS	Metals	Hydrocarbons
Pollution Hazard Indices				
Residential Roofs	Very Low	0.20	0.20	0.05
Driveways, residential car parks and low traffic roads	Low	0.50	0.40	0.40
SuDS Mitigation Indices				
Detention Basin	-	0.50	0.50	0.60
Total SuDS Mitigation Index ≥ Pollution Hazard Index (for each contaminant type)				

6.7 Operation and Maintenance

6.7.1 The function of the surface water drainage system must be understood by those responsible for maintenance, regardless of whether individual components are below ground or on the surface. In any system properly designed, monitored and maintained, performance deterioration can usually be minimised.

6.7.2 The long-term operation and maintenance of the proposed surface water drainage strategy will be the responsibility of the entities, as detailed in Table 6.3. Appropriate legal agreements defining maintenance responsibilities and access rights over the lifetime of the proposed development must be established prior to construction.

Table 6.3: Entities Responsible for SuDS Maintenance

SuDS Component	Location	Function	Responsible Entity
Green Roof	Individual plots	Store & treat runoff	Owner or private management company
Filter Drain	Roadsides	Store, convey and treat runoff	Local highways authority or private management company
Pervious Pavement	Private & public parking areas	Store & treat runoff	Owner or private management company
Detention Basin	Public open spaces	Store & treat runoff	Local authority, water company or private management company

6.7.3 Where the user / benefiter of a system is not responsible for maintenance, then it is important to ensure that they know when the SuDS is not functioning correctly and who to contact if any issue arises.

6.7.4 Maintenance plans are often required to clearly identify who is responsible for maintaining proposed SuDS as well as the maintenance regime to be applied. Maintenance plans can also form a useful tool for public engagement with SuDS and understanding their wider benefits. The maintenance requirements of the proposed surface water drainage strategy are summarised in Table 6.4.

Table 6.4: Typical Operation and Maintenance Requirements

Operation and Maintenance Activity	SuDS Component			
	Green Roof	Filter Drain	Pervious Pavement	Detention Basin
Regular Maintenance				
Inspection	■	■	■	■
Litter and debris removal		■	■	■
Grass cutting		■	□	■
Weed and invasive plant control	■	□	□	□
Shrub management (including pruning)			□	□
Shoreline vegetation management				□
Aquatic vegetation management				□
Occasional Maintenance				

Operation and Maintenance Activity	SuDS Component			
	Green Roof	Filter Drain	Pervious Pavement	Detention Basin
Sediment management		■	■	■
Vegetation replacement	■			□
Vacuum sweeping and brushing			■	
Remedial Maintenance				
Structure rehabilitation/repair	□	□	□	□
Infiltration surface reconditioning		□	□	
Key: ■ Will be required □ May be required				

6.8 Drainage During Construction

6.8.1 Drainage is typically an early activity in the construction of a development, taking form during the earthworks phase. However, the connection of piped drainage system to SuDS components should not take place until the end of construction works, unless a robust strategy for silt removal prior to occupation of the site is implemented.

6.8.2 Silt-laden runoff from construction sites represents a common form of waterborne pollution and cannot enter SuDS components not specifically designed to manage this, as it can overwhelm the system and pollute receiving water features. Any gullies and piped systems should be capped off during construction and fully jetted and cleaned prior to connection to SuDS components.

6.8.3 The three principal aspects of drainage during construction are conveying runoff, controlling runoff and trapping sediments:

- Conveyance of runoff can be achieved through small ditches / swales, channels and drains. Runoff control measures should be implemented to ensure that runoff does not overwhelm the temporary drainage system causing flooding on site or elsewhere.
- Control of runoff can be achieved through perimeter ditches or appropriate grading to ensure that any runoff from the construction site stays on site. Runoff rates leaving the site should be managed so they do not exceed pre-development conditions.
- Construction runoff should be directed to dedicated infiltration basins with adequate upstream sediment and pollution control such as sediment basins, silt fences and straw bales prior to infiltration or off-site discharge.

6.8.4 Additional conveyance, control and treatment measures should be installed as needed during grading. Slope stability needs to be considered when using open water features to convey, control and treat runoff across the site. Any necessary surface stabilisation measures should be applied immediately on all disturbed areas where construction work is either delayed or incomplete.

6.8.5 Maintenance inspections should be performed weekly, and maintenance repairs should be made immediately after periods of rainfall.

6.8.6 All drainage infrastructure (namely underground features) must be protected from damage by construction traffic and heavy machinery through the implementation of measures such as protective barriers and storing construction materials away from the drainage infrastructure.

7 FOUL WATER DRAINAGE STRATEGY

7.1.1 Sewerage undertakers have a legal obligation under the Water Industries Act 1991 to provide developers with the right to connect to public (foul) networks. The Water Industries Act 1991 also contains safeguards to ensure that flows resulting from new developments do not cause detriment to the existing public sewerage networks by imposing a duty on sewerage undertakers to carry out works required to accommodate additional flows into their networks.

7.1.2 The undeveloped (greenfield) development site does not benefit from a formal foul water drainage system, but in accordance with records obtained from YW (Appendix I), there are combined sewers in Huddersfield Road to the south. The nearest public combined sewer is the 300 mm pipe in the north side of the road.

7.1.3 Invert levels of the sewer have not been provided by YW, therefore it is assumed that a gravity connection can be achieved.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1.1 JNP Group has been commissioned by Robert Halstead Chartered Surveyors & Town Planners to prepare a Flood Risk Assessment and Drainage Strategy for the proposed development at 'Land at 894 Huddersfield Road, Mirfield'.

8.1.2 The site is greenfield and is approximately 0.75 ha and is located near Mirfield. The proposed development comprises 0.75 ha of residential development with public open space in the south. The proposed impermeable area is 0.27 ha.

8.1.3 No artificial or made ground is indicated to be present underlying the site. Superficial deposits are also absent from beneath the site although Alluvium is indicated to be present immediately to the south east of the site. The underlying geology is indicated to be Pennine Lower Coal Measures. These were noted as predominately cohesive by a site investigation close to the west of the site. Infiltration drainage is deemed unfeasible at the development site

8.1.4 The nearest natural watercourse is the River Calder which is located approximately 10m to the south of the development site, to the south of Huddersfield Road. Discharge to the river is considered to be feasible subject to being able to cross the road.

8.1.5 The Flood Risk Assessment section of this report demonstrates that the risk of flooding from most sources (tidal, groundwater, sewer and reservoir) is low.

8.1.6 The southern part of the site is classified as Flood Zone 2. Development will be restricted to the norther part of the site which is classified as Flood Zone 1. FFLs will be set well above the predicted 1 in 100 year plus climate change flood level.

8.1.7 Development of the site will increase the impermeable area and associated surface water run-off. Surface water will be routed away from buildings and maintain the existing runoff routes to the north east and south.

8.1.8 The proposed drainage strategy intends to collect runoff via a series of rainwater pipes before discharging into a below ground drainage network and conveying water to a detention basin in the POS in the south of the site. This will discharge at a restricted rate of 2.5 l/s (practical minimum) and outfall to the River Calder.

8.1.9 Groundwater monitoring will be required to determine the level of the water table in relation to the basin. Should groundwater ingress into the basing be possible, the basin may need to be lined.

8.1.10 Should crossing the road not be achievable, there are two surface water sewers close to the site. Subject to suitable invert levels and agreement to connect, these could be used as an alternative outfall; they both then discharge to the River Calder close to the site.

8.1.11 The proposed surface water drainage strategy can manage surface water flood risk at the development site without increasing flood risk elsewhere for storm events up to the 1.0% AEP plus 30% climate change allowance.

8.1.12 Water quality management is to be achieved through the treatment potential of the detention basin. The hazard level is low or very low, and the water quality treatment is considered acceptable following the completion of the simple index approach from the SuDS Manual.

8.1.13 The proposed foul water drainage strategy is to drain into the combined sewer network in the surrounding highway network. Confirmation of invert levels is required to confirm a gravity connection is possible.

8.1.14 It is expected that the surrounding network will have enough capacity for the proposed development. This will need to be confirmed with YW and is subject to a S106 application.

8.1.15 An operation and maintenance plan has been provided as part of this report in accordance with the SuDS Manual, which includes a review of all drainage elements, including SuDS features.

8.1.16 In conclusion, the proposed development is not at risk of flooding and does not increase flood risk off-site. Surface water runoff from the proposed development will be collected and managed on-site before discharging to the River Calder (directly or indirectly) at a maximum discharge rate of 2.5 l/s. The foul water drainage will discharge unrestricted to the combined sewer network.

8.1.17 This report is intended for the use of the developer of the site in support of their planning application for the site only.

9 LIMITATIONS

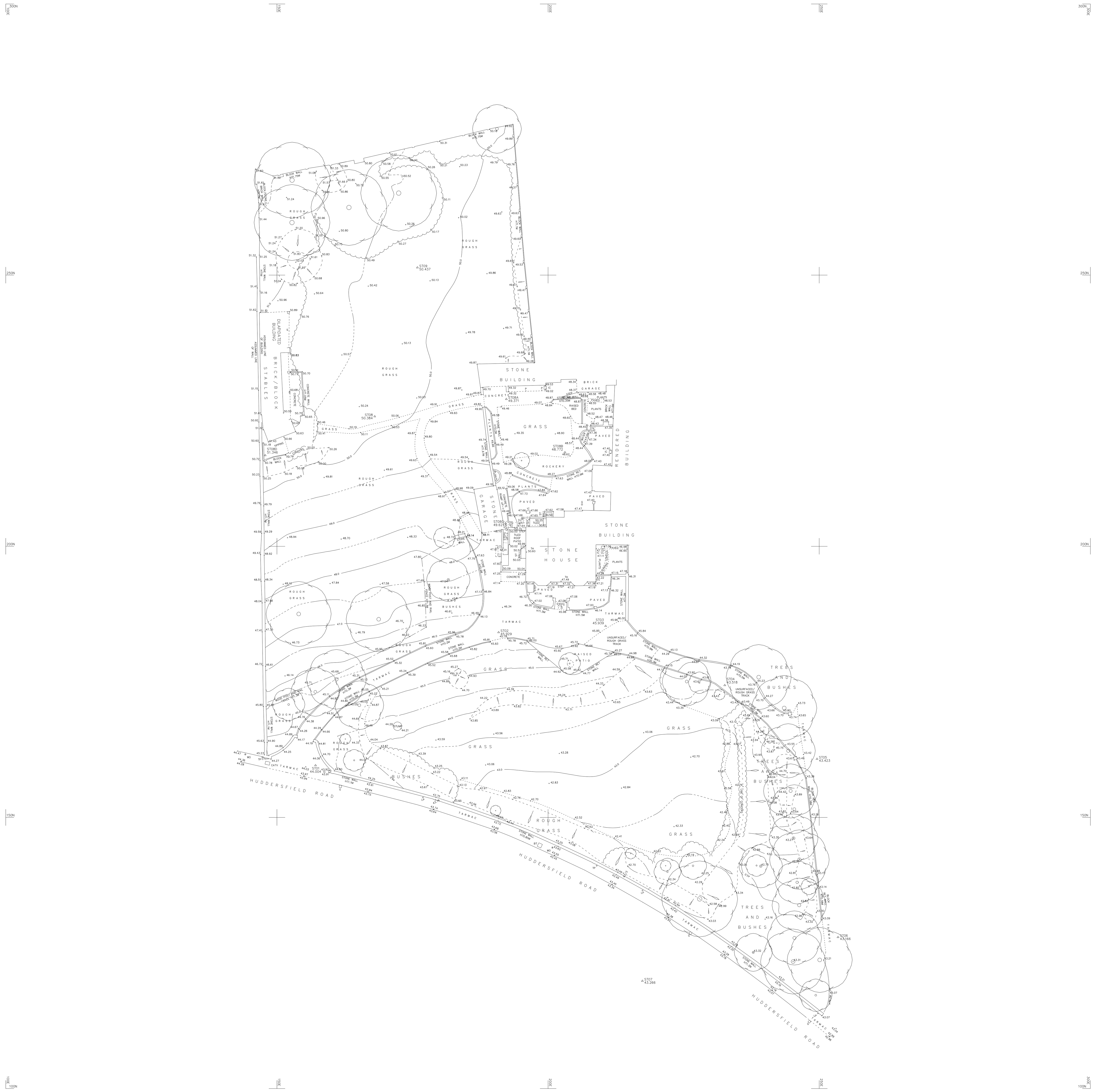
9.1.1 The information, conclusions and recommendations presented within this report are deemed to be current at the time of issue. No guarantee can be given to the status of this information other than at the time of issuing. Where necessary, the user shall confirm the status of any applicable assessments and consents.

9.1.2 This report has been commissioned by Robert Halstead Chartered Surveyors & Town Planners. No third party may receive a copy of this report without first obtaining our permission in writing.

9.1.3 This report is confidential and has been prepared solely for the benefit of Robert Halstead Chartered Surveyors & Town Planners and those parties with whom a warranty agreement has been executed or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of this report, written approval must be sought from JNP Group and a charge may be levied against such approval. JNP Group accepts no responsibility or liability for the consequences of this document being used for any purpose or project other than for which it was commissioned, or this document being used by any third party with whom an agreement has not been executed.

9.1.4 The copyright of this report remains with JNP Group at all times.

APPENDIX A: TOPOGRAPHICAL SURVEY



ELLAM LAND SURVEYS
Land, Engineering & Building Surveys

ANCHOR HOUSE, DEWSBURY MILLS, THORNHILL ROAD, DEWSBURY, WF12 9QE
TEL . (01924) 467621 FAX . (01924) 459970
E - MAIL . ELS@ELBANE.COM

LOCATION
894 HUDDERSFIELD ROAD
RAVENSTHORPE

CLIENT
ROBERT HALSTEAD

PLEASE DO NOT ROTATE OR MOVE THIS DRAWING
ALL SERVICES TO BE FIELD VERIFIED

LEGEND

AV	AIR VALVE	CC	CONCRETE COVER	FWS	FOUL WATER SEWER	LP	LAMP POST	ST	STOP TAP
B	BOLLARD	CDC	DRAINAGE CHANNEL	G	GULLY	MC	METAL COVER	SV	STOP VALVE
BH	BOREHOLE	CP	CATCH PIT	GV	GAS VALVE	MH	MANHOLE	SWS	SURFACE WATER SEWER
BS	BUS STOP	CTV	CABLE TV I.C	HV	HIGH VOLTAGE	MDC	DRAINAGE CHANNEL	TL	TRAFFIC LIGHTS
BT	BRITISH TELECOM	DP	DOWN PIPE	IC	INSPECTION COVER	P	POST / POLE	TP	TELEGRAPH POLE
		ECP	ELEC. CABLE PIT	JB	JUNCTION BOX	RE	RODDING EYE	TH	THRESHOLD
		EP	ELEC. POLE/PYLON	KW	KERB WEIR	RS	ROAD SIGN	VP	VENT PIPE
		ER	EARTH ROD	LB	LITTER BIN	S	STAY	WM	WATER METER
		FH	FIRE HYDRANT	LH	LAMP HOLE	SC	STOP COCK	WO	WASH OUT

SHEET	1 OF 1	LEVEL DATUM	NEWLYN
SCALE	1 : 200	GRID DATUM	GPS
DRAWN	J.G.WHITE SENIOR SURVEYOR	B.M. USED	None - GPS on ST02 Value 45.929m
DATE	JULY 08		

DRAWING NO. 6683/1

APPENDIX B: PROPOSED DEVELOPMENT

KEY:

- New Tree Planting
- Site Boundary
- Flood Zone Areas
- Root Protection Areas
- Landscape Planting
- 600mm Wide Road Margin
- Visitor Parking Space
- Mixed Boundary hedging

NOTES

All dimensions must be checked on site and not scaled from this drawing, except for planning.

Any discrepancy found between drawings or details should be reported to DesignHouse as soon as possible where the correct information will be given.

ACCOMMODATION: (Internal Areas)

DETACHED DWELLINGS:

6No. Four bedroom detached houses (168.45m2) 4B/8P
4No. with 3 off street parking spaces and
2No. with 2 off street parking spaces

2No. Three bedroom terraced houses (107.03m2) 3B/5P
With 2No. on street parking bays

3No. Three bedroom terraced houses (99.77m2) 3B/5P
With 2No. on street parking bays

Plus additional 6No. visitor parking bays (total 2.9 spaces per dwelling)

Rev.	Date	Revision
		Original drawing size A0
E	02.08.22	SUDS storm water basin added
D	27.07.22	Unit 6 parking area enlarged.
		Pond enlarged & extra planting
C	21.07.22	Final transport issues amended
B	19.07.22	Transport issues corrected
A	30.05.22	Tree T29 retained, terrace
		amended and road layout changed

DesignHouse
74 Victoria Street
Dunstable
Bedfordshire
LU6 3BA
Phone/Fax: 07860 798939
e-mail :- mail@kevinpatrick.co.uk

Client
Leyton Homes Ltd

Job Title
New Residential development
At Land Adjacent To:-
894 Huddersfield Road
Mirfield
WF14 9HS

Drawing Title
Proposed Site Plan
Showing Complete Site

Scale 1:200 @ A0

Date Apr 2022 | Drawn By KJP

Drwg No. 21/6320/10 | Rev. D

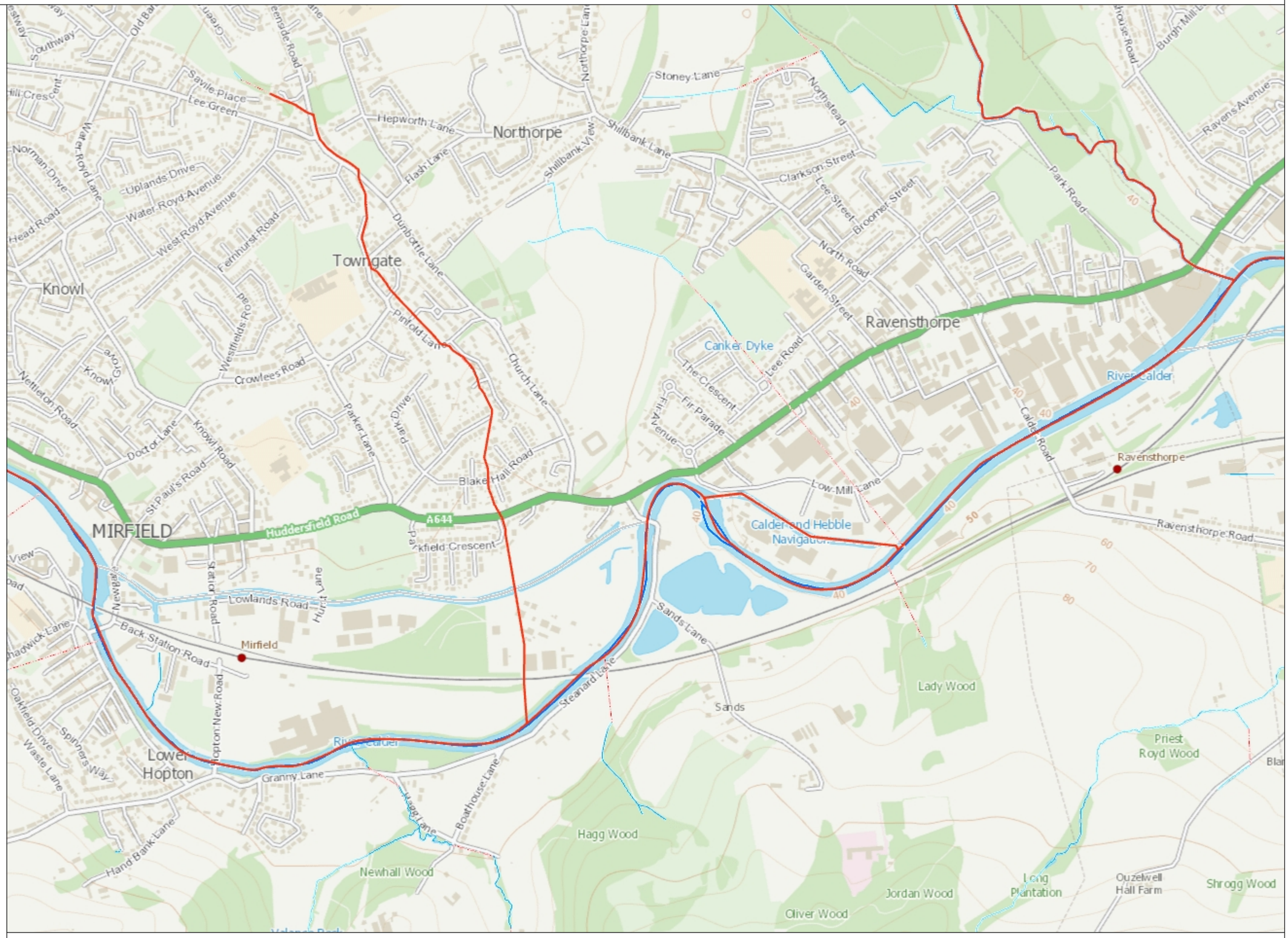
APPENDIX C: EA DATA

RFI/2022/249872 Main River and Detailed River Network Map centered on Huddersfield Road, Mirfield

Environment Agency

Legend

- Statutory Main Rivers
- Detailed River Network
  - Primary River
  - Secondary River
  - Tertiary River
  - Lake / Reservoir
  - Canal
  - Canal Tunnel
  - Extended Culvert
  - Multiple Channel Culvert
  - Underground River (potential sewer)
  - Underground River (inferred)
  - Underground River (local knowledge)
  - Undefined
- Offline Drainage features



1: 10,000

0 250

Metres

N W E S

Flood risk assessment data

Location of site: 421595 / 419972 (shown as easting and northing coordinates)
Document created on: 14 March 2022
This information was previously known as a product 4.
Customer reference number: 4UBFN5ACAY2F

Map showing the location that flood risk assessment data has been requested for.

How to use this information

You can use this information as part of a flood risk assessment for a planning application. To do this, you should include it in the appendix of your flood risk assessment.

> **We recommend that you work with a flood risk consultant to get your flood risk assessment.**

Included in this document

In this document you'll find:

- how to find information about surface water and other sources of flooding
- information on the models used
- definitions for the terminology used throughout
- flood map for planning (rivers and the sea)
- areas benefiting from defences
- historic flooding
- modelled data
- climate change modelled data
- information about strategic flood risk assessments
- information about this data
- information about flood risk activity permits
- help and advice

Not included in this document

This document does not include a Flood Defence Breach Hazard Map.

As your location benefits from flood defences, you need to request a Flood Defence Breach Hazard Map and information about the level of flood protection offered at your location from the Yorkshire Environment Agency team at neyorkshire@environment-agency.gov.uk. This information will only be available if modelling has been carried out for breach scenarios.

Include a site location map in your request.

Information that's unavailable

This document **does not** contain:

- flood defences and attributes

We aren't able to display flood defence locations and attributes as there are no formal flood defences in the area of interest.

Please note that information about high ground, structures (such as weirs, control gates or screens) and channels (culverts) is no longer given out in Product 4, unless specifically requested. If you'd like to see this data, please let us know.

Information about assets and structures can be viewed on our Data Services Platform https://environment.data.gov.uk/asset-management/index.html

Surface water and other sources of flooding

Use the long term flood risk service to find out about the risk of flooding from:

- surface water
- ordinary watercourses
- reservoirs

For information about sewer flooding, contact the relevant water company for the area.

About the models used

Model name: 2009 FIM River Spen
Scenario(s): Defended fluvial, defences removed fluvial
Date: 1 March 2009

Model name: 2015 Calder and Canals - downstream of Sowerby Bridge
Scenario(s): Defended fluvial, defences removed fluvial, defended climate change fluvial
Date: 31 March 2014

These models contain the most relevant data for your area of interest.

Terminology used

Annual exceedance probability (AEP)

This refers to the probability of a flood event occurring in any year. The probability is expressed as a percentage. For example, a large flood which is calculated to have a 1% chance of occuring in any one year, is described as 1% AEP.

Metres above ordnance datum (mAOD)

All flood levels are given in metres above ordnance datum which is defined as the mean sea level at Newlyn, Cornwall.

Flood map for planning (rivers and the sea)

Your development is in flood zone 2.

Flood zone 3 shows the area at risk of flooding for an undefended flood event with a:

- 0.5% or greater probability of occurring in any year for flooding from the sea
- 1% or greater probability of occurring in any year for fluvial (river) flooding

Flood zone 2 shows the area at risk of flooding for an undefended flood event with:

- between a 0.1% and 0.5% probability of occurring in any year for flooding from the sea
- between a 0.1% and 1% probability of occurring in any year for fluvial (river) flooding

It's important to remember that the flood zones on this map:

- refer to the land at risk of flooding and do not refer to individual properties
- refer to the probability of river and sea flooding, ignoring the presence of defences
- do not take into account potential impacts of climate change

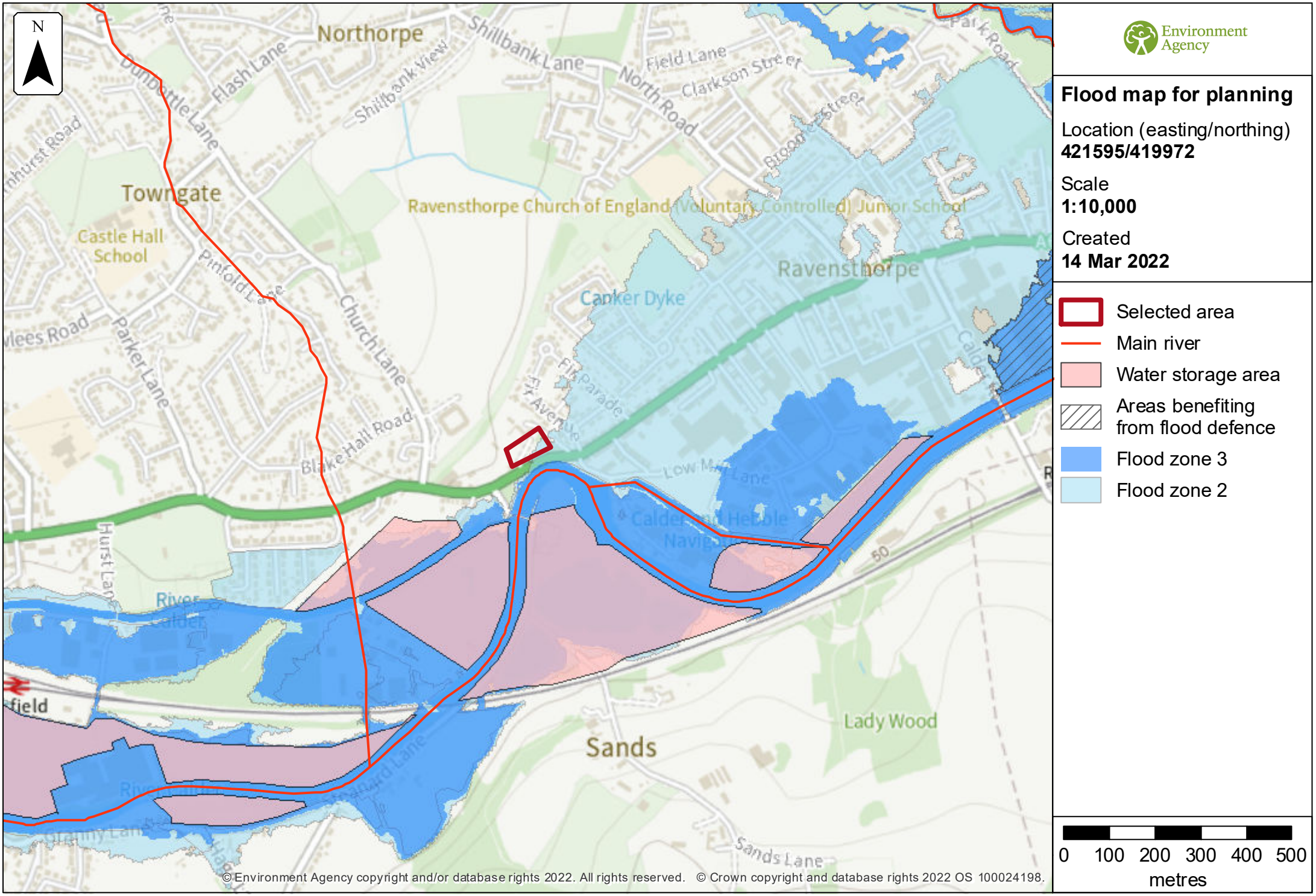
This data is updated on a quarterly basis as better data becomes available.

Areas benefiting from defences

This map shows the areas benefiting from defences for 2 possible events:

- fluvial (river flooding) event that has a 1% annual exceedance probability (AEP), this means a 1% chance of occurring in any one year
- tidal or coastal event that has a 0.5% annual exceedance probability (AEP), this means a 0.5% chance of occurring in any one year

Download the GIS dataset for areas benefiting from defences


N
Northorpe
Townrgate
Castle Hall School
Ravensthorpe Church of England (Voluntary Controlled) Junior School
Ravensthorpe
Canker Dyke
Sands
Lady Wood
Sands Lane
Blake Hall Road
Church Lane
Parker Lane
Flash Lane
Shillbank Lane
Field Lane
North Road
Clarkson Street
Park Road
Low Mill Lane
River
Environment Agency
Flood map for planning
Location (easting/northing)
421595/419972
Scale
1:10,000
Created
14 Mar 2022
Selected area
Main river
Water storage area
Areas benefiting from flood defence
Flood zone 3
Flood zone 2
0 100 200 300 400 500
metres
© Environment Agency copyright and/or database rights 2022. All rights reserved. © Crown copyright and database rights 2022 OS 100024198.

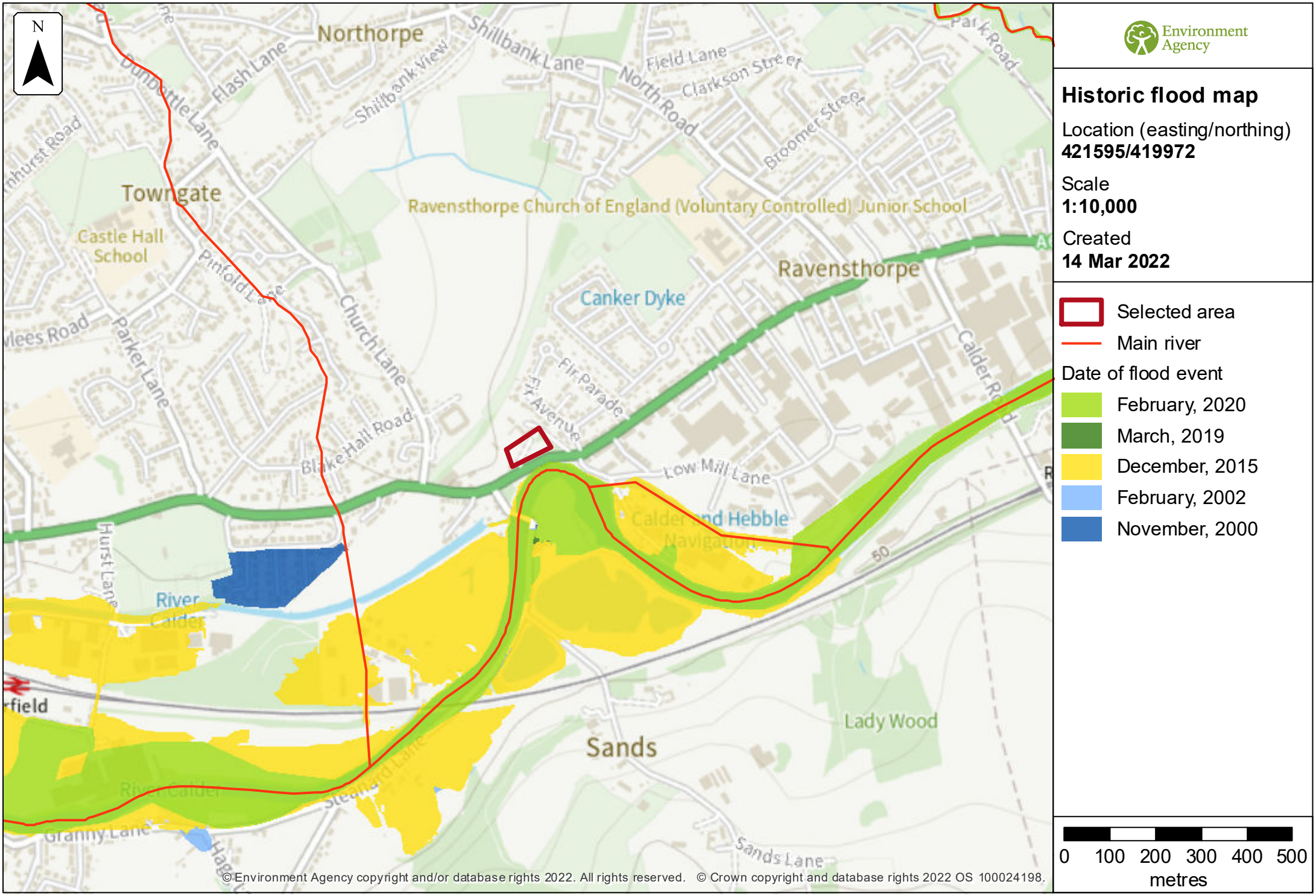
Historic flooding

This map is an indicative outline of areas that have previously flooded. Remember that:

- our records are incomplete, so the information here is based on the best available data
- it is possible not all properties within this area will have flooded
- other flooding may have occurred that we do not have records for
- flooding can come from a range of different sources - we can only supply flood risk data relating to flooding from rivers or the sea

You can also contact your Lead Local Flood Authority or Internal Drainage Board to see if they have other relevant local flood information. Please note that some areas do not have an Internal Drainage Board.

Download recorded flood outlines in GIS format



Environment Agency

Historic flood map

Location (easting/northing)
421595/419972

Scale
1:10,000

Created
14 Mar 2022

Historic flood event data

Start date	End date	Source of flood	Cause of flood	Affects location
8 February 2020	19 March 2020	main river	channel capacity exceeded (no raised defences)	No
14 March 2019	17 March 2019	main river	unknown	No
25 December 2015	29 December 2015	main river	channel capacity exceeded (no raised defences)	No
10 February 2002	13 February 2002	main river	channel capacity exceeded (no raised defences)	No
6 November 2000	4 December 2000	main river	unknown	No

Modelled data

This section provides details of different scenarios we have modelled and includes the following (where available):

- outline maps showing the area at risk from flooding in different modelled scenarios
- modelled node point map(s) showing the points used to get the data to model the scenarios and table(s) providing details of the flood risk for different return periods
- map(s) showing the approximate water levels for the return period with the largest flood extent for a scenario and table(s) of sample points providing details of the flood risk for different return periods

Climate change

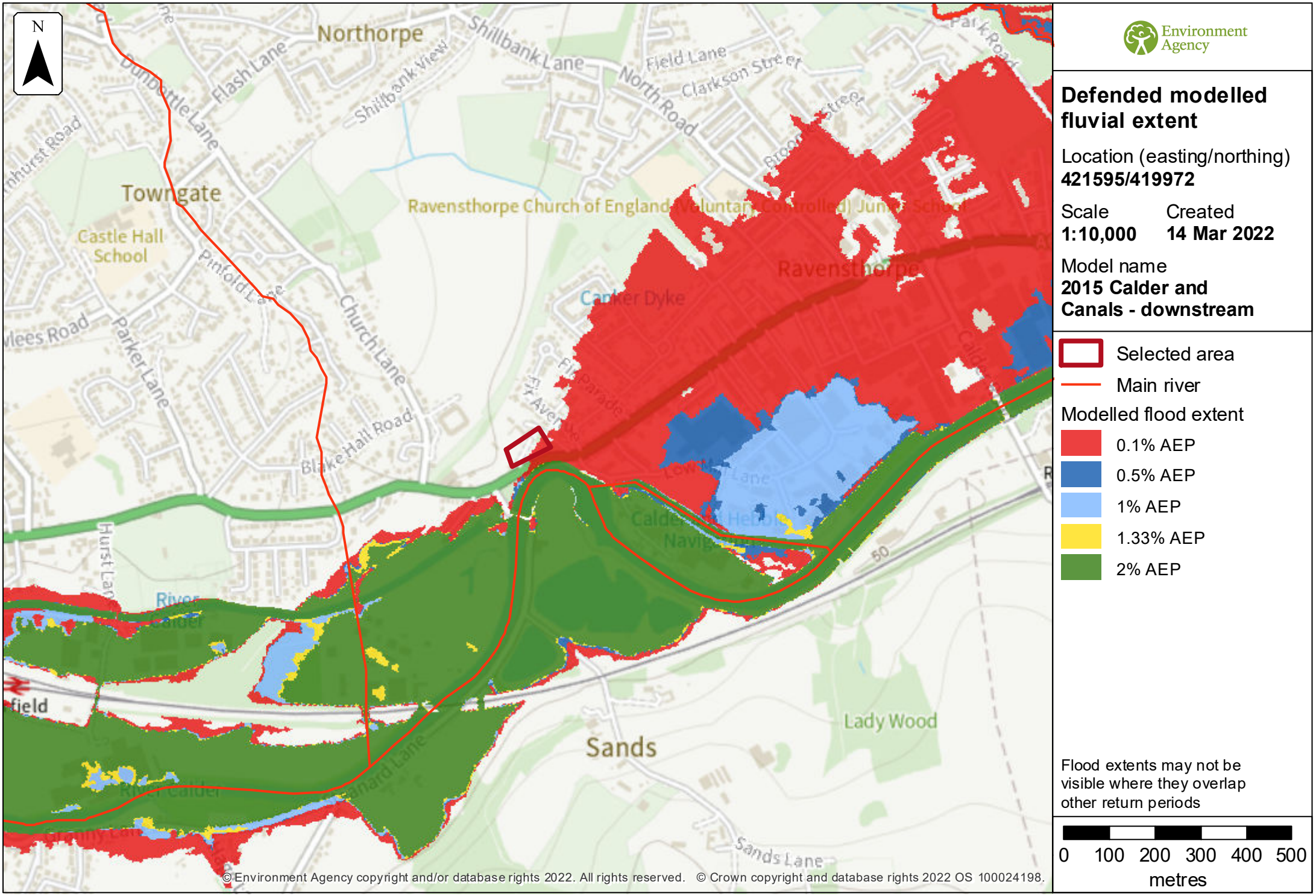
The climate change data included in the models may not include the latest flood risk assessment climate change allowances. Where the new allowances are not available you will need to consider this data and factor in the new allowances to demonstrate the development will be safe from flooding.

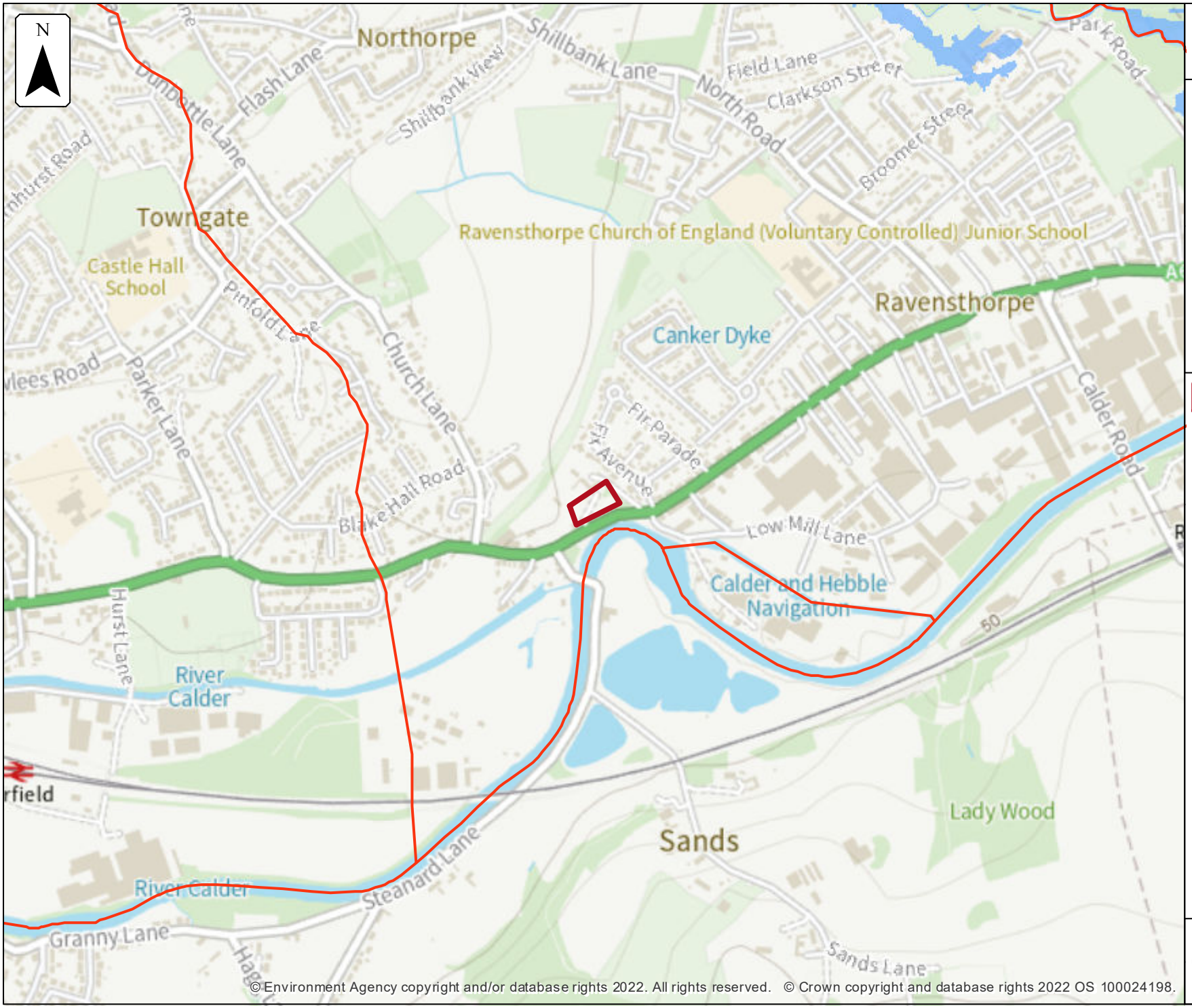
The Environment Agency will incorporate the new allowances into future modelling studies. For now, it's your responsibility to demonstrate that new developments will be safe in flood risk terms for their lifetime.

Modelled scenarios

The following scenarios are included:

- Defended modelled fluvial: risk of flooding from rivers where there are flood defences
- Defences removed modelled fluvial: risk of flooding from rivers where flood defences have been removed
- Defended climate change modelled fluvial: risk of flooding from rivers where there are flood defences, including estimated impact of climate change
- Defences removed climate change modelled fluvial: risk of flooding from rivers where flood defences have been removed, including estimated impact of climate change


N
Northorpe
Shillbank Lane
Field Lane
North Road
Clarkson Street
Flash Lane
Dunbottle Lane
Shillbank View
Townrgate
Castle Hall School
Ravensthorpe Church of England (Voluntary Controlled) Junior School
Ravensthorpe
Canker Dyke
Church Lane
Parker Lane
Blake Hall Road
Pinfold Lane
Hurst Lane
Sands
Lady Wood
Sands Lane
Environment Agency
Defended modelled fluvial extent
Location (easting/northing)
421595/419972
Scale
1:10,000
Created
14 Mar 2022
Model name
2015 Calder and Canals - downstream
Selected area
Main river
Modelled flood extent
0.1% AEP
0.5% AEP
1% AEP
1.33% AEP
2% AEP
Flood extents may not be visible where they overlap other return periods
0 100 200 300 400 500
metres
© Environment Agency copyright and/or database rights 2022. All rights reserved. © Crown copyright and database rights 2022 OS 100024198.



Environment Agency

Defended modelled fluvial extent

Location (easting/northing)
421595/419972

Scale
1:10,000

Created
14 Mar 2022

Model name
2009 FIM River Spen

Selected area

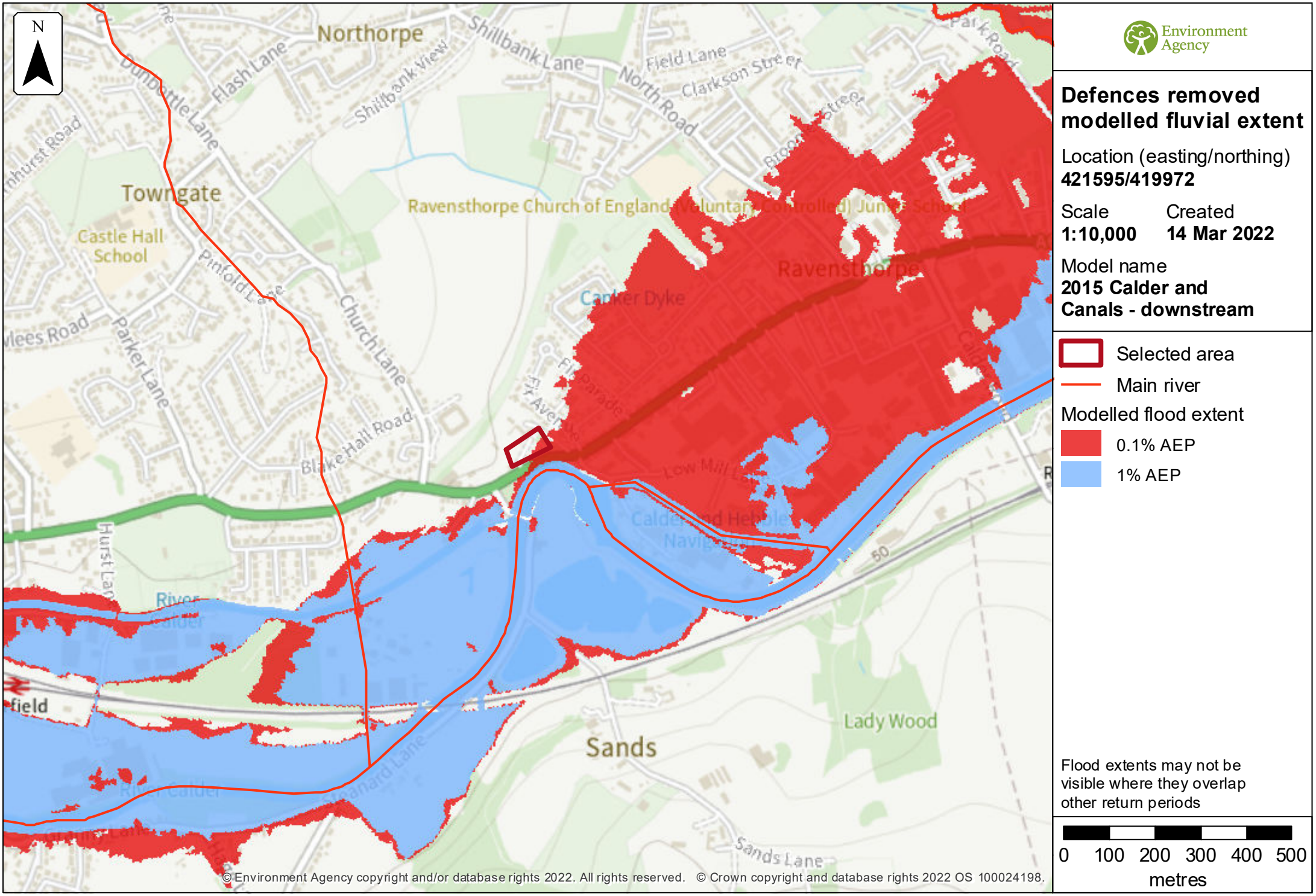
Main river

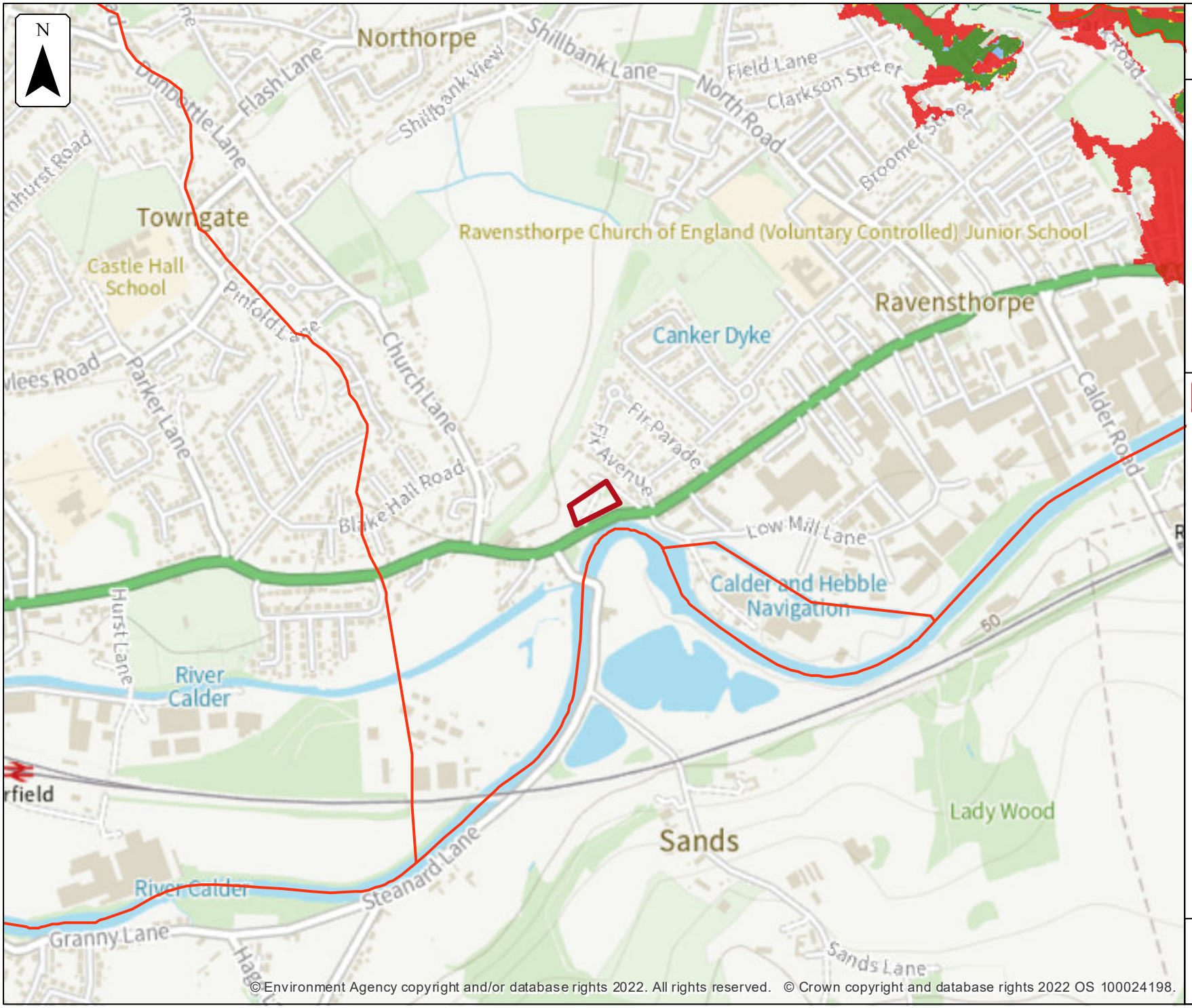
Modelled flood extent

1% AEP

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres


N
Northorpe
Townrgate
Castle Hall School
Ravensthorpe Church of England (Voluntary Controlled) Junior School
Ravensthorpe
Canker Dyke
Flash Lane
Dunbottle Lane
Shillbank View
Shillbank Lane
Field Lane
North Road
Clarkson Street
Park Road
Broom Street
Pinfold Lane
Church Lane
Parker Lane
Blake Hall Road
Hurst Lane
Fir Parade
Fir Avenue
Low Mill Lane
Sands
Lady Wood
Sands Lane
Leonard Lane
50
Environment Agency
Defences removed modelled fluvial extent
Location (easting/northing)
421595/419972
Scale
1:10,000
Created
14 Mar 2022
Model name
2015 Calder and Canals - downstream
Selected area
Main river
Modelled flood extent
0.1% AEP
1% AEP
Flood extents may not be visible where they overlap other return periods
0 100 200 300 400 500
metres
© Environment Agency copyright and/or database rights 2022. All rights reserved. © Crown copyright and database rights 2022 OS 100024198.



Environment Agency

Defences removed modelled fluvial extent

Location (easting/northing)
421595/419972

Scale
1:10,000

Created
14 Mar 2022

Model name
2009 FIM River Spen

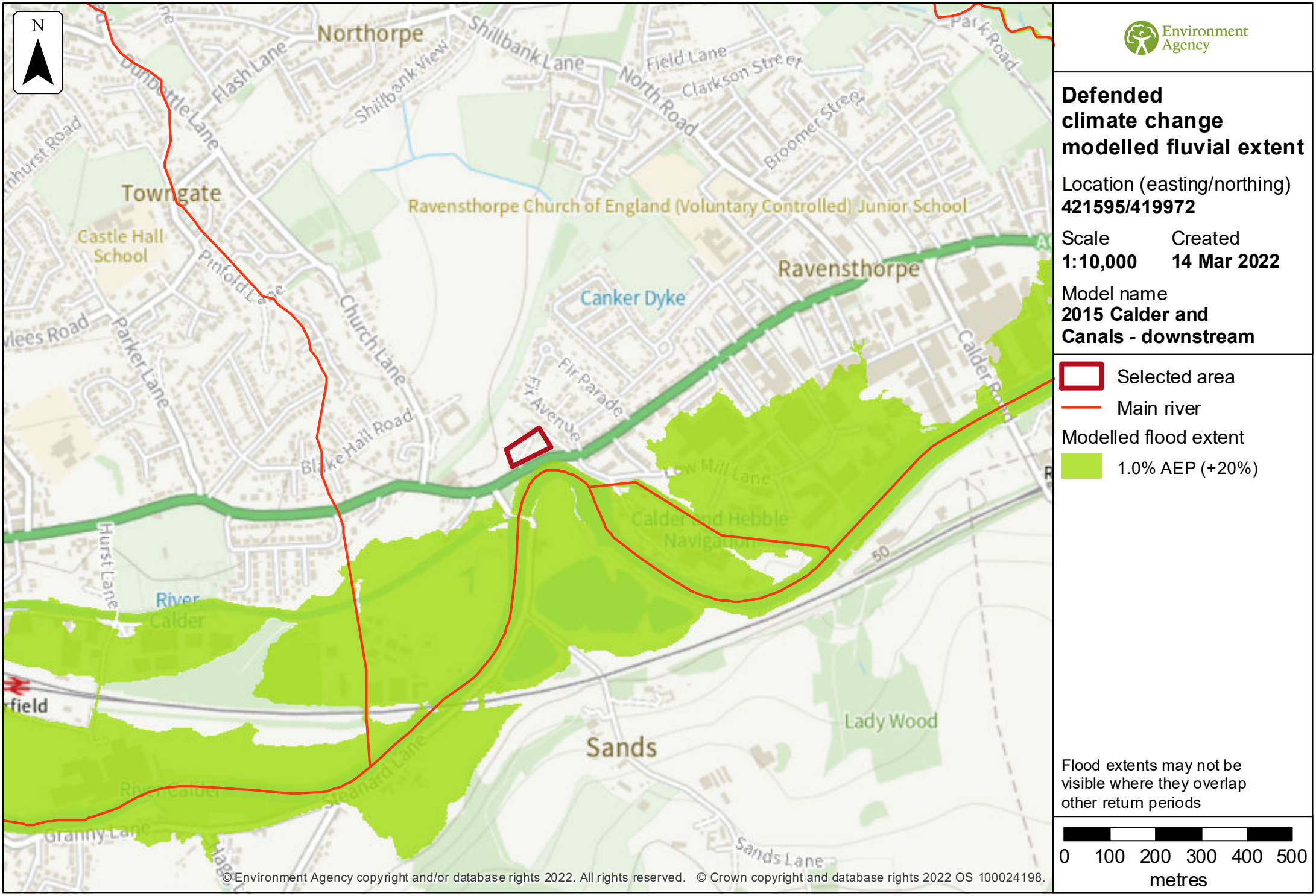
- Selected area
- Main river

Modelled flood extent

- 0.1% AEP
- 1% AEP
- 1.33% AEP
- 2% AEP

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Environment Agency

Defended climate change modelled fluvial extent

Location (easting/northing)
421595/419972

Scale
1:10,000

Created
14 Mar 2022

Model name
2015 Calder and Canals - downstream

Selected area

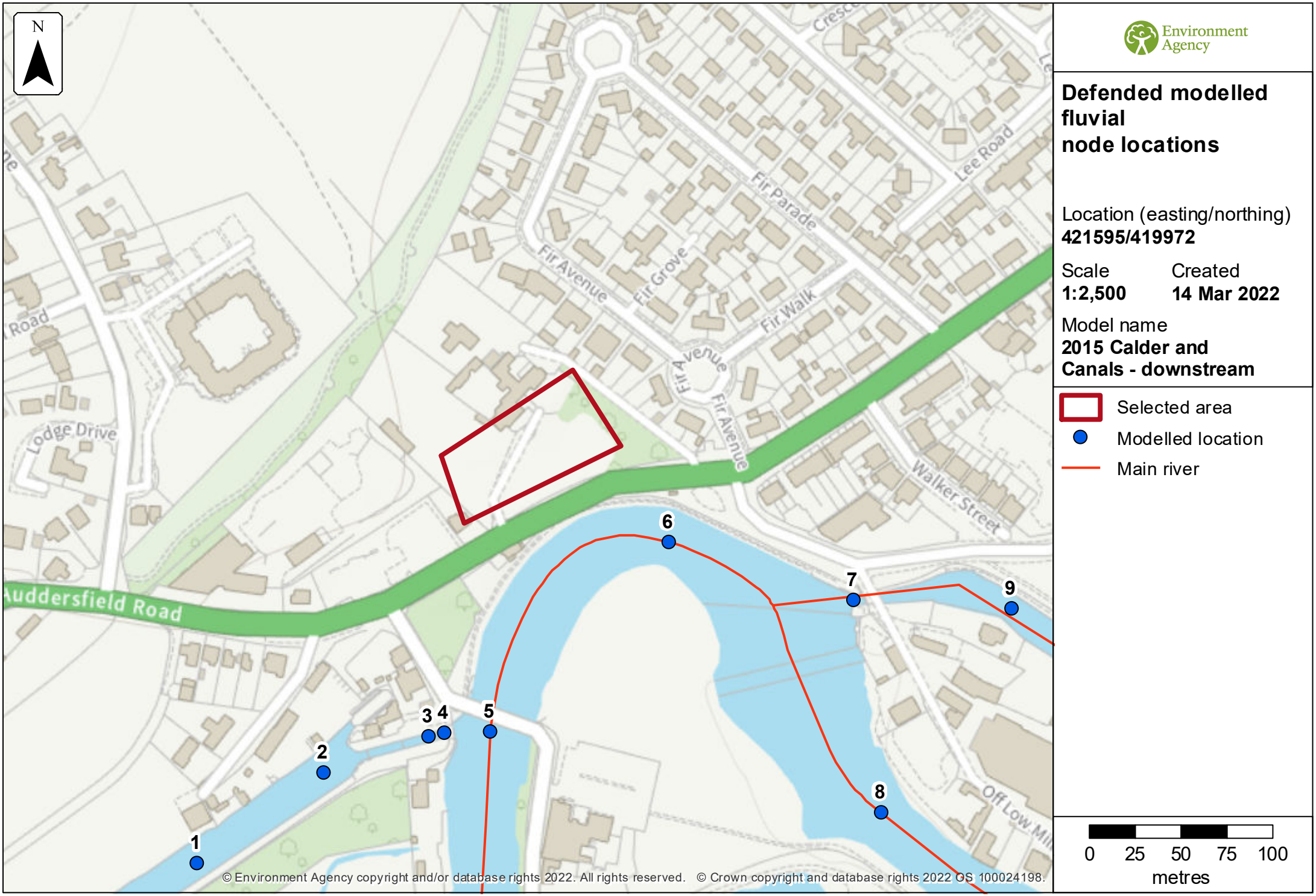
Main river

Modelled flood extent

1.0% AEP (+20%)

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres

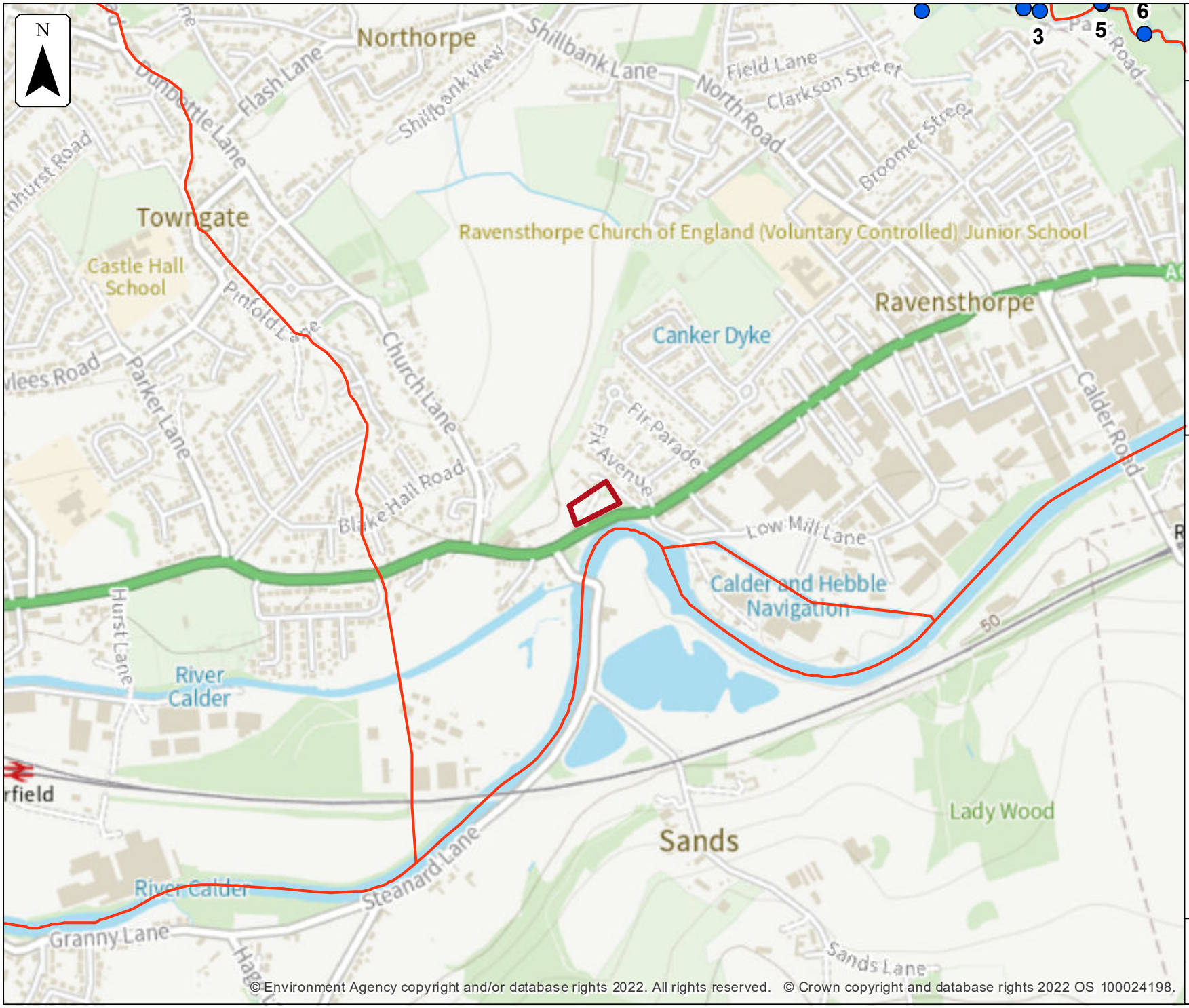

N
Environment Agency
Defended modelled fluvial node locations
Location (easting/northing)
421595/419972
Scale
1:2,500
Created
14 Mar 2022
Model name
2015 Calder and Canals - downstream
Selected area
Modelled location
Main river
Fir Parade
Fir Avenue
Fir Grove
Fir Walk
Fir Avenue
Fir Avenue
Lee Road
Walker Street
Lodge Drive
Road
Huddersfield Road
Off Low Mill
1
2
3
4
5
6
7
8
9
0
25
50
75
100
metres
© Environment Agency copyright and/or database rights 2022. All rights reserved. © Crown copyright and database rights 2022 OS 100024198.

Modelled node locations data

Defended

Label	Modelled location ID	Easting	Northing	4% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	1129911	421414	419744	43.36	2.0	43.41	4.63	43.42	5.32	43.44	5.85	43.45	7.27	44.24	170.53
2	1130048	421483	419794	43.36	1.35	43.41	1.38	43.42	1.37	43.44	1.50	43.45	1.65	44.48	155.54
3	1130252	421541	419813	42.29	1.01	42.49	1.04	42.59	1.22	42.65	1.49	42.83	1.63	43.86	42.01
4	1129944	421549	419815	42.29	1.01	42.49	1.04	42.59	1.22	42.65	1.49	42.83	1.64	43.87	42.01
5	1129849	421575	419816	42.29	350.10	42.49	364.07	42.59	371.75	42.65	377.21	42.83	382.50	43.87	486.01
6	1129722	421672	419920	42.12	336.68	42.34	347.69	42.45	354.08	42.50	358.96	42.70	363.38	43.62	535.28
7	1129740	421773	419888	42.10	4.48	42.32	6.48	42.44	7.64	42.49	8.05	42.69	10.60	43.77	26.43
8	1130151	421789	419772	41.86	323.22	42.13	328.13	42.26	329.85	42.28	358.04	42.56	335.51	43.66	428.40
9	1129749	421860	419884	41.45	4.48	41.57	6.48	41.66	7.63	42.06	8.05	41.88	10.98	43.28	55.44

Data in this table comes from the 2015 Calder and Canals - downstream of Sowerby Bridge model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.



Environment Agency

Defended modelled fluvial node locations

Location (easting/northing)
421595/419972

Scale
1:10,000

Created
14 Mar 2022

Model name
2009 FIM River Spen

Selected area
Modelled location
Main river

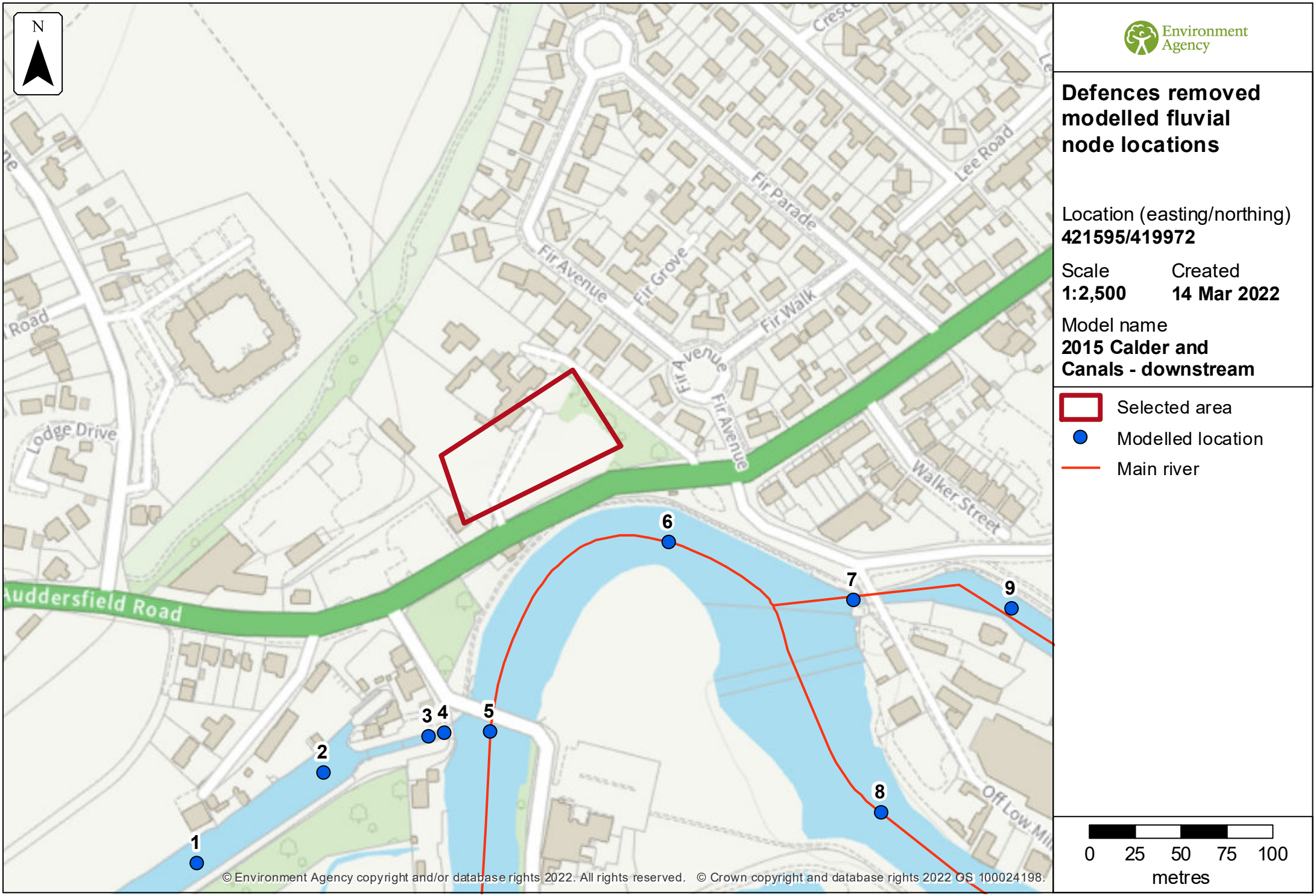
0 100 200 300 400 500
metres

Modelled node locations data

Defended

Label	Modelled location ID	Easting	Northing	4% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	77084	422235	420930							41.98	0.36				
2	227302	422434	420937							41.78	0.38				
3	145152	422465	420931							41.78	0.38				
4	217124	422583	420946							41.20	30.85				
5	122869	422588	420943							41.20	30.85				
6	150045	422669	420886							40.77	29.62				

Data in this table comes from the 2009 FIM River Spen model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.

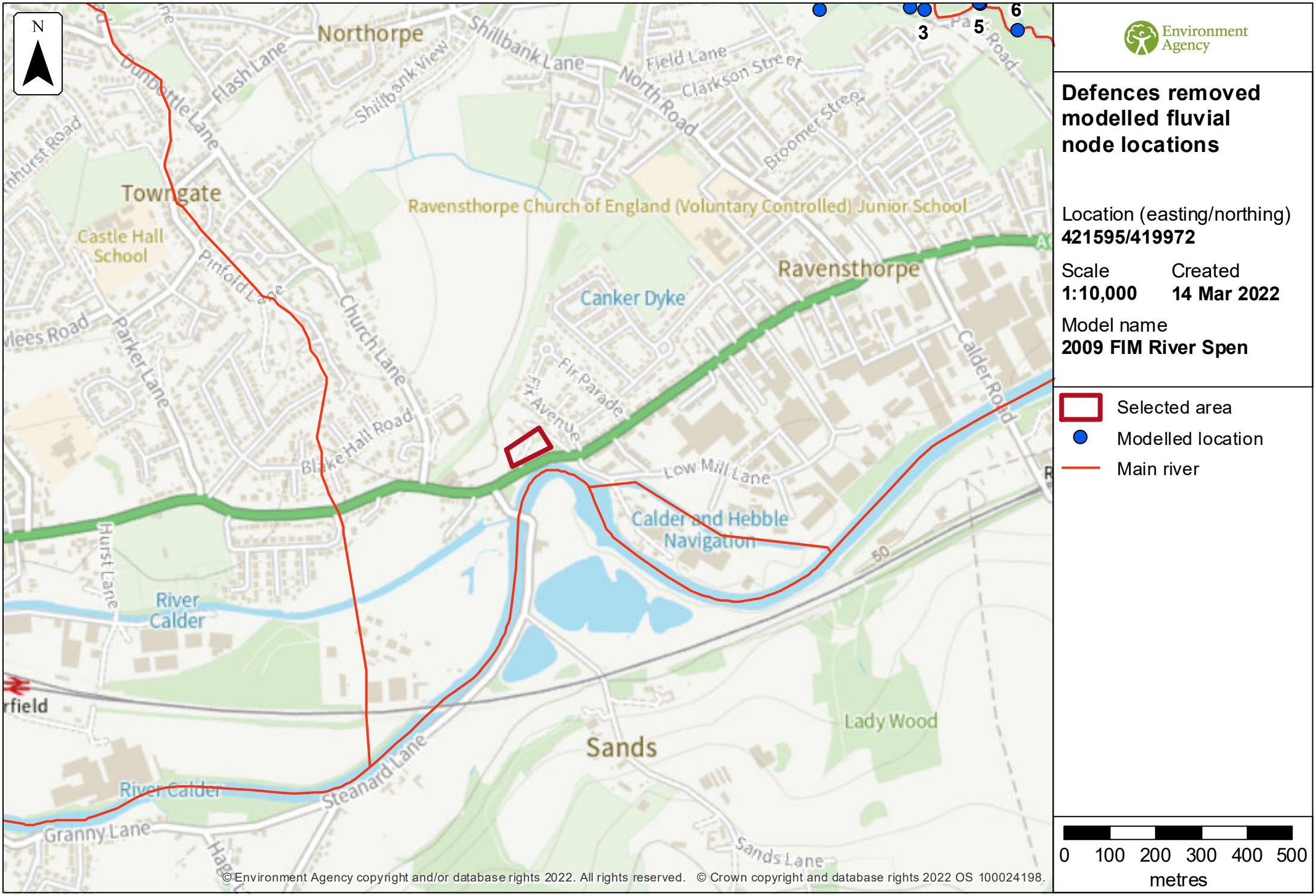

N
Environment Agency
Defences removed modelled fluvial node locations
Location (easting/northing)
421595/419972
Scale
1:2,500
Created
14 Mar 2022
Model name
2015 Calder and Canals - downstream
Selected area
Modelled location
Main river
Huddersfield Road
Lodge Drive
Fir Avenue
Fir Grove
Fir Parade
Fir Walk
Lee Road
Walker Street
Off Low Mill
1
2
3
4
5
6
7
8
9
0 25 50 75 100
metres
© Environment Agency copyright and/or database rights 2022. All rights reserved. © Crown copyright and database rights 2022 OS 100024198.

Modelled node locations data

Defences removed

Label	Modelled location ID	Easting	Northing	4% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	1129911	421414	419744	43.32	1.50	43.35	1.80	43.37	2.09	43.42	5.38	43.42	4.63	44.15	171.57
2	1130048	421483	419794	43.32	1.34	43.35	1.51	43.37	1.56	43.43	1.50	43.42	1.74	44.48	89.14
3	1130252	421541	419813	41.90	1.02	42.08	1.02	42.18	1.02	42.62	1.21	42.48	1.75	43.88	42.69
4	1129944	421549	419815	41.90	1.02	42.08	1.02	42.18	1.06	42.62	1.21	42.48	2.01	43.89	42.69
5	1129849	421575	419816	41.90	318.98	42.08	323.74	42.18	326.38	42.62	367.54	42.48	330.85	43.89	483.88
6	1129722	421672	419920	41.78	318.18	42.02	321.63	42.14	323.90	42.48	349.94	42.48	327.19	43.65	531.63
7	1129740	421773	419888	41.73	1.97	41.96	3.47	42.08	4.33	42.47	7.92	42.40	7.25	43.78	26.73
8	1130151	421789	419772	41.66	303.13	41.92	305.30	42.08	306.29	42.25	353.99	42.41	307.31	43.68	431.71
9	1129749	421860	419884	41.28	1.95	41.41	3.45	41.47	4.30	41.77	7.92	41.78	8.86	43.28	53.29

Data in this table comes from the 2015 Calder and Canals - downstream of Sowerby Bridge model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.



Environment Agency

Defences removed modelled fluvial node locations

Location (easting/northing)
421595/419972

Scale
1:10,000

Created
14 Mar 2022

Model name
2009 FIM River Spen

- Selected area
- Modelled location
- Main river

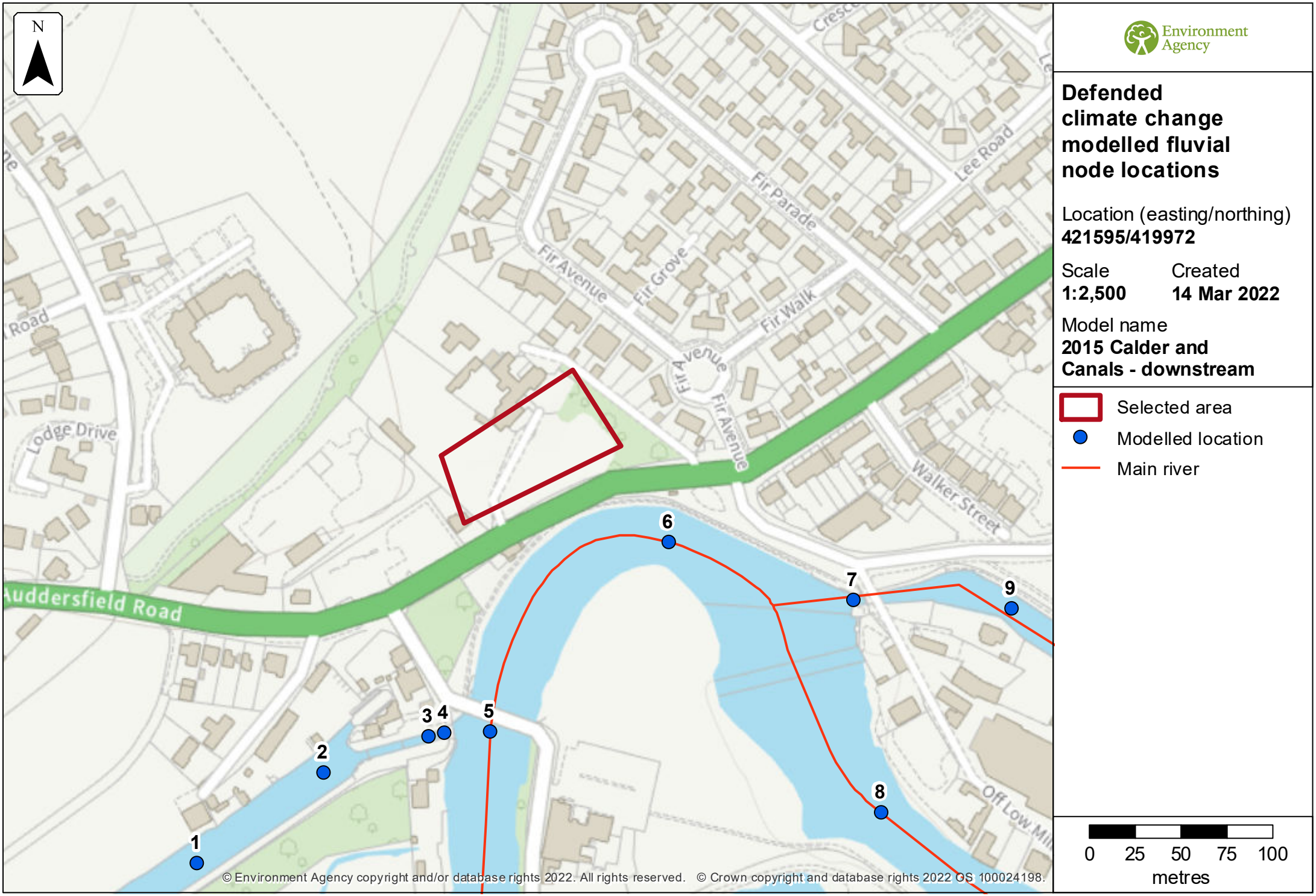
0 100 200 300 400 500
metres

Modelled node locations data

Defences removed

Label	Modelled location ID	Easting	Northing	4% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	77084	422235	420930	41.98	0.36	41.98	0.36	41.98	0.37	41.98	0.37			42.42	0.37
2	227302	422434	420937	41.71	0.37	41.81	0.37	41.88	0.38	41.92	0.38			42.42	0.39
3	145152	422465	420931	41.71	0.37	41.81	0.38	41.88	0.38	41.92	0.38			42.42	0.42
4	217124	422583	420946	41.14	28.91	41.24	31.89	41.32	33.68	41.37	35.12			42.27	75.24
5	122869	422588	420943	41.14	28.91	41.24	31.89	41.32	33.68	41.37	35.12			42.27	75.24
6	150045	422669	420886	40.71	27.81	40.79	30.61	40.83	32.29	40.87	33.64			41.54	70.65

Data in this table comes from the 2009 FIM River Spen model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.


N
Environment Agency
Defended climate change modelled fluvial node locations
Location (easting/northing)
421595/419972
Scale
1:2,500
Created
14 Mar 2022
Model name
2015 Calder and Canals - downstream
Selected area
Modelled location
Main river
Huddersfield Road
Lodge Drive
Fir Avenue
Fir Grove
Fir Parade
Fir Walk
Lee Road
Walker Street
Off Low Mill
1
2
3
4
5
6
7
8
9
0 25 50 75 100
metres
© Environment Agency copyright and/or database rights 2022. All rights reserved. © Crown copyright and database rights 2022 OS 100024198.

Modelled node locations data

Defended climate change

Label	Modelled location ID	Easting	Northing	1.0% AEP (+20%)	
				Level	Flow
1	1129911	421414	419744	43.46	8.11
2	1130048	421483	419794	43.46	1.83
3	1130252	421541	419813	42.94	1.76
4	1129944	421549	419815	42.94	1.77
5	1129849	421575	419816	42.94	386.91
6	1129722	421672	419920	42.81	367.12
7	1129740	421773	419888	42.82	12.16
8	1130151	421789	419772	42.69	339.39
9	1129749	421860	419884	41.99	13.51

Data in this table comes from the 2015 Calder and Canals - downstream of Sowerby Bridge model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.

Strategic flood risk assessments

We recommend that you check the relevant local authority's strategic flood risk assessment (SFRA) as part of your work to prepare a site specific flood risk assessment.

This should give you information about:

- the potential impacts of climate change in this catchment
- areas defined as functional floodplain
- flooding from other sources, such as surface water, ground water and reservoirs

About this data

This data has been generated by strategic scale flood models and is not intended for use at the individual property scale. If you're intending to use this data as part of a flood risk assessment, please include an appropriate modelling tolerance as part of your assessment. The Environment Agency regularly updates its modelling. We recommend that you check the data provided is the most recent, before submitting your flood risk assessment.

Flood risk activity permits

Under the Environmental Permitting (England and Wales) Regulations 2016 some developments may require an environmental permit for flood risk activities from the Environment Agency. This includes any permanent or temporary works that are in, over, under, or nearby a designated main river or flood defence structure.

Find out more about flood risk activity permits

Help and advice

Contact the Yorkshire Environment Agency team at neyorkshire@environment-agency.gov.uk for:

- more information about getting a product 5, 6, 7 or 8
- general help and advice about the site you're requesting data for

Modelling

River Calder, Walsden Water and Canals Study 2015
We are providing you with the results from the 2015 study, with extents from which our Flood Map has been updated.

Please note that when Product 4 and 6 are requested, in order to avoid duplication of information, data provided in digital form such as depth grids are not provided as maps and tables in pdf format. Flood depth and velocity for all return periods are provided as product 6. There is no breach modelling available from this model.

Product 5 and 6 are available from the following links:
2015 Calder and Canals Model – Mirfield and Dewsbury domain
https://ea.sharefile.com/d-s9335edbb36b44f8da22a9315c5b0ea9b

Please note the links will expire 30 days from 15/03/2022. Please see the attached conditional licence for details of acceptable use and information warnings.

Climate Change

Updated guidance on how climate change could affect flood risk to new development - 'Flood risk assessments: climate change allowances' is published on gov.uk. You should confirm the flood risk vulnerability classification and lifetime of your proposed development in line with NPPF and apply the appropriate climate change allowances.

Bespoke Flood Risk Assessment (FRA) advice:

If the pre-application advice is required with regards the preparation of a site-specific Flood Risk Assessment, this can be requested via the Yorkshire Sustainable Places team (email: sp-yorkshire@environment-agency.gov.uk). Charges may apply for any advice that is provided, this currently stands at £100 per hour per person. The .gov.uk pages provide a good starting point on what to include within a site-specific Flood Risk Assessment and can be accessed via https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications. A site-specific Flood Risk Assessment will need to consider flood risks from all sources, including those associated with defence failure (e.g. breach) and accounting for the predicted impacts as a result of climate change. Please contact the Sustainable Places team if you require advice on how to include these within a Flood Risk Assessment.

Non Main River

Calder and Hebble Navigation Mirfield Cut or the ordinary culverted watercourse (south west of the site) are not designated as Main River. Is is classed as Ordinary Watercourse. The Environment Agency does not have any further information concerning this watercourses. Please contact Canal and River Trust and your City Council Drainage Section for further guidance.

Surface Water Map

Lead Local Flood Authorities (LLFA) are responsible for managing local flood risk from surface water flooding and groundwater flooding. You should check with the LLFA as they may have more up to date information regarding this type of flooding.

The Risk of Flooding from Surface Water Flood Map (including extents, depths and velocities) can be viewed and downloaded as a PDF file on GOV.UK by following this link: https://flood-warning-information.service.gov.uk/long-term-flood-risk
Risk of Flooding from Surface dataset is also available in GIS format from Defra Data Services Platform https://environment.data.gov.uk/

Surface Water Drainage

The Lead Local Flood Authority is the statutory consultee for planning matters relating to surface water drainage, therefore it is recommended they should be consulted separately regarding this.

Surface water discharge from new development should ideally 'mimic' the pre-development situation using a sustainable drainage system so that the flow and volume of water in watercourses is not increased.

A permit may be required, under the Environmental Permitting Regulations 2016 from the Environment Agency for any proposed works or structures in, under, over or within eight metres of a 'main river' (e.g. a new outfall). A permit is separate to and in addition to any planning permission granted. Further details and guidance are available on the GOV.UK website: https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

Risk of Flooding from Reservoirs Map

Outlines and simplified depth and velocity maps can be viewed on our website: https://flood-warning-information.service.gov.uk/long-term-flood-risk/#x=438988&y=406600&scale=2

Please, zoom into the location of interest, and then click on the inundated location for details. As a result a list of reservoirs will be provided with supporting information and a links to other data, such as estimated depths and speed of flooding, at the bottom of the result page.

A map of showing the outlines was also be provided as requested.

Flood Warning

To register for Flood Warning service, you can call Floodline 24 hours a day on 0845 988 1188.

LIDAR Data

Please note that our LiDAR data is now available free of charge (Open Data) from https://environment.data.gov.uk/DefraDataDownload/?Mode=survey (once zoomed to the relevant location the available LiDAR products as listed below will be available to choose from in the Layer List icon – top right).

Two LIDAR products are available:

1. Tiled LIDAR data - The full tiled dataset consists of historic LIDAR data which has been gathered since 1998. For some areas we have carried out repeat surveys and data is available in a range of resolutions.
2. Composite LIDAR data - The composite dataset is derived from a combination of our full tiled dataset which has been merged and re-sampled to give the best possible spatial coverage.

Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. This technique results in the production of an accurate, cost-effective terrain model suitable for assessing flood risk and other environmental applications.

The Environment Agency owns two LIDAR systems, which are installed in a survey aircraft along with its other operational remote sensing instruments.

The aircraft is positioned and navigated using Global Positioning System (GPS) corrected to known ground reference points. The aircraft typically flies at a height of about 800 metres above ground level and a scanning mirror allows a swath width of about 600 metres to be surveyed during a flight.

The Rights & Responsibilities of a Riverside Owner

The owner of property adjacent to a watercourse is usually deemed to be the riparian owner and, as such, has both riparian rights and responsibilities with regard to the watercourse within their ownership.

For more information on Rights and Responsibilities of a riverside owner, you can visit our website at:
https://www.gov.uk/guidance/owning-a-watercourse

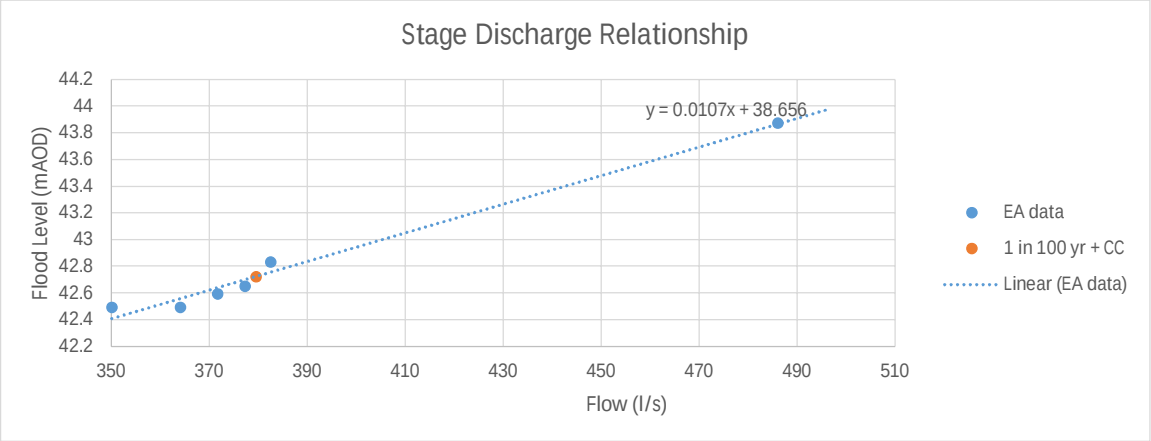
Ordnance Survey Data

Under the terms of our licence agreement with the Ordnance Survey, we are unable to supply the OS data. Under this agreement we can only supply OS data to consultants/contractors carrying out work on our behalf.

APPENDIX D: STAGE DISCHARGE ANALYSIS

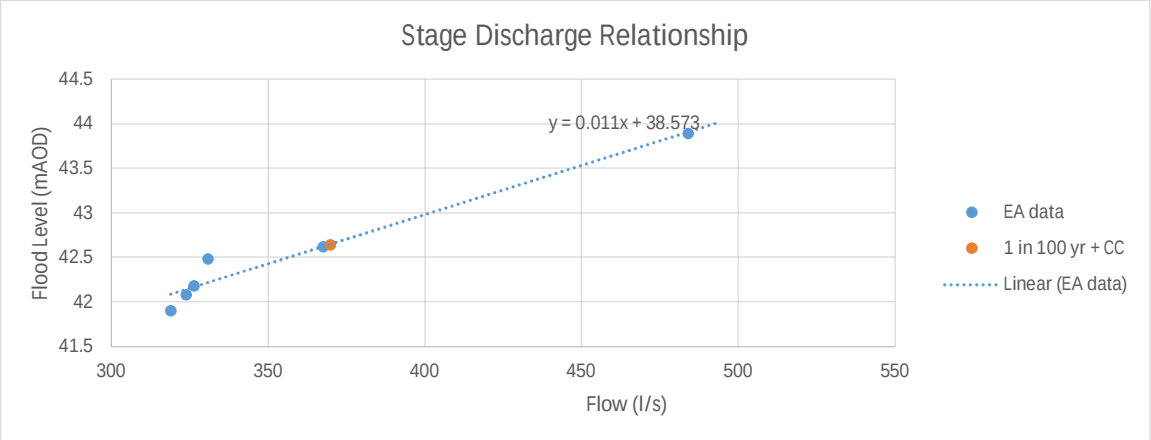
Flood Event	Flow (l/s)	Flood Height (mAOD)
25 yr (4% AEP)	350.1	42.49
50 yr (2% AEP)	364.07	42.49
75 yr (1.3% AEP)	371.75	42.59
100 yr (1% AEP)	377.21	42.65
200 year (0.5% AEP)	382.5	42.83
1000 yr (0.1% AEP)	486.01	43.87

Model Ref:	2015 Calder and Canals - downstream
Node Ref:	Node 5 defended
New Climate Change Allowance - Central Allowance (%)	23
New Climate Change Flow (l/s)	379.51
New Climate Change Flood Level (mAOD) - regression 1	42.72



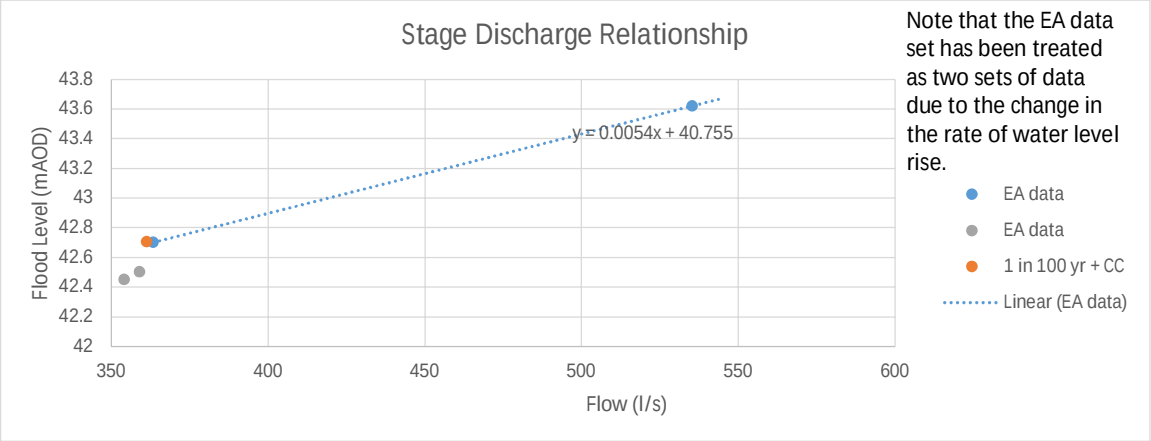
Flood Event	Flow (l/s)	Flood Height (mAOD)
25 yr (4% AEP)	318.98	41.9
50 yr (2% AEP)	323.74	42.08
75 yr (1.3% AEP)	326.38	42.18
100 yr (1% AEP)	367.54	42.62
200 year (0.5% AEP)	330.85	42.48
1000 yr (0.1% AEP)	483.88	43.89

Model Ref:	2015 Calder and Canals - downstream
Node Ref:	Node 5 undefended
New Climate Change Allowance - Central Allowance (%)	23
New Climate Change Flow (l/s)	369.84
New Climate Change Flood Level (mAOD) - regression 1	42.64



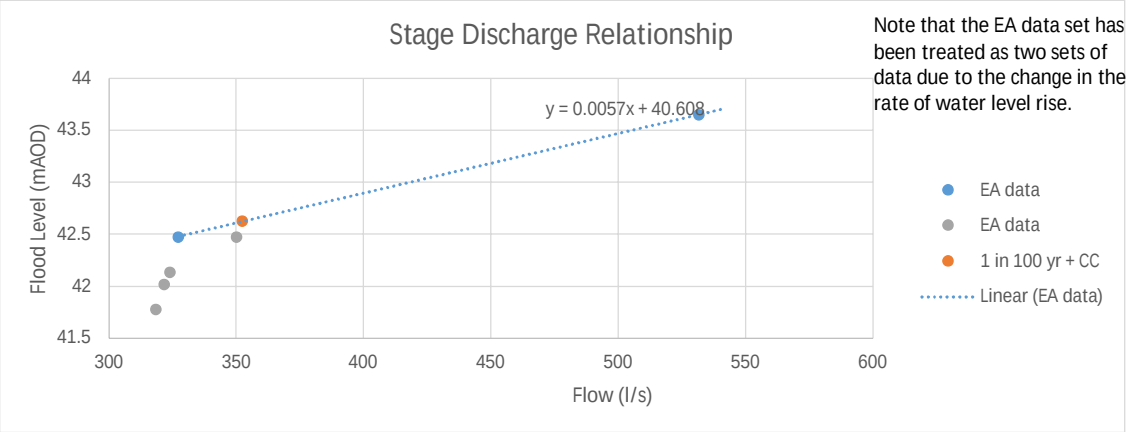
Flood Event	Flow (l/s)	Flood Height (mAOD)
25 yr (4% AEP)	336.68	42.12
50 yr (2% AEP)	347.69	42.34
75 yr (1.3% AEP)	354.08	42.45
100 yr (1% AEP)	358.96	42.5
200 year (0.5% AEP)	363.38	42.7
1000 yr (0.1% AEP)	535.28	43.62

Model Ref:	2015 Calder and Canals - downstream
Node Ref:	Node 6 defended
New Climate Change Allowance - Central Allowance (%)	23
New Climate Change Flow (l/s)	361.26
New Climate Change Flood Level (mAOD) - regression 1	42.71



Flood Event	Flow (l/s)	Flood Height (mAOD)
25 yr (4% AEP)	318.18	41.78
50 yr (2% AEP)	321.63	42.02
75 yr (1.3% AEP)	323.9	42.14
100 yr (1% AEP)	349.94	42.48
200 year (0.5% AEP)	327.19	42.48
1000 yr (0.1% AEP)	531.63	43.65

Model Ref:	2015 Calder and Canals - downstream
Node Ref:	Node 5
New Climate Change Allowance - Central Allowance (%)	23
New Climate Change Flow (l/s)	352.24
New Climate Change Flood Level (mAOD)	42.63



Note that the EA data set has been treated as two sets of data due to the change in the rate of water level rise.

APPENDIX E: MICRODRAINAGE CALCULATIONS

ICP SUDS Mean Annual Flood

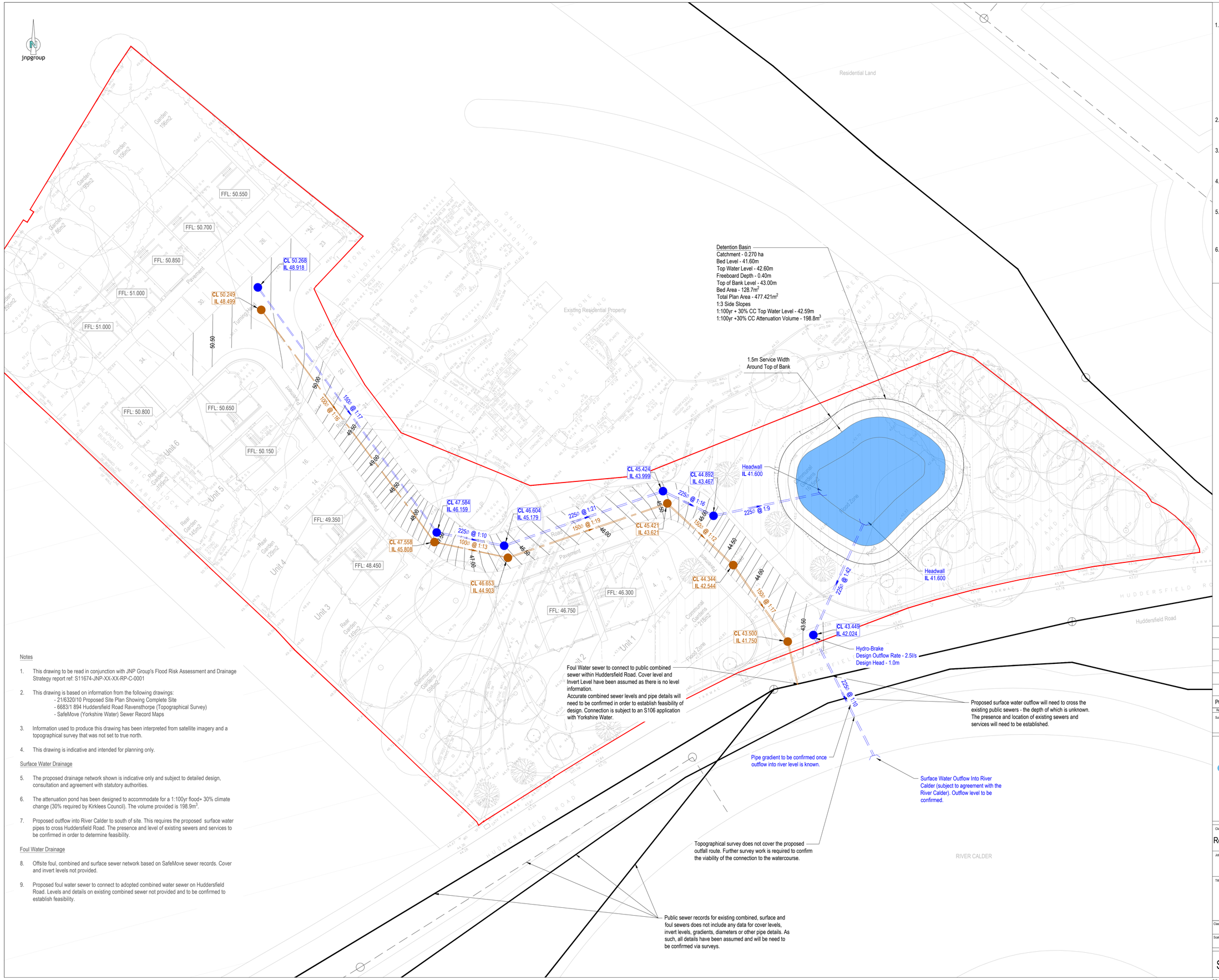
Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.000	Urban	0.000
SAAR (mm)	771	Region Number	Region 3

Results l/s

QBAR Rural	2.0
QBAR Urban	2.0
Q100 years	4.2
Q1 year	1.8
Q30 years	3.6
Q100 years	4.2

APPENDIX F: DRAINAGE LAYOUT



General Notes

1. Where this drawing has been issued in electronic .dwg format, it has been done so in good faith. JNP Group do not take any responsibility for any inaccuracies in the electronic data, which should be checked against the paper (or .pdf) drawing issue. Any apparent discrepancies should be immediately reported to JNP Group. The electronic .dwg file should not be assumed to be to scale and should not be used for 'overlaying', setting out or checking of any third party information. All dimensions should be taken from the paper (or .pdf) version of the drawing. Electronic drawings may contain third party information. JNP Group take no responsibility for this information, which should be checked against the originators paper drawing(s).
2. All dimensions are millimetres (mm), and levels are in metres (m) unless noted otherwise and should be checked on site prior to construction/fabrication.
3. Do not scale from this drawing. Only figured dimensions are to be relied upon. Don't hesitate to get in touch with JNP Group if additional information is required.
4. Any discrepancies between drawings of different scales and between drawings and specifications, where appropriate, to be reported to JNP Group for decision.
5.
6. This drawing should only be used for construction if the drawing status is "Construction". JNP Group takes no responsibility for construction works undertaken to drawings that are not marked with this status.

Legend

- Site Boundary
- Existing Adopted Combined Sewer
- Existing Adopted Surface Water Sewer
- Proposed Adoptable Surface Water Sewer
- Proposed Adoptable Foul Water Sewer
- FFL: 46.300 — Proposed Finished Floor Level

Notes

1. This drawing to be read in conjunction with JNP Group's Flood Risk Assessment and Drainage Strategy report ref: S11674-JNP-XX-XX-RP-C-0001
2. This drawing is based on information from the following drawings:
   - 21/6320/10 Proposed Site Plan Showing Complete Site
   - 6683/1 894 Huddersfield Road Ravensthorpe (Topographical Survey)
   - SafeMove (Yorkshire Water) Sewer Record Maps
3. Information used to produce this drawing has been interpreted from satellite imagery and a topographical survey that was not set to true north.
4. This drawing is indicative and intended for planning only.

Surface Water Drainage

5. The proposed drainage network shown is indicative only and subject to detailed design, consultation and agreement with statutory authorities.
6. The attenuation pond has been designed to accommodate for a 1:100yr flood+ 30% climate change (30% required by Kirklees Council). The volume provided is 198.9m³.
7. Proposed outflow into River Calder to south of site. This requires the proposed surface water pipes to cross Huddersfield Road. The presence and level of existing sewers and services to be confirmed in order to determine feasibility.

Foul Water Drainage

8. Offsite foul, combined and surface sewer network based on SafeMove sewer records. Cover and invert levels not provided.
9. Proposed foul water sewer to connect to adopted combined water sewer on Huddersfield Road. Levels and details on existing combined sewer not provided and to be confirmed to establish feasibility.

Rev.	Date	Description	Drn / Chk'd / App'd
P01	27/05/2022	First Issue	AB/SH/LC

Suitability:

S2 - Suitable for Information

JNP GROUP
CONSULTING ENGINEERS
Chesham • Brighouse • Bristol • Glasgow • Hartlepool • Leamington Spa • Sheffield
www.jnpgroup.co.uk

Client:

Robert Halstead Chartered Surveyors & Town Planners

Job:

Land at 894 Huddersfield Road, Mirfield

Title:

Proposed Drainage Strategy

Classification: FI_60_20

Scale @ A1: 1:250

Project - Originator - Volume/System - Level/Location - Type - Discipline - Number: S11674 - JNP - 92 - XX - DR - Z - 2000

Revision: P01

Document/Drawing Number

JNP Group Internal Project Number: S11674

APPENDIX G: MICRODRAINAGE SIMULATIONS

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.516	0.516	2.5	84.6	O K
30 min Summer	0.645	0.645	2.5	112.2	O K
60 min Summer	0.768	0.768	2.5	140.9	Flood Risk
120 min Summer	0.843	0.843	2.5	159.8	Flood Risk
180 min Summer	0.880	0.880	2.5	169.6	Flood Risk
240 min Summer	0.901	0.901	2.5	175.2	Flood Risk
360 min Summer	0.919	0.919	2.5	179.9	Flood Risk
480 min Summer	0.920	0.920	2.5	180.2	Flood Risk
600 min Summer	0.913	0.913	2.5	178.2	Flood Risk
720 min Summer	0.904	0.904	2.5	175.9	Flood Risk
960 min Summer	0.887	0.887	2.5	171.2	Flood Risk
1440 min Summer	0.851	0.851	2.5	162.0	Flood Risk
2160 min Summer	0.801	0.801	2.5	149.2	Flood Risk
2880 min Summer	0.752	0.752	2.5	137.1	Flood Risk
4320 min Summer	0.648	0.648	2.5	112.8	O K
5760 min Summer	0.522	0.522	2.5	85.9	O K
7200 min Summer	0.421	0.421	2.5	66.1	O K
8640 min Summer	0.340	0.340	2.5	51.5	O K
10080 min Summer	0.276	0.276	2.5	40.6	O K
15 min Winter	0.516	0.516	2.5	84.6	O K
30 min Winter	0.645	0.645	2.5	112.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	128.337	0.0	86.0	19
30 min Summer	85.790	0.0	115.0	34
60 min Summer	54.841	0.0	147.8	64
120 min Summer	32.267	0.0	173.9	122
180 min Summer	23.642	0.0	191.1	182
240 min Summer	18.947	0.0	204.2	242
360 min Summer	13.845	0.0	223.9	362
480 min Summer	11.084	0.0	238.9	480
600 min Summer	9.329	0.0	251.3	574
720 min Summer	8.105	0.0	262.0	622
960 min Summer	6.496	0.0	279.9	750
1440 min Summer	4.755	0.0	306.9	1010
2160 min Summer	3.489	0.0	339.0	1428
2880 min Summer	2.808	0.0	363.7	1844
4320 min Summer	2.073	0.0	402.7	2680
5760 min Summer	1.679	0.0	435.1	3400
7200 min Summer	1.430	0.0	463.1	4040
8640 min Summer	1.257	0.0	488.5	4752
10080 min Summer	1.130	0.0	512.0	5440
15 min Winter	128.337	0.0	86.0	19
30 min Winter	85.790	0.0	115.0	33

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.768	0.768	2.5	141.0	Flood Risk
120 min Winter	0.844	0.844	2.5	160.0	Flood Risk
180 min Winter	0.882	0.882	2.5	170.0	Flood Risk
240 min Winter	0.904	0.904	2.5	175.9	Flood Risk
360 min Winter	0.923	0.923	2.5	181.0	Flood Risk
480 min Winter	0.926	0.926	2.5	181.8	Flood Risk
600 min Winter	0.920	0.920	2.5	180.3	Flood Risk
720 min Winter	0.910	0.910	2.5	177.5	Flood Risk
960 min Winter	0.886	0.886	2.5	171.1	Flood Risk
1440 min Winter	0.838	0.838	2.5	158.6	Flood Risk
2160 min Winter	0.759	0.759	2.5	138.9	Flood Risk
2880 min Winter	0.674	0.674	2.5	118.7	O K
4320 min Winter	0.462	0.462	2.5	74.0	O K
5760 min Winter	0.302	0.302	2.5	44.9	O K
7200 min Winter	0.199	0.199	2.4	28.2	O K
8640 min Winter	0.140	0.140	2.3	19.2	O K
10080 min Winter	0.106	0.106	2.1	14.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	54.841	0.0	147.8	62
120 min Winter	32.267	0.0	173.9	120
180 min Winter	23.642	0.0	191.1	180
240 min Winter	18.947	0.0	204.2	238
360 min Winter	13.845	0.0	223.9	352
480 min Winter	11.084	0.0	238.9	464
600 min Winter	9.329	0.0	251.3	572
720 min Winter	8.105	0.0	262.0	674
960 min Winter	6.496	0.0	279.9	768
1440 min Winter	4.755	0.0	306.9	1080
2160 min Winter	3.489	0.0	339.0	1536
2880 min Winter	2.808	0.0	363.7	1988
4320 min Winter	2.073	0.0	402.7	2720
5760 min Winter	1.679	0.0	435.1	3352
7200 min Winter	1.430	0.0	463.1	3968
8640 min Winter	1.257	0.0	488.5	4592
10080 min Winter	1.130	0.0	512.0	5248

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 421600 419972 SE 21600 19972	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.270

Time (mins) From:	To:	Area (ha)
0	4	0.270

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	128.7	1.000	286.8	1.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0075-2500-1000-2500
Design Head (m)	1.000
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.5	Kick-Flo®	0.627	2.0
Flush-Flo™	0.307	2.5	Mean Flow over Head Range	-	2.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	0.800	2.3	2.000	3.4	4.000	4.7	7.000	6.2
0.200	2.4	1.000	2.5	2.200	3.6	4.500	5.0	7.500	6.4
0.300	2.5	1.200	2.7	2.400	3.7	5.000	5.3	8.000	6.6
0.400	2.5	1.400	2.9	2.600	3.9	5.500	5.5	8.500	6.8
0.500	2.4	1.600	3.1	3.000	4.1	6.000	5.7	9.000	7.0
0.600	2.1	1.800	3.3	3.500	4.5	6.500	6.0	9.500	7.1

APPENDIX H: OVERLAND FLOW ROUTES

Existing Site Conditions

Proposed Site Conditions

General Notes

1. Where this drawing has been issued in electronic .dwg format, it has been done so in good faith. JNP Group do not take any responsibility for any inaccuracies in the electronic data, which should be checked against the paper (or .pdf) drawing issue. Any apparent discrepancies should be immediately reported to JNP Group. The electronic .dwg file should not be assumed to be to scale and should not be used for 'overlaying', setting out or checking of any third party information. All dimensions should be taken from the paper (or .pdf) version of the drawing. Electronic drawings may contain third party information. JNP Group take no responsibility for this information, which should be checked against the originators paper drawing(s).
2. All dimensions are millimetres (mm), and levels are in metres (m) unless noted otherwise and should be checked on site prior to construction/fabrication.
3. Do not scale from this drawing. Only figured dimensions are to be relied upon. Don't hesitate to get in touch with JNP Group if additional information is required.
4. Any discrepancies between drawings of different scales and between drawings and specifications, where appropriate, to be reported to JNP Group for decision.
5. Copyright reserved. This drawing may only be used for The Client and location specified in the title block. It may not be copied or disclosed to any third party without the prior written consent of JNP Group.
6. This drawing should only be used for construction if the drawing status is "Construction". JNP Group takes no responsibility for construction works undertaken to drawings that are not marked with this status.

Legend

- Indicative Site Boundary
- Route of overland flow
- Areas of Ponding
- Proposed Attenuation Basin
- FFL: 46.300 — Proposed Finished Floor Level

Rev.	Date	Description	Drn / Chk'd / App'd
P01	27/05/2022	First Issue	AB/SH/LC

Suitability: S2 - Suitable for Information

JNP GROUP
CONSULTING ENGINEERS
Chesham • Brighouse • Bristol • Glasgow • Hartlepool • Leamington Spa • Sheffield
www.jnpgroup.co.uk

Client: Robert Halstead Chartered Surveyors & Town Planners

Job: Land at 894 Huddersfield Road, Mirfield

Title: Drainage Exceedance Flow Paths

Classification: FI_60_20
Scale @ A1: 1:500

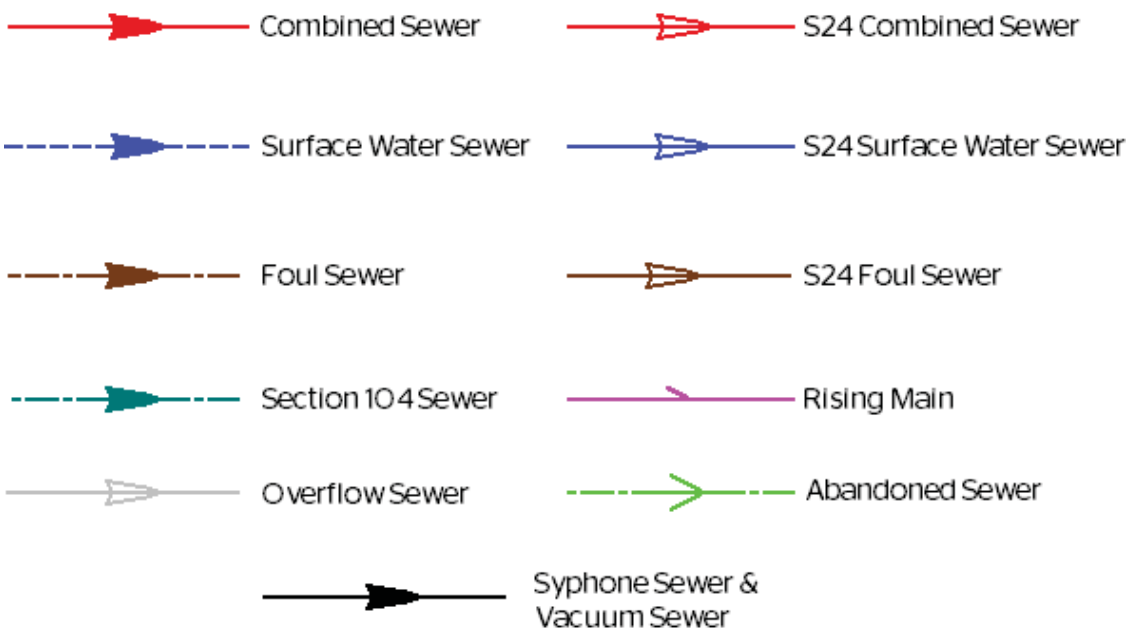
Project - Originator - Volume/System - Level/Location - Type - Discipline - Number: S11674 - JNP - 92 - XX - DR - D - 2002 (Document/Drawing Number)
Revision: P01

JNP Group Internal Project Number: S11674

APPENDIX I: YORKSHIRE WATER RECORDS

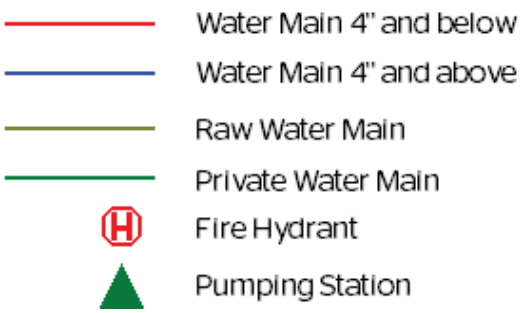
Property Identfier

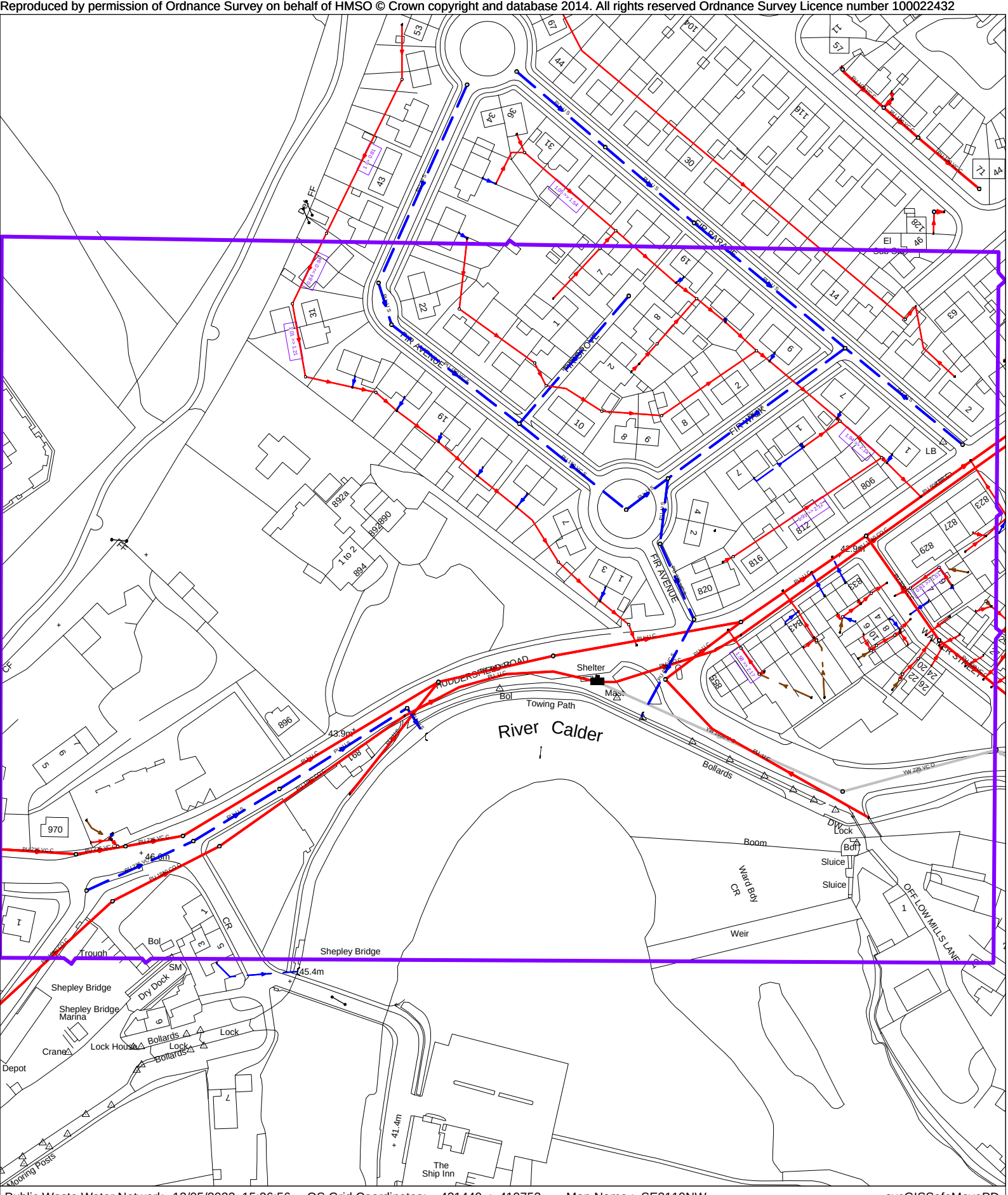
Sewer Legend



Please note that the direction of flow arrows may not always appear depending on the scale of the map.

Water Legend





Public Waste Water Network 12/05/2022 15:26:56 OS Grid Coordinates: 421449 : 419752 Map Name : SE2119NW svcGISSafeMovePD

JNP GROUP

CONSULTING ENGINEERS

Brighouse
Woodvale House
Woodvale Road
Brighouse
West Yorkshire
HD6 4AB

telephone
01484 400691

email
brighouse@jnpgroup.co.uk

Chesham (HQ)
Link House
St Mary's Way
Chesham
Buckinghamshire
HP5 1HR

telephone
01494 771221

email
chesham@jnpgroup.co.uk

Glasgow
Oxford House
71 Oxford Street
Glasgow
G59 EP

telephone
0141 378 0808

email
glasgow@jnpgroup.co.uk

Hartlepool
The Innovation Centre
Venture Court
Queens Meadow Business Park
Hartlepool
TS25 5TG

telephone
01429 239539

email
hartlepool@jnpgroup.co.uk

Leamington Spa
Marlborough House
48 Holly Walk
Leamington Spa
Warwickshire
CV32 4XP

telephone
01926 889955

email
leamingtonspa@jnpgroup.co.uk

Sheffield
MBP2 Meadowhall Business Park
Carbrook Hall Road
Sheffield
South Yorkshire
S9 2EQ

telephone
0114 244 3500

email
sheffield@jnpgroup.co.uk