

River Dearne, Smithies floodplain restoration flood risk assessment

Final

September 2019

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Yorkshire Wildlife Trust

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Revision History

Revision Ref/Date	Amendments	Issued to
06/11/2018	Draft Report	Pete Wall
20/08/2019	Final report, includes additional geomorphology in channel design features	Pete Wall
30/09/2019	Inclusion of section 6.5 and 6.6 as per client comments.	Pete Wall

Contract

This report describes work commissioned by the Yorkshire Wildlife Trust under purchase order PO19995. Yorkshire's Wildlife Trust representative for the contract was Pete Wall. Katie Burnham, David Mould and Gavin Hodson of JBA Consulting carried out this work.

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Purpose

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1 Introduction

1.1 Background

Yorkshire Wildlife Trust wish to carry out both in-channel and floodplain restoration works at the Smithies site. The site is located adjacent to the River Dearne (SE 34484 08168), North of Barnsley in South Yorkshire, Figure 1-1.

An Environmental Permit must be obtained before any works can be undertaken. An assessment of the potential impact of the proposed works on flood risk is therefore, required. The model appraisal is based on the available EA hydraulic model.

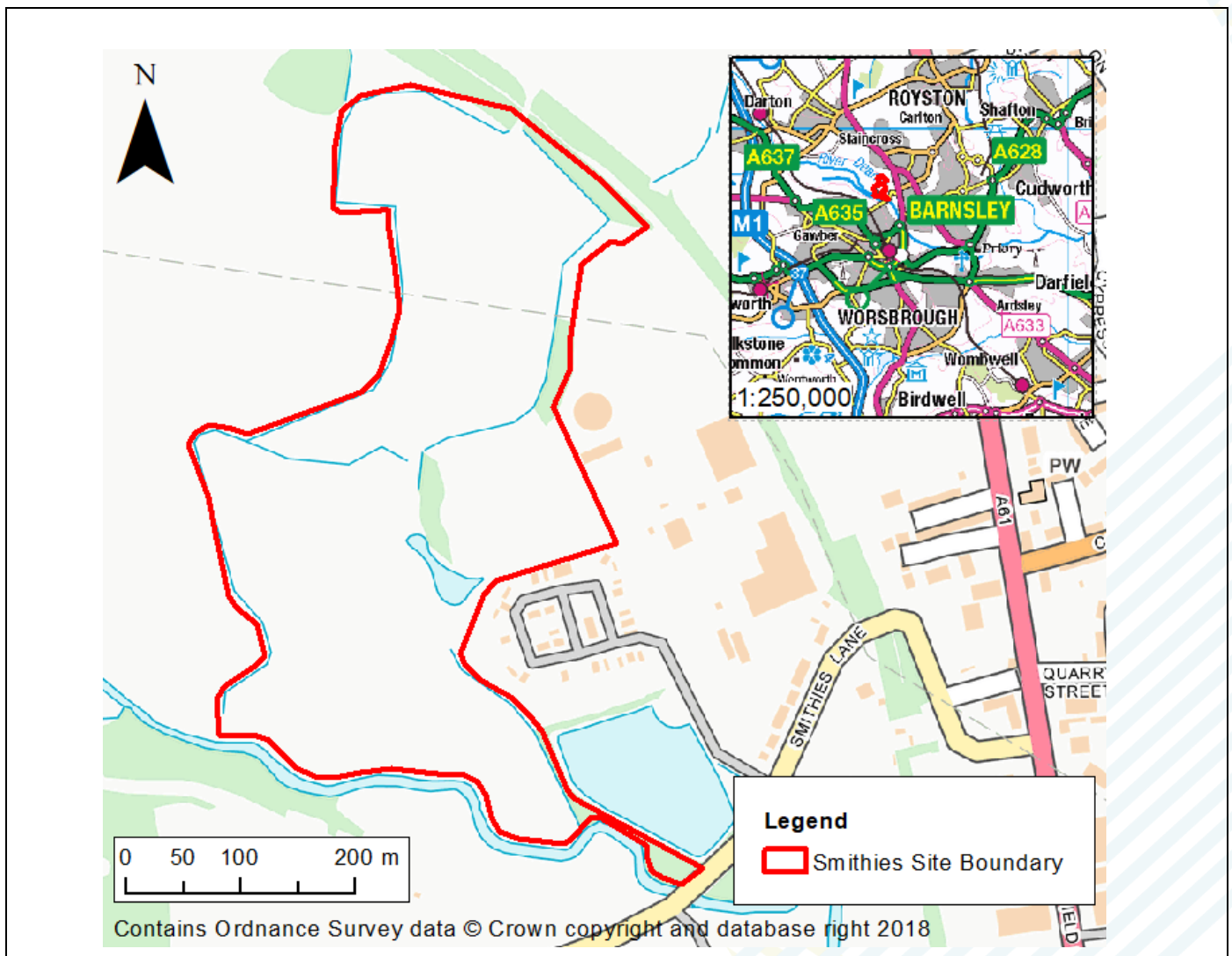


Figure 1-1 Smithies Site

1.2 Information available

The following information has been used in this study:

- Halcrow Group Ltd 2010 1D ISIS model of the Upper Dearne, the following return periods provided 5, 10, 25, 50, 75, 100 and 1000 year events (i.e. 20%, 10%, 4%, 2%, 1.33%, 1% and 0.1% Annual Exceedance Probability).
- 2015 JBA Smithies feasibility report (ref: 2015s2245)¹.
- 2019 JBA survey data collected in June 2019. Open source Environment Agency 1m LIDAR DTM data.

1.3 Description of Site

The following is a summary of the site description found in JBA (2015).

1.3.1 Topography

The site as a whole slopes down towards the south, to where it meets the River Dearne. It has an elevation of between 44mAOD (at the Dearne) and 58mAOD to the north. The site can be split in half to show two distinct topographical regions; north and south. The southern half has a much flatter topography, with minor changes in elevations generally between 45 and 46mAOD. The northern half is characterised by steeper gradients in the north-south profile, with elevations from 46mAOD in the south to 58mAOD in the north.

1.3.2 Geology

The geology beneath the site is summarised in Table 1-1.

Table 1-1 Summary of site geology

Age	Group	Formation / Member	Description	Thickness
Quaternary		Alluvium	Clay and silt	Unknown
Carboniferous	Pennine Coal Measures Group	Pennine Middle Coal Measures Formation	Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams.	~ 650 m ***
Sources: *Nearby borehole records ** BGS 1:50,000 Geology Map, Solid and Drift Edition, Sheet 100, Sheffield (1974) *** BGS online Lexicon of Named Rock Units				

1.3.3 Hydrology

The River Dearne rises to the west of Birdsedge in West Yorkshire and flows in a generally eastwards direction through several urban areas, including Barnsley, to its confluence with the River Don at Conisborough.

The upper River Dearne catchment (upstream of Smithies) is predominantly rural, with land cover consisting mainly of woodland, grassland and arable/ horticultural land use. The lower River Dearne catchment contains significant urban development in the valley.

1 JBA Consulting, 2015. River Dearne, Smithies - Habitat Creation Feasibility Study.

The River Dearne (in the vicinity of Smithies) is a Heavily-Modified water body in accordance with the Water Framework Directive (WFD) classification system. At present the WFD defines the overall river potential as Moderate, with a target of reaching Good Ecological Potential (GEP) by 2027.

The River Dearne has a moderately flashy flow regime (Figure 1-2), where the rise to peak is often rapid. The River Dearne is a heavily modified, low gradient, predominantly single thread channel, and the channel has been modified significantly over time by channel straightening, widening and deepening.

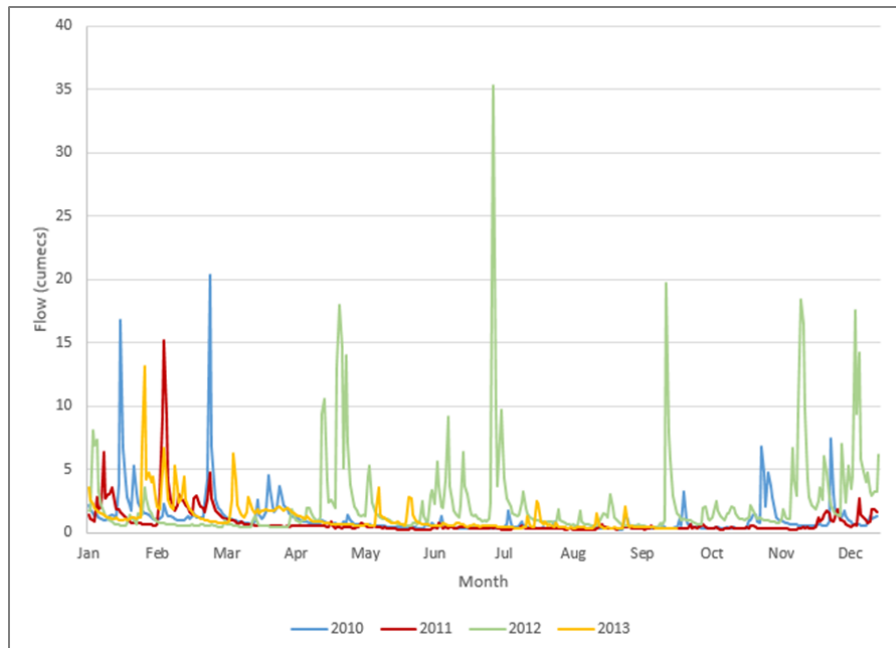


Figure 1-2 River Dearne at Barnsley Weir © 2015 NERC. UK National River Flow Archive

1.3.4 Site Hydrology

There are several drains around the boundaries of the site, Figure 1-1. The drains form the north, east and western boundaries of the site, with a drain running through the centre of the site from east to west. The middle drain is the remnants of an old mill race that flowed eastwards across the site. The old mill race was originally embanked and following the removal of the embankment the function of the drain has altered from operating as a high-level carrier to a catchwater drain which now transports water westwards then south along the western boundary of the site.

The eastern drains run along the base of the raised made ground before entering the river adjacent to the reservoir. Historical maps suggest that the drain running down the eastern boundary of the site was once used to feed the reservoir to the east and therefore didn't run the full length of the site. The drain in its present geometry is believed to have been formed following the cessation of this topping up of the reservoir.

1.4 Scope of study

The scope of this study is to investigate the impact on flood risk from the completion of the proposed in-channel and floodplain restoration works at the Smithies site, for the purpose of gaining an Environmental Permit.

2 Development description

In 2015 a habitat creation feasibility study was completed by JBA Consulting. The following were selected as the preferred options for the River Dearne at Smithies site (Figure 2-1):

- Option 1 - Embankment removal at the south-west corner of the site
- Option 2 - Scrape creation
- Option 3 - Point bar creation
- Small-scale habitat opportunities.

The current detailed designs ([Appendix A](#)) includes the features above. Small modifications have been made to the exact configuration to make the most of the existing wetted area, improve the quality of the habitat and to avoid the historic wagon track (Figure 2-2).

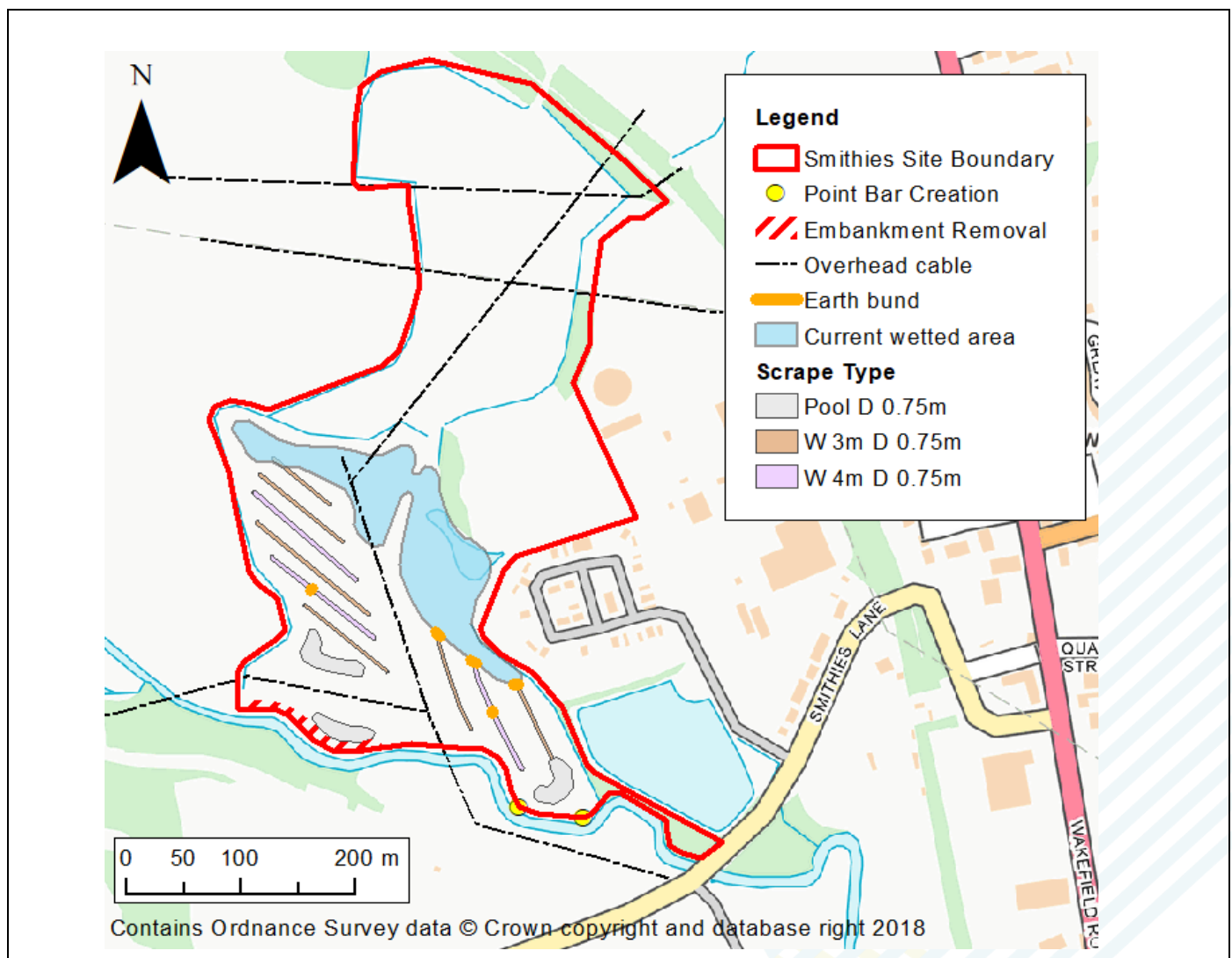


Figure 2-1 Proposed habitat creation scheme at the Smithies Site from the original feasibility study

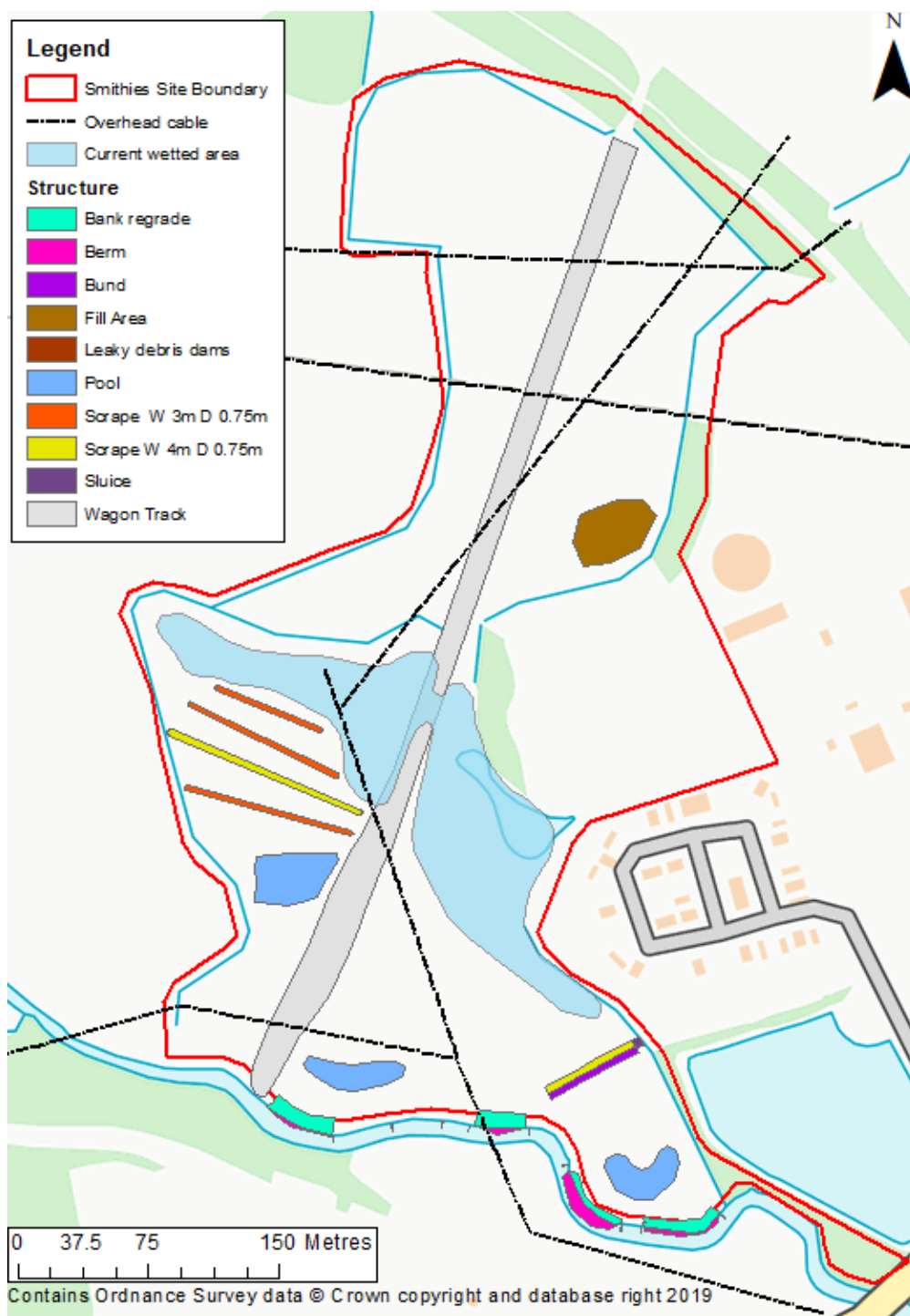


Figure 2-2 Updated design following on from the initial feasibility assessment

3 Flood Risk Assessment

3.1 Planning context

All forms of flooding and their impact on the natural and built environment are material planning considerations. The National Planning Policy Framework (NPPF) and subsequent Planning Practice Guidance (published in March 2014) stress the importance of assessing, appraising and managing flood risk at all stages of the planning process. The NPPF aims to avoid inappropriate development in areas at risk from flooding but where development is necessary, making it safe without increasing flood risk elsewhere.

The NPPF outlines that only 'water-compatible uses' and 'essential infrastructure' should be permitted within Flood Zone 3. The River Dearne at Smithies site is split into two parts. The southern half is low lying, within the functional floodplain and Flood Zone 3. The northern half occupies the valley side, the lower section of which lies in Flood Zone 2. All the habitat creation works are proposed to occur in Flood Zone 3. As the site would be used for nature conservation and biodiversity, then the proposed restoration works can be deemed to be a 'Water-Compatible Development' under the NPPF Planning Practice Guidance 6th March 2013². Under this guidance, water-compatible uses can be permitted in this zone as long as they³:

- remain operational and safe for users in times of flood,
- result in no net loss of flood storage,
- not impede water flows; and
- not increase flood risk elsewhere.

3.2 Fluvial flood risk

The Environment Agency (EA) has developed a flood map which shows the risk of flooding in England and Wales for different return period events, Figure 3-1. This map provides the basis for the assessment of flood risk and development suitability according to the National Planning Policy Framework (NPPF).

In a normal situation flooding from the rivers may occur when the flow exceeds the hydraulic capacity of the rivers as represented in the EA flood map. This will result in floodwaters spilling over the bank tops and onto adjacent land. The southern part of the site is in the floodplain and is classified as Flood Zone 3 (FZ3). Part of the valley side lies within in Flood Zone 2 (FZ2), the highest part of the site is within Flood Zone 1 (FZ1, area outside of FZ3 and FZ2).

Flood Zone 2 is defined as where land is assessed as having a 1 in 100 and 1 in 1000 annual probability of river flooding in any year. Flood Zone 3 is defined as land which is assessed as having a 1 in 100 or greater annual probability of river flooding in any year.

Figure 3-1 shows that there are no receptors (including properties) in FZ3 or FZ2 within the Smithies site. Approximately 90m downstream of the proposed works Smithies Lane Bridge is shown to be within Flood Zone 3. This is reasonably remote from the works, and it is unlikely that any design would impact on flood risk at the road. An assessment of EA 1m LIDAR DTM data suggests the development within Flood Zone 2, south of the site boundary is approximately 5m above the local floodplain level, thus unlikely to be impacted by the works.

² see <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-2-flood-risk-vulnerability-classification/> (accessed October 3rd 2018)

³ see <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-3-flood-risk-vulnerability-and-flood-zone-compatibility/>

Hydraulic modelling has been used to assess the flood risk at the site in greater detail, as presented in section 5 of this report.

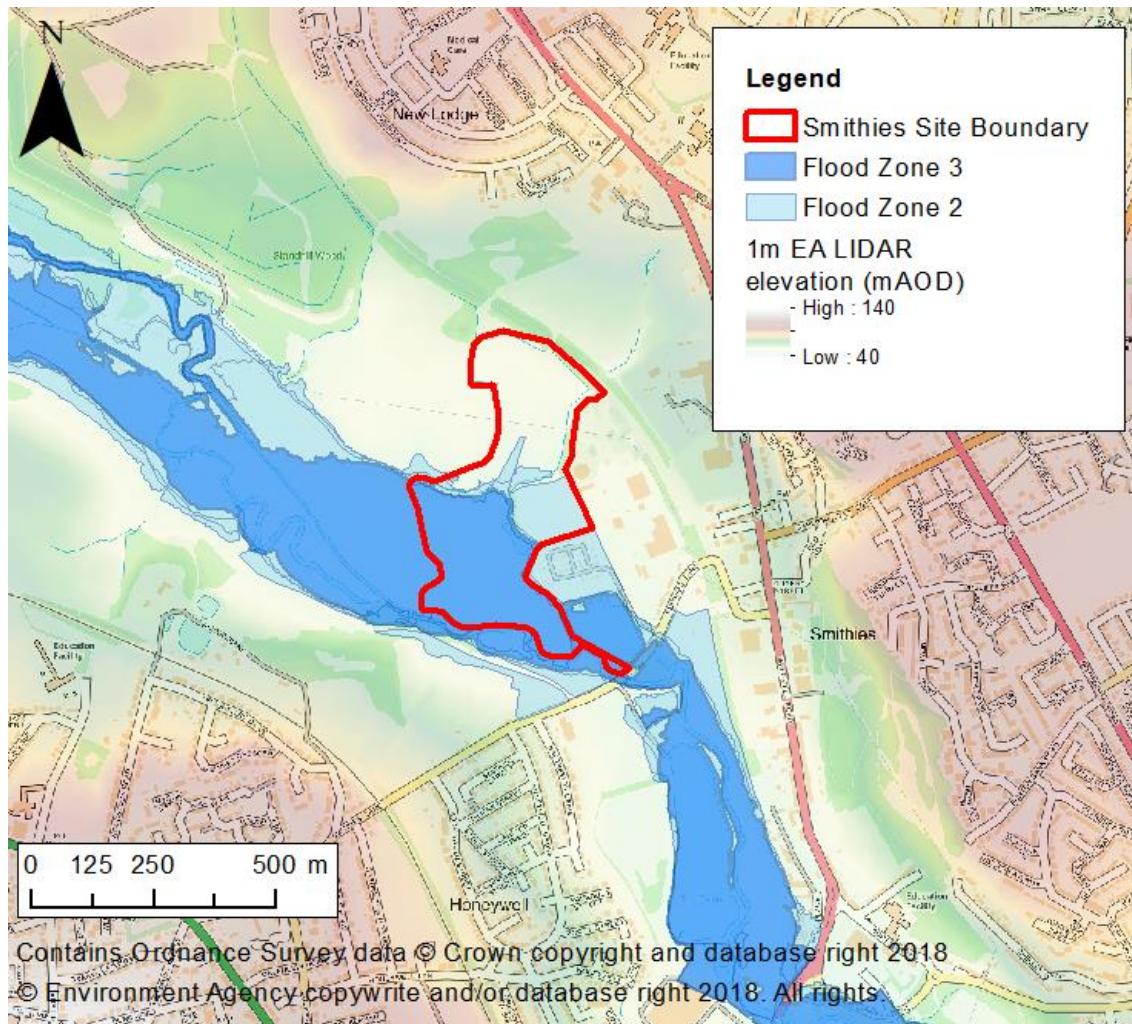


Figure 3-1 Fluvial flood risk upstream and downstream of the Smithies site

3.3 Surface water flood risk

Surface water flood risk to the site has been assessed using the national scale EA Risk of Flooding from Surface Water Map (Figure 3-2) which identifies areas where surface water flooding poses a risk, classified in four categories as follows:

- High – an area has a chance of flooding greater than 1 in 30 each year
- Medium – an area has a chance of flooding of between 1 in 30 and 1 in 100 each year
- Low – an area has a chance of flooding of between 1 in 100 and 1 in 1,000 each year
- Very Low – an area has a chance of flooding of less than 1 in 1,000 each year

Figure 3-2 shows that generally surface water flooding is limited to the floodplain area and along flow paths east of the site. Areas with medium to high risk of surface water flooding tend to be limited to in-channel areas or the lowest lying areas of the floodplain which are currently mainly dominated by reedbed/ swamp habitat.

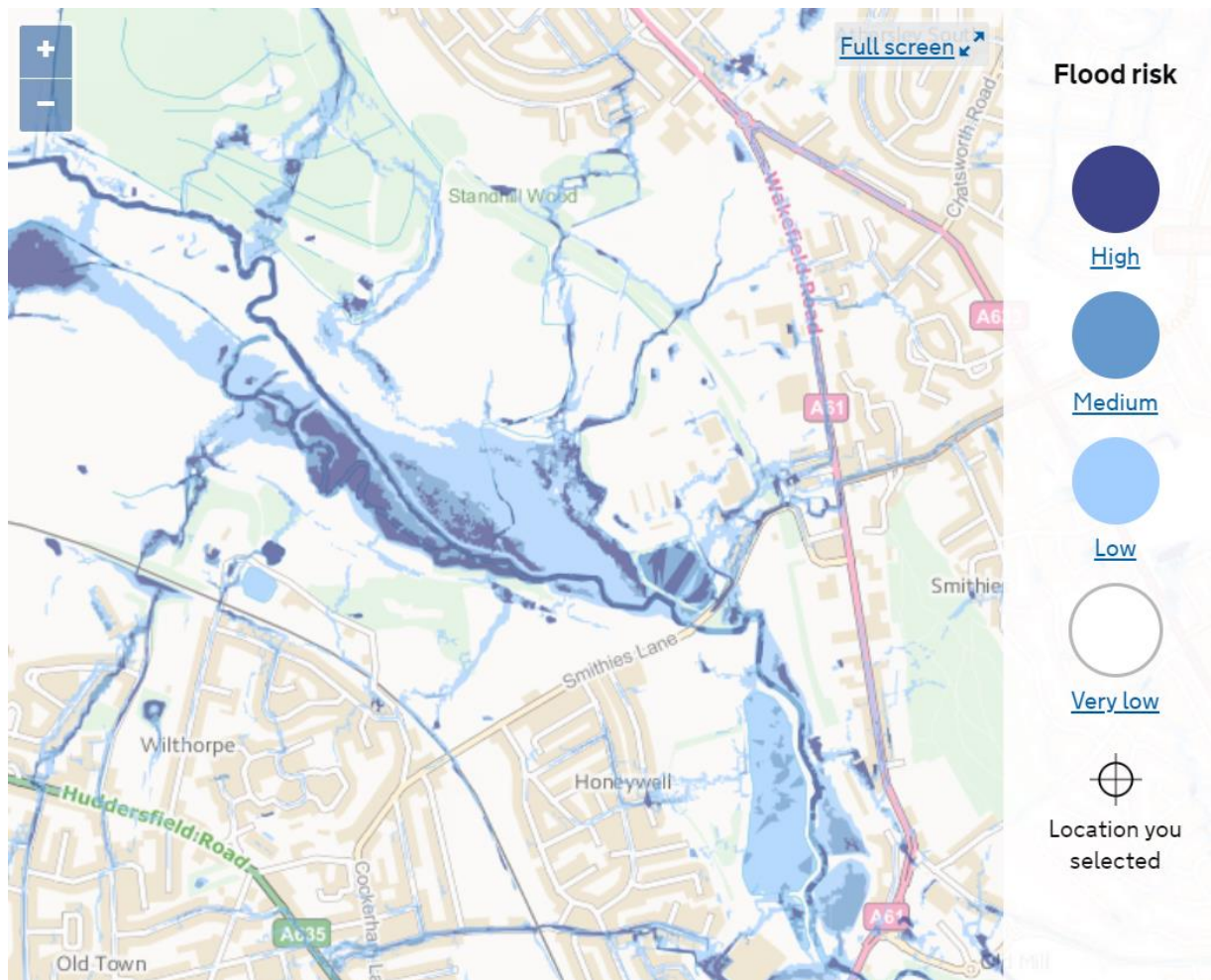


Figure 3-2 Surface water flood risk upstream and downstream of the Smithies site⁴

3.4 Other sources of flood risk

The EA flood map for planning showed that the site is not at risk of coastal flooding.

The low permeability clayey alluvium on site also means that the groundwater flood risk is likely to be low.

The site is at risk of flooding from a reservoir located 7kms upstream of the site at NGR 429022, 412455. This is owned by Wakefield Metropolitan Borough Council.

3.5 Desk assessment of changes in flood risk as a result of proposed development

The following section aims to review the key features of the proposed development design against the tests outlined in the NPPF for water-compatible uses in FZ3 (Table 3-1) as outlined in section 3.1.

⁴ Environment Agency, 2018. <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>. Accessed October 2018.

Table 3-1 Assessment of changes in flood risk for key development features

NPPF test criteria	Scrape creation	Bank regrade	In channel features
1) Remain operational and safe for users in times of flood	The scrapes will not be required to be visited during times of flood. A Public Safety Risk Assessment (PSRA) assessed the potential risk of this to site visitors further as part of the original project works (JBA, 2015).	N/A	N/A
2) Result in no net loss of floodplain storage	The spoil material if deposited within Flood Zone 3 could result in a loss of floodplain storage. However, it is proposed the material be deposited in Flood Zone 1 to the north of the site, thus mitigating this risk. The water levels within the scrapes will be at or below the current ground level.	If the spoil from the bank regrade is deposited in Flood Zone 1 it will result in an increase in flood plain storage. Floodplain storage will increase for low return period events as a new area of floodplain will be accessible.	N/A
3) Do not impede water flows	The scrapes will be set below the current ground surface, so it is not envisaged that they will impede water flow across the floodplain.	Bank regrade should not impede the flow of water and will increase channel capacity.	In channel features should not impede flows during a flood even and should encourage water on to the floodplain thus improving the flood retention function.
4) Do not increase flood risk elsewhere	The potential storage within the scrapes has the potential to slightly reduce flood risk in certain circumstance or have a neutral impact when full.	Bank regrading is designed to improved floodplain connectivity during flood events and therefore, there will be increased floodplain wetting frequency and extent within the site boundary. This is likely to result in either no change or lowered water levels downstream during flood events.	In-channel features should encourage water on to the floodplain, and therefore assist the flood retention function. They will be designed to ensure no change in the water levels upstream and could act to reduce water levels downstream during flood events.

4 Existing flood risk modelling

4.1 Summary of model

The Halcrow Group Ltd existing 1D model has been supplied by the EA. The model was built in 2010 using the ISIS modelling software, version 6.5.2.75. The full model covers the River Dearne and Tributaries (as survey by Halcrow in 2009) from Denby Dale down to the A61, approximately 50m downstream of Barnsley Weir. The reach downstream of A61 road bridge was added from the existing S105 River Don Model

Survey sections were extended where necessary using the LIDAR / SAR composite DTM supplied by the EA to represent the floodplain. Floodplain storage has been represented using lateral spills and reservoir units.

The Smithies site is contained within model cross sections DEA01494 and DEA00984D, Figure 4-1. The floodplain at the site is represented using extended sections on the right bank, and multiple lateral spills on the left bank (DEA01494, DEA014322, DEA01253), which feed into a single reservoir unit (DEA01941Ld).

Lateral spills have been added at model sections as well as at several interpolated sections in between (not shown on mapping). At interpolates spill sections values have been set at 99.99mAOD, a level which will not over top in any of the modelled flood events. It is unclear why these spills were included in the original modelling, but sensitivity testing (section 6.4) showed their removal makes little to no difference to results at Smithies. Therefore, they will be left in the baseline model.

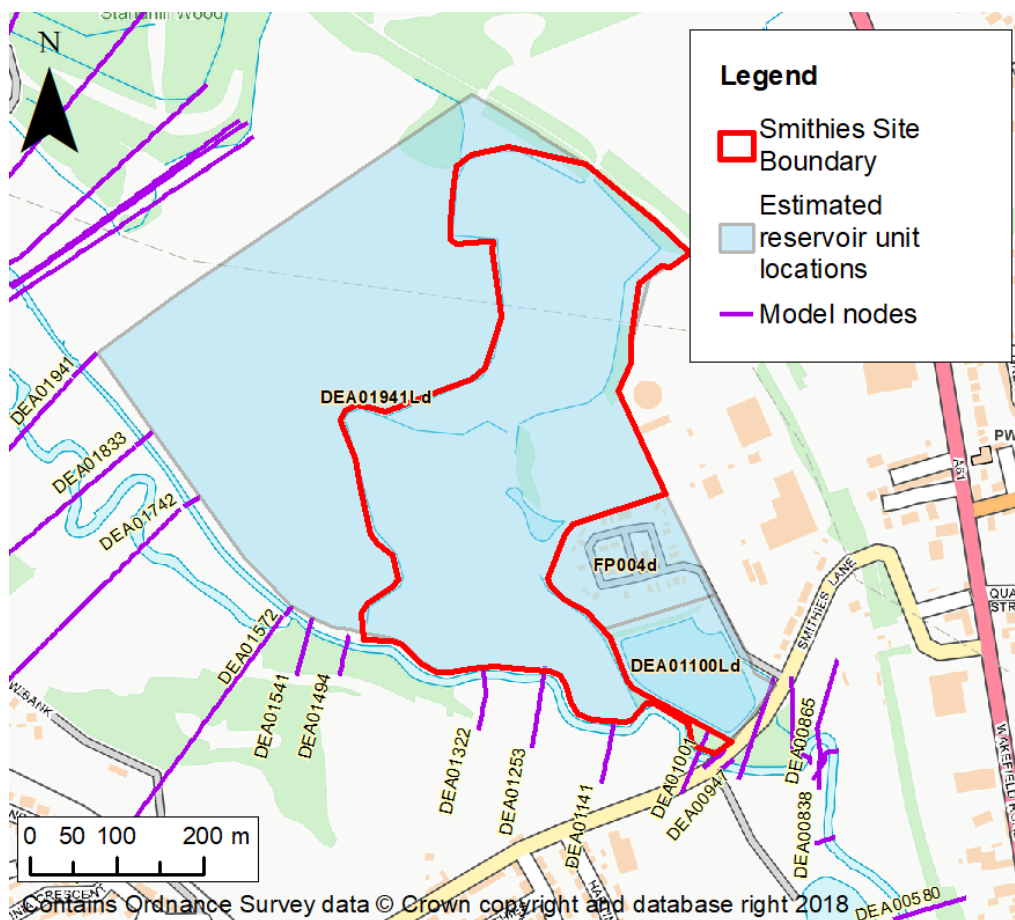


Figure 4-1 Existing 1d model geometry at Smithies

4.1.1 Model hydrology

No changes have been made to the supplied model hydrology. The information detailed below describes how the original model hydrology was derived.

Design inflows were derived using ReFH units for both point inflows and lateral catchments using the FEH CDRM (v3). A statistical flood frequency analysis at Barnsley weir (downstream modelling extent) was then completed using WINFAP v3. Single site, pooling and enhanced pooling approaches were undertaken.

The ReFH units were reconciled using the results of the statistical pooling analysis.

The following return periods were generated: 5, 10, 25, 50, 75, 100 and 1,000-year events (20%, 10%, 4%, 2%, 1.33%, 1% and 0.1% Annual Exceedance Probability (AEP)). A 20% allowance for climate change has been also applied to the 100-year event.

The model pre-dates the most up to date climate change allowance guidance⁵. Therefore, the applied climate allowance will be re-evaluated, as part of the model development. No other changes will be made to the model inflows.

⁵ Gov, 2018. <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>. Accessed October 2018.

5 Model schematisation

5.1 Introduction

It is the purpose of this section to introduce the changes made to the model for both the Smithies baseline and design modelling.

5.2 Baseline

The following changes have been made to the supplied model for the purpose of this study (Table 5-1).

Table 5-1 Summary of changes made to baseline model

Model trimmed	The supplied model covered an area that was much larger than required for the purposes of the Smithies flood risk assessment. It consisted of 3265 modelled nodes. As a result, the model has been trimmed down to ease in the model development and to speed up the model run times. Upstream the model was trimmed downstream of the railway bridge (DEA04786D), at this location all water is contained within the railway embankment upstream. Therefore, flow downstream should capture all discharge through the main channel and bridge opening. The model was not trimmed downstream.
Floodplain	No changes have been made to the floodplain representation in the model or at the site. The Smithies floodplain is represented as a reservoir unit with lateral spills.
In channel	The model has been updated locally to the site with some in-channel survey collected by JBA in 2019.
Hydrology updates	As the model has been trimmed upstream, new model inflows were required. These were derived from the discharge at the upstream node location, from the results of the full model which was re-run in September 2018. One lateral inflow remains within the reduced model area. This has been being distributed based on reach length. Three model nodes (out of a total of 86) that received a proportion of the flow from the inflow, have been removed from the model as part of the trim. This will result in a small increase at each node connected to the lateral flow, however, this is unlikely to impact the results greatly and is conservative from a flood risk perspective.
20% climate change allowances	In line with current NPPF guidance, a 20% allowance has been made for climate change and applied to the 100 year model inflow. This represents the 'Upper End' for the Humber region, within the timeframe, for a design life for 30 years (i.e. Total potential change anticipated for the '2050s' (2040 to 2069))⁶.

⁶ Gov, 2018. <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> - Table 1. Accessed October 2018.

Altered chainages

Chainages in the channel adjacent to the study site were felt to be slightly underrepresented against the spatial distances measured from mapping data from the site boundary to the road bridge downstream (underestimate of 15m). Therefore, the chainages have been updated locally to better represent the reach length, and so differ from the supplied model. However, however this is thought to have little impact on the modelled results (Section 6 trimmed vs updated baseline).

5.3 Development design model

The floodplain at Smithies site (and immediately upstream) is represented as one reservoir unit (Figure 4-1). Therefore, it is not possible to characterise small scale modifications (such as scrapes) as you would with a 2d only or 1d / 2d linked hydraulic model.

The changes could be represented by amending the change in storage volume within the reservoir unit itself. However, these will amount to only very small differences and would be unlikely to have a significant impact on the results. All the design measures will act to increase storage on the modelled floodplain, and the spoil from the excavations is being deposited outside of FZ3. As a result, any impact on flood risk should be positive as more water is retained on the floodplain.

Therefore, only in-channel features have been represented in the design model, these are detailed in Table 5-2. To suitably represent the new in-channel features several additional nodes have been added to the model at the site between existing model nodes DEA01494 and DEA01001, Figure 5-3.

Table 5-2 In channel design features

Feature	Description
Berm and bank regrade	Berm features were designed by the geomorphology team at JBA. There are four features in total, these have been added to the model by locally modifying the bed levels in the model to represent the raised elevations of the berms. A typical berm cross section (plotted against the corresponded baseline section) is provided in Figure 5-1.
Leaky debris dams	Leaky barriers have been added to the model by modifying the bed levels locally to represent woody features. For the purpose of the modelling it is assumed that the woody material will not constrict more than one third of the channel width and that they will be no greater in height than 0.4m. A typical cross section (plotted against the corresponding baseline section) is provided in Figure 5-2.

5.4 Model runs

Both the baseline and design model have been run for the 5-year (20% AEP), 100-year (1% AEP) and the 100-year (1% AEP) + climate change event (CC30%). The results of the modelling are presented in section 6.

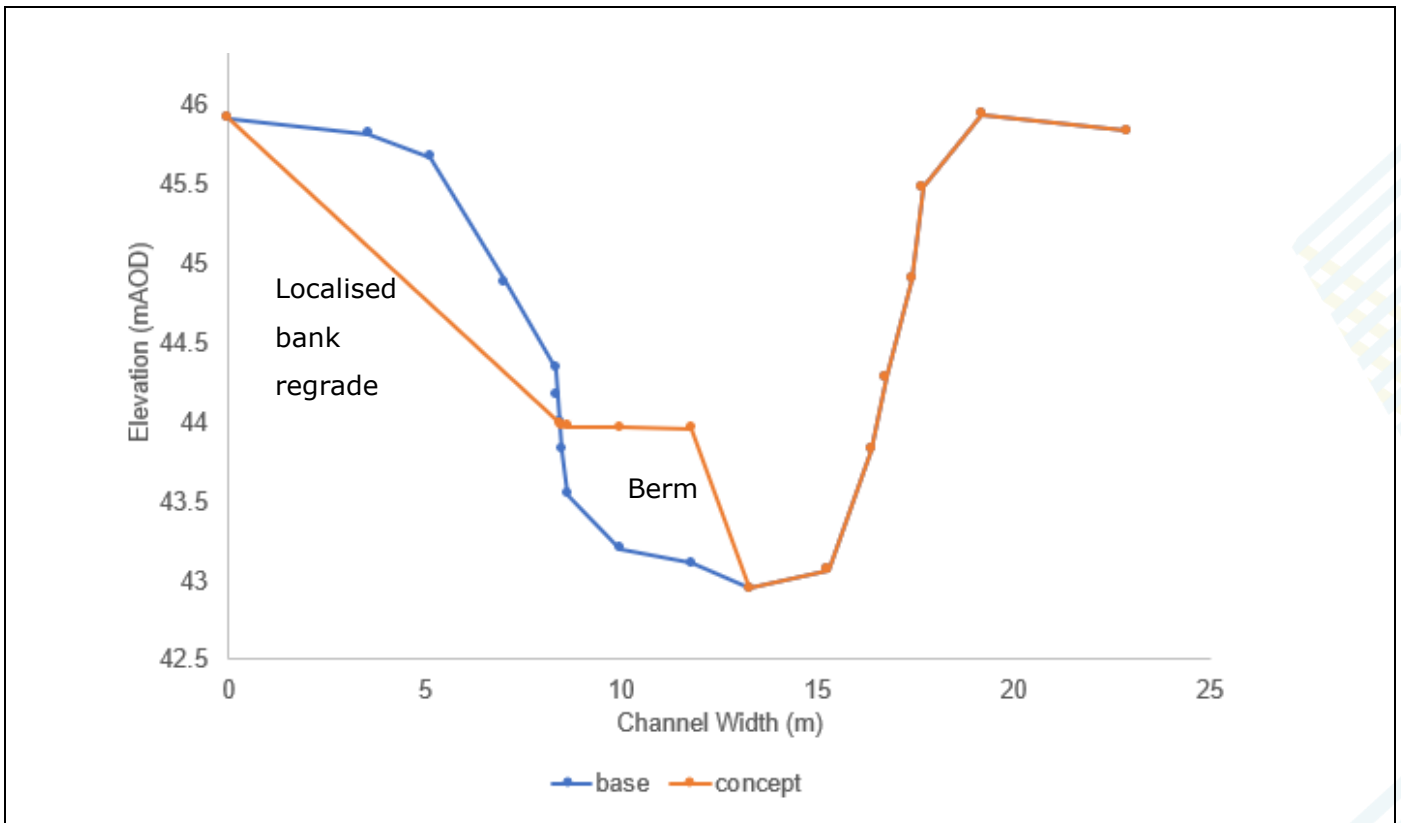


Figure 5-1 Design model in channel features – typical berm section

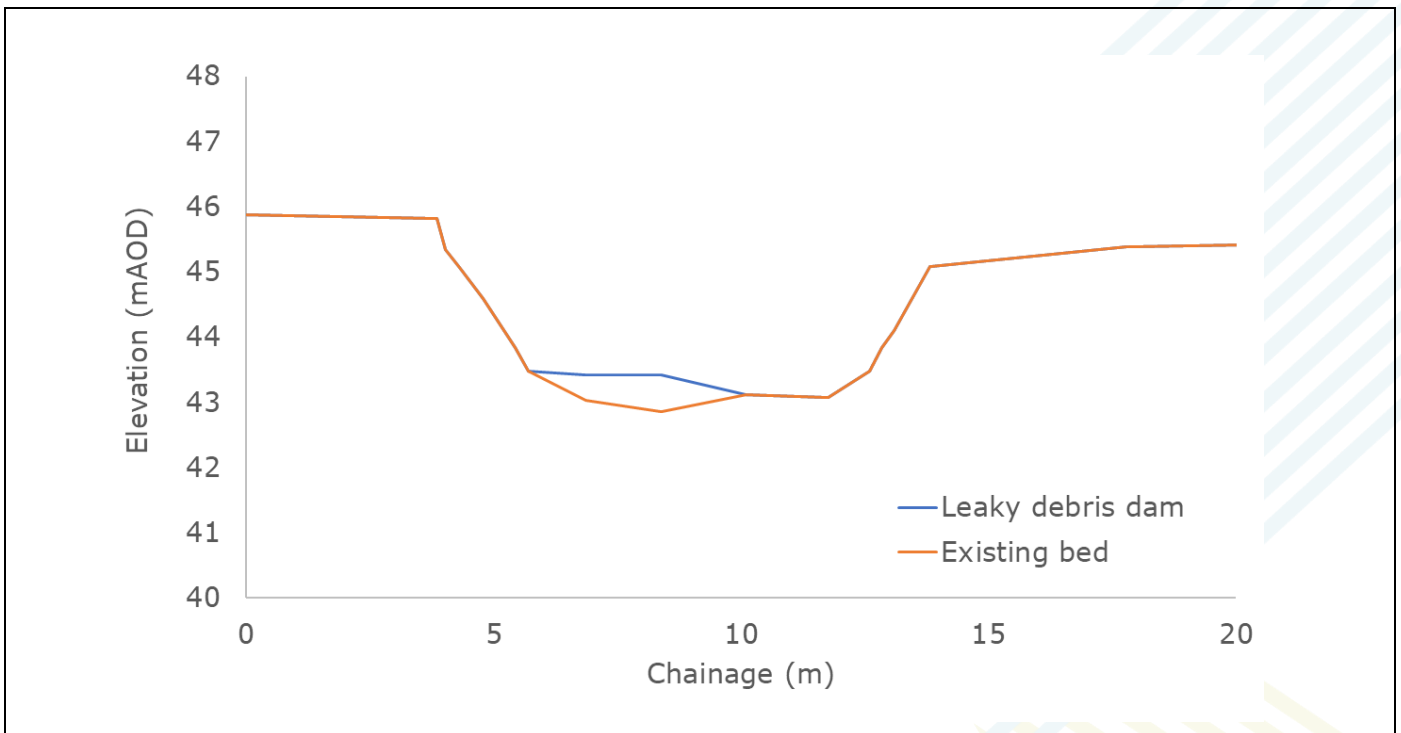


Figure 5-2 Design model in channel features – typical leaky debris dam section

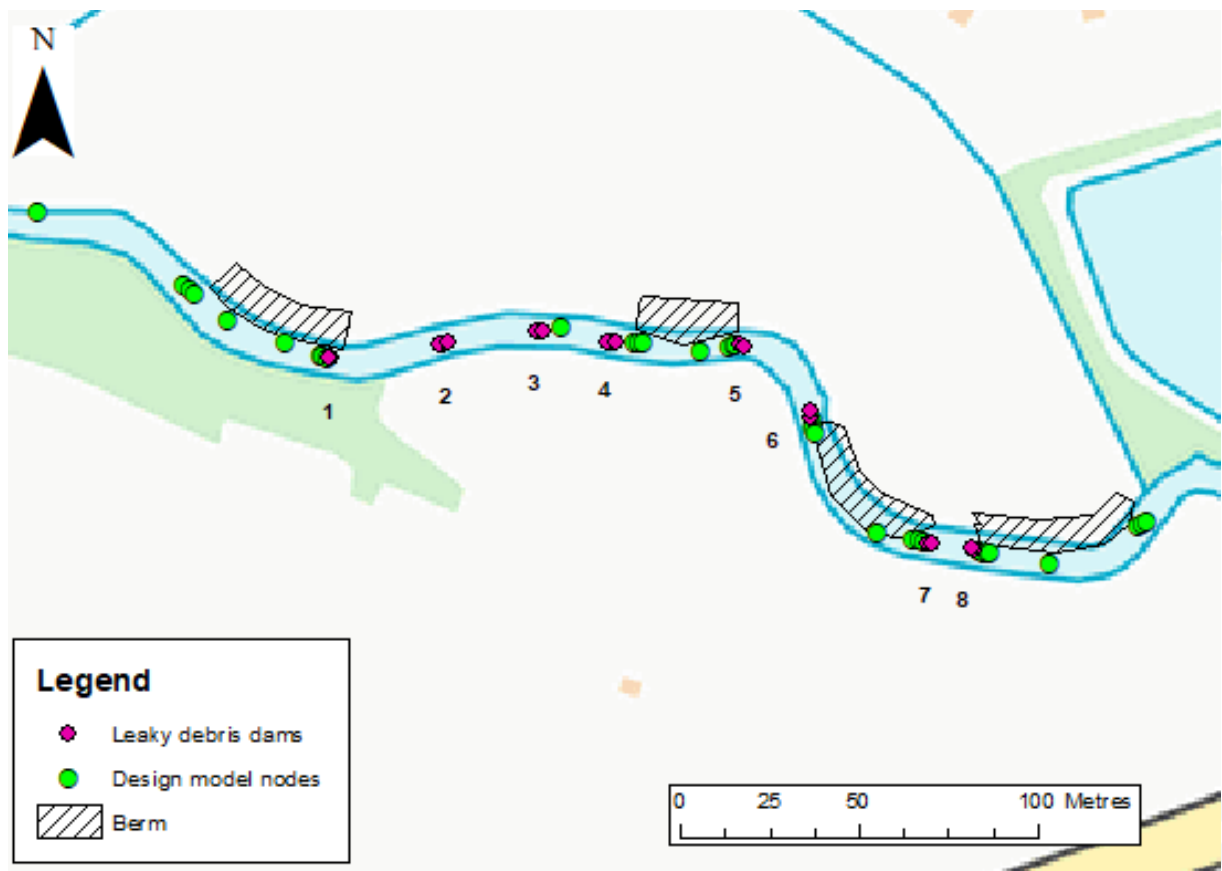


Figure 5-3 Model nodes to incorporate in channel leaky debris dams design features

6 Impact on flood risk

6.1 Introduction

The aim of this section is to present the results of the modelling. The model was run for the 5-year, 100-year and 100-year (CC30%) events to cover the potential impact on both small and large flood events. Three key reporting locations have been selected (Figure 4-1 and Table 6-1)

Table 6-1 Key reporting locations

Node	Rationale
DEA01941	400m upstream of Smithies, upstream extent of left bank floodplain
DEA01541	Approximately 50m upstream of the Smithies site boundary.
DEA01494	Upstream extent of Smithies site.
DEA00984U	Downstream extent of Smithies site, upstream of Smithies Lane Road bridge.

6.2 Comparison to supplied model

As a sense check, the supplied model results have been compared to:

- The results for the full model, re-run in August 2018 using flood modeller version 4.3.0.265; and
- The results of the trimmed model.
- The results of the updated model.

Results were compared for the 5-year and 100-year event at the upstream extent of the Smithies site, as well as immediately upstream and downstream (Table 6-1). Table 6-2 shows that there are differences between the supplied results and the full model re-run, with a reduction in maximum modelled water level of 0.03mAOD noted in the latter.

As the original model was run using an older version of the modelling software the differences may be explained by minor changes in the calculations within the different version releases. As the changes are minimal the results of the latest runs (August 2018) will be used to inform on the trimmed model hydrology.

It is reassuring to note that the water level results in the August 2018 baseline runs and the trimmed model (from which the model inflows were derived) are comparable. There is a slight increase in both the water levels in the trimmed model. This could be the result of the changes to the representation of the lateral inflow (Table 5-1).

The results of the updated model differ slightly from the trimmed model with localised increases in water levels. This could be the result of the differences of the two models as the updated model contains additional cross sections to allow the addition of the berms in the design model. Additionally, the spill data was updated with a bank top survey to provide further representation of this unit.

As the works are low risk and the purposes of the modelling is to show indicative change in flood risk, rather than absolute levels, the above observations are deemed acceptable.

Table 6-2 Results comparison of baseline model iterations

Model iteration	100-year	5-year
	Stage (mAOD)	Stage (mAOD)
	Upstream extent of left bank floodplain (DEA01941)	
Supplied results	46.99	46.21
Full model re-run August 2018	46.96	46.21
Trimmed baseline	46.97	46.21
Updated baseline	47.03	46.28
	Upstream of Smithies site (DEA01541)	
Supplied results	46.99	46.14
Full model re-run August 2018	46.97	46.10
Trimmed baseline	46.97	46.12
Updated Baseline	47.03	46.26
	Upstream extent of Smithies site (DEA01494)	
Supplied results	46.99	46.13
Full model re-run August 2018	46.97	46.10
Trimmed baseline	46.97	46.12
Updated Baseline	47.03	46.22
	Downstream of Smithies site (DEA00984U)	
Supplied results	46.32	45.70
Full model re-run August 2018	46.30	45.67
Trimmed baseline	46.31	45.68
Updated Baseline	46.31	45.68

6.3 Comparison to design model

Baseline model results have been compared to the design model for the 100-year (CC30%) (Table 6-3), and 5-year event (Table 6-4) at the key reporting locations. The results show that relative to the baseline model there is no change in the modelled water levels to within two decimal places in the 100 year + CC and slight reductions in the 5 year.

A check on flow downstream of the site (DEA00984U) upstream Smithies Lane road bridge (Table 6-5) has been completed. This shows there is minimal change in the maximum modelled flow as a result of the scenario design. In both the 100 year +CC and 5 year there was a slight change in modelled flows, though no change in water level is observed.

Table 6-3 Results comparison of baseline to design model - 100 year +CC

Node	Baseline Stage (mAOD)	Design Stage (mAOD)
DEA01941	47.26	47.26
DEA01541	47.27	47.27
DEA01494	47.27	47.27
DEA00984U	46.47	46.47

Table 6-4 Results comparison of baseline to design model - 5 year

Node	Baseline Stage (mAOD)	Design Stage (mAOD)
DEA01941	46.28	46.23
DEA01541	46.26	46.22
DEA01494	46.22	46.22
DEA00984U	45.68	45.65

Table 6-5 Comparison of flows downstream of the Smithies site (DEA00984U) for the baseline and design model.

Node	Baseline flow (m ³ /s)	Design flow (m ³ /s)
100-year +CC	106.75	107.16
5-year	44.83	43.33

6.4 Sensitivity testing

6.4.1 Lateral spills at interpolates

Lateral spills at interpolated sections were included in the supplied model. At these spills values have been set at 99.99mAOD, a level which will not over top in any of the modelled flood events. It is unsure why these spills were included in the original modelling.

To try and understand the significance of the lateral spills used at interpolated sections the full model was re-run with the spills removed. The results downstream of the Smithies site (DEA00984U) are provided, Table 6-6; little to no difference was observed between the modelled results. As a result, the spills were left in the trimmed baseline model.

Table 6-6 Sensitivity testing lateral spills downstream of Smithies (DEA00984U)

	100-year		5-year	
Iteration	Stage (mAOD)	Flow (m ³ /s)	Stage (mAOD)	Flow (m ³ /s)
Existing EA re-run August 18	46.30	87.16	45.67	44.07
As above, interpolate lateral spills at Smithies removed	46.30	86.97	45.66	44.22

6.4.2 Roughness

The model roughness was increased and decreased by 20% to determine the effect of the water levels as part of the sensitivity testing.

Table 6-7 provides the results of the roughness sensitivity results; these show that the model is sensitive to alterations in roughness, as you would expect a higher roughness results in an increase to water levels and a lower roughness results in a decrease to water levels. The modelled roughness values have not been altered from the supplied model as they were deemed reasonable based on-site observations. As roughness in both the baseline and design model are the same and as such the differences in flood risk will be relative.

Table 6-7 Sensitivity testing roughness						
	Baseline (100yr) (mAOD)	+20% (mAOD)	-20% (mAOD)	Design (100yr +CC) (mAOD)	+20% (mAOD)	-20% (mAOD)
DEA01941	47.03	47.14	46.86	47.26	47.43	47.07
DEA01541	47.04	47.14	46.87	47.27	47.43	47.08
DEA01494	47.04	47.14	46.87	47.27	47.43	47.08
DEA00984U	46.32	46.45	46.13	46.47	46.66	46.25

6.4.3 Design model testing

To determine the precise size of the berms and the leaky barriers extensive modelling was undertaken to ensure that the water levels upstream of the site do not increase, whilst allowing water onto the floodplain as designed.

As a sensitivity test the final berm designs were increased in size with an increase of 20% length and increased elevation of 0.25m. The results shown in Table 6-8 shows that there is only a 1cm difference indicating that the channel is relatively insensitive to alterations in the berm size and elevation.

Table 6-8 Results comparison of baseline to design model - 100 year +CC		
Node	Larger berm stage (mAOD)	Design Stage (mAOD)
DEA01941	47.27	47.26
DEA01541	47.27	47.27
DEA01494	47.28	47.27
DEA00984U	46.47	46.47

6.5 Temporary works

Temporary works will need to be detailed within the method statement for the works. This will need to include considerations for flood risk as well as water quality issues that could arise from the disturbance of sediment.

6.6 Long term maintenance

Blockages could result in an increase to flood levels and drainage problems upstream. A long-term maintenance plan should be established to ensure blockages at the site are removed.

7 Conclusions

The site is within Flood Zone 3 but the wetland creation scheme is defined as a water-compatible use under the NPPF. In relation to the scrape creation and bank regrade, the needs of the NPPF, with regards to flood risk, will be met if spoil is disposed of outside Flood Zone 3.

In-channel features including berms and leaky debris dams have been hydraulically modelled to determine the impact of water levels and flood risk at the site.

The river restoration works may change the flow regime of the river as the design facilitates an increase in flood storage on the left floodplain at the site. However, hydraulic modelling has demonstrated that any changes in water level will be localised as there is no increase in the maximum modelled water levels upstream or downstream of the Smithies site (as a result of the design).

Therefore, in line with the NPPF, this study concludes there will be no increase in flood risk to any vulnerable receptors, and there could even be benefits associated with an increase in floodplain storage observed downstream. No formal modelling of the scrapes has been completed as part of this works.

Management measures are suggested during the construction and operational phase of the scheme so that site personnel remain safe at all times.

Considerations should be made for temporary works and long term maintenance.

Appendices

A Drawings

A.1 General arrangement

A.2 Cross section detail

Offices at

Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
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