Wings Across the Ings Flood Risk Assessment

FINAL Report

August 2017

The Garganey Trust

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Revision History

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Contract

This report describes work commissioned by Jeff Lunn, on behalf of the Garganey Trust, by an email dated 21-1-15. The Garganey Trust's representative for the contract was Jeff Lunn. Alex Jones of JBA Consulting carried out this work.

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Purpose

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1 Introduction

1.1 Terms of reference

JBA Consulting were appointed by the Garganey Trust in December 2016 to prepare a Flood Risk Assessment (FRA) to support a wetland creation scheme at Wombwell, South Yorkshire. This scheme has been named "Wings Across the Ings" or WATI. This FRA provides information on the flood risk at the site and follows Government guidance with regards to development and flood risk (National Planning Policy Framework and accompanying Planning Practice Guidance).

The scheme is being part funded by the Environment Agency's flood defence grant in aid, due to the flood alleviation benefits the scheme brings.

1.2 Requirements

It is a requirement for development applications to consider the potential risk of flooding to a proposed development over its expected lifetime and any possible impacts on flood risk elsewhere, in terms of its effects on flood flows and run-off.

This FRA follows guidance given on development and flood risk in the National Planning Policy Framework and accompanying Planning Practice Guidance.

1.3 Report Structure

The report has the following structure:

- Main Body - Flood Risk Assessment,
- Appendix A - Figures
- Appendix B - Outline Design and Modelling
    - This report was presented to EA NPAS in order to obtain funding.

2 Site Description

2.1 Site Location

The WATI site is located in the Bulling Dyke floodplain north of Broomhill Darfield, South Yorkshire. The site is currently covered by arable land.

2.2 Proposed Development

The proposal for the site has the following features:

- A new bund and channel for Bullings Dyke to provided increased protection for a caravan site.
- A flap valve on the bund, on the old line of Bulling Dyke, to allow the area behind the bund to drain in normal conditions.
- Develop a wet grassland and reedbed complex which also increases flood storage.

A general arrangement and a figure showing the cut and fill designs for the site are shown in Appendix A. Versions of those figures are shown below.

Figure 2-1: New Design

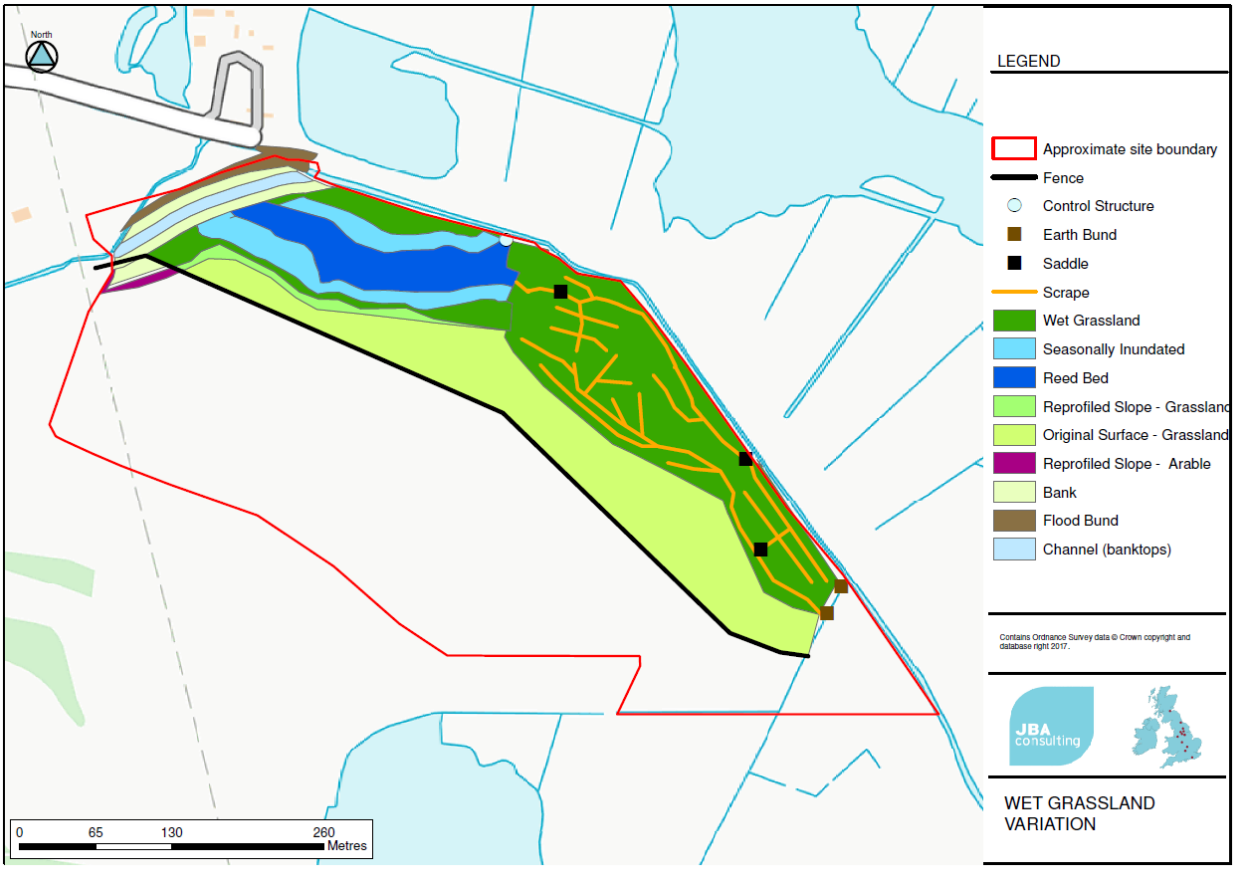
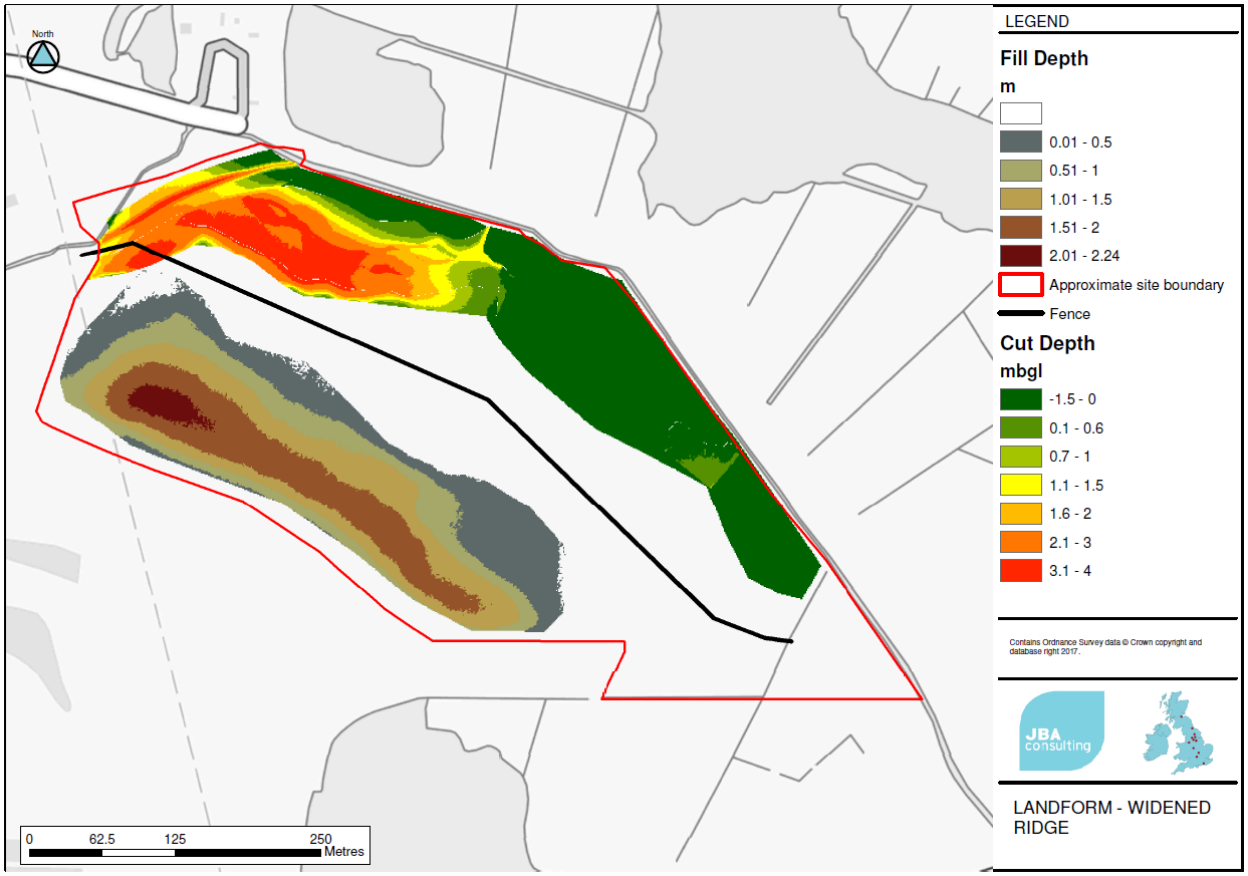


Figure 2-2: New Design Cut and Fill

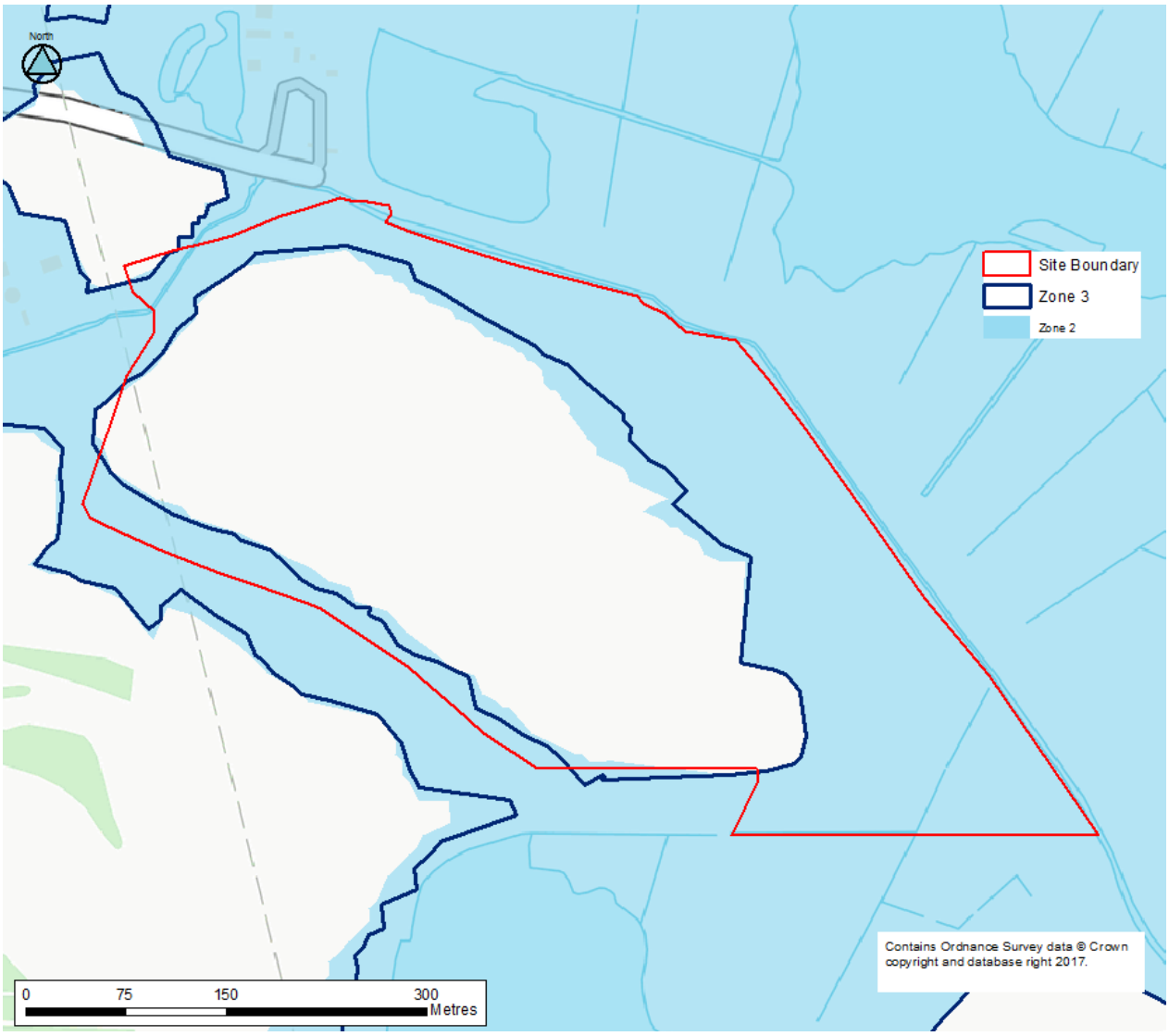


2.3 Site Baseline

2.3.1 Fluvial Flood Risk

The site is surrounded by Flood Zone 3 and 2 on all sides. A hill in flood Zone 1 occupies the top of centre of the site.

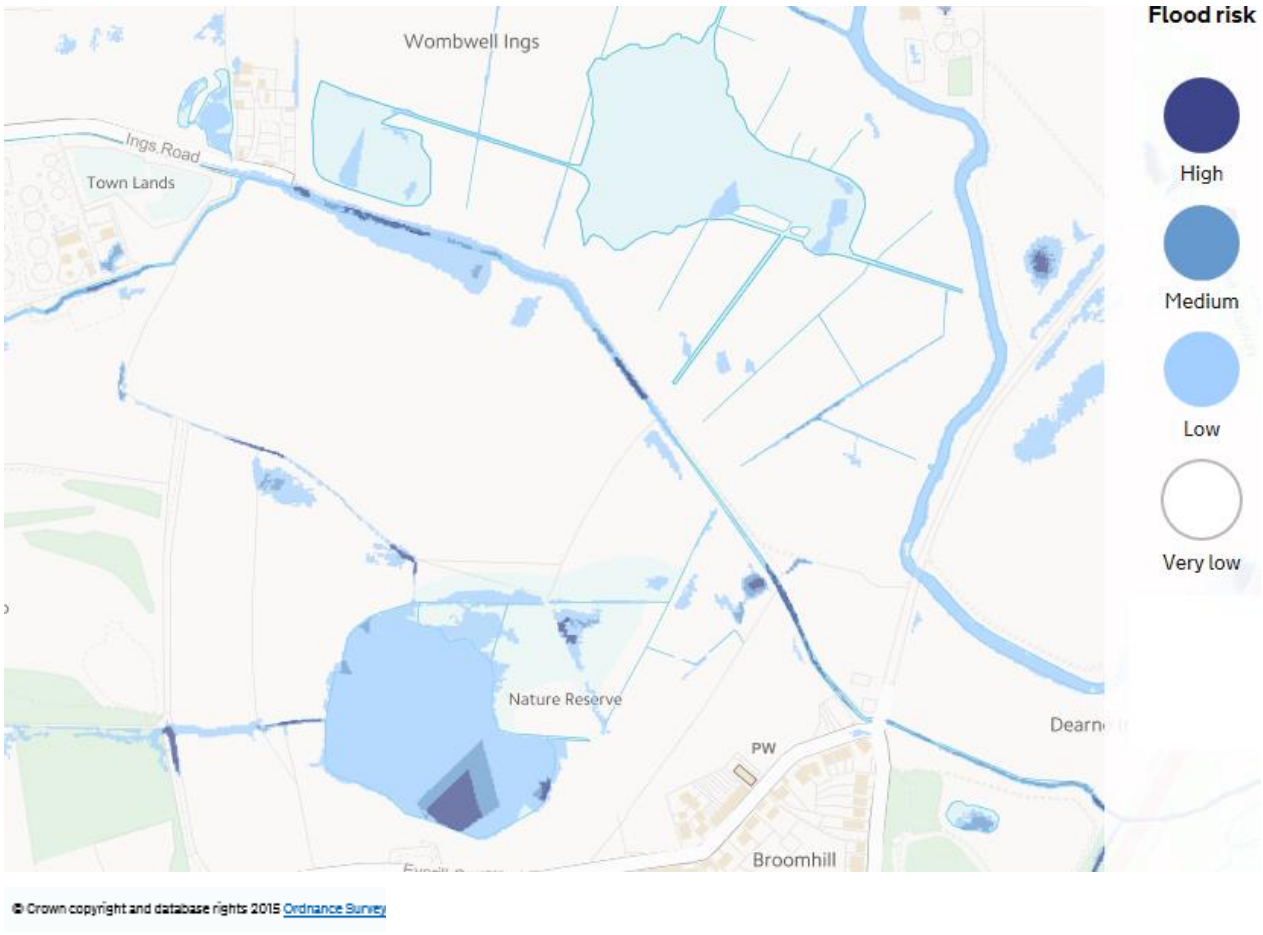
Figure 3: Fluvial Flood Risk



2.3.2 Surface Water Flood Risk

Surface water flooding arises when rain falling on a saturated, severely compacted or low permeability ground surface and flows overland, following natural runoff pathways through the local topography. Surface water flood risk to the site has been assessed using the Environment Agency's national scale Risk of Flooding from Surface Water mapping. The map below indicates that the low-lying floodplain on the site is susceptible to surface water flooding (see Figure 4).

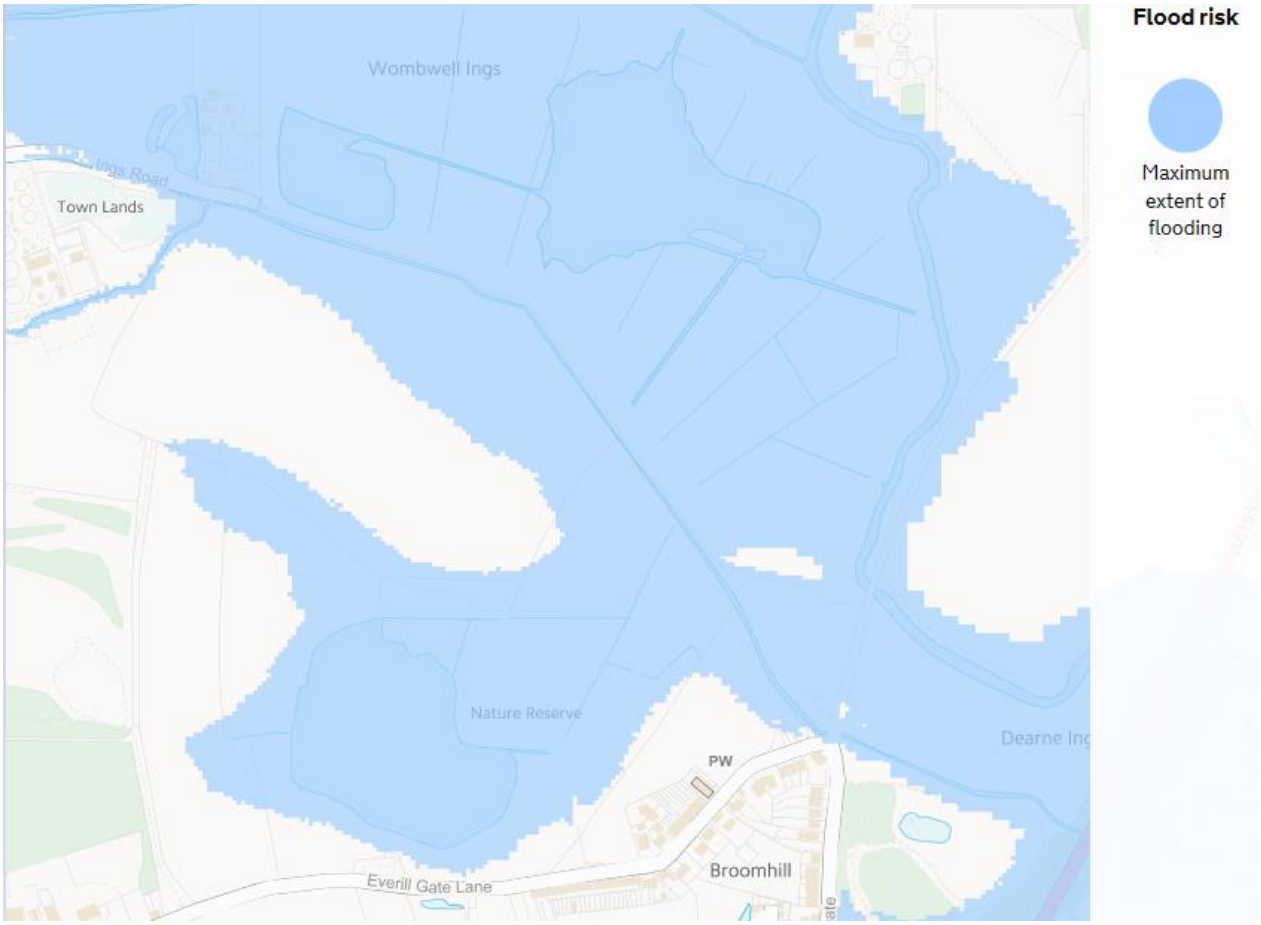
Figure 4: Surface Water Flood Risk



2.3.3 Reservoirs

The area is at risk from flooding from reservoirs (Figure 5), i.e. in the event of the reservoir dam/embankment being breached. The likely source of this risk is the Worsbrough Reservoir at the top of the Dove catchment.

Figure 5: Risk of Flooding from Reservoirs



2.4 Flood mechanisms

This section firstly describes the key fluvial flooding mechanisms in the area, outlining a description of the key areas at flood risk and how and why they flood.

2.4.1 Dearne valley

Both Bulling Dike and the River Dove, flow predominantly from West to East before meeting up with the River Dearne. The Dearne has extensive washlands in the valley, including Wombwell Ings, which are located between the River Dove and the Bulling Dike, but water levels in Wombwell Ings have no impact on water levels in the Dove and Bulling Dike, as they are not hydraulically connected.

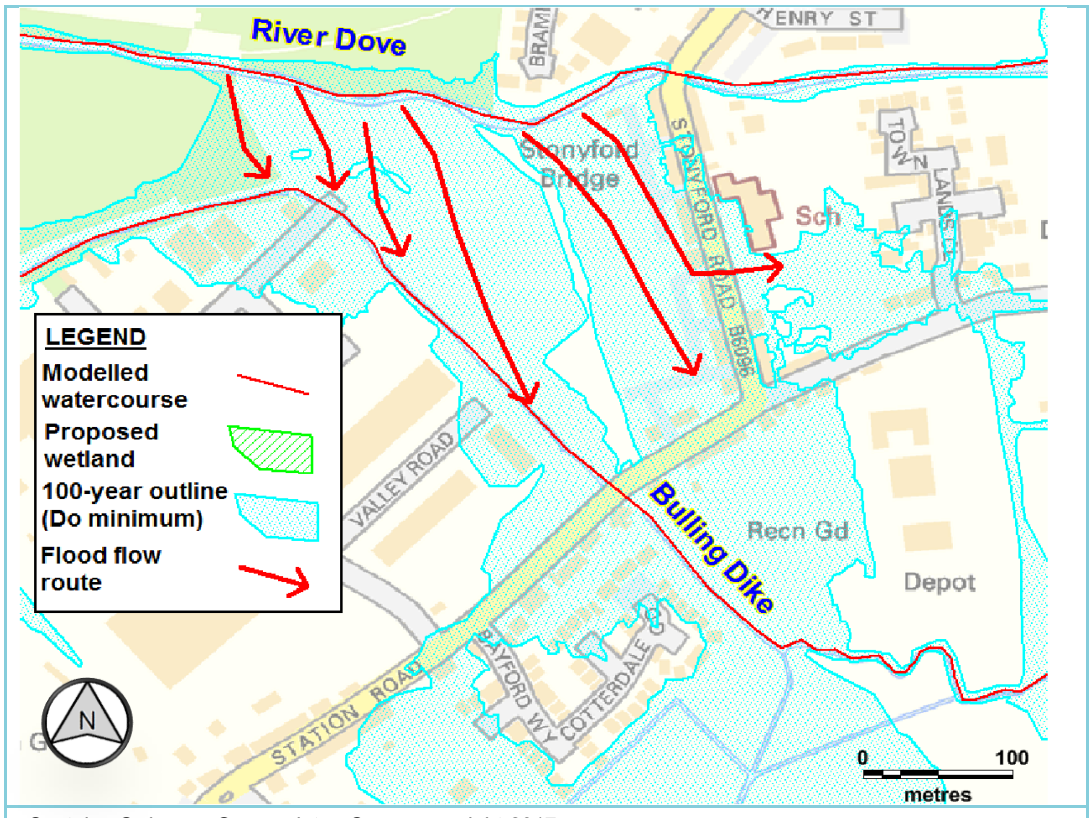
The Dearne will, however, have some influence on water levels on the Dove and Bulling Dike by controlling water levels at the confluence of the rivers. This influence will be localised, and will not impact upon flood mechanisms in the Dove and Bulling Dike.

2.4.2 Flood mechanisms

There are several key flooding mechanisms that are summarised in the following:

- River Dove - Upstream of the Stonyford Bridge "dogleg". Water overtops the right bank and spills into the Old works/ development site near Valley Road Industrial Estate (Figure 2-6) and flows south draining into Bulling Dike increasing the water levels, flow and flood risk to properties in the former industrial estate.

Figure 2-6: Old works/ development site and Stonyford Bridge "dogleg" spill points and flow routes to Bulling Dike (2009 flood mapping)



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- River Dove - The Stonyford Bridge "dogleg" (see photographs 1 and 2 below). Water overtops the right bank to the rear of the properties on Stonyford Road and then floods the properties from the rear. Once out-of-bank the flood waters then spread south and east flooding properties on Station Road, the other side of Stonyford Road and along Ings Lane. Finally, floodwater flows south from Ings Lane towards the waste water treatment works (WWTW) and into Bulling Dike.

Figure 2-7: Stonyford Bridge photographs

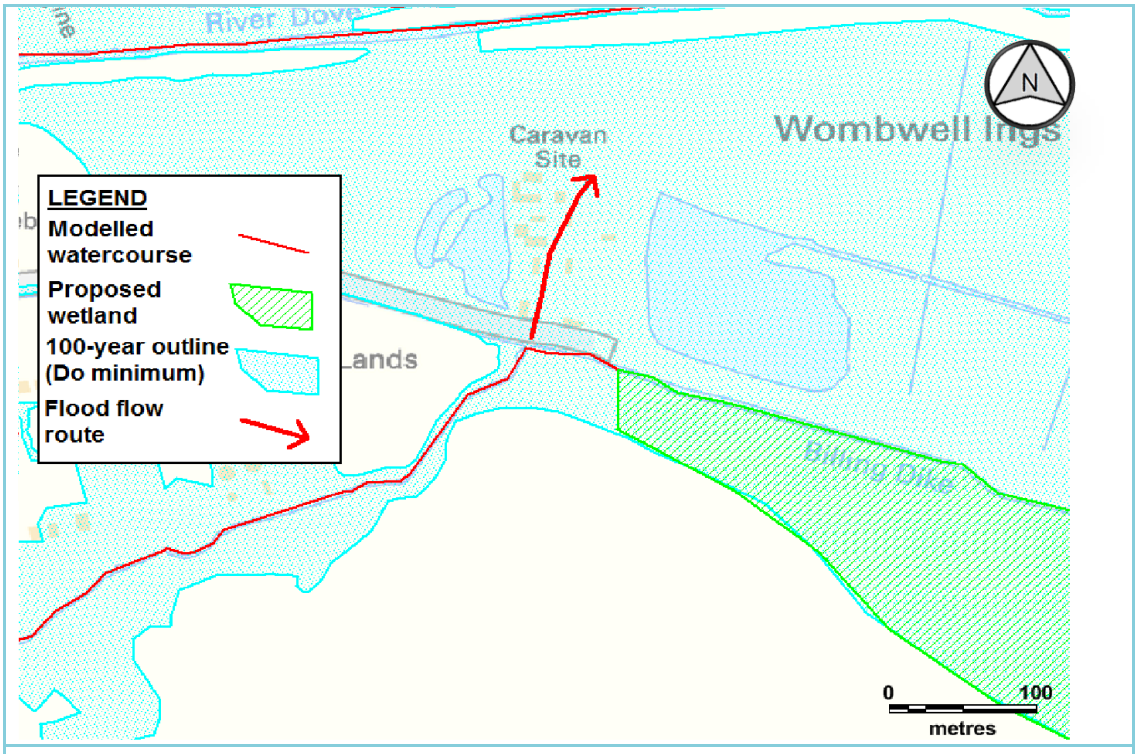
Low bank crest level upstream of Stonyford Bridge - Photograph 1 (2009)	Low bank crest level upstream of Stonyford Bridge - Photograph 2 (2009)
	

- River Dove - Aldham Bridge. Overtopping of the left bank downstream of Wombwell Lane at Aldham Bridge, industrial units on Wombwell Lane affected.

The transfer of floodwater from the River Dove into Bulling Dike causes significant overtopping and flooding of properties in several areas along Bulling Dike's reach. The two key flood related pinch points are:

- Bulling Dike - Station Road Bridge. The bridge becomes overwhelmed during large flood events. The structure overtops and floodwater inundates sections of the Cotterdale Gardens housing estate.
- Bulling Dike - "Dogleg" adjacent to Caravan Site. The large flows within Bulling Dike, associated to the upstream transfer of flood waters from the River Dove, results in significant overtopping of the left bank of Bulling Dike, adjacent to the Darfield Caravan Site, located at the eastern end of Ings Lane. This causes significant flooding to properties within the Caravan Site (Figure 2-8).

Figure 2-8: Flood routes into Ings Lane Caravan Site (2009 flood mapping)



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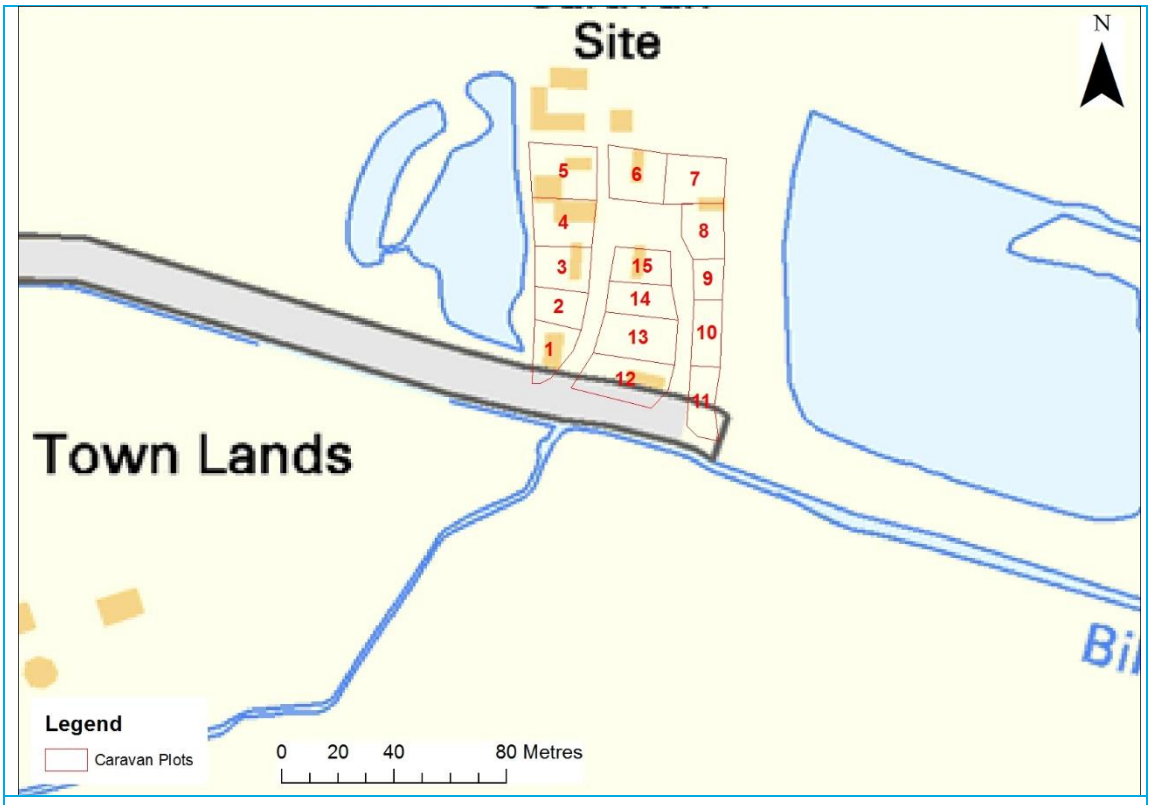
2.4.3 Key flood receptors

The key flood receptor, which could be impacted upon by the proposed scheme, is the Caravan Site located on the left hand bank of Bulling Dike. A property survey undertaken by the Yorkshire Wildlife Trust on the 13th July 2015 showed that the site had 15 individual plots, often with numerous caravans or buildings on each plot.

Figure 2-9: Location of caravan plots



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No flooding occurs at the Caravan Site at return periods lower than 10-years. Table 2-1 shows the modelled flood depths at each of the Caravan Site plots (Figure 2-9) for return periods of 10-years and higher. Eight of the plots are inundated during the 10-year event, with all plots inundated at the 25-year return period and larger floods. These modelling that created these results is shown in Appendix B.

Table 2-1: Flood depths at each plot

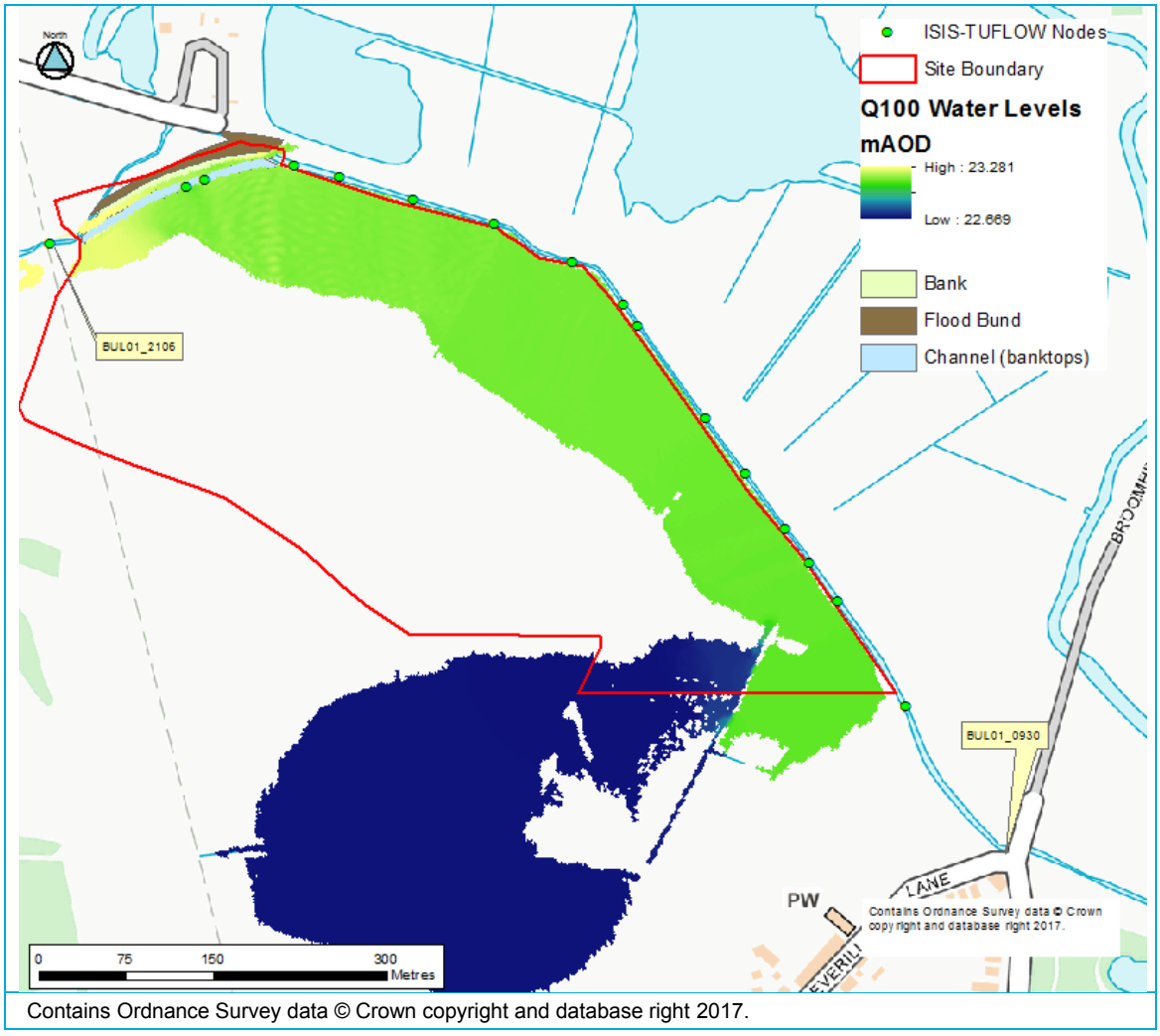
	Depth of flood water (m)					Standard of Protection
Plot	**Q10**	**Q25**	**Q50**	**Q75**	**Q100**	
1	0.18	0.71	1.11	1.30	1.35	Q10
2	0.28	0.81	1.22	1.41	1.46	Q10
3	0	0.50	0.90	1.09	1.14	Q25
4	0	0.56	0.97	1.15	1.21	Q25
5	0	0.61	1.01	1.20	1.25	Q25
6	0	0.38	0.78	0.97	1.02	Q25
7	0	0.59	0.99	1.18	1.23	Q25
8	0	0.49	0.90	1.08	1.14	Q25
9	0.04	0.57	0.98	1.17	1.22	Q10
10	0.15	0.68	1.08	1.27	1.32	Q10
11	0.27	0.80	1.20	1.39	1.44	Q10
12	0.19	0.72	1.21	1.31	1.36	Q10
13	0.27	0.80	1.20	1.39	1.44	Q10
14	0.12	0.65	1.06	1.24	1.30	Q10
15	0	0.49	0.90	1.08	1.13	Q25

Table note: Q10 is 10 year return period flood event; Q25 is 25 year return period flood event, etc.

2.5 Proposed situation

The key elements of the design, from a flood risk perspective, is redirecting the river channel and raising the bund along the left hand bank of the channel. Figure 2-10 shows that by redirecting Bulling Dike, the addition of the flood bund, and changes made to the floodplain, the Caravan Site is no longer at risk even in the 100-year return period event.

Figure 2-10: Post-change 100-year flood outline and flood depths



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3 Planning Policy and Flood Risk

3.1 Planning Context

The National Planning Policy Framework (NPPF) was introduced by the Department for Communities and Local Government in March 2012 and supersedes the Planning Policy Statements (PPS25). Its technical guidance relates to development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency (EA) Flood Map, and mineral policy. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development based on an assessment of current and future conditions. The NPPF is accompanied by the Planning Practice Guidance (NPPG) on Flood Risk and Coastal Change, which provides further information on the approaches to be adopted in the assessment of flood risk for new development.

3.2 Development Site Flood Zones

The Environment Agency states that flood risk is a function of:

- *"The likelihood of a particular flood happening, best expressed as a chance or probability over a period of one year. For example, 1 in 100-year (1% AEP) flood means that there is a 1 in 100 chance of a flooding in any given year in this location.*
- *The impact or consequence that will result if the flood occurs."*

The EA categorises the risk into a series of flood zones; a definition of such flood zones can be found in Table 2. The EA has developed a Flood Map which shows the risk of flooding in England and Wales for different return period events. This map provides the basis for the assessment of flood risk and development suitability.

The EA Flood Map for Rivers and Seas shows the site to be located within Flood Zone 2 and 3. This zone comprises land which has been assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

Table 2 shows how the Flood Zones relate to a sequential planning response. Advisory notes places upon various types of development are detailed in Table 3, and details of the Sequential and Exception Tests are provided in Table 4.

Table 2 Flood Zone Classification

Zone 1: Low Probability	
Land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%)	**Appropriate uses** All uses of land are appropriate in this zone. **FRA requirements** For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water runoff, should be incorporated in a FRA. **Policy aims** Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 2: Medium Probability	
Land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river	**Appropriate uses** The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure are

flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%) in any year	appropriate in this zone. Highly vulnerable uses are only appropriate in this zone if the Exception Test is passed. **FRA requirements** All proposals in this zone should be accompanied by a FRA. **Policy aims** Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 3a: High Probability	
Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.	**Appropriate uses** The water-compatible and less vulnerable uses of land are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable and essential infrastructure uses should only be permitted in this zone if the Exception Test is passed. **FRA requirements** All proposals in this zone should be accompanied by a FRA. **Policy aims** Developers and local authorities should seek opportunities to: - reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; - relocate existing development to land with a lower probability of flooding; - create space for flooding to occur by allocating and safeguarding open space for flood storage.
Zone 3b: Functional Floodplain	
Land where water has to flow or be stored in times of flood. Local Planning Authorities should identify in their SFRAs area of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designated to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify functional floodplain.	Appropriate uses Only the water-compatible uses and the essential infrastructure should be permitted. It should be designed and constructed to: - remain operational and safe for users in times of flood; - result in no net loss of floodplain storage; - not impede water flows; - not increase flood risk elsewhere/ FRA requirements All proposals in this zone should be accompanied by an FRA. Policy aims In this zone, developers and local authorities should seek opportunities to: - reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; - relocate existing development to land with a lower probability of flooding.

Source: Table 1, NPPF Technical Guidance

Table 3 Flood Risk Vulnerability Classification

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

Development	- Water transmission infrastructure and pumping stations. - Sewage transmission infrastructure and pumping stations. - Sand and gravel workings. - Docks, marinas and wharves. - Navigation facilities. - MOD defence installations. - Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. - Water-based recreation (excluding sleeping accommodation). - Lifeguard and coastguard stations. - Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. - Essential ancillary sleeping or residential accommodation for staff required by uses in this category, *subject to a specific warning and evacuation plan.*
Source: Table 2, NPPF Technical Guidance	

3.3 Sequential and Exception Tests

The NPPF requires the Sequential and Exception Tests to be applied when choosing the location of new developments and the layout of the development sites. The Sequential Test aims to promote development in low flood risk areas. The Exception Test is used where no suitable development areas can be found in low risk zones.

When planning a development, a sequential approach should be applied to identify suitable sites which are at minimal risk from flooding and avoid Flood Zones 2 and 3 wherever possible. If there are no suitable areas identified in Flood Zone 1 then sites with the lowest flood risk should be considered next. If development is necessary within a medium to high risk zone an Exception Test may be required to demonstrate the need for the development in that location and plans to mitigate flood risk.

The site is partly located in Flood Zone 3 and as a water compatible land use passes the Sequential Test.

No Exception Test should be required as it is a water compatible land-use and the nature of providing flood alleviation benefits to identified receptors and creating a wetland means that there are not by its nature alternative locations where the development can occur.

Table 4 Flood Risk Vulnerability and Flood Zone 'Compatibility'

Vulnerability Classification (Table 2)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test	✓	✓
	Zone 3a	Exception Test	✓	×	Exception Test	✓
	Zone 3b	Exception Test	✓	×	×	×
Source: Table 2, NPPF Technical Guidance (year???)						
✓ Development is appropriate						

× Development should not be permitted

Notes:

This table does not show:

The application of the sequential test which guides development to Flood Zone 1 first, then Zone 2, and then Zone 3;

Flood risk assessment requirements;

The policy aims for each flood zone.

3.4 Water Compatible Developments

Under the guidance, water-compatible uses can be permitted in Zone 3, as long as they:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage (i.e. loss of land where flood waters used to collect);
- do not impede water flows; and
- do not increase flood risk elsewhere.

The site will be used as a wetland and therefore there is little need to assess whether the site can remain operational and safe for users in times of flood as the use of the site carries few risks.

4 Assessment of Flood Risk

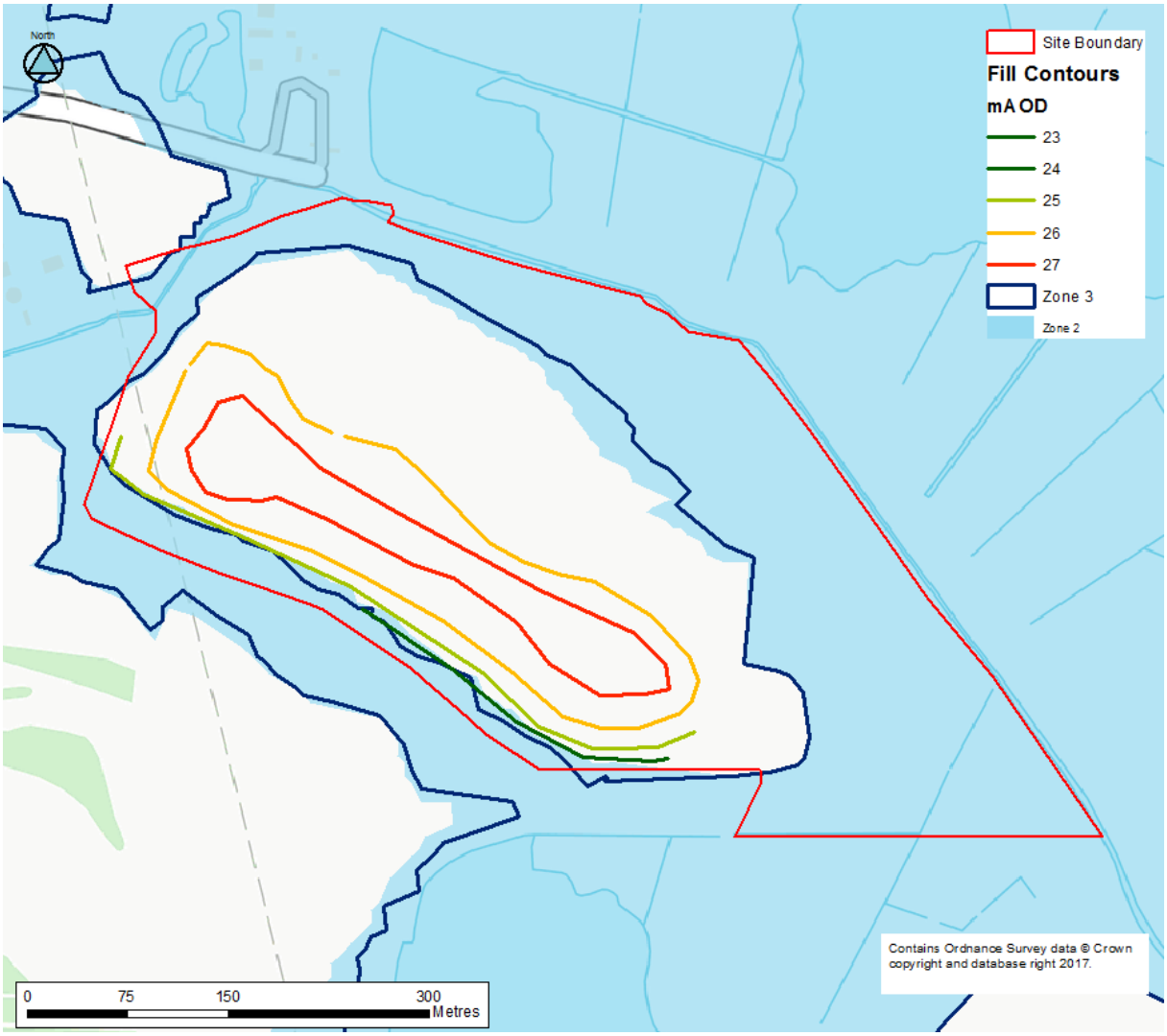
The flood risk assessment will focus on the impact on fluvial flooding.

The wetland works occur from the channel to the edge of the floodplain. The rising ground to the south, is agricultural land owned by Garganey Trust and therefore will not be impacted by drainage issues from the development of the wetland.

By its very nature, the wetland will not be susceptible to groundwater flooding impacts.

4.1 Changes in Floodplain Storage

The scheme will result in an increase in floodplain storage due the excavation work. The area of fill (see figure below) has been designed to occur in Flood Zone 1.



Note - the 23 and 24m contour ties into land at those respected heights and their ends

4.2 Impact on Fluvial Flood Events

4.2.1 Hydraulic Model

A baseline model of the catchment has been developed in ISIS-TUFLOW using a 1D-2D linked approach was developed for the site. This is described in detail in Appendix B. The only change to the model over the details discussed in Appendix B is to change the modifications to the floodplain to reflect the current wetland design (Figure 2-1), rather than the design used to gain approval from NPAS. No other changes to the model or hydrology have been made.

4.2.2 Fluvial Conveyance

The conveyance of flows through the 1D and 2D domains has been examined. The scheme increases floodplain storage and the new channel and bund has the potential to modify the flow of water through the system.

Table 4-1 provides a summary of the changes in the maximum stage of the modelled 100 year fluvial event. The locations of the model cross sections are shown in Figure 4-1 and the hydrographs are shown in

Figure 4-2 and Figure 4-3. The results show that the design provides a significant upstream benefit of 25.9cm (though this has been reduced by 10.2 cm, from the original design) for the Waste Water Treatment Works (WWTW) immediately upstream. Downstream of the site, the new design results in a negligible (1.4cm) change in water levels compared to the existing condition. The banktop downstream is at approximately 23.1mAOD. The 100 year event for the current situation and the scheme both do not come out of bank.

There are no receptors between the end of the scheme reach and the confluence of the Dearne and Bulling Dyke, as the properties at Broomhill are well above river level (24.7mAOD compared to Q100 maximum modelled level of 22.85mAOD). There is no increase in maximum modelled water levels at the confluence of Bulling Dike and the River Dearne.

Table 4-1: Summary of 100 Year Event Stage Changes

Version	Max Stage Upstream		Max Stage Downstream	
	mAOD	Change in cm	mAOD	Change in cm
Existing	23.424	N/A	22.850	N/A
New Design	23.165	-25.9	22.864	+1.4

Figure 4-1: Location of Channel Cross Sections in Model

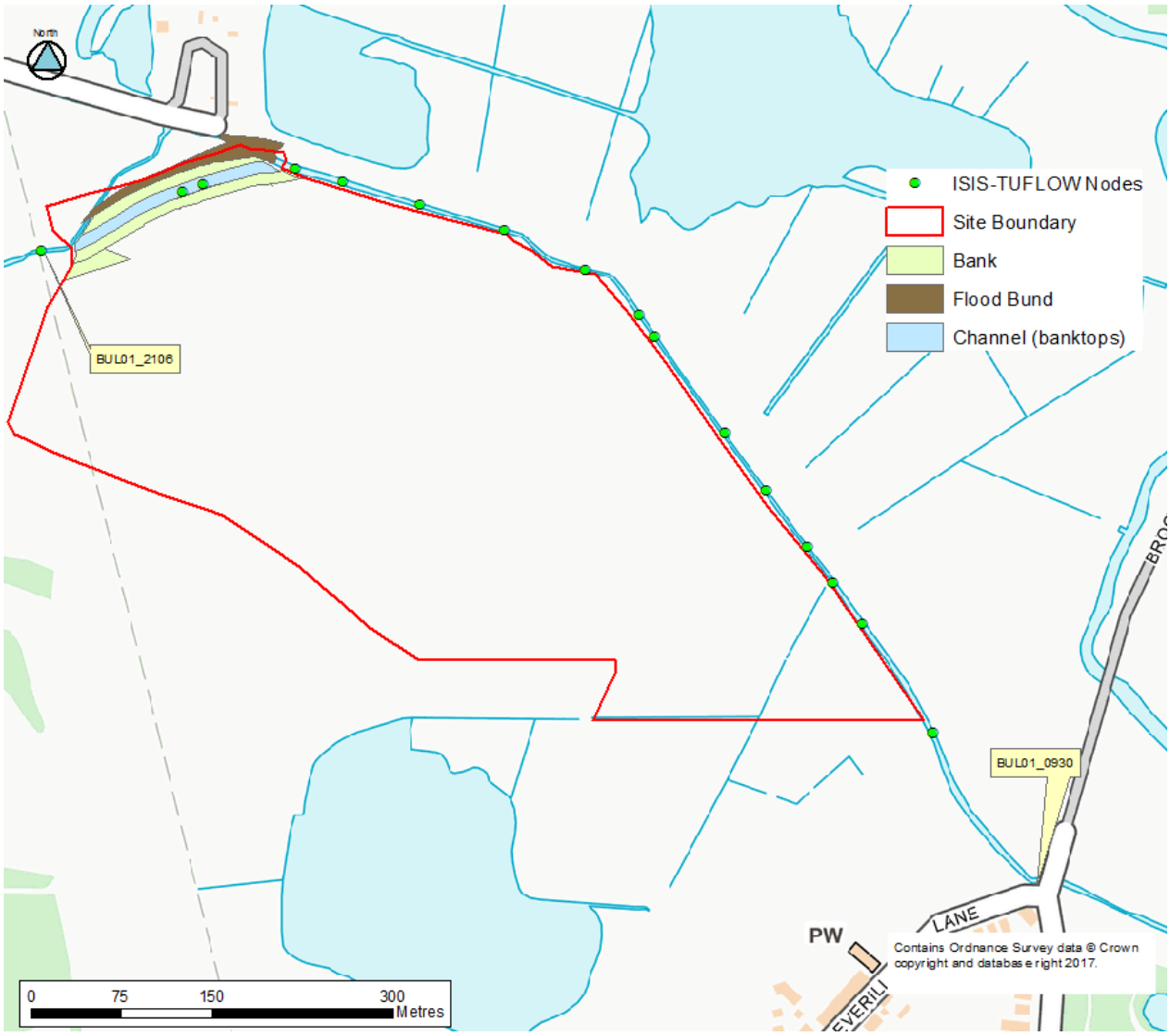


Figure 4-2: 100 Year Event Upstream Hydrograph at WWTW at Cross-Section BUL01_2106

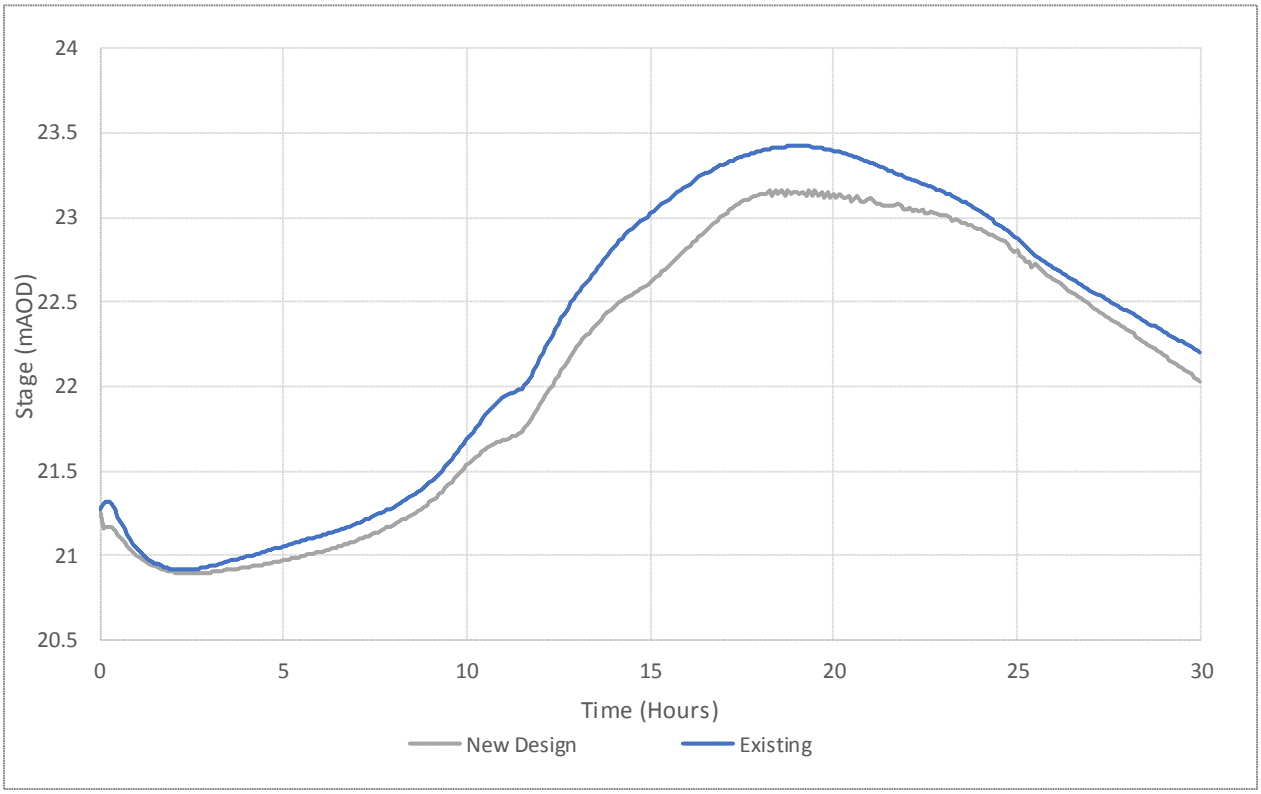
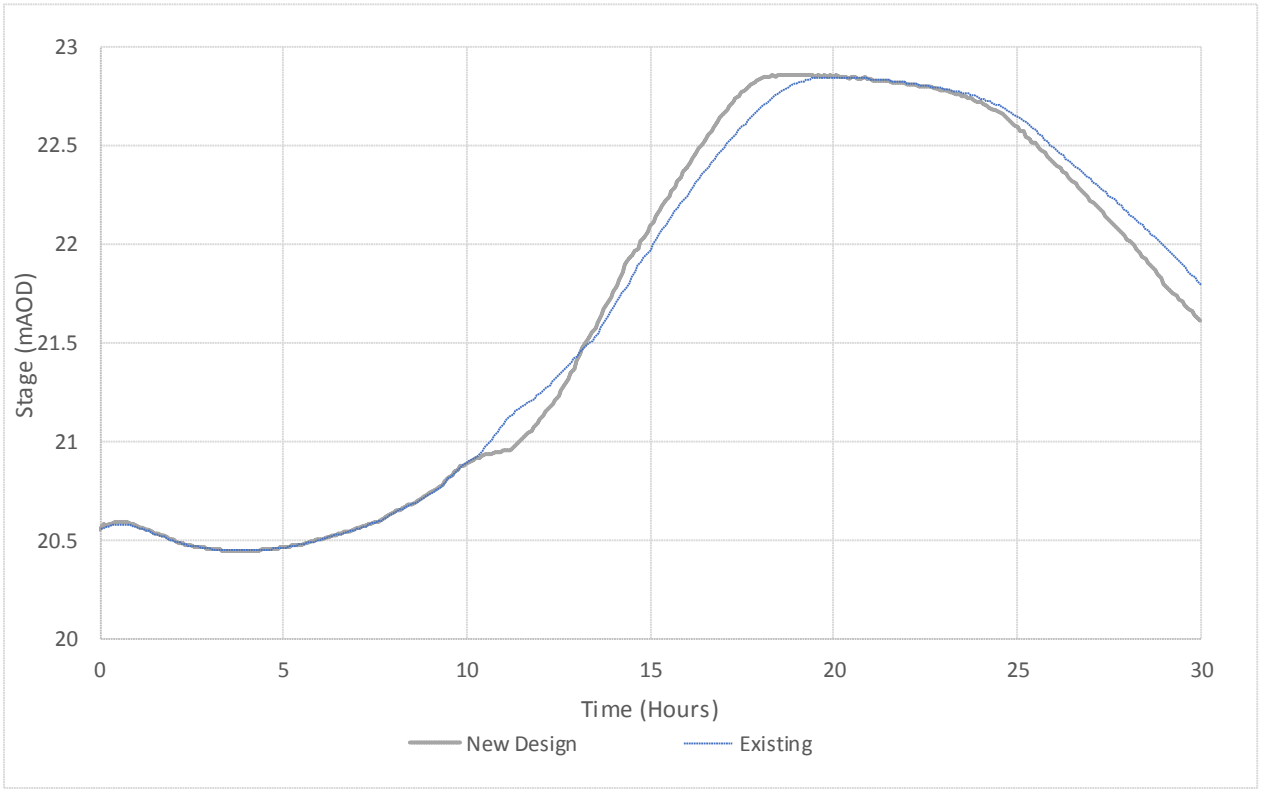


Figure 4-3: 100 Year Event Downstream Hydrograph at Broomhill at Cross-Section BUL01_0930



Conclusions

The scheme provides flood benefits for the Caravan site (see Section 2.5). The scheme also provides significant reductions in flood water levels at the sewage treatment works upstream. There is a slight increase in water levels immediately downstream (1.4cm for the Q100 event), however these levels are still within bank and the potential receptors (housing at Broomhill) are already sited significantly above this level. Overall, therefore the scheme provides significant benefits in terms of reducing flood levels.

5 Conclusions

Under the NPPF Technical Guidance, water-compatible uses can be permitted in Flood Zone 3, as long as they:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage (i.e. loss of land where flood waters used to collect);
- do not impede water flows; and
- do not increase flood risk elsewhere.

The site will be used as a wetland and therefore there is little need to assess whether the site can remain operational and safe for users in times of flood as the use of the site carries few risks. The FRA shows that all these requirements are met. In addition, the scheme provides significant flood benefits to the Caravan Site and the WWTW.

A Figures

Figure A 1: General Arrangement

Figure A 2: Cut and Fill

B Outline Design and Modelling

See: 2015s2285 - WATI - Appendix B - Outline Design and Modelling - FINAL ISSUE

North

0 65 130 260 Metres

LEGEND

- Approximate site boundary
- Fence
- Control Structure
- Earth Bund
- Saddle
- Scrape
- Wet Grassland
- Seasonally Inundated
- Reed Bed
- Reprofiled Slope - Grassland
- Original Surface - Grassland
- Reprofiled Slope - Arable
- Bank
- Flood Bund
- Channel (banktops)

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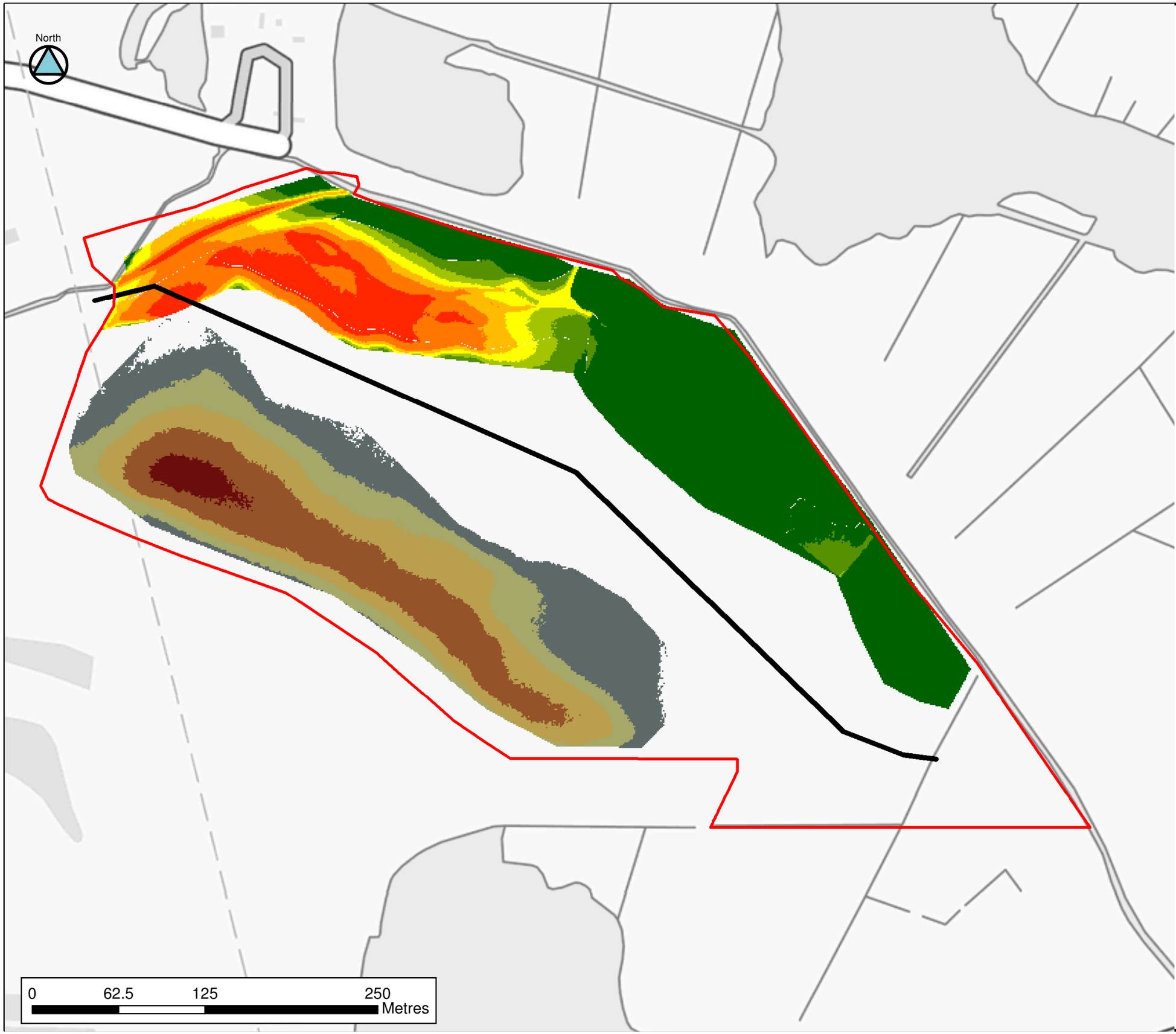
WET GRASSLAND VARIATION



LEGEND

Fill Depth

m

- 0.01 - 0.5
- 0.51 - 1
- 1.01 - 1.5
- 1.51 - 2
- 2.01 - 2.24
- Approximate site boundary
- Fence

Cut Depth

mbgl

- -1.5 - 0
- 0.1 - 0.6
- 0.7 - 1
- 1.1 - 1.5
- 1.6 - 2
- 2.1 - 3
- 3.1 - 4

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LANDFORM - WIDENED RIDGE

References

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Flood Risk and Coastal Change Planning Practice Guidance (ID:7), March 2014.

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