Doveside
Flood Risk Assessment

Final Report

August 2017

The Garganey Trust

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Revision History

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Draft v1		The Garganey Trust
Final	EA comments	The Garganey Trust

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 Doveside, Darfield, South Yorkshire. 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).

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.

2 Site Description

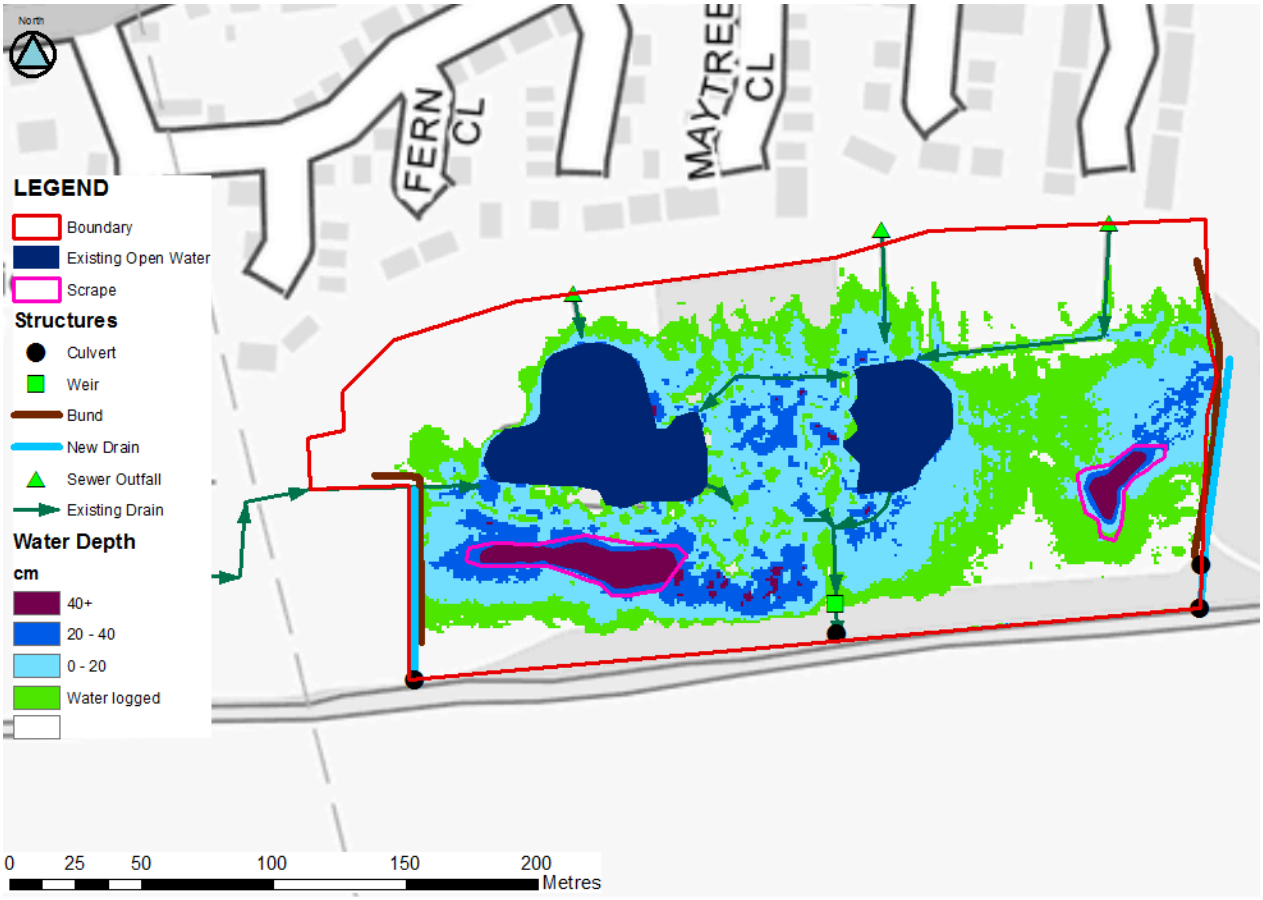
2.1 Site Location

Doveside site is located in the River Dove floodplain on the southern edge of Darfield, South Yorkshire. The site is currently covered by grassland, two ponds and an area of scrub woodland.

2.2 Proposed Development

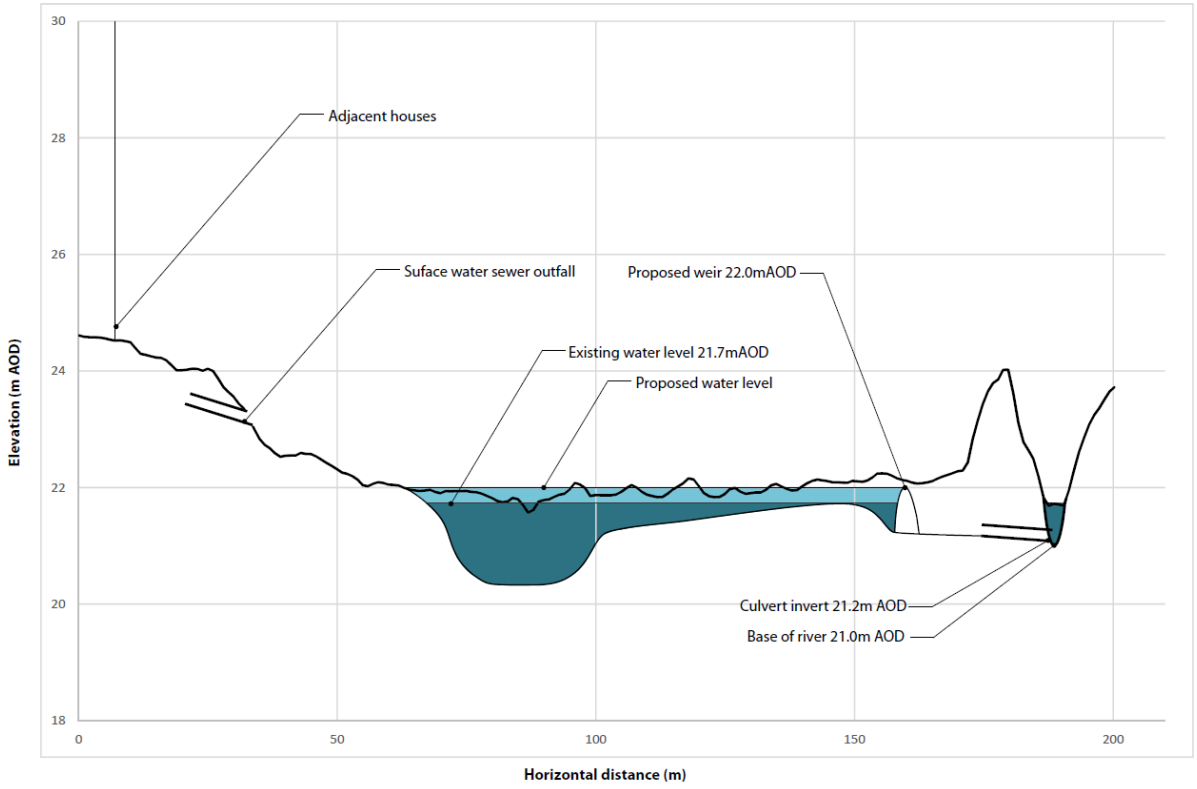
The proposal for the site is to develop a fen and reedbed complex around the existing pond. The full design is outlined in JBA Consulting (2017) - Doveside wetland design and is should on the figure below. The main feature of the design is the installation of a small weir on the main drain discharge through a culvert from the site. This weir will control water levels so that they spill onto the low-lying depression that surrounds the ponds. The scheme will result in normal water levels on site rising by circa 30cm; this is shown in Figure 2, which present a cross section of the site will current and future water levels on them. The weir will be a of a drop board construction so can also water levels to be adjusted (below a maximum height of 22mAOD). Additional drainage features (discussed in Section 4.2.2) will ensure that surrounding land is not affected.

Figure 1: Outline Wetland Design



Note: Water Levels are controlled at 22mAOD

Figure 2: Wetland Design Cross Section



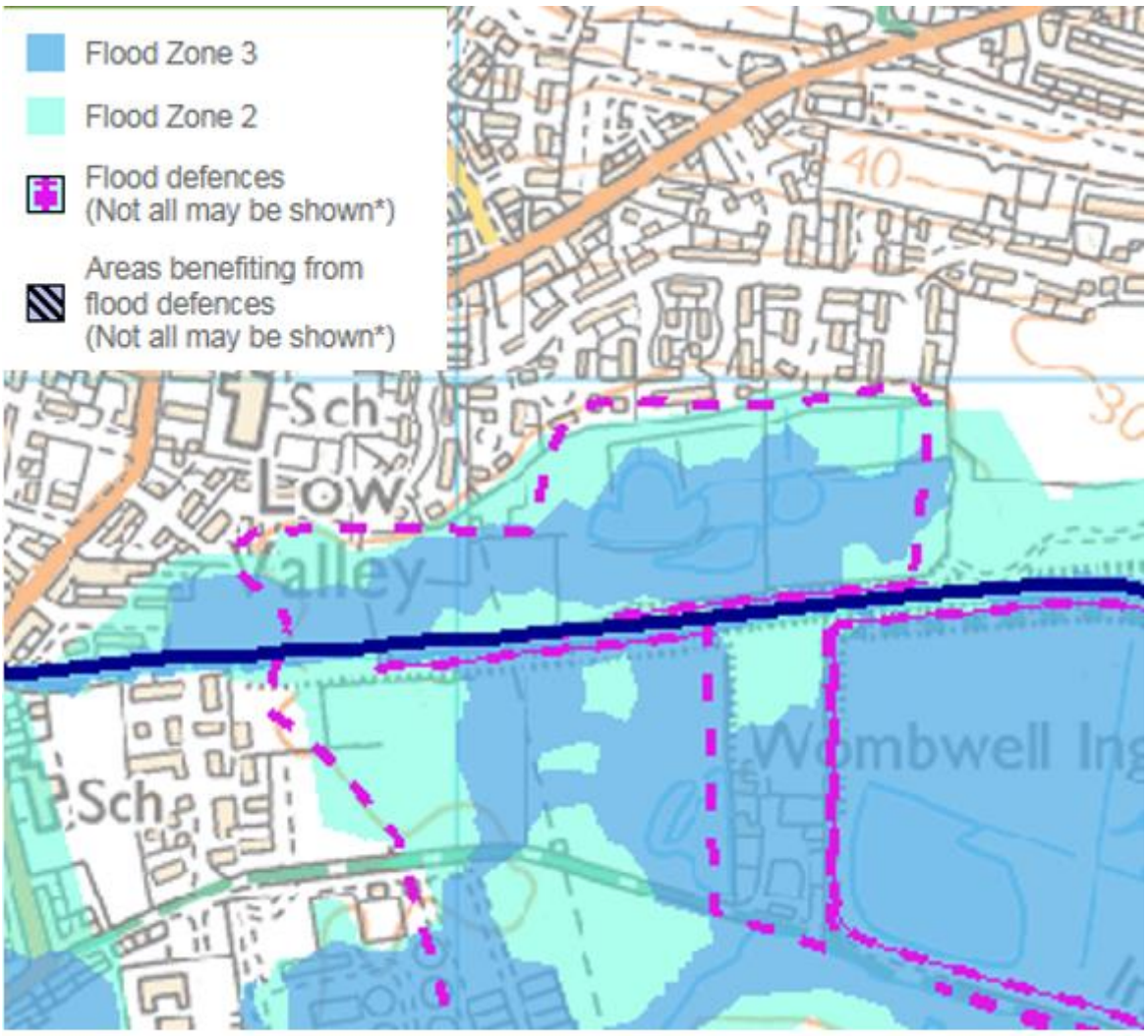
2.3 Site Baseline

2.3.1 Fluvial Flood Risk

The majority of the site is in Flood Zone 3 with the higher ground in the north of the site lying in Flood Zone 2 (see Figure below).

Localised flooding from drains may occur when the flow exceeds the hydraulic capacity of these channels. This will result in floodwaters spilling over the bank tops and onto adjacent land.

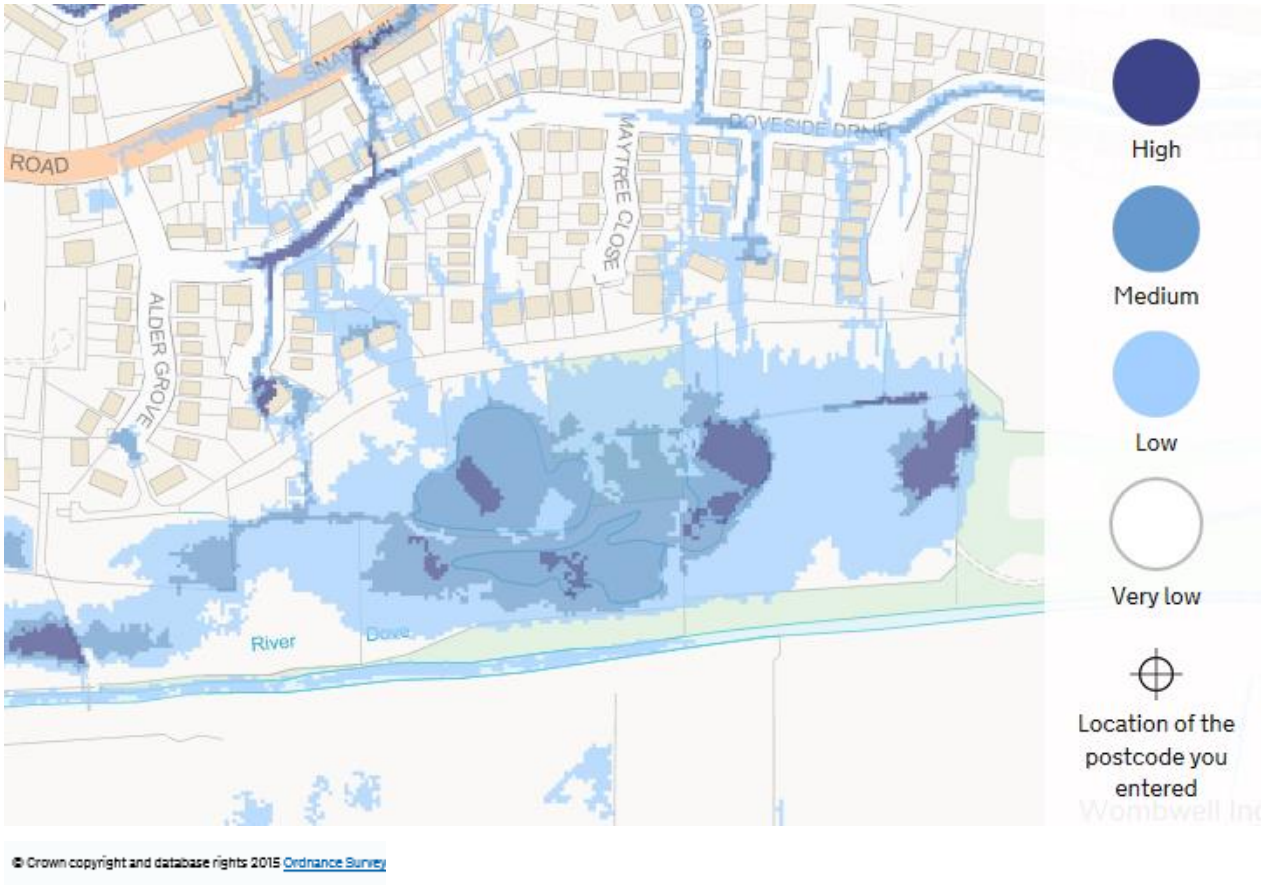
Figure 3: Fluvial Flood Risk



2.3.2 Surface Water Flood Risk

Surface water flooding arises when rain falling on saturated ground 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 that the site occupies is susceptible (see Figure 4).

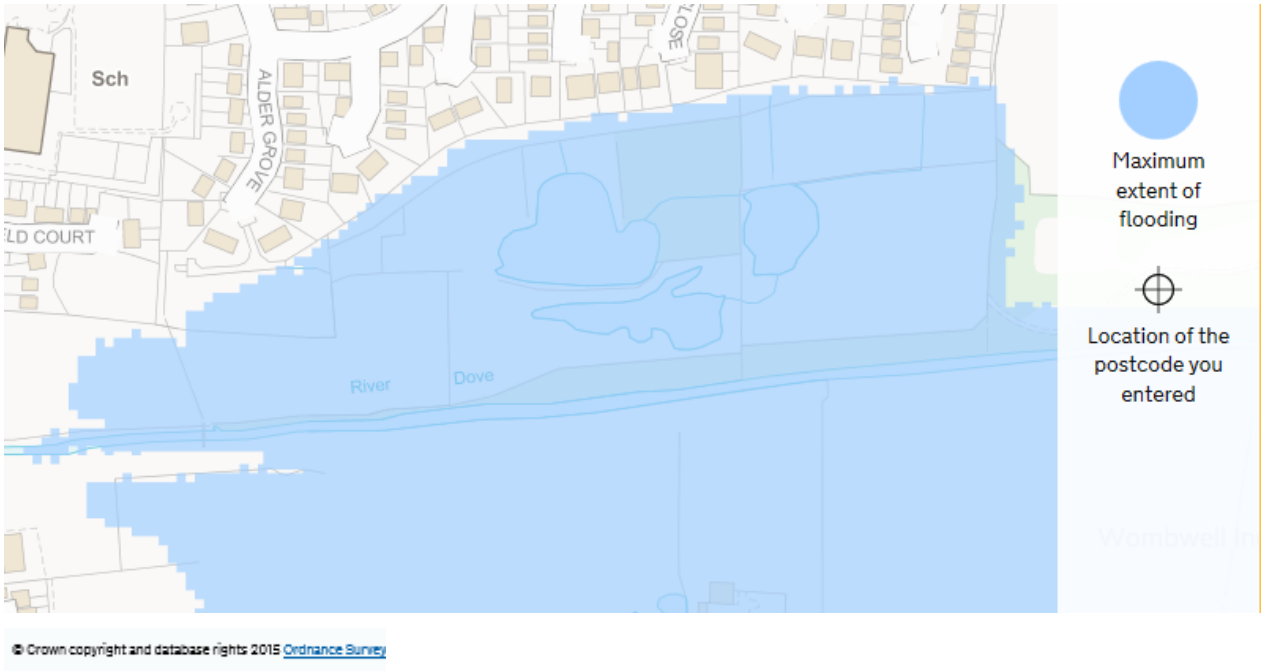
Figure 4: Surface Water Flood Risk



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



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 1. 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 1 shows how the Flood Zones relate to a sequential planning response. Advisory notes places upon various types of development are detailed in Table 2, and details of the Sequential and Exception Tests are provided in Table 3.

Table 1 Flood Zone Classification

Zone 1: Low Probability	
Land assessed as having a less than 1 in 1000 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 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual	**Appropriate uses** The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure are appropriate in this zone. Highly vulnerable uses are

probability of sea flooding (0.5% - 0.1%) in any year	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 2 Flood Risk Vulnerability Classification

Essential Infrastructure	- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. - Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. - Wind turbines.
Highly Vulnerable	- Police 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 Development	- Flood control infrastructure. - 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 restoring a wetland means that there are not by its nature alternative locations where the development can occur.

Table 3 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						
✓ 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 two main areas:

- Changes in floodplain storage,
    - To ensure that the proposed scheme will not significantly change floodplain storage locally.
- Change in drainage status of surrounding ground,
    - Ensure the scheme will not lead to an increased risk of more frequent saturation of surrounding ground.

4.1 Changes in Floodplain Storage

The scheme aims to raise water levels on site to allow water to spill from the ponds onto the surrounding ground. This could have the potential to remove floodplain storage, however, due to the nature of the site, the effect on floodplain storage should be minimised. This is because, in a flood event, a significant volume of water is likely to be standing on the site before the river overtops the embankment; in effect reducing the actual available floodplain storage of the site at that time. This is due to the following reasons:

- The site drainage is not efficient in draining the site and water levels onsite in the ponds are currently controlled by a 'hump' in the drain leading to the outfall culvert (see JBA 2017),
- The culvert discharge point does not currently have a flap on it. Therefore, when river levels increase above the height of the ponds, water enters the site from the river through the culvert.
- There are likely to be significant run-off and sewer inputs into the site during the flood events, which will also fill the site prior to the river overtopping the embankment.

The proposed weir will increase the level at which water from the river can enter the site through the culvert. In a flood event, this will initially delay water entering the site from the river compared to current conditions, but once the river is above the weir crest water will once again flow into the site.

Appendix A includes a calculation of the theoretical maximum potential floodplain storage loss. This is based on the assumption that the site is effectively drained before a flood event and thus provides a maximum potential loss. However as explained this is unlikely to be the case when the Dove is in high flow conditions since surface water and in bank flow at lower levels will have contributed to occupying the available flood plain storage.

The wetland may contribute to providing some flood attenuation benefits, as the extended reed bed proposals are likely to reduce the rate at which water can drain from the site back into the Dove.

Overall, any loss of floodplain storage volume is not significant and the land will not be lost from floodplain storage.

4.1.1 Cut and Fill calculations

JBA Consulting (2017) Doveside Wetland Design report includes a cut and fill calculation for the scrapes, bunds and drains as part of the scheme. Excess material from the scrapes will be disposed of below the existing surface of the ponds to improve marginal habitats. This will therefore not result in a change in floodplain storage.

4.2 Drainage Impacts

4.2.1 Introduction

Surrounding areas of land drain into the site and therefore the proposed wetland should not impede this drainage function. The two main functions are:

- Three surface water sewer culverts from the housing developments to the north discharge into the site;
- The land to the west of the site is drained by a ditch which enters the western pond.

These are shown in the figure below.

Figure 6: Existing Site Drainage

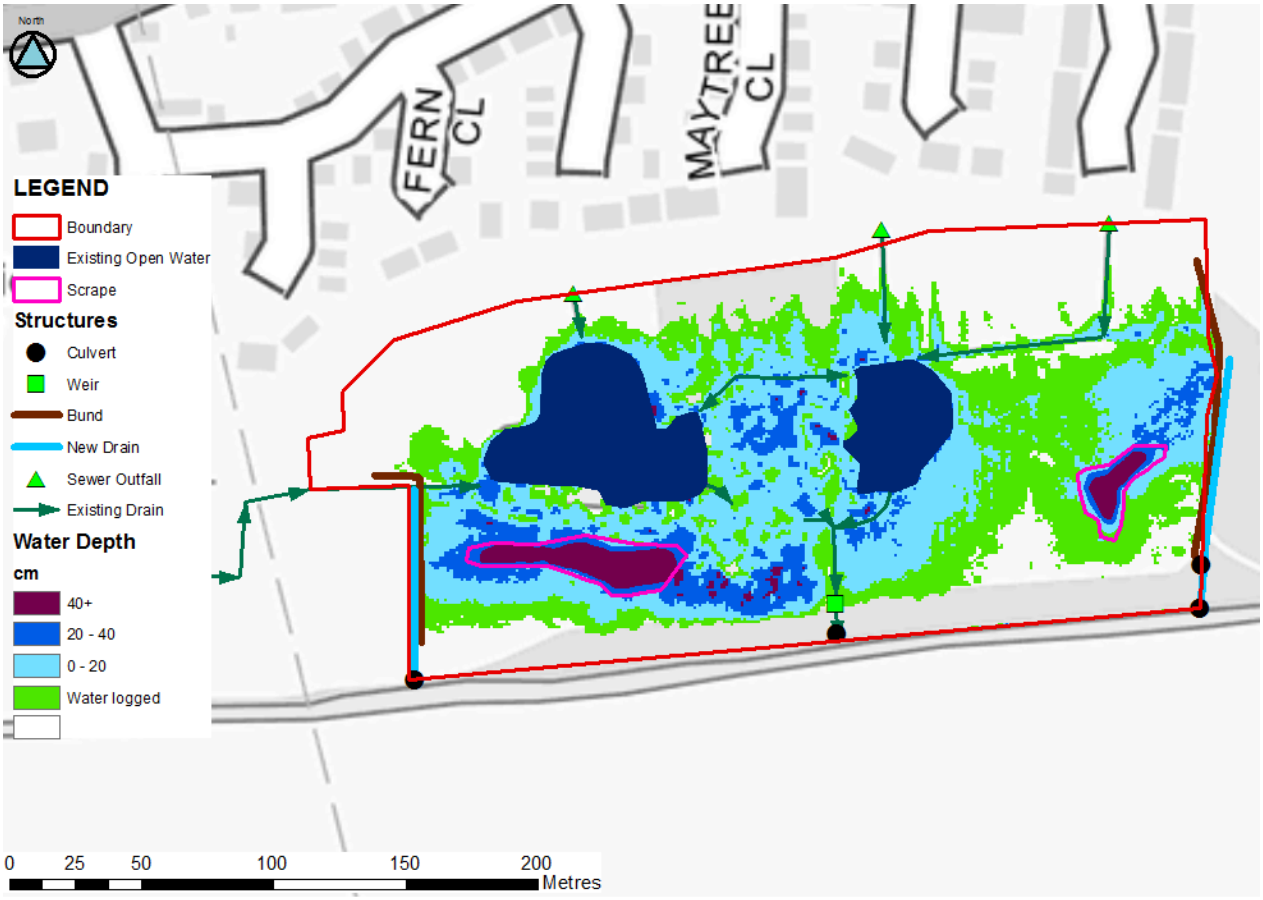
4.2.2 Impacts and Mitigation

Two mitigation measures have been built into the design to ensure no impacts on surrounding land (see Figure 7):

- The water levels on site have been set significantly lower than the inverts of the sewer outfalls to ensure that their operation is not affected and that they continue to discharge to the site.
- A new drain and outfall have been designed to convey water from the land to the west.

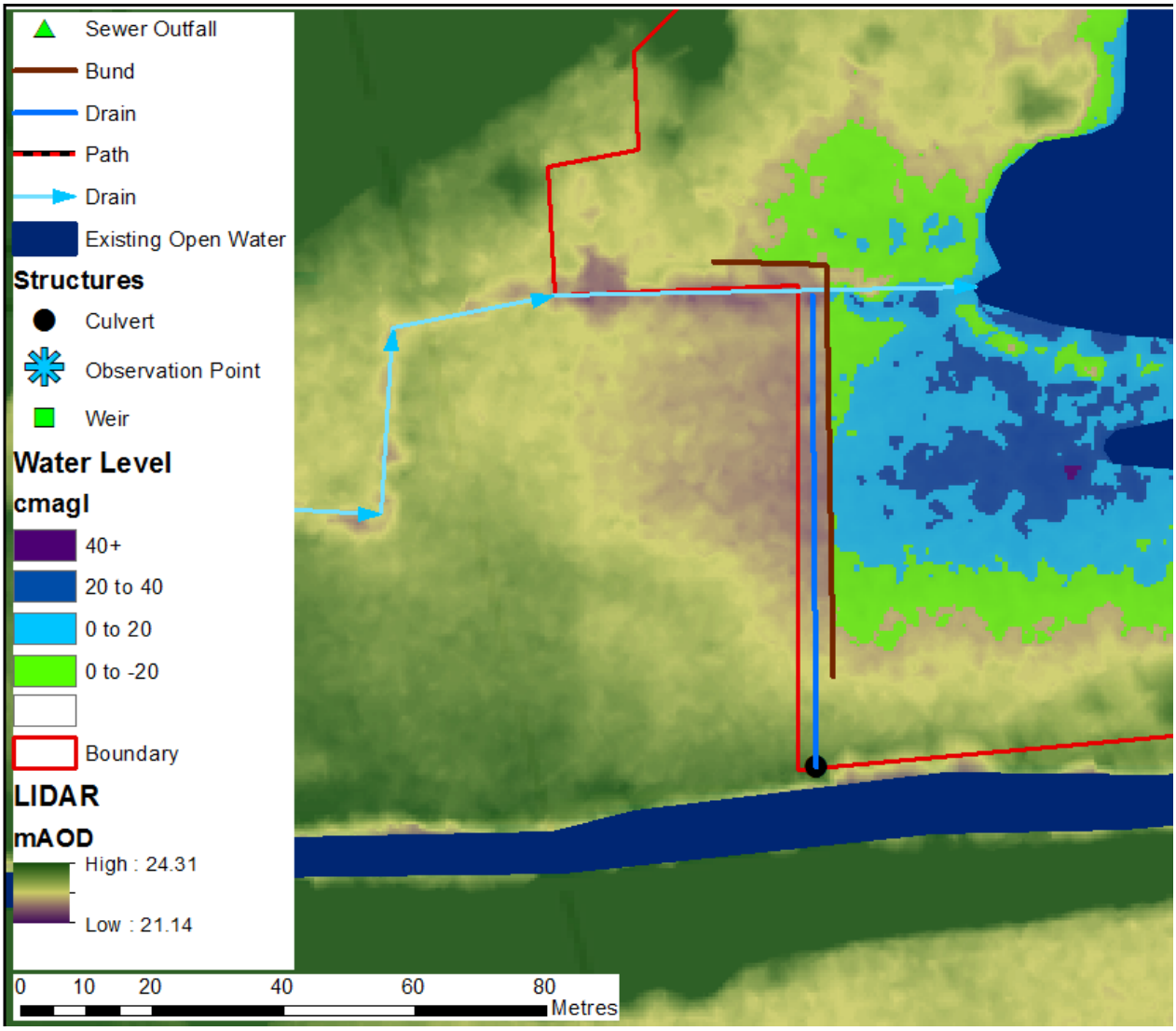
The latter mitigation is more complex and is discussed below.

Figure 7: Wetland Design and Drainage Mitigation



On all sides of the scheme, the boundary is formed by rising ground. The exception to this is part of the western boundary, where one corner of the adjoining field is at a similar elevation to the low lying ground of the site (see Figure 6). This area (and the area immediately to the west) is dependent on the site for its drainage. The raising of the water levels on the site, would thus cause significant inundation of part of the western adjacent field (see Figure 6), without mitigation. The design thus includes provision for diverting the existing drain through a new culverted discharge point, along the site boundary and isolating the inundation from the wetland scheme with a bund (Figure 8). The specification of the drain will be confirmed at the detailed design stage; however, it should have the same or better conveyance than the existing channel. This should be easily achieved as the route of the new drain will be shorter and steeper and not run through the pond system so will be easier to access and maintain. The new culverts will include flap valve so they will not allow water from the river, in high stage, to enter the site through them.

Figure 8: Arrangement of Relief Drain and Bund on Western Edge



5 Summary and Conclusions

Part of the site lies within Flood Zone 3 and is used for nature conservation and biodiversity. The proposed restoration works represent 'Water-Compatible Development' under the National Planning Policy Framework (NPPF) technical guidance. Under this guidance, water-compatible uses can be permitted in this zone as long as they:

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

The FRA addressed these elements by assessing the impact of the scheme on: its effect on floodplain storage, and on the drainage of surrounding land. The conclusion of all these assessments is that the likely impact of the scheme on flood risk is minimal. In order to ensure this, the proposed drain diversions should have similar or better capacity than the existing drains.

A Flood Plain Storage Calculation

Table A presents the volume of water stored above the ground surface (i.e. not including the volume below the surface of the existing ponds) in two situations:

- when the waters levels are being controlled by the levels set by the wetland design (at 22mAOD),
- during a 100yr flood event (at 22.98mAOD).

The 100yr event is based on the results of a detailed JBA model of the River Dove produced in 2009, which included a cross section which bisected the site. The table indicates that the scheme could result in 3239m^3 loss of floodplain storage volume; which equates to 8.6% of the on-site storage of water during the 1 in 100 year event (37534 m^3), and a significantly smaller proportion of the storage on the wider River Dove - Billing Brook floodplain.

When compared to the flow in the River Dove, the water stored on site as part of the wetland also appears to have limited significance. The Q2 (the flow exceeded every two years on average) is 8.04m3/s; this would fill the 3239m2 stored on site in less than 6 minutes.

Table A1: Inundation Area and Volume within the Site at the Managed Water Level and in a 100yr flood event

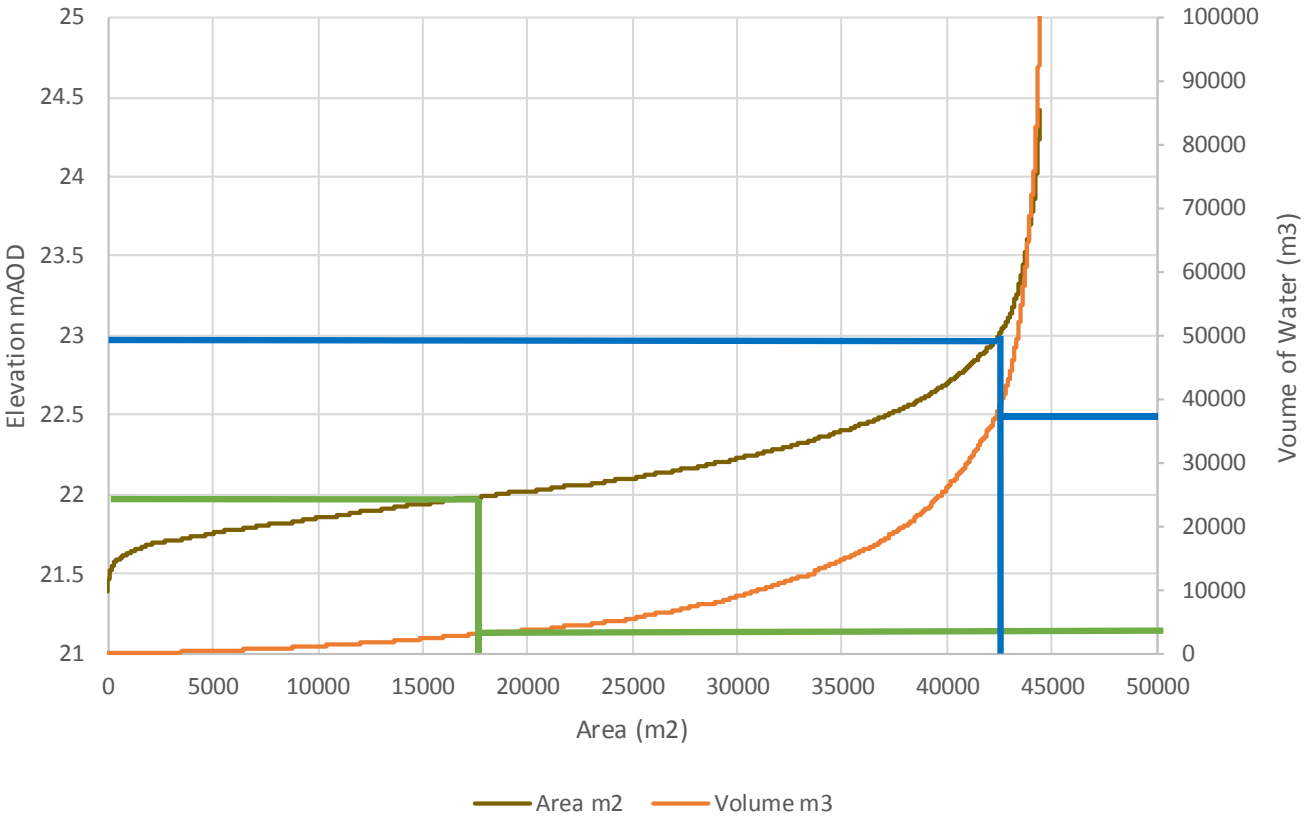
	Water Elevation mAOD	Inundation Area (m^2)	Inundation Volume (m^3)
Managed Level	22	19,094	3,239
100yr Maximum	22.98	42,395	37,524

The results in Table A1 were calculated based on the analysis shown in Figure A1. LIDAR DTM data for the site was used to create an Elevation vs cumulative area plot, which presents the range of elevations across the site, the area occupied by that elevation and all lower ground; in effect an averaged cross section. This was then used to produce an area vs volume of water plot, which calculates for a given area of inundation created across the site, the volume of water that would be stored. The analysis above has the following limitations:

- It is based on the assumption that the level of the ponds in the LIDAR data is representative.
    - Give the poor controls on the level of the ponds (hump in the drain base - see JBA 2017), identifying a suitable pond level for the analysis is difficult. The ponds may naturally for periods be much higher than the analysis assumes.
- This analysis does not take into account, that water will flood from the river into the site, through the culvert before overtopping. Much of the site floodplain storage will, therefore, be lost before the river floods into the site. This process is discussed more in Section 4.1.

Overall, the analysis produces a maximum theoretical loss of floodplain storage. In reality, the site is poorly drained, and in a flood, is likely to have significant volumes of standing water on the site before it overtops. The wetland will not change this situation, so the loss/change in floodplain storage from the scheme should not be significant.

Figure A1: Elevation and Volume vs Area Plot



References

Department of Communities and Local Government, 2014. National Planning Policy Framework Flood Risk and Coastal Change Planning Practice Guidance (ID:7), March 2014.

JBA Consulting (2017), Doveside Wetland Design

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