



**The Low Valley Arms Public House, Station Road, Low
Valley, Wombwell, Barnsley, S73 0BD**

NPPF: Flood Risk Assessment

For White Rose Homes Limited

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Project	NPPF: Flood Risk Assessment
Client	White Rose Homes Limited
Status	Final
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EXECUTIVE SUMMARY

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF.

The development should not therefore be precluded on the grounds of flood risk.

The results show that the afflux (difference between normal depth profile and backwater profile) does not vary as a result of the proposed culvert extension for a given event. The 1 in 20 year (5%), 1 in 100 year (1%) and 1 in 1000 year (0.1%) events have been modelled.

Extending the culvert by 13m in length is shown to increase the estimated maximum water level upstream of the culvert by 130mm during the 1 in 1000 year (0.1%) event. The primary cause of the rise in water level is an increase in energy loss due to friction.

Although a small increase in upstream water levels are calculated, water levels are shown to stay within the channel of the Bulling Dike when compared to the topographical survey of the site. The nearest upstream ground level to the culvert is 25.45mAOD.

The proposed extension to the culvert will not result in a significant increase in flood risk to offsite locations based on the available level information. The flood risk to the site will also not be increased significantly.

The risk from this Bulling Dike will be further managed and mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site. Therefore, the risk of flooding from the Bulling Dike is considered to be of **low significance**.

The flood risk at the site will be reduced by property level protection measures. Measured used:

Site Layout - Sequential Approach: The sequential approach has been applied within the site by locating the most vulnerable elements of a development in the lowest risk areas. The most vulnerable use, the dwellings, has been situated on the higher part of the site at a lower risk of flooding with the more flood-compatible uses such as the garden/landscaped areas being situated in the lower part of the site at a higher risk of flooding.

The site ground levels rise from south east to north west, the dwellings will be located to the north west of the site where ground levels are higher and the gardens and car parking will be located to the south east of the site where ground levels are lower.

Site Layout - Finished Floor Levels: Raising the floor levels of the dwellings will be used to mitigate the effects of flooding at the site. The finished floor levels should be located a minimum of 300mm above the existing ground level or frontage road level, whichever is higher. Therefore, reducing the flood risk posed to the dwellings.

The finished floor level of the dwellings cannot be raised any higher as it would not be possible to safely access the building, there would not be the required headroom on the ground floor and other planning constraints mean that the finished floor level cannot be raised higher.

Site Layout - Raised Thresholds: The threshold levels of the dwellings be raised a minimum of 300mm above the existing ground level or frontage road level, whichever is higher. Therefore, reducing the flood risk posed to the dwellings.

Site Layout - First Floor Accommodation: Residential accommodation will be located on the first floor floors. This will allow residents to retreat to higher floor levels if needed.

The level of the first floor will be located approximately 2.75m above the ground floor finished floor level well above any flood water levels.

This will provide a 'safe haven' above any flood water levels. This will enable rapid escape should an unlikely failure in the flood defences occur. The upper floors will be accessed via internal stairs and are sufficient in size to safely house all occupants of the dwelling.

The 'safe haven' will only be required in very extreme events or if a flood warning has not been received.

Flood Resilience and Resistance: To make the dwellings more resistant to seepage the following measures will be incorporated. Sealant will be used around external doors and windows. All windows will be located 1000mm above the ground levels. All external doors and windows will be constructed from synthetic materials. The walls of the dwellings will be thick.

To improve the dwellings resilience to flooding the following measures will be incorporated. All electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 450mm above the finished floor level.

Flood Warning and Evacuation: The site is located in a flood risk area therefore; the dwelling will participate in the Environment Agency flood warning telephone service. The site will register contact details with the Environment Agency' Flood Warnings Direct Service (Floodline 0845 988 1188) in order to receive Flood Warnings for the following Flood Warning area:-

- Aldham Bridge including Aldham Crescent and Barnsley Road. Low Valley including Valley Road, Station Road, Bayford Way, Cotterdale Gardens, Stonyford Road, Town Lands Close, Henry Street and Wombwell Ings Caravan Site.

The Environment Agency operate a free flood warning service providing alerts by phone, text or email when flooding is anticipated providing an opportunity for owners to take necessary precautions, giving enough time for the building to be safely evacuated and mitigation measures to be put in place.

Flood Plan: A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed.

Safe Access and Egress Routes: The surrounding area is located within Flood Zone 1 and therefore has a 'low probability' of flooding, with less than 1 in 1000 annual probability of river in any year (<0.1%). Therefore, during the 1 in 100 year (plus climate change) event safe access and egress routes can be maintained in accordance with the NPPF and Environment Agency Guidance. Safe access and egress routes can also be maintained during the 1 in 1000 year event.

Safe access and egress routes, including emergency access can be maintained for vehicles and/or by foot. The Safe Exit Routes shown in Drawing 3 indicates the exit route that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received.

People should make their way to areas outside of the flood zone via London Road. The nearest location outside of the floodplain includes:

- Darfield to the north east.
- Wombwell to the east.

Facilities such as community centres, shops etc. are located within this town/village which may be used in the event of a flood event. There may also be large areas that are flood free located nearer and within the vicinity of the site.

In the event of a Flood Warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site using the routes.

If required a 'safe haven' can also be maintained and may be required in very extreme events if a flood warning has not been received.

1.0 INTRODUCTION

1.1 Background

This Flood Risk Assessment (FRA) has been prepared by KRS Environmental Limited at the request of White Rose Homes Limited to support a planning application for the proposed development at The Low Valley Arms Public House, Station Road, Low Valley, Wombwell, Barnsley, S73 0BD.

An FRA - Level 1 Screening Study has been undertaken for the site (Report No. 3433, January 2014). The requirement for this assessment comes from the local Internal Drainage Board (IDB); namely the Danvm DC (part of the Shire Group of IDB's) who provided the following comment:

'Overall the IDB needs to be ensured that flood risk is not increased upstream for the residents of the area. If there is an increase in water levels upstream then the impact of flooding will need to be addressed'.

Therefore, the change in maximum water level, if any, at the Station Road culvert has been calculated. A significant increase in culvert length may increase flood depths upstream of the structure during high flows due to increased energy loss through the culvert associated with an increase in friction.

To provide the required evidence, the Environment Agency's Afflux Estimation System (AES) has been used to calculate the afflux (an increase in water level upstream of a structure at high flows) and maximum upstream water levels at the structure before and after the proposed extension works,

This FRA also provides more detailed information with regards to the flood risk posed to the site from fluvial source (i.e. the Bulling Dike), assesses the impact of the proposed culvert extension of the Bulling Dike on flood risk and proposes mitigation measures to reduce the flood risk poses to the site.

This FRA has been carried out in accordance with guidance contained in the National Planning Policy Framework (NPPF)¹ and Planning Practice Guidance². This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

It is recognised that developments which are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues.

1.2 National Planning Policy Framework (NPPF)

One of the key aims of the NPPF is to ensure that flood risk is taken into account at all stages of the planning process; to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

¹ Department for Communities and Local Government (2012) National Planning Policy Framework.

² Communities and Local Government (2014) Planning Practice Guidance - Flood Risk and Coastal Change.

It advises that where new development is exceptionally necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall.

A risk based approach is adopted at stages of the planning process, applying a source pathway receptor model to planning and flood risk. To demonstrate this, an FRA is required, this FRA assess whether the proposed development:

- will increase flood risk elsewhere; and
- whether the measures proposed to deal with these effects and risks are appropriate.

1.3 Report Structure

This FRA has the following report structure:

- Section 2 details the sources of information that have been consulted;
- Section 3 describes the location area and the existing and proposed development;
- Section 4 outlines the culvert assessment approach;
- Section 5 outlines the input data and parameters;
- Section 6 shows the afflux advisor outputs; and
- Section 6 presents a summary and conclusions.

2.0 SOURCES OF INFORMATION

2.1 Discussion with Regulators

Consultation and discussions with the relevant regulators have been undertaken during this FRA including the Environment Agency, the Local Planning Authority (LPA), and Sewerage Undertakers.

2.1.1 Environment Agency

The Flood and Water Management Act 2010 gives the Environment Agency a strategic overview role for all forms of flooding and coastal erosion. They also have direct responsibility for the prevention, mitigation and remediation of flood damage for main rivers and coastal areas. The Environment Agency is the statutory consultee with regards to flood risk and planning.

Environment Agency Flood Risk Standing Advice for England – National Version 2.0, the NPPF and Technical Guidance to the NPPF has been consulted and reviewed during this FRA. This has confirmed the level of FRA required. Information regarding the current flood risk at the application site, local flood defences and flood water levels has been obtained from the Environment Agency.

2.1.2 Barnsley Council

Barnsley Council is the LPA and the Lead Local Flood Authority (LLFA) and has responsibilities for 'local flood risk', which includes surface runoff, groundwater and ordinary watercourses. Planning guidance written by Barnsley Council regarding flood risk was consulted to assess the mitigation policies in place.

The Barnsley Council Strategic Flood Risk Assessment (SFRA) and the Barnsley Council Preliminary Flood Risk Assessment (PFRA) which cover the site have been reviewed.

2.1.3 Yorkshire Water

Yorkshire Water is responsible for the disposal of waste water and supply of clean water for this area. Information with regards to sewer and water main flooding contained within the Barnsley Council SFRA and the Barnsley Council PFRA has been consulted as part of this FRA. All Water Companies have a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system, and this is shown on the DG5 Flood Register.

2.1.4 Danvm DC

The Danvm DC maintains the Bulling Dike which is located on the site. The requirements for this assessment come from the local Internal Drainage Board (IDB); namely the Danvm DC (part of the Shire Group of IDB's) who provided the following comment:

'Overall the IDB needs to be ensured that flood risk is not increased upstream for the residents of the area. If there is an increase in water levels upstream then the impact of flooding will need to be addressed'.

3.0 LOCATION & DEVELOPMENT DESCRIPTION

3.1 Site Location

The site is located at The Low Valley Arms Public House, Station Road, Low Valley, Wombwell, Barnsley, S73 0BD (see Drawing 1). The National Grid Reference (NGR) of the site is SE 405 034.

The site comprises a piece of land covering an area of approximately 0.10 hectares (ha) or 1000m²

3.2 Existing Development

The current site is occupied by a two storey public house.

3.3 Proposed Development

It is understood that the proposals are for the erection of 7 dwellings along with associated car parking and access (see Appendix 1).

To facilitate the development, it is proposed that the existing box culvert located under Station Road is extended by 13m to provide sufficient space for the proposed development access.

Further details with regard to the proposed development can be found in the accompanying information submitted with the planning application.

3.4 Ground Levels

A topographical survey of the site was undertaken in December 2013 (see Appendix 2). The site ground level is approximately 25.00 to 26.00 metres above Ordnance Datum (mAOD).

The site ground levels rise from south east to north west (see Appendix 2), the dwellings will be located to the north west of the site where ground levels are higher and the gardens and car parking will be located to the south east of the site where ground levels are lower (see Appendix 1).

3.5 Catchment Hydrology

The Bulling Dike passes under Station Road, and passes beneath part of the site within a box culvert of approximately 30m in length (see Drawing 2). The Bulling Dike is designated as an Ordinary Watercourse.

It is proposed to extend the existing culvert by 13m (see Appendix 3). The proposed culvert will match the existing culvert in width, height and type to reduce the impact on water levels within the Bulling Dike and therefore the flood risk posed to the site and offsite locations.

The Bulling Dike poses the primary but unlikely flood risk to the site. In extreme events the Bulling Dike may inundate the site with floodwater. The water level of Bulling Dike is located approximately 1.70m below the road level.

Photographs of the existing culvert and Bulling Dike are shown in Figures 1 to 4.



Figure 1 - Downstream Face 1 (on site)



Figure 2 - Downstream Face 2 (on site)



Figure 3 - Profile of the Culvert



Figure 4 - Channel Downstream of Culvert

4.0 CULVERT ASSESSMENT APPROACH

4.1 Afflux

Afflux is an increase in water level than can occur upstream of a structure at high flows as illustrated in Figure 5 below. It is caused by energy losses at high flows through bridges and culverts, and it is made worse by blockage. Afflux can be physically significant in terms of flood levels and leads to a potential for increased losses due to blockage.

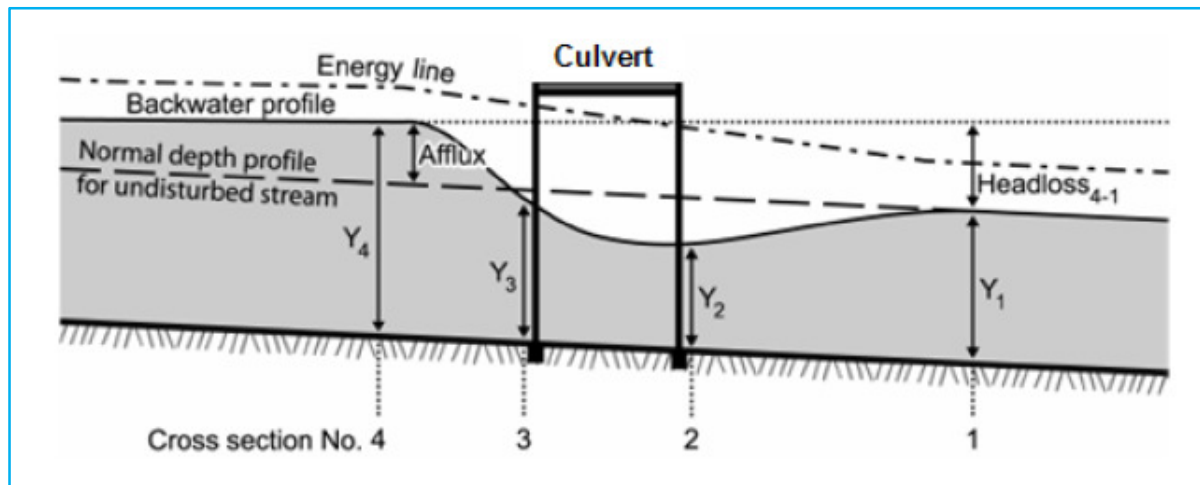


Figure 5 - Side Elevation at a Culvert Contraction (source: Afflux Estimation System, Defra/Environment Agency August 2007)

To calculate the maximum afflux for the existing and post development scenarios along with the maximum upstream water levels, the Environment Agency's Afflux Estimation System (AES) for bridges and culverts has been used; particularly the Afflux Advisor (AA) excel spreadsheet programme.

The AA spreadsheet allows users to calculate rating curves with and without a structure for a single cross section in a river. It also calculates water levels for the main classes of culverts described in the current CIRIA culvert design manual. Given the subject culvert is a simple box structure, the use of this programme is suitable.

It is important to note that the AA has been developed towards simplicity in use. There are therefore some limitations to the accuracy of the values. To provide more accurate assessment of the afflux and flood risk in an area, detailed computational hydraulic modelling would be required. However, given the scope of the proposals, the use of the AA is considered adequate and accurate for the purpose of this investigation.

5.0 INPUT DATA & PARAMETERS

5.1 Cross Section Data

The basic watercourse cross section data is shown in Figure 5. This has been input into the AA spreadsheet to describe the general channel geometry at the culvert. The data has been extracted from the topographical survey (see Appendix 2) and the culvert details (see Appendix 3).

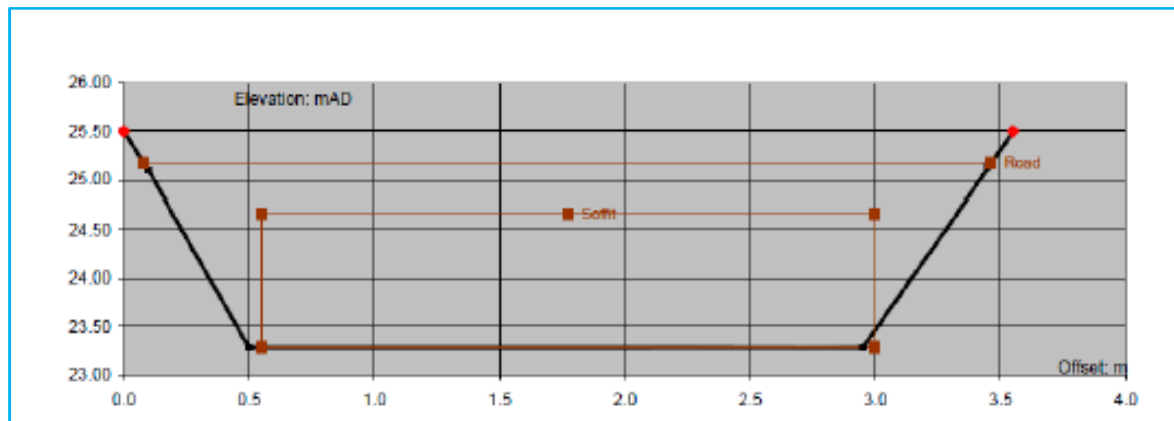


Figure 5 - Watercourse Cross section

5.2 Culvert Details

Table 1 shows the existing, proposed culvert details and confirms that the proposed culvert will match existing culvert.

Table 1 - Existing and Proposed Culvert Details

Inlet Shape	Inlet Type	Dimensions (m) (W x H)	Length (m)	Soffit Level (mAOD)	Invert Level (mAOD)	Road Level (mAOD)	Manning's n Roughness
Rectangular; Concrete	Type A – Headwall only; Square Edge	2.45 x 1.38	Existing - 30; Proposed - 43 (+13m)	24.66	23.28	25.17	0.014

5.3 Slope

A slope of 1 in 100 (0.1%) has been input into the AA spreadsheet and has been based on the topographical survey (see Appendix 2).

5.4 Inflow Hydrology

To fully analyse the potential variation in maximum afflux and upstream water levels associated with the proposed culvert extension, a range of extreme fluvial events for the Bulling Dike have been considered. The 1 in 20 year (5%), 1 in 100 year (1%) and 1 in 1000 year (0.1%) events have been modelled.

Peak flows have been calculated using ‘industry standard’ techniques such as the Centre for Ecology and Hydrology (CEH) Flood Estimation Handbook (FEH) CD-ROM v3.0³, and the Revitalised Rainfall Runoff (ReFH) Method⁴. The method is based on robust hydrological modelling techniques.

Peak flows are shown in Table 2 and associated hydrographs are shown in Figure 6.

Table 2 - Peak Flows

Event (AEP)	Return Period (years)	Peak Flow (m ³ /s)
5%	1 in 20	1.54
1%	1 in 100	2.27
0.1%	1 in 1000	4.91

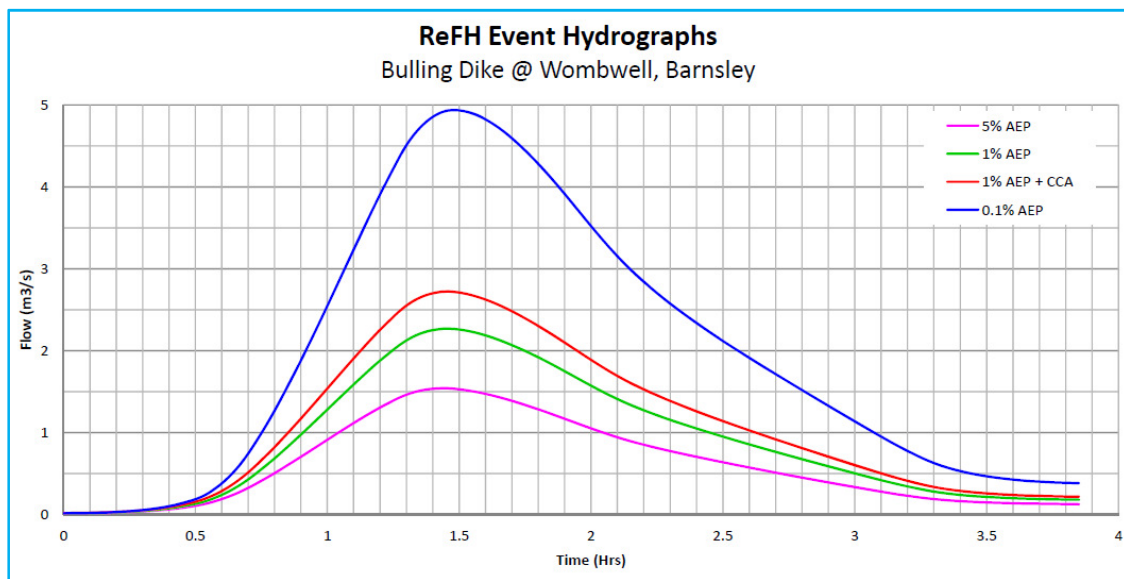


Figure 6 - ReFH Event Hydrographs

5.5 Sensitivity Testing

To improve confidence in the calculation outputs a range of sensitivity tests have been undertaken which investigates the effect of significant variations in various parameters on final calculated flood levels and afflux. The parameters considered are channel/bed roughness (+/- 20%), slope (+/- 20%) and barrel roughness (+20%).

³ Flood Estimation Handbook CD-ROM v3.0 2009, Centre for Ecology and Hydrology.

⁴ Flood Estimation Handbook, Supplementary Report No. 1 2007, The revitalised FSR/FEH rainfall-runoff method, Centre for Ecology and Hydrology.

6.0 AFFLUX ADVISOR OUTPUTS

6.1 Results

The AA spreadsheet has been used to estimate the maximum change in peak water level at the upstream face of the Station Road culvert during a range of flow events. Selected screenshots are shown in Appendix 4 for information along with a tabulated set of result data.

The primary calculations are shown in Table 3.

Table 3 – Afflux Advisor Output

Bed Roughness	0.04	Bank Roughness	0.05
Slope	0.01	Barrel Roughness	0.014

Event (AEP)	Return Period (years)	Peak Flow (m ³ /s)	Afflux (m)			Upstream Water Level (mAOD)		
			Existing Culvert (30m)	Proposed Culvert (43m)	Variation	Existing Culvert (30m)	Proposed Culvert (43m)	Variation
5%	1 in 20	1.54	0.095	0.095	0.00	24.151	24.281	+ 0.130
1%	1 in 100	2.27	0.132	0.132	0.00	24.325	24.455	+ 0.130
0.1%	1 in 1000	4.91	0.244	0.244	0.00	24.841	24.971	+ 0.130

6.2 Discussion

The results show that the afflux (difference between normal depth profile and backwater profile) does not vary as a result of the proposed culvert extension for a given event. The 1 in 20 year (5%), 1 in 100 year (1%) and 1 in 1000 year (0.1%) events have been modelled.

Afflux remains unchanged after the 13m extension of the culvert as the proposals do not include alterations to the inlet/outlet geometry i.e. the barrel shape will remain the same. During the 1 in 1000 year (0.1%) event the afflux remains the same for the existing and proposed culvert length at 244mm.

While afflux is unchanged, extending the culvert by 13m in length is shown to increase the estimated maximum water level upstream of the culvert by 130mm during the 1 in 1000 year (0.1%) event. During the 1 in 1000 year (0.1%) event, for the existing culvert arrangements the maximum upstream water level is 24.48mAOD. When the proposed culvert arrangement is considered, the upstream water level increases to 24.94mAOD. The primary cause of the rise in water level is an increase in energy loss due to friction.

Although a small increase in upstream water levels are calculated, water levels are shown to stay within the channel of the Bulling Dike when compared to the topographical survey of the site. The nearest upstream ground level to the culvert is 25.45mAOD.

The proposed extension to the culvert will not result in a significant increase in flood risk to offsite locations based on the available level information. The flood risk to the site will also not be increased significantly.

The risk from this Bulling Dike will be further managed and mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 7.0). Therefore, the risk of flooding from the Bulling Dike is considered to be of **low significance**.

7.0 RISK MANAGEMENT

7.1 Introduction

The flood risk at this location is considered suitable for ‘more vulnerable’ developments within the NPPF. In this flood zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development and the use of flood mitigation measures.

A number of techniques and mitigation strategies to manage and reduce the overall flood risk in the area will be used. This will ensure the development will be safe and there is:

- Minimal risk to life;
- Minimal disruption to people living and working in the area;
- Minimal potential damage to property;
- Minimal impact of the proposed development on flood risk generally; and;
- Minimal disruption to natural heritage.

The flood risk at the site will be reduced by property level protection measures (see Table 5); these are discussed in more detail below.

The proposed development will improve the sites resilience, resistance to flooding and by using property level protection measures to protect the site from flooding the vulnerability of the site will be improved.

Table 4 - Property Level Protection Measures

Measure	Details	Description
Site Layout	1. Sequential Approach 2. Finished floor levels 3. Raised thresholds 4. First floor accommodation	Prevents water ingress and reduce vulnerability of occupants to flooding
Flood Resistance/ Flood Resilience	1. Thick walls 2. Sealant used around external doors and windows 3. Hard tiled floor surfaces 4. Raised utility entry points, ceiling down electrical circuits and electrical systems distributed at a high level	Prevents water ingress
Safe Access and Egress Routes	1. Safe access and escape route to areas outside of floodplain	Reduce vulnerability of occupants to flooding
Flood Warning	1. Warning so the property can be safely evacuated and mitigation measures to be put in place	Reduce vulnerability of occupants to flooding
Flood Plan	1. Outlines precautions and actions taken when a flood event is anticipated	Reduce vulnerability of occupants to flooding and makes them aware of the mechanisms of flooding at the site

7.2 Site Layout

7.2.1 Sequential Approach

The sequential approach has been applied within the site by locating the most vulnerable elements of a development in the lowest risk areas. The most vulnerable use, the dwellings, has been situated on the higher part of the site at a lower risk of flooding with the more flood-compatible uses such as the garden/landscaped areas being situated in the lower part of the site at a higher risk of flooding.

The site ground levels rise from south east to north west (see Appendix 2), the dwellings will be located to the north west of the site where ground levels are higher and the gardens and car parking will be located to the south east of the site where ground levels are lower (see Appendix 1).

7.2.2 Finished Floor Levels

Raising the floor levels of the dwellings will be used to mitigate the effects of flooding at the site. The finished floor levels should be located a minimum of 300mm above the existing ground level or frontage road level, whichever is higher. Therefore, reducing the flood risk posed to the dwellings.

The finished floor level of the dwellings cannot be raised any higher as it would not be possible to safely access the building, there would not be the required headroom on the ground floor and other planning constraints mean that the finished floor level cannot be raised higher.

7.2.3 Raised Thresholds

The threshold levels of the dwellings be raised a minimum of 300mm above the existing ground level or frontage road level, whichever is higher. Therefore, reducing the flood risk posed to the dwellings.

7.2.4 First Floor Accommodation

Residential accommodation will be located on the first floor floors. This will allow residents to retreat to higher floor levels if needed.

The level of the first floor will be located approximately 2.75m above the ground floor finished floor level well above any flood water levels.

This will provide a 'safe haven' above any flood water levels. This will enable rapid escape should an unlikely failure in the flood defences occur. The upper floors will be accessed via internal stairs and are sufficient in size to safely house all occupants of the dwelling.

The 'safe haven' will only be required in very extreme events or if a flood warning has not been received.

7.3 Flood Resilience and Resistance

The development of the layout should always consider that the site is potentially at risk from an extreme event and as such the implementation of flood resilience and resistance methods should be assessed.

To make the dwellings more resistant to seepage the following measures will be incorporated. Sealant will be used around external doors and windows. All windows will be located 1000mm above the ground levels. All external doors and windows will be constructed from synthetic materials. The walls of the dwellings will be thick.

To improve the dwellings resilience to flooding the following measures will be incorporated. All electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 450mm above the finished floor level.

7.4 Flood Warning and Evacuation

The site is located in a flood risk area therefore; the dwelling will participate in the Environment Agency flood warning telephone service. The site will register contact details with the Environment Agency's Flood Warnings Direct Service (Floodline 0845 988 1188) in order to receive Flood Warnings for the following Flood Warning area:-

- Aldham Bridge including Aldham Crescent and Barnsley Road. Low Valley including Valley Road, Station Road, Bayford Way, Cotterdale Gardens, Stonyford Road, Town Lands Close, Henry Street and Wombwell Ings Caravan Site.

The Environment Agency operate a free flood warning service providing alerts by phone, text or email when flooding is anticipated providing an opportunity for owners to take necessary precautions, giving enough time for the building to be safely evacuated and mitigation measures to be put in place.

All occupants of the site will be made aware of the Environment Agency Floodline telephone number and the Flood Warning Codes and their meaning.

The owners of the properties will carry out the role of Flood Warden for the site and ensure they have an understanding of the flood mechanisms of the site and will ensure that the safety of the occupants and visitors will not be compromised.

The Environment Agency uses Flood Warnings Codes. They can be issued in any order, usually ending with an 'all clear'. They are issued by the Environment Agency through their website⁵ and Floodline Warning Direct.

The flood warning will be passed onto the occupiers and visitors of the site verbally, by telephone and/or in person. It will be ensured that everyone receives the flood warnings when required.

7.4.1 Flood Plan

A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed.

Sensible precautions would include raising electrical items, irreplaceable items and sentimental items off the ground or where possible moving them to a higher floor, rolling up carpets and rugs and turning off utilities. In addition, consider what actions you would take should the property need to be evacuated including access and egress routes and preparing a flood kit in advance containing warm clothing, medication, a torch, food and wellingtons.

The Flood Plan is a 'living' document and therefore should be periodically reviewed and updated to provide advice and guidance to occupants in the event of an extreme flood.

The Flood Plan will therefore reduce the vulnerability of the occupants to flooding and makes them aware of the mechanisms of flooding at the site.

Residual Risk

If flooding starts to affect the site without any pre-warning i.e. in real time (e.g. through a failure of the flood warning delivery) the following actions will be taken:

⁵ Available at <http://www.environment-agency.gov.uk/homeandleisure/floods/31618.aspx>. Where specific information can be found by entering the house postcode or address.

- Occupants and visitors should consider evacuating the site.
- If flood levels continue to rise, occupants and visitors are advised to evacuate before safe access is lost. Occupants and visitors should monitor the flood progression and evacuate.

The Flood Warden will monitor flood levels and keep occupants and visitors informed and will decide whether to initiate the Flood Plan.

7.4.2 Safe Access and Egress Routes

The NPPF requires that, where required, safe access and escape is available to/from new developments in flood risk areas. Access routes should be such that occupants can safely access and exit their dwellings in design flood conditions. These routes must also provide the emergency services with access to the development during a flood event and enable flood defence authorities to carry out any necessary duties during the period of flood.

The surrounding area is located within Flood Zone 1 and therefore has a 'low probability' of flooding, with less than 1 in 1000 annual probability of river in any year (<0.1%). Therefore, during the 1 in 100 year (plus climate change) event safe access and egress routes can be maintained in accordance with the NPPF and Environment Agency Guidance. Safe access and egress routes can also be maintained during the 1 in 1000 year event.

Safe access and egress routes, including emergency access can be maintained for vehicles and/or by foot. The Safe Exit Routes shown in Drawing 3 indicates the exit routes that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received.

People should make their way to areas outside of the flood zone via London Road. The nearest location outside of the floodplain includes:

- Darfield to the north east.
- Wombwell to the east.

Facilities such as community centres, shops etc. are located within this town/village which may be used in the event of a flood event. There may also be large areas that are flood free located nearer and within the vicinity of the site.

In the event of a Flood Warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site using the routes shown in Drawing 3.

If required a 'safe haven' (see Section 7.2.3) can also be maintained and may be required in very extreme events if a flood warning has not been received.

7.4.3 Flood Warning Codes / Flood Evacuation Procedures

In order for the following evacuation procedures to be effective:

- The building will participate in the Environment Agency flood warning telephone service. The site will register contact details with the Environment Agency' Flood Warnings Direct Service (Floodline 0845 988 1188) in order to receive Flood Warnings/Alerts.
- The flood warning will be passed onto the visitors of the site verbally, by telephone and/or in person. It will be ensured that everyone receives the flood warnings when required.

Flood Alert



'Flooding of low-lying land and roads is expected. Be aware, be prepared, watch out!'. The Environment Agency will issue a Flood Alert status when flooding is possible, based upon weather and river/sea conditions.

Be prepared to act on your flood plan. At this stage occupants and visitors should make themselves aware of the Flood Plan and evacuation routes. Prepare a flood kit of essential items. Monitor local water levels and the flood forecast.

The Safe Exit Routes shown in Drawing 3 indicates the exit route that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received. This is appropriate for vehicles and/or by foot.

Flood Warning



'Flooding of homes and businesses is expected. Act now!'. The Flood Warning alert will be issued when water levels are rising and further rain is expected.

The site will be evacuated. Move family, pets and valuables to a safe place.

Safe access and egress, including emergency access can be maintained for vehicles and/or by foot. The Safe Exit Routes shown in Drawing 3 indicates the exit route that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received.

Water, electricity and gas supplies should be located and switched off before evacuating. The Environment Agency Floodline on 0845 988 1188 should be contacted to get more information, periodically and listen to and watch for weather and flood warnings on local radio and television stations.

Severe Flood Warning



'Severe Flooding is expected. There is extreme danger life and property. Act now!'.

If the site has not already been evacuated it will be evacuated immediately. Co-operate with the emergency services and call 999 if immediately in danger.

Safe access and egress, including emergency access can be maintained for vehicles and/or by foot. The Safe Exit Routes shown in Drawing 3 indicates the exit route that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received.

Warning No Longer in Force

'Flood Watches or Flood Warnings are no longer in force for this area'. Occupants and visitors should contact the LPA to check that it is safe to return to the site.

Please be careful water may be around for several days. If there is any doubt that appliances may be water damaged they must be checked before switching the power or gas back on. Contact your insurance company as soon as possible to get their approval before arranging any clean-up or repairs.

7.5 Flooding Consequences

The property level mitigation measures detailed above show that the flood risk can be effectively managed and therefore the consequences of flooding are acceptable.

The chance of flooding each year is low each year. This takes into account the effect of any flood defences that may be located within the vicinity of the site as well property level protection measures.

The site is unlikely to flood except in extreme conditions.

8.0 SUMMARY AND CONCLUSIONS

8.1 Introduction

This report presents a FRA in accordance with the NPPF for the proposed development at The Low Valley Arms Public House, Station Road, Low Valley, Wombwell, Barnsley, S73 0BD.

This FRA includes a Culvert Assessment of the proposed extension to the Station Road culvert.

8.2 Culvert Assessment

The results show that the afflux (difference between normal depth profile and backwater profile) does not vary as a result of the proposed culvert extension for a given event. The 1 in 20 year (5%), 1 in 100 year (1%) and 1 in 1000 year (0.1%) events have been modelled.

Extending the culvert by 13m in length is shown to increase the estimated maximum water level upstream of the culvert by 130mm during the 1 in 1000 year (0.1%) event. The primary cause of the rise in water level is an increase in energy loss due to friction.

Although a small increase in upstream water levels are calculated, water levels are shown to stay within the channel of the Bulling Dike when compared to the topographical survey of the site. The nearest upstream ground level to the culvert is 25.45mAOD.

The proposed extension to the culvert will not result in a significant increase in flood risk to offsite locations based on the available level information. The flood risk to the site will also not be increased significantly.

The risk from this Bulling Dike will be further managed and mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 7.0). Therefore, the risk of flooding from the Bulling Dike is considered to be of **low significance**.

8.3 Risk Management

The flood risk at the site will be reduced by property level protection measures. Measured used:

Site Layout - Sequential Approach: The sequential approach has been applied within the site by locating the most vulnerable elements of a development in the lowest risk areas. The most vulnerable use, the dwellings, has been situated on the higher part of the site at a lower risk of flooding with the more flood-compatible uses such as the garden/landscaped areas being situated in the lower part of the site at a higher risk of flooding.

The site ground levels rise from south east to north west, the dwellings will be located to the north west of the site where ground levels are higher and the gardens and car parking will be located to the south east of the site where ground levels are lower.

Site Layout - Finished Floor Levels: Raising the floor levels of the dwellings will be used to mitigate the effects of flooding at the site. The finished floor levels should be located a minimum of 300mm above the existing ground level or frontage road level, whichever is higher. Therefore, reducing the flood risk posed to the dwellings.

The finished floor level of the dwellings cannot be raised any higher as it would not be possible to safely access the building, there would not be the required headroom on the ground floor and other planning constraints mean that the finished floor level cannot be raised higher.

Site Layout - Raised Thresholds: The threshold levels of the dwellings be raised a minimum of 300mm above the existing ground level or frontage road level, whichever is higher. Therefore, reducing the flood risk posed to the dwellings.

Site Layout - First Floor Accommodation: Residential accommodation will be located on the first floor floors. This will allow residents to retreat to higher floor levels if needed.

The level of the first floor will be located approximately 2.75m above the ground floor finished floor level well above any flood water levels.

This will provide a 'safe haven' above any flood water levels. This will enable rapid escape should an unlikely failure in the flood defences occur. The upper floors will be accessed via internal stairs and are sufficient in size to safely house all occupants of the dwelling.

The 'safe haven' will only be required in very extreme events or if a flood warning has not been received.

Flood Resilience and Resistance: To make the dwellings more resistant to seepage the following measures will be incorporated. Sealant will used around external doors and windows. All windows will be located 1000mm above the ground levels. All external doors and windows will be constructed from synthetic materials. The walls of the dwellings will be thick.

To improve the dwellings resilience to flooding the following measures will be incorporated. All electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 450mm above the finished floor level.

Flood Warning and Evacuation: The site is located in a flood risk area therefore; the dwelling will participate in the Environment Agency flood warning telephone service. The site will register contact details with the Environment Agency' Flood Warnings Direct Service (Floodline 0845 988 1188) in order to receive Flood Warnings for the following Flood Warning area:-

- Aldham Bridge including Aldham Crescent and Barnsley Road. Low Valley including Valley Road, Station Road, Bayford Way, Cotterdale Gardens, Stonyford Road, Town Lands Close, Henry Street and Wombwell Ings Caravan Site.

The Environment Agency operate a free flood warning service providing alerts by phone, text or email when flooding is anticipated providing an opportunity for owners to take necessary precautions, giving enough time for the building to be safely evacuated and mitigation measures to be put in place.

Flood Plan: A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed.

Safe Access and Egress Routes: The surrounding area is located within Flood Zone 1 and therefore has a 'low probability' of flooding, with less than 1 in 1000 annual probability of river in any year (<0.1%). Therefore, during the 1 in 100 year (plus climate change) event safe access and egress routes can be maintained in accordance with the NPPF and Environment Agency Guidance. Safe access and egress routes can also be maintained during the 1 in 1000 year event.

Safe access and egress routes, including emergency access can be maintained for vehicles and/or by foot. The Safe Exit Routes shown in Drawing 3 indicates the exit route that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received.

People should make their way to areas outside of the flood zone via London Road. The nearest location outside of the floodplain includes:

- Darfield to the north east.
- Wombwell to the east.

Facilities such as community centres, shops etc. are located within this town/village which may be used in the event of a flood event. There may also be large areas that are flood free located nearer and within the vicinity of the site.

In the event of a Flood Warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site using the routes.

If required a 'safe haven' can also be maintained and may be required in very extreme events if a flood warning has not been received.

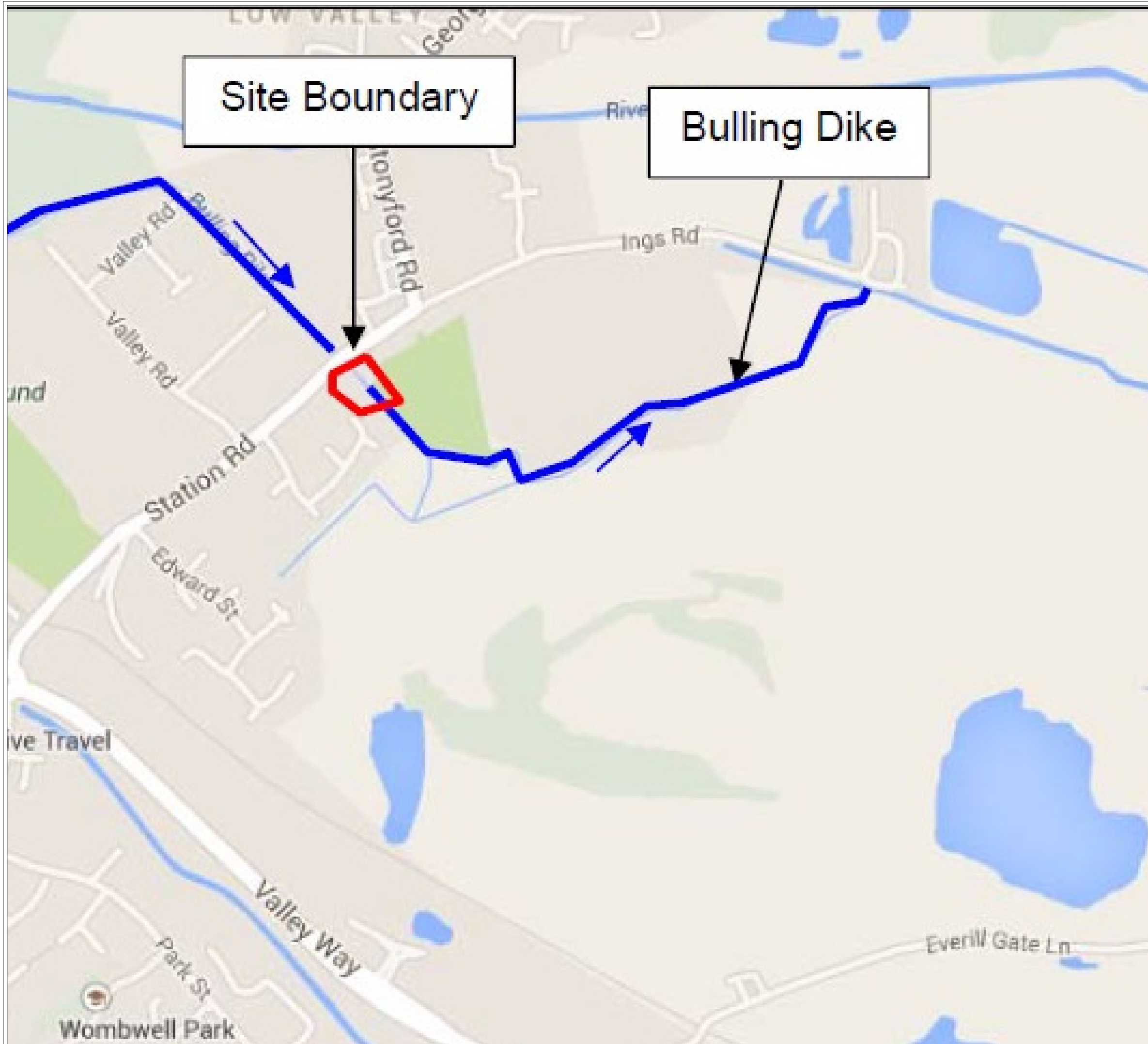
8.4 Conclusion

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF.

The development should not therefore be precluded on the grounds of flood risk.

DRAWINGS

DRAWING 1 – Site Location



KEY
 Site Boundary



The Low Valley Arms Public House, Station Road, Low Valley, Wombwell, Barnsley, S73 0BD		PROJECT
White Rose Homes Limited		CLIENT
Site Location		TITLE
KRS.0091.001		PROJECT REF
1		DRAWING NO
NTS@A3		SCALE
June 2014		DATE

DRAWING 2 – Existing Culvert Location



KEY

 Site Boundary

 Existing Culvert



The Low Valley Arms Public House,
Station Road, Low Valley, Wombwell,
Barnsley, S73 0BD

PROJECT

White Rose Homes Limited

CLIENT

Existing Culvert

TITLE

KRS.0091.001

PROJECT REF

2

DRAWING NO

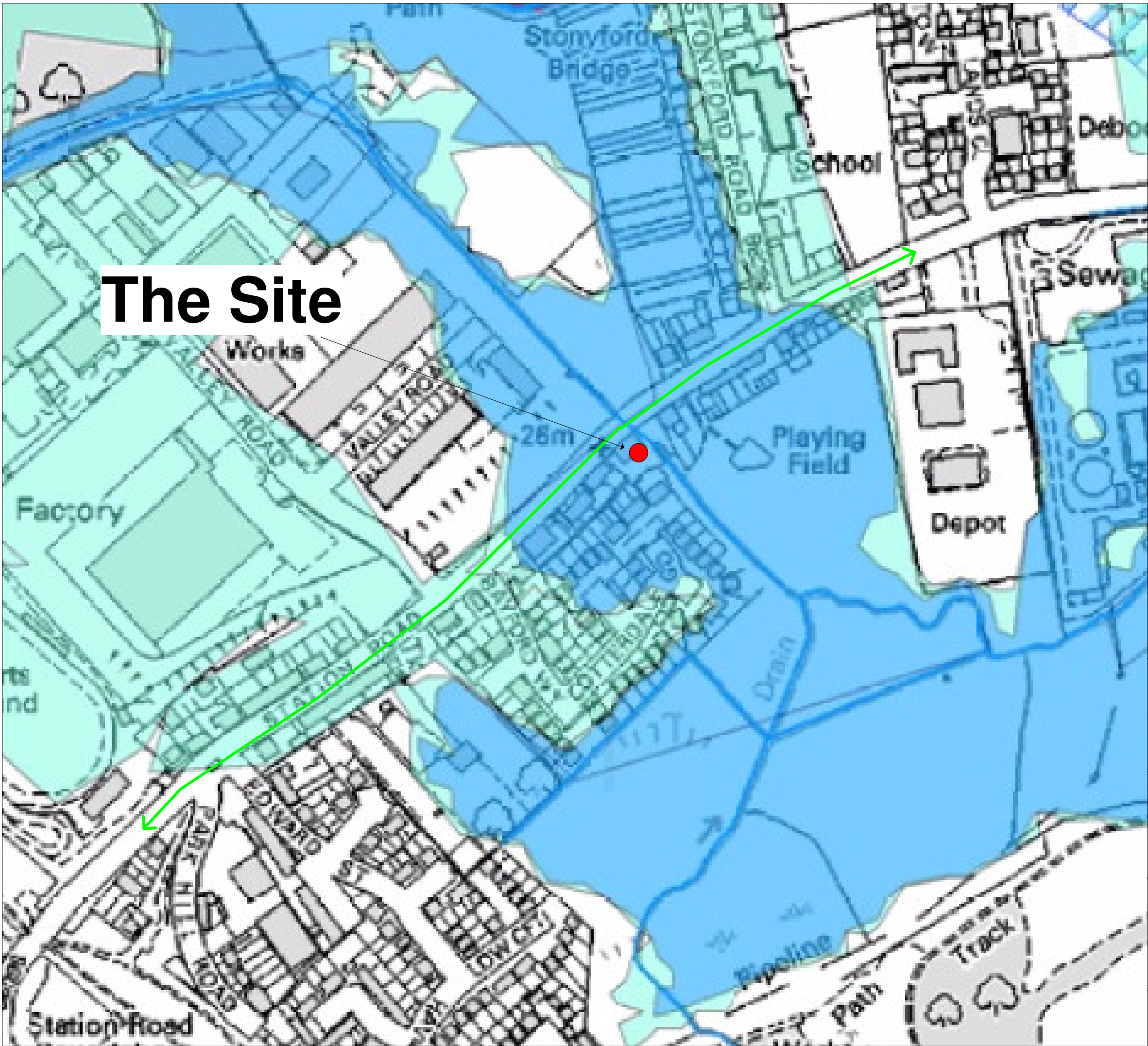
NTS@A3

SCALE

June 2014

DATE

DRAWING 3 – Safe Exit Routes



KEY	
	Site Location
	Safe Access and Egress Route
	
The Low Valley Arms Public House, Station Road, Low Valley, Wombwell, Barnsley, S73 0BD	PROJECT
White Rose Homes Limited	CLIENT
Safe Access and Egress Routes	TITLE
KRS.0091.001	PROJECT REF
3	DRAWING NO
NTS@A3	SCALE
June 2014	DATE

APPENDICES

APPENDIX 1 – Proposed Site Layout

LAND OFF STATION ROAD, WOMBWELL

NOTES

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ALL DIMENSIONS TO BE CHECKED ON SITE

ALL SUBJECT TO STRUCTURAL ENGINEERS CHECKS AND CALCULATIONS

DO NOT SCALE FROM THIS DRAWING EXCEPT FOR THE PURPOSES OF LOCAL AUTHORITY PLANNING

IF ANY VARIATIONS ARE MADE TO SPECIFICATION/DRAWINGS WITHOUT DK DESIGNS KNOWLEDGE, DK DESIGNS WILL NOT BE HELD ACCOUNTABLE FOR NON COMPLIANCE OF PLANNING AND BUILDING REGUALTIONS

4 No 3 Bedroom Town Houses
3 No 2 Bedroom Town Houses



Key



Rotary Dryer



Garden/Bike Store



Bin Storage Area



Rain Water Butt



Parking Space



Visitor Parking Space

SUBJECT PLANNING APPROVAL

SUBJECT TO BUILDING REGS APPROVAL

Rev. Date Remarks

DK DESIGNS
FUTURE PROJECTS TODAY

96 BLACKBURN DRIVE
CHAPELTOWN
SHEFFIELD
S35 2ZP

TEL/FAX:- 0114 2571043 MOB:- 07710783875
EMAIL :- DESIGNS@DK-DESIGNS.CO.UK
WEB:- WWW.DK-DESIGNS.CO.UK

Client

White Rose Homes Ltd

Project/Title

Station Road, Wombwell
Proposed Site Layout

Scale

1:200

Date

Dec 13

Drawing Number

2013-76-03

Revision

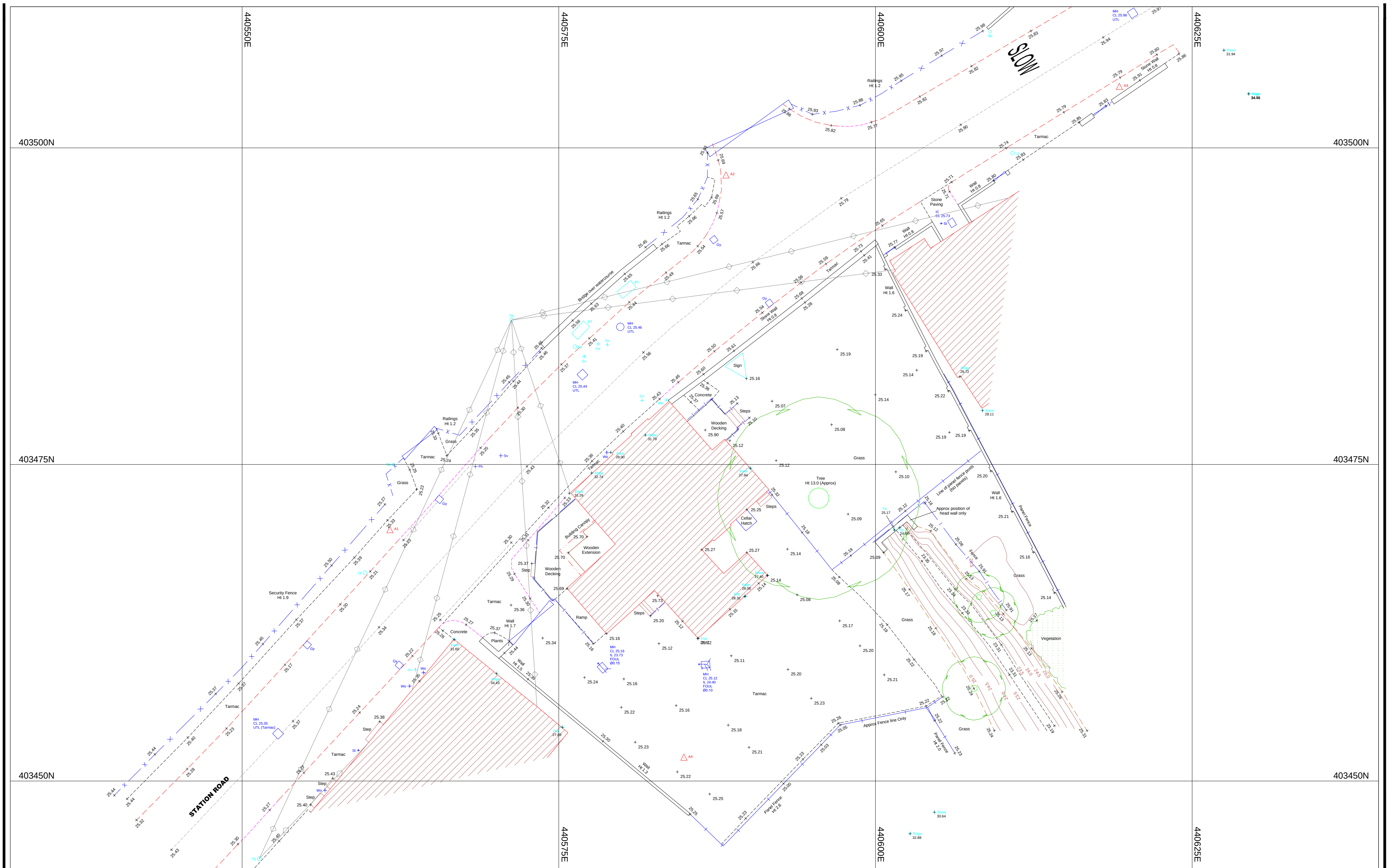
B.

Drawn by

PROPOSED SITE LAYOUT

Note:- All subject to Structural Engineers Calculations

APPENDIX 2 – Topographical Survey

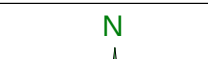


REV. NO.	DESCRIPTION TO REVISION	REV. BY	DATE
A			
B			
C			
D			
NOTES:			

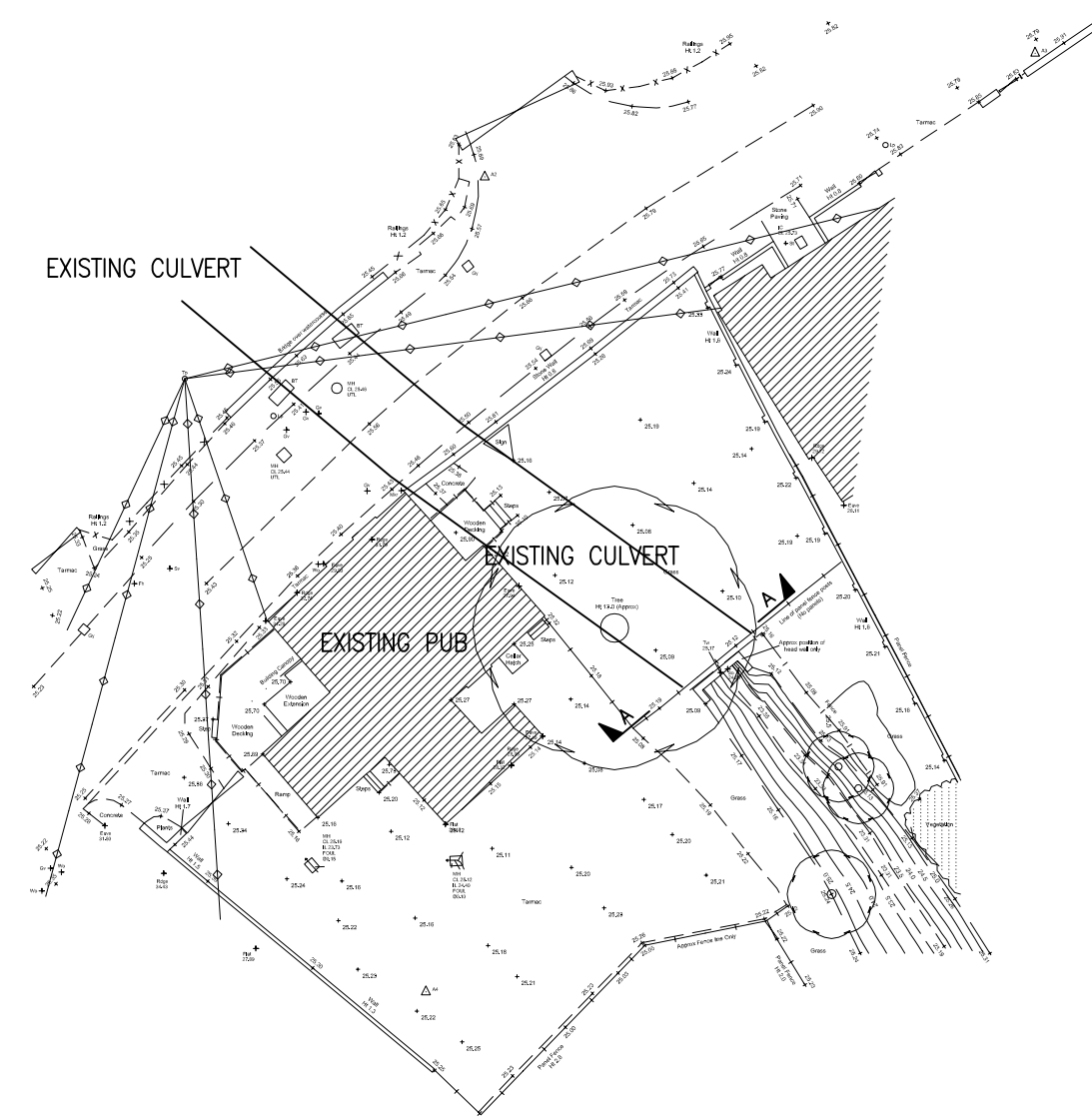


Telephone 01773 790080 Fax 01773 790080
Email info@terra measurement.com
Website www.terra measurement.com

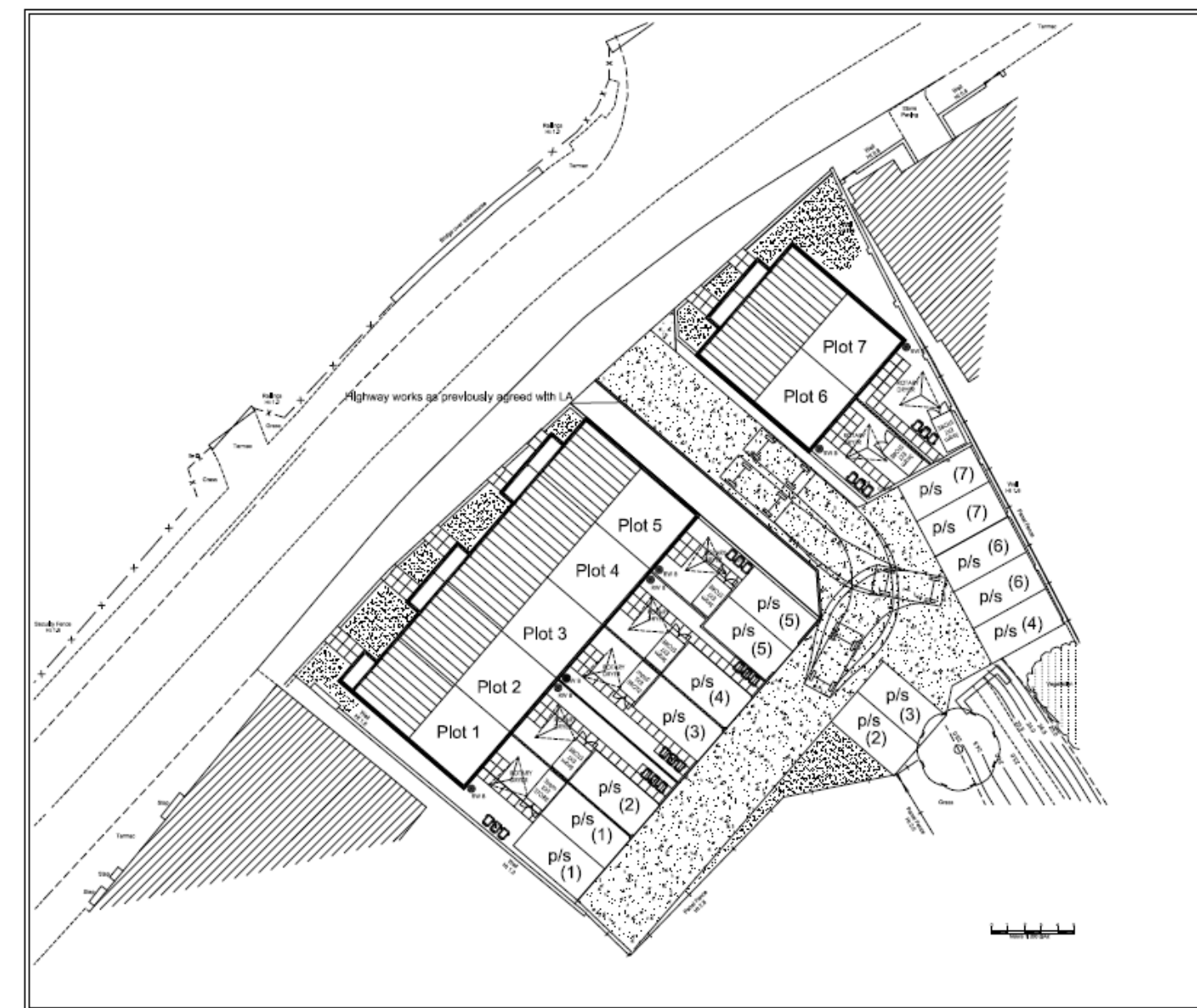
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CLIENT: DK DESIGNS		TITLE: TOPOGRAPHICAL SURVEY			
PROJECT: STATION ROAD WOMBWELL, SOUTH YORKSHIRE		DATE: 05.12.13			
GRID: ORDNANCE SURVEY	LEVEL: ORDNANCE SURVEY	DATA TYPE: 2D	OTHER DATA AVAILABLE: DTM NO. YES 3D GROUND MODEL - YES FLOODING - YES CUT & FILL ANALYSIS - YES		
DRAWN BY: A1B	SCALE @ A2: 1:200	PROJECT NO.: 1001	DRAWING NAME: 1001_OGL	REV. 1	

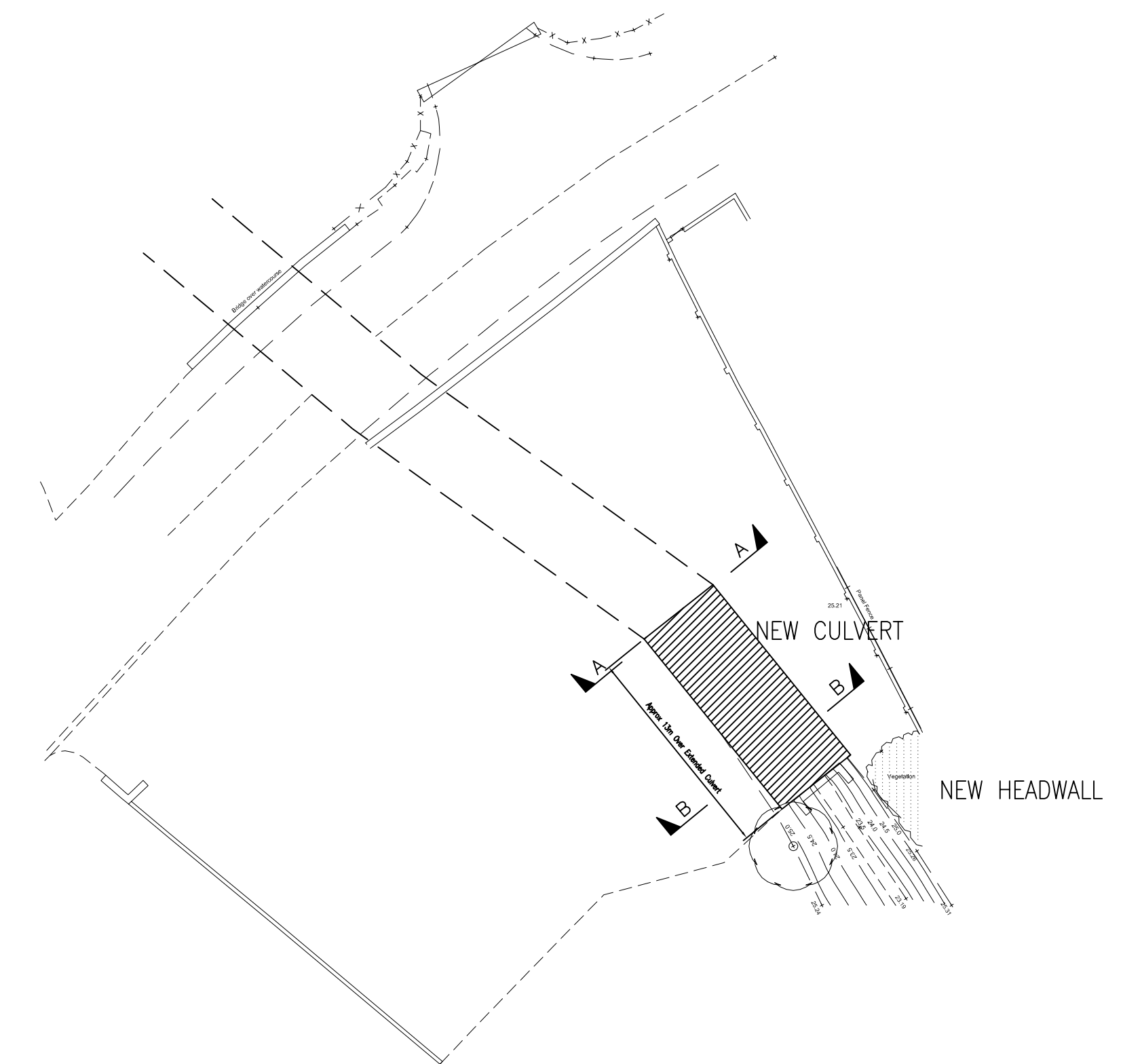
APPENDIX 3 – Proposed Culvert Details



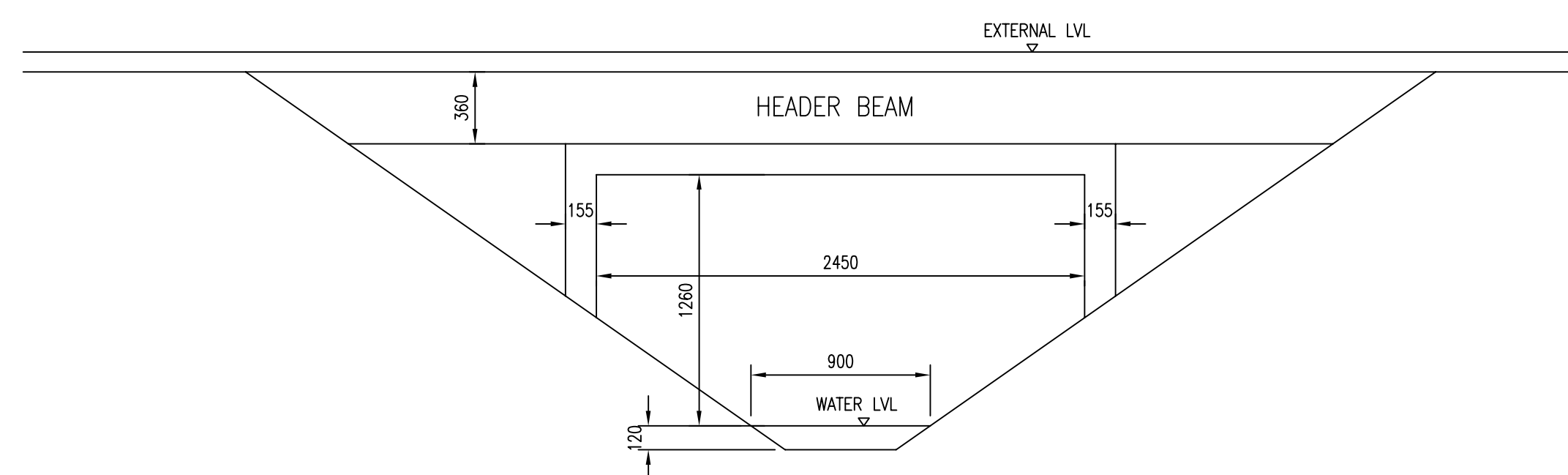
EXISTING SITE LAYOUT



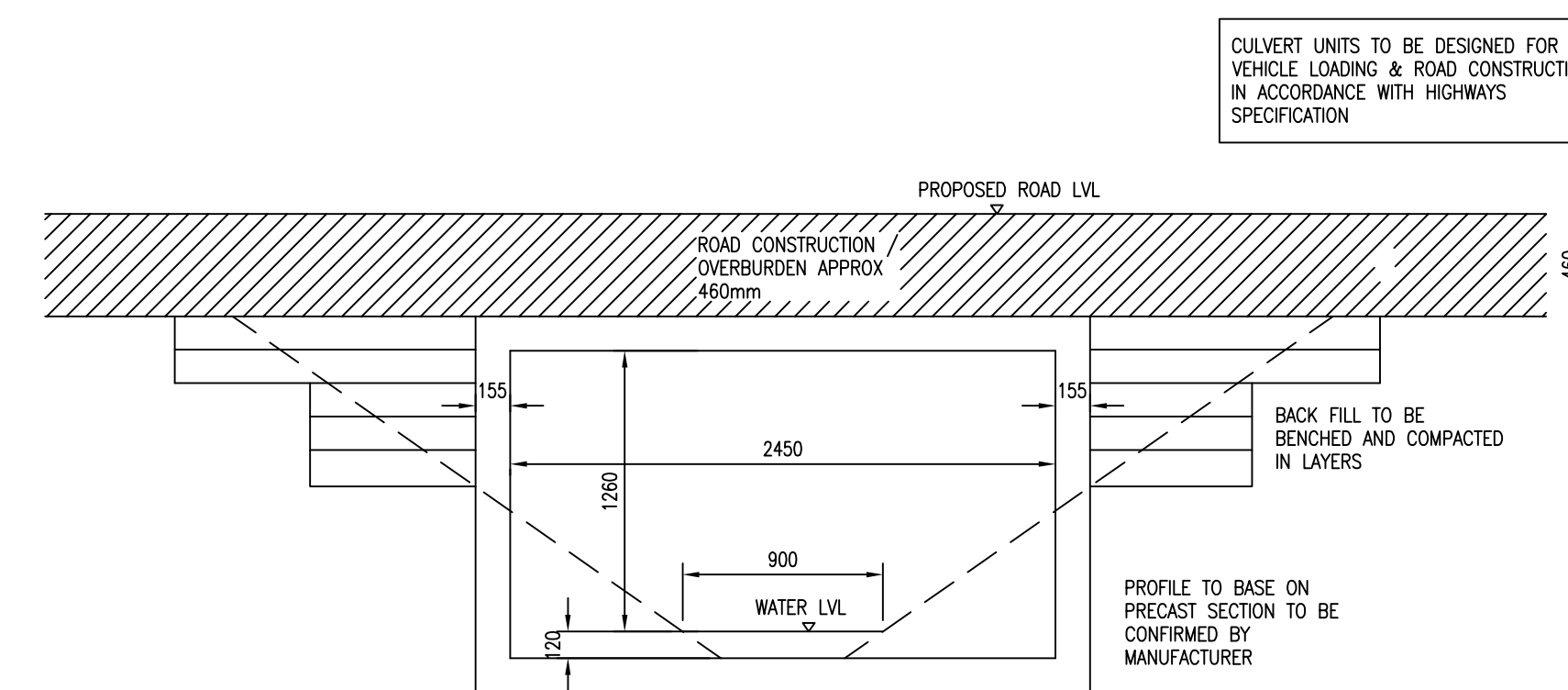
PROPOSED SITE LAYOUT



PROPOSED CULVERT EXTENSION



SECTION A-A
ON EXISTING CULVERT HEAD WALL



SECTION B-B
PROPOSED CULVERT EXTENSION

A1 DRAWING SHEET – DO NOT SCALE.

20/02/14	PRELIMINARY ISSUE	IT	A
Date	Revisions	Drawn	Rev.

Design IT
Structural Solutions

e : designit.struct@gmail.com
w : www.design-it-solutions.com
m : 07794510438

Project

THE ELM
STATION RD, WOMBWELL

Title

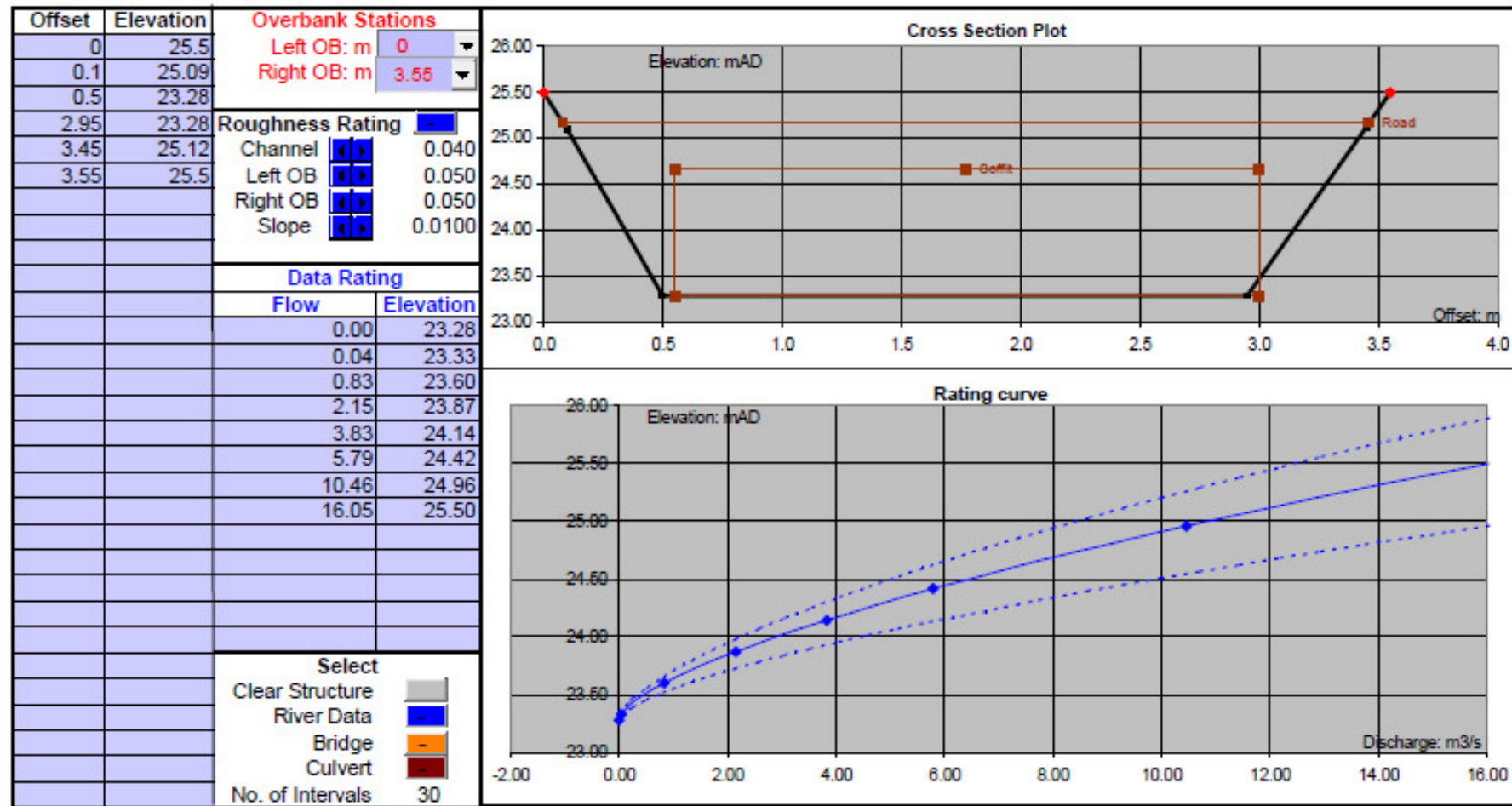
PROPOSED CULVERT
EXTENSION

Scale	Drawn	Checked	Date

Job No.	Drawing No.	Revision
Dit/13/157	SITE/01	P2

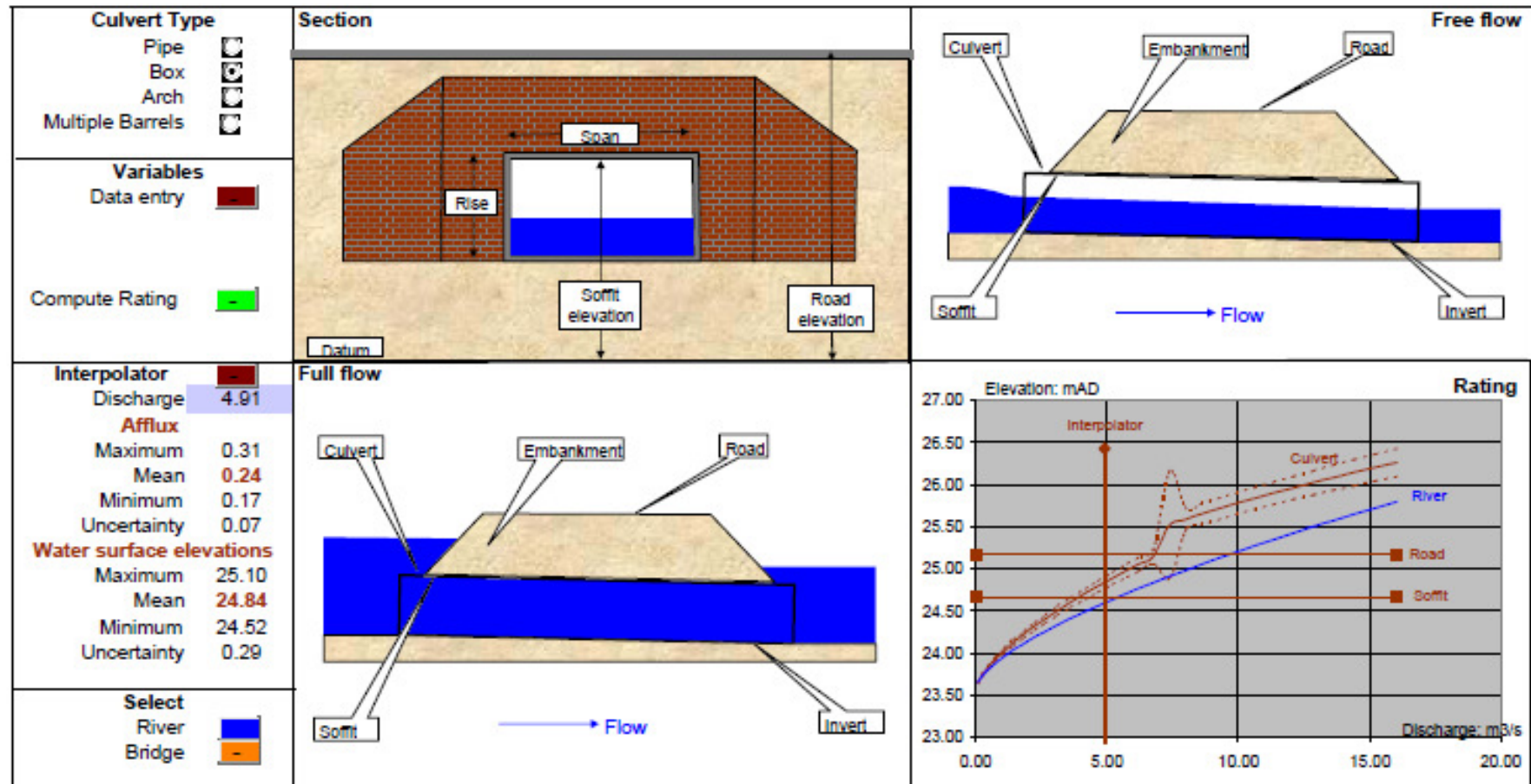
APPENDIX 4 – Afflux Estimation System (AES) Outputs

Afflux Advisor - River Application



Existing Culvert Layout - 0.1% AEP Flow

Afflux Advisor - Culvert Application



Culvert Data Entry

Box section

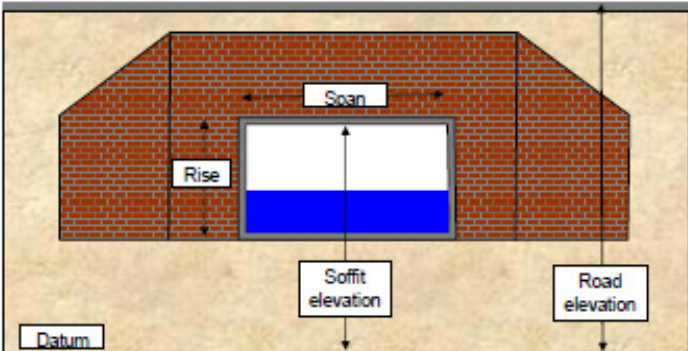
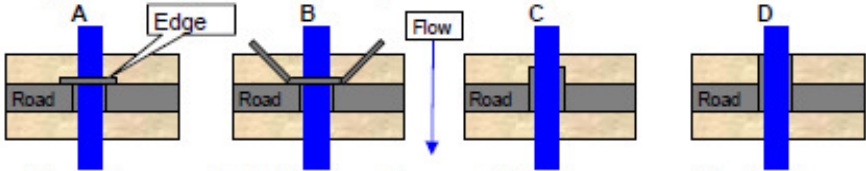


Diagram illustrating the box section of a culvert. The structure is shown in cross-section, with the span (width) and rise (height) indicated. The soffit elevation (bottom of the culvert) and road elevation (top of the embankment) are marked. The datum is also indicated.

Barrel roughness	Concrete box, good joints, smooth walls		
Span	2.45	Rise	1.38
		Length	30.00
Inlet shape	Rectangular	Culvert n =	0.014
Inlet material	Concrete	Inlet Ki =	0.500
Inlet type	A	Inlet sketch	
Inlet edge type	Square	Coefficients	
Outlet Invert elevation	23.28		
Road elevation	25.17	Culvert	

Inlet Type - showing plan view of culvert, road and embankment

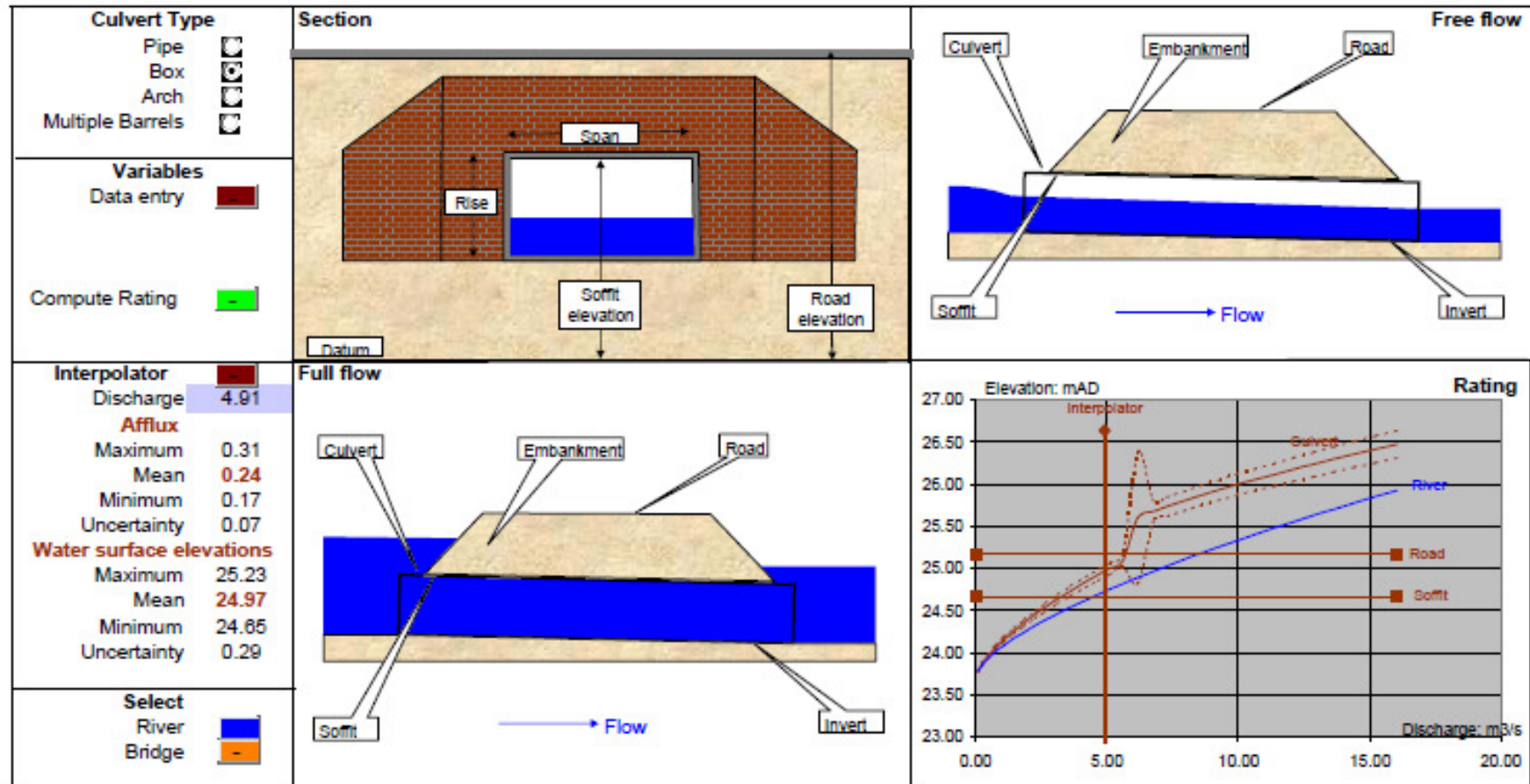


Four diagrams illustrating different inlet types for a culvert, showing the plan view of the culvert, road, and embankment:

- A Headwall**: Shows a simple headwall structure.
- B Headwall & Wingwalls**: Shows a headwall with wingwalls extending to the sides.
- C Projecting**: Shows a projecting inlet structure.
- D Mitred to slope**: Shows an inlet structure mitred to the slope.

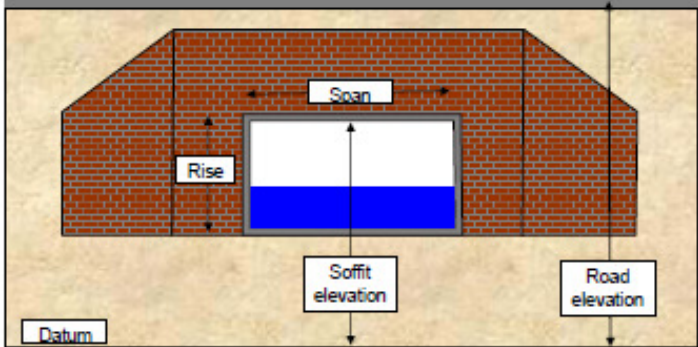
Proposed Culvert Layout - 0.1% AEP Flow

Afflux Advisor - Culvert Application



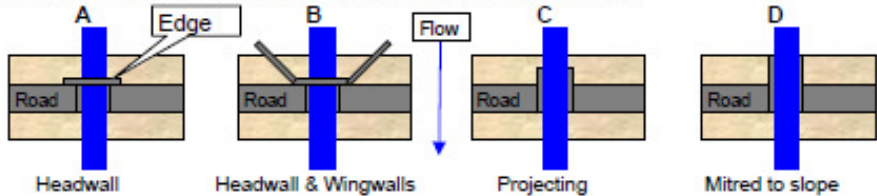
Culvert Data Entry

Box section



Barrel roughness	Concrete box, good joints, smooth walls				
Span	2.45	Rise	1.38	Length	43.00
Inlet shape	Rectangular	Culvert n =	0.014		
Inlet material	Concrete	Inlet K _i =	0.500		
Inlet type	A	Inlet sketch			
Inlet edge type	Square	Coefficients			
Outlet invert elevation	23.28	Culvert			
Road elevation	25.17				

Inlet Type - showing plan view of culvert, road and embankment



A: Headwall
B: Headwall & Wingwalls
C: Projecting
D: Mitred to slope

Primary Calculations

Bed Roughness	0.04	Bank Roughness	0.05
Slope	0.01	Barrel Roughness	0.014

Event [AEP]	Flow [m³/s]	Afflux [m]			Upstream Water Level [m AOD]		
		Existing	Proposed	Variation	Existing	Proposed	Variation
5%	1.54	0.095	0.095	0.000	24.151	24.281	0.130
1%	2.27	0.132	0.132	0.000	24.325	24.455	0.130
0.1%	4.91	0.244	0.244	0.000	24.841	24.971	0.130

Sensitivity Testing

Channel Roughness +20%

Bed Roughness	0.048	Bank Roughness	0.06
Slope	0.01	Barrel Roughness	0.014

Event [AEP]	Flow [m³/s]	Afflux [m]			Upstream Water Level [m AOD]		
		Existing	Proposed	Variation	Existing	Proposed	Variation
5%	1.54	0.035	0.035	0.000	24.151	24.281	0.130
1%	2.27	0.055	0.055	0.000	24.325	24.455	0.130
0.1%	4.91	0.113	0.113	0.000	24.841	24.971	0.130

Slope +20%

Bed Roughness	0.04	Bank Roughness	0.05
Slope	0.012	Barrel Roughness	0.014

Event [AEP]	Flow [m³/s]	Afflux [m]			Upstream Water Level [m AOD]		
		Existing	Proposed	Variation	Existing	Proposed	Variation
5%	1.54	0.121	0.121	0.000	24.210	24.366	0.156
1%	2.27	0.166	0.166	0.000	24.384	24.540	0.156
0.1%	4.91	0.302	0.302	0.000	24.900	25.056	0.156

Barrel Roughness +20%

Bed Roughness	0.04	Bank Roughness	0.05
Slope	0.01	Barrel Roughness	0.017

Event [AEP]	Flow [m³/s]	Afflux [m]			Upstream Water Level [m AOD]		
		Existing	Proposed	Variation	Existing	Proposed	Variation
5%	1.54	0.095	0.095	0.000	24.151	24.281	0.130
1%	2.27	0.132	0.132	0.000	24.325	24.455	0.130
0.1%	4.91	0.244	0.244	0.000	24.841	24.971	0.130

Channel Roughness -20%

Bed Roughness	0.032	Bank Roughness	0.04
Slope	0.01	Barrel Roughness	0.014

Event [AEP]	Flow [m³/s]	Afflux [m]			Upstream Water Level [m AOD]		
		Existing	Proposed	Variation	Existing	Proposed	Variation
5%	1.54	0.158	0.158	0.000	24.151	24.281	0.130
1%	2.27	0.215	0.215	0.000	24.325	24.455	0.130
0.1%	4.91	0.383	0.383	0.000	24.841	24.971	0.130

Slope -20%

Bed Roughness	0.04	Bank Roughness	0.05
Slope	0.008	Barrel Roughness	0.014

Event [AEP]	Flow [m³/s]	Afflux [m]			Upstream Water Level [m AOD]		
		Existing	Proposed	Variation	Existing	Proposed	Variation
5%	1.54	0.061	0.061	0.000	24.093	24.197	0.104
1%	2.27	0.087	0.087	0.000	24.267	24.371	0.104
0.1%	4.91	0.167	0.167	0.000	24.782	24.886	0.104



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