sanderson associates (consulting engineers) ltd

Highways | Traffic | Transportation | Water

Sanderson Associates (Consulting Engineers) Ltd, Sanderson House
Jubilee Way, Grange Moor, Huddersfield, West Yorkshire WF4 4TD
T 01924 844080
F 01924 844081
mail@sandersonassociates.co.uk
www.sandersonassociates.co.uk

Prepared on behalf of

Michael Brinkard

**Commercial Development, Land off Wimbourne Road,
Barry, Vale of Glamorgan, CF63 3DH**

Flood Consequence Assessment

Directors
A J France IEng FIHE AMICE MCIHT
C R France

VAT No. GB 873219218
Company No. 3235830
Registered Office
Sanderson House, Jubilee Way
Grange Moor WF4 4TD

ISO 9001 REGISTERED FIRM

Acknowledgements:

Natural Resources Wales

Disclaimer

The methodology adopted and the sources of information used by Sanderson Associates (Consulting Engineers) Ltd in providing its services are outlined within this Report.

Any information provided by third parties and referred to herein has not been checked or verified by Sanderson Associates (Consulting Engineers) Ltd, unless otherwise expressly stated within this report.

This report was checked and approved on the 13 November 2014 and the Report is therefore valid on this date, circumstances, regulations and professional standards do change which could subsequently affect the validity of this Report.

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Report Ref:	8244/TW/001/01		November 2014
Author:	Thomas Walker		
Checked & Approved:	Darren Hawkyard	**Date:**	13 November 2014

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APPENDIX B - Consultations

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1 Introduction

1.1 Sanderson Associates (Consulting Engineers Ltd) have been appointed to undertake a site specific Flood Consequence Assessment for the proposed expansion of a light industrial site located off Wimbourne Road, Barry, Vale of Glamorgan. The aim of this assessment is to discuss the present and future flood risk to the site using available data and to assess the requirement for mitigation measures to protect the development and the end user.

1.2 This Flood Consequence Assessment has been undertaken in accordance with Technical Advice Note 15 (TAN15).

1.3 Consultation with Natural Resources Wales (NRW) has taken place. The consultation response is discussed in Sections 3 and 6. The documentation received is included in Appendix B.

1.4 Vale of Glamorgan planning documents have been reviewed whilst producing this report.

2 Existing Situation

2.1 Existing Site Description

2.1.1 The existing light industry site is located off Wimbourne Road to the southeast of Barry in the Vale of Glamorgan. A site centred O.S. grid reference is 313455,167694. Drawing 8244/001 included in Appendix A shows the sites location.

2.1.2 The site itself is bound by the Cadoxton River to the north. Industrial units and training facility to the east. An unnamed access road and Commercial/industrial units to the south and Wimbourne Road to the west.

2.1.3 The site itself is currently made up of 10 no. clad industrial/starter units with associated hardstanding and access facilities. The units themselves are split between two separate sheds which have been subdivided one shed is adjacent to Wimbourne Road and one is adjacent to the Cadoxton River. The units are occupied by a number of small businesses which form, in part, to the economic regeneration of an area left dormant after the closure of large heavy industrial plants that once dominated this area of Barry.

2.1.4 Access to the site is from an unnamed access road that junctions with the Winbourne Road roundabout to the south of the site.

2.1.5 The nearest main watercourse to the site is the Cadoxton River which is located to the site northern boundary, the Cadoxton flows from northeast to southwest in the vincinity of site and joins the Bristol Channel approximately 600m southwest of the site.

2.1.6 The Bristol Channel is located 530m to the south of the site at its closest point.

2.2 Existing Site analysis

2.2.1 The units construction consists of a steel portal frame with brickwork and sheet cladding.

2.2.2 The site area is 5,211m^2 upon the implementation of the proposals the area will remain as existing.

2.2.3 To ascertain external site levels, LiDAR data has been obtained for the area. The data provided has an accuracy of +/- 250mm. For the purpose of this report 250mm will be deducted from the shown LiDAR levels in line with the tolerance of the data and to ensure a robust assessment.

2.2.4 Drawing 8244/002 contained within Appendix A shows contours produced using the LiDAR data for the area. The data suggests the lowest external level is to the northern boundary of the site to the rear of the existing units and is at 8.6m AOD. Therefore, taking into account the +/- 250mm accuracy of the LiDAR data, the lowest external level is 8.35m AOD for the purpose of the analysis. The highest level is 10.450m AOD and is located at the sites Northern boundary (reduced from 10.7m AOD).

3 Consultations

3.1 Natural Resources Wales

3.1.1 As part of this assessment, Natural Resources Wales (NRW) have been consulted regarding the flood risk for this site. The consultation response is contained within Appendix B.

3.1.2 The response from NRW confirms that the site falls within Flood Zone 3 with a greater than 1 in 200 (0.5%) annual probability of tidal flooding in any given year.

3.1.3 In accordance with TAN 15 the site lies on the limits of Zone C1, which is land within the limits of the 1 in 1000 year flood extents that is not served by significant defence infrastructure. This is confirmed by the NRW development advice maps online.

3.1.4 NRW have also provided modelled tidal levels for this area of Newport. The data includes a number of return periods for extreme storm/tidal events within the Bristol Channel and Cadaxton River. The data received will be discussed further in Section 6.

3.1.5 NRW have also stated that they hold no historic flood data for the area.

4 Proposed Development

4.1 It is proposed that 2 additional units are constructed, one on each of the sheds that currently occupy the site, extending each of the existing buildings to facilitate the expansion. They will be constructed as per the existing buildings using steel frames and cladding. The development will not change the use of the site and will introduce further economic activity on the site and by extension to the area.

4.2 The overall site area remains asper existing. Upon implementation of the development proposals there will be no changes to the boundaries of the site.

4.3 With implementation of the proposals there will be an increase in the overall footprint of the onsite buildings by approximately 230m^2. There will be no additional connections made to the local sewer network and the proposed buildings will utilise existing drainage connections.

4.4 There will be minor alterations to external ground levels with the implementation of the proposals.

5 Justification and Flood Consequence

5.1.1 As previously stated the site falls within Flood Zone 3 with a greater than 1 in 200 (0.5%) annual probability of tidal flooding in any given year.

5.1.2 In accordance with TAN 15 the site lies within Zone C2, which is land within the limits of the 1 in 1000 year flood extents that is not served by significant infrastructure including flood defences.

5.1.3 The development is the extension of the two onsite sheds to provide 2 additional units. In accordance with Figure 2 of Tan 15 both these land uses are classed as 'Less Vulnerable' in terms of flood risk, therefore the proposals will not increase the flood risk vulnerability of the site as it will remain asper existing.

5.1.4 The expansion of the existing light industrial site is on a previously developed brownfield land and would introduce further economic development to the area.

5.1.5 Inline with the Vale of Glamorgan Unitary Development Plan. The site is on the fringe of an area of the land allocated for employment use. This area was left dormant after the closure of a number of heavy industrial plants/facilities and is in the process of regenerating and introducing new businesses and economic activity to the area.

6 Assessment of Flood Risk

6.1 Flooding from Land

6.1.1 The main risk of flooding from overland flow comes from impermeable areas within the area of the site and land at a higher elevation that forms a pathway to the site.

6.1.2 The Environment Agency modelled surface water map shows that the site is in an area with a 'Very Low Risk' of surface water flooding. This is the lowest classification of surface water vulnerability and is described as flooding with less than 1 in 1000 annual probability of occurring in any given year.

6.1.3 The closest area of modelled higher probability surface water flooding is shown 50m to the southwest of the site to the south of the Wimbourne Road roundabout, this area is isolated in nature which suggests a relative low point in the local topography and does not form an extensive flow path. It is shown to have between a 1 in 100 and 1 in 1000 annual probability of occurring in any given year which is deemed to be a 'Low Risk'.

6.1.4 It is concluded that the risk of flooding from surface water flooding to the site is no different from the existing scenario. The mitigation measures proposed as part of this report will help protect the development should flooding from land occur. It should also be noted that the type of construction and materials to be used, i.e. steel frame/concrete floor have a degree of resistance to the effects of water.

6.2 Flooding from Rivers / Watercourses

6.2.1 As discussed in Section 3, the site is shown to fall within Flood Zone 3 (greater than 1 in 200 annual probability of flooding from a tidal source in any given year) and TAN 15 Zone C2, land within the 1 in 1000 year flood envelope which is not served by significant flood defence infrastructure.

6.2.2 Natural Resources Wales have provided modelled flood data for a number of return periods upto a 1 in 1000 year event. The data sets provided are for extreme flooding within the Bristol Channel which is channelled up the Cadaxton River to the rear of the site.

6.2.3 The data for the areas has been provided for two nodes which are most relevant to the site. The nodes are referenced 426 and 424 and are shown on the received plan in Appendix B.

6.2.4 Modelled flood data has been provided for a 1 in 200 and 1 in 1000 year return period for modelled flooding between 2008 and 2114 (inline with predicted sea level increase and covering the design life of the development). The site has a minimum external level of 8.35m AOD which is outside of the area that would be effected by 1 in 200 year flooding until between the 2064 and 2089 scenario, these events have modelled levels of 8.3m AOD and 8.6m AOD respectively.

6.2.5 For the 2114 data a 1 in 200 year flood level is stated as 9.0m AOD, this is 650mm above the lowest site level of 8.35m AOD. This event would affect the proposed extension to the shed adjacent to the Cadaxton to a maximum depth of 400mm, shallow towards its frontage. The shed adjacent to Wimbourne road would be effected to a depth of 0.250m again shallow to its frontage.

6.2.6 These levels and maps are contained in Appendix B with the full consultation response.

6.3 Flooding from Sewers

6.3.1 If any of the sewers adjacent to the site were to surcharge and flood, it is likely that any floodwaters would be shallow, relatively slow moving and constrained within hardstanding areas of the site, not within the building itself.

6.3.2 At the time of writing the report there was no evidence available to suggest the site has been directly affected from flooding from overloaded sewers/drainage

apparatus in the past; therefore the risk of flooding from sewers would be considered low.

6.4 Flooding from Groundwater

6.4.1 As part of this report the Environment Agency and British Geological Survey borehole and groundwater mapping has been reviewed.

6.4.2 The Environment Agency groundwater mapping shows the sites underlying superficial (drift) deposits are classed as an undifferentiated secondary aquifer. An undifferentiated secondary aquifer is strata that has areas capable of holding groundwater to some degree and areas that would be deemed unproductive in its capacity to hold and store water. The underlying bedrock (Mercia Mudstone Group) is classed as a principle aquifer, these are layers of rock that have high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage. They may also support water supply and/or river base flow on a strategic scale. Principal aquifers are aquifers previously designated as major aquifer.

6.4.3 The British Geological Survey borehole scans contain borehole records that were excavated on the site as part of work on the Barry East Drain. The boreholes show a superficial strata of unspecified made ground underlain by Marley clay. Groundwater was not encountered within the 3 reviewed boreholes.

6.4.4 Due to the nature of local ground conditions which is predominantly clay and its limited capacity to hold water in the upper strata. It is unlikely that groundwater would emerge within the site.

6.4.5 The mitigation measures recommended to protect the development from other sources of flooding would also protect against groundwater emergence should the risk increase in the future or should groundwater emerge remote from the site and flow overland.

6.5 Flooding from Climate Change

6.5.1 It is generally considered that the intensity of rainfall will increase by up to 30% by the year 2115 and that winter months will become proportionately wetter.

6.5.2 Peak river flows are anticipated to increase by up to 20% due to climate change.

6.5.3 These factors have be considered when producing this report and are covered by the Natural Resources Wales data.

6.5.4 Section 7 discusses mitigation measures to be put in place which would provide additional protection for the proposed development which would more than offset any increase in flood risk due to climate change.

7 Mitigation Measures

7.1 Recommended Mitigation Measures

7.1.1 It is important that any proposed development that has the potential to change the flood mechanisms on a site is designed such that there is no increased flood risk to the site itself, or sites upstream and downstream of the development.

7.1.2 Any critical plant or water sensitive stored goods within the site should be raised a minimum of 600mm above the finished floor level of the proposed units where practicable to do so.

7.1.3 The floor slab of the unit and internal walls upto 600mm above slab level should be sealed with a treatment that will prevent the leaching of flood waters. This will also assist in cleaning the units should a flood event occur.

7.1.4 Drains within the limits of the site should be regularly inspected and cleared where necessary to reduce the risk of blockages and subsequent flooding.

7.1.5 A flood evacuation plan should be provided for the site staff. The flood evacuation should include the following information for the current occupiers and also to pass onto any subsequent occupiers to ensure continuity as far as practicably possible:

- How to register for 'Flood Warnings Direct', a free NRW service which provides flood warnings to each registered member by selected media such as telephone, email, text message which is tailored to each registered members requirements.

- What the different flood codes mean for the property when issued by the NRW and what actions to take.

- Confirmation on what the sources of flood risk are to the property

- Confirmation of escape routes from the site should evacuation be attempted
- Advice on what to include in the flood kit.
- Useful contact numbers if required.

8 Conclusions

8.1 This report serves to review and assess the sources of potential flooding to the site, the impact of the proposed development on the flooding mechanisms of the site and the impact on existing development both upstream and downstream of the site.

8.2 The report have been undertaken in accordance with the TAN 15 and it is concluded that the development is suitable for this location taking into account the proposed end use and potential risk.

8.3 Suitable mitigation measures have been recommended in Section 7 that will reduce this risk to acceptable levels for the end user should a flood event occur.

8.4 This report concludes that the proposed development can take place without being at an unacceptable risk of flooding and without increasing the risk to the site itself or other sites in the vicinity.

8.5 The proposals offer betterment over the existing scenario as site staff can be made aware of the potential flood risk and how to respond should a flood event occur and the development forms part of the ongoing regeneration of the South East of Barry.

APPENDIX A - Drawings

Site Location: 8244-001

Contour Plan: 8244-002

East : 313455
North : 167694

Rev	Amendment	Drawn	Date	Checked

sanderson associates (consulting engineers) ltd
Highways | Traffic | Transportation | Water
T 01924 844080 mail@sandersonassociates.co.uk
F 01924 844081 www.sandersonassociates.co.uk

Project Name

Wimborne Road, Barry
Vale Of Glamorgan

Drawing Title

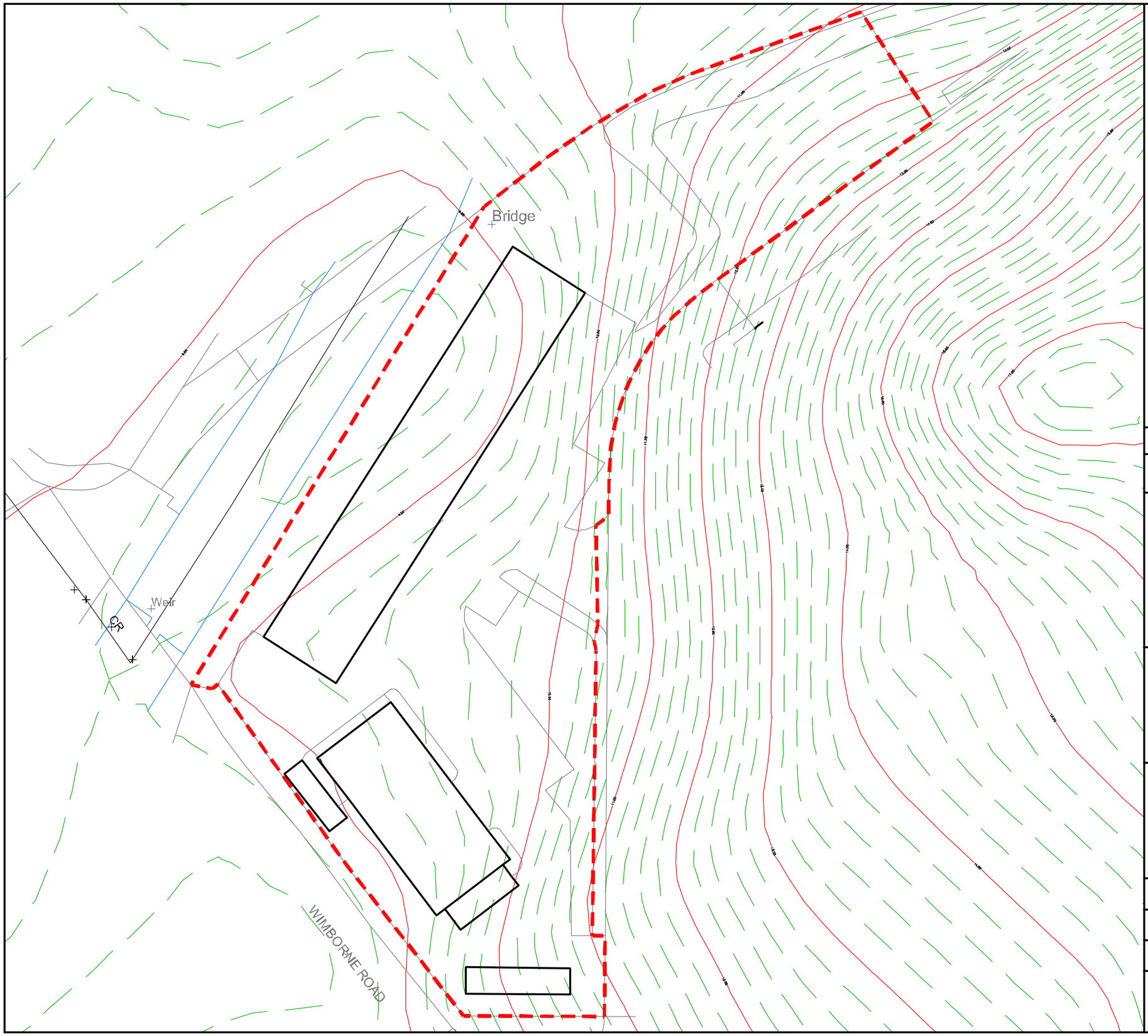
Site Location Plan

Scale NTS	Drawn By KB
Drawing Size A3	Checked By TW
Date 10.14	Approved By TW

ISO 9001 REGISTERED FIRM

Drawing Number 8244-001

Rev



Rev	Amendment	Drawn	Date	Checked

sanderson associates (consulting engineers) ltd
Highways | Traffic | Transportation | Water
T 01924 844080 mail@sandersonassociates.co.uk
F 01924 844081 www.sandersonassociates.co.uk

Project Name

Flood Consequence Assessment
Land off Wimbourne Road
Barry, Vale of Glamorgan

Drawing Title

Contour Plan

Scale 1:500	Drawn By TW
Drawing Size A3	Checked By DH
Date 10.14	Approved By DH

QiMS ISO 9001 REGISTERED FIRM

Drawing Number 8244-002

Rev

FILE REF:

APPENDIX B - Consultations

Natural Resources Wales

ATI-05548a – Wimborne Road, Barry

E: 313455 N: 167694

1.0 Current Flood Map

Figure 1 shows the current Flood Map (version 201406) at this location. The Flood Map represents the undefended fluvial and tidal flood extents derived from a combination of detailed and generalised modelled data.

The current tidal flood data in this area was updated by NRW in 2013. This study uses sea level nodes within the Severn Estuary, based on a set of extreme sea levels generated by the EA in 2011 (*ref2)* for current day (2008). The levels were projected in-land over a digital terrain model to produce depth and elevation grids as well as tidal mapped outlines for both the 0.5% (1 in 200) AEP (annual exceedance probability) and the 0.1% (1 in 1000) AEP; including climate change and upper confidence intervals (+/-95%).

More information on the Flood Map can be obtained from the Environment Agency website https://www.gov.uk/government/organisations/environment-agency

2.0 Extreme Sea Levels & Climate Change Guidance

In February 2011, extreme sea levels used in this model were superseded by a nationally consistent set of extreme sea levels (*ref 2*). These levels were derived using a tidal model calibrated to UK tidal gauge data. The model output is provided for node locations spaced at approximately 2km. 95% confidence bounds for these values were also derived using the confidence intervals for each node location. The extreme sea levels comprise still water level including storm surge, however they do not account for local wave action. The baseline estimations are for the year 2008, so climate change is calculated relative to this year, for example add 17.5mm for the year 2013.

Table 1: 2008 Baseline Extreme Sea Levels for adjacent nodes

Node	Easting	Northing	Extreme Event Sea Level (mAOD)					
			T25	T50	T75	T100	T200	T1000
424	313663	167054	7.22	7.33	7.39	7.44	7.55	7.87
426	312039	166117	7.19	7.30	7.36	7.41	7.51	7.82

To provide the estimate of extreme sea levels for the site (**Table 2**), levels were interpolated from the adjacent nodes.

Table 2: 2008 Baseline Extreme Sea Levels interpolated between adjacent nodes

Node	Easting	Northing	Extreme Event Sea Level (mAOD)					
			T25	T50	T75	T100	T200	T1000
Site	313439	167029	7.22	7.33	7.39	7.44	7.55	7.86
95% Confidence Bound (+/- m):			*0.20*	*0.20*	*0.30*	*0.30*	*0.40*	*0.70*

The current guidance on climate change from DEFRA is as follows:

Table 3: Sea level rise, mm per year

Assumed vertical land movement	1990-2025	2025-2055	2055-2085	2085-2115
-0.5	3.5	8.0	11.5	14.5

The calculated future extreme sea levels are shown in **Table 4.** Adopting a precautionary approach as advised by Environment Agency guidance *(ref 4)*, these levels include the upper level 95% confidence bound.

Table 4: Extreme sea levels for the site (including 95% Confidence Bound)

Year	Sea level rise(m)	Extreme Event Sea Level (mAOD)					
		T25	T50	T75	T100	T200	T1000
2014	0.021	7.4	7.5	7.7	7.8	8.0	8.6
2064	0.403	7.8	7.9	8.1	8.1	8.3	9.0
2089	0.703	8.1	8.2	8.4	8.4	8.6	9.3
2114	1.065	8.5	8.6	8.8	8.8	9.0	9.6

3.0 Additional Information

NRW holds no historic flood information for the site or nearby vicinity.

The local authority may be able to provide information on issues such as localised flooding from sewers, drains and culverts.

The surface water maps show your site not to be affected (red line boundary) for any of the scenarios.

JBA on behalf of NRW are undertaking a Flood Risk Mapping study along the River Cadoxton, which will assess both fluvial and tidal risk. This study is expected to be completed by December 2014. Paul Morris from the Flood Risk Analysis team is managing this project and can be contacted on 02920 245227 if more information is required.

4.0 References

1. Tidal Flood Mapping Study (Penarth and Chepstow), Study report Issue 1, Atkins July 2008
2. Department for Environment, Food and Rural Affairs, 2011. *Technical Report Design sea levels*. R&D Report SC060064. Defra/Environment Agency
3. Flood and Coastal Defence Appraisal Guidance: FCDPAG3 Economic Appraisal. Supplementary Note to Operating Authorities – Climate Change Impacts; October 2006; Department for Environment, Food and Rural Affairs.
4. Using the national coastal flood boundary data for England and Wales, Environment Agency Operational Instruction 490_11, Issued 4/2/2011

5.0 Notes

Undefended scenarios are provided as being a possible worst case scenario in the event of defence failure. They are used as the basis of the Flood Map.

Extreme sea levels provided as part of this project are accurate to one decimal place (**Table 4**). Two decimal places have been provided to show the gradual change between nodes seen in the model, however, this does not imply greater accuracy.

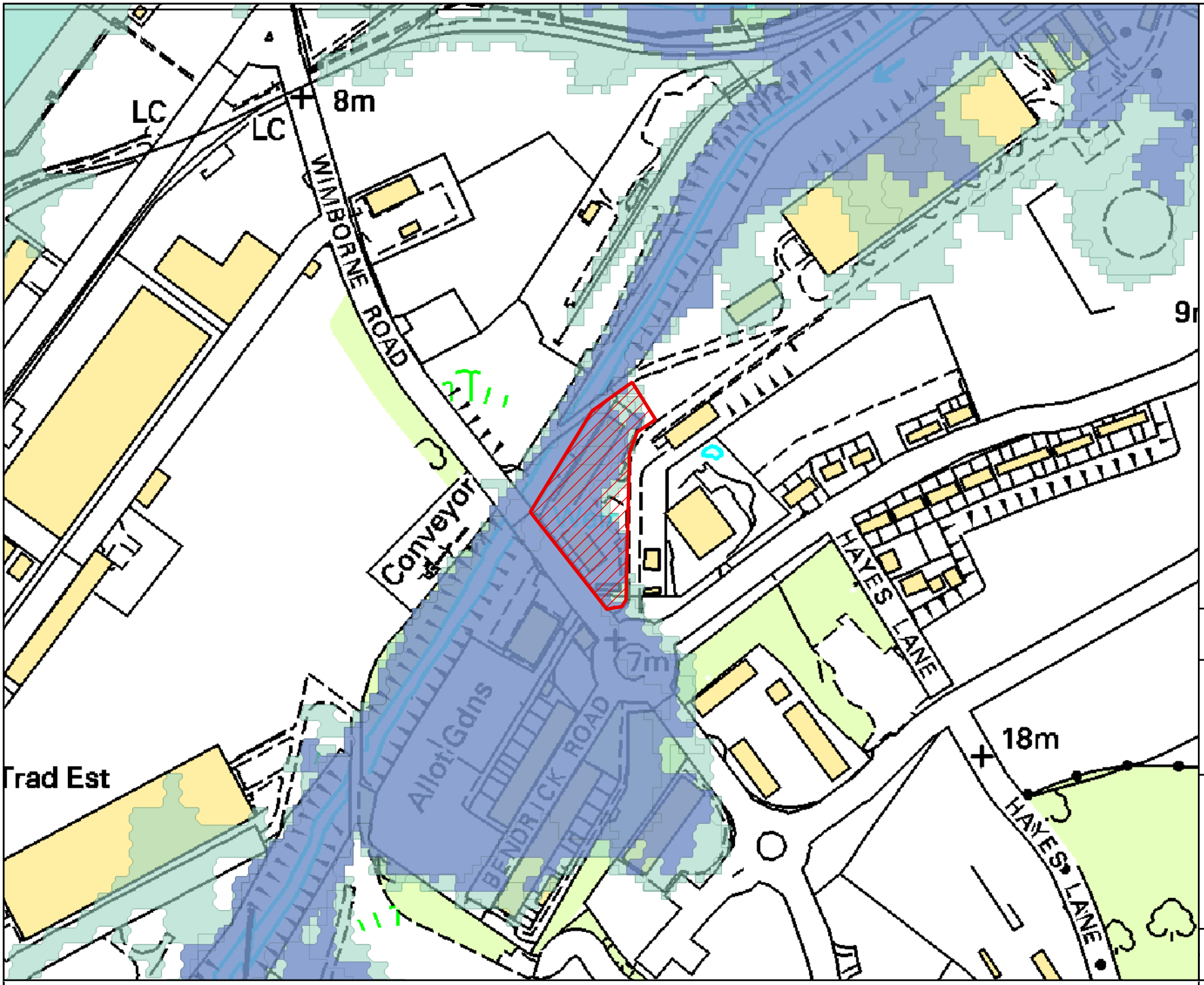
The scope of the model is the mapping of flood risk, it is not intended for detailed design.

The model should be considered as the starting point for more detailed modelling, commensurate with the consequences of flooding at the site of interest.

NRW models are available under licence agreement for the purpose of further development. Contact Natural Resources Wales Access to Information team for details of terms, conditions and pricing.

If the data is used in support of an FCA, please include the reference number.
Please refer to NRW standard terms and conditions.

Flood Risk Analysis
19/09/2014



Legend

- Site Location
- Flood Zone 3 (1 in 100 year undefended fluvial and 1 in 200 year undefended tidal extents)
- Flood Zone 2 (1 in 1000 year undefended fluvial and tidal extents)
- Areas benefiting from defences
- Defences

Cyfoeth Naturiol Cymru
Natural Resources Wales

Project

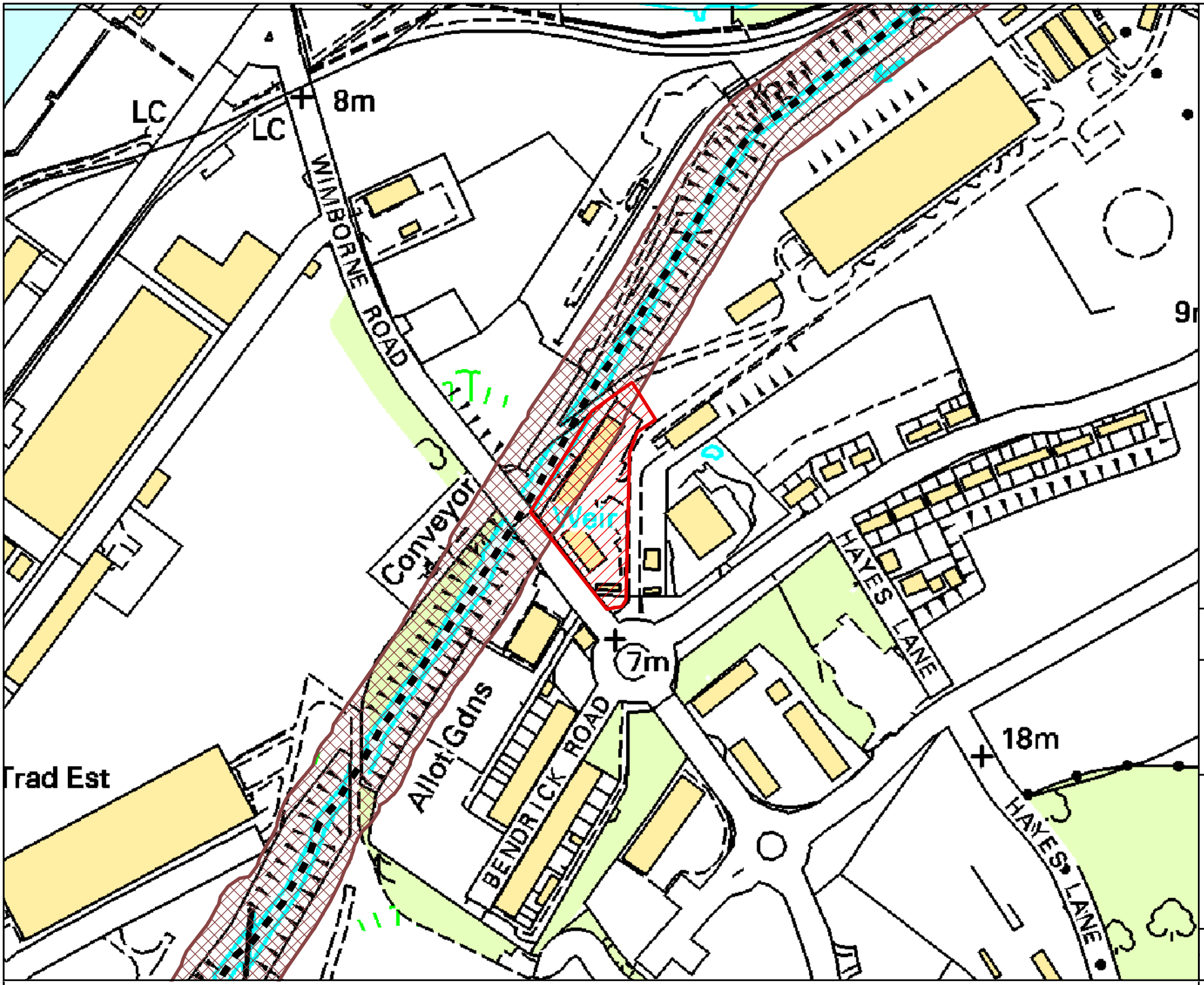
Wimborne Road, Barry
[Ref: ATI-05548a)

Drawing

Figure 1:
Current Floodmap
[v201406]

Date 19th September 2014

Scale 1:3,000



Legend

- Site Location
- Statutory Main River
- Bank Top E-Planning Tool (comprising: 20m buffer around the Main River network, River Bank features & around the mean high water level for estuaries wider than 40m)

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Natural Resources Wales

Project

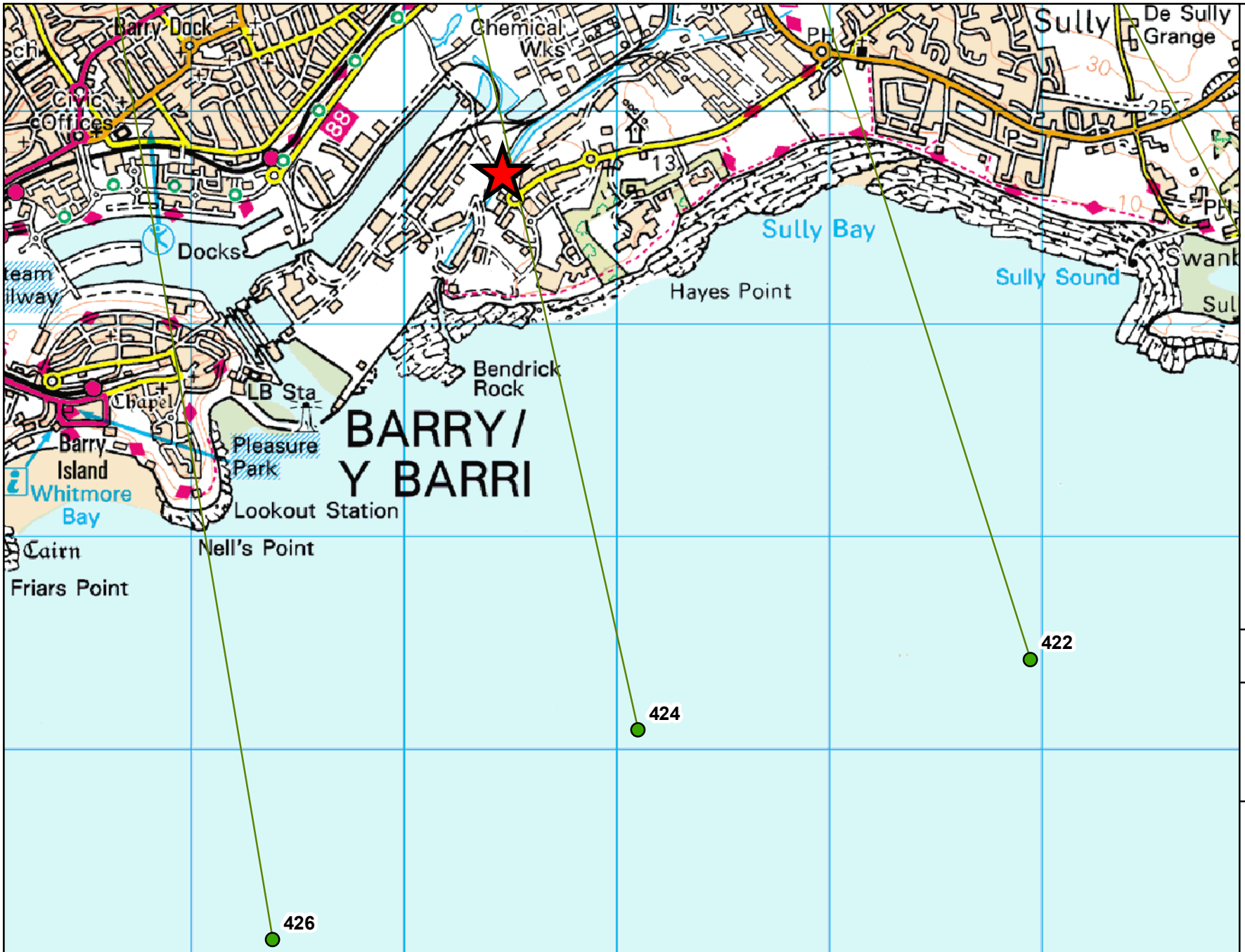
Wimborne Road, Barry
[Ref: ATI-05548a)

Drawing

Figure 2:
Statutory Main Rivers

Date 19th September 2014

Scale 1:3,000



Legend

- Site Location
- Projection Lines
- Node Point

Cyfoeth Naturiol Cymru
Natural Resources Wales

Project

Wimborne Road, Barry
[Ref: ATI-05548a)

Drawing

Figure 3:
Extreme Sea Level
Node Locations

Date 19th September 2014

Scale 1:25,000