

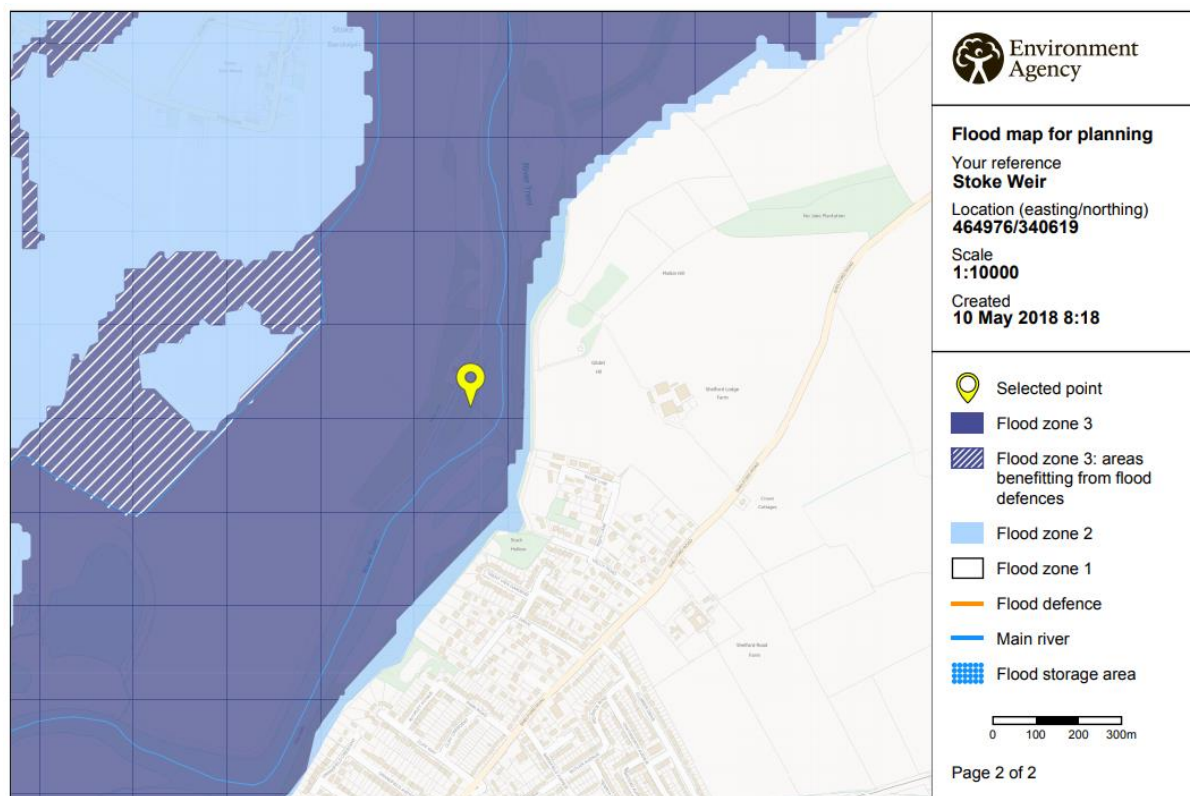
# Stoke Bardolph Weir Hydroelectric Project

## Flood Risk Assessment

## Introduction

- 1.1 This assessment is associated with planning and Environment Agency consents for a hydropower scheme and associated infrastructure at Stoke Bardolph Weir. Please see the relevant supporting statement for general background information on the site and proposed development.
- 1.2 The applicant for this project is the Canal and River Trust, which is also the landowner and navigation authority at the site.
- 1.3 This site specific assessment follows guidance set out the Communities and Local Government Guidance on Flood Risk Assessment for Developments Planning Policy Strategy 25 (2010) [\[link\]](#). It also makes reference to EA Product 7 Flood Data and Greater Nottingham Strategic Flood Risk Assessment, 2008 & 2017 (GNSFRA 2008, GNSFRA 2017) [\[link\]](#) and the Humber river basin district summary [\[link\]](#).
- 1.4 The development is water compatible, with reference to the vulnerability classification (table D.2, annex D, PPS25).
- 1.5 Figure 1 below shows that the development is located in Flood Zone 3, which is appropriate for its function (table D.1, annex D, PPS25). An exception is appropriate under the Exception Test because the development is water compatible and it is infrastructure (table D.3, annex D, PPS25).
- 1.6 The latest relevant flood data for the site were obtained from the Environment Agency.

Figure 1 – Environment Agency Flood Map.



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## Definition of the flood hazard

1.7 Appraising the sources of possible flood water, the SFRA signals surface water, sewers, groundwater and reservoirs/canal sources. The River Trent has a residual flood risk in a 1 in 100 year flood event.

## Proposal description

1.8 The river at this point comprises a weir and a canal lock (Stoke Bardolph Lock). The canal and lock sit on the left bank, separated from the main channel of the River Trent by a man-made island. There is a floating boom approximately 35 m upstream of the weir, on the main channel.

1.9 The weir serves the purpose of maintaining navigation levels upstream of the site.

1.10 The existing weir is a concrete structure with a breadth of approximately 140 m and crest level 16.22 mAOD.

1.11 The proposal comprises two Archimedes screw turbines, an adjustable weir crest, a new multi-species fish pass, a turbine house building, hydraulic channels, trash screening, access improvements, an electrical substation and underground cabling.

1.12 The proposal will not result in any changes in water level outside the range normally experienced at the site. However it will slightly alter the frequency at which certain water levels occur as described below.

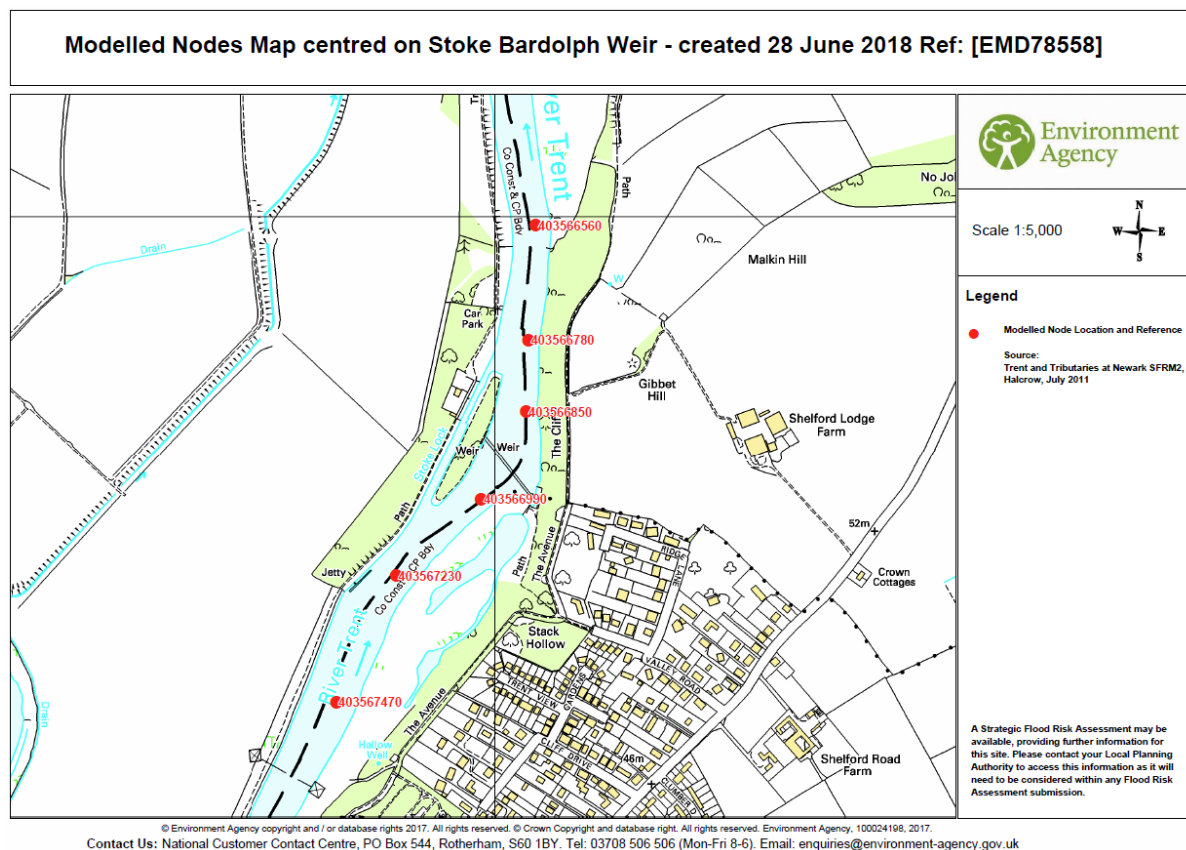
1.13 The weir crest will have a maximum crest level of 16.82 mAOD during low flows, which is 0.6 m above the existing crest level. As flow increases it will gradually deflate to maintain, as far as possible, a water level equal to approximately 17.07 mAOD, which is the existing mean level plus 0.3 m. This water level currently occurs during a flow condition of around Q12. During high flows the weir crest level will be as existing.

1.14 The weir crest will include a fail-safe mechanism to ensure that it automatically deflates, in a controlled manner, during loss of power or communications.

1.15 The adjustable weir crest allows operation of a hydropower scheme without resulting in unacceptable 'drawdown' of water levels, and provides greater control over the navigational waters upstream of the site.

<b>Summary of Flood Levels from EA data, just upstream of weir</b>	
Typical bank level	20.5 mAOD
Weir crest level	16.22 mAOD
<b><u>Flood levels</u></b>	
100 year flood 1% AEP	20.32 mAOD
100 year flood (+ climate change @20%)	20.55 mAOD
1000 year flood 0.1% AEP	20.85 mAOD

Figure 2 – Environment Agency Node Map



## Historic Flood Events

- 1.16 The River Trent at Stoke Bardolph is a large river with a catchment area of 7,575 km<sup>2</sup>. The hydropower scheme and associated infrastructure are located in the functional floodplain of the River Trent.
- 1.17 The River Trent has a long history of significant flooding in this area. Most recently, the river at Gunthorpe flooded in 2000, during which a number of properties and roads in the local were flooded.
- 1.18 Following the flood event from 2000, the Environment Agency worked with partner organisations to study the flood risk over the entire length of the River Trent and its main tributaries. The Nottingham Left Bank Flood Alleviation Scheme (FAS) was subsequently developed by the Environment Agency.

## Probability

- 1.19 From the Environment Agency's flood data, the flood height behind the weir during the 1 % Annual Exceedance Probability (AEP) is modelled to be 20.32 mAOD, with 0.1% Annual

Exceedance Probability (AEP) is modelled at 20.85 mAOD. The 1% AEP is below the typical bank height of 20.50 mAOD.

## Climate change

1.20 The EA flood data has the 1 in 100 year levels with a 20% 'Climate Change' allowance. This increases the levels from 20.32 to 20.55 mAOD.

## Flood risk management measures

1.21 The hydropower scheme will not be operational during times of extreme flood. Therefore, providing access to and from the building in times of flood has not been considered necessary.

1.22 Water level sensors will be installed on both sides of the weir to allow automation of the hydropower scheme and adjustable weir crest. During very high flows, the weir crest will be lowered to the existing crest level and as such the flood conveyance area will be as existing. As a result, the adjustable weir crest will not increase flood risk.

1.23 The weir crest will include a fail-safe mechanism to ensure that it automatically lowers, in a controlled manner, during loss of power or communications.

1.24 No maintenance of the hydropower scheme or weir crest will be carried out during high flow conditions.

1.25 All electrical equipment will be protected against flood damage to at least the 1 in 100 year (+ climate change) flood level, which is 20.55 mAOD.

## Off-site impacts

1.26 Building on the floodplain increases the risk of flooding to upstream property as well as the proposed development. However, at only 60 m<sup>2</sup>, the turbine house represents a small fraction of overall floodplain and as such makes a negligible contribution to flood risk.

1.27 The run-off from the proposed development will not greatly change due to the small footprint of impermeable surfaces and additional capacity of the hydropower channels.

1.28 A number of minor tributaries and other discharges are present upstream of the weir. These discharges may experience a change in water levels to the same extent as the main channel. However as the weir will return to its existing level during flood conditions, there will be no increase in flood risk associated with any of the discharges.

1.29 As the adjustable weir crests will be fully lowered during flood conditions, the flood conveyance capacity of the channel will remain as existing.

## Residual risks & mitigation measures

- 1.30 During construction, all material scraped back will be moved off-site away from the canal bank. The appointed contractor will be required to provide appropriate method statements, risk assessments and mitigation measures under the EA environmental permitting process. Appropriate cofferdam structures will be used.
- 1.31 The hydropower scheme includes a trash rack to exclude debris from the hydropower channels. This will be cleaned very regularly, to avoid loss of energy generation due to head losses.
- 1.32 All minor ancillary equipment will be stored inside the turbine house or off-site to prevent it being lost during a flood event.
- 1.33 There is potential during the construction phase to temporarily dewater very small sections of the river channel. The construction method statement will include site-specific requirements to ensure no further drainage of existing wet areas, or diversion of existing drainage channels, occurs.
- 1.34 Operatives will be able to monitor operating conditions, including upstream water levels remotely. The associated risks and compliance enforcement will be managed by the operator.
- 1.35 Frequent routine inspections of the hydropower scheme will be carried out. Planned maintenance is dependent upon the specific requirements of the individual items of equipment but maintenance will be in line with manufacturer's recommendations to ensure smooth and reliable operation.
- 1.36 Any weir crest maintenance operations will only be carried out after consultation with the Environment Agency, CRT and any other affected parties.

## Environmental permit

- 1.37 An application for a new bespoke environmental permit (flood risk activities) will be submitted to the Environment Agency. This will include a risk assessment and management system.

## Conclusions

- 1.38 The hydropower scheme will automatically shut down and the adjustable weir crest will return to existing crest levels during very high flows. The scheme will not impede flows and the flood conveyance area will be unchanged.
- 1.39 The adjustable weir crest features a fail-safe mechanism to ensure that it lowers, in a controlled manner, during loss of power or communications.
- 1.40 The turbine house presents a negligible additional flood risk due to its small size within the floodplain.

- 1.41 All electrical equipment will be protected to a suitable flood level and the hydropower scheme has been designed to exclude debris.
- 1.42 Construction and maintenance works will only be carried out during relatively low flow conditions.
- 1.43 Environmental Permits will be obtained for both temporary and permanent works.
- 1.44 Overall the proposal is considered to be adequately protected against flood damage and will not present any additional flood risk to others.