STANWICK SLUICES HYDROPOWER PROJECT

FLOOD RISK ASSESSMENT

1. INTRODUCTION

This Flood Risk Assessment for the proposed mini-hydropower scheme at Stanwick Sluices has been written with due regard to Planning Policy Statement 25 (PPS25): *Development and Flood Risk.*

1.1 Context

Hydropower is one of the key renewable energy technologies available in the UK to help the government meet its ambitious near-term renewable energy targets (20% of primary energy by 2020).

As well as confirming its own commitment to these targets, the Environment Agency state in their Hydropower Handbook (2003) that:

"The Agency's policy of no building within flood risk areas may be relaxed in appropriate situations because the very nature of hydropower requires structures in and adjacent to watercourses. However, any impact must be minimised."

The opportunities for low-head hydropower in the UK are site-specific and limited to former mill sites and locations adjacent to existing weirs and sluices. Such schemes as the one proposed at Stanwick Sluices can be considered as an appropriate floodplain development because they are small in scale, their impact can be minimised and because the benefits of renewable generation outweigh any minor risks that may remain.

1.2 Flood Risk and Vulnerability

Flood risk takes account of both the probability of flooding and the consequences of flooding.

Classes of 'Vulnerability' are defined in PPS25 as: Essential Infrastructure, Highly Vulnerable, More Vulnerable, Less Vulnerable and Water Compatible Development.

The proposed scheme is a combination of:

- Essential Infrastructure (*electricity generating power station*), and
- Water Compatible Development (*water transmission infrastructure*).

More information on these two categories is provided in Appendix I.

1.3 Flood Zones

There are four classifications for flood zones, as defined in PPS25:

Zone 1 Low probability (less than 1 in 1000 annual probability of river or sea flooding in any year).
Zone 2 Medium probability (between 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1000 annual probability of sea flooding in any year).
Zone 3a High probability (1 in 100 or greater annual probability of river flooding in any year or 1 in 200 or greater annual probability of sea flooding in any given year).
Zone 3b High probability (functional flood plain. Essentially the 1 in 20 or greater annual probability of flooding in any given year).

The hydropower scheme is in Zone 3 (as indicated in the EA flood zone map – Appendix-I). Additional information on the definitions of Zones 3a and 3b is also provided in Appendix-I.

1.4 The Sequential Test and Exception Test

The Sequential Test is a risk-based test that aims to steer new developments to areas with the lowest probability of flooding (Zone 1).

The Exception Test can be applied to certain forms of new development (including 'essential infrastructure') to justify works in Zones 2 and 3. The test considers the vulnerability of the new development to flood risk and must demonstrate:

- There are sustainability benefits that outweigh the flood risk.
- It is on previously developed land, or there are no other suitable sites.
- The new development is safe without increasing flood risk elsewhere.

In this case:

- the development of the hydropower scheme provides wider sustainability benefits by exploiting the river to generate hydro electric power, reducing the reliance on non-renewable fuel sources.
- the scheme utilises the footprint and channel from an existing flood gate which the EA are seeking to take out of service
- flood modelling (see below) demonstrates that the scheme will not increase flood risk elsewhere

2. FLOOD MODELLING

2.1 Introduction

The Environment Agency commissioned JBA-Bentley to undertake a flood modelling assessment in order to understand the impact on flood risk from a proposed hydro installation within the River Nene at Stanwick Sluices. The key results and conclusions are summarised below:

2.2 Methodology

The 2012 Middle Nene 1D ISIS model was used for the purposes of the study, but the floodplain on the left bank of Stanwick Lakes sluice was re-modelled in 2D to better represent the flow routes in that area. The model was considered suitable for assessing the <u>relative</u> impact of changes at Stanwick Lake sluice.

Three options were modelled for this study:

1. An Archimedes Screw turbine downstream of the existing vertical gate (i.e. the scheme as proposed).
2. A turbine downstream of the existing tilting gate.
3. A fixed weir option to replace both sluices.

For options 1 and 2, the sluice gate feeding the Screw was assumed to be closed (i.e. turbine 'off') and the height of the remaining gate was increased by 150mm (to prevent draw-down in the upstream reach when the turbine is operating).

The fixed weir (Option 1) was sized to overspill by 100mm when maintaining normal upstream water levels.

2.3 Model Results

The model looked at water level changes caused by Options 1, 2 and 3 relative to the modelled status quo, and considered flood return events of 2, 20, 100 and 1000 years.

The ‘baseline’ flood level immediately upstream of Stanwick Sluices was modelled as follows, illustrating a relatively small rise in level between minor and major flood events:

Return Period (Years)	U/S Water Level (mAOD)
2	35.290
20	35.430
100	35.490
1000	35.590

The quantitative outputs from the model are still being verified internally by the Environment Agency, but the overall, qualitative conclusions from modelling the 3 scenarios can be summarised as follows:

- Option 1 has the least impact on upstream water levels in all flood conditions, Option 3 has the most impact.
- Impacts of all 3 schemes are modelled as zero under 100 and 1000 year flood conditions, relative to the status quo.
- Any changes to the maximum flood extents in the 2 and 20-year flood events are small and do not extend beyond the Stanwick Lakes site.

2.4 Comment

- The flood model used in the above analysis did not account for an additional flood sluice being included in the design, adjacent to the Archimedes Screw. The new 2m x 2m sluice gate, as shown in the submitted drawings, will act to further reduce the small differences in flood impact between Option 1 and the status quo.
- Overall, it can be seen that the chosen Option 1is preferred from a flood perspective, and any changes to the status quo will be minor, will be retained within the Stanwick Lakes site, and will be imperceptible in a 100-year flood event.

3. ADDITIONAL FLOOD DEFENCE ISSUES

3.1 Flood Resilience

The powerhouse design has allowed for an entrance door sill set at 35.700mAOD, above the 1000yr flood level.

There are no windows and the entrance door will be a steel security door closing inwards against a rubber seal, such that even more extreme flood levels will tend to force the door closed against this seal.

All the electrical control equipment, switchgear, fuseboard, etc. will be located at least 700mm higher than this flood level, accessed from a raised gantry within the powerhouse with FFL above 35.600mAOD.

These levels are illustrated in the layout drawing.

The generator is located just above the predicted 100-year flood level. However, if necessary, the generator can be dried-out and refurbished following a flood, and it is a standard item that can be replaced if necessary.

The top bearing and gearbox are flood resilient products, which can survive being submerged (requiring a complete oil/grease change afterwards).

3.2 Floodplain Volume

The very nature of a low-head hydropower scheme requires a structure within or adjacent to the watercourse. However the impact will be minimised as follows:

- The control shed is the only significant structure set above existing ground level.
- The 100-year flood level downstream of the sluices is predicted to be 35.390mAOD.
- The control shed has a footprint of 4m x 4m (i.e. 16m² in area), with base slab set at 34.625mAOD. Hence at a 100-year flood level of 35.390mAOD the shed will occupy a volume of 12m³ within the floodplain.
- To the north of the sluices is an area of raised, overgrown land still containing spoil and rubble from the remains of Hollands Mill. As marked on the layout drawing, this area will be partially cleared and lowered in order to increase the downstream floodplain by at least 20m³.

4. CONCLUSIONS

The proposed hydro development offers significant sustainability benefits by generating around 150,000 kWh per year of renewable electricity (equivalent to 40 UK homes), saving 130 tonnes of CO_2 emissions annually from UK power stations. It conforms to national, regional and local targets for renewable energy generation.

The development lies within Flood Zone 3, but the Exception Test should be passed because:

- The site consists only of Essential Infrastructure and Water Compatible Development.
- The only significant new structure within the floodplain will be a small, unmanned control shed.
- The entrance door sill will be set above the 100-year flood level and the electro-mechanical system is flood resilient in design.
- The net volume of the floodplain will be increased by modest landscaping works adjacent to the site.
- A new, automated flood gate will provide an immediate response to rising river levels (a net improvement on the manual gate it replaces).
- Flood modelling demonstrates that the overall scheme will not increase flood risk beyond the extent of the site, and has no impact on the 100-year flood level.
- The development has sustainability benefits that outweigh any minor residual flood risks.

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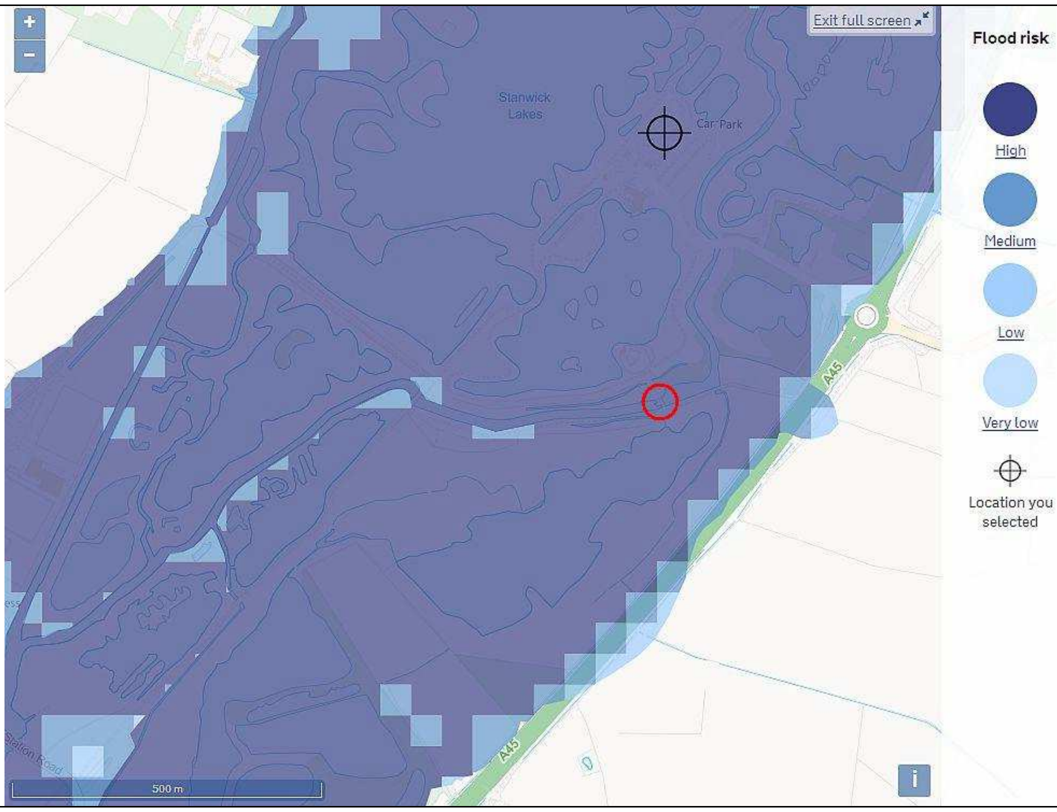
Appendix-I

Figure 1 : Environment Agency Flood Map for the area around Stanwick Sluices



Vulnerability Categories defined in PPS25

Essential Infrastructure Essential transport infrastructure (including mass evacuation routes)which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
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.

Definition of Flood Zones

Zone 3a High Probability: This zone comprises 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.
Zone 3b Functional Floodplain: This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme event (0.1%) flood.