Adran yr Economi a'r Seilwaith
Department for Economy and Infrastructure

Llywodraeth Cymru
Welsh Government

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The M4 Motorway (Junction 23 (East of Magor) to West of Junction 29 (Castleton) and Connecting Roads) and The M48 Motorway (Junction 23 (East of Magor) Connecting Road) (Amendment) Scheme 201-

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Summary Proof of Evidence

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Welsh Government, Flood Consequences Assessment

Document WG 1.17.2

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M4 CORRIDOR AROUND NEWPORT

Summary Proof of Evidence – Flood Consequences Assessment

1 Author

Personal profile and qualifications

1.1 My name is Michael John Vaughan.

1.2 My role has been to review the Flood Consequences Assessment and consider the fluvial and pluvial flood risk issues related to the proposed development of the M4 corridor around Newport.

1.3 I am a Chartered Civil Engineer and Chartered Water and Environmental Manager. I have over 21 years of professional experience.

1.4 The evidence which I have prepared and provide in this Proof of Evidence is true and has been prepared, and is given, in accordance with the guidance of my professional institution, and I confirm that the opinions expressed are my true and professional opinions.

2 Scope of Proof of Evidence

2.1 My evidence addresses the fluvial flood risk aspects relating to the M4 Corridor around Newport proposals. That is matters concerning to surface water flooding, and that from watercourses.

2.2 My evidence does not address matters of tidal flooding. This specialist area is addressed by Dr Paul Canning, Chartered Civil Engineer in his Proof of Evidence on tidal flooding (WG 1.16.1).

3 The Scheme proposal in terms of flood risk

3.1 The route passes across the Caldicot and Wentlooge levels (together known as the Gwent Levels) on a raised embankment. The area is identified as floodplain (predominantly Zone C1) in the Welsh Government's Development Advice Maps (Welsh Government, 2015), based on Natural Resources Wales' extreme flood outlines. This indicates that the flood risk area is served by significant infrastructure including flood defences.

3.2 A network of reens drain the Gwent Levels into the Severn Estuary though a series of tide gates and sluices within the tidal defences. During high tides, the reen network is tide locked and is unable to discharge. Tidal waters are prevented from entering the reens and the levels.

3.3 As the route crosses the Gwent Levels, it bisects a number of reens and field ditches. These will be infilled under the footprint as part of the Scheme. Hydraulic connectivity will be maintained by the provision of culverts and implementation of the reen mitigation strategy, as detailed later.

4 Support of the Flood Consequences Assessment

Hydrology

4.1 Runoff and flow estimates have been made based on UK industry standard methodologies: specifically the Environment Agency's flood estimation guidelines (Document 17.2.10) have been followed, which use the Revitalised Flood Hydrograph (ReFH1) and Statistical approaches.

4.2 Climate change has been allowed for within the hydrological estimates, applying 20% to flows in accordance with Welsh Government's 2007 guidance (Document 17.2.20).

4.3 Tide-locking, and the impact of sea level rise, is also considered in the Flood Consequences Assessment at Appendix 16.1 of the Volume 3 Environmental Statement (Document 2.3.2).

Hydraulic modelling

4.4 Hydraulic modelling has been undertaken to support the Flood Consequences Assessment for the proposed Scheme.

4.5 The baseline was developed to assess the current flood risks on the Gwent Levels and evaluate any change likely to arise from the Scheme. Two separate models were developed: of the Caldicot Levels east of the River Usk; and of the Wentlooge Levels west of the River Ebbw.

4.6 The Environmental Statement (Document 2.3.2) and, and its supplements (Document 2.4.4) report that no residential or industrial property would experience an increased risk of fluvial or pluvial flooding as a result of the Scheme. This is evidenced by the hydraulic modelling, which demonstrates a typical change in peak flood level in the range of -10mm to +10mm.

Drainage modelling

4.7 Each drainage run comprises a lined drainage channel or pipework, passing into a pollution control forebay and then into an attenuation lagoon. The lagoon pass a regulated flow of water into a treatment reedbed which discharges into a receiving watercourse.

4.8 The hydraulic design of the drainage system has been developed using the industry standard MicroDrainage software.

4.9 In terms of runoff, a 30% allowance for climate change was applied to rainfall intensity which originates from the 2007 Welsh Government guidance (Document 17.2.20).

4.10 The piped and channelled drainage has been designed to accept flows from the more intense (short duration) 1 in 100 year storm with climate change. Longer duration storms of the same frequency were also tested, and are by nature less intense and so also accommodated by the Scheme.

4.11 It is notable that this design standard far exceeds that usually applied to schemes of this type, where the Design Manual for Roads and Bridges (Document 13.2.6) design standard is 5 years.

4.12 The attenuation lagoons have each been sized to restrict runoff during all events, up to and including the 1 in 100 year storm (with allowance for climate change), to the greenfield runoff set by Natural Resources Wales.

Mill Reen

4.13 The proposed Scheme sees the existing Mill Reen culvert under the existing M4 motorway lengthened by 72½m, from 61½m to 134m, in order to carry the new Magor junction. As this lengthening has the potential to increase flood levels upstream, and the area is not covered by the Gwent Levels modelling, additional work was carried out to investigate the impacts.

4.14 A with-Scheme application of the model was developed by changing the culvert and motorway embankment in accordance with the Scheme drawings of October 2015.

4.15 The results of the modelling indicated that the proposed Scheme could increase water levels in the farmland to the north-east of the Magor junction. Increases of up to 350mm were predicted at the culvert entrance during the 1 in 1,000 year flood. The impact on flood levels extends approximately 600m upstream through farmland almost towards the culvert below St Bride's Road, although no properties would be affected.

4.16 The land predicted to suffer increased flooding has been included in the Compulsory Purchase Order as with Rights to discharge surface water and floodwater (shown for plots 19/5a, 19/5b and 19/6).

Reen mitigation strategy

6.1 The Reen Mitigation Strategy is applied in the design to ensure the hydraulic connectivity of water across the Gwent Levels, specifically considering the reens (watercourses), and smaller field ditches (ephemeral drains).

6.2 The Scheme will require numerous reens to be infilled, where they run across or along the alignment. Severance of these reens, without any mitigation, could alter the way that water moves across the Gwent Levels, blocking overland flow paths during flooding, concentrating flows in certain areas and removing water from others.

6.2 Hence the mitigation strategy is to:

a) Collect water from the north side of the embankment in a new reen parallel to the alignment on the north side
b) Pass it through a series of culverts under the embankment
c) Spread the water out via a new reen parallel to the alignment on the south side

6.3 The hydraulic performance of the reen mitigation strategy was tested in the hydraulic model. That work determined that the Scheme would have no impact on fluvial flood risk to property, and only localised and minor adverse impacts on the agricultural land.

6.4 In my opinion, the reen mitigation strategy suitably addresses the potential hydraulic issues that a raised embankment and reen severance could cause, as the approach to collect, convey and distribute floodwater is best practice and logical.

Flood Consequences Assessment

4.17 As reported in the Flood Consequences Assessment, no residential or industrial property would experience an increased risk of fluvial or pluvial flooding as a result of the Scheme.

4.18 The Scheme is not predicted to flood from surface water or the reen network during the 1 in 100 year event, over the lifetime of the project.

4.19 The Scheme is not predicted to flood from surface water or the reen network during the 1 in 1,000 year event.

4.20 At Mill Reen, there is minimal impact of the proposed development on flood risk generally, which is included as part of a right to flood agreement.

4.21 Consequently, the evidence demonstrates that the Scheme satisfies the acceptability criteria laid out in TAN15 (Document 17.2.2) for fluvial and pluvial flooding and that it would not cause any unacceptable impacts from fluvial flooding elsewhere.

4.22 I can report that the Scheme will be free from fluvial flooding during the 1 in 100 year event over the lifetime of the development, and the consequences of fluvial flooding under extreme conditions are acceptable in accordance with the TAN15 guidelines (Document 17.2.2).

5 Objections

5.1 Objections to the proposed Scheme citing matters of fluvial flood risk have been received from a range of public bodies, as well as from private individuals and companies and other bodies.

5.2 The objections cover 6 main themes:

a) Runoff

b) Drainage

c) Reen mitigation

d) Water level management

e) Maintenance and access

f) General flooding

5.3 I have discussed the themes of these objections in more detail within my Proof of Evidence (WG 1.17.1).

6 Conclusion

6.1 My Proof of Evidence provides a detailed description of the hydraulic modelling undertaken on the Gwent Levels and demonstrates that the Scheme addresses matters of fluvial and pluvial flood risk.

6.2 I am of the opinion that the Scheme will have negligible impact on fluvial and pluvial flood risk.

6.3 This evidence represents my true and professional opinion and is given in accordance with the Institution of Civil Engineer's Rules of Professional Conduct.

6.4 I understand my duty to the Public Local Inquiry to assist it with matters within my expertise and I believe that I have complied with that duty.