Llywodraeth Cymru / Welsh Government

A487 New Dyfi Bridge

Environmental Statement – Volume 1: Chapter 3 Alternatives Considered

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3 Alternatives Considered

3.1 Introduction

3.1.1 This chapter of the ES outlines the main alternatives considered during the development of the Scheme. In addition, it sets out the main reasons for the selection of the Scheme.

3.1.2 The A487 trunk road at Pont-ar-Ddyfi has been the subject of a number of studies into the operation and serviceability of the existing route and alternative crossing points that may be suitable to cross the Afon Dyfi floodplain. In the last thirty years increased traffic and the continuing deterioration of the masonry structure has necessitated structural strengthening works and repairs to keep the bridge operational.

3.2 Legal Context

3.2.1 The 2011 EIA Directive 2011/92/EU (as amended) requires the following to be included within an ES.

'An outline of the main alternatives studied by the developer and an indication of the main reasons for his choice, taking into account environmental effects'. (Article 5, 3(d) Directive 2011/92/EU).

3.2.2 As set out in Chapter 1 of this ES, Directive 2011/92/EU has been amended by Directive 2014/52/EU. Although the transitional measures in place mean that the provisions of Directive 2011/92/EU remain applicable for the Scheme, the requirements of Directive 2014/52/EU have been taken into account within this ES.

3.2.3 Directive 2014/52/EU amends Article 5, 3 as follows:

'A description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment'. (Article 5, 3(d) Directive 2011/92/EU).

3.2.4 This chapter includes an outline account of the main and reasonable alternatives to the Scheme that have been considered by the Welsh Government and its advisors, taking into account their potential environmental impacts. Secondly, this chapter includes a description of the iterative development of the Scheme and the justification behind any design changes.

3.3 Alternatives Considered 1996-2003

Feasibility Study and Technical Assessment Report, Powys County Council (1996)

3.3.1 Powys County Council, acting as Trunk Road Agents (TRA), commissioned a Feasibility Study and a Technical Assessment Report from RUST Consultants in 1996. In the study a number of on-line improvement options to Pont-ar-Ddyfi were evaluated, strengthening and alternate signalised one way operation emerged as the only viable solution. A preferred offline improvement was also identified crossing the Afon Dyfi 200m upstream of the existing bridge on a skew bridge and re-connecting to the A487.

A487 Fishguard to Bangor Trunk Road; Pont ar Ddyfi Improvement - Technical Appraisal Report (March 2003)

3.3.2 In November 2000 Powys County Council, acting as TRA, were directed to review the earlier work and produce a Stage II Technical Appraisal Report with an accompanying Environmental Assessment. The "A487 Fishguard to Bangor Trunk Road; Pont-ar-Ddyfi Improvement - Technical Appraisal Report (March 2003)" examined five initial options which are detailed in Table 3.1.

Table 3.1: Technical Appraisal Report Options

Option	Option Description
Option 0	'Do minimum' - The works considered for this Option are the minimum necessary to: • ensure that the load capacity of the Pont-ar-Ddyfi meets the trunk road standard for this type of structure (40/44 tonnes); • maintain the existing Pont-ar-Ddyfi as a viable structure; • minimise the requirements for non-routine maintenance works; • maximise service life.
Option 1.1 (variation of Option 1)	This option includes the works for Option 0 with the addition of: • signal controls for alternate one way traffic operation over bridge; • local road geometry improvements, signing and road marking; • raising levels on the trunk road southern approach to bridge to maintain route above flood levels and to accommodate minimum

Option	Option Description
	100m wide culvert 1.5m high beneath the carriageway.
Option 2.1 (variation of Option 2)	This option provides two-way traffic flow on an off-line elevated structure 525m long across the floodplain, with a new bridge across the Afon Dyfi re-joining the A487 some 280m upstream of the existing bridge. The existing A487 across the flood plain and the existing Pont-ar-Ddyfi would be de-trunked and used only for access and recreational purposes.
Option 2.2	This option provides an off-line improvement on viaduct structure across the floodplain with a skew crossing of the Afon Dyfi, re-joining the A487 approximately 200m upstream of the existing bridge and at a higher elevation. The existing A487 across the floodplain and the existing Pont-ar-Ddyfi would be de-trunked and used only for access and recreational purposes.
Option 3.1 (variation of Option 3)	This option provides two-way traffic flow on a more easterly off-line improvement on a 570m long viaduct structure across the floodplain with a marginally skew crossing of the Afon Dyfi. The alignment connects directly to the Ffridd Gate Improvement approximately 480m upstream of the existing bridge crossing, with the A493 joining the A487 via a ghost island 'tee' junction.

3.3.3 From Table 3.1, Powys County Council recommended the following three options be taken forward for evaluation:

- Option 0, 'do minimum' as base Scheme;
- Option 2.2, A487 on straight viaduct;
- Option 3.1, A487 on curved on plan embankment opening onto a part curved, part straight viaduct.

3.3.4 The principal conclusions of the Technical Appraisal Report were:

- Any off line improvement must be on an elevated structure;
- Flood defence works are required for an off line improvement;
- There are additional flood benefits resulting from an offline improvement;
- Off line improvements have significantly higher costs (x4) and off line improvements would perform poorly in cost benefit terms;
- The principle environmental impacts affect the river environment and the floodplain visually; however it is considered that none of these impacts are of sufficient magnitude to prejudice the proposed improvement;

- If it is considered that integrity of the network is maintained despite regular route severance flooding, then Option 0, or a variant, must be the preferred option;
- If it is considered that integrity of the network is not maintained by virtue of the regular flooding and severance of the route, then an offline improvement is essential;
- Of the two offline options considered, Option 3.1 offers advantages in terms of environment and network operation and merits more detailed investigation;
- Whilst noting the previous point, Option 2.2 offers the best value and is therefore presently the preferred option.

3.3.5 The report therefore concluded that for the trunk road to remain accessible to traffic at all times the recommended option was to construct an offline multi span viaduct across the floodplain. However, should regular flooding and resulting severance of the route be considered acceptable then strengthening of the bridge or a variant was the optimum solution.

3.3.6 It is important to note that the Jubilee Bridge Grofft, situated approximately 8km east from the Pont-ar-Ddyfi, has not been considered as an alternative option as a minor country road would be unsuitable for the traffic flow of Heavy Goods Vehicles.

3.4 Welsh Transport Planning and Appraisal Guidance (2008)

3.4.1 In 2008, the Welsh Government developed and adopted the Welsh Transport Planning and Appraisal Guidance (WelTAG) (Welsh Assembly Government, 2008b). WelTAG sets out a methodology and process for assessing proposed strategies, plans and Schemes. It aims to provide decision makers with information about significant economic, environmental and social impacts from proposals. It enables decision makers to judge the merits of proposals and helps reasoned decisions to be made using a consistent approach. It also provides an audit trail of decision making.

3.4.2 WelTAG has two primary purposes:

- *"To assist in the development of proposals enabling the most appropriate Scheme to be identified and progressed - one that is focused on objectives, maximises the benefits and minimises negative impacts;* and
- *To allow the comparison of competing Schemes on a like-for-like basis, so that decision-makers can make funding decisions".*

3.4.3 The WelTAG process starts with the planning stage, which establishes the conditions in the area, its transport problems and opportunities and generates objectives for the steps that follow. These are referred to as Transport Planning Objectives. This is followed by the identification of possible solutions, which are tested first informally against the objectives set (referred to as 'sifting') and then in more detail, leading in due course to the appraisal stage.

3.4.4 The appraisal stage has two components - Stage 1 and Stage 2 appraisal. The WelTAG guidance sets out that for Schemes both Stages 1 and 2 are required. Stage 2 requires more detailed consideration and is a much more resource intensive process.

3.5 WelTAG Planning Stage Appraisal (August 2011)

3.5.1 In August 2011, Halcrow was commissioned by the Welsh Government (WG) to carry out WelTAG planning stage appraisal for Pont-ar-Ddyfi and surrounding area. The purpose of the study being to:

- Develop and identify the Transport Planning Objectives (TPOs);
- Identify, develop and sift transport options to resolve problems in the study area.

3.5.2 The first part of the appraisal led to the identification of objectives (Transport Planning Objectives) for the Scheme (refer to Table 1.1).

3.5.3 A three-step process was used in identifying possible solutions. The short-list of options is summarised in Table 3.2.

Table 3.2: WelTAG Planning Stage Appraisal Short-list of Options

Ref	Solution Name
1	Signal controls at Pont-ar-Ddyfi
2	Close Pont-ar-Ddyfi to traffic. Allow NMUs only.
3	Raise A487 south of Pont-ar-Ddyfi
4	Widen northwest entrance to Pont-ar-Ddyfi
5	Strengthening Pont-ar-Ddyfi
6	Upgrade A470
7	Upgrade B4404
8	New road and river crossing upstream
9	Bypass Machynlleth to the east
10	New road and river crossing from Railway station east of Dyfi Eco park

Ref	Solution Name
11	New road and river crossing from Machynlleth Town Centre east of Dyfi Eco park
12	New road and river crossing downstream
13	Tunnel under Afon Dyfi
14	New A487/A493 road link at Dyfi junction
15	New parallel bridge with one-way operation on each
16	Bypass Machynlleth to the west
17	Remove flood water beneath railway bridge
18	Manage floodplain to absorb more water
19	Hold the Afon Dyfi upstream and generate hydro power
20	Manage the catchment water speed of arrival
21	Realign river through floodplain
22	Weight and length limits for HGVs
23	Reduce the demand for HGV movements over Pont-ar-Ddyfi
24	Out of town park & ride
25	Re-establish old Corris railway line for road and rail
26	Public transport hub at Cemmaes Road
27	Continuous walking & cycling on A487, including opening tramway arch
28	Construct a new cottage hospital in Dolgellau
29	Travel planning
30	Widening and strengthening Pont-ar-Ddyfi
31	Barrage downstream to control tidal movements
32	Flood channels
33	New single carriageway viaduct across the floodplain upstream
34	New single carriageway viaduct across the floodplain downstream

3.5.4 Options were sifted against TPOs and deliverability criteria to ensure they were (1) contributing to the essential objectives of the study; and (2) realistic, in that they were feasible, acceptable and affordable.

3.5.5 A “Summary of Option Sift against WelTAG Criteria” and a “Summary of appraisal against TPOs, Deliverability and WelTAG Criteria” is included in Volume 3, Appendix 3.1. This shows all the criteria considered in the appraisal of each option.

3.5.6 Following stakeholder consultation, the WelTAG Planning Stage Appraisal report recommended that the four options ranked 1-4 in Table 3.3 were taken forward to the WelTAG Stage 1 Appraisal for further assessment.

Table 3.3: WelTAG Planning Stage Recommendations

Rank	Ref	Package
1	UP1	New crossing 200-500m upstream
2	DO1	New crossing 200-500m downstream
3	WS3	Widening & strengthening + flood mitigation + raise A487
4	WS2	Widening & strengthening + flood mitigation
5	WS1	Widening & strengthening
6	UP2	New crossing approx 500m upstream, southern approach from station east of Dyfi Eco Park
7	TM1	Traffic Management
8	ON1	Raise A487 + traffic management + flood mitigation
9	TM2	Traffic Management + flood mitigation

3.6 WelTAG Stage 1 Appraisal

3.6.1 The WelTAG Planning Stage Appraisal report recommended four options to be taken forward to WelTAG Stage 1 Appraisal The option ranked No.1 at WelTAG Planning Stage, a new crossing 200-500m upstream (Table 3.3), was further split into two options, a new crossing 200m upstream and a new crossing 500m upstream. The following packages were taken forward to further detailed appraisal. These are illustrated in Volume 2 Figure 3.1.

3.6.1.1 **Option 1 New crossing 200m upstream**: This option consists of a new crossing 200m upstream of the existing Pont-ar-Ddyfi. The A487 southern approach would be on embankment or viaduct and the existing Pont-ar-Ddyfi Bridge would be de-trunked or closed (except for non-motorised users). This alignment allows for a transverse crossing of the river, with a single main bridge span crossing the river channel. The highway alignment would connect to the existing A493 route to the north of the Afon Dyfi. Flood channels and culverts would be incorporated beneath the embankment (unless viaduct). Flood protection bunds and walls to protect the Dyfi Eco Park, Railway bridge, Pen-y-Bont Cottages would also be incorporated.

3.6.2 **Option 2 New crossing 500m upstream**: This option consists of a new crossing 500m upstream of the existing Pont-ar-Ddyfi. The A487 southern approach would be on embankment or viaduct and the existing Pont-ar-Ddyfi would be de-trunked or closed (except for non-mortised users). This alignment allows for a transverse crossing of the river, with a single main bridge span crossing the river channel. Flood channels and culverts would be incorporated beneath the embankment (unless viaduct). Flood protection bunds and walls to protect the Dyfi Eco Park, Railway bridge, Pen-y-Bont Cottages would also be incorporated. The

highway alignment would accommodate a continuous free flowing connection to the existing A487 route without a requirement for a roundabout to change direction.

3.6.3 **Option 3 New crossing 200-500m downstream**: This option consists of a new road and river crossing 200-500m downstream of the existing Pont-ar-Ddyfi. The A487 southern approach would be on embankment and the Pont-ar-Ddyfi would be de-trunked or closed (except for non-mortised users). Flood channels and culverts would be incorporated beneath the embankment. Flood protection bunds and walls to protect the Dyfi Eco Park, Railway bridge, Pen-y-Bont Cottages would also be incorporated.

3.6.4 **Option 4 Widening and strengthening, flood mitigation and raising of A487**: This option consists of raising the A487 south of Pont-ar-Ddyfi, widening the existing bridge on the downstream side to incorporate a wider carriageway and a new footway provision. The existing bridge would be widened by 7.6m to provide a 7.3m carriageway , a two metre hatched separation strip between traffic lanes and footways 2.0m wide on each side. This would result in a continuous walking and cycling route on the A487, including a footway on Pont-ar-Ddyfi. Flood mitigation would involve managing the flood plain to absorb more water and managing the speed of arrival of water into the catchment water. Flood channels and flood protection bunds and walls to protect the Dyfi Eco Park, Railway bridge, Pen-y-Bont Cottages would also be incorporated.

3.6.5 **Option 5 Widening and strengthening plus flood mitigation**: This option consists of widening the existing bridge on the downstream side to incorporate a wider carriageway and new footway provision. The existing bridge would be widened by 7.6m to provide a 7.3m carriageway , a two metre hatched separation strip between traffic lanes and footways 2.0m wide on each side. This would result in a continuous walking and cycling route on the A487, including a footway on Pont-ar-Ddyfi. Flood mitigation would involve removing flood water beneath the railway bridge, managing the flood plain to absorb more water and managing the speed of arrival of water into the catchment water. Flood channels and flood protection bunds and walls to protect the Dyfi Eco Park, Railway bridge, Pen-y-Bont Cottages would also be incorporated.

3.6.6 The WelTAG Stage 1 Appraisal Summary Table (AST) which was completed for each option appraised at WelTAG Stage 1 is included in Volume 3, Appendix 3.2. This shows all the criteria considered in the appraisal of each option.

3.6.7 The WelTAG Stage 1 Scheme Appraisal resulted in four options being discarded for the reasons set out in their respective comparison of significance of appraisal summary tables.

3.6.8 Option 2 scored the highest in the appraisal against the Welsh Impact Areas, particularly in relation to the impact on the Environment. This option was taken forward to the WelTAG Stage 2 Appraisal for further detailed assessment.

WelTAG Stage 2 Appraisal

3.6.9 Following the completion of the WelTAG Stage 1 appraisal, option 2 was taken forward to be assessed at the Scheme level. This appraisal confirmed the current Scheme as the preferred option and supports the findings of the previous DMRB Stage 2 Assessment undertaken by Powys County Council.

3.7 Design Alternatives Considered Prior to Publication of Draft Orders

3.7.1 A conceptual design was issued on award of the Early Contractor Involvement contract for the Scheme in June 2015. The main components of the conceptual design included the following.

- The proposed Scheme consists of a new viaduct structure to cross the Afon Dyfi approximately 480m upstream of the existing bridge. At the northern end of the Scheme the alignment ties into the existing A487 in the area of the completed Ffridd Gate Improvement and the existing A487 would be renumbered as the A493, joining the new A487 alignment via a ghost island 'tee' junction. The Scheme crosses the Afon Dyfi and floodplain on a structure, connecting via a short embankment to the existing A487 north of the Cambrian Line Railway Bridge over the A487 on the edge of Machynlleth. The length of the proposed Scheme is approximately 1100m with approximately 570m being on viaduct.
- It is intended to de-trunk the existing A487 between the tie in points with the new Scheme. Preliminary design indicates the viaduct spans being typically 1No. x 60m over the Afon Dyfi with 2No. x 35m,14No. x 30m and 1No. x 20m spans crossing the floodplain. The viaduct structure is assumed to be carried by single circular columns on piled foundations with the deck structure being continuous steel/concrete construction.
- It is not within the scope of this Scheme to solve the separate flooding mechanism below the Cambrian Line Railway Bridge which also interrupts the use of the A487. This will be addressed separately.

3.7.2 The main changes to the conceptual design prior to submission of the draft Statutory Orders (leading to the Scheme design set out in Chapter 2) are described below.

3.7.3 **Scheme Lengths** – The conceptual design was approximately 1100m long with approximately 570m being on viaduct. The design was reviewed following flood modelling which indicated increases in flooding as a result of the Scheme. The adopted design is approximately 1200m with approximately 720m being on structures.

3.7.4 **Southern Tie In and Embankment** – The conceptual design had a short embankment to tie into the existing A487, immediately north of the Dyfi Eco Park. The embankment encroached into the floodplain and restricted the conveyance of flow across it. The adopted design removed this by commencing the Scheme immediately north of the existing Cambrian Line Railway Bridge, moving the embankment south away from the floodplain. The change to the southern tie in has moved the embankment from north of the Dyfi Eco Park to the west of the existing A487, opposite the entrance to the Dyfi Eco Park. It has also resulted in the reconfiguration of the junction to the Dyfi Eco Park with a short connection provided between the existing junction and the new alignment. A major-minor priority junction would connect the new alignment with the existing A487 at Ch. 0+140.

3.7.5 **Extended Viaduct** – The conceptual design incorporated a river bridge with a span of 60m over the Afon Dyfi with 2No. x 35m, 14No. x 30m and 1No. x 20m viaduct spans crossing the floodplain. The design was reviewed taking into account the desire to reduce the flooding caused by the Scheme. The adopted design includes a river bridge of 74m over the Afon Dyfi, with a 50m back span adjacent to the main river bridge. The viaduct across the floodplain to the south of the river bridge consists of 16 No. 34m span and 2 No. 27m spans at the southern end.

3.7.6 **Northern Tie In** – The conceptual design included a ghost island ‘tee’ junction with the existing A487, which would be de-trunked to become the A493. The existing A487 would be realigned slightly to approach the new A487 at near perpendicular. The design was reviewed following consultation with adjacent landowners. The adopted design reconfigures the Y Ffridd Farm access and includes a cattle underpass in front of the northern abutment to enable the farmer to get their animals from the farm, across the A493 south, under the River Bridge to the fields on the other side of the realigned A487.

3.7.7 **Flood Protection** – The conceptual design included a flood bund along the northern boundary of the Dyfi Eco Park. One of the changes to the conceptual design now incorporates a flood bund along the western verge of the A487 opposite the entrance to the Dyfi Eco Park. These bunds have been designed to protect both the realignment of the A487, the A487 under the Cambrian Line

Railway Bridge and the Dyfi Eco Park from river flooding, via overland flow, in the 1 in 100 year storm event. The residential properties to the north of Pont-ar-Dyfi will see an improvement in the level of flood risk, as a result improvement works. They will subsequently be protected from fluvial flooding up to a 1 in 1000 year event and from surface water flooding up to a 1 in 100 year event.

3.7.8 **Lighting** – The conceptual design did not incorporate any road lighting as there was no specific requirement for highway lighting. As the southern limit of the Scheme has moved south towards Machynyllyth to accommodate the extended viaduct, there is a need to light the southern end of the Scheme within the 30mph speed limit to replicate the existing provision.

3.7.9 **Horizontal and Vertical Alignment** – The horizontal alignment of the Scheme has been adjusted at the southern end of the Scheme adjacent to the Dyfi Eco Park to allow the construction of the approach embankment off line of the existing A487 in the field opposite the Dyfi Eco Park entrance. This has therefore moved the alignment of the new road away from the Dyfi Eco Park. The vertical alignment at the southern end of the Scheme has been raised, associated with the extended viaduct, to provide sufficient clearance for debris between the flood water and underside of the structure.

3.7.10 **Flood Mitigation** – The design was reviewed following flood modelling which indicated increases in flooding to the cottages to the north of Pont-ar-Ddyfi, as a result of the Scheme. The adopted Scheme now incorporates flood mitigation measures to ensure no increase in flood risk to the existing bridge and adjacent residential properties.

3.7.11 **Railway Bridge Flooding** – It was not within the original scope of the Scheme to solve the separate flooding issue which occurs below the Cambrian Line Railway Bridge. It was agreed following comments received at the Public Information Exhibition that the issue needs to be addressed as part of the Scheme. The adopted design now incorporates a new pumped drainage system to be installed adjacent to the existing Cambrian Line Railway Bridge to prevent flooding below the bridge. The pumped drainage system would discharge to the west of the flood bund via the normal highway drainage outfalls.

3.8 Design Alternatives assessed through KS3

3.8.1 The ECI contract requires the consideration of design options to establish the preferred option for the Scheme. A Design Options Report was produced which set out a range of options and assessed each of them against a set of relevant objectives. This is included in Volume 3, Appendix 3.3.

3.8.2 In addition to this report there was a separate Bridge Design Options Report which considered the structural options for the viaduct and river bridge.

3.8.3 Based on the design assessments detailed within the Design Options Report, the options recommended to be taken forward in preliminary design were as follows:

- New river crossing to be located 480m upstream of existing Pont-ar-Ddyfi;
- 550m long elevated viaduct/ bridge structure – the viaduct option offers a reduction in community severance compared to other options mentioned above;
- Northern Junction to be Ghost Island T-Junction;
- Southern Junction to be Simple T-Junction;
- Existing de-trunked A487 carriageway to be retained for access;
- Existing Pont-ar-Ddyfi bridge should be retained but limited to NMU and restricted vehicular access only – this increases the safety of Non-Motorised Users using this section;
- Existing A487/ A493 junction to be converted to straight through 2-lane section of A493;
- Informal footway only to be provided across new viaduct – the provision of a shared footway/cycleway along the viaduct would encourage more active travel;
- Existing flood bund should be diverted to tie into proposed highway embankment to protect A487 against flooding from upstream;
- Kerb and gulley/combined kerb drainage system to be utilised to match exiting – the proposed pollution prevention measures offer an improvement on the existing situation; and
- Permanent land take to be offset 2m outside extent of permanent works, with land under viaduct to return to land owner where possible.