WSP | PARSONS BRINCKERHOFF

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A40 ST.CLEARS TO HAVERFORDWEST STUDY

DESIGN OPTIONS REPORT VOLUME 1

Welsh Government

43696/902

Final

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# A40 St.Clears to Haverfordwest Study

# Design Options Report Volume 1

**43696/902**

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EXECUTIVE SUMMARY

This study was commissioned from WSP | Parsons Brinckerhoff and TACP to enable a comparative assessment of A40 improvement options identified by the 2004 A40 Corridor Study and proposals targeted at congestion in Haverfordwest and routes to the Haven as identified in Pembrokeshire County Council's (PCC) 2009 Haverfordwest South Eastern Bypass Pre-feasibility Report. The study ran in parallel with a separate study, commissioned from Peter Brett Associates, into the economic performance of South West Wales and the impact transportation links may have on growth and inward investment.

The study addressed six options agreed with the Welsh Government;

1. Current A40 committed schemes including Llanddewi Velfrey and Redstone Cross
2. 2+1 improvements providing maximum overtaking opportunity St.Clears to Haverfordwest
3. Upgrade A40 to full dual carriageway standard from St.Clears to Haverfordwest
4. Haverfordwest junction improvement (including PCC Option 5 - Merlin's Bridge)
5. Haverfordwest South Eastern Bypass (PCC Option 3 - SE bypass to Sentry Cross)
6. Shortened version of Option 5 (PCC Option 3) terminating on the A4076 near Pope Hill

Option concept drawings are provided in Appendix A.

The study brief was to undertake a high level WelTAG planning Stage 1 appraisal covering economic, environmental and social factors but without a formal consultation with stakeholders and the public due to the time limitations of the study. The study team undertook a review of existing reports, conducted a desktop study of the route, commissioned surveys to update data sources and held consultation with selected key stakeholders.

Transport Planning Objectives (TPO) drawing upon the TPOs contained within the earlier Welsh Government and Pembrokeshire County Council reports were developed at WelTAG workshops. Details of the TPO development are provided in Appendix B resulting in the agreed TPO listed below.

Criteria	Transport Planning Objective
Economy	Improve journey time and reliability
	Enhance network resilience
	Aid regeneration & support regional economy
Environment	Avoid adverse environmental impact
	Provide environmental benefit
Society	Reduce personal injury accidents
	Improve permeability and opportunities for active travel

The study programme precluded full traffic modelling based on new traffic surveys so it was agreed that traffic assessment would be based on recorded link count data supplemented by TrafficMaster journey time data and specifically commissioned turning count data in Haverfordwest. This base data is insufficient to provide validated traffic model flow forecasts or routing information so it was agreed that traffic performance should be based on the time and safety benefits accrued by car users at 2015 base year flows. These parameters are considered good measures for the congestion relief and increased overtaking opportunity offered by the study schemes.

The existing traffic information shows E/W traffic passing through St.Clears has a choice of routes to the Haven development area; A40 to Haverfordwest then south on the A4076, or A477 to Pembroke Dock then across the Cleddau estuary. Several local roads connect the two routes but these are

unsuitable for high traffic volumes and distances are such that their use is largely limited to incident/event diversion.

The latest available DfT count data (2013) shows that roughly 65% of the traffic at St.Clears routes via A40 and 35% via the A477. Of the two routes the A477 serves the higher HGV proportion with both slightly above national average. A40 traffic volumes are in the range 9,200-13,700 AADT with 8,800-16,000 AADT on the A4076 whilst the A477 serves around 7,200 AADT. These flows are all within the TA46/97 advised economic range for a single carriageway (inc. WS2+1) 6,000-21,000 AADT. Due to the limited timeline of TEMPRO traffic growth predictions it is not possible to confidently predict when future A40 traffic flows might exceed single carriageway capacity and move into the range appropriate for dual carriageways (11,000-39,000 AADT) but is generally considered to be in excess of current design year.

Notwithstanding traffic flows the routes have limited overtaking opportunity and particular congestion points that result in poor journey time reliability which combined with alignment and vehicle mix gives rise to safety concerns.

Traffic analysis based on the TrafficMaster journey time data predicts that the proposed options will accrue both travel time and journey reliability savings as shown in the table below.

Option	Time Benefits (sec)			Safety Benefits (collisions saved)
	Total Travel Time Improvement	Journey Variability	Maximum travel time benefit	
Option 1	25	0-2	27	57
Option 2	70	0-23	93	94
Option 3	584*	7-82	666	150
Option 4	20**	n/a	20	n/a
Option 5	121	11-41	162	n/a***
Option 6	59	0-21	80	n/a***

* Increase in dual carriageway derestricted speed to 70mph, others only release local speed restrictions.
** includes some directional disbenefits but provides a net positive benefit overall.
*** quantitative assessment has not been possible but positive safety benefits are expected.

Price base and other accounting differences between original reporting sources made it difficult to directly compare option costs so it was resolved that costs would be re-calculated for all schemes using industry standard SPONS rates at current costs. The resulting scheme costs (excluding Lands, Statutory Undertaker and VAT costs) are:

Option	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Option 1	26.8	6.9	5.7	17.3	**56.8**
Option 2	45.5	13.0	10.0	30.1	**98.6**
Option 3	150.7	49.0	33.9	102.8	**336.3**
Option 4	5.9	1.9	1.4	3.8	**12.9**
Option 5	22.5	7.3	5.1	15.4	**50.3**
Option 6	15.5	5.0	3.5	10.6	**34.6**

The study team acquired information on environmental and social factors that might be impacted by the options. The key constraints are identified on the environmental drawings (Volume 2) with impacts

appraised during WelTAG workshops and summarised on the Appraisal Summary Tables (ASTs) (Appendix C).

WelTAG procedure requires the appraisal be considered as a whole without summing or discounting of individual significance scores. However the negative environmental impacts of the A40 options generally increase with option scope with the dual carriageway option on a par with the Haverfordwest bypass Options 5&6. Society and TPO benefits are generally positive. Option 4 tended to score neutral on environmental and social impacts throughout due to a lack of scale.

Based on the full range of economic, environmental and social impacts together with TPO performance and programme considerations the study draws the following conclusions.

The study supports the progression of Option 1, the Llanddewi Velfrey to Penblewin Improvement in line with the current Welsh Government programme of works.

Current traffic levels suggest that improvement of the A40 to maximum 2+1 standard, proposed by Option 2, provides better value for money than the dualling of Option 3.

Whilst not assessed in detail as part of the study staged implementation of Option 2 schemes could provide an on-going A40 route improvement strategy until such time as increased traffic flows justify the business case for dualling.

Option 4 schemes show marginal impact with limited benefit to TPO objectives. Whilst local congestion relief might complement an A40 improvement strategy the expenditure is at risk of routing changes brought about by Haverfordwest bypass options.

Although the Haverfordwest South Eastern Bypass Options 5 and 6 perform strongly against economic, society and TPO criteria they score poorly for environmental impacts. If either of these options are to be progressed further appraisal work will need to be undertaken to minimise the environmental impact and review scheme termination so as to better coordinate with Haven access routes.

It should be noted that although the WelTAG appraisal process that informs the conclusions above allow for the EALI impacts identified in the Peter Brett Associates report into the economic performance of South West Wales its transportation link preferences differ from the conclusions presented here.

1 INTRODUCTION

1.1 Purpose of Report

1.1.1 In 2004 Parsons Brinckerhoff was appointed to the A40 West of St Clears Study in response to the Welsh Government's Trunk Road Forward Programme 2002. The conclusion of that study was that two bypasses for Robeston Wathen and Llanddewi Velfrey were suitable using a 2+1 carriageway configuration to enhance road safety and overtaking opportunities. On 7th December 2004, as part of his announcement of a 15 year programme to deliver an integrated transport system for Wales, Andrew Davies (AM), the then Assembly Government Minister for Economic Development and Transport, announced two separate improvements

- A40 Penblewin to Slebech Park Improvement (which was completed and opened in 2011) and
- A40 Llanddewi Velfrey to Penblewin Improvement which is currently in the National Transport Plan and scheduled for delivery within the next 5 years

1.1.2 In July 2013, Edwina Hart AM CStJ MBE, Minister for Economy, Science and Transport, published a written statement outlining her priorities for Transport. The statement included that:

"Improving the A40 has been identified as a priority by the Haven Waterway Enterprise Zone Board and I intend to undertake further development of previously proposed improvements."

1.1.3 The issue of the A40 was further brought into focus in November 2014 by the announcement of the closure of the Milford Haven Refinery and its conversion into a 'storage and distribution facility'. On 12th November 2014, in providing an update on the closure of the refinery, the Minister made an oral Statement in Plenary:

"In terms of transport links…I have instructed my officials to accelerate to the fullest extent possible the programme for delivering improvements at Llanddewi Velfrey. I have also asked my officials to conduct further urgent work to explore additional ways to improve the A40, including the potential for dualling."

A40 West of St Clears Study 2015

1.1.4 The purpose of the update study is to update the work completed in 2004 (and reviewed in 2008) and evaluate if changes to conditions in the region warrant additional transport interventions along the A40, such as:

- Changes in traffic patterns, traffic volumes and other conditions along the route in recent years
- the recession, sustained global economic downturn and subsequent public sector spending reductions. the designation of the Haven Waterway Enterprise Zone;
- the formation of the Swansea Bay City Region and Pembrokeshire's role within it; and,
- the closure of the Milford Haven Refinery and the wider problems and opportunities in the Pembrokeshire energy sector, which is key to the economic vitality of the area.

1.1.5 Following feedback in the early stages of this study, where traffic problems were also identified on the A4076, a route that leads directly to areas of the Haven Waterway Enterprise Zone and the Murco Refinery, the study was extended to also consider, in preliminary terms, improvement options to this length of the trunk road.

1.1.6 This study has two distinct elements. Consideration of the Economic Area and Local Impacts (EALI) of the proposed A40 upgrades, and whether the problems associated with the A40 are in some way constraining the economic performance and development of Pembrokeshire. This work is being completed by Peter Brett Associates (PBA) the findings of which will be reported separately and does not form part of this report.

1.1.7 This report investigates in engineering and transport economic terms (TEE) improvements to the A40 trunk road between St. Clears roundabout and Haverfordwest and road access through Haverfordwest to the Haven Waterway Enterprise Zone to the south. The report reviews the work done to date and explores road improvement options. It will inform the Minister for Science, Economy & Transport in deciding how transport improvements within Pembrokeshire can be taken forward.

1.1.8 Key objectives of the improvement options are to enhance traffic flow, road safety and increase journey time reliability along the study corridor whilst enhancing road network resilience. It is expected that a range of other benefits may be achieved, such as aiding regeneration and supporting the regional economy and these have been defined in a set of transport planning objectives which the options are assessed against.

1.1.9 A total of six design options have been identified and these have been reviewed using the framework set out in the Welsh Transport Planning Appraisal Guidance (WelTAG). This is the Welsh Government's method of assessing transport planning proposals and involves testing the identified options against the transport planning objectives and the defined Welsh impact areas of Economy, Environment and Society. The principles of WelTAG have been applied in a high level Stage1 WelTAG assessment which is considered appropriate to this stage of the study.

1.1.10 This section sets out the road access problems experienced in the study area, the background to the study work carried out to date and the scope of the current study. The six design options are described in Section 3, the performance against the Welsh Impact Areas are discussed in Sections 4 to 6, and the summary of the WelTAG appraisal of the options is included in Section 8.

1.2 The Problem

The A40 Trunk Road

1.2.1 The A40 serves the county town of Haverfordwest, Fishguard ferry port, the tourist economy of central and north Pembrokeshire and the town of Milford Haven in the south; and forms the key road link between south-east Wales and Haverfordwest which itself is a gateway town for connections to the ports of Milford Haven and Fishguard.

1.2.2 The St.Clears to Haverfordwest section of the A40 has developed over time to connect small villages and hamlets built upon a ridgeway route that follows field boundaries and topographical features. As such the unimproved sections of the A40 pass through the middle of population centres with tortuous sections of road between.

These conditions lead to community severance and instances of poor operation both in terms of link performance and traffic safety. Whilst providing a strategic link to the ports of Fishguard and Milford Haven, the section of the A40 west of St Clears is generally rural in nature.

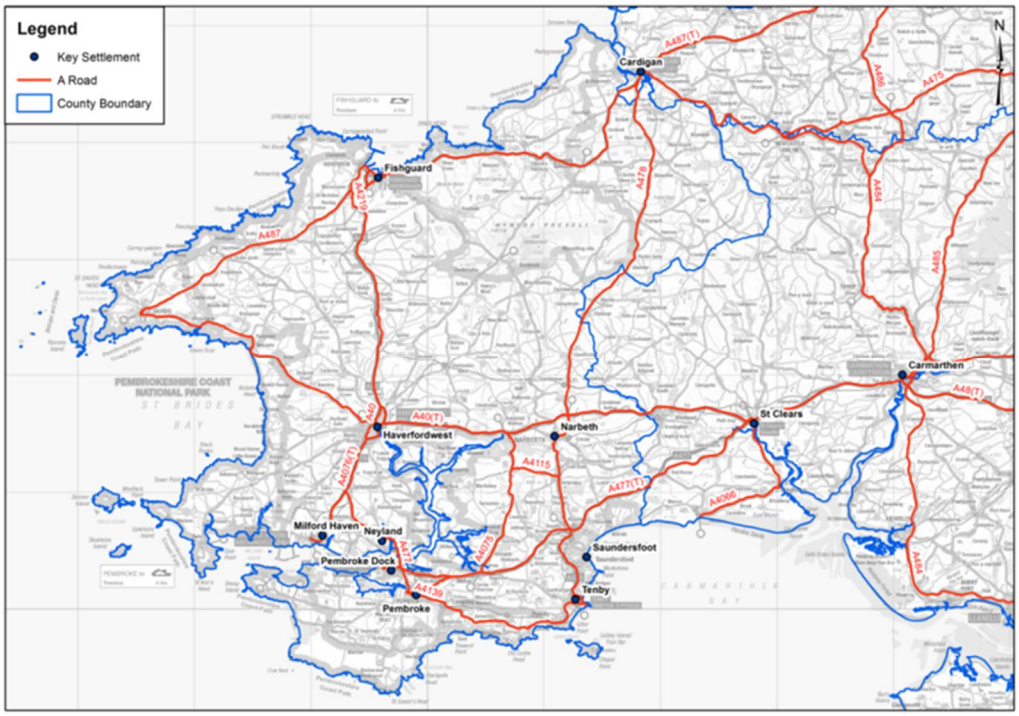


Figure 1: South West Wales Trunk Road Network

1.2.3 Part of the A40 forms a section of the (unsigned) Euroroute E30, between Cork and Moscow, which provides a land bridge to Ireland and has previously been referred to as '*one of the lowest standard sections of the Trans European Road Network in the United Kingdom'*.

1.2.4 For the majority of its length it is 7.3 metres wide with, in some places 1.0 metre hardstrips and variable width grassed verges. There are various types of junction within this length which include:

- At grade roundabouts
- Staggered crossroads
- Simple T-junctions with and without ghost island and
- Approximately 200 direct access to properties, farms and fields excluding those in Llanddewi Velfrey

1.2.5 Where the trunk road passes through the community of Llanddewi Velfrey, the horizontal alignment is generally poor, road narrows to about 6.5m in places and a 40 mph speed restriction applies. There are no hardstrips and footways, where provided, are narrow with little in the way of verges. Several properties front the trunk road and have direct access onto it. Forward visibility is poor and below minimum levels in places.

1.2.6 The A477, which diverges from the A40 at St Clears and runs to south near Saundersfoot and Tenby is of a similar standard to the A40 and offers an alternative route into the south of the County. The A477 serves the industrial hub at Pembroke Dock, the Pembroke refinery, much of the Haven Waterway supply chain and the south-coast tourism destinations from Amroth to Manorbier. There is local connectivity between the A40 and A477 along their length, through numerous links including the A478 and A4075 as well as the Cleddau Bridge bringing added network resillience.

1.2.7 At present, journey times to Pembroke Dock (south of the Waterway) via the A477 are considerably quicker than via the A40 whilst journey times to Milford Haven (north of the waterway) are approximately the same on either route. There is however a toll on the Cleddau Bridge connecting the south and north of the Haven Waterway.

1.2.8 Both Trunk Roads have a mix of traffic types using the road. In the core winter months, both routes carry:

- local residents (typically car-based traffic);
- commercial vehicles, particularly in and around ferry arrival and departure times; and
- agricultural vehicles (although the A40 tends to be dominant in this regard).

1.2.9 In the summer months, the above mix is supplemented by a high volume of tourist traffic including cars and caravans, whilst agricultural markets also introduce a smaller peak in traffic levels on certain days of the year.

1.2.10 The A48 and the A40 to the east of St Clears provide a good standard dual carriageway road corridor from the end of the M4 motorway to St Clears. In terms of public transport options, the major towns in Pembrokeshire all have rail connections. Service frequency on these lines is moderately low, and journey times are not competitive with road-based transport on the majority of routes.

1.2.11 Traffic demand on A40 as with A477 has historically reflected the fortunes of the ports and their support industries but in recent years underlying traffic growth and particularly tourist traffic has started to play a larger role. Tourist destinations such as Oakwood, Bluestone and Pembrokeshire National Park have shown particular increase in traffic demand. Although traffic modelling shows overall traffic volumes remain within the capacity of a single carriageway the mix of slower traffic travelling the A40's constrained alignment places a premium on overtaking provision which if not satisfied leads to driver frustration and increased accidents.

1.2.12 The main problems associated with this section of the A40 are:

- Limited overtaking opportunities (particularly eastbound), which leads to poor journey time reliability and driver frustration risky manoeuvres and collision incidents.
- Inconsistency in the level of overtaking provision between the eastbound and westbound directions with currently a total of 5.5km in the westbound direction and 3.2km in the eastbound
- Where overtaking provision does exist it is currently not spread along the length of the A40 such that there are long lengths in each direction with no opportunity for overtaking.
- Occasional convoys of heavy goods vehicles from the ferry ports and slow moving agricultural vehicles both of which contribute to periods of platooning and journey time unreliability when combined with limited overtaking opportunity.

- Slow moving traffic during the summer tourist seasons causing platooning and journey time unreliability when combined with limited overtaking opportunity.
- Community severance at Llanddewi Velfrey
- Sub-standard sections of existing road especially at Llanddewi Velfrey
- A mix of traffic types including local motorists, HGVs, agricultural vehicles, strategic travellers and tourists on the same road.
- Numerous side road junctions and the high number of direct accesses to property and fields
- There are seasonal spikes in traffic volumes on the A40 and indeed the A477 during the summer months

1.2.13 In this context platooning is the traffic condition, similar to a convoy, where a queue of traffic builds up behind the front vehicle. If the front vehicle is moving at a slower speed than the rest it creates queues of traffic if there is no opportunity for overtaking. In the context of the roads within the region, including the A40 and A477 platooning is particularly experienced:

- When there has been a ferry arrival at either Milford Haven or Fishguard and there are a number of HGVs heading east along the trunk road at the same time
- When agricultural vehicles are travelling along the A40
- When slow moving vehicles such as caravans are travelling along the trunk roads – particularly prevalent during the summer months.

1.2.14 Welsh Government have previously implemented a number of improvements on the A40 improvement to addressed some of the key congestion bottlenecks such as the single carriageway Whitland Bypass, the climbing lane provision at Pengawse and Arnold's Hill as well as the Robeston Wathen bypass (Penblewin to Slebech Park Improvement) which was opened in 2011.These route improvements together with similar improvements to the A477 have already improved journey time reliability with reduced journey times and improved safety.

1.2.15 At present the existing A40 between St.Clears and Haverfordwest has six sections of dedicated overtaking opportunity, two eastbound and four westbound amounting to some 13% of the total 32.5km length split as shown in Table 1 below.

Chainage		Overtaking Length (Km)	
		Eastbound	Westbound
Ch.32+500	Ch.31+500		1.0
Ch.28+350	Ch.27+350		1.0
Ch. 22+200	Ch. 20+400		1.9
Ch.13+100	Ch.11+200	1.9	
Ch.11+100	Ch.9+500		1.6
Ch.5+200	Ch.3+900	1.3	
	Total	**3.2 (10%)**	**5.5 (17%)**

Table 1: Existing A40 Overtaking Provision

1.2.16 Where overtaking provision does exist it is currently not spread along the length of the A40 such that there are long lengths in each direction with no opportunity for overtaking. For instance there is no opportunity for vehicles travelling east to overtake for at least 19km from Robeston Wathen towards St. Clears roundabout. Similarly for vehicles travelling west there is no opportunity for vehicles to overtake for at least 9.5km from Canaston Bridge to Haverfordwest roundabout.

A4076 & Haverfordwest

1.2.17 Haverfordwest is a medium sized market town at a three way intersection of Fishguard, St.Davids and Milford Haven destinations. The historic city centre comprises narrow winding streets surrounded on the SE and NE quadrants by a ring road which itself is constrained by residential, river and rail constraints such that congestion bottlenecks prevent the links from achieving the required traffic throughput.

1.2.18 The A4076 connects directly to the A40 at the eastern end of Haverfordwest at Salutation Square roundabout. The route then runs around the south eastern perimeter of the town heading south on Freemans Way continuing until it curves to the west to become nearly parallel to Merlin's Brook and continues to Merlin's Bridge roundabout.

1.2.19 From Merlin's Bridge the A4076 heads south towards Milford Haven. At mid-link the A4076 runs through the expanding town of Johnston where it meets the A477 and continues into Milford Haven leading directly into the Haven Waterfront Enterprise Zone. The A4076 follows a tortuous path through Milford Haven leaving the town to the west before connecting into the local road network to access the Murco Refinery site, Sandy Haven and South Hook LNG Terminal.

1.2.20 The route around Haverfordwest is punctuated by traffic lights, varying speed limits and experiences frequent instances of peak period congestion in particular at Merlin's Bridge roundabout.

1.2.21 The route is generally single carriageway although there is one stretch that permits overtaking in the southbound direction. The mid-link town of Johnston is subject to a 30mph speed limit and has a number of properties abutting the carriageway.

1.3 Scheme Background

1.3.1 In 2002 Parsons Brinckerhoff was appointed to the A40 West of St. Clears Study in response to the Welsh Government's Trunk Road Forward Programme 2002. For the previous three decades, there had been a number of improvements to the A40 west of Carmarthen to Pembroke Dock and Fishguard that were aimed at providing a road to a consistent standard compatible with the traffic flows. The study formed part of the east-west route development process and is a part of the Welsh Government's strategy for maintaining and improving the trunk road network in Wales. The A40 with the A48, A477 and the M4, forms part of the TEN-T and provides an important link between the M4 and Fishguard.

1.3.2 The A40 West of St Clears Study appraised possible route corridors using the Scottish Transport Appraisal Guidance (STAG) process. Those corridors identified as suitable generally followed the existing road corridor over the 32 km length of the A40 from St. Clears to Haverfordwest. Single and dual carriageway routes were appraised via the STAG process and a total of seventy options were considered. Those that did not meet the scheme objectives were discarded as better alternatives were developed.

1.3.3 The conclusion of that study was that two bypasses for Robeston Wathen and Llanddewi Velfrey were suitable using a 2+1 carriageway configuration to enhance road safety and overtaking opportunities. On 7th December 2004, as part of his announcement of a 15 year programme to deliver an integrated transport system for

Wales, Andrew Davies (AM), the then Assembly Government Minister for Economic Development and Transport, announced two separate improvements

- A40 Penblewin to Slebech Park Improvement
- A40 Llanddewi Velfrey to Penblewin Improvement

1.3.4 In August 2005 the Welsh Government appointed Costain Ltd to undertake construction of the A40 Penblewin to Slebech Park 2+1 standard improvement under Early Contractor Involvement (ECI). The ECI contractor, with their designers Atkins and Cresswell, undertook the design development and prepared the Environmental Statement and draft Orders through to Public Inquiry in 2007.

1.3.5 In 2007 Pembrokeshire County Council maintained an objection to the draft Orders and invoked a Special Assembly Procedure (SAP). In 2008 the SAP procedure and Commission confirmed the A40 Penblewin to Slebech Park proposals were to proceed. The construction of the A40 Penblewin to Slebech Park Improvement started in 2009 and opened in 2011. The scheme is currently subject to a 5 year environmental aftercare period.

1.3.6 Design development has begun on the Welsh Government's Llanddewi Velfrey to Penblewin Improvement scheme using a 2+1 configuration. Progression of this scheme is dependent on the completion of this study and the Minister's decision on how improvements on the A40 should proceed.

1.3.7 Pembrokeshire County Council prepared a Briefing Paper: TRA40 – St Clears to Haverfordwest Review in August 2014. This paper proposed short term, medium term and long term schemes to improve the A40 which comprise the Llanddewi Velfrey to Penblewin Improvement, a 2+1 carriageway improvement of the A40 and a dual carriageway improvement respectively.

1.3.8 In July 2009, Capita Symonds prepared 'The Haverfordwest South Eastern Bypass Pre-feasibility Study' for Pembrokeshire County Council. This identified five options to bypass Haverfordwest and included a Stage 1 WelTAG assessment of the options.

1.4 Transport Strategy and Plans

1.4.1 The Wales Transport Strategy (WTS) published in 2008 sets the policy framework for transport in Wales and the long term outcomes that transport interventions should contribute to. These outcomes are grouped under the headings of Social, Economic and Environmental. The WTS is a statutory document required by the Transport (Wales) Act 2006. The WTS notes the importance of good, reliable connections between Wales and other parts of the UK and EU for business and tourism. It recognises the importance of the east-west corridors and in particular the TEN-T routes as priority.

1.4.2 The National Transport Plan (NTP) supports the WTS by providing the detail of delivery of the outcomes, for example through implementation of transport improvements. The Consultation Draft Welsh Government National Transport Plan 2015 was published in December 2014 and the consultation period ended on 11 March 2015.

1.4.3 The NTP identifies the A40 west of St. Clears as a route that experience slower journey speeds. It also records transport connectivity issues that have been raised by the Enterprise Zone Board regarding the Haven, identifying that improved reliability

and travel time to the Haven Waterway Enterprise Zone is required, in particular, improvements to the A40.

1.4.4 The A40 Llanddewi Velfrey to Penblewin Improvement is included as a committed scheme in the NTP. This is subject to the business case still justifying the expenditure and obtaining the necessary statutory consents and a start of works programme of late 2017 is indicated in the NTP. It is included to address road safety and improve accessibility to the Haven Waterway Enterprise Zone and employment sites on a TEN-T Core Route.

1.5 Current A40 St. Clears to Haverfordwest Study

1.5.1 The purpose of the update study is to update the 2004 A40 St. Clears to Haverfordwest Study, and evaluate if changes to conditions in the region warrant additional transport interventions along the A4. It supports the NTP's aim to ensure that Welsh Government funding is directed to secure maximum value for money and impact.

1.5.2 As well as the policy documents outlined in Section 1.4 above, the following documentation has been reviewed as part of this study and has inputted into the development of the design options:

- Welsh Government - TRA40 Plans for Major Schemes
- Pembrokeshire County Council - TRA40 Briefing Paper St Clears to Haverfordwest review, 21 August 2014.
- Capita Symonds - Haverfordwest South Eastern Bypass Pre-feasibility Study July 2009
- Parsons Brinckerhoff – A40 West of St Clears Study Technical Appraisal Report, 2004.

1.5.3 The first three options involve the provision of three different standards of road improvements for the 32.5km A40 route between St.Clears and Haverfordwest. The fourth option includes a range of traffic improvements within and around Haverfordwest. The fifth and sixth options are for a Haverfordwest South Eastern Bypass. The options are named as follows:

<u>A40 Trunk Road</u>

- Option 1 Single Carriageway Committed Schemes
- Option 2 Single Carriageway Maximum "2+1"
- Option 3 Dual Carriageway Route Option

<u>A4076/ Haverfordwest</u>

- Option 4 Haverfordwest Town Centre Traffic Improvements
- Option 5 Haverfordwest South Eastern Bypass A40 Golf Course to A477 Sentry Cross
- Option 6 Haverfordwest South Eastern Bypass A40 Golf Course to A4076

<u>A40</u>

1.5.4 Option 1 is the existing A40 arrangement between St. Clears and Haverfordwest (including the Penblewin to Slebech Park Improvement scheme completed in 2011) in addition to the Llanddewi Velfrey to Penblewin Improvement scheme included in the NTP and the Redstone Cross Improvement which is currently being considered for inclusion into the Llanddewi Velfrey Improvement scheme.

This Option would deliver a mostly single carriageway route with some existing lengths of 2+1 carriageway and some new 2+1 sections of carriageway delivered by the Llanddewi Velfrey Improvement. The 2+1 standard of road construction provides overtaking opportunities in the two lane direction, while overtaking in the single lane direction is prohibited.

1.5.5 Option 2 is an extension of Option 1 where a number of further lengths of existing single carriageway have been identified as having the potential for the introduction of a 2+1 layout, in order to provide additional overtaking opportunities in the two lane direction to Option 1. This option has been included to establish if further operational benefits can be derived for the A40 from additional overtaking opportunities to improve journey times, road safety and reliability. It will consider how this option compares to Options 1 & 3 in delivering Value for Money.

1.5.6 Option 3 would provide a dual carriageway for the entire 32.5km route between St Clears and Haverfordwest. The option assessed is based on a standard D2AP carriageway cross-section, with no grade separation at the junctions. This option would provide 100% overtaking provision (notwithstanding junctions) in both directions.

A4076 & Haverfordwest

1.5.7 Option 4 includes three areas of improvement in Haverfordwest town centre. Opportunities to improve traffic flow in and around the town centre have been investigated including a revised junction arrangement at Merlin's Bridge Roundabout and Salutation Square Roundabout. These are referred to as Options 4A and 4B respectively. An additional set of traffic management amendments to the town centre is referred to as Option 4C and this incorporates new sections of one-way traffic operation, performance reviews of roundabouts and optimisation of signalised junctions. The Merlin's Bridge Roundabout, Option 4A was identified from the July 2009 Capita Symonds report.

1.5.8 Option 5 is one of the options investigated in the July 2009 Capita Symonds report. This is a new single carriageway road that links the A40 east of Haverfordwest at Haverfordwest Golf Club with the A477 at Sentry Cross south of Johnston.

1.5.9 Option 6 is a shorter version of the Option 5 Bypass. This is a new single carriageway road that links the A40 east of Haverfordwest at Haverfordwest Golf Club with the A4076 at Dredgeman's Hill.

1.5.10 This report will concentrate on the appraisal of these six options.

1.5.11 The option descriptions and appraisals are included in this Volume 1 whilst the background data collected to inform the appraisal is contained in the separate Volume 2.

2 EXISTING ROUTE CONDITION

2.1 Traffic Flows

2.1.1 The Department for Transport (DfT) count point (CP) data was extracted to identify traffic flows in relation to the study area. Count points were located at six points on the A40 between St. Clears and Haverfordwest, with further data from two points on the A4076 and one point on the A477. The values presented in Table 2 below are indicative of two way Annual Average Daily Traffic (AADT) flows for all motor vehicles in 2002 and 2013.

		2002		2013	
DfT CP Reference	Description	AADT	HGV %	AADT	HGV %
99788	A40 – Cartlett/Narberth Rd	11,201	5.43%	15,319	5.05%
10517	A40 – Deeplake Bridge	12,761	7.00%	13,700	6.02%
30517	A40 – Robeston Wathen	8,366	8.21%	9,161	7.29%
515	A40 – Llanddewi Velfrey	9,429	9.93%	11,838	5.80%
50607	A40 – St. Clears	13,993	7.01%	18,813	6.73%
20517	A40 – Pwll-trap	8,768	7.89%	12,165	7.33%
50550	A477 – Rhos-goch	7,899	8.63%	7,179	8.65%
30646	A4076 – Pope Hill (between Merlin's Bridge and Johnston)	15,002	3.44%	15,981	3.52%
78470	A4076 – Thornton Road (between Johnston and Steynton)	7,625	4.88%	8,764	2.42%

Table 2: DfT Count Point Data

2.1.2 The count point data in Table 2 shows that the traffic on A40 at St. Clears splits into two distinct flows. Around 65% remains on the A40, with the remaining 35% moving onto the A477. Both Trunk Roads have a mix of traffic types using the road. In the core winter months, both routes carry:

- local residents (typically car-based traffic);
- commercial vehicles, particularly around ferry arrival and departure times; and
- agricultural vehicles (although the A40 tends to be dominant in this regard).

2.1.3 To inform the assessment of Options 4, 5 and 6, Automatic Traffic Count (ATC) surveys were undertaken during March 2015 along Cartlett Road, which is north of Salutation Square Roundabout in Haverfordwest. The flows in Table 3 below are a portrayal of two-way flows respective to the survey location.

Haverfordwest, March 2015	Weekday Avg.	7 day Avg.
07:00-19:00	20,718	19,258
00:00-24:00	23,796	22,260

Table 3 - ATC Survey Data - Cartlett Road, Haverfordwest (March 2015)

2.1.4 The survey data determined that the highest volume of traffic at the morning peak period (08:00 – 09:00) was 1,826 vehicles. Similar volumes of traffic occur in the PM peak period (16:00 – 17:00) which reaches as high as 2,079 vehicles.

2.2 Seasonality

2.2.1 The A40 experiences increased traffic flow during the summer months, including cars and caravans, whilst agricultural markets also introduce a smaller peak in traffic levels on certain days of the year. This is illustrated in Figure 2. At Whitland, traffic flows are increased by 46% in August when compared to a neutral winter month (February). This supports the view that tourism generates significant additional trips in the study corridor during the summer period.

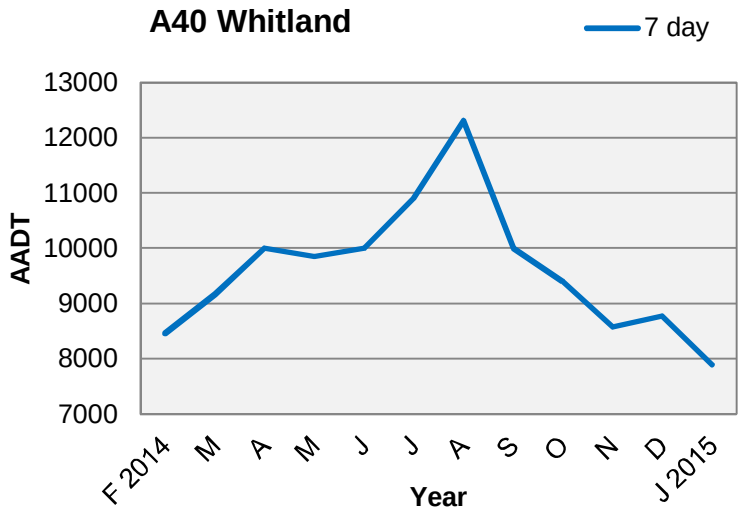


Figure 2: AADT (A40 Whitland)

2.4 Road Safety

2.4.1 Collision data has been provided by the South Wales Trunk Road Agent (SWTRA) and Pembrokeshire County Council for use in this study along the A40 and A4076 from St. Clears to Milford Haven. The data covers the period from 1st January 2009 to 31st December 2013.

2.4.1.1 A breakdown of collisions and severities by year is provided in Table 4 and 5. The table shows that of the total 99 collisions, 3 were fatal and 10 were serious. On average there were 20 collisions per year, with years 2009, 2012 and 2013 exceeding the annual average each year.

Year	Total Collisions	Collisions by Severity		
		Slight	Serious	Fatal
2009	16	14	2	0
2010	10	9	1	0
2011	12	11	0	1
2012	22	20	0	2
2013	17	13	4	0
Total	**77**	**67**	**7**	**3**

Table 4 – Summary of Study Area-wide Collision Statistics (A40)

Year	Total Collisions	Collisions by Severity		
		Slight	Serious	Fatal
2009	5	4	1	0
2010	3	3	0	0
2011	4	3	1	0
2012	6	6	0	0
2013	4	3	1	0
Total	**22**	**19**	**3**	**0**

Table 5 – Summary of Study Area-wide Collision Statistics (A4076)

2.4.2 Three fatal accidents have occurred between 2009 and 2013. They occurred at the following locations:

- A40 Junction at Pont Frolic, to the west of the Whitland roundabout;
- A40 west of the western access junction for Pont-y-Fenni; and
- A40 west of the A478 roundabout

2.4.3 Five cluster sites were identified based on the Welsh Government's definition of a cluster site being where there are 4 or more injury collisions in a 3 year period within a 100m diameter. These were:

- A4076/A487 Merlin's Bridge roundabout - 4 collisions of slight severity
- A4076 Freemans Way, East of Merlin's Bridge - 4 collisions of slight severity
- A40 West of Kings Park Farm - 5 collisions of slight severity
- A40 Canaston Bridge - 4 collisions of slight severity
- A40 Slebech - 4 collisions of slight severity

2.5 A40 St. Clears to Haverfordwest

2.5.1 Route Description

2.5.1.1 For the purposes of this report the descriptions of the route are written in an east-west direction. Chainages start from Ch 0 at Haverfordwest to Ch 32+500 at St.Clears. This description of the existing A40 is divided into sections defined by the six 2+1 overtaking sections. Refer to drawing numbers 169 and 170 in Appendix A.

2.5.2 St.Clears to Pont Y Fenni (Ch 32+500 to Ch 28+500)

2.5.2.1 The first section of 2+1 climbing lane of the A40 is from St. Clears roundabout to the layby east of Oaklands junction. A single carriageway takes the A40 from the layby east of Oaklands junction to Pont Y Fenni. Three junctions in this location provide access to farms on the northern side of the A40. Prior to Pont Y Fenni, the A40 crosses the railway track via an overbridge as well as crossing the Afon Fenni river. East of the railway overbridge, there are several side roads providing access to numerous farms on the southern side of the A40, plus an underpass connecting fields either side of the A40.

2.5.3 Pont Y Fenni to Pengawse Hill (Ch 28+500 to Ch 22+500)

2.5.3.1 The second section starts from Pont Y Fenni to Haulfan which is a 2+1 carriageway in the westbound direction. Three side roads join the A40 in this location for access to properties and access into Penygraig which is used by local residents. A single carriageway takes the A40 from Haulfan to Pen-Y-Coed roundabout. Approximately 400 metres to the west of Haulfan, an underpass links fields on the northern side of the A40 to fields on the southern side. From Pen-Y-Coed roundabout the A40 is single carriageway up to Whitland roundabout. Approximately 750 metres west of Pen-Y-Coed roundabout there are two field accesses. An over bridge between Pen-Y-Coed roundabout and Whitland roundabout takes North Road over the A40. From Whitland roundabout, a single carriageway takes the A40 up to Pengawse Hill. Between Whitland roundabout and Pengawse Hill the A40 crosses a railway track and two rivers (Afon Taf and Afon Marlais) via three over bridges. There are also three side roads and two accesses to properties/land in this location.

2.5.4 Pengawse Hill to Narberth Roundabout (Ch 22+500 to Ch 13+000)

2.5.5 The third section starts from Pengawse Hill to Bethel Chapel which is a 2+1 carriageway in the westbound direction. At Pengawse Hill an underpass used by land owners comes from a side road on the northern side of the A40 linking into fields on the southern side of the A40. There are four properties with access coming directly from the A40 at this location including Bethel Chapel. A single carriageway takes the A40 from Bethel Chapel to Penblewin roundabout. From Bethel Chapel the A40 passes by two housing estates, a number of side roads, and properties whose only accesses are directly from the A40. From Penblewin roundabout a single carriageway takes the A40 to Narberth roundabout. Between Penblewin roundabout and Narberth roundabout there are two side roads and six properties which have direct access off the A40.

2.5.7 Narberth Roundabout to Canaston Bridge Roundabout (Ch 13+000 to Ch 11+500)

2.5.7.1 The fourth section is the Robeston Wathen bypass from Narberth roundabout to Canaston Bridge roundabout which is a 2+1 carriageway, with the overtaking provision in the eastbound direction. No side roads connect into the route in this location.

2.5.8 Canaston Bridge roundabout to Arnold's Hill (Ch 11+500 to Ch 5+000)

2.5.8.1 The fifth section starts from Canaston Bridge roundabout. From here to approximately one kilometre west of Llawhaden junction, the A40 is a 2+1 carriageway with overtaking provision in the westbound direction. No side roads join the A40 in this location. The A40 Canaston Bridge crosses the Eastern Cleddau River. A single carriageway takes the A40 from approximately one kilometre west of Llawhaden junction to Arnold's Hill. In this location joining the A40 are eight side roads, five properties/fields with direct access directly to the A40. The single carriageway passes through Slebech, where access to the various garages is directly from the A40.

2.5.9 Arnold's Hill to Haverfordwest (Ch 5+000 to Ch 0)

2.5.9.1 The sixth section starts from Arnolds Hill. From here to Deep Lake Bridge is a 2+1 carriageway with overtaking provision in the eastbound direction. There is one access for a farm on the southern side of the A40 and a field access opposite on the northern side in this location. Deep Lake Bridge crosses Millin Brook. From Deep Lake Bridge a single carriageway takes the A40 into Haverfordwest. From Deep Lake Bridge to Haverfordwest roundabout nine side roads join the A40 as well as approximately fourteen properties and two fields having direct accesses. In this location there is a direct access to a garage and power cables which would need to be maintained. Haverfordwest Golf Club has a direct access to the A40 approximately 1.1 kilometres to the east of Haverfordwest roundabout, where the A40 terminates.

2.5.10 Existing A40 Overtaking Provision

2.5.11 The sections of 2+1 carriageway on the existing A40 are listed in Table 6 below. This shows that over the 32.5km A40 route between St. Clears to Haverfordwest, the existing overtaking provision is 10% in the eastbound direction and 17% in the westbound direction. This averages out to approximately 13% of the 32.5km route overall.

Chainage		Overtaking Length (Km)		Constructed
		e/b	w/b	
Ch.32+500	Ch.31+500		1.0	
Ch.28+350	Ch.27+350		1.0	
Ch. 22+200	Ch. 20+400		1.9	
Sub-Total		0	3.9 (12%)	
Ch.13+100	Ch.11+200	1.9		2011- A40 Penblewin to Slebech Improvement
Ch.11+100	Ch.9+500		1.6	
Ch.5+200	Ch.3+900	1.3		2014
	Total	**3.2 (10%)**	**5.5 (17%)**	

Table 6: Existing Overtaking Provision – A40 St.Clears to Haverfordwest

2.6 A4087 Haverfordwest - Merlin's Bridge

2.6.1 Route Description

2.6.1.1 Heading north on Dredgeman Hill, a bridge takes the railway track over the carriageway. Approximately 50 metres north of the bridge there are a set of traffic signals. Oncoming traffic travelling southbound have the opportunity to turn on to Glen View to the west of the signals via a turning lane or to continue southbound. Northbound, approximately 75 metres from the traffic signals, there is a junction with access to the car park and properties on Mill Lane. After the junction an over bridge takes the carriageway over Merlin's Brook. From the over bridge the single carriageway diverges into two lanes as it enters the roundabout. The roundabout is signal controlled. Access to Magdalen Street, which has no through route, is via the roundabout.

2.7 Haverfordwest - Salutation Square Roundabout

2.7.1 Route Description

2.7.1.1 Travelling north on Freemans Way, a junction to the west provides access to County Hall. County Hall is accessed by a right turn from the northbound carriageway or a right turn from the dedicated lane from the southbound carriageway. From the County Hall junction, two lanes take Freemans Way to Salutation Square roundabout. Salutation Square roundabout provides access to Carlett Road and Cambrian Place as well as Freemans Way. Cambrian Place continues onto New Road where both provide access to properties. Continuing on New Road, a junction to the east provides access for residents to the properties on Windsor Road.

2.7.2 Haverfordwest - Town Centre

2.7.3 Route Description

2.7.3.1 There is a one-way traffic system travelling west from High Street through to Dew Street. Joining High Street from the south is Market Street where traffic can only turn left at the junction. Traveling from High Street to Tower Hill, two separate routes are available. The first right turn on High Street leads to Dark Street which joins Tower Hill towards the top of the street; the second right turn on High Street leads onto St. Mary's Street which joins Tower Hill half way along the street. At the junction of St. Mary's Street traffic must give way. Both Dark Street and St. Mary's Street are one-way. Tower Hill joins High Street 100 metres to the west of where High Street joins St. Mary's Street. From Dark Street there is no left turn whereas from St. Mary's Street there is no right turn.

2.7.3.2 At the top of Tower Hill there is only a left turn which leads onto Marines Square. From Marines Square there is only a right turn which leads onto the A487 Barn Street which is one-way. Spring Gardens Lane joins the A487 from the west which can only turn left. Heading north on A487 Barns Road towards the mini roundabout, the first right from the right hand lane leads onto Perrot Avenue; the second right from the right hand lane leads to Church Street. Taking the left hand lane leads to the mini roundabout. Taking a left on the mini roundabout leads to City Road and taking a right leads to Perrot Road. Traveling south from the mini roundabout, taking a left leads onto Church Street. After the turning for Church Street, traffic must give way to traffic turning right onto Perrot Avenue coming from the A487 Barn Street. After giving way, traffic traveling straight lead to Perrot Avenue which is one-way. A left turn on Perrot

Avenue is available which leads to Tower Hill. Perrot Avenue merges into Marines Square on the bend at the junction at the top of Tower Hill.

2.8 A4076 Trunk Road

2.8.1 Route Description

2.8.1.1 The A4076 begins in Haverfordwest at Salutation Square roundabout where Cambrian Place joins the roundabout from the east and Carlett Road joins from the north. The A4076 leaves the roundabout to the south on Freemans Way which has a 30mph speed limit until it passes on the eastern side of County Hall to which then it changes to a national speed limit. Freemans Way crosses the Western Cleddau river via an over bridge. Freemans Way continues until it curves to the west to become nearly parallel to Merlin's Brook and continues to Merlin's Bridge roundabout where it changes back to a 30mph speed limit.

2.8.1.2 From Merlin's Bridge roundabout the A4076 travels south on Dredgeman Hill. The A4076 Dredgeman Hill crosses Merlin's Brook immediately after coming off the roundabout. South of Glen View, the A4076 Dredgeman Hill passes under a railway over bridge. At the junction for Avallenau Drive, the A4076 changes to a national speed limit. Approximately 350 metres to the south of Avallenau Drive, the A4076 changes from a single carriageway into a 2+1 carriageway in the southbound direction. The A4076 then changes back to a single carriageway approximately 700 meters after changing into a 2+1 carriageway. The A4076 Dredgeman Hill then merges into Vine Road north of Vine Road roundabout which is north of Johnston Park.

2.8.1.3 As the A4076 comes into Johnston, the speed limit changes to 30mph as this is a built up village with many junctions and accesses to properties. The A4076 Vine Road continues south from Vine Road Roundabout to merge into St Peters Road. The A4076 St Peters Road crosses a railway track via an over bridge just before Station Road. South of the over bridge, St Peters Road merges into Milford Road. Milford Road continues and crosses over a railway track via an over bridge.

2.8.1.4 After the junction for Bulford Road, the A4076 comes to a signalised junction. At the signalised junction, traffic has the opportunity to travel east on the A477. Approximately 130 metres beyond the signalised junction, the speed limit changes to a national speed limit. Milford Road merges into Steynton Road south of Thornton Road at the point of where the traffic signals are. Approximately 100 metres before the A4076 reaches Thornton Road, the speed limit changes to 40mph. Approximately 500 metres after Thornton Road, the speed limit changes to 30mph just beyond Mariners Way. Just before Phillips Avenue junction, a pedestrian crossing is in place. Steynton Road merges into Castle Terrace just south of B4325. Along Castle Terrace, just before Yorke Street, there is also a pedestrian crossing. The A4076 then turns west and merges into Victoria Road. Before Haverfordwest roundabout, there is a pedestrian crossing before The Rath junction, and a zebra crossing just after the Priory Street junction.

3 THE OPTIONS

3.1 A40 2+1 Options Design Philosophy

3.1.1 Options 1 and 2 include proposals to improve the A40 with sections of improved 2+1 carriageway following the principles established in the 2004 study. These 2+1 options were included in the study because of the operational improvements of the A40 Penblewin to Slebech Park Improvement constructed in 2011. The provision of 2+1 is to provide opportunities for unambiguous overtaking with a view to delivering improvement to journey times, road safety and reduce journey time reliability. The Design Manual for Roads and Bridges (DMRB) standard TD 70/08 "*Design of Wide Single 2+1 Roads"* states a wide single 2+1 carriageway can be a more effective solution than other single carriageway options in promoting journey time reliability on long distance single carriageway roads.

3.1.2 The "Overtaking Value" of the road has been used to set the design parameters and measure the effectiveness of the 2+1 design. The Overtaking Value is defined in the DMRB standard TD 9/93 *"Highway Link Design"* as the total length of overtaking sections for each direction summed and divided by the total length of road. For the purposes of this study, overtaking sections of single carriageway road have not been included, only the 2+1 sections have been assessed.

3.1.3 The TD 9/93 minimum overtaking provision recommendations is set out in Table 7 below, with the addition of descriptions of road types.

Road Type	Overtaking Value	**Road Type Description**
Category 1	15%	Normal S2 (Single 7.3m kerbed)
Category 2/3	30%	S2 (Single 7.3m +1m hard strips) & WS2 (Wide Single 10m)
Category 4	40%	WS2 (Wide Single 10m with clearway restrictions)

Table 7: TA 9/93 "Table 7 Overtaking Provision" with Road Type Descriptions

3.1.4 For the purposes of this study, the link to be considered is between Haverfordwest and St Clears roundabouts a total length of 32.5km. The target overtaking provision therefore to meet the requirements of TD9/93 would be 10.8km in both the eastbound and westbound direction.

3.2 Option 1 - 2+1 Committed Schemes

3.2.1 Route Description – Option 1

3.2.1.1 Option 1 consists of the 2+1 committed schemes, namely the A40 Llanddewi Velfrey to Penblewin Improvement (Sub Section 1C) and a single carriageway improvement at Redstone Cross (Sub Section 1D) (see Appendix A Drgs.HHC43696/169 & HHC43696//170). The current committed scheme was identified in the 2004 study and is referenced within the NTP. Project development has already begun and is currently programmed to commence on site in late 2017. The study has also included for improvement works at Redstone Cross, which has been raised as a potential accident cluster. For the purpose of this study Redstone Cross will be considered as part of the committed schemes although to date no decision has been made if it is to form part of the scheme to be taken forward.

3.2.1.2 The A40 Llanddewi Velfrey to Penblewin Improvement is a 5km long single carriageway improvement incorporating three elements of 2+1 carriageway within it to facilitate overtaking all of which are offline, two in the eastbound direction and one in the westbound direction. The first eastbound section bypasses Llanddewi Velfrey to the north and originates from the proposed new roundabout at Bethel Chapel to just east of the proposed bridge over the road travelling north to Llanfallteg West. Blaen-Pen-Troydin is the only side road that is currently proposed to have no direct access onto the A40. The second section of 2+1 but this time westbound is from the Pen-Troydin-Fach side road, which is stopped up, to just east of the proposed over bridge. Between the second and third sections of new 2+1 carriageway, the existing A40 route will be stopped up and a new junction will provide access to the new A40 route which will allow residents access into Blaen-Pen-Troydin. West of the new junction, the access for the property north of the proposed A40 is stopped up and a new junction provides a new access for residents. To the west of this new junction two private roads are to be stopped up and residents will be provided with alternative access via county roads. The third section of 2+1 is from Trefangor Cottage to approximately 300 metres west of Trefangor Farm. The access to Trefangor Cottage, Trefangor Farm, and the property 200 metres west of Trefangor Farm are to be stopped up, in addition to the track heading north that is located opposite.

3.2.1.3 Sub-section 1D is the Redstone Cross Improvement involving changes to the junction and does not include any 2+1 overtaking sections. Approximately 1km of the scheme is offline. The section bears south-west from the Penblewin roundabout and merges back into the existing A40 at Redstone Farm where there are two new junction layouts.

3.2.2 Overtaking provision – Option 1

3.2.2.1 The overtaking provision associated with Option 1 is summarised in Table 8. The length of the Redstone Cross Improvement section 1D in Option 1 does not have any 2+1 overtaking sections and is only shown in the table for completeness.

3.2.2.3 Table 8 shows that Option 1 increases the overtaking provision along the A40 from 3.2km (eastbound) and 5.5km westbound) to a new total 4.6km in the eastbound direction and 6.2km in the westbound direction. This equates to 14% overtaking provision along the 32.5km route in the eastbound direction and 19% westbound overtaking provision. The average in both directions is approximately 17%. This exceeds the TD 9/93 minimum overtaking provision of 15% for a Category 1 road (7.3m wide single carriageway) as set out in Table 7.

Chainage		Section Group	Option 1 2+1 Committed Schemes			
			Overtaking Length (km)		Existing/ Proposed	Scheme Description
			e/b	w/b		
Ch.32+500	Ch.31+500	A		1.0	Existing	-
Ch.28+350	Ch.27+350	A		1.0	Existing	-
Ch.22+200	Ch.20+400	B		1.9	Existing	-
Ch.20+300	Ch.19+400	C	0.8		1C Proposed	Llanddewi Velfrey to Penblewin Scheme
Ch.19+400	Ch.18+400	C		0.7	1C Proposed	
Ch.18+400	Ch.16+350	C	0.6		1C Proposed	
Ch.16+350	Ch.15+000	D	0.0#		1D Proposed	Redstone Cross Improvement
Ch.13+100	Ch.11+200	E	1.9		Existing	-
Ch.11+100	Ch.9+500	E		1.6	Existing	-
Ch.5+200	Ch.3+900	F	1.3		Existing	-
Option 1 - A40 Total Overtaking Provision			**4.6km (14%)**	**6.2km (19%)**		

Redstone Cross junction improvement, no additional overtaking provision

Table 8: Overtaking Provision – Option 1

3.3 Option 2 - Maximum 2+1

3.3.1 Route Description – Option 2

3.3.1.1 A number of lengths of existing single carriageway have been identified as having the potential for the introduction of a 2+1 layout, allowing overtaking opportunities in the two lane direction.. Combined together these provide a total 12.9km of additional 2+1 overtaking lane to result in a total 2+1 carriageway provision of 21.6km (see Appendix A Drgs.HHC43696/171 & HHC43696//172). Option 2 has been split into five separate sub-sections for the ease of reference and potential future delivery sequence based on their location, ease of delivery, affordability or similarity. These sub-sections could however be delivered as one complete scheme or as a series of discrete separate schemes.

3.3.1.2 Sub-section 2C is the A40 Llanddewi Velfrey Improvement identified in Option 1. It provides an additional 2.1km of 2+1 overtaking length and is described in section 3.2.1.2 above.

3.3.1.3 Sub-section 2D is the Redstone Cross Improvement identified in Option 1, with the addition of an element of 1.2km of 2+1 carriageway, which would be offline. The section bears south-west from the Penblewin roundabout and merges back into the existing A40 at Redstone Farm where there are two new junction layouts.

3.3.1.4 Sub-section 2G comprises four elements of 2+1 carriageway which total 3.9km, all of which are online, three eastbound and one westbound all in the vicinity of the Whitland Bypass. The first section from Afon Feni to Grovelands incorporates two side roads around the Grovelands junction which have been kept to provide access for residents at Bwlchdomen and Blaencorse. The over bridge over the railway is widened to accommodate the 2+1 carriageway. The second section is located between Pen-y-coed roundabout and to the west of Haulfan. The third section is west from Pen-y-coed roundabout to the east of the Afon Gronw River. The fourth section is from west of Afon Gronw to Black bridge roundabout.

3.3.1.5 Sub-section 2H comprises of three elements of 2+1 carriageway which are all online and total 4km. These are referred to in Table 9 as Redstone Cross to Haverfordwest online Improvements. The first 2+1 section provides approximately 1.9km of additional overtaking lane in the westbound direction from Redstone Cross to the A40/B4314 roundabout west of Cotts Farm at the eastern end of the A40 Penblewin to Slebech Park Improvement. The second section of new 2+1 carriageway starts at the western end of the A40 Penblewin to Slebech Park Improvement, 800 metres east of Meadow View to 300 metres west of Prickett's Wood. This provides approximately 1.5km of additional overtaking lane in the eastbound direction. The third section of 2+1 is to the east of Haverfordwest Golf Club. It introduces approximately 0.6km of additional overtaking lane in the westbound direction between 700 metres west of Deep Lake Farm to 100 metres west of Cotts Park. Several accesses and side roads will need to be stopped up and alternative access provisions made. The new access to Prickett's Wood is via a proposed side road through Slebech Park which joins onto the existing access road

3.3.1.6 Sub-section 2I comprises one element of 2+1 carriageway which is an offline bypass of Slebech. The additional lane is in the westbound direction. This section is 1.7km long from 400 metres west of Prickett's Wood to 250 metres east of Little Arnold's Hill. It bypasses Slebech Retail Park to the north. The side road 250 metres west of Wiston Junction is stopped up and is replaced by an over bridge at Wiston Junction with a side road linking Wiston Junction's road and the side road 250 metres west.

3.3.2 Overtaking Provision – Option 2

3.3.2.1 Table 9 shows that the existing and new lengths of overtaking sections for Option 2 total 10.5km in the eastbound direction and 11.1km in the westbound direction. This equates to 32% overtaking provision along the 32.5km route in the eastbound direction between St. Clears and Haverfordwest and 34% westbound overtaking provision. The average in both directions is 33%. This exceeds the TD 9/93 minimum overtaking provision of 30% for Category 2 & 3 roads (S2 Single 7.3m / WS2 Wide Single 10m) as set out in Table 7.

Chainage		Section Group	Option 2 Maximum 2+1			
			Overtaking Length (Km)		Existing/ Proposed	Description
			e/b	w/b		
Ch.32+500	Ch.31+500	A		1.0	Existing	-
Ch.30+800	Ch.28+500	G	1.1		2G Proposed	Whitland Bypass
Ch.28+350	Ch.27+350	A		1.0	Existing	-
Ch.27+200	Ch.26+200	G	0.8		2G Proposed	Whitland Bypass
Ch.26+200	Ch.25+250	G		0.7	2G Proposed	Whitland Bypass
Ch.25+250	Ch.23+800	G	1.3		2G Proposed	Whitland Bypass
Ch.22+200	Ch.20+400	B		1.9	Existing	-
Ch.20+300	Ch.19+400	C	0.8		2C Proposed	Llanddewi Velfrey to Penblewin Scheme
Ch.19+400	Ch.18+400	C		0.7	2C Proposed	
Ch.18+400	Ch.16+350	C	0.6		2C Proposed	
Ch.16+350	Ch.15+000	D	1.2		2D Proposed	Redstone Cross 2+1
Ch.15+500	Ch.13+100	H		1.9	2H Proposed	Redstone Cross to Haverfordwest online Improvements
Ch.13+100	Ch.11+200	E	1.9		Existing	-
Ch.11+100	Ch.9+500	E		1.6	Existing	-
Ch.9+100	Ch.7+450	H	1.5		2H Proposed	Redstone Cross to Haverfordwest online Improvements
Ch.7+450	Ch.5+550	I		1.7	2I Proposed	Slebech Bypass (offline)
Ch.5+200	Ch.3+900	F	1.3		Existing	-
Ch.3+750	Ch.1+000	H		0.6	2H Proposed	Redstone Cross to Haverfordwest online Improvements
Option 2 - A40 Total Overtaking Provision			**10.5 (32%)**	**11.1 (34%)**		

Table 9: Overtaking Provision – Option 2

3.3.3 Figure 3 below provides a summary schematic of the various 2+1 improvement lengths within the Option 1 and Option 2 proposals.

Figure 3: Overtaking Provision – 2+1 Improvement Options

3.4 Option 3 - Dual Carriageway

3.4.1 Route Description – Option 3

3.4.1.1 For the purposes of this report Option 3 has been sub-divided into four contiguous sections. This is to help provide some context against the existing overtaking provision and the overtaking introduced by Options 1 and 2, but also to provide some structure to the reporting. While the sections fall into geographically deliverable work packages, no investigation has been undertaken on the staged construction of selected sections. A phased delivery schedule similar to that used for the A465 upgrade could be adopted but is not the most efficient method of delivery and would likely incur additional costs. In addition to the nature of dual carriageway works it does not deliver a linear benefit release by section. Refer to drawing numbers 173 and 174 in Appendix A.

3.4.1.2 A large portion of the 200 accesses onto the trunk road are stopped up with additional length of side road and PMA provided to rationalise these accesses and connect them to the trunk road

3.4.2 Section 3A - St.Clears to Black Bridge

3.4.2.1 From St. Clears roundabout to Whitland Bypass the route follows the line of the existing A40 with the majority of existing road retained as the westbound carriageway. The existing roundabout junction at St. Clears is retained as part of the scheme. Pwll Trap junction has been stopped up as a safety measure. All local traffic has to re-route through St. Clears to gain access to the trunk road. A roundabout junction is provided at Grovelands. Additional lengths of PMA and side road would be constructed to provide suitable access to the trunk road for all road users.

3.4.2.2 Between the railway crossing at Pont-y-Fenni and the start of the Whitland Bypass the route is located south of the existing road to retain a section of it to provide access to several properties on its northern side. In addition to the existing structures, which would require widening, or replacement, a new over bridge is proposed just west of Pont-y-Fenni to maintain access to properties from the minor road network together with a new private means of access.

3.4.2.3 From the A40/A477 roundabout junction at St. Clears the route climbs gradually for about half a kilometre. It then undulates for the next two kilometres reaching a high point again at the Grovelands junction. From here it falls constantly for over a kilometre until crossing the railway and the Afon Fenni. Beyond the river it starts to climb again reaching a high point at Haulfan.

3.4.2.4 The majority of the widening of the Whitland Bypass takes place on the northern side of the present A40. The existing roundabout junctions at Llanboidy Road and Black Bridge are be retained, although both require enlarging to accommodate dual carriageway approaches. The over bridge leading to Cwmfelin Boeth requires reconstructing to accommodate the wider dual carriageway cross section. A property may need to be demolished at the site of the existing over bridge to accommodate the widening.

3.4.2.5 From Haulfan the route climbs to a crest at the B4328 Llanboidy Road roundabout at Pen-y-coed. From this roundabout the route falls to a low point at Black Bridge.

3.4.3 Section 3B - Black Bridge to Penblewin

3.4.3.1 Between Black Bridge roundabout and the crossing of the Afon Marlais, one kilometre to the west, the dual carriageway runs north of the existing A40, which is retained for access to local properties and is linked back to the Trunk Road via Black Bridge roundabout. Between Pont Frolic and Gwyndy the route is on the line of the existing trunk road utilising the alignment of the Pengawse Hill Improvement. The existing county road through Pengawse would be available for local traffic movements. A new underpass would be required at Pont Frolic to connect the retained A40, to the south, with the old road to the north and a new over bridge provided at Gwyndy linking properties to the north and south. The horizontal and vertical alignments closely follow the existing alignment.

3.4.3.2 West of Gwyndy, the proposed dual carriageway is off-line with the existing A40 retained for local traffic movements. Between Gwyndy and the eastern end of Llanddewi Velfrey the proposed route lies to the south of the A40, therefore crossing it just west of Bethel Chapel; a further roundabout is proposed at this location.

3.4.3.3 From Black Bridge the route undulates gently for two and a half kilometres before commencing the long climb up Pengawse Hill. Here it would reach a maximum gradient of 7.7% over a distance of some 400 metres before reaching the highest point on the route near Gwyndy.

3.4.3.4 This route leaves the existing alignment at the roundabout west of Bethel Chapel and proceeds in a north-westerly direction to skirt north of Blaen–Pen–Troydin wood on a 510m radius curve (two steps below desirable minimum radius) to swing south westwards passing south of Pen–Troydin-fach. Just west of this point it crosses the existing trunk road near Ffynnon Wood. The proposed line would remain south of the existing road for a further kilometre, at which point it crosses the existing A40 before re-joining the existing road and the A478 via a new roundabout at Penblewin.

3.4.3.5 Five over bridges and one under bridge may be required for this option with a number of lengths of side road and PMAs, to maintain the local road network.

3.4.4 Section 3C - Penblewin to Prickett's Gate

3.4.4.1 From Penblewin the route follows Redstone Cross single carriageway south of Blackmoor Hill, but on a more southerly direct line. Instead of re-joining the existing A40 west of Redstone Cross it runs parallel with and close to it as far as Cotts Farm before joining the route of the Robeston Wathen Bypass.

3.4.4.2 West of Canaston Bridge the dual carriageway route follows closely the line of the existing road. Parallel service roads would be provided to maintain access to properties where required. The widening to accommodate the dual carriageway is on the north side of the existing A40. The last 800m of this option is shown as encroaching marginally over the boundary of the National Park. To widen on the north side would affect the farm complex at Clerkenhill, with its associated leisure park. This is a matter of detail that will require further discussions with Pembrokeshire Coast National Park to develop the details and review the alignment when a detailed topographical survey is available.

3.4.4.3 From Canaston bridge the route climbs gradually, reaching a high point at Clerkenhill, 1km east of Slebech. There is one short sag curve on the approach to Slebech.

3.4.5 Section 3D – Pricket's Gate to Golf Club

3.4.5.1 Just west of Prickett's Wood the dual carriageway crosses to the north of the existing road and runs alongside it for 300m and continues on as far as the minor road to Wiston where a roundabout junction is proposed. West of this junction the route remains north of the existing road passing north of Slebech and Little Arnolds Hill where it continues to swing south-westwards to run parallel with the existing A40 down Arnolds Hill to the Deep Lake junction. This option would have a significant impact on bat feeding grounds immediately north of Slebech.

3.4.5.2 The route continues on a downhill gradient alongside of Arnolds Hill to cross Millin Brook. An improvement to the existing Deep Lake Bridge will be required here.

3.4.5.3 The existing downhill gradient of Arnolds Hill from the west is about 8.0%, which reduces to 3.1% on the immediate approaches. This is steeper than the maximum allowable 2.0% gradient for the approaches to a roundabout as detailed in TD 16/07, therefore a grade-separated layout is proposed.

3.4.5.4 This junction comprises a compact grade separated junction, with the side road passing over the trunk road. It would incorporate parallel deceleration lanes that allow vehicles to leave the main flow of traffic before slowing down to leave the trunk road. This is particularly important given the steep approach gradients from the east where the approach speeds are likely to be close to the design speed of 120kph.

3.4.5.5 Beyond Deep Lake the route crosses to the south of the existing A40, then runs south of it until 300m east of the access to Haverfordwest Golf Club where the new and existing road join at a roundabout on the existing road. Between Deep Lake junction and Deep Lake Farm the existing road is re-aligned to the south of the new route to cater for local traffic. It is connected to the retained section on the north via a new over bridge near the farm. Beyond Deep Lake Bridge the route climbs for a kilometre. It then falls briefly, climbing again to a plateau at the proposed junction west of Haverfordwest Golf Club.

3.4.6 Overtaking Provision – Option 3

3.4.6.1 Option 3 provides dual carriageway provision for the entire St.Clears to Haverfordwest section of the A40 (see Appendix A Drgs.HHC43696/173 & HHC43696//174). Notwithstanding junctions Option 3 provides 100% overtaking provision in both directions. Staged construction overtaking opportunity, including existing provision on un-improved links, are shown in Tables 10 to 13.

Chainage		Section Group	Overtaking Length (Km)		Existing/ Proposed	Key Features
			e/b	w/b		
32+500	**23+800**	**3A**	**8.7**	**8.7**	**Proposed**	**Landtake farmland southside St.Clears, off-line Haulfan, northside Whitland bypass. Alignment departures (esp. Black Bridge & Railway). Enlarged r/b Llanboidy Road and Black Bridge. New bridges 1x railway, 2x river, 2x side road , 1x accommodation. PLI risk stopping-up Pwll Trap & Haulfan**
22+200	20+400	B		1.9	Existing	
13+100	11+200	E	1.9		Existing	
11+100	9+500	E		1.6	Existing	
5+200	3+900	F	1.3		Existing	
Option 3A - A40 Total Overtaking Provision			**11.9 (37%)**	**12.2 (38%)**		

Table 10: Overtaking Provision – Option 3A – St Clears to Blackbridge

Chainage		Section Group	Overtaking Length (Km)		Existing/ Proposed	Key Features
			e/b	w/b		
32+500	31+500	A		1.0	Existing	
28+350	27+350	A		1.0	Existing	
23+800	**16+350**	**3B**	**7.4**	**7.4**	**Proposed**	**Landtake floodplain northside Black Bridge, on-line Pengawse Hill, off-line farmland Llanddewi Velfrey. Alignment departures (esp. LV & Penblewin r/b approaches), climbing lane requirement. New r/b LV, enlarged r/b Penblewin (6 arm). New bridges 1x railway, 2x river, 7x side road , 2x accommodation. Large rock cutting Pengawse Hill, high embankments LV. PLI risk NRW Taf floodplain, Ffynnon Wood, visual/noise LV**
13+100	11+200	E	1.9		Existing	
11+100	9+500	E		1.6	Existing	
5+200	3+900	F	1.3		Existing	
Option 3B - A40 Total Overtaking Provision			**10.6 (33%)**	**11.0 (34%)**		

Table 11: Overtaking Provision – Option 3B – Blackbridge to Penblewin

Chainage		Section Group	Overtaking Length (Km)		Existing/ Proposed	Key Features
			e/b	w/b		
32+500	31+500	A		1.0	Existing	
28+350	27+350	A		1.0	Existing	
22+200	20+400	B		1.9	Existing	
16+350	**7+450**	**3C**	**8.9**	**8.9**	**Proposed**	**Landtake off-line farmland Redstone Cross to Robeston Wathen, farmland northside RW to Wiston. Alignment departures (esp. National Park). New grade-sep RW, new r/b Wiston. Property demolition RC Forge+1, Cotts Farm & Meadow View. New bridges 2x river, 4x side road, 2x accommodation. PLI risk National Park, NRW floodplain & SAC.**
5+200	3+900	F	1.3		Existing	
Option 3C - A40 Total Overtaking Provision			**10.2 (33%)**	**12.7 (40%)**		

Table 12: Overtaking Provision – Option 3C – Penblewin to Prickett's Gate

Chainage		Section Group	Overtaking Length (Km)		Existing/ Proposed	Key Features
			e/b	w/b		
32+500	31+500	A		1.0	Existing	
28+350	27+350	A		1.0	Existing	
22+200	20+400	B		1.9	Existing	
13+100	11+200	E	1.9		Existing	
11+100	9+500	E		1.6	Existing	
7+450	**1+000**	**3D**	**6.4**	**6.4**	**Proposed**	**Landtake off-line farmland. Large cutting Arnolds Hill & Cotts Park. Climbing lane requirement. New bridges 2x river, 1x side road, 1x accommodation. New r/b Deep Lake & Golf Club, at-grade junction Narberth Road. PLI risk farm & Golf Club access, NRW cuttings visual, Slebech loss of trade.**
Option 3D - A40 Total Overtaking Provision			**8.3 (26%)**	**11.9 (37%)**		

Table 13: Overtaking Provision – Option 3D – Prickett's Gate to golf club

3.6 Option 4 - Haverfordwest Town Centre Proposals

3.6.1 This Option considers three potential improvements within Haverfordwest Town Centre (Appendix A Drg.HHC43646/175). These generally comprise:

- Option 4a - Introduction of an elevated 'flyover' at Merlin's Bridge Roundabout to give continuity on the A4076 route.
- Option 4b - Amendments to the existing Salutation Square Roundabout with the addition of a dedicated at-grade filter lane, and new signalised junction.
- Option 4c - A series of potential traffic management opportunities, including re-working of existing one-way system.

3.6.2 Option 4A - Merlin's Bridge Route Description

3.6.2.1 The route leaves the existing A4076 Freemans Way about 250m east of the Merlin's Bridge Roundabout and diverges to the south west on a curve. Access to and from the roundabout for local traffic is gained via west facing slip roads. The route rises quickly, initially on embankment then crosses the westbound slip road to Merlin's Bridge Roundabout, Merlin's Brook and Pembroke Road on a viaduct before joining the A4076 Dredgeman Hill just north of the junction with Old Hakin Road. The existing section of Dredgeman Hill between Old Hakin Road and Merlin's Bridge Roundabout would become the northbound slip road for local traffic. Due to the vertical alignment of the flyover there is insufficient vertical clearance for a southbound slip road from Merlin's Bridge roundabout. Therefore it is proposed to use Pembroke Road and Magdalen Street for this purpose, re-opening the junction between Magdalen Street and Dredgeman Hill for westbound/ southbound traffic only. This arrangement would require the existing three arm traffic signal junction to be changed into a four arm signalised junction.

3.6.3 Option 4B - Salutation Square Roundabout Route Description

3.6.3.1 South of the existing Salutation Square Roundabout, a new mini roundabout is introduced between New Road and Cambrian Place to provide a new access link to the A4076 Freemans Way. The mini roundabout is elevated on retaining wall up to approximately 3m. West of the mini roundabout, a 4 arm signalised junction provides access south onto Freemans Way, west to the car park at County Hall, and north onto Freemans Way. Access to Freemans Way from A40 Cambrian Place is via a new segregated dedicated at-grade left filter lane which diverges from the A40 Cambrian Place and merges onto Freemans way approximately 50m from the signals. The diverge lane at Cambrian Place takes a small amount of land from the car park north of the houses on Cambrian Place. This removes the Cambrian Place arm from the southern point of the existing Salutation Square Roundabout.

3.6.4 Option 4C - Traffic Management Opportunities Route Description

3.6.4.1 Travelling west on High Street there is a one-way system through to Dew Street. Joining High Street from the south is Market Street which can only turn left at the junction. Traveling from High Street to Tower Hill two separate routes are available. The first right turn on High Street leads to Dark Street which joins Tower Hill towards the top of the street; the second right turn on High Street leads onto St. Mary's street which joins Tower Hill half way in the street. At the junction of St. Mary's Street traffic can turn both left and right. Both Dark Street and St. Mary's Street are one-way. From the St. Mary's junction on Tower Hill, taking a left towards Dew Street is a one-way heading south and also taking a right and heading north towards Marines Square is a one-way. Tower Hill joins High Street 100 metres to the west of where High Street

joins St. Mary's Street. From Dark Street there is no left turn. At the top of Tower Hill, staying in the left lane takes traffic onto Marines Square whereas staying in the right lane takes traffic either to the car park on Perrot Avenue or on towards the mini roundabout. From Marines Square there's only a right turn which leads onto the A487 Barn Street which is one-way. Between Marines Square, Barn Street, and Spring Gardens Lane there are traffic signals. Spring Gardens Lane joins the A487 from the west which can only turn left. Heading north on A487 Barns Road towards the mini roundabout, staying in the initial right lane leads to Church Street. Taking the left hand lane leads to the mini roundabout. Taking a left on the mini roundabout leads to City Road and taking a right leads to Perrot Road. Traveling south from the mini roundabout, taking a left leads onto Church Street. Past Church Street Perrot Road is a one-way road which leads to the car park. Entry to the car park is via a right turn on Perrots Avenue coming from the south or a left turn on Perrots Avenue coming from the north.

3.7 Option 5 - Haverfordwest SE Bypass – A40 Golf Club to A477 Sentry Cross

3.7.1 Route Description – Option 5

3.7.1.1 This option introduces approximately 9.2km of new offline single carriageway road between the A40 east of Haverfordwest and the A477 south of Johnston (see Appendix A Drg.HHC453696/176). This provides an alternative route to the A40 and A4076 trunk roads through Haverfordwest and requires a considerable structure (approximately 350m in length) would be required to span the Western Cleddau River. The scheme bypasses the urban congestion of both Haverfordwest and Johnston with a new rural carriageway to current design standards with limited junctions.

3.7.1.2 The route leaves the roundabout on the A40 Narberth Road near the Golf Course Club House, first in shallow cut then on embankment up to 8m high, and travels in a southerly direction. It crosses Creamston Road, where an at-grade junction is proposed and turns to a south westerly direction towards the Western Cleddau. The route is in cut up to 15 m deep and Uzmaston Road crosses on an over bridge, near The Old Barn property.

3.7.1.3 The route crosses the Western Cleddau on a 350m long structure with piers up to approximately 17m high. On the western side of the river the route goes into cut up to 12m deep and Fern Hill Farm Lane crosses on an over bridge. The route continues in a south westerly direction in shallow cut and embankment to Pembroke Road. A roundabout junction is proposed near the property of South Haylett. The route continues from Pembroke Road in a south westerly direction on a series of embankments up to 13m high and turns to a southerly direction near where it crosses a local lane.

3.7.1.4 The route continues in a southerly direction running parallel to the overhead power lines on a series of shallow embankments and cuttings. It then crosses a dismantled railway, which runs east from Johnston on an embankment up to 6m high. Continuing southwards the route is in cut up to 8m deep and Langford Road, which runs east from Johnston, crosses on an over bridge. The route continues onto embankment up to 13m high. This embankment also crosses a disused railway which is used as a cycleway hence provision for this will be made. The route passes once more into cutting up to 19m deep and Church Road crosses on an over bridge. The route is on embankment up to 6m high where it crosses a local watercourse. Finally the route continues on shallow cut and embankment before joining the A477 at Sentry Cross roundabout.

3.7.1.5 The route passes through an historic landscape area to the south east of Haverfordwest and through the Western Cleddau Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI).

3.8 Option 6 – Haverfordwest SE Bypass - A40 Golf Club to A4076

3.8.1 Route Description – Option 6

3.8.1.1 Option 6 is a shortened version of Option 5 which starts on the A40 east of Haverfordwest but joins the A4076 trunk road to the southwest of Haverfordwest at Dredgeman Hill to the north of Johnston (see Appendix A Drg.HHC43696/177). It provides approximately 4.8km of new offline single carriageway road including the same considerable structure (approximately 350m in length) to span the Western Cleddau River as for Option 5.

3.8.1.2 The route leaves the roundabout on the A40 Narberth Road near the Golf Course Club House, first in shallow cut then on embankment up to 8m high, and travels in a southerly direction. It crosses Creamston Road, where an at-grade junction is proposed and turns to a south westerly direction towards the Western Cleddau. The route is in cut up to 15 m deep and Uzmaston Road crosses on an over bridge, near The Old Barn property.

3.8.1.3 The route crosses the Western Cleddau on a 350m long structure with piers up to approximately 17m high. On the western side of the river the route goes into cut up to 12m deep and Fern Hill Farm Lane crosses on an over bridge. The route continues in a south westerly direction in a shallow cut and fill to Pembroke Road. A roundabout junction is proposed near the property of South Haylett. The route continues west from the roundabout and joins the A4076 south of Rose Cottage.

3.8.1.4 The route passes through an historic landscape area to the south east of Haverfordwest and through the Western Cleddau Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI).

4 ECONOMIC BENEFITS

4.1 Costs

4.1.1 Existing Cost Data

4.1.1.1 A majority of the options considered in this report are derived from options appraised during the A40 St.Clears to Fishguard Key Stage 2 Study or identified in the Haverfordwest South Eastern Bypass Pre-Feasibility Study. Although option estimates have been prepared in both these studies they have been developed using different accounting practice, levels of detail and price base such that, even in a normalised form, direct comparison of prices is problematic. A further complication is the requirement for new/modified option costings that may be considered alongside these pre-existing cost estimates.

4.1.1.2 As a result and in order to provide a consistent current option costings new cost estimates have been developed for all options, wherever possible using the earlier study route detailing and quantification but costed to industry standard bill rates (SPONS 2015).

4.1.1.3 The Section 1C (Llanddewi Velfrey Preferred Route) scheme costs were reviewed in 2011 at £30.4M Q4 2010 prices (inc £1.3M land, £0.7M stats & 25% optimism bias) but to ensure compatibility the review main works quantities were re-totalled at 2015 rates and the appropriate factors and percentages applied to achieve the costs identified in this report. In addition the costs were benchmarked against recent 2+1 schemes delivered in the area such as the A40 Robeston Wathen Bypass completed in 2011 and the A477 St Clears to Red Roses scheme completed in 2014.

4.1.2 Cost Development

4.1.2.1 The cost estimates for each option detailed in the following section have been compiled using rates, primarily, from SPON'S CIVIL ENGINEERING AND HIGHWAY PRICE BOOK 2015, PART 5 APPROXIMATE ESTIMATING, except for the A40 Llanddewi Velfrey cost estimate (Section 1C), where the original estimate has been updated using the Tender Price Indices, for consistency.

4.1.2.2 The original A40 Llanddewi Velfrey cost estimate produced was in Q4 2007. This was then further updated in Q4 2010, using the Tender Price Index. For consistency, the same method was adopted to bring the original cost estimate up to date. Indices were available up to Q2 2014. To bring the estimate up to Q1 2015, an average was taken of the indices from Q1 2013 to Q2 2014. The original quantities used for the estimate build up have not been verified, as this information is unavailable. The percentage for contractor's overhead and preliminaries has not been applied to the updated cost estimate, as from inspection of the original estimate it appears to already be included. The amount allowed for land and statutory undertakers diversions has been removed, so to compare like with like with the other estimates.

4.1.2.3 The following allowances and assumptions have been made to the cost estimates for the six options:

- costs and associated fees are excluded for all options, including land acquisition and compensation costs.
- No allowance has been made for works associated with statutory undertakers diversions.

- An Optimism Bias of 44% had been used in accordance with HM Treasury Green Book (Supplementary Guidance).
- The 6% allowance which has been applied for overhead and preliminaries on SPON'S Civil Engineering and Highway Price Book 2015 is indicative only and will vary between tenderers. (This is assumed to be included within the rates, originally produced, on Llanddewi Velfrey.)
- VAT is excluded. On line improvements are considered VAT recoverable whereas lengths of new road (offline) are non-recoverable for VAT. Where schemes are part on-line and part off-line they are considered as 'hybrid' schemes and VAT apportioned accordingly for the on-line/ off-line elements of work.

4.1.3 Option Costs

4.1.3.1 Tables 14 to 19 provide estimates of the construction costs for each option.

Section	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Section 1C	23.8	5.9	5.1	15.3	50.1
Section 1D	3.0	1.0	0.7	2.0	6.7
TOTAL	**26.8**	**6.9**	**5.7**	**17.3**	**56.8**

Table 14: Estimated Construction Costs - Option 1

Section	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Section 2C	23.8	5.9	5.1	15.3	50.1
Section 2D	4.7	1.5	1.1	3.2	10.5
Section 2G	5.0	1.6	1.1	3.4	11.2
Section 2H	4.5	1.5	1.0	3.0	10.0
Section 2I	7.5	2.5	1.7	5.1	16.8
TOTAL	**45.5**	**13.0**	**10.0**	**30.1**	**98.6**

Table 15: Estimated Construction Costs - Option 2

Section	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Section 3A	42.0	13.6	9.5	28.6	93.7
Section 3B	35.5	11.6	8.0	24.2	79.3
Section 3C	46.1	15.0	10.4	31.4	102.8
Section 3D	27.1	8.8	6.1	18.5	60.4
TOTAL	**150.7**	**49.0**	**33.9**	**102.8**	**336.3**

Table 16: Estimated Construction Costs - Option 3

Sub-Option	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Option 4A	5.0	1.6	1.1	3.4	11.3
Option 4B	0.5	0.2	0.1	0.3	1.1
Option 4C	0.3	0.1	0.1	n/a	0.5

TOTAL	**5.9**	**1.9**	**1.4**	**3.8**	**12.9**

Table 17: Estimated Construction Costs - Option 4

	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Option 5	**22.5**	**7.3**	**5.1**	**15.4**	**50.3**

Table 18: Estimated Construction Costs - Option 5

	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Option 6	**15.5**	**5.0**	**3.5**	**10.6**	**34.6**

Table 19: Estimated Construction Costs - Option 6

4.2 Traffic and Economic Assessment

4.2.1 Forecast Traffic Demand

4.2.1.1 To understand the required carriageway standard along the A40, an assessment of future traffic growth was undertaken using the DfT's Trip End Model Presentation Program (TEMPRO) in conjunction with the DMRB standard TA 46/97 *"Traffic Flow Ranges for Use in the Assessment of New Rural Roads*". The TA 46/97 standard recommends opening year economic flow ranges for different standards of roads. These have been abstracted into Table 20 below for a range of road types relevant to this study.

Carriageway Standard	Opening Year AADT	
	Minimum	Maximum
S2 (Single 7.3m)	Up to 13,000	
WS2 (Wide Single 10m)	6,000	21,000
D2AP (Dual 2 lane all purpose)	11,000	39,000
D3AP (Dual 3 lane all purpose)	23,000	54,000

Table 20: Abstract from TA 46/97 "Table 2.1 Opening Year Economic Flow Ranges"

4.2.1.2 The DMRB standard TD 70/08 "*Design of Wide Single 2+1 Roads"* was developed after TA46/97 so this standard of road is not included in the above table. However, TD 70/08 advises that the provision of a WS2+1 road can be a more effective solution to promote journey time reliability on long distance single carriageway roads than other single carriageway road options for flows of up to 25,000 AADT.

4.2.1.3 TEMPRO growth factors were used in conjunction with DfT count point data to forecast AADT over 5 year periods and are illustrated in Figure 4 below. Beyond 2040 TEMPRO growth factors are not available and thus are unable to make a reliable prediction beyond this point.

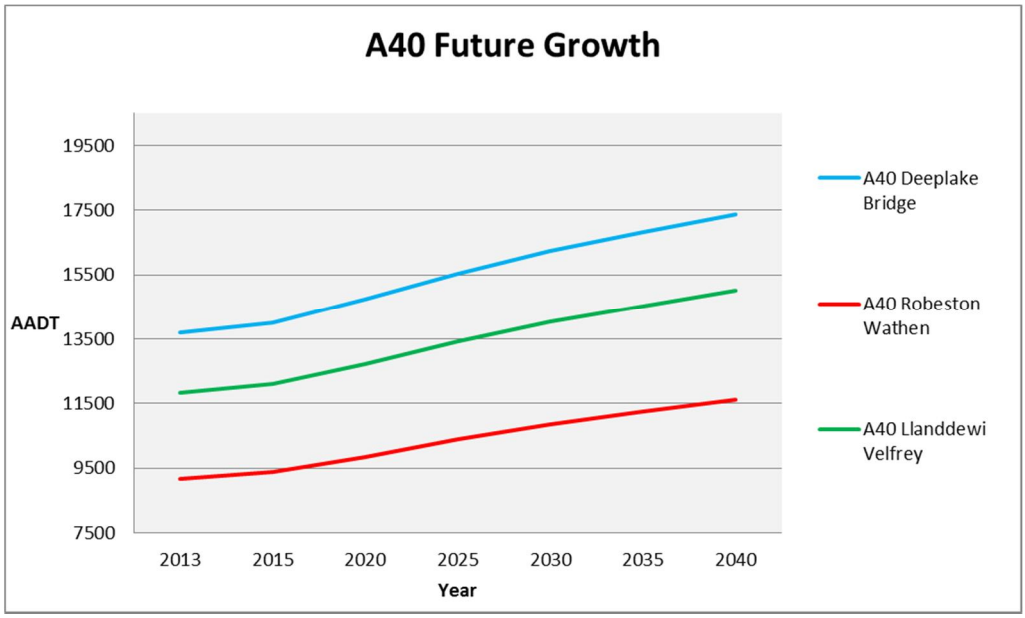


Figure 4: A40 Forecasted Traffic Flows

4.2.1.4 Existing A40 traffic flows are comparatively low (9,000 to 14,000 AADT). Even allowing for an increase for seasonal traffic increases they are reasonably within the capacity of an improved wide single carriageway as defined in the table (6,000 to 21000 AADT) and a below the capacity threshold of 25,000 AADT for a wide single 2+1 carriageway as outlined in the standard

4.2.1.5 The range of flows where dual carriageway D2AP may be considered economically justifiable are between 11,000 to 39,000 AADT. The current A40 flows are within the capacity range but very near to the bottom.

4.3 Journey Time Variability

4.3.1.1 The issue that is most pertinent to the traffic assessment of the study corridor is that of journey time variability. The current lack of overtaking opportunities and the nature and mix of traffic along the A40 deliver conditions where the time taken to travel along the A40 can vary significantly. This is exacerbated during the summer months.

4.3.1.2 Variability along the A4076 results from the number of junctions, traffic lights, varying speed limits and frequent instances of peak period congestion in particular at Merlin's Bridge roundabout.

4.3.1.3 A methodology of utilising existing TrafficMaster data to demonstrate the value of reducing the variability of journeys along this route has been developed. Due to the nature of the improvements, this methodology was applied to the following options:

A40
- Option 1
- Option 2
- Option 3

A4076
- Option 5
- Option 6

4.3.1.4 Option 4 consists of localised improvements to junctions within Haverfordwest. The sensitivity of potential benefits for these improvements would not be picked up by the journey time variability methodology. A VISSIM model was developed of the trunk road network within Haverfordwest to analyse journey time benefits in a more traditional way. The results of this analysis are presented in Section 4.4.1.4.

4.3.2 TrafficMaster Data

4.3.2.1 The TrafficMaster database holds data collected from in-vehicle GPS tracking devices. This data can be used to derive average speed, journey times, journey time variability and journey time reliability. This data is then mapped to the Ordnance Survey's Integrated Transport Network (ITN).

4.3.2.2 TrafficMaster data was supplied by the Welsh Government which represented the calendar year, 2013 and consisted of approximately 8,500,000 records, split into 15 minute segments. The appropriate links from the ITN network respective to the proposed options and direction of travel were extracted from the raw data to cover sections from Haverfordwest to St. Clears along the A40, and along the A4076 to Milford Haven.

4.3.2.3 This data was then filtered to analyse neutral dates (142 days as outlined by Traffic Wales) to represent traffic conditions that are not vulnerable to irregular variation i.e. bank holidays, Easter/Christmas and school holidays.

4.3.2.4 The methodology for deriving benefits due to journey time variability was based on determining the variability of journey times throughout the year. Benefits can be assessed by estimating the total travel time associated with reducing the variation in the worst periods (by introducing greater overtaking opportunities either via dual carriageway or wide single 2+1) to match that of the best periods.

4.3.2.5 The calculation of journey time variability is based upon the coefficient of variation (CV) by link and time period, assuming that the journey times that are above average over a link are those that will achieve greatest benefit. The CV is the standard deviation of journey time divided by the average and tends towards zero if the observations are close together (i.e. values with a CV approaching zero are representative of low variability).

4.3.2.6 Taking a peak period and assuming a normal distribution, we would expect two thirds of observations between the average journey time and one standard deviation with the remaining third being between one and two standard deviations.

4.3.2.7 Mapping this against a traffic flow, a journey time distribution of the vehicles experiencing above average journey times was generated. The journey time distribution is then inferred and a travel time benefit derived based on the period that has the best instance of journey time variability by link.

4.3.2.8 Table 21 outlines the car user benefits related to journey time variability by option as a percentage of overall travel time between St.Clears and Haverfordwest (for Options 1 to 3) and between the A40 Golf Course and the A4076 at Steynton (for Options 5 and 6).

Car Users		Journey Time Variability Benefit (% benefit of overall travel time)			
		Morning Peak	Inter Peak	Afternoon Peak	Off Peak
Option 1	Eastbound	0%	0.1%	0.04%	0.2%
	Westbound	0.3%	0.2%	0%	0.2%
Option 2	Eastbound	0.1%	0.3%	0.2%	0.4%
	Westbound	4%	2%	1%	1%
Option 3	Eastbound	7%	14%	6%	5%
	Westbound	14%	10%	4%	5%
Option 5	Southbound	17%	21%	7%	13%
	Northbound	34%	23%	8%	27%
Option 6	Southbound	2%	2%	0.3%	0.4%
	Northbound	21%	14%	7%	19%

Table 21: Journey Time Variability Benefit Shown as a % Benefit of Overall Travel Time

4.3.2.9 Table 22 below converts the above journey time variability results into units of seconds to give a better understanding of the scale of the variability improvements expected.

Car Users		Journey Time Variability Benefit (seconds)			
		Morning Peak	Inter Peak	Afternoon Peak	Off Peak
Option 1	Eastbound	0	0	0	0
	Westbound	2	1	0	0
Option 2	Eastbound	1	1	1	0
	Westbound	23	4	6	2
Option 3	Eastbound	40	39	29	7
	Westbound	82	40	30	7
Option 5	Southbound	28	40	12	41
	Northbound	36	37	11	24
Option 6	Southbound	1	1	0	0
	Northbound	21	10	4	16

Table 22: Journey Time Variability Benefit Shown as Travel Time Savings (seconds)

4.3.2.10 The results above highlight that Option 3 would generate the greatest journey time benefit due to the reduced level of journey time variability along the A40 associated with 100% overtaking provision. Tables 21 and 22 also illustrate that some of the greatest levels of benefit are identified within the interpeak. This is possibly as a result of higher levels of HGVs, and instances of agricultural and right turning traffic along the A40.

4.3.2.11 Despite there being more improvements to eastbound sections of the route, benefits that accrue due to improvements in journey time variability are prevalent more so in westbound rather than eastbound trips. This is due to the worst instances of journey time variability occurring on westbound sections, and thus reflects a higher level of benefits despite covering less distance than the proposed eastbound improvements. For example, westbound improvements at Slebech suffer from high levels of variation and hence generate larger benefits.

4.3.2.12 Options 5 and 6 also generate significant benefit as a result of the nature of the urban route through the town of Haverfordwest which both scheme bypass.

4.4 Journey Time Benefit

4.4.1.1 Another major component of journey times is the benefit as a result of increased speeds associated with the new road improvements and therefore shorter journey times. Due to time and cost limitations of this study, a traffic model has not been developed to analyse the impact of the schemes on end to end journey times directly. To give an indication of the level of benefits which could be expected, a very basic calculation of the assumed travel time benefit based on free flow speeds (based on marked speed limits and design speeds of proposed options) has been undertaken instead.

4.4.1.2 Table 23 outlines the calculated travel time benefits of the proposed options by travel direction and by the length of the study corridor affected by the option.

Proposed Scheme		Speed limit (mph)	Do Nothing (Minutes)		Do Something (Minutes)		Benefit (Minutes)	
			Weekday AM Peak	Weekday PM Peak	Weekday AM Peak	Weekday PM Peak	Weekday AM Peak	Weekday PM Peak
Option 1	Eastbound	60	01:24	01:20	00:59	00:59	**00:25**	**00:21**
	Westbound	60	00:52	00:46	00:32	00:32	**00:20**	**00:14**
Option 2	Eastbound	60	*04:27*	*04:07*	*03:17*	*03:17*	***01:10***	***00:51***
	Westbound	60	*04:37*	*04:12*	*03:17*	*03:17*	***01:10***	***00:45***
Option 3	Eastbound	70	26:07	23:38	16:38	16:38	**09:29**	**07:00**
	Westbound	70	26:33	24:01	16:49	16:49	**09:44**	**07:12**

Table 23: Journey Time Benefit for Options 1, 2, and 3

4.4.1.3 The table above demonstrates that Option 1 can generate approximately 25 seconds of journey time benefit, 1 minute and 15 seconds for Option 2 and over 9 minutes for Option 3.

Option	Travel Time Within Sections (Minutes)					
	Eastbound (EB)		Westbound (WB)		EB	WB
	Do Nothing	Do Something	Do Nothing	Do Something	Benefit (time saving)	
A40 Scotchwell Roundabout to A4076 Merlin's Bridge Roundabout (3.15km)						
Option 4A	4.33	4.73	2.85	2.36	-0.40	0.49
Option 4B	4.33	3.64	2.85	2.96	0.69	-0.11
A40 Golf Course to A4076 Steynton (11.95km)						
Option 5	8.86	6.84	8.86	6.84	2.02	2.02
Option 6	8.86	7.88	8.86	7.88	0.98	0.98

Note: 1. Travel times are in minutes
2. Results for Options 4A and 4B are taken directly from the VISSIM model (see below)

Table 24: Journey Time Benefit Associated with change in Alignment/Road Speed (mins)

4.4.1.4 The benefits demonstrated in Table 24 are based on the comparison of free flow travel time, not surveyed travel time as per TrafficMaster data. The calculation does not take into account any delays experienced on the existing or new routes, for example turning movements at junctions. The above assessment of travel time benefits can therefore only provide an indication of relative time savings over the do nothing situation after the implementation of the improvement options and for the purpose of this assessment.

4.4.1.5 The A40 route is characterised with higher traffic flows during the summer months due to seasonality, as people use the route to gain access to the holiday sites of west Pembrokeshire, and the ferry terminal at Fishguard. The traffic benefits highlighted in this report are based on neutral months which aim to remove the bias of seasonality from the appraisal process. However, the travel time benefits, especially journey time variability would increase during the summer months due to the increase in traffic flow resulting in more delays on the network. Therefore the travel time benefits summarised above are an underestimation of the amount of benefit derived during the summer months.

4.5 VISSIM Model – Option 4

4.5.1.1 A VISSIM model was developed of the A40 and A4076 within Haverfordwest to analyse the journey time benefits as a result of Options 4A and 4B. The VISSIM model was based on traffic data collected in 2015 and represents both the morning and evening peak periods. The model was validated against traffic flows and queue data at the following junctions:

- Salutation Square Roundabout (A40 Cambrian Place / Cartlett Road / A4076 Freemans Way)
- A40 Scotchwell Roundabout (east of Salutation Square Roundabout)
- A4076 Merlin's Bridge Roundabout
- Cartlett Road / A487 / Sydney Rees Way Roundabout (north of Salutation Square Roundabout)

4.5.1.3 To be consistent with the methodology adopted for journey time variability, traffic growth has not been applied to the two options assessed, and are therefore based on 2015 base year flows. Table 25 below illustrates the journey time benefits of both Options 4A and 4B. The journey time benefits are calculated along the A40 from Scotchwell Roundabout (east of the Salutation Square roundabout) through to Merlin's Bridge roundabout.

	Travel Time (seconds)						Travel Time Benefit (seconds)			
	DN		Option 4A		Option 4B		Option 4A		Option 4B	
Direction	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Eastbound	243.1	260.3	276.4	284.1	218.3	205.4	-33.3	-23.8	24.8	54.8
Westbound	170.7	161.6	141.7	138.1	177.8	172.7	29.0	23.5	-7.1	-11.1

Note: Values are average per vehicle

Table 25: Overall Journey Time Benefit (seconds) – Option 4

4.6 Summary of Journey Time Benefits

4.6.1.1 The two components of the journey time benefits can be combined to provide a maximum travel time benefit associated with each improvement option.

4.6.1.2 The improvement in journey time associated with a change in speed of the road and the new alignment has been taken from Tables 23 & 24, converted from minutes to seconds and added to the range of journey time benefits associated with the improved journey time reliability from Table 22. The results are shown in Table 26.

Option	Time Benefits (seconds)		
	Journey Time Improvement (Related to Free Flow Speed)	Journey Time Variability (range)	Maximum travel time benefit
Option 1	25*	0-2	27
Option 2	70*	0-23	93
Option 3	584	7-82	666
Option 4	20**	n/a	20
Option 5	121	11-41	162
Option 6	59	0-21	80

* the limited nature of the speed/route calculation results in benefits shown in Llanddewi Velfrey only
** includes some directional disbenefits but provides a net positive benefit overall.

Table 26: Overall Journey Time Benefit (seconds)

4.6.1.3 Table 26 shows that the overall journey time benefit for Option 2 is greater than for Option 1. Should Option 2 be taken forward for further study, the travel time benefits should be modelled in greater detail to identify whether certain sections of 2+1 carriageway provide greater benefits than others, alongside an economic assessment of each 2+1 section.

4.6.1.4 Option 3 performs the best of the A40 options as expected. However, this should be viewed alongside the construction costs comparison in section 4.1 and also the capacity discussion in section 4.2.1.

4.6.1.5 Option 5 performs better than Option 6 as it bypasses Johnston as well as Haverfordwest. The results reflect the increase in speed limit and better reliability of journey time that Option 5 provides over Option 6 by bypassing Johnston. In economic terms, the capital cost of Option 6 is also disproportionately high for the length of road, largely to due to the high costs associated with the Western Cleddau river crossing. It is recommended that further work be undertaken at a WelTAG Stage 2 assessment, to better refine the economic performance of these options and compare them against the environmental disbenefits.

4.7 DELIVERABILITY

4.7.1 Of those considered Option 1 is the most straightforward to deliver and would involve completion of the A40 Llanddewi Velfrey to Penblewin Improvement scheme. The scheme has been through a public consultation exercise with the Preferred Route published in 2010.

4.7.2 Option 1 is the cheapest of the A40 options considered and is already included in the National Transport Plan. Funding allowance has been made within the current Transport Capital Programme while an initial Expression of Interest has been issued to seek European funding to part-fund the project.

4.7.3 The scheme would deliver small improvements to journey times, journey time reliability and road safety and would benefit the residents of Llanddewi Velfrey by reduced severance, less traffic noise and air quality impacts as a result of the removal of trunk road traffic from the village.

4.7.4 Project development has already begun and the scheme could be completed within 4 years. The scheme would be developed so as not to preclude any future plans to dual the A40.

4.7.5 There are a number of environmental impacts associated with the scheme but nothing that could not be accommodated via a detailed Environmental Impact Assessment and appropriate package of mitigation.

4.7.6 The scheme has local support and would likely receive the cautious support of Pembrokeshire CC in the absence of a commitment to dual the A40.

4.7.7 This Option would increase overtaking opportunities by 1.4km in the eastbound direction and 0.7km in the westbound direction. Together with existing provisions, this would equate to overtaking opportunities for around 17% of the total length of the A40 between St Clears and Haverfordwest.

4.8 Maximising 2+1 (incrementally)

4.8.1 There is an operational case for further improvements to the A40, in the shape of providing lengths of 2+1 along its length in addition to the A40 Llanddewi Velfrey to Penblewin scheme currently under development. Maximising the lengths of 2+1 along the route would deliver lengths of overtaking and provide further improvements to journey time, reliability and safety when compared to Option 1 but less than the dualling option.

4.8.2 These works could be combined with strategic signing of the location of up-coming overtaking opportunities to minimise driver frustration. If all the packages identified in Option 2 were taken forward it would provide overtaking opportunities to 30% of the entire length in each direction of the A40 between St Clears and Haverfordwest.

4.8.3 Journey times savings of over 90 seconds could be achieved which will be greater during busy holiday periods when the volume of traffic and number of slow moving vehicles (e.g. caravans & HGVs) is increased. The same is also true in providing some meaningful improvements to journey time reliability of the route.

4.8.4 The majority of these lengths are online to the A40 and would involve widening the existing road.

4.8.5 Aside from the Llanddewi Velfrey scheme which is assumed as being delivered, those packages taken forward first would be those with low numbers of adjacent landowners or even within the existing highway boundary if possible and could therefore be delivered within 3-4 years by minimising the extent of statutory process needed. There is also the potential that they could be delivered without the need for a full Environmental Impact Assessment.

4.8.6 The priority for which sections will be undertaken first requires a decision on the priorities for the route. Those taken forward first would be those co-incident with the most likely route for any future dualling of the A40 and would be designed so as not to preclude the potential for future dualling.

4.8.7 There is a need to deliver overtaking provision in the areas where currently there is none to reduce long lengths without the capacity to pass slower moving vehicles. Currently that is eastbound in the area around the Whitland bypass, and westbound between Arnolds Hill and Haverfordwest.

4.8.8 Delivery of these packages would be subject to the availability of funding from Welsh Government capital budgets. Taking through the simplest packages to deliver maximises the potential of seeking part-funding through the ERDF from the current round of funding with the remaining packages could be fed into the Capital programme for delivery when resources allowed.

4.9 Dualling

4.9.1 Although this study has not undertaken a full cost benefit analysis, the identified costs and anticipated transport economics benefits (eg future traffic flows, journey time savings, reliability and accident benefits) suggest that the Benefit to Cost ratio of dualling would be marginal and unlikely to demonstrate value for money in transportation terms in the short or the medium term.

4.9.2 Dualling would improve regional, national and international accessibility however dualling would also necessitate limiting the number of junctions and accesses onto the trunk road and would result in some local people having longer journeys.

4.9.3 When adding all scheme expenditure to the costs outlined in section 4.1.3 Table 16 the cost of dualling is estimated at over £400m and is not included in Transport Capital Forecasts. Dualling would take the longest to deliver of the options taking approximately 7 years to complete as a single project. Advice from the Welsh Government is that work could not start until 2020 at the earliest.

4.9.4 A phased delivery schedule similar to that adopted for the A465 upgrade could be adopted. The earliest date work could start would be 2020 and take 10 to 15 years to complete. This approach would preclude access to the current round of European structural funds. The environmental impacts would be greatest of all the options considered.

4.9.5 Dualling would likely receive support from Pembrokeshire CC as well as local businesses but would be resisted by environmental groups such as Friends of the Earth, the National Park Authority as well as residents adjacent to the A40 affected by more by this option.

5 ENVIRONMENT

5.1 Noise

Methodology for data gathering

5.1.1 A qualitative appraisal of the impact on noise has been undertaken for this stage of the study, primarily based on the changes in road position in relation to noise receptors.

5.1.2 Where online improvements are undertaken on sections of road where Hot Rolled Asphalt (HRA) surfacing is in place, there may be potential noise benefits as the Welsh Government's standard surfacing for all new roads is Thin Surface Course Systems (TSCS) which generates less tyre noise than HRA. Depending upon the timing of the improvement however, this may only be a short term benefit as maintenance resurfacing works are likely to be with TSCS. SWTRA have advised that some sections of the A40 are known to have HRA surfacing.

5.1.3 Workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including noise were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

5.1.4 Option 1 – The offline Llanddewi Velfrey to Penblewin Improvement section of this option will remove the trunk road traffic from the existing A40 that runs through Llanddewi Velfrey. This will decrease the level of traffic noise experienced at properties in Llanddewi Velfrey although some isolated properties will experience an increase in traffic noise. The offline Redstone Cross Improvement will have a similar effect on adjacent properties but on a smaller scale. Overall a slight beneficial impact is expected.

5.1.5 Option 2 – The impact of this option on noise is expected to be similar to Option 1 as it has the same offline improvements of Llanddewi Velfrey to Penblewin and Redstone Cross. Overall a slight beneficial impact is expected as more properties will experience a reduction in traffic noise.

5.1.6 Option 3 – This option results in some residential areas experiencing reduce traffic noise where the road is moved offline however the increase in road width associated with the dual carriageway on the online sections brings the road closer to some other properties resulting in an increase in traffic noise. There may be some increase in traffic noise associated with the junction improvements however overall a neutral impact is expected.

5.1.7 Option 4 - The change in the traffic layouts for the two junction improvements 4A at Merlin's Bridge Flyover and 4B Salutation Square Roundabout result in a slight change in noise envelope however the urban nature of the sites means some properties are adversely affected and some experience a benefit. On balance the impact is considered to be neutral.

5.1.8 Option 5 – The offline nature of this improvement in open countryside will introduce noise impacts into areas that do not currently experience the level of traffic noise associated with a trunk road. This is considered to be offset against the traffic noise reductions that will be experienced at properties adjacent to the A4076 trunk road which should see a reduction in traffic in favour of the new road. This will benefit the communities in Haverfordwest and Johnston. The impact is therefore considered to be neutral.

5.1.9 Option 6 – As with Option 5, the offline nature of this improvement in open countryside will introduce noise impacts into areas that do not currently experience the level of traffic noise associated with a trunk road. This is considered to be offset against the traffic noise reductions that will be experienced at properties adjacent to the A4076 trunk road which should see a reduction in traffic in favour of the new road. This will benefit the communities in Haverfordwest. The impact is therefore considered to be neutral.

5.2 Local air quality

Methodology for data gathering

5.2.1 Detailed traffic forecasting of the options has not been undertaken at this stage of the study and so a qualitative assessment on air quality has been undertaken based on the scale of the improvement, primarily based on the changes in road position in relation to receptors sensitive to air quality similar to the noise section above.

5.2.2 Workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including air quality were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

5.2.3 Option 1 – The offline Llanddewi Velfrey to Penblewin Improvement section of this option will remove the trunk road traffic from the existing A40 that runs through Llanddewi Velfrey. This will improve the air quality experienced at properties in Llanddewi Velfrey although some isolated properties will experience a decrease in air quality. The offline Redstone Cross Improvement will have a similar effect on adjacent properties but on a smaller scale. Overall a slight beneficial impact is expected.

5.2.4 Option 2 – The impact of this option on air quality is expected to be similar to Option 1 as it has the same offline improvements of Llanddewi Velfrey to Penblewin and Redstone Cross. Overall a slight beneficial impact is expected as more properties will experience an improvement in air quality.

5.2.5 Option 3 – This option results in some residential areas experiencing improvements to air quality where the road is moved offline however the increase in road width associated with the dual carriageway on the online sections brings the road closer to some other properties resulting in an decrease in air quality. There may be some reduction in air quality associated with the junction improvements however overall a neutral impact is expected.

5.2.6 Option 4 - The change in the traffic layouts for the two junction improvements 4A at Merlin's Bridge Flyover and 4B Salutation Square Roundabout result in a slight change in the air quality envelope however the urban nature of the sites means some properties are adversely affected and some experience a benefit. Whilst further study needs to be undertaken into the impact of the town centre traffic management opportunities of Option 4C, the Air Quality Management Area in Haverfordwest town centre could benefit. On balance the impact is considered to be neutral.

5.2.7 Option 5 – The offline nature on this improvement in open countryside will impact on the air quality of properties in areas that do not currently experience the level of traffic associated with a trunk road. This is considered to be offset against the improvements to air quality that will be experienced at properties adjacent to the A4076 trunk road which should see a reduction in traffic in favour of the new road. This will benefit the communities in Haverfordwest and Johnston. The impact is therefore considered to be neutral.

5.2.8 Option 6 – As with Option 5, the offline nature of this improvement in open countryside will impact on the air quality of properties in areas that do not currently experience the level of traffic associated with a trunk road. This is considered to be offset against the improvements to air quality that will be experienced at properties adjacent to the A4076 trunk road which should see a reduction in traffic in favour of the new road. This will benefit the communities in Haverfordwest. The impact is therefore considered to be neutral.

5.3 Greenhouse Gas Emissions

Methodology for data gathering

5.3.1 The greenhouse gas emissions assessment criteria primarily relates to carbon dioxide emissions and the impact on global warming and climate change. As this is difficult to measure, the assessment usually relates greenhouse gases to changes in fuel consumption as a result of the scheme and carbon released in the implementation of the scheme. Detailed traffic forecasting of the options has not been undertaken at this stage of the study and so a qualitative assessment on greenhouse gas emissions has been undertaken based on the scale of the improvement.

5.3.2 Workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including greenhouse gas emissions were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

5.3.3 Option 1 – A reduction in greenhouse gases is expected from road users from an increase in vehicle speeds and a reduction in congestion during the operation phase of this improvement. There will be an increase in greenhouse gases generated during the construction phase from the increase in vehicular activities and use of construction plant and imported materials. Overall there is expected to be a slight beneficial impact on greenhouse gas emissions.

5.3.4 Option 2 – A reduction in greenhouse gases is expected from road users from an increase in vehicle speeds and a reduction in congestion during the operation phase

of this improvement. There will be an increase in greenhouse gases generated during the construction phase from the increase in vehicular activities and use of construction plant and imported materials. The operation phase greenhouse gas emission reductions will be larger than those for Option 1 however the construction phase emissions will be larger. Overall there is expected to be a slight beneficial impact on greenhouse gas emissions.

5.3.5 Option 3 – As with Options 1 and 2, a reduction in greenhouse gases is expected from an improved consistency in vehicle speeds and reduced congestion during the operation phase of the improvement. There will be an increase in greenhouse gases generated during the construction phase from the increase in vehicular activities and use of construction plant and imported materials. The operational phase greenhouse gas emission reductions will be larger than those for all the other options however the construction phase emissions will be larger. Overall there is expected to be a slight beneficial impact on greenhouse gas emissions.

5.3.6 Option 4 – The impact on greenhouse gas emissions is expected to be neutral for this option due to the small scale of this improvement and the offset of any minor improvements in traffic flow for some traffic movements against the increased congestion for other traffic movements.

5.3.7 Option 5 – The impact of Option 5 on greenhouse gas emissions is expected to result in a slight beneficial impact similar to the A40 improvement Options 1 to 3.

5.3.8 Option 6 – The impact of Option 6 on greenhouse gas emissions is expected to result in a slight beneficial impact similar to the A40 improvement Options 1 to 3.

5.4 Landscape and townscape

Methodology for data gathering

5.4.1 A 30 m horizontal resolution digital elevation model (DEM) was sourced from USGS/NASA (Shuttle Radar Telemetry Mission). The option's routes were intersected with a 100 m evenly spaced point-grid with those points selected being used as 'observer' points in a GIS based viewshed analysis. A 50 m tolerance was used in order to capture more points representing the location of the routes. The observer points, representing vehicles, were set at a height of 4 m with the target locations (all surrounding land within 5 km of each point), representing humans, and set at a height of 2 m.

5.4.2 Site confirmation of the digital pattern of visual impact has refined the boundaries to a degree in order to define a zone of theoretical visibility. This does not take account of the screening effects of existing vegetation, buildings or boundaries. It also considers the alignment only based on the existing ground levels. At a later stage a further level of site analysis will include significant screening elements and the proposed vertical alignment of the scheme options.

5.4.3 Landmap Visual & Sensory evaluation data has been cross-referenced with the scheme options to provide an indication of sensitivity for those areas either directly or indirectly affected. Landmap describes the landscape as five evaluated aspects, and in more detailed assessment each would be considered. However the Visual & Sensory aspect is the most directly affected and therefore this information is provided here to identify sensitivity.

5.4.4 Other landscape designations include the Pembrokeshire Coast National Park and the Milford Haven Registered Landscape of Historic Interest in Wales. Scheduled Ancient Monuments and Listed Buildings have also been identified, as their landscape setting and visual context may be affected by development.

5.4.5 The baseline information is illustrated in the following series of figures (in volume 2), in combination with the various scheme options.

- 60706/001 - A40 Committed 2+1 - LANDMAP
- 60706/002 - A40 Maximum 2+1 - LANDMAP
- 60706/003 - A40 Dual carriageway - LANDMAP
- 60706/004 - Haverfordwest town centre - LANDMAP
- 60706/005 - Haverfordwest SE Bypass – LANDMAP
- 60706/027 - Haverfordwest SE Bypass (Short) - LANDMAP
- 60706/006 - A40 Committed 2+1 - Env. designations and heritage
- 60706/007 - A40 Maximum 2+1 - Env. designations and heritage
- 60706/008 - A40 Dual carriageway - Env. designations and heritage
- 60706/009 - Haverfordwest town centre - Env. designations and heritage
- 60706/010 - Haverfordwest SE Bypass - Env. designations and heritage
- 60706/028 - Haverfordwest SE Bypass (Short) - Env. designations and heritage

Potential effects of each option

5.4.6 Option 1 – 2+1 committed schemes

5.4.7 The offline section north of Llanddewi Velfrey would have an extensive zone of visual influence due to the prevailing topography and open landscape. The scheme here would pass through an open countryside landscape of Moderate Visual & Sensory evaluation, although further north a High value aspect area would be likely to be subjected to visual effects on character and receptors. Consequently this scheme section would result in significantly adverse landscape and visual impacts.

5.4.8 The on-line and tie-in sections would result in the loss of existing highway boundary vegetation, exposing the route to views from the wider landscape context. However this would generally be on one side only and would be a temporary effect which can be mitigated through the establishment of landscape planting, and therefore the overall impact would be relatively minor.

5.4.9 Option 2 – A40 maximum 2+1

5.4.10 In addition to the effects identified above the further on-line works in the maximum 2+1 option would result in more extensive boundary vegetation loss, causing temporary effects beyond the highway corridor. The landscape context is largely of Moderate evaluation, but with localised areas of High Visual & Sensory value, for example within the Pembrokeshire Coast National Park.

5.4.11 Option 3 – A40 dual carriageway

5.4.12 The off-line sections are as described above, with the significant landscape and visual impacts arising from the built development and the linear form intruding into the currently predominantly countryside character.

5.4.13 The on-line dualling will result in the loss of existing boundary vegetation, although in many cases this will be along one side only. This loss will expose the highway and its traffic to view from outside the road corridor, resulting in adverse visual impacts and indirect effects on landscape character. However the highway boundary vegetation could be re-established and therefore the impact would be temporary.

5.4.14 The southern boundary of the western section of this option abuts the Pembrokeshire Coast National Park and falls within the national park boundary. This is also a Landmap area of High value with respect to the Visual & Sensory aspect. Consequently effects on this area would result in a more significant impact due to its heightened sensitivity.

5.4.15 Option 4 – Haverfordwest town centre improvements

5.4.16 The proposals within this option would have limited landscape effects but would impact upon townscape character. The detailed design of the proposed components can do much to alleviate adverse effects, and therefore the potential impact is undefined. Similarly the visual effect on receptors will be defined through detailed design, although clearly within the urban environment there is a greater density of receptors.

5.4.17 Option 5 – Haverfordwest SE bypass

5.4.18 As an offline highway proposal in the open countryside there would be significant adverse landscape and visual impacts arising from this scheme. The zone of visual influence is extensive due to the prevailing topography, although in some sections this would be reduced where the road is in cutting, but conversely would be increased where on embankment. The scheme proposal includes significant earthworks to achieve the vertical alignment.

5.4.19 The Landmap evaluation for this option's context is largely Moderate with respect to the Visual & Sensory aspect. However the western Cleddau Valley is assessed as Outstanding, and here the scale and height of the proposed bridge structure would have a substantial impact in the landscape.

5.4.20 The Milford Haven Registered Historic Landscape is crossed by this scheme option and therefore this introduces a further sensitive receptor with respect to landscape and visual effects.

5.4.21 Option 6 – Haverfordwest SE bypass

5.4.22 As Option 5, this route is an offline proposal through open countryside, although shorter in length. Consequently the zone of visual influence is smaller, and the extent of landscape and visual impact.

5.4.23 However the most sensitive landscape area, being the western Cleddau Valley, would still be impacted upon by this option, as the bridge crossing would have a substantial adverse effect.

5.4.24 Similarly the Milford Haven Registered Historic Landscape would be impacted upon to the same degree as Option 5.

5.5 Biodiversity

Methodology for data gathering

5.5.1 A desk-based assessment was carried out to inform the appraisal. The options were viewed against aerial photographic backgrounds to gain an understanding of the habitats affected. The proximity of the options to environmental designated sites were also considered.

5.5.2 A biodiversity information records search was undertaken for protected species within a 1km of the A40 corridor and Haverfordwest SE bypass (Option 5). Data were sourced from the West Wales Biodiversity Information Centre (WWBIC) for all protected species records. The data were mapped in a GIS, summarised by option and species and then interpreted for the purposes of the appraisal.

5.5.3 The baseline information is illustrated in the following series of figures (in volume 2), in combination with the various scheme options.

- 60706/011 - A40 Committed 2+1 - Protected species
- 60706/012 - A40 Maximum 2+1 - Protected species
- 60706/013 - A40 Dual carriageway - Protected species
- 60706/014 - Haverfordwest town centre (A, B & C) - Protected species
- 60706/015 - Haverfordwest SE Bypass - Protected species
- 60706/029 - Haverfordwest SE Bypass (Short) - Protected species

5.5.4 Results of the desk-based assessment are summarised in the 'Appraisal Summary Tables' (ASTs).

5.5.5 The following species have been identified within 1 km of the A40 between St. Clears and Haverfordwest:

European Protected Species:

- Grey seal *Halichoerus grypus* (3 records)
- European Otter *Lutra lutra* (60 records including road casualties)
- Common pipistrelle bat *Pipistrellus pipistrellus* (11 records)
- Soprano pipistrelle bat *Pipistrellus pygmaeus* (16 records)
- Brown Long-eared bat *Plecotus auritus* (24 records)
- Greater horseshoe bat *Rhinolophus ferrumequinum* (12 records)
- Lesser horseshoe bat *Rhinolophus hipposideros* (23 records)
- Natterer's bat *Myotis nattereri* (2 records)
- Daubenton's bat *Myotis daubentonii* (3 records)
- Noctule *Nyctalus noctula* (5 records)
- Barbastelle bat *Barbastella barbastellus* (1 record)
- Atlantic Salmon *Salmo salar* (4 records)
- Bullhead *Cottus gobio* (6 records)

Wildlife and Countryside Act 1981 (as amended), Schedule 5 (protection from killing or injury) species:

- Water Vole *Arvicola terrestris* (1 record)
- Grass snake *Natrix natrix* (7 records)
- Adder *Vipera berus* (1 record)
- Common Lizard *Lacerta vivipara* (7 records)

- Slow worm *Anguis fragillis* (6 records)

Other notable species:

- Badger *Meles meles* (114 records including road casualties)

5.5.6 The following species have been identified within 1 km of Haverfordwest & the proposed SE Haverfordwest and Johnston bypass:

European Protected Species:

- Grey seal *Halichoerus grypus* (3 records)
- European Otter *Lutra lutra* (8 records including road casualties)
- Soprano pipistrelle bat *Pipistrellus pygmaeus* (2 records)
- Brown Long-eared bat *Plecotus auritus* (2 records)
- Greater horseshoe bat *Rhinolophus ferrumequinum* (1 records)
- Lesser horseshoe bat *Rhinolophus hipposideros* (1 records)

Wildlife and Countryside Act 1981 (as amended), Schedule 5 (protection from killing or injury) species:

- Water Vole *Arvicola terrestris* (1 record)
- Grass snake *Natrix natrix* (3 records)
- Adder *Vipera berus* (2 record)
- Common Lizard *Lacerta vivipara* (2 records)
- Slow worm *Anguis fragillis* (1 records)

Other notable species:

- Badger *Meles meles* (114 records including road casualties)

Potential effects of each option

5.5.7 Option 1 – The off-line section north of Llanddewi Velfrey will result in the loss and severance of some mature hedgerows. A number of protected species may be affected, such as bats (of particular concern Greater and Lesser horseshoe), badgers, otters and reptiles.

5.5.8 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 9km to the south-west. This site is a Great horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this sites designation. They are known to travel further than 9km from their roost sites and could be at risk from traffic collision and habitat severance.

5.5.9 Option 2 - The off-line section north of Llanddewi Velfrey and Slebech will result in the loss and severance of some mature hedgerows. A number of protected species may be affected, such as bats (of particular concern Greater and Lesser horseshoe), badgers, otters and reptiles.

5.5.10 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 1.5km to the south. This site is a Great horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this

sites designation. They are known to travel further than 1.5km from their roost sites and could be at risk from traffic collision and habitat severance.

5.5.11 Option 3 – The off-line section north of Llanddewi Velfrey and Slebech will result in the loss and severance of some mature hedgerows. The widening of the carriageway is also likely to affect habitats, particularly hedgerows. A number of protected species may be affected, such as bats (of particular concern Greater and Lesser horseshoe), badgers, otters, reptiles, Atlantic Salmon and Bullhead.

5.5.12 The southern boundary of the western section of the option abuts the Pembrokeshire Coast National Park and falls within the national park boundary. The proposed main route and new access road to the north cross the Eastern Cleddau River at Canaston Bridge. A tributary of the Eastern Cleaddau is crossed by the southern arm of the existing A4075 Roundabout. Both watercourses are designated as part of the Cleddau Rivers SAC and Eastern Cleddau River SSSI.

5.5.13 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 1.5km to the south. This site is a Great horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this sites designation. They are known to travel further than 1.5km from their roost sites and could be at risk from traffic collision and habitat severance.

5.5.14 Option 4 – Due to the urban location of the option the impacts to biodiversity are expected to be limited. The western Cleddau River is designated as an SAC (Cleddau Rivers SAC) and SSSI (Western Cleddau River SSSI) where it passes through the centre of Haverfordwest. Otters are known to use this section of the River, however the proposals are unlikely to cause any additional impact to the otters or the site as a whole.

5.5.15 The proposed flyover element of this option at Merlin's Bridge passes over a watercourse that might be used by otters. This watercourse does not have any environmental designations associated with it.

5.5.16 Option 5 – This option is off-line and creates new severance of the open countryside. A number of habitats are likely to be affected with a large number of hedgerows severed. There would be potential impact to a number of protected species including bat species (Greater horseshoe of particular note), otters, badgers, reptiles and Atlantic Salmon.

5.5.17 The option crosses the western Cleddau Valley. The Western Cleddau River is designated as part of the Pembrokeshire Marine SAC and Milford Haven Waterways SSSI at this point. Approximately 900 m north-west of this, the Western Cleddau is designated as part of the Cleddau Rivers SAC and Western Cleddau River SSSI. The Pembrokeshire Coast National Park is located approximately 1 km to the southeast of the route (at its closest point). The national park also lies to the west of the route (approximately 500 m at its closest point).

5.5.18 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 6.3 km east of the northern section of the route. This site is a Great horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this sites designation. They are known to travel further than 6.3km from their roost sites and could be at risk from traffic collision and habitat severance.

5.5.19 Option 6 – Is also an off-line option located to the east of Haverfordwest It creates new severance of the open countryside and a number of habitats are likely to be affected with a large number of hedgerows severed. It is shorter in length than Option 5 and therefore the extent of habitat affected would be less. There would be potential impact to a number of protected species including bat species (Greater horseshoe of particular note), otters, badgers, reptiles and Atlantic Salmon.

5.5.20 The option crosses the western Cleddau Valley. The Western Cleddau River is designated as part of the Pembrokeshire Marine SAC and Milford Haven Waterways SSSI at this point. Approximately 900 m north-west of this, the Western Cleddau is designated as part of the Cleddau Rivers SAC and Western Cleddau River SSSI. The Pembrokeshire Coast National Park is located approximately 1 km to the southeast of the route (at its closest point). The national park also lies to the west of the route (approximately 500 m at its closest point).

5.5.21 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 6.3 km east of the northern section of the route. This site is a Greater horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this sites designation. They are known to travel further than 6.3km from their roost sites and could be at risk from traffic collision and habitat severance.

5.6 Heritage

Methodology for data gathering

5.6.1 A desk-based assessment was carried out to inform the appraisal. Data were sourced from the Dyfed Archaeological Trust (DAT) including data in the Historic Environment Record (HER) within 250 m of each option and the Milford Haven Waterway historic landscape. Data collated by the following organisations were also made available by DAT:

- Cadw (relating to the locations of listed buildings and scheduled ancient monuments);
- National Museum of Wales;
- The Royal Commission on the Ancient and Historical Monuments of Wales; and
- The Portable Antiques Scheme

5.6.2 The data were mapped in a GIS, summarised by option, type and location (i.e. beneath proposed route or adjacent to it) and then interpreted for the purposes of the appraisal.

5.6.3 Results of the desk-based assessment and are summarised in the 'Appraisal Summary Tables' (ASTs).

5.6.4 The baseline information is illustrated in the following series of figures (in volume 2), in combination with the various scheme options.

- 60706/016 - A40 Committed 2+1 - Heritage
- 60706/017 - A40 Maximum 2+1 - Heritage
- 60706/018 - A40 Dual carriageway - Heritage
- 60706/019 - Haverfordwest town centre (A, B & C) - Heritage
- 60706/020 - Haverfordwest SE Bypass – Heritage

- 60706/030 - Haverfordwest SE Bypass (Short) - Heritage

Potential effects of each option

5.6.5 Option 1 intersects with a prehistoric burnt mound and post-medieval lodge, both within the community of Llanddewi Velfrey. There are a further 57 historic artefacts, five listed buildings and eight ancient and historical monuments within 250 m of the proposed route.

5.6.6 Option 2 intersects with three historic artefacts; a burnt mound and lodge at Llanddewi Velfrey and a cottage at St. Clears. There are a further 157 historic artefacts, 10 listed buildings, 17 ancient and historical monuments, two National Museum of Wales sites and one scheduled ancient monument within 250 m of the proposed route. The proposed route runs along the boundary of the Milford Haven Waterway historic landscape designation between Canaston Bridge Roundabout and Slebech

5.6.7 Option 3 intersects with 35 historic artefacts distributed along the entirety of the proposed route, one listed building (a milepost near to Toch Farm) and one ancient and historical monument (a pillbox at Uzmaston). There are a further 243 historic artefacts, 13 listed buildings, 29 ancient and historical monuments, 2 National Museum of Wales sites and one scheduled ancient monument within 250 m of the proposed route. The proposed route runs along the boundary of the Milford Haven Waterway historic landscape designation between Canaston Bridge Roundabout and Slebech and intersects it on the final ~0.5 km at the western end.

5.6.8 Option 4 intersects with three historic artefacts (a bridge at Merlin's Bridge, a war memorial and a milepost) and two listed buildings (a war memorial and milepost). There are a further 108 historic artefacts, 56 listed buildings, 75 ancient and historical monuments and five portable antiques within 250 m of the proposals. All proposals are within the Milford Haven Waterway historic landscape designation.

5.6.9 Option 5 does not intersect with any known historic artefacts or listed buildings along the entirety of its proposed route. There are 25 historic artefacts, one listed building, four ancient and historical monuments and one scheduled ancient monument within 250 m of the proposed route. The proposed route intersects the Milford Haven Waterway historic landscape as its travels around the SE quadrant of Haverfordwest and over the River Cleddau. It leaves the designation before then re-entering it for a short distance to the west of Rosemarket. Its tie-in point at Sentry Cross Roundabout is on the boundary of the designation.

5.6.10 Option 6 is shorter in length than Option 5, joining the A4076 north of Johnston Data from the Dyfed Archaeological Trust has not been obtained for the 1.2km southern section of the route, where it ties in with the A4076.

5.6.11 Option 6 does not intersect with any known historic artefacts or listed buildings along the section common to Option 5. There are 11 historic artefacts, one listed building, four ancient and historical monuments and one scheduled ancient monument within 250 m of the proposed route common to Option 5. The proposed route intersects the Milford Haven Waterway historic landscape as its travels around the South-eastern quadrant of Haverfordwest and over the River Cleddau.

5.7 Water Environment

Types of Impacts on the Water Environment

5.7.1 The construction and operation of roads has the potential for pollution of the water environment above and below ground. This has the potential to contaminate drinking water and harm wildlife and their habitats. It can also have wider adverse effects should pollutants be carried through the water networks. The accidental release of pollutants such as hydrocarbons into watercourses and groundwater sources will need to be managed through design of appropriate pollution control measures for the road in the construction and operation phases. Construction Environmental Management Plans (CEMPs) will need to be developed for the construction phase and a maintenance regime established for the operation phase, e.g. maintenance of petrol interceptors, cleaning out of silt traps in drainage manholes and gullies.

5.7.2 The construction of new hard paved roads could have an impact on flooding if surface water runoff from the road is not captured and attenuated before being released into watercourses at the greenfield runoff rate. This is because the increase in the impermeable area of the road surface will result in water being discharged at a faster rate. Methods of storage of runoff need to be incorporated into the highway drainage design, such as large sized drainage pipes, storage tanks or attenuation ponds. Methods for capturing suspended solids, such as silt traps, need to be incorporated into the drainage design to reduce the risk of flooding from watercourses silting up. Opportunities for use of sustainable urban drainage systems (SUDS) in the new road construction, such as swales, should be investigated and agreed with the highway authority.

5.7.3 Flooding also needs to be mitigated by appropriate design of watercourse crossings to ensure adequate clearance over the watercourse to permit free flow.

5.7.4 A risk based approach is used to identify impacts on sensitive receptors. Sensitive receptors such as source protection zones and potable water sources have not been identified as part of this study. Protected water environment sites are identified in the Biodiversity section above.

5.7.5 While the Option 4 town centre improvements are different in nature to the larger scale new road construction of the other options, flooding and pollution mitigation measures need to be incorporated into the design of all the options and managed during the construction and operation phases. The scale (and cost) of this mitigation will generally be directly related to the scale of the improvements however special consideration needs to be given to watercourse crossings.

Potential effects of each option

5.7.6 Option 1 – The increase in hard paved area is the smallest compared to the new highway construction Options 2, 3 and 5. It also has the least watercourse crossings of these options.

5.7.7 Options 2 and 5 – The increase in hard paved area is similar in both these options, larger than Option 1 but smaller than Option 3. Option 2 will require a review and extension/reconstruction of some existing watercourse crossings. Option 5 is a new build scheme and so will require completely new watercourse crossings, the most significant is the crossing of the Western Cleddau River which has several environmental designations.

5.7.8 Option 3 – The dual carriageway scheme has the largest increase in paved area of all the options. It will require new and extended watercourse crossings along the 32.5km A40 route.

5.7.9 Option 4 – This option does not introduce a significant additional area of hard paved area as the works are proposed in an urban area. The crossing of river with Option 4A does not impact on the river directly and the potential for impact on water quality and flooding is less than the other options.

5.7.10 Option 6 – Option 6 is a new build scheme and so will require completely new watercourse crossings, the most significant is the crossing of the Western Cleddau River which has several environmental designations.

5.8 Soils

Methodology for data gathering

5.8.1 The scope of the study of the Soils assessment criteria includes a review of the amount of land take required to construct each option and a general assessment of the land classification i.e. whether it is urban or agricultural land affected. A detailed review of the Agricultural Land Classification (ALC) of the land affected was not judged to be required at this stage, nor was a geological assessment of the ground conditions along the improvement routes. The requirement for additional land take for Option 4 is the least of all the options.

Potential effects of each option

5.8.2 Option 1 – This scheme is 5.3km long with approximately 3.5km of offline new road. The amount of agricultural land take is the smallest compared to the new highway construction Options 2, 3, 5 and 6. Option 1 is considered to have a slight adverse impact.

5.8.3 Option 2 – The requirement for agricultural land take is larger than Option 1 but smaller than Options 3 and 5. The new sections of 2+1 carriageway are achieved by widening the existing A40 in discreet sections, plus introducing approximately 5.5km of new offline road. This is considered to have a slight adverse impact.

5.8.4 Option 3 – The 32.5km long dual carriageway scheme has the largest requirement for agricultural land take of all the options and is considered to have the greatest impact on land take.

5.8.5 Option 4 – This option will require a small amount of urban land take which will result in a slight reduction in the amount of green open space outside County Hall. This is not considered to be significant compared to the other options.

5.8.6 Option 5 – The requirement for agricultural land take is greater than for Options 1 and 2 but less than that required for the dual carriageway Option 3. This is a wholly offline option 9.2km long however so the potential for severance of land needs to be considered carefully. This is judged to have a moderate adverse impact.

5.8.7 Option 6 – This scheme is 4.8km long and is wholly offline. The amount of agricultural land take is similar to that of Options and is considered to have a slight adverse impact.

6 SOCIETY

6.1 Transport Safety

6.1.1.1 Collision data has been provided by SWTRA and Pembrokeshire County Council covering the period from 1st January 2009 to 31st December 2013. Analysis of the collision history has been undertaken to identify key statistics and trends from the data, such as collisions per year, collision severity, KSI's, collision type and conditions of collisions such as lighting and carriageway conditions at the time of the collision. These factors have been assessed for each section of the route.

6.1.1.2 As part of the analysis of the collision history, cluster sites or other areas of concerns have been highlighted. Cluster sites have been identified based on guidance published by the Welsh Government, which states a cluster site is where there are 4 or more injury collisions in a 3 year period within a 100m radius. Other areas of concern have been identified as being locations where numerous collisions have occurred in a relatively short distance from one another but do not fit under the Welsh Government's definition of a cluster site.

6.1.1.3 As a traffic model has not been commissioned which includes the A40 / A4076 route through the study area, or for the proposed bypass scheme, a quantitative assessment of the safety benefits has not been undertaken at this stage. Therefore the assessment of the impacts of the proposed scheme options in terms of safety has been assessed qualitatively.

6.1.1.4 Table 27 below outlines the accident summary statistics for the three A40 Options calculated from a COBALT analysis of the change in accident patterns. COBALT (COst and Benefit to Accidents – Light Touch) is a computer program developed by the DfT to undertake the analysis of the impact on accidents as part of economic appraisal for a road scheme.

	Option 1	Option 2	Option 3
Collisions Saved (compared to existing layout)	56.6	93.7	150.3

Note: Accident savings based on 60 year appraisal period.

Table 27: Number of Collisions saved with A40 Options

6.1.1.5 Table 27 demonstrates that Option 3 provides the greatest saving in terms of accidents accident saved, 150 over a 60 year period, as a result of the greatest length of carriageway upgraded to modern standards.

6.1.1.6 The current collision rate for Merlins Bridge roundabout (Option 4A) of 8 collisions in 5 years is below the COBALT default rate for the junction type, road classification and traffic flows at the junction. It is therefore unlikely that changes to the junction would significantly reduce collisions at the roundabout itself.

6.1.1.7 Whilst the proposed grade separated left turn lane would be expected to reduce rear end shunt collisions on the A4076 Freemens Way approach, the proposed signal junction to the south of the roundabout at which the proposed left turn lane will terminate has the potential for introducing collisions to the network, specifically rear end shunts on approach to the signals. It is therefore considered that overall Option 4A would have no impact on collisions at this location.

6.1.1.8 The current collision rate of 2 collisions in 5 years at Salutation roundabout (Option 4B) is below the COBALT default rate for the junction type, road classification and traffic flows at the junction. It is not likely that the changes to the junction will significantly impact on the low rate of collisions at that location. One collision occurred at the Pembrokeshire County Council (PCC) office access junction. The proposed signalisation of the PCC offices access junction may result in an increase in other types of collisions, such as rear end shunts on the approach to the signals.

6.1.1.9 The improvements to signal timings at the Picton Place signal junction are not expected to impact on the collision rate at this junction. Overall it is considered that the proposed scheme would not impact on the collisions at or in the vicinity of Salutation Roundabout.

6.1.1.10 Options 5 and 6 will remove a significant proportion of trips routing from Milford Haven and south of Haverfordwest to the A40 towards St. Clears and Camarthen. It is therefore expected that there would be a reduction in collisions at Merlins Bridge, Salutation and Scotchwell Roundabouts and on the A40 / A4046 route, as a result of the reduction in traffic flows. The assessment of collision history showed there were 23 collisions in the study area between Merlins Bridge and Scotchwell Roundabouts during the last 5 years.

6.1.1.11 Despite being designed to modern standards, the proposed bypass will inevitably introduce collisions along the new route and at the junctions at either end. The route will be designed to modern standards and will have fewer junctions along its route, and the number of collisions on the new road is expected to be less than for the equivalent journey via the existing route.

6.1.1.12 It is therefore considered that Options 5 and 6 will reduce collisions overall.

6.2 Personal security

6.2.1 The WelTAG term “personal security” is intended to mean “relative freedom from risk or fear of attack or robbery and extends to the transport user’s personal possessions, including bicycles. If the transport proposals under consideration are considered to affect personal security of users, this needs to be taken into account within the appraisal framework.” (extract from WelTAG, 2008).

6.2.2 The options do not involve a great amount of change to pedestrian or cycle routes, other than possibly some underpasses required to accommodate cycle routes on the Option 5. The impact of all the options on personal security is therefore assessed as neutral.

6.3 Permeability

Methodology for data gathering

6.3.1 A desk-based assessment was carried out. The locations of public rights of way (PRoW) were sourced from Pembrokeshire County Council, Pembrokeshire Coast National Park Authority and Carmarthenshire County Council. These were mapped in a GIS and then interpreted for the purposes of the appraisal.

6.3.2 Internal workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including permeability were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, WSP|Parsons

Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

6.3.3 Results of the desk-based assessment and are summarised in the 'Appraisal Summary Tables' (ASTs).

6.3.4 The baseline information is illustrated in the following series of figures (in volume 2), in combination with the various scheme options.

- 60706/021 - A40 Committed 2+1 - LDP & PRoW
- 60706/022 - A40 Maximum 2+1 - LDP & PRoW
- 60706/023 - A40 Dual carriageway - LDP & PRoW
- 60706/024 - Haverfordwest town centre (A, B & C) - LDP & PRoW
- 60706/025 - Haverfordwest SE Bypass - LDP & PRoW
- 60706/031 - Haverfordwest SE Bypass (Short) - LDP & PRoW

Potential effects of each option

6.3.5 Option 1 severs the following PRoW:

- SP19/38/1 south of Pen-Troydin-Fach
- SP19/1/1 north of Blaen-Pen-Troydin
- SP19/2/2 east of Blaen-Pen-Troydin
- SP19/3/2 east of Blaen-Pen-Troydin

A further 7 are indirectly affected.

6.3.6 The option bypasses Llanddewi Velfrey. This would reduce traffic flows through this community providing a benefit.

6.3.7 Option 2 severs the following PRoW:

- SP39/6/2 North-east of Slebech Church
- SP39/8/1 North-east of Slebech Church
- SP39/5/5 North-west of Wiston Junction
- SP19/38/1 south of Pen-Troydin-Fach
- SP19/1/1 north of Blaen-Pen-Troydin
- SP19/2/2 east of Blaen-Pen-Troydin
- SP19/3/2 east of Blaen-Pen-Troydin
- 66/3/1 east of north road
- 18/1A/1 Pont Y Fenni

A further 13 are indirectly affected.

6.3.8 The option bypasses Llanddewi Velfrey and Slebech. This will reduce traffic flows through these communities providing a benefit.

6.3.9 Option 3 severs the following PRoW:

- SP39/6/2 North-east of Slebech Church
- SP39/8/1 North-east of Slebech Church
- SP39/5/5 North-west of Wiston Junction
- SP19/38/1 south of Pen-Troydin-Fach

- SP19/1/1 north of Blaen-Pen-Troydin
- SP19/2/2 east of Blaen-Pen-Troydin
- SP19/3/2 east of Blaen-Pen-Troydin
- 66/3/1 east of north road
- 18/1A/1 Pont Y Fenni

A further 22 are indirectly affected.

6.3.10 The option bypasses Llanddewi Velfrey and Slebech. This will reduce traffic flows through these communities providing a benefit.

6.3.11 Option 4 does not sever any PRoW, however the Merlin's Bridge Flyover and Roundabout element may have some minor impact on the following:

- PP28/1/4
- PP25/1/6
- PP25/1/5

6.3.12 There are no impacts (beneficial or adverse) in terms of community severance.

6.3.13 Option 5 severs the following PRoW:

- PP96/3/1 eastern side of Western Cleddau
- PP96/2/2 eastern side of Western Cleddau
- PP25/7/1 western side of Western Cleddau
- PP25/8/1 south-east of Merlin's Bridge
- PP21/5/1 (shown red) east of A4076 Dredgman Hill
- PP21/4/2 east of A4076 Dredgman Hill
- PP21/1/1 north of Langford Road, Johnston
- PP81/22 approx. 1km north of proposed A477 roundabout

6.3.14 The option bypasses Haverfordwest and Johnston. This will reduce traffic flows through these communities providing a benefit.

6.3.15 Option 6 – severs the following PRoW:

- PP96/3/1 eastern side of Western Cleddau
- PP96/2/2 eastern side of Western Cleddau
- PP25/7/1 western side of Western Cleddau
- PP25/8/1 south-east of Merlin's Bridge

6.3.16 The option bypasses Haverfordwest. This will reduce traffic flows through these communities providing a benefit.

6.4 Physical fitness

Methodology for data gathering

6.4.1 Internal workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including physical fitness were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, WSP|Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and

engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

6.4.2 Option 1 – No NMU facilities are proposed as part of the option. Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may however be some limited local benefits where traffic is removed through Llanddewi Velfrey.

6.4.3 Option 2 - No NMU facilities are proposed as part of the option. Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may however be some limited local benefits where traffic is removed through Llanddewi Velfrey and Slebech.

6.4.4 Option 3 - No NMU facilities are proposed as part of the option. Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may however be some limited local benefits where traffic is removed through Llanddewi Velfrey and Slebech.

6.4.5 Option 4 - No NMU facilities are proposed as part of the option. Travel by active modes is not expected to significantly increase or decrease as a result of the option.

6.4.6 Option 5 – No NMU facilities are proposed as part of the option. Removal of traffic from the existing A4076 may help facilitate traffic by active modes.

6.4.7 Option 6 – No NMU facilities are proposed as part of the option. Removal of traffic from the existing A4076 may help facilitate traffic by active modes.

6.5 Social inclusion

Methodology for data gathering

6.5.1 Internal workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including social inclusion were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, WSP|Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

6.5.2 Option 1 – The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from improvements to the A40 trunk road.

6.5.3 Option 2 – The option may provide a moderate benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from improvements to the A40 trunk road.

6.5.4 Option 3 – The option may provide a moderate benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from improvements to the A40 trunk road.

6.5.5 Option 4 – The option is likely to have a neutral effect in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.

6.5.6 Option 5 – The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from bypassing the A4076 which suffers from traffic congestion.

6.5.7 Option 6 – The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from bypassing the A4076 which suffers from traffic congestion.

6.6 Equality, diversity and human rights

Methodology for data gathering

6.6.1 Internal workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including equality, diversity and human rights were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, WSP|Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

6.6.2 All six options are likely to have a neutral effect in terms of the WelTAG equality impact groups[1] and unlikely to be relevant in terms of human rights legislation.

[1] WelTAG equality impact groups include: race ethnicity, colour or nationality; sex or marital status; disability (physical, sensory or mental); age; religion or belief; sexual orientation; Welsh language; other – lone parent, economic inactivity, social and multiple deprivation (extract from WelTAG, 2008).

7 STAKEHOLDER ENGAGEMENT

7.1 Scope of Stakeholder Engagement

7.1.1 Various documents and studies have been reviewed to understand the transport problems being experienced on the A40 between St. Clears and Haverfordwest, in Haverfordwest and south towards The Haven, plus the solutions to address them. This includes the Pembrokeshire County Council TRA40 Briefing Paper St. Clears to Haverfordwest review, 21 August 2014 and the Capita Symonds - Haverfordwest South Eastern Bypass Pre-feasibility Study July 2009.

7.1.2 Discussions between the project team and the South Wales Trunk Road Agent (SWTRA) have resulted in the inclusion of the Option 5 Haverfordwest South Eastern Bypass A40 Golf Course to A477 Sentry Cross Improvement in this study, together with Options 4 and 6 for comparison purposes to investigate improved access from the A40 south of Haverfordwest. SWTRA favour a bypass of Johnston as it is known as a traffic bottleneck and there are concerns congestion will be exacerbated in future years.

7.1.3 To understand the impact of the schemes on land planning, Pembrokeshire County Council's and Pembrokeshire Coast National Park Authority's local development plans (LDPs) have been reviewed. This is discussed in the following section.

7.2 Local Development Plans

Methodology for data gathering

7.2.1 The spatial data accompanying Pembrokeshire County Council's and Pembrokeshire Coast National Park Authority's LDPS were sourced. The data were mapped in a GIS, summarised by option and then interpreted for the purposes of developing the ASTs.

7.2.2 The baseline information is illustrated in the following series of figures (in Volume 2) in combination with the various scheme options.

- 60706/021 - A40 Committed 2+1 - LDP & PRoW
- 60706/022 - A40 Maximum 2+1 - LDP & PRoW
- 60706/023 - A40 Dual carriageway - LDP & PRoW
- 60706/024 - Haverfordwest town centre (A, B & C) - LDP & PRoW
- 60706/025 - Haverfordwest SE Bypass - LDP & PRoW
- 60706/031 - Haverfordwest SE Bypass (Short) - LDP & PRoW
- 60706/026 - LDP legend

Potential effects of each option

7.2.3 Option 1 - there are no impacts to land allocated for housing, employment, green wedge or open space under Pembrokeshire LDP or Pembrokeshire Coast National Park Authority LDP. The proposed route intersects with some mineral resources which are mainly Limestone with some sand and gravel deposits.

7.2.4 Option 2 - there are no impacts to land allocated for housing, employment, green wedge or open space under Pembrokeshire LDP or Pembrokeshire Coast National Park Authority LDP. The proposed route intersects with some mineral resources which are mainly Limestone with some sand and gravel deposits.

7.2.5 Option 3 - there are no impacts to land allocated for housing, employment, green wedge or open space under Pembrokeshire LDP or Pembrokeshire Coast National Park Authority LDP. The proposed route intersects with some mineral resources which are mainly Limestone with some sand and gravel deposits.

7.2.6 Option 4 – There are no impacts to land allocated for housing, employment, green wedge or open space under Pembrokeshire LDP. One of the proposed new roundabout alignments encroaches slightly onto a retail allocation (RT/04/01).

7.2.7 Option 5 - the northern section of the proposed route would affect a site designated under the Pembrokeshire County Council's LDP as ‘New and Existing Employment Sites’ (ref: 040/00034 / name: The Yard, Creamston Road, Haverfordwest / area: 0.41 ha).

7.2.8 Option 6 - the northern section of the proposed route would affect a site designated under the Pembrokeshire County Council's LDP as ‘New and Existing Employment Sites’ (ref: 040/00034 / name: The Yard, Creamston Road, Haverfordwest / area: 0.41 ha).

8 WELTAG APPRAISAL

8.1 Appraisal Methodology

8.1.1 Whilst a discipline approach to option appraisal may serve to highlight specific issues, it risks not considering impacts that might be evidenced from a structured more holistic approach. WelTAG provides an established template for comparing disparate issues and it was resolved that option appraisal should follow the WelTAG approach. This process is based on the WelTAG Appraisal Summary Table (AST) covering the defined Welsh impact areas of Economy, Environment and Society and sub-indicators and the problem-specific Transport Planning Objectives (TPOs).

8.1.2 The option text presented in this report highlights the key features and impacts of each option providing a narrative alongside the AST summary table which summarises the option assessment.

8.1.3 As discussed in Section 1, the WelTAG appraisal undertaken for this phase of the study is a high level WelTAG planning Stage 1 appraisal appropriate to this phase of this study. The impact areas and TPOs have been assessed using both quantitative and qualitative assessment methods.

8.1.4 The AST information from the Capita Symonds Haverfordwest South Eastern Bypass Pre-feasibility Study report of July 2009 has been used to inform the ASTs for the Merlin's Bridge Flyover Option 4A (Option 5 in the Capita report) and the A40 Golf Course to A477 Sentry Cross Option 5 (Option 3 in the Capita report). The scoring has been revisited to reflect the study area for this report and the TPOs developed for this study.

8.2 WelTAG Workshop

8.2.1 WelTAG workshops were held on the 11th March and 14th April 2015 to discuss the options and complete draft ASTs. The workshop was attended by project team members from the Welsh Government, Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

8.2.2 Following the formalising of options initial ASTs, including draft impact text and significance criteria, were developed at the WelTAG workshops. Later these initial ASTs were amended and refined by discipline leaders informed by subsequent investigation and analysis into the option ASTs presented in Appendix C.

8.3 Transport Planning Objectives (TPOs)

8.3.1 WelTAG requires practitioners to adopt an objective-led approach. Problems and opportunities need to be identified and what is to be achieved needs to be defined with the ultimate outcomes expressed as TPOs. This approach is used rather than focusing on the means to achieve the outcomes i.e. the projects or schemes themselves.

8.3.2 A technical note has been prepared to explain the development of the TPOs for this A40 St. Clears to Haverfordwest Study. This is included in Appendix B. These draft TPOs were used in the WelTAG workshop and have been incorporated into the ASTs and this report.

8.4 Appraisal Summary Tables (ASTs)

8.4.1 The ASTs incorporate the appraisal criteria sub-indicators of Economy, Environment and Society and the TPOs. A summary of "Other Issues" was also incorporated into the ASTs, in line with the format used in the Capita Symonds Haverfordwest South Eastern Bypass Pre-Feasibility Report; however these are more for information and have not been allocated a significance score.

8.4.2 The AST for Option 5 was based on the AST in the Capita Symonds Haverfordwest South Eastern Bypass Pre-Feasibility Report for their Option 3: A40 Golf Course to A477 Sentry Cross.

8.4.3 The results of the assessment of the impact significance in the ASTs is summarised using the following seven-point scale:

- Large beneficial (+++)
- Moderate beneficial (++)
- Slight beneficial (+)
- Neutral (0)
- Slight adverse (-)
- Moderate adverse (- -)
- Large adverse (- - -)

8.4.4 A largely qualitative approach to assessing the impact significance in the ASTs has been used at this stage; however some quantitative assessment has been included.

8.4.5 The impact of each option has been assessed against the context of the existing unimproved study corridor from the A40 St. Clears to Haverfordwest, through Haverfordwest on the A40 and A4076, then south on the A4076 through Johnston to end at Steynton. This is considered the "Do-nothing Option" which only allows for routine maintenance of the existing roads. For example, Option 4 Haverfordwest Town Centre Traffic Proposals has been allocated a neutral score (0) for the "Aid regeneration & support regional economy" TPO compared to the Moderate Beneficial score (++) for Option 3 Dual Carriageway due to the localised and smaller scale nature of the improvement.

8.4.6 The AST for Option 4C Traffic Management Opportunities cannot be scored at this stage as the work involves further study to identify the scope of the improvement. The ASTs for Option 4A Merlin's Bridge Flyover and Option 4B Salutation Square Roundabout have been scored separately. The AST for Option 4 Haverfordwest Town Centre Traffic Proposals has been scored to reflect the impact of implementing Options 4A and 4B together.

8.4.7 Table 28 below summarises the impact significance against the appraisal criteria for each option.

Appraisal Criteria	Option 1	Option 2	Option 3	Option 4*	Option 4A	Option 4B	Option 4C	Option 5	Option 6
Economy									
Transport Economic Efficiency -TEE	+	+ +	- -	-	-	-		+ +	+ +
Wider Economic Impacts - EALI[#]	0	+	+ +	0	0	0		+ +	+ +
Environment									
Noise	+	+	0	0	0	0		0	0
Local Air Quality	+	+	0	0	0	0		0	0
Greenhouse Gas Emissions	+	+	+	0	0	0		+	+
Landscape and Townscape	-	-	- -	-	-	0		- - -	- -
Bio-diversity	-	- -	- -	0	0	0		- - -	- -
Heritage	-	- -	- - -	- -	- -	-	Requires	- -	- -
Water Environment	+	+	+	0	0	0		- -	- -
Soils	-	-	- - -	0	0	0	further	- -	-
Society									
Transport Safety	+	+ +	+ + +	0	0	0	study to	+ +	+ +
Personal security	0	0	0	0	0	0		0	0
Permeability	+	+	+	0	0	0	populate	+ +	+
Physical Fitness	0	0	0	0	0	0		+	+
Social Inclusion	+	+ +	+ +	0	0	0	AST	+	+
Equality, Diversity & Human Rights	0	0	0	0	0	0		0	0
Transport Planning Objectives									
Improve journey time and reliability	+	+ +	+ + +	0	0	0		+ +	+ +
Enhance network resilience	+	+ +	+ +	0	0	0		+	+
Aid regeneration & support regional economy	0	+	+ +	0	0	0		+ +	+ +
Avoid adverse environmental impact	-	- -	- -	+ +	+ +	+ +		- -	- -
Provide environmental benefit	0	+	+	0	0	0		+	+
Reduce personal injury accidents	+	+ +	+ + +	0	0	0		+ +	+ +
Improve permeability and opportunities for active travel	+	+	+	0	0	0		+ +	+ +

Notes * Option 4 is based on implementing both Options 4A and 4B
[#] Summary EALI based on impacts identified by separate Peter Brett Associates study into the economic performance of South West Wales

Table 28: Collation of Appraisal Summary Table Significance scoring

9 WELTAG ASSESSMENT SUMMARY

9.1 Option 1 - Single Carriageway Committed Schemes

9.1.1 This option improves 5.3km (16%) of the 32.5km long A40 between St. Clears and Haverfordwest at Llanddewi Velfrey and Redstone Cross. The Llanddewi Velfrey section provides approximately 4km of new 2+1 standard single carriageway whilst the Redstone Cross Improvement is normal 7.3m wide single carriageway. Option 1 has an estimated cost of £56.8M.

9.1.2 Option 1 partly addresses one of the key problems experienced on the A40 which is journey time and reliability. Journey time savings of Option 1 are estimated to be up to a maximum of 27 seconds over the calculated existing journey time of 21.67 minutes (over the 32.5 km A40 route) using current traffic flows. The localised nature of the schemes result in quite a low improvement in journey time reliability and most of the benefit is achieved through the higher speed limit on the new road alignment (60mph) when compared to the existing road speed limit (30-50mph). The new sections of 2+1 carriageway increases the overall overtaking provision of the A40 length of the study corridor from approximately 13% to 17%. This results in a slight beneficial impact for the WelTAG Transport Economic Efficiency appraisal sub-criteria. Due to the localised nature of the works the impact on the Wider Economic Impacts sub-criteria is considered neutral.

9.1.3 Option 1 results in slight beneficial and slight adverse impacts on the WelTAG Environment appraisal criteria. The slight beneficial impacts are expected in the Noise, Air Quality, Greenhouse Gases and Water sub-criteria. The slight adverse impacts are expected in the Landscape and Townscape, Bio-diversity, Heritage and Soils (land take) sub criteria. A direct impact has been identified on two heritage sites in Llanddewi Velfrey.

9.1.4 The impacts of Option 1 on the WelTAG Society appraisal criteria are generally neutral to slight beneficial. The slight beneficial impacts are from Transport Safety (57 collision savings over 60 years), Permeability and Social Inclusion.

9.1.5 The above slight beneficial to slight adverse range of impacts is reflected in the performance against the TPOs. These include a slight beneficial impact on the Journey Time and Reliability, Enhance Network Resilience, Reduce Accidents and Improve Permeability/Active Travel TPOs. Option 1 attracts a slight adverse score against the Avoid Adverse Environmental Impact TPO and a neutral impact on the Provide Environmental Benefit TPO. The Aid Regeneration & Support Regional Economy TPO is considered neutral.

9.1.6 Overall Option 1 can be considered to have a slight beneficial performance against the appraisal criteria.

9.2 Option 2 – Single Carriageway Maximum 2+1

9.2.1 Option 2 improves 12.9km (40%) of the 32.5km long A40 between St. Clears and Haverfordwest with a 2+1 standard carriageway. The estimated cost of Option 2 is £98.6m.

9.2.2 The journey time savings of Option 2 have been estimated to be up to a maximum of 93 seconds (1.6 minutes) over the calculated existing journey time of 21.67 minutes (over the 32.5 km A40 route). The limitations of the assessment show that the main journey time saving will be achieved through the implementation of the Llanddewi

Velfrey and Redstone Cross Improvements, due to the change in alignment and increase in speed limit as with Option 1 (approximately 70 seconds). In this assessment, the benefits that Option 2 provides over Option 1 are reflected in the improved journey time reliability (up to approximately 23 seconds) associated with improved overtaking provision of the additional sections of 2+1 carriageway. In reality, additional journey time savings will be expected with Option 2 from a better free flow of traffic due to the improvement to the road standard and the reductions in the number of junctions and turning movement delays. Whilst the journey time reliability assessment can be considered robust, only a very basic assessment of the journey time savings associated with the improved road alignment has been possible within the time and budget constraints of the study. The new sections of 2+1 carriageway increases the overall overtaking provision of the A40 length of the study corridor from approximately 13% to 33%. This will reduce driver frustration, particularly on longer journeys. Additionally, the extra lane that the sections of 2+1 carriageway introduce in Option 2 will improve capacity of the A40 in the summer months. Option 2 has been allocated a moderate beneficial impact score against the WelTAG Transport Economic Efficiency appraisal criteria. The scoring of the Wider Economic Impacts sub-criteria is considered slight beneficial.

9.2.3 Option 2 results in a range of slight beneficial to moderate adverse impacts on the WelTAG Environment appraisal criteria. The slight beneficial impacts are expected in the Noise, Air Quality, Greenhouse Gases and Water sub-criteria. The slight adverse impacts are expected in the Landscape and Townscape and Soils (land take) sub criteria. Due to the larger scale of the improvement over Option 1, and the closer proximity to Slebech Stable Yard Loft and Cellars SSSI, the impact on Bio-diversity sub-criteria is slightly greater and a moderate adverse score has been allocated. The Heritage sub-criteria has been scored a moderate adverse impact as Option 2 impacts directly on three heritage sites and partly adjoins the boundary of the Milford Haven Waterway historic landscape designation.

9.2.4 The impacts of Option 2 on the WelTAG Society appraisal criteria are generally neutral to moderate beneficial. The moderate beneficial impacts are from Transport Safety (94 collision savings over 60 years) and Social Inclusion with a slight beneficial impact on Permeability. This is an improvement on the Option 1 scores.

9.2.5 Option 2 performs well against the TPOs and better than Option 1. A moderate beneficial impact has been allocated to the Journey Time and Reliability, Enhance Network Resilience and Reduce Accidents TPOs. The Improve Permeability/Active Travel and Aid Regeneration & Support Regional Economy TPOs have been scored slight beneficial. Option 2 attracts a moderate adverse score against the Avoid Adverse Environmental Impact TPO but is considered to score better against the Provide Environmental Benefit TPO than the committed scheme Option 1 and has been allocated a slight beneficial score.

9.2.6 Option 2 performs better against the appraisal criteria than Option 1 and attracts more moderate beneficial scores than moderate adverse scores. The moderate adverse scores occur in the Bio-diversity and Heritage criteria and the Avoid Environmental Impact TPO only. It is considered that the environmental impacts can be mitigated to achieve a scheme which performs positively overall.

9.3 Option 3 – Dual Carriageway

9.3.1 Option 3 improves 31.4km (97%) of the 32.5km long A40 between St. Clears and Haverfordwest with a dual 2 lane carriageway. The estimated cost of Option 3 is

£336.3M (excluding VAT, Land, compensation and work to Statutory Undertaker apparatus).

9.3.2 Option 3 results in the greatest journey time savings of all the options due to the increased speed of 70mph and the 100% overtaking opportunity on the improved sections in both directions. The journey time savings are estimated to be up to a maximum of 666 seconds over the calculated existing journey time of 21.67 minutes over the 32.5 km A40 route. This will reduce driver frustration over the existing situation, particularly on longer journeys. Whilst these appear significant improvements, overall the scheme is considered to demonstrate poor value for money in transport economics terms when the significant capital costs are weighed against the fact that the traffic flows are insufficient to warrant the extra capacity. Option 3 has therefore been allocated a moderate adverse impact score against the WelTAG Transport Economic Efficiency appraisal criteria. The scoring of the Wider Economic Impacts sub-criteria is considered moderate beneficial.

9.3.3 Option 3 generally performs poorly against the WelTAG Environment appraisal criteria with a range of slight beneficial to large adverse scores. The slight beneficial impacts are expected in the Greenhouse Gases and Water sub-criteria with neutral impacts expected in the Noise and Air Quality sub-criteria. Moderate adverse impacts are expected in the Landscape and Townscape and Bio-diversity sub criteria with the scheme potentially impacting on 4 protected sites and the Pembrokeshire Coast National Park. The Heritage sub-criteria has been scored a large adverse impact as Option 3 impacts directly on thirty five heritage sites and enters the Milford Haven Waterway historic landscape designation. The Soils sub-criteria has been scored as a large adverse impact due to the significant agricultural land take associated with the scheme.

9.3.4 The impacts of Option 3 on the WelTAG Society appraisal criteria range from neutral to large beneficial. Transport Safety is considered to attract a large beneficial score (150 collision savings over 60 years). Social Inclusion has been scored moderate beneficial with a slight beneficial impact on Permeability. This is a slight improvement on the Option 2 scores in transport safety terms.

9.3.5 Option 3 performs the best against the TPOs of all of the options with large beneficial scores against the Journey Time and Reliability and Reduce Accidents TPOs. The remaining scores are similar to Option 2 except for the Aid Regeneration & Support Regional Economy TPO which has been allocated a moderate beneficial score, which is a higher score than the slight beneficial score of Option 2.

9.3.6 Option 3 has varied performance against the appraisal criteria with the best (large beneficial) scores for the transport safety and improved journey time and reliability related criteria but also some of the worst (large adverse) scores for Heritage and Soils criteria. The negative impact scores are mainly environment related however the significant weakness of Option 3 is the significant capital cost and poor value for money associated with the business case for dualling. Whist the environmental impacts could be mitigated, it is difficult to justify the promotion of Option 3 when the traffic capacity issue can be addressed, particularly in the short term, with the cheaper 2+1 options.

9.4 Option 4 - Haverfordwest Town Centre Proposals

9.4.1 Option 4 is a package of traffic management measures within Haverfordwest which have an estimated cost of £12.9m. These include revised junction arrangements at the A4076 Merlin's Bridge Roundabout (Option 4A) and the A40/A4076 Salutation

Square Roundabout (Option 4B) plus a Traffic Management Opportunities scheme (Option 4C). Option 4C is the reprioritisation of the town centre one way system and a study into roundabout performance and traffic signal optimisation. As Option 4C requires further detailed study outside the scope of the current study, it has not been possible to undertake a detailed WelTAG appraisal of this part of the Option 4 proposal.

9.4.2 The WelTAG assessment of Option 4 therefore comprises scores for Options 4A and 4B. The AST scores are generally neutral with slight/moderate negative scores against the Transport Economic Efficiency, Landscape and Townscape and Heritage appraisal sub-criteria. Option 4 has been allocated a moderate adverse impact against the Avoid Adverse Environmental Impact sub-criteria which reflects the small scale and impact of the schemes.

9.4.3 The study of the potential journey time savings of implementing both Options 4A and 4B has demonstrated that benefits may be achieved in either the eastbound or the westbound direction in each option but delays (disbenefits) are seen in the opposite direction due to the change in traffic patterns introduced by the schemes. The journey time is calculated between the A40 Scotchwell Roundabout to a point just to the south-east of the A4076 Merlins Bridge Roundabout. Whilst overall this produced a net benefit to journey time and reliability of 20 seconds, this is not considered sufficient justification for the £12.9M cost of these two schemes. This is the reason for the slight negative score against the Transport Economic Efficiency appraisal sub-criteria. The small scale of the works compared to the study corridor results in a neutral score of the Wider Economic Impacts sub-criteria.

9.4.4 Overall Option 4 performs slightly negatively against the appraisal criteria in this study.

9.5 Option 5 - Haverfordwest SE Bypass – A40 Golf Club to A477 Sentry Cross

9.5.1 Option 5 provides 9.2km of new offline single carriageway between the Haverfordwest Golf Course on the A40 to the east of Haverfordwest to the A477 Sentry Cross Roundabout to the south. There is no 2+1 provision with this option. The estimated cost of Option 5 is £50.3m.

9.5.2 Option 5 has estimated journey time savings of up to a maximum of 162 seconds (2.7 minutes) over the 11.95 km route between the A40 Haverfordwest Golf Course and the A4076 at Steynton. This length of A40/A4076 has been chosen to provide a suitable comparison with the shorter Option 6 route. The journey time to travel the existing unimproved route has been calculated at 8.86 minutes assuming free flow traffic travelling at the speed limit. The scheme bypasses the urban congestion of both Haverfordwest and Johnston with a new rural carriageway to current design standards with limited junctions and these benefits are reflected in the improved journey time. The Transport Economic Efficiency and Wider Economic Impacts appraisal sub-criteria have both been allocated moderate beneficial scores to reflect the improved access from the A40 south of Haverfordwest to the Haven that Option 6 offers.

9.5.3 Option 5 generally performs poorly against the WelTAG Environment appraisal criteria with a range of slight beneficial to large adverse scores. The slight beneficial impact is expected in the Greenhouse Gases appraisal sub-criteria with neutral impacts expected in the Noise and Air Quality sub-criteria. Large adverse impacts are expected in the Landscape and Townscape and Bio-diversity sub criteria with the scheme impacting on 4 protected sites and potentially the Pembrokeshire Coast

National Park. Option 5 will introduce a new 350km long bridge across the Western Cleddau valley which has an Outstanding LandMap Visual and Sensory evaluation. The Heritage sub-criteria has been scored a moderate adverse impact. It does not directly intersect any known historic artefacts or listed buildings but it does cross the Milford Haven Waterway historic landscape designation. The Soils sub-criteria has been scored a moderate adverse impact due to the significant agricultural land take associated with the scheme. The Water sub-criteria has been scored a moderate adverse impact due to the new bridge crossing of the Western Cleddau River to potentially impact on water quality, hydrology and flooding.

9.5.4 The impacts of Option 5 on the WelTAG Society appraisal criteria range from neutral to moderate beneficial. Transport Safety is considered to attract a moderate beneficial score as it is expected there would be a reduction in accidents in Haverfordwest and on the A40/A4076 route where traffic flows reduce in favour of the new road. Physical Fitness and Social Inclusion sub-criteria has been scored slight beneficial.

9.5.5 Option 5 performs well against the TPOs mostly moderate beneficial scores. against the Journey Time and Reliability and Reduce Accidents TPOs. Only a slight beneficial score has been allocated against the Enhance Network Resilience TPO as although Option 5 is beneficial in providing an alternative route, there are additional maintenance costs associated with this. The Provide Environmental Benefit TPO attracts a slight beneficial score but the Avoid Adverse Environmental Impact has been scored as moderate adverse overall.

9.5.6 Overall, Option 5 performs well against the Economy, Society and TPO appraisal criteria but generally attracts negative scores against the Environment criteria.

9.6 Option 6 – Haverfordwest SE Bypass - A40 Golf Club to A4076

9.6.1 Option 6 provides 4.8km of new offline single carriageway between the Haverfordwest Golf Course on the A40 to the east of Haverfordwest and joins back on to the A4076 at Dredgeman Hill to the south east of Haverfordwest. There is no 2+1 provision with this option. The estimated cost of Option 6 is £34.6m.

9.6.2 Option 6 has estimated journey time savings of up to a maximum of 80 seconds (1.3 minutes) over the 11.95 km route between the A40 Haverfordwest Golf Course and the A4076 at Steynton. The journey time to travel the existing unimproved route has been calculated at 8.86 minutes assuming free flow traffic travelling at the speed limit. The scheme bypasses the urban congestion of Haverfordwest with a new rural carriageway to current design standards with limited junctions and these benefits are reflected in the improved journey time. The Transport Economic Efficiency and Wider Economic Impacts appraisal sub-criteria have both been allocated moderate beneficial scores accordingly.

9.6.3 Option 6 generally performs poorly against the WelTAG Environment appraisal criteria with a range of slight beneficial to moderate adverse scores. The slight beneficial impact is expected in the Greenhouse Gases appraisal sub-criteria with neutral impacts expected in the Noise and Air Quality sub-criteria. Moderate adverse impacts are expected in the Landscape and Townscape and Bio-diversity sub criteria with the scheme impacting on 4 protected sites and potentially the Pembrokeshire Coast National Park. As with the longer Option 5, Option 6 will introduce a new 350km long bridge across the Western Cleddau valley which has an Outstanding LandMap Visual and Sensory evaluation. The Heritage sub-criteria has been scored a moderate adverse impact. It does not directly intersect any known historic artefacts

or listed buildings but it does cross the Milford Haven Waterway historic landscape designation, but to a slightly lesser extent than Option 5. The Water sub-criteria has been scored a moderate adverse impact due to the new bridge crossing of the Western Cleddau River to potentially impact on water quality, hydrology and flooding. The Soils sub-criteria has been scored a slight adverse impact due to the moderate amount of agricultural land take associated with the scheme.

9.6.4 The impacts of Option 6 on the WelTAG Society appraisal criteria range from neutral to moderate beneficial. Transport Safety is considered to attract a moderate beneficial score as it is expected there would be a reduction in accidents in Haverfordwest and on the A40/A4076 route where traffic flows reduce in favour of the new road. Permeability, Physical Fitness and Social Inclusion sub-criteria has been scored slight beneficial.

9.6.5 Option 6 performs well against the TPOs mostly moderate beneficial scores and a similar scores to Option 5. Only a slight beneficial score has been allocated against the Enhance Network Resilience TPO as although Option 6 is beneficial in providing an alternative route, there are additional maintenance costs associated with this. The Provide Environmental Benefit TPO attracts a slight beneficial score but the Avoid Adverse Environmental Impact has been scored as moderate adverse overall.

9.6.6 Overall, Option 6 performs well against the Economy, Society and TPO appraisal criteria but generally attracts negative scores against the Environment criteria.

10 DISCUSSION

10.1 Sectional Improvement of Option 2

10.1.1 This study suggests there is merit in further investigation of the Option 2 - Maximum 2+1 improvement. Although a rigorous assessment of a phasing strategy is beyond the scope and programme of this study, Option 2 is in essence a collection of improvement schemes that might be implemented independently.

10.1.2 Phased implementation of Option 2 would depend on the key project driver, for example; budget, programme, social, traffic performance or safety. Each key driver is likely to benefit from a particular phasing strategy guided by the performance metrics of the individual improvement schemes. The following text is intended to draw out some of these performance metrics and where they might suggest a particular phasing strategy.

10.1.3 The Llanddewi Velfrey sub-section 2C performs the best in terms of journey time benefits, largely due to the increase in speed limit of the new alignment, compared to the current 40mph limit through the village but with limited journey time reliability improvements. However these benefits need to be offset against the higher capital cost and statutory process factors inherent in an off-line improvement. On-line improvement sections such as sub-sections 2G Whitland Bypass and 2H Redstone Cross to Haverfordwest offer better affordability than the more expensive and ecologically disruptive off-line improvements and would in all probability be quicker to implement due to the only moderate change in highway corridor.

10.1.4 The off-line Option 2I Slebech Bypass improvement presents similar implementation issues to Llanddewi Velfrey with the added problem that it is not as advanced in the current improvement programme. Sub-section 2G Whitland Bypass shows a slightly better performance in reducing accidents than 2H Redstone Cross to Haverfordwest online Improvements. It is noted that the 2I Slebech Bypass improvement shows the best performance of all of the 2+1 sections in the journey time reliability element of the journey time savings assessment. Sub-sections 2G and 2H have similar journey time reliability performance

10.1.5 Notwithstanding the above it should be noted that WS2+1 standard TD 70/08 advises that the implementation of a WS2+1 should be viewed in the context of the overall route strategy. This would mitigate against phased implementation of Option 2 however in practice such a policy would progressively improve upon the current mix of single carriageway, climbing lanes, overtaking opportunity and full WS2+1 towards the desired route consistency objective.

10.1.6 While current and projected future traffic flows for the short and medium term make it difficult to establish a robust business case in transport terms for dualling now. The A40 traffic should be revisited periodically to monitor the traffic patterns and any future justification for dualling.

10.2 Conclusions

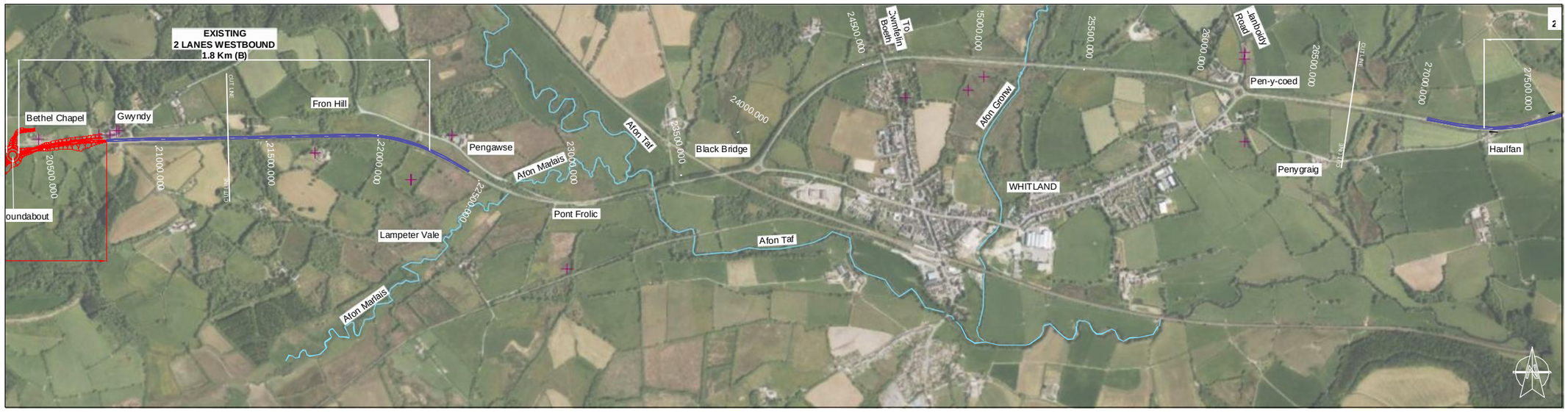
10.2.1 This study supports the progression of Option 1, the Llanddewi Velfrey to Penblewin Improvement in line with the current Welsh Government programme of works. The study shows the Option 1 committed schemes are the best performing sections of Option 2 based on current traffic flows. These off-line improvements are subject to statutory process and if programme critical the on-line improvements in developed corridors such as Whitland bypass offer an opportunity to realise early benefits. Less

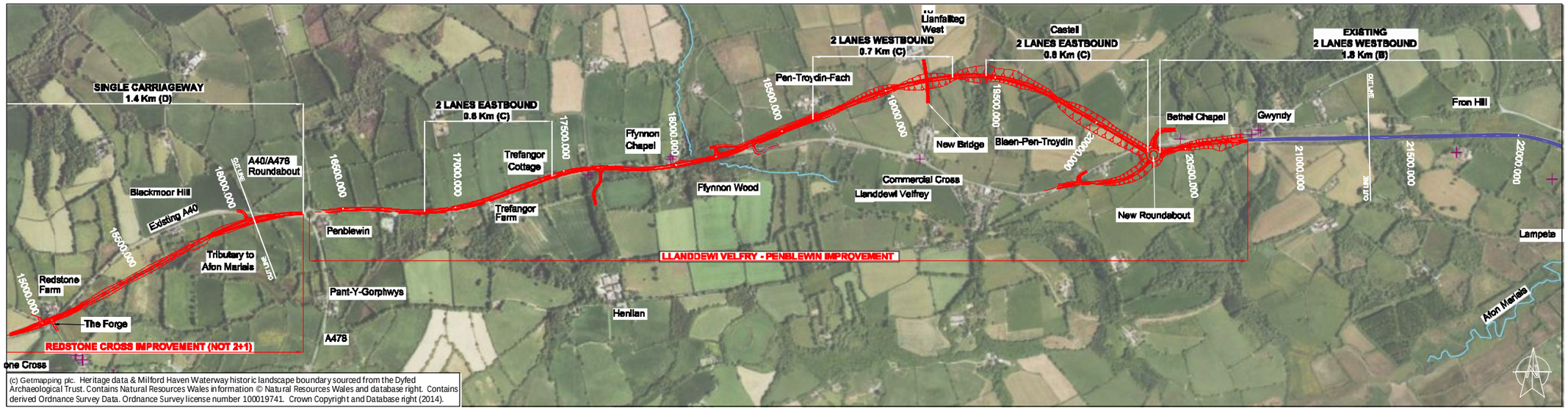
developed on-line corridors, would also realise journey time and accident savings but at risk of increased programme delay from constraints.

10.2.2 The study suggests that in the short and medium term improvement of the A40 to maximum 2+1 standard, proposed in Option 2, could provide better value for money than the dualling Option 3. This also provides an on-going route strategy for the A40 until such time as dualling may be seen to give positive returns in the longer term. A significant amount of assessment work has been collected on the improvement of the A40 route corridor and this could be used to develop a Stage 2 WelTAG assessment to refine the 2+1 options for the A40. Further economic assessment work will need to been undertaken.

10.2.3 The Haverfordwest South Eastern Bypass Options 5 and 6 perform strongly against the assessment criteria. Option 5 shows a better journey time performance than Option 6 as it bypasses the congested community of Johnston as well as Haverfordwest, but scores poorly against the environment appraisal criteria. There may be merit in developing further options to minimise the environmental impact and provide better access to The Haven south of Haverfordwest, as well as investigating the optimum end point for an improvement. Further optioneering and Stage 1 WelTAG assessment is therefore an appropriate strategy for investigating improvements from the A40 south of Haverfordwest to the Haven.

Appendix A - Concept Drawings





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KEY

- PROPOSED SCHEME
- EXISTING PROVISION
- STOPPED UP SIDE ROAD
- MILFORD HAVEN WATERWAY
- NATIONAL PARK
- SAC
- SSSI
- WATERCOURSES
- HERITAGE POINT

Rev	Date	Description	By	Chk	App
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6	01/05/15	AERIAL PHOTOGRAPHY AMENDED	RB	AH	AH
5	20/04/15	AERIAL PHOTOGRAPHY AND CONSTRAINTS ADDED	RB	AH	AH
4	13/04/15	ANNOTATIONS AMENDED	RB	AH	AH
3	10/04/15	ANNOTATIONS AMENDED	RB	AH	AH
2	02/03/15	LABELS AMENDED	RB	MG	MG
1	18/02/15	NEW OS	GH	MG	MG

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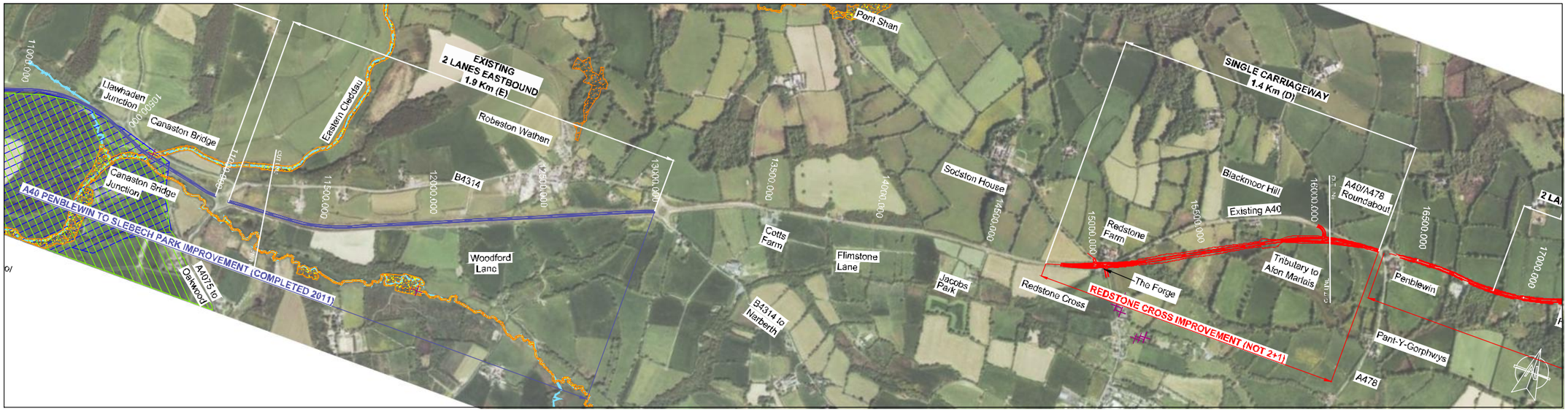
Client:
WELSH GOVERNMENT

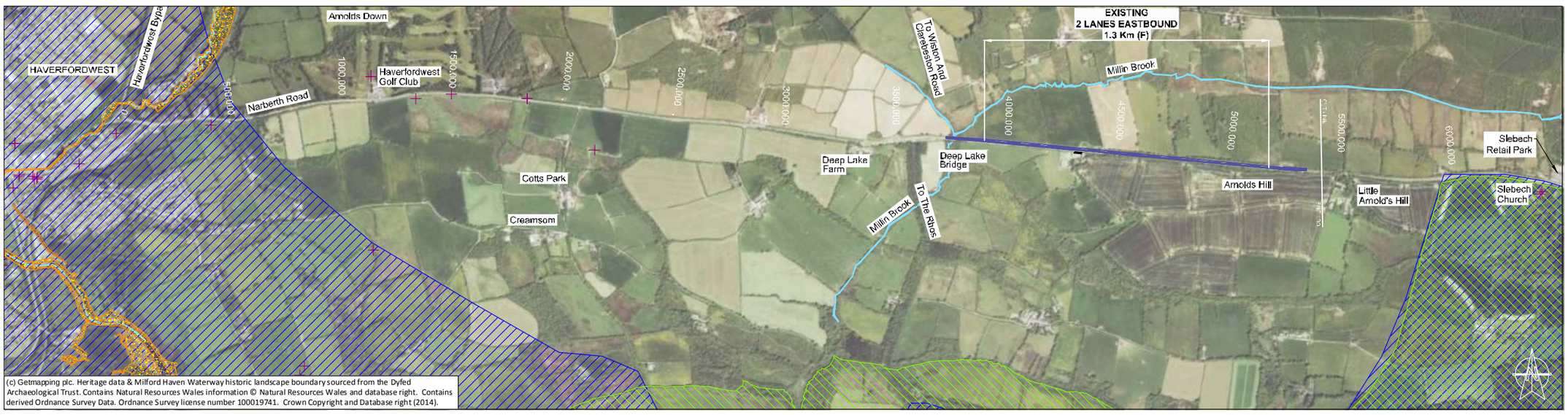
Site/Project:
ST.CLEARS TO HAVERFORDWEST STUDY

Title:
OPTION 1
SINGLE CARRIAGEWAY
COMMITTED SCHEMES
SHEET 1 OF 2

Drawn: RB		Checked: MG	
Designed: 26.01.15		Approved: MG	
Date: 09/04/2015	Scale: 1:10,000 A1	Sheet: 1 OF 2	
Project Number: HHC43696		Drawing Number: 169	Revision: 7

HHC43696 | 170 | 7





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Rev	Date	Description	By	Chk	App
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3	10/04/15	ANNOTATIONS AMENDED	RB	AH	AH
2	02/03/15	LABELS AMENDED	RB	MG	MG
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Site/Project:
ST.CLEARS TO HAVERFORDWEST STUDY

Title:
OPTION 1
SINGLE CARRIAGEWAY
COMMITTED SCHEMES
SHEET 2 OF 2

Drawn: RB		Checked: MG	
Designed: 26.01.15		Approved: MG	
Date: 09/04/2015	Scale: 1:10,000	A1	Sheet: 2 OF 2

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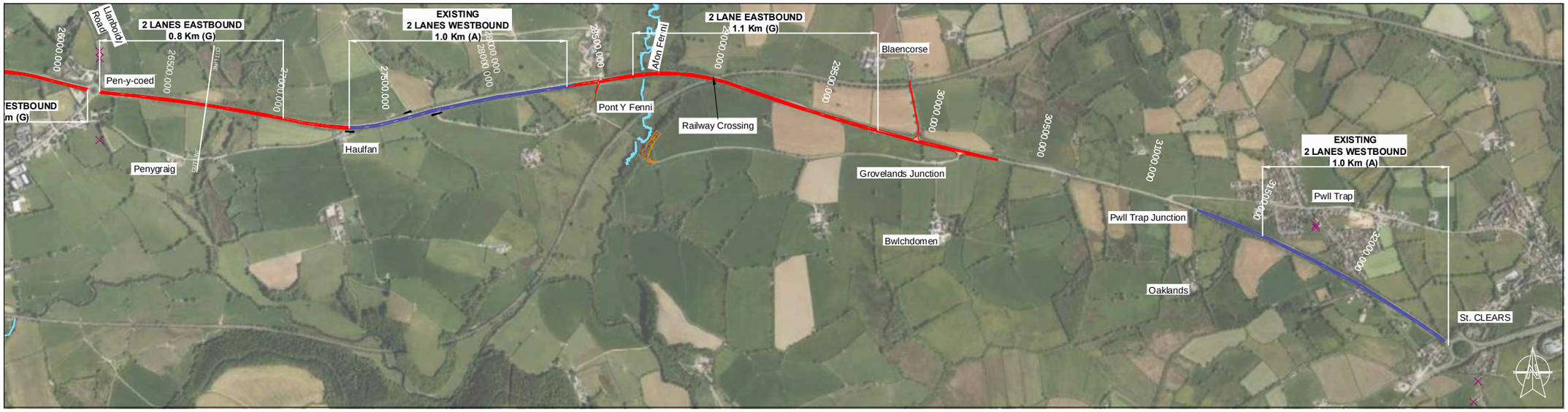

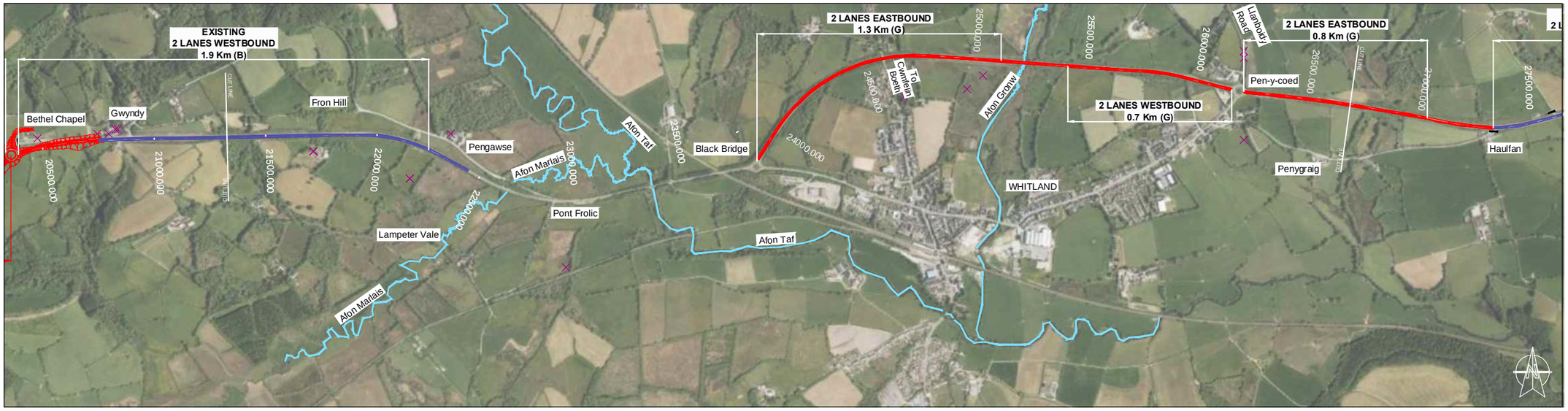

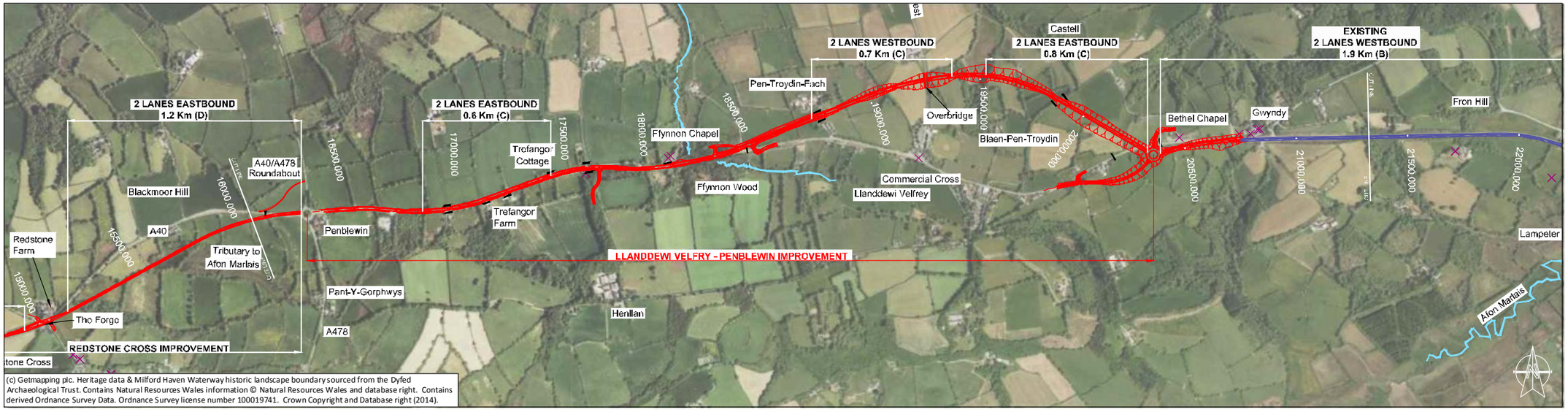

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- SSSI
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- HERITAGE POINT

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6	05/06/15	AMENDMENTS AS PER WELSH GOVERNMENT COMMENTS	RB	AH	AH
5	01/05/15	AERIAL PHOTOGRAPHY AND WATERCOURSES AMENDED	RB	AH	AH
4	17/04/15	NEW AERIAL PHOTOGRAPHY AND CONSTRAINTS ADDED	RB	AH	AH
3	10/04/15	ANNOTATIONS AMENDED	RB	AH	AH
2	02/03/15	LABELS AMENDED	RB	MG	MG
1	18/02/15	NEW OS	GH	MG	MG

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Client: WELSH GOVERNMENT

Site/Project: ST.CLEARS TO HAVERFORDWEST STUDY

Title: OPTION 2
SINGLE CARRIAGEWAY
MAXIMUM '2+1'
SHEET 1 OF 2

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Designed: 26.01.15		Approved: MG	
Date: 26/01/2015	Scale: 1:10,000 A1	Sheet: 1 OF 2	
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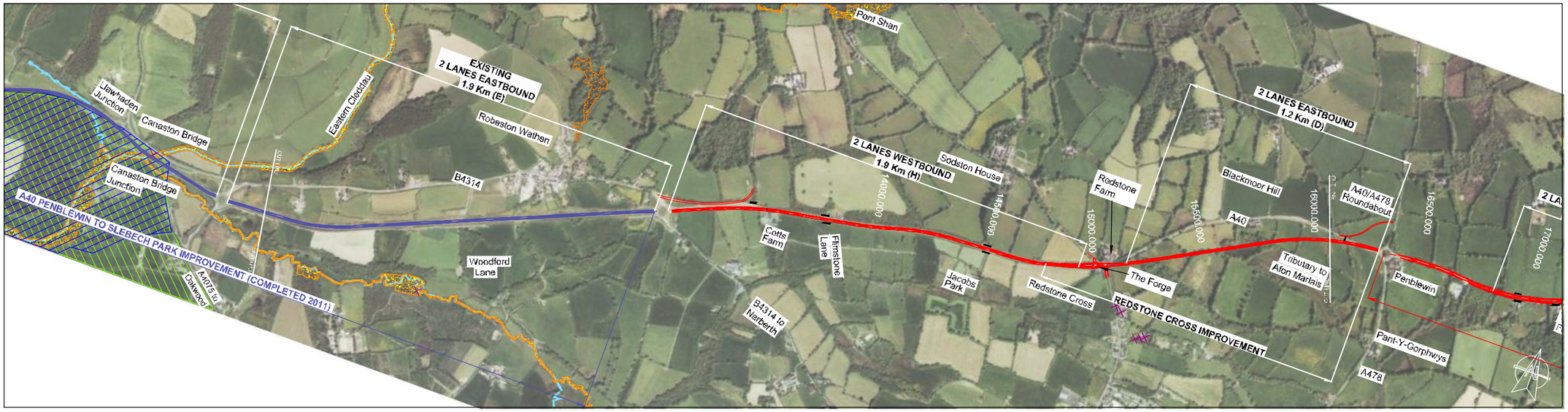

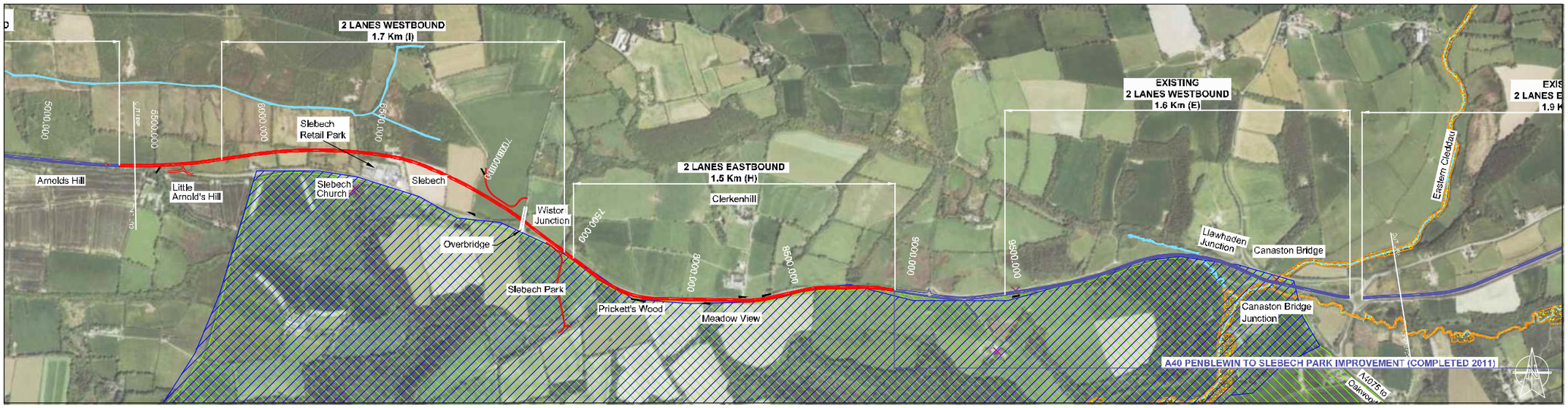

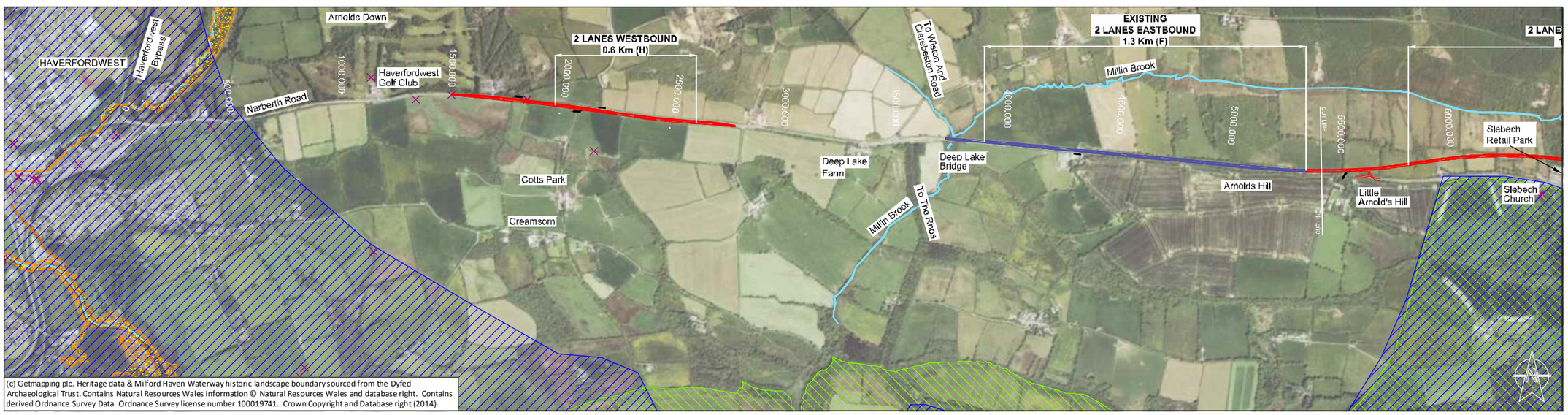

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- WATERCOURSES
- HERITAGE POINT

Rev	Date	Description	By	Chk	App
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4	17/04/15	NEW AERIAL PHOTOGRAPHY AND CONSTRAINTS ADDED	RB	AH	AH
3	10/04/15	ANNOTATIONS AMENDED	RB	AH	AH
2	02/03/15	LABELS AMENDED	RB	MG	MG
1	18/02/15	NEW OS	GH	MG	MG

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Site/Project: ST.CLEARS TO HAVERFORDWEST STUDY

Title: OPTION 2
SINGLE CARRIAGEWAY
MAXIMUM '2+1'
SHEET 2 OF 2

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Designed: 26.01.15		Approved:	
Date: 26/01/2015	Scale: 1:10,000 A1	Sheet: 2 OF 2	
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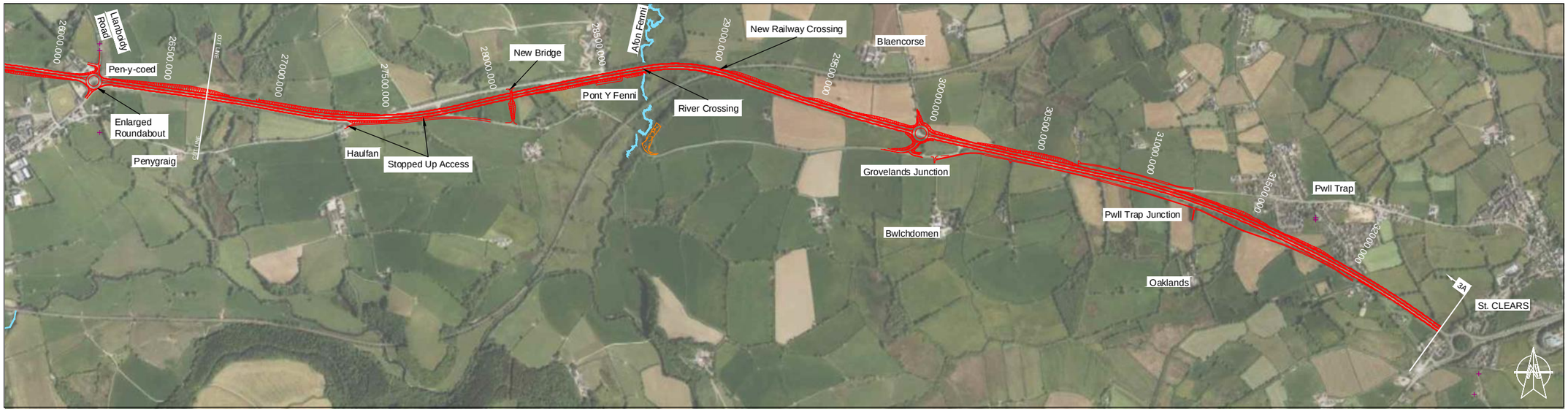

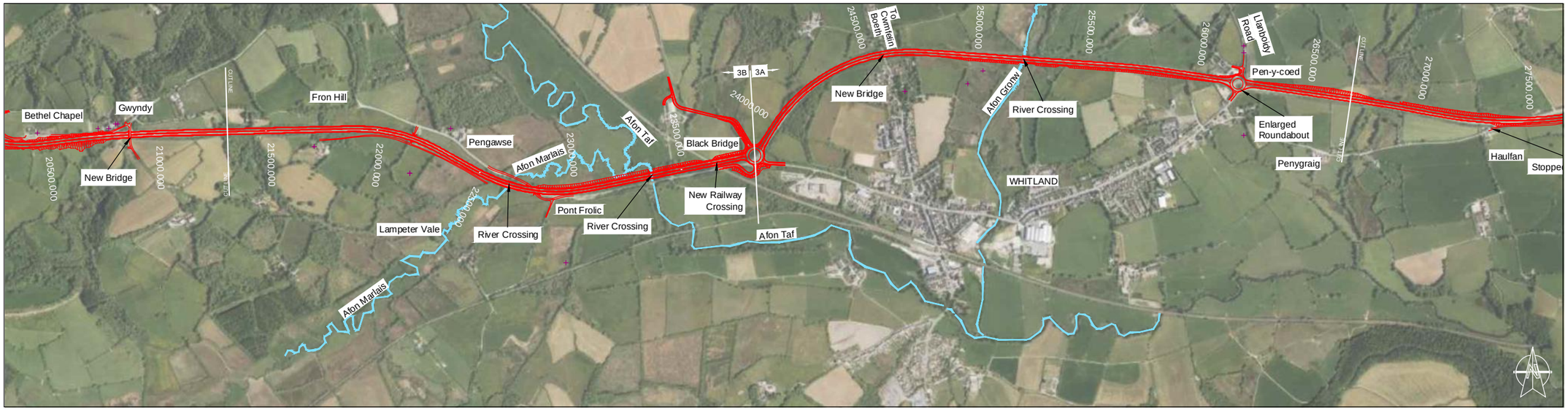

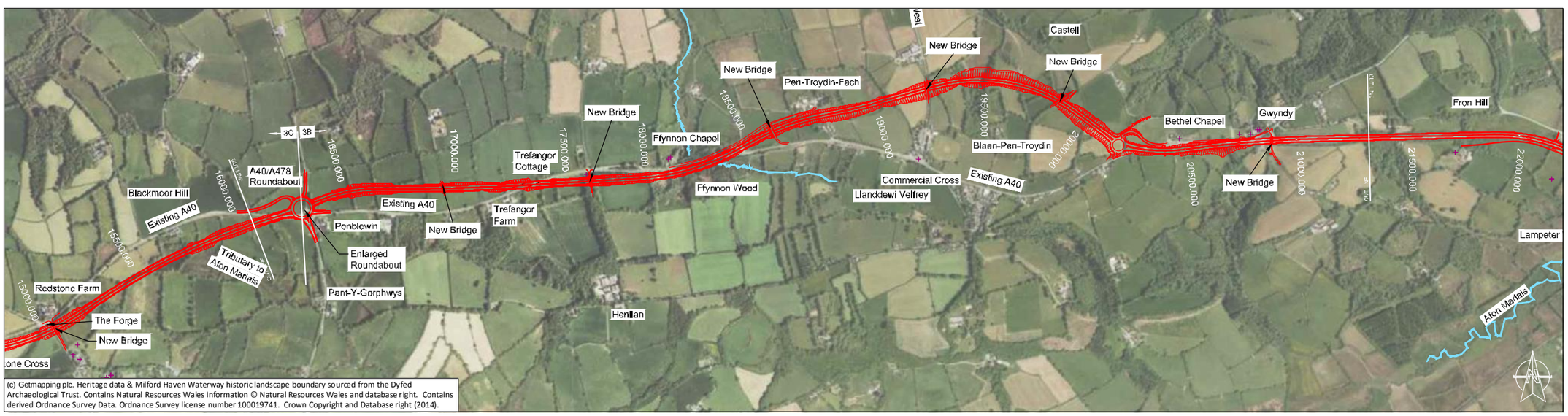

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2	20/04/15	AERIAL PHOTOGRAPHY AND CONSTRAINTS ADDED	RB	AH	AH
1	13/04/15	ANNOTATIONS AMENDED	RB	AH	AH

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Site/Project: ST.CLEARS TO HAVERFORDWEST STUDY

Title: OPTION 3 DUAL CARRIAGEWAY DUAL CARRIAGEWAY SHEET 1 OF 2

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Designed: 23.01.15		Approved: 23.01.15	
Date: 22/01/2015	Scale: 1:10,000	A1	Sheet: 1 OF 2

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Revision 4
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Project No. HHC43696
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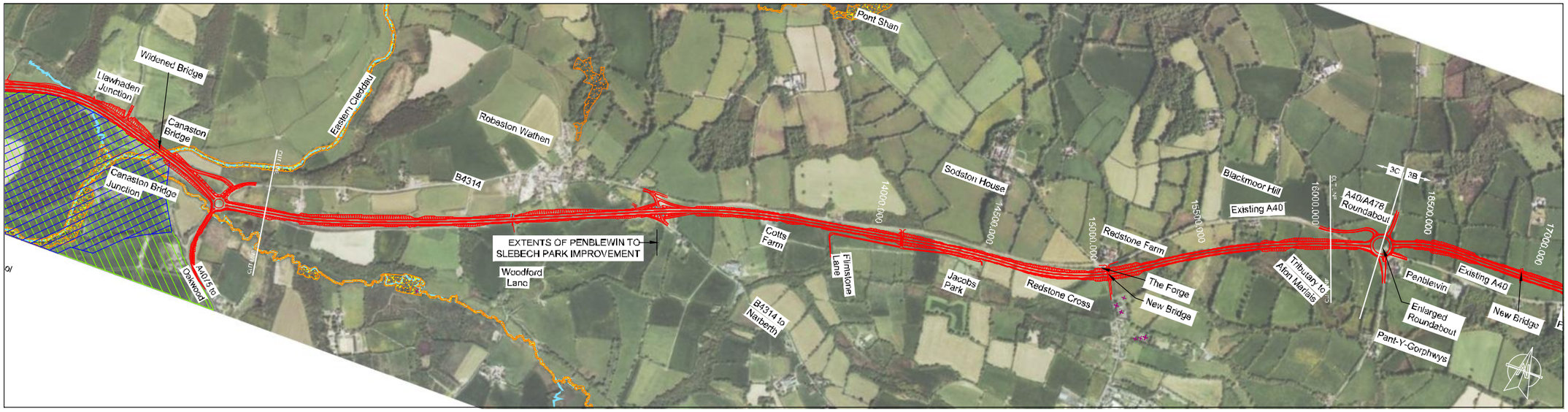
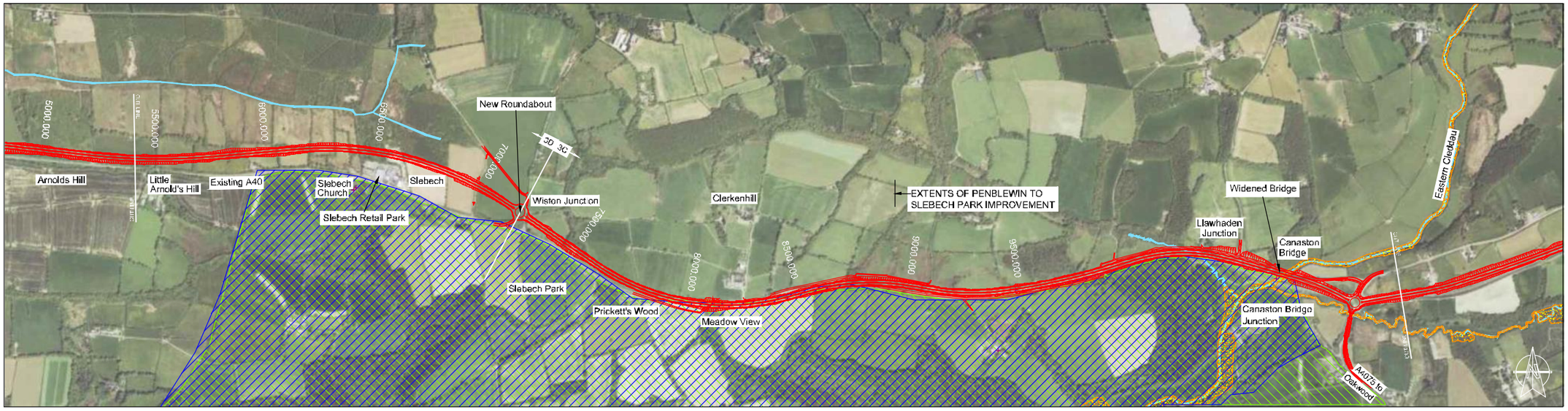
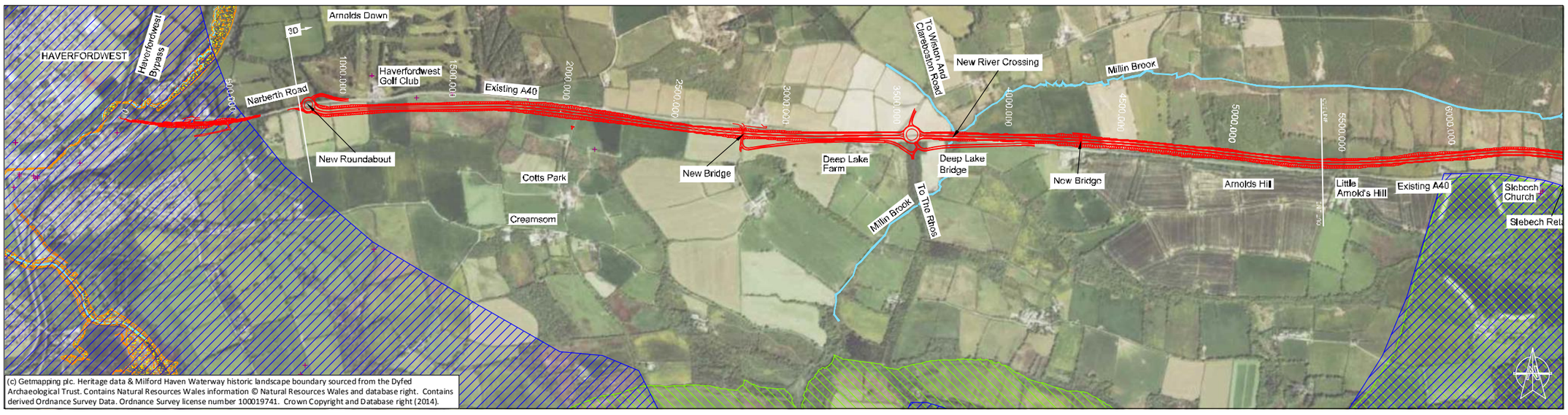
Plot Date: 05/06/2015 10:16:17







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- SSSI
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2	20/04/15	AERIAL PHOTOGRAPHY AND CONSTRAINTS ADDED	RB	AH	AH
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Site/Project: ST.CLEARS TO HAVERFORDWEST STUDY

Title: OPTION 3 DUAL CARRIAGEWAY ROUTE OPTION SHEET 2 OF 2

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Designed: 23.01.15		Approved: 23.01.15	
Date: 22/01/2015	Scale: 1:10,000	A1	Sheet: 2 OF 2
Project Number: HHC43696		Drawing Number: 174	Revision: 4

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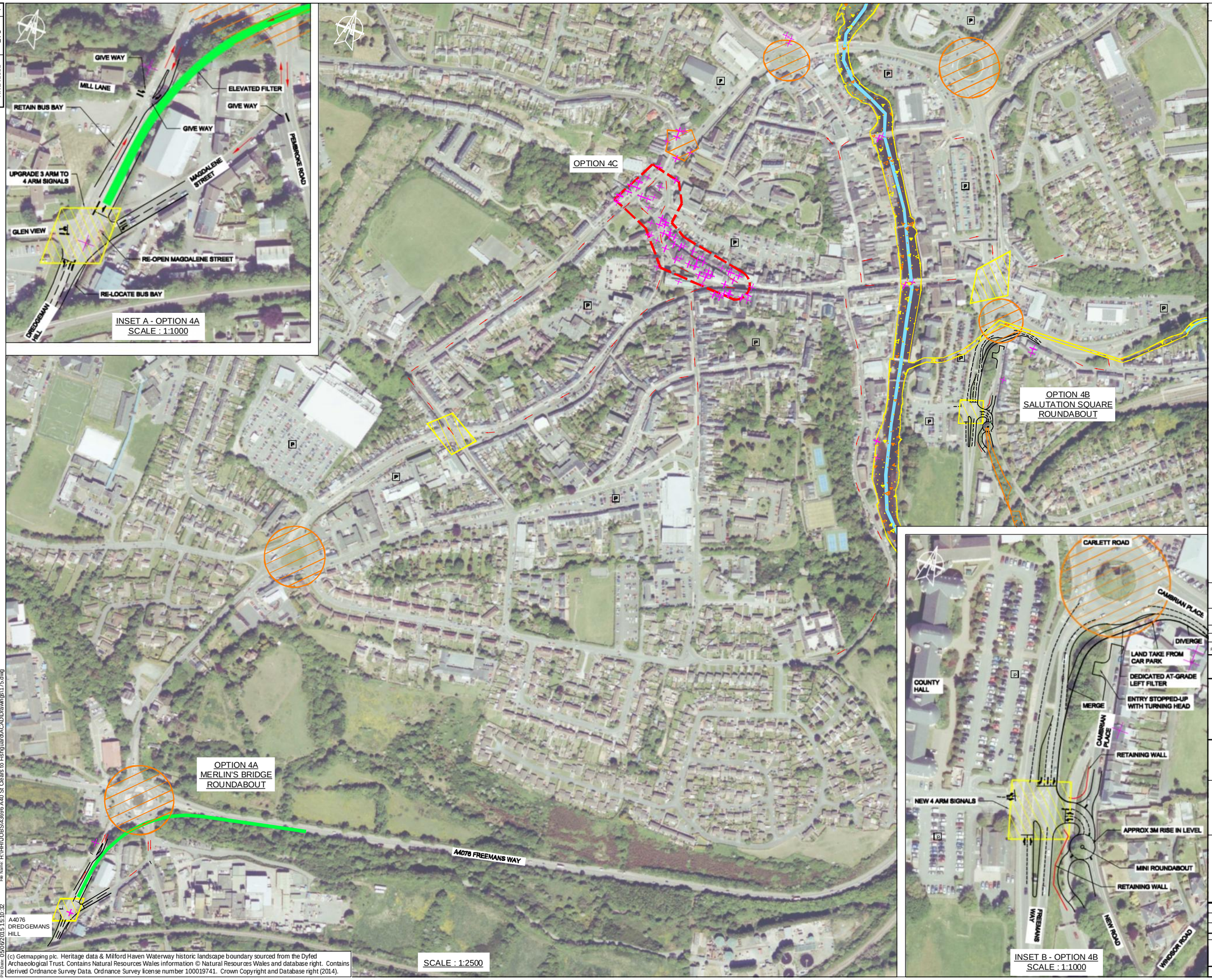
HHC43696 | 174 | 4



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KEY

- EXISTING SIGNAL OPTIMISATION
- ROUNDABOUT PERFORMANCE REVIEW
- REPRIORITISE ONE-WAY SYSTEM
- EXISTING ONE-WAY SYSTEM
- EXISTING CAR PARKING
- GRADE SEPARATION FILTER
- MILFORD HAVEN WATERWAY (COVERS EXTENTS OF DRAWING BUT OMITTED FOR CLARITY)
- NATIONAL PARK
- SAC
- SSSI
- WATERCOURSES
- HERITAGE POINT (POINTS OUTSIDE LIMITS OF SCHEME INTEREST HAVE BEEN OMITTED FOR CLARITY)
- AVAILABLE CAR PARKING

Rev	Date	Description	By	Chk	App
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2	10/04/15	ANNOTATIONS AMENDED	RB	AH	AH
1	19/03/15	INSET A AND B ADDED	RB	MG	MG

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Site/Project: ST.CLEARS TO HAVERFORDWEST STUDY

Title: OPTION 4 HAVERFORDWEST TOWN CENTRE TRAFFIC IMPROVEMENTS

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Designed: RB		Approved: MG	
Date: 26/01/2015	Scale: AS SHOWN	A1	Sheet: 1 OF 1

Project Number:	Drawing Number:	Revision:
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JOB NUMBER HHC43696

HAVERFORDWEST GOLF CLUB
A40
CARLETT ROAD
CAMBRIAN PLACE
COUNTY HALL
SALUTATION SQUARE ROUNDABOUT
HAVERFORDWEST
A4076 FREEMANS WAY
CREAMSTON ROAD
NEW AT-GRADE JUNCTION
UZMASTON ROAD
MERLIN'S BRIDGE ROUNDABOUT
A4076
NEW OVERBRIDGE
NEW VIADUCT (350 METRES)
GLEN VIEW
PEMBROKE ROAD
AVALLENAU DRIVE
A4076 DREDGEMAN HILL
NEW OVERBRIDGE
A4076
LOWER FREYSTROP
NEW ROUNDABOUT
A4076 VINE ROAD
MOORLAND ROAD
FREYSTROP CROSS
CUT LINE
JOHNSTON

A4076 VINE
CUT LINE
JOHNSTON
LANGFORD ROAD
OVERBRIDGE
A477
CHURCH ROAD
OVERBRIDGE
A477
SENTRY CROSS ROUNDABOUT
A477

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File Name: H:\HHW\JOBS\43696 A40 St Clears to Fishguard\ACAD\Drawings\176.dwg
Login: Boyle, Richard
Plot Date: 05/06/2015 10:54:21

NOTES

A1

1. THIS IS A C.A.D. DRAWING AND SHOULD NOT BE AMENDED BY HAND.
2. ALL DIMENSIONS IN METRES UNLESS OTHERWISE STATED.

KEY

- BYPASS ROUTE AS PER CAPITA SYMONDS HAVERFORDWEST SOUTH EASTERN BYPASS PRE-FEASIBILITY STUDY REPORT JULY 2009
- MILFORD HAVEN WATERWAY
- NATIONAL PARK
- SAC
- SSSI
- WATERCOURSES
- HERITAGE POINT

Rev	Date	Description	By	Chk	App
5	02/06/15	AMENDED AS PER WELSH GOVERNMENT COMMENTS	RB	AH	AH
4	07/05/15	IMAGERY AMENDED	RB	AH	AH
3	20/04/15	AERIAL PHOTOGRAPHY AND CONSTRAINTS ADDED	RB	AH	AH
2	13/04/15	ANNOTATIONS ADDED	RB	AH	AH
1	19/03/15	ANNOTATIONS ADDED	RB	AH	AH

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Site/Project:
ST. CLEARS TO HAVERFORDWEST STUDY

Title:
OPTION 5
HAVERFORDWEST SOUTH EAST BYPASS
A40 GOLF COURSE TO A477

Drawn: RB		Checked: MG	
Designed: RB		Approved: MG	
Date: 26/01/2015	Scale: 1:10,000 A1	Sheet: 1 OF 1	
Project Number:	Drawing Number:	Revision:	
HHC43696	176	5	

HHC43696 | 177 | 3

HAVERFORDWEST GOLF CLUB
A40
A40
CARLETT ROAD
CAMBRIAN PLACE
COUNTY HALL
SALUTATION SQUARE ROUNDABOUT
CREAMSTON ROAD
HAVERFORDWEST
A4076 FREEMANS WAY
NEW AT-GRADE JUNCTION
UZMISTON ROAD
MERLIN'S BRIDGE ROUNDABOUT
A4076
NEW OVERBRIDGE
NEW VIADUCT (350 METRES)
GLENVIEW
AVALLENAU DRIVE
PEMBROKE ROAD
A4076 DREDGEMANHILL
NEW OVERBRIDGE
A4076
LOWER FREYSTROP
NEW ROUNDABOUT
A4076 VINE ROAD
MOORLAND ROAD
FREYSTROP CROSS
JOHNSTON

NOTES (A1)

1. THIS IS A C.A.D. DRAWING AND SHOULD NOT BE AMENDED BY HAND.
2. ALL DIMENSIONS IN METRES UNLESS OTHERWISE STATED.

KEY

- PROPOSED ROUTE
- MILFORD HAVEN WATERWAY
- NATIONAL PARK
- SAC
- SSSI
- WATERCOURSES
- + HERITAGE POINT

Rev	Date	Description	By	Chk	App
3	02/06/15	AMENDMENTS AS PER WELSH GOVERNMENT COMMENTS	RB	AH	AH
2	07/05/15	LAYOUT AND IMAGERY AMENDED	RB	AH	AH
1	28/04/15	TEXT AMENDMENT	RB	AH	AH

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Site/Project: ST. CLEARS TO HAVERFORDWEST STUDY

Title: OPTION 6 HAVERFORDWEST SOUTH EAST BYPASS A40 GOLF COURSE TO A4076

Drawn: RB		Checked: MG	
Designed: RB		Approved: MG	
Date: 23/04/2015	Scale: 1:10,000 A1	Sheet: 1 OF 1	
Project Number:	Drawing Number:	Revision:	
HHC43696	177	3	

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Login: Boyle, Richard
Plot Date: 05/06/2015 10:59:41

Appendix B - Development of Transport Planning Objectives

Subject:	**DRAFT TPO**	**BIM Ref:**	HHC43696/902.1	**Version**	V3
Prepared:	Matthew Godfrey	**Approved:**	Russell Bennett		
Date:	03/03/15	**Date:**	03/03/15		

This note has been developed to outline the development of draft Transport Planning Objectives for the A40 St.Clears to Haverfordwest Study as a basis for option appraisal of the highway improvement options arising from the study.

The Wales Transport Strategy lists 'long term (transport) outcomes'

Criteria	Long Term Outcomes
Economic	improve access to employment opportunities
	improve connectivity within Wales and internationally
	improve the efficient, reliable and sustainable movement of people
	improve the efficient, reliable and sustainable movement of freight
	improve access to visitor attractions
Environmental	increase the use of more sustainable materials
	reduce the contribution of transport to greenhouse gas emissions
	adapt to the impacts of climate change
	reduce the contribution of transport to air pollution and other harmful emissions
	improve the impact of transport on the local environment
	improve the impact of transport on our heritage
	improve the impact of transport on biodiversity
Social	improve access to health care
	improve access to education, training and lifelong learning
	improve access to shopping and leisure facilities
	encourage healthy lifestyles
	improve the actual and perceived safety of travel

The SWWTCH Regional Transport Plan provides a matrix of key transport objectives and stakeholder identified access problems.

Commonly Raised Access Problems RTP Objectives	Poor access to health services and facilities	Poor Access to employment opportunities	Poor integration at policy and service delivery levels	Need for step change in quality and frequency of public transport options	Poor Quality Interchanges	Need more and better sustainable transport options
To improve access for all to a wide range of services and facilities including employment and business, education and training, healthcare, tourism and leisure facilities.	√√	√√√	√√	√√	√√	√√√
To improve the sustainability of transport by improving the range and quality of, and awareness about, transport options, including those which improve health and well being.	√√	√	√√	√√√	√√√	√√√

Commonly Raised Access Problems RTP Objectives	Poor access to health services and facilities	Poor Access to employment opportunities	Poor integration at policy and service delivery levels	Need for step change in quality and frequency of public transport options	Poor Quality Interchanges	Need more and better sustainable transport options
To improve the efficiency and reliability of the movement of people and freight within and beyond south west Wales to support the regional economy.	√	√√	√	√√	√√	√√
To improve integration between policies, service provision and modes of transport in south west Wales.	√√	√√	√√√	√√	√√√	√√
To implement measures which make a positive contribution to improving air quality and reducing the adverse impact of transport on health and Climate Change.	√	√	√√	√√	√	√√√
To implement measures which help to reduce the negative impact of transport across the region on the natural and built environment, including biodiversity.	√	√	√√	√√	√	√√√
To improve road safety and personal security in south west Wales.	√	√	√	√√	√	√√√

Where √ = minor fit, √√ = moderate fit, √√√= major fit

The original A40 St.Clears to Fishguard Study was subject to a STAG appraisal and as such defined by policy/scheme objectives rather than WelTAG derived TPO.
The Study scheme objectives as defined in the TAR were;

Criteria	**Scheme Objectives**
Accessibility	To improve links with west Wales, Ireland, the English trunk road network and Europe
	To improve regional accessibility and mobility.
	To reduce severance caused by traffic for communities on the A40 west of St Clears
	To meet the needs of disabled people
	To give priority to the core network
Safety	To contribute towards safer communities including managing the speed of traffic to appropriate levels
	To improve safety generally but particularly on the A40 west of Carmarthen
	To provide or encourage appropriately spaced stopping/resting places and facilities on the network
	To improve the detection, response and management of incidents on the trunk road network

Criteria	Scheme Objectives
Environment	To improve the quality of life for people in communities close to the trunk road network
	To promote cycling and walking and provide opportunities for healthy lifestyles.
	To minimise any adverse effects on the environment generally
	To conserve and enhance, where appropriate, landscapes, townscapes and historic and cultural resources.
	To conserve and enhance, where appropriate, bio-diversity on the network through the Bio-diversity Action Plan.
Economy	To bring up to standard and maintain the function of the trunk road network.
	To improve and maintain the trunk road asset
	To preserve and enhance the operational efficiency of the trunk road network.
	Help meet Wales' wider economic needs in a cost effective manner.
	To improve journey time reliability on the A40 between St Clears and Haverfordwest.
	To improve journey time reliability on the A40 between St Clears and Haverfordwest by at least 10%.
Integration	To facilitate improved interchanges between transport modes for people and freight.
	To improve integration with the Celtic Trail Cycle Route (National Cycle Network), Swansea to Fishguard
	To take account of the interface between the network and the strategy and plans of the SWSWITCH consortia and other transport authorities.
	To make available information about the current and predicted level of service on the M4 motorway and associated roads and to facilitate the delivery of integrated transport solutions
	To take into account the needs for local and national planning and agriculture

It is considered that the WTS, RTP and TAR objectives are too disparate and generic to provide a satisfactory measure of A40 study option performance and so a focus / concentration of the objectives was undertaken leading a 1st pass sub-set scheme TPO.

Criteria	1st pass Draft TPO
Economy	Improve Journey Time reliability on Trans-European Network
	Improve Journey Time reliability to Haven Enterprise Zone
	Improve network resilience on Trans-European Network
Environment	Reduce noise and improve air quality in urban areas
Society	Improve access to goods and services
	Reduce the amount of collisions caused by overtaking manoeuvres

The above TPO have lost some of the original SMART properties and do not provide an adequate measure for the appraisal of Haverfordwest SE Bypass options.

The (Jul'09) Pembrokeshire CC Feasibility Study lists the objectives for the Haverfordwest SE Bypass.

Haverfordwest SE Bypass Scheme Objectives
Provide a distributor road network that effectively links the Trunk Road network to the key energy sites at the north side of the Haven.
Provide relief to the communities of Haverfordwest.
Enhance and improve access to sites to facilitate regeneration, particularly toward the South Hook and Waterston areas.
Remove restrictions on the network at Merlin's Bridge Roundabout and the low bridge (Merlin's Bridge).
Provide traffic relief to the congested highway network in Haverfordwest, particularly at Merlin's Bridge Roundabout and Salutation Square Roundabout.
Potentially provide a marker for development limits.

Facilitate sustainable transport modes

The subsequent (Aug'14) Pembrokeshire CC TRA40 Briefing Paper identifies strategic transportation needs for the Swansea Bay City Region and Haven Waterway Enterprise Zone.

PCC Strategic Transportation Needs
Increase journey time reliability
Decrease journey time
Aid regeneration and attract inward investment
Reduce the number of personal injury accidents (collisions).
Provide environmental benefits for the communities on the route.
Reduce the problems associated with peripherality and improve links to Ireland and European markets

Merging the A40 Study and Haverfordwest SE Bypass objectives 2nd pass draft TPO were derived.

Criteria	**2nd Pass Draft TPO**
Economy	Improve journey time reliability on scheme corridors by 10%
	Provide positive BCR on capital expenditure
	Enhance network resilience and efficient use of existing highway assets
	Improve connectivity of key development sites in Milford Haven area
	Aid regeneration and attract inward investment to Pembrokeshire
Environment	Minimise scheme impacts upon the environment
	Reduce noise and improve air quality for communities
Society	Reduce community severance
	Reduce personal injury accidents by 10%
	Improve NMU facilities and reduce modal conflicts

Following comment on the 2nd pass TPO and a further TPO review 3rd pass draft TPO were proposed for use at the WelTAG workshop.

Criteria	**3rd Pass Draft TPO**
Economy	Improve journey time and reliability
	Enhance network resilience
	Aid regeneration & support regional economy
Environment	Avoid adverse environmental impact
	Provide environmental benefit
Society	Reduce personal injury accidents
	Improve permeability and opportunities for active travel

NB SMART objectives not considered appropriate for current appraisal level

Appendix C - Appraisal Summary Tables

Option 1	**Description**	St.Clears to Haverfordwest Single Carriageway 2+1 Committed Schemes Existing 2+1 provision plus 1C Scheme published off-line Llanddewi Velfrey (2.1Km) and 1D Scheme off-line Redstone Cross (Junction safety, no 2+1)

Economy	**Assessment / Comment**	**Significance**
Transport Economic Efficiency -TEE	£56.8M (no land or stats) (1C £50.1M, 1D £6.7M) Localised journey time and variability benefits (1%) only and limited increase in overtaking opportunities. Journey time benefit of up to 25 seconds.	+
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	0

Environment		
Noise	Some isolated property noise increase but generally route moves away from residential area of Llanddewi Velfrey with overall noise reduction	+
Local Air Quality	Some isolated property air quality reduction but generally route moves away from residential area of Llanddewi Velfrey with overall air quality improvement	+
Greenhouse Gas Emissions	Road user reduction in greenhouse gasses from increased vehicle speed and reduced congestion. Greenhouse gas increase from construction activities & materials.	+
Landscape and Townscape	In Llanddewi Velfrey area adverse landscape effects and beneficial townscape. Overall route slight adverse	-
Biodiversity	Potential impact on 2 protected sites; Pembrokeshire bat sites and Bosherston Lakes SAC and Slebech stable yard loft & cellars SSSI. Potential impact protected species including; bats, badgers, otters and reptiles. Potential impact to hedgerow habitats.	-
Heritage	Potential impact to unknown archaeology on off-line area. Direct impact on 2 HER site. Within 250m of 5 listed buildings.	-
Water Environment	Potential construction stage pollution. Highway run-off treatment attenuation and pollution prevention incorporated into design.	+
Soils	Slight adverse impact agricultural landtake.	-

Society		
Transport Safety	Localised accident benefits, saving 56.6 accidents over 60 years. No impact at recognised accident cluster sites.	+
Personal security	No adverse or beneficial impacts identified	0
Permeability	Provides relief from existing community severance in Llanddewi Velfrey. Severs 4 PoW and effects further 7 PoW. Impacts to RoW can be mitigated. Slight beneficial overall	+
Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may be some limited local benefits where traffic is removed through Llandewi Velfrey.	0
Social Inclusion	The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	+
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	0

Transport Planning Objectives		
Improve journey time and reliability	Localised improvement expected from inclusion of 2+1 sections of carriageway designed to national speed limit, 1% saving in journey time variability and 25 seconds in journey time benefit..	+
Enhance network resilience	Offline sections of new carriageway provide only slight improvement to network resilience by providing alternative route.	+
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	0
Avoid adverse environmental impact	Slight adverse impact	-
Provide environmental benefit	Balance of slight beneficial and slight adverse impacts on environments result in a neutral impact overall	0
Reduce personal injury accidents	56.6 accidents saved over 60 years with improved road standard and overtaking opportunities.	+
Improve permeability and opportunities for active travel	Slight benefits in terms of permeability in Llandewi Velfrey. Limited opportunity to improve active travel.	+

Other Issues	
Health impact	Neutral
Stakeholder acceptability	Scheme buy-in from Llanddewi Velfrey residents, PCC reservation 'needs dual'
Technical and operational feasibility	No issues
Affordability and deliverability	In current forward programme
Risk	Qualified risk register, managed risk
Comment	

Option 2	**Description**	St.Clears to Haverfordwest Single Carriageway Maximum 2+1 Existing 2+1 provision plus 1C Scheme published off-line Llanddewi Velfrey, 2D Scheme off-line Redstone Cross (1.2Km), 2G Scheme on-line Whitland bypass (3No.=3.2km), 2H Scheme on-line Penblewin to Haverfordwest (3No.=4.0Km) and 2I Scheme off-line Slebech bypass (1.7Km)

Economy	**Assessment / Comment**	**Significance**
Transport Economic Efficiency -TEE	£98.6M (no land or stats) (1C £50.1M, 2D £10.5M, 2G £11.2M, 2H £10.0M, 2I £16.8M) Journey time savings along A40 between St Clears and Haverfordwest due to increased speed, and up to 4% savings in journey time variability. Journey time benefit of up to 1 minute 10 seconds.	**+ +**
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	**+**

Environment		
Noise	Some isolated property noise increase for on-line, off-line sections move away from residential areas with overall noise reduction	**+**
Local Air Quality	Some isolated property air quality reduction for on-line, off-line sections move away from residential areas with overall improvement in air quality	**+**
Greenhouse Gas Emissions	Road user reduction in greenhouse gasses from increased vehicle speed and reduced congestion. Greenhouse gas increase from construction activities & materials.	**+**
Landscape and Townscape	Llanddewi Velfrey & Slebech adverse landscape effects and beneficial townscape. More extensive loss of hedgerow screening vegetation but can mitigate. Potential slight impact on PCNP boundary. Overall route slight adverse	**-**
Bio-diversity	Potential impact on 2 protected sites; Pembrokeshire bat sites and Bosherston Lakes SAC, Slebech stable yard loft & cellars SSSI. Potential impact protected species including; bats, badgers, otters and reptiles. Extensive hedgerow loss impact on habitats.	**- -**
Heritage	Potential impact to unknown archaeology on off-line area. Direct impact on 3 HER site. Within 250m of 10 listed buildings and 1 Scheduled ancient monument. The proposed route runs along the boundary of the Milford Haven Waterway historic landscape boundary between Canaston Bridge Roundabout and Slebech.	**- -**
Water Environment	Potential construction stage pollution. Highway run-off treatment attenuation and pollution prevention incorporated into design. Water Framework Directive issues	**+**
Soils	Slight adverse impact agricultural landtake.	**-**

Society		
Transport Safety	Increased safe overtaking opportunity and reduces side road accesses. Accident benefits along the A40, with savings of 94 accidents over 60 years. Improvements to accident cluster sites at West of Kings Park Farm access and Slebech.	**+ +**
Personal security	No adverse or beneficial impacts identified	**0**
Permeability	Provides relief from existing community severance in Llanddewi Velfrey & Slebech. Severs 9 RoW and effects further 13 RoW. Impacts to RoW can be mitigated. Slight beneficial overall	**+**

Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may be some limited local benefits where traffic is removed through Llandewi Velfrey and Slebech.	**0**
Social Inclusion	The option may provide a moderate benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	**+ +**
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	**0**

Transport Planning Objectives		
Improve journey time and reliability	Improved journey times along the A40 expected from inclusion of 2+1 sections of carriageway designed to national speed limit, up to 4% saving in journey time variability and 1 minute 10 seconds of journey time benefit..	**+ +**
Enhance network resilience	Construction disruption, whole life improvement	**+ +**
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	
Avoid adverse environmental impact	Hedgerow clearance & off-line works	**- -**
Provide environmental benefit	Additional opportunity over committed schemes	**+**
Reduce personal injury accidents	94 accidents saved over 60 years with improved road standard and overtaking opportunities.	**+ +**
Improve permeability and opportunities for active travel	Slight benefits in terms of permeability in Llandewi Velfrey and Slebech. Limited opportunity to improve active travel.	**+**

Other Issues	
Health impact	Neutral
Stakeholder acceptability	Scheme buy-in from A40 communities, PCC reservation 'needs dual', potential environmental group opposition due to scale
Technical and operational feasibility	No issues, more work needed on PMA connections
Affordability and deliverability	Only part in current forward programme, could be delivered in discrete schemes, significant construction disruption
Risk	Qualified risk register, managed risk
Comment	

Option 3	Description	St.Clears to Haverfordwest Single Dual Carriageway TAR Schemes (31.7 km)

Economy	Assessment / Comment	Significance
Transport Economic Efficiency -TEE	£336.3M (no land or stats) Large journey time savings along entire A40 route due to increased speed, and up to 14% savings in journey time variability and over 9 minutes in journey time benefit. Demonstrates poor VFM as result of traffic flows insufficient for dual c/way capacity in short/medium term	- -
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	+ +

Environment		
Noise	Some isolated property noise increase for on-line sections, off-line sections move away from residential areas so noise reductions expected. Potential junction/speed noise increase.	0
Local Air Quality	Some isolated property air quality reduction for on-line, off-line sections move away from residential areas with overall improvement in air quality.	0
Greenhouse Gas Emissions	Road user reduction in greenhouse gasses from increased vehicle speed and reduced congestion. Greenhouse gas increase from construction activities & materials.	+
Landscape and Townscape	Llanddewi Velfrey & Slebech adverse landscape effects and beneficial townscape. Loss of hedgerow screening increased by alignment footprint expansion. Potential moderate impact on PCNP boundary. Overall route moderate adverse	- -
Bio-diversity	Potential impact on 4 protected sites; Pembrokeshire bat sites and Bosherston Lakes SAC, Slebech stable yard loft & cellars SSSI, Cleddau Rivers SAC, Eastern Cleddau SSSI. Potential impact protected species including; bats, badgers, otters and reptiles. Extensive hedgerow loss impact on habitats.	- -
Heritage	Potential impact to unknown archaeology on off-line areas. Direct impact on 35 HER sites and 1 listed structure. Within 250m of an additional 13 listed buildings and 3 Scheduled ancient monuments. The proposed route runs along the boundary of the Milford Haven Waterway historic landscape between Canaston Bridge Roundabout and Slebech and then enters the designation for the final ~0.5 km at the western end.	- - -
Water Environment	Potential construction stage pollution. Highway run-off treatment attenuation and pollution prevention incorporated into design. Water Framework Directive issues. Additional c/way surface run-off	+
Soils	Large adverse impact on agricultural landtake, greatest of all the options.	- - -

Society		
Transport Safety	Removes oncoming collision accidents and no side road accesses. Large accident benefits along the A40, with savings of 150 accidents over 60 years. Significant improvements to accident cluster sites at West of Kings Park Farm access, Canaston Bridge and Slebech. Increased severity potential due to speed.	+ + +
Personal security	No adverse or beneficial impacts identified	0
Permeability	Provides relief from existing community severance in Llanddewi Velfrey & Slebech. Severs 9 RoW and effects further 22 RoW. Impacts to RoW can be mitigated. Slight beneficial overall	+

Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may be some limited local benefits where traffic is removed through Llandewi Velfrey and Slebech.	**0**
Social Inclusion	The option may provide a moderate benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	**+ +**
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	**0**

Transport Planning Objectives		
Improve journey time and reliability	Significant improvement to journey times along the A40 expected from 100% overtaking opportunities and carriageway designed to national speed limit with benefit in peak holiday season. Up to 14% saving in journey time variability and over 9 minutes of journey time benefit.	**+ + +**
Enhance network resilience	Construction disruption, whole life improvement	**+ +**
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	**+ +**
Avoid adverse environmental impact	Hedgerow clearance & off-line works	**- -**
Provide environmental benefit	Additional opportunity over Max 2+1 scheme	**+**
Reduce personal injury accidents	150 accidents saved over 60 years with improved road standard and 100% overtaking opportunities.	**+ + +**
Improve permeability and opportunities for active travel	Slight benefits in terms of permeability in Llandewi Velfrey and Slebech. Limited opportunity to improve active travel.	**+**

Other Issues	
Health impact	Neutral
Stakeholder acceptability	Reduced scheme buy-in from A40 communities, PCC preferred option, environmental group opposition to be expected. Could be seen to be contrary to WG previously stated position
Technical and operational feasibility	No issues, more work needed on PMA connections
Affordability and deliverability	Doesn't demonstrate VFM, not in current WG future budgets, likely to be unaffordable, phased delivery possible
Risk	Qualified risk register, managed risk
Comment	

Option 4	Description	Haverfordwest Town Centre Traffic Proposals (combined option) Option 4A Merlins Bridge Flyover & Option 4B Salutation Square Roundabout/County Hall Traffic Signals *(scores exclude Option 4C Traffic Management Opportunities which require further study)*

Economy	Assessment / Comment	Significance
Transport Economic Efficiency -TEE	£12.9M (no land or stats) (Option 4A £11.3M, Option 4B £1.1M, *Option 4C £0.5M)* Localised journey time benefits within Haverfordwest, but offset with disbenefit caused by additional traffic signals.	-
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	0

Environment		
Noise	The change in the traffic layouts for the two junction improvements 4A and 4B result in a slight change in noise envelope however the urban nature of the sites means some properties are adversely affected and some experience a benefit. On balance the impact is neutral.	0
Local Air Quality	As with the impact on noise, the minor change in traffic positions results in a neutral impact.	0
Greenhouse Gas Emissions	Primarily relates to C02 (carbon dioxide). Whilst improved highway standards and junction performance compared to the existing route giving improved traffic flow and fuel consumption for some movements. It is unlikely that there will be any real changes in overall traffic flow as a result of the Options 4A and 4B improvement works.	0
Landscape and Townscape	Slight adverse impacts on both townscape and landscape from the loss of vegetation and introduction of an elevated structure at Merlins Bridge, with minimal effects on properties. Salutation Square works cause minor townscape effects but within an area already characterised by modern highway infrastructure.	-
Bio-diversity	Flyover will cross a watercourse that passes to the immediate south of Merlin's Bridge Roundabout. Although not part of the Cleddau Rivers SAC or Western Cleddau SSSI otters could use the water course. Due to the urban nature of the area there is unlikely to be any other impacts on biodiversity and the impacts are considered neutral overall.	0
Heritage	Potential impact to unknown archaeology. Potential direct impact to 3 HER sites and 2 listed buildings/structures. There are a further 108 HER, 56 listed buildings, 75 ancient and historical monuments and five portable antiques within 250 m of the proposed option. All proposals are within the Milford Haven Waterway historic landscape.	- -
Water Environment	The proposed watercourse crossing of Option 4A may have the potential to impact on water quality, hydrology and the potential for flooding however the structure does not impact the river directly. Pollution of watercourses receiving highway drainage may be affected during construction and operation but this will be mitigated with Construction Environmental Management Plans and through design.	0
Soils	A small amount of urban land take is required for the Option 4A and 4B works compared to the other options. The impact is therefore neutral.	0

Society		
Transport Safety	Limited reduction in accidents at Salutation Rbt and Merlins Bridge. No impact upon identified cluster sites,	0
Personal security	No change expected from existing situation.	0
Permeability	Reduction of traffic flows might provide some localised benefit to NMUs crossing the roundabout. But overall is unlikely to increase or reduce community severance.	0
Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option.	0
Social Inclusion	The option is likely to have a neutral effect in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	0
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	0

Transport Planning Objectives		
Improve journey time and reliability	Limited improvements to journey time benefits offset by additional delay caused by additional traffic signals and traffic re-distribution.	0
Enhance network resilience	Additional highway assets but minor increased maintenance liabilities.	0
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	0
Avoid adverse environmental impact	Minimal environmental impact so avoidance of environmental impact better than other options	++
Provide environmental benefit	Little improvement expected due to small scale and localised nature of works.	0
Reduce personal injury accidents	Little improvement expected due to small scale and localised nature of works.	0
Improve permeability and opportunities for active travel	Permeability of Option 4A slightly impaired by elevated structure and traffic re-routing and little change for Option 4B. Overall impact considered neutral.	0

Other Issues	
Health impact	Marginal improvement to access to Withybush Hospital may be experienced from Option 4A.
Stakeholder acceptability	No stakeholder consultation undertaken however Pembrokeshire CC support the progression of Option 4A Merlins Bridge Flyover. Loss of some green space and increased traffic control/congestion outside County Hall for Option 4B not expected to be favoured by Pembrokeshire CC. Some small amount of private land take required,
Technical and operational feasibility	Very feasible to construct and maintain, well established traffic signal technology.
Affordability and deliverability	The cost estimate is undertaken on very preliminary designs only and does not account for land or statutory undertakers' diversion costs. Technically feasible to design and construct and maintain.
Risk	Difficulties may be experienced achieving technical approval by Pembrokeshire CC of the non-standard traffic layout on a county road for Option 4B (departures from standard). Stakeholder consultation required and not yet undertaken e.g. with Option 4B with Pembrokeshire CC regarding interface with county road network and with NRW regarding watercourse crossing. Availability of funding not known at present.
Comment	

Option 4A	Description	Haverfordwest Town Centre Traffic Proposals Merlin's Bridge Flyover (PCC Option 5)

Economy	Assessment / Comment	Significance
Transport Economic Efficiency -TEE	£11.3M (no land or stats) Localised journey time benefits within Haverfordwest, but offset with disbenefit caused by additional traffic congestion E/B.	-
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	0

Environment		
Noise	New elevated link will move traffic closer to properties on Magdalen Street and Haroldston Terrace causing additional traffic noise. Other properties fronting the roundabout will experience less traffic noise due to a reduction in circulatory traffic. Changes in noise will be very local to the Merlin's Bridge Roundabout area.	0
Local Air Quality	New elevated link will move traffic closer to properties on Magdalen Street and Haroldston Terrace causing worsening air quality. Other properties fronting the roundabout will experience improved conditions due to a reduction in circulatory traffic. Changes in air quality noise will be very local to the Merlin's Bridge Roundabout area.	0
Greenhouse Gas Emissions	Primarily relates to CO2 (Carbon dioxide). Improved highway standards and junction performance compared to the existing route giving improved traffic flow and fuel consumption for some movements. It is unlikely that there will be any real changes in overall traffic flow as a result of this option.	0
Landscape and Townscape	Slight adverse impacts on both townscape and landscape from the loss of vegetation and introduction of an elevated structure. Minimal effect on properties.	-
Bio-diversity	Will cross a watercourse that passes to the immediate south of Merlin's Bridge Roundabout. Although not part of the Cleddau Rivers SAC or Western Cleddau SSSI otters could be present in the area. Due to the urban nature of the area there is unlikely to be any other impacts on biodiversity and the impacts are considered neutral overall.	0
Heritage	Potential impact to unknown archaeology. Potential direct impact to 3 HER sites and 2 listed buildings/structures. There are a further 11 HER sites, 2 listed buildings and 4 ancient and historical monuments within 250 m of the proposed option. The proposed option is within the Milford Haven Waterway historic landscape.	- -
Water Environment	It is likely that the crossing of the watercourse will be a viaduct although details of its construction are unknown. No piers will be located in the watercourse itself. Any watercourse crossing has the potential to impact upon water quality, hydrology, and the potential for flooding. NRW will have to be consulted and hydrological modelling possibly carried out.	0
Soils	Although no ground investigation along the proposed alignment of this option has been carried out, it is likely that all structures will be piled.	0

Society		
Transport Safety	Limited reduction in accidents at Merlins Bridge. No impact upon identified cluster sites,	0
Personal security	No personal security impacts have been identified.	0

Permeability	Reduction of traffic flows might provide some localised benefit to NMUs crossing the roundabout However, the effect is considered neutral overall.	**0**
Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option.	**0**
Social Inclusion	The option is likely to have a neutral effect in terms of accessibility to health care, education, shopping and leisure facilities.	**0**
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	**0**

Transport Planning Objectives		
Improve journey time and reliability	Limited improvements to journey time benefits W/B offset by additional delay caused by additional congestion E/B.	**0**
Enhance network resilience	Additional highway assets but increased maintenance liabilities	**0**
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	**0**
Avoid adverse environmental impact	Minimal environmental impact so avoidance of environmental impact better than other options.	**++**
Provide environmental benefit	Limited opportunity for environmental enhancement	**0**
Reduce personal injury accidents	Grade separation advantage off-set by junction complexity.	**0**
Improve permeability and opportunities for active travel	Permeability slightly impaired by elevated structure and traffic re-routing	**0**

Other Issues	
Health impact	Marginal improvement to access to Withybush Hospital may be experienced.
Stakeholder acceptability	No public or stakeholder consultation has been undertaken
Technical and operational feasibility	Option will have 50kph design standards horizontally with 30kph Design Speed due to vertical alignment constraints. This complies with recognised lower standards in the Design Manual for Roads and Bridges (DMRB) although a combination of the two may not be acceptable. Due to the urban nature of the area there will be a considerable amount of disruption when this option is constructed.
Affordability and deliverability	The cost estimate is very preliminary and does not take into account any land or statutory undertaker's costs
Risk	Funding – the availability of funding is unknown at present. General acceptability – no consultation has been carried out. Process - PI may be needed due to impact on local area Ecology – Environmental Groups may object to this option
Comment	

Option 4B	**Description**	Haverfordwest Town Centre Traffic Proposals Salutation Square roundabout stopping up of New Road arm, dedicated at-grade left filter for Cambrian Place and new 4 arm signalised junction on Freeman's Way at County Hall. Freeman's Way widening at signalisation; 3 lane storage s/b, 2 lanes n/b

Economy	**Assessment / Comment**	**Significance**
Transport Economic Efficiency -TEE	£1.1M (no land or stats) Localised journey time benefits within Haverfordwest, but offset with disbenefit caused by additional traffic signals.	**-**
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	**0**

Environment		
Noise	Marginal change in vehicle positions and noise envelope may affect some receptors.	**0**
Local Air Quality	Marginal change in vehicle positions and air quality envelope may affect some receptors.	**0**
Greenhouse Gas Emissions	Little change on balance as reduced congestion at Salutation roundabout offset by increased congestion at County Hall traffic signalis.	**0**
Landscape and Townscape	Minor townscape effects but within an area already characterised by modern highway infrastructure.	**0**
Bio-diversity	Within an urban built-up environment. Impacts to biodiversity are considered neutral.	**0**
Heritage	Potential impact to unknown archaeology. There are 100 historic artefacts, 54 listed buildings, 71 ancient and historical monuments and 5 portable antiques within 250 m of the proposed option. The proposed option is within the Milford Haven Waterway historic landscape.	**-**
Water Environment	Increased hard paved area but mitigated by drainage design.	**0**
Soils	Small amount of urban land take.	**0**

Society		
Transport Safety	Limited reduction in accidents at Merlins Bridge. No impact upon identified cluster sites,	**0**
Personal security	Illuminated footways will be maintained, little change.	**0**
Permeability	Unlikely to increase or reduce community severance for NMUs.	**0**
Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option.	**0**
Social Inclusion	The option is likely to have a neutral effect in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	**0**
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	**0**

Transport Planning Objectives		
Improve journey time and reliability	Limited improvements to journey time benefits W/B offset by additional delay caused by additional set of traffic signals.	**0**
Enhance network resilience	Similar assets, little extra maintenance.	**0**
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	**0**
Avoid adverse environmental impact	Minimal environmental impact so avoidance of environmental impact better than other options.	**++**

Provide environmental benefit	Little improvement expected due to small scale and localised nature of works.	**0**
Reduce personal injury accidents	Little improvement expected due to small scale and localised nature of works.	**0**
Improve permeability and opportunities for active travel	Neutral	**0**

Other Issues	
Health impact	Neutral impact on journey time to Withybush Hospital, reduced congestion at roundabout offset by increased congestion at traffic signals.
Stakeholder acceptability	Loss of some green space and increased traffic control/congestion outside County Hall not expected to be favoured by Pembrokeshire CC. Some small amount of private land take required,
Technical and operational feasibility	Very feasible to construct and maintain, well established traffic signal technology.
Affordability and deliverability	Low cost and easy to construct. Some traffic disruption during construction in town centre.
Risk	Difficulties may be experienced achieving technical approval by Pembrokeshire CC of the non-standard traffic layout on a county road (departures from standard).
Comment	

Option 4C	Description	Haverfordwest Town Centre Traffic Proposals (Study) Various traffic performance assessments and minor layout/timing/signage works incorporating 4 roundabouts, 2 signalised junctions and one-way system in St.Mary's area. ***REQUIRES FURTHER STUDY TO POPULATE AST***

Economy	Assessment / Comment	Significance
Transport Economic Efficiency -TEE	£0.5M (proposed budget allocation)	
Wider Economic Impacts - EALI		

Environment		
Noise		
Local Air Quality		
Greenhouse Gas Emissions		
Landscape and Townscape		
Bio-diversity		
Heritage		
Water Environment		
Soils		

Society		
Transport Safety		
Personal security		
Permeability		
Physical Fitness		
Social Inclusion		
Equality, Diversity & Human Rights		

Transport Planning Objectives		
Improve journey time and reliability		
Enhance network resilience		
Aid regeneration & support regional economy		
Avoid adverse environmental impact		
Provide environmental benefit		
Reduce personal injury accidents		
Improve permeability and opportunities for active travel		

Other Issues	
Health impact	
Stakeholder acceptability	
Technical and operational feasibility	
Affordability and deliverability	
Risk	
Comment	

Option 5	Description	Haverfordwest South East Bypass A40 Golf Course to A477 Sentry Cross Proposed off-line bypass to Haverfordwest & Johnston 9.2Km no 2+1 (PCC Option 3)

Economy	Assessment / Comment	Significance
Transport Economic Efficiency -TEE	£50.3M (no land or stats) Journey time savings for existing traffic along the A4076 due to increased speed, shorter distance and up to 34% savings in journey time variability. Journey time benefit of just over 2 minutes.	+ +
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	+ +

Environment		
Noise	As this option passes through open countryside there will be noise impacts in areas that are currently not subject to any of a direct nature. A reduction in traffic flows on existing roads that currently carry through traffic will result in reductions in traffic noise in adjacent communities.	0
Local Air Quality	Option passing through open countryside there will be a worsening of air quality in areas that are currently not subject to any air pollution of a direct nature. A reduction in traffic flows on existing roads that currently carry through traffic will result in improvements in air quality in adjacent communities, and for pedestrians and cyclists who use local roads.	0
Greenhouse Gas Emissions	Improved highway standards compared to the existing route will result in improvements in fuel consumption as flow conditions will be more constant. However, this will be offset through the construction of an entirely new road. A reduction in traffic flows on some other existing roads will also have a role to play in improving fuel consumption due to less congestion. Compared to the other options, a slight improvement in greenhouse gas emissions similar to that experienced for Options 1 to 3 is expected.	+
Landscape and Townscape	Scheme proposals cut across open countryside, including crossing the Western Cleddau valley. Potential adverse impacts on landscape character and visual receptors, both on the urban fringe and individual rural settlements. The Western Cleddau is evaluated as Outstanding in the Landmap Visual & Sensory aspect and the proposed crossing is close to the Pembrokeshire Coast National Park boundary. Rural field pattern, boundaries and prevailing topography will be disrupted by the scheme proposals.	- - -
Bio-diversity	Potential impacts to protected sites including the Pembrokeshire Marine SAC, Milford Haven Waterways SSSI, Pembrokeshire Bat Sites and Bosherston Lakes SAC and Slebech Stable Yard Loft and Cellars SSSI. Potential impact to protected species including a number of bat species (Greater horseshoe of particular note), otters, badgers, reptiles and Atlantic Salmon. Potential impacts to habitats such as hedgerows.	- - -

Heritage	Potential impact to unknown archaeology on off-line areas. No direct impacts to any known HER sites, listed buildings/ structures or Scheduled ancient monuments. Within 250m of 1 listed building and 1 Scheduled Ancient Monument. Intersects with Milford Haven Waterway historic landscape. The proposed option intersects the Milford Haven Waterway historic landscape as its travels around the SE quadrant of Haverfordwest and over the River Cleddau. It leaves the designation before then re-entering it for a short distance to the west of Rosemarket. Its tie-in point at Sentry Cross Roundabout is on the boundary of the designation.	- -
Water Environment	It is likely that the Western Cleddau river crossing will be a multi-span structure. Piers are likely to be positioned in the floodplain rather than the river itself. Any river crossing has the potential to impact upon water quality, hydrology, and the potential for flooding. The EA will have to be consulted and hydrological modelling carried out. The proposal passes within 500 metres of at least seven bodies of water, including a large one at Johnston Kilns. Two of these are likely to be directly affected.	- -
Soils	Moderate adverse impact due to large land take required and completely offline nature of scheme. Severance of land needs to be considered.	- -

Society		
Transport Safety	Increased safe overtaking opportunity and reduces side road accesses. Reduction in collisions at Merlins Bridge, Salutation and Scotchwell Roundabouts with reductions expected along the route due to designed to modern standards with less junctions No impact at identified accident cluster sites.	+ +
Personal security	No personal security impacts have been identified. Consideration needs to be given to the design of underpasses to accommodate cycle routes that cross the alignment.	0
Permeability	Provides relief from community severance through Haverfordwest and Johnston. Severs eight public rights of way. As the impacts to public rights of way can be mitigated the impact is considered moderate beneficial overall.	++
Physical Fitness	No NMU facilities are proposed as part of the option. Removal of traffic from the existing A4076 may help facilitate traffic by active modes.	+
Social Inclusion	The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	+
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	0

Transport Planning Objectives		
Improve journey time and reliability	Significant improvement to journey times along the route expected from shorter distance travelled and designed to national speed limit. Up to 34% saving in journey time variability.	+ +
Enhance network resilience	Wholly offline so provides good alternative route to the A40, A4076 and A477 around Haverfordwest and Johnston. Limited construction disruption to motorists due to offline nature except for crossings of local roads and Eastern Cleddau. Increased maintenance liability of 9.2km of new single carriageway including new structures.	+
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	+ +

Avoid adverse environmental impact	Overall moderate adverse impact expected as scheme cuts across greenfield site and Western Cleddau with environmentally important designations.	- -
Provide environmental benefit	Limited opportunities to provide benefit other than improvement to greenhouse gas emissions.	+
Reduce personal injury accidents	Accident savings with improved road standard and overtaking opportunities.	+ +
Improve permeability and opportunities for active travel	Provides relief from community severance through Haverfordwest and Johnston. Removal of traffic from the existing A4076 may help facilitate traffic by active modes.	++

Other Issues	
Health impact	Neutral
Stakeholder acceptability	No public or stakeholder consultation has been undertaken on this option.
Technical and operational feasibility	No technical issues have been identified to date - standard highway and bridge construction and routine maintenance. A significant bridge is required to cross the Western Cleddau (approximately 360m long) which will require flood assessment and consideration of environmental mitigation, Work required to accommodate.protect services including overhead power lines and LNG pipeline.
Affordability and deliverability	Not currently funded in any road improvement programmes. Outline design stage only - further optioneering, WelTAG Stage 1 study and economic assessment work required to justify route option.
Risk	Funding and economic viability risk. Early stage of development so risk register required to identify and manage risks.
Comment	

Option 6	**Description**	Haverfordwest South East Bypass A40 Golf Course to A4076 Dredgeman's Hill Proposed off-line bypass to Haverfordwest & A4076 Dredgeman's Hill north of Johnston 4.8km no 2+1 (Truncated version of PCC Option 3)

Economy	**Assessment / Comment**	**Significance**
Transport Economic Efficiency -TEE	£34.6M (no land or stats) Journey time savings for existing traffic along the A4076 due to increased speed, shorter distance and up to 21% savings in journey time variability. Journey time benefit of just under 1 minute.	**+ +**
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	**+ +**

Environment		
Noise	As this option passes through open countryside there will be noise impacts in areas that are currently not subject to any of a direct nature. A reduction in traffic flows on existing roads that currently carry through traffic will result in reductions in traffic noise in adjacent communities.	**0**
Local Air Quality	Option passing through open countryside there will be a worsening of air quality in areas that are currently not subject to any air pollution of a direct nature. A reduction in traffic flows on existing roads that currently carry through traffic will result in improvements in air quality in adjacent communities, and for pedestrians and cyclists who use local roads.	**0**
Greenhouse Gas Emissions	Improved highway standards compared to the existing route will result in improvements in fuel consumption as flow conditions will be more constant. However, this will be offset through the construction of an entirely new road. A reduction in traffic flows on some other existing roads will also have a role to play in improving fuel consumption due to less congestion. Compared to the other options, a slight improvement in greenhouse gas emissions similar to that experienced for Options 1 to 3 is expected.	**+**
Landscape and Townscape	Scheme proposals cut across open countryside, including crossing the Western Cleddau valley. Potential adverse impacts on landscape character and visual receptors, both on the urban fringe and individual rural settlements. The Western Cleddau is evaluated as Outstanding in the Landmap Visual & Sensory aspect and the proposed crossing is close to the Pembrokeshire Coast National Park boundary. Rural field pattern, boundaries and prevailing topography will be disrupted by the scheme proposals. Area of visual influence and landscape effects less extensive than Option 5, but still includes the most sensitive landscape receptors and significant impacts.	**- -**
Bio-diversity	Potential impacts to protected sites including the Pembrokeshire Marine SAC, Milford Haven Waterways SSSI, Pembrokeshire Bat Sites and Bosherston Lakes SAC and Slebech Stable Yard Loft and Cellars SSSI. Potential impact to protected species including a number of bat species (Greater horseshoe of particular note), otters, badgers, reptiles and Atlantic Salmon. Potential impacts to habitats such as hedgerows.	**- -**

Heritage	Potential impact to unknown archaeology on off-line areas. No direct impacts to any known HER sites, listed buildings/ structures or Scheduled ancient monuments. Within 250m of 1 listed building and 1 Scheduled Ancient Monument. Intersects with Milford Haven Waterway historic landscape. Despite the route being shorter than option 5 the potential impact on known listed buildings and scheduled ancient monuments remains the same.	- -
Water Environment	It is likely that the Western Cleddau river crossing will be a multi-span structure. Piers are likely to be positioned in the floodplain rather than the river itself. Any river crossing has the potential to impact upon water quality, hydrology, and the potential for flooding. The EA will have to be consulted and hydrological modelling carried out.	- -
Soils	Slight adverse impact due to large land take required and completely offline nature of scheme.	-

Society		
Transport Safety	Increased safe overtaking opportunity and reduces side road accesses. Reduction in collisions at Merlins Bridge, Salutation and Scotchwell Roundabouts with reductions expected along the route due to designed to modern standards with less junctions No impact at identified accident cluster sites.	+ +
Personal security	No personal security impacts have been identified.	0
Permeability	Provides relief from community severance through Haverfordwest. Severs eight public rights of way. As the impacts to public rights of way can be mitigated the impact is considered slight beneficial overall.	+
Physical Fitness	No NMU facilities are proposed as part of the option. Removal of traffic from the existing A4076 may help facilitate travel by active modes.	+
Social Inclusion	The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	+
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	0

Transport Planning Objectives		
Improve journey time and reliability	Significant improvement to journey times along the route expected from shorter distance travelled and designed to national speed limit. Up to 21% saving in journey time variability.	+ +
Enhance network resilience	Wholly offline so provides good alternative route to the A40 and A4076 around Haverfordwest. Limited construction disruption to motorists due to offline nature except for crossings of local roads and Eastern Cleddau. Increased maintenance liability of 4.8km of new single carriageway including new structures.	+
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	+ +
Avoid adverse environmental impact	Overall moderate adverse impact expected as scheme cuts across greenfield site and Western Cleddau with environmentally important designations.	- -
Provide environmental benefit	Limited opportunities to provide benefit other than improvement to greenhouse gas emissions.	+
Reduce personal injury accidents	Accident savings with improved road standard and overtaking opportunities.	+ +

Improve permeability and opportunities for active travel	Provides relief from community severance through Haverfordwest. Removal of traffic from the existing A4076 through Haverfordwest may help facilitate traffic by active modes.	++

Other Issues	
Health impact	Neutral
Stakeholder acceptability	No public or stakeholder consultation has been undertaken on this option.
Technical and operational feasibility	No technical issues have been identified to date - standard highway and bridge construction and routine maintenance. A significant bridge is required to cross the Western Cleddau (approximately 360m long) which will require flood assessment and consideration of environmental mitigation, Work required to accommodate.protect services including overhead power lines.
Affordability and deliverability	Not currently funded in any road improvement programmes. Outline design stage only - further optioneering, WelTAG Stage 1 study and economic assessment work required to justify route option. Shorter route than Option 5 but involves Western Cleddau bridge design and construction so may not be quicker to deliver.
Risk	Funding and economic viability risk. Early stage of development so risk register required to identify and manage risks.
Comment	