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A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

ENVIRONMENTAL STATEMENT
VOLUME 1: TECHNICAL ASSESSMENT REPORT

July 2019

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Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 1: Introduction

A40LVP-RML-EGN-SWI-RP-LE-0001

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08/07/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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1 Introduction

1.1 The Scheme

1.1.1 This document is Volume 1 of the Environmental Statement (ES) for the A40 Llanddewi Velfrey to Penblewin Improvement (referred to in this document as 'the Scheme'). The ES reports the findings of the Environmental Impact Assessment (EIA) process. The Scheme consists of:

a) A northern bypass for the village of Llanddewi Velfrey from Bethel Chapel to Ffynnon.

b) Online improvements to the A40 from the settlement of Ffynnon westwards to Penblewin Roundabout.

1.1.2 In accordance with Regulation 61 of the Conservation of Habitats and Species Regulations 2010 and Regulation 63 of the Conservation of Habitats and Species Regulations 2017, an Assessment of Implications on European Sites (AIES) has also been prepared to consider the possible effects of the Scheme on European sites. The findings of the AIES are reported separately. ES Chapter 8 Ecology and Nature Conservation also addresses ecological and nature conservation aspects of the Scheme.

1.1.3 The existing A40 Trunk Road runs between London and Goodwick and is officially known as the London to Fishguard Trunk Road. The A40 crosses the River Severn at Gloucester and the River Wye at Ross-on-Wye and then passes through Brecon, Abergavenny, Carmarthen and Haverfordwest terminating on the harbour in Fishguard Bay. The Scheme includes a proposed improved section of Trunk Road over a total length of 4.3km between Llanddewi Velfrey and Penblewin Roundabout.

1.1.4 The redundant sections of existing A40 road would be reclassified and cease to be a trunk road, reverting to the local authority.

1.1.5 The location of the Scheme is shown on Figure 1.1 in Volume 2. Further details of the Scheme are provided in Chapters 2 and 3 of this ES.

1.2 Purpose of the Environmental Statement (ES)

1.2.1 EIA is a means of identifying and collating information to inform an assessment of the likely significant environmental effects of a project. The findings of the EIA process are reported in an ES in order to ensure that, when deciding whether to grant consent for a project, the decision-maker has access to information regarding the likely significant effects on the environment. This allows these effects to be considered in the decision-making process. The requirement to prepare an ES is set out in law.

The EIA Directive

1.2.2 Amendments made to the EIA Directive 2011/92/EU by Directive 2014/52/EU, require several significant changes to the EIA regime in Wales. The legislative framework for EIA is set by European Directive 2011/92/EU, as amended by Directive 2014/52/EU (collectively referred to as the EIA Directive). The current Directive requires EIA to be undertaken in support of an application for development consent for certain types of schemes.

1.2.3 In accordance with Regulation 61 of The Conservation of Habitats and Species Regulations 2010, an Assessment of Implication of European Sites (AIES) has also been carried out to consider the possible effects of the Scheme on European sites. The findings of the AIES are reported within a Statement to Inform an Appropriate Assessment.

The EIA Regulations

1.2.4 For highways schemes, the requirements of the EIA Directive are currently transposed by the Highways Act 1980, as amended by The Highways (Assessment of Environmental Effects) Regulations 1999 and The Highways (Environmental Impact Assessment) Regulations 2007 and more recently by the Environmental Impact Assessment (Miscellaneous Amendments Relating to Harbours, Highways and Transport) Regulations 2017. The latter came into effect on 5 December 2017.

Requirement for EIA

1.2.5 The proposed 4.3km long A40 Llanddewi Velfrey to Penblewin Improvements requires an EIA because the Scheme is of sufficient size

to be a 'relevant project' as defined in Annex II, '*a project for constructing or improving a highway where the area of the completed works together with any area occupied during the period of construction or improvement by requisite apparatus, equipment, machinery, materials, plant, spoil heaps or other such facilities exceeds 1 hectare or where any such area is situated in whole or in part in a sensitive area.'* The Scheme will require over 27 hectares of land and therefore exceeds the minimum threshold to become a 'relevant project'.

1.2.6 Guidance in relation to the procedure for determining whether or not an EIA is required for highways schemes is set out in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 3 (HD 47/08) (Highways Agency et al., 2008) and Interim Advice Note (IAN) 126/09(W) (Welsh Assembly Government, 2011). This requires that a 'determination' process is followed for certain highways schemes. The determination process (Screening) for this EIA is set out in Chapter 4 Environmental Impact Assessment Methodology, Section 3 and the full Screening Report and Record of Determination are included in Volume 3 Appendix 4.3.

1.3 Scope and content of the ES

1.3.1 Although there is no statutory provision as to the form of an ES, Section 105A of the Highways Act 1980, as amended, requires that the ES must contain the information referred to in Annex IV of the EIA Directive. That information must include at least:

c) a description of the project (comprising information on the site, design and size of the project);

d) a description of the measures envisaged in order to avoid, reduce, and, if possible, remedy significant adverse effects;

e) the data required to identify and assess the main effects which the project is likely to have on the environment;

f) an outline of the main alternatives studied by the Secretary of State and an indication of the main reasons for their choice (taking into account the environmental effects);

g) a non-technical summary of the information mentioned in paragraphs (a) to (d).' (Highways Act 1980, as amended, Section 105A)

1.3.2 This ES provides the information set out above, together with other relevant information listed in the EIA Directive. The information

supplied within this ES is considered to provide a clear understanding of the main or likely significant effects of the Scheme on the environment. Further detail regarding the scope of the ES in relation to legislative requirements is provided in ES Chapter 4 Environmental Impact Assessment Methodology. The Scoping Report is included in Volume 3 Appendix 4.1.

Structure of the ES

1.3.3 The ES has been structured in order to allow relevant environmental information to be easily accessible. This volume of the ES (Volume 1) includes the main text of the ES.

Chapter 2: description of the Scheme and information relating to construction of the Scheme
Chapter 3: information relating to the main alternatives considered during the evolution of the Scheme and the reasons for the choices made.
Chapter 4: outlines the approach and methodology adopted during the EIA process.
Chapter 5: legislative and policy context

1.3.4 The ES Volume 1 environmental assessment topic chapters that follow Chapter 5 are listed in Table 1.1.

Table 1.1 Structure of this ES

Chapter	Topic title
2	The Project
3	Alternatives Considered
4	Environmental Impact Assessment Methodology
5	Legislation and Policy Context
6	Geology and Soils
7	Road Drainage and the Water Environment
8	Ecology and Nature Conservation
9	Landscape and Visual Effects
10	Archaeology and Cultural Heritage
11	Community and Private Assets (excluding agriculture)
12	Community and Private Assets: Agriculture
13	Air Quality
14	Noise and Vibration
15	All Travellers
16	Materials
17	Population and Human Health
18	Climate Change
19	Assessment of Cumulative Effects: Introduction
20	Assessment of Cumulative Effects: Same scheme effects
21	Assessment of Cumulative Effects: different scheme effects
22	Management of Environmental Effects
23	Conclusions

1.3.5 Figures and appendices to accompany the text of the ES are provided separately in Volumes 2 and 3. Volume 3 includes specialist reports providing relevant background and technical information.

1.3.6 A Non-Technical Summary (NTS) of the ES, using non-technical terminology, is available as a separate bilingual document.

1.3.7 A habitats regulations assessment has been undertaken for the project due to the proximity of European designated sites and the presence of European Protected Species. Following a screening assessment a full Assessment of the Impacts on European Sites (AIES) has been completed. The completed assessment is include in appendix 1.1

The Assessment Team

1.3.8 The Welsh Government (as the Overseeing Organisation) awarded a Professional Services Contract for the Scheme development and environmental surveys, including publication of the ES and up to any Public Local Inquiry. The contract was awarded to Carillion plc, supported by Arup and Richards Moorehead & Laing Ltd (RML). In January 2018, Carillion went into liquidation and so Welsh Government awarded a contract to Arup supported by RML to complete the contract for preparation of draft Orders and the statutory process (Key Stages 3 and 4).

1.3.9 The EIA process was managed by Arup and RML, taking into account information and assessments provided by the Welsh Government and the design team. Individual chapters were prepared by authors from Arup and RML.

1.4 Publication of the ES

1.4.1 This ES has been submitted alongside the draft Orders for the Scheme. Statutory Orders are prepared by Welsh Ministers and published in draft. The draft Orders for the Scheme include the following.

A draft Line Order to provide for the new section of trunk road and the reclassification of the existing A40 (detrunking).

A draft Side Roads Order to deal with local highway issues (including roads, footpaths, bridleways, byways and cycleways) and private access issues. Side Roads Orders can relate to closure, diversion, improvement or new provision.

A draft Compulsory Purchase Order, which provides for the acquisition of the land and rights required.

How to view or obtain copies of the documents

1.4.2 Copies of the draft Orders, the ES and supporting information are available to view during normal office hours at the following locations:

Welsh Government office of the Orders Branch, Transport, Department of Economy Science and Transport, Welsh Government, Cathays Park, Cardiff, CF10 3NQ.

Pembrokeshire County Council, County Hall, Haverfordwest, Pembrokeshire, SA61 1TP

Llanddewi Velfrey Village Hall, Llanddewi Velfrey SA67 7PA;

Preseli Services Petrol Station, Llanddewi Velfrey SA67 7PD

Narberth Library, Kirkland Arms, 34 St. James St, Narberth SA67 7BU; or Narberth Queen's Hall, 44 High Street, Narberth, SA67 7AS

Whitland Town Hall, 1 King Edward Street, Whitland SA34 0AA

1.4.3 Further copies of the Non-Technical Summary can be obtained free of charge from the Welsh Government in Cardiff at the following address: Orders Branch Transport Department of Economy, Science and Transport Welsh Government Cathays Park, Cardiff CF10 3NQ.

1.4.4 The full ES is available to view and download from the Welsh Government website: http://www.wales.gov.uk/transport

1.4.5 Electronic copies of the ES (on DVD) can be purchased from the above Welsh Government address at a cost of £20 (including postage and packaging).

1.4.6 Paper copies of the ES are also available from the above address, although an administrative charge will be made to cover the cost of copying (price on application).

1.5 Next Steps

1.5.1 Following publication of the draft Orders, there will be an opportunity to support, comment or object to the draft Orders, put forward alternative proposals, or comment on the ES by writing to the Welsh Government at the address below:

Orders Branch,
Transport Department of Economy, Science and Transport,
Welsh Government,
Cathays Park,
Cardiff CF10 3NQ.

1.5.2 All such correspondence should be sent to arrive at the Welsh Government no later than Friday 20th September 2019.

1.5.3 Welsh Government will consider all of the responses to the draft Orders and then decide whether to hold a Public Local Inquiry. Such Inquiries

are held before an independent Inspector who would hear and consider the evidence both for and against the published Scheme and subsequently report the findings and recommendations to the responsible Welsh Ministers. The Welsh Ministers would consider all issues before deciding whether to proceed with the Scheme and, if so, make the Orders with or without modification.

1.5.4 Subject to the above process, the key dates for progressing the Scheme are set out in Figure 1.2. Note that Key Stage 5 is an internal Welsh Government procedure.

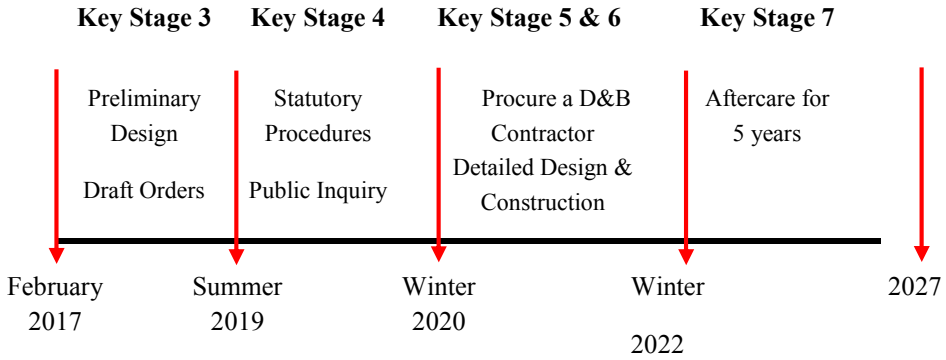

Figure 1.2 Project timeline

1.6 Abbreviations within the Environmental Statement

1.6.1 Below is a table of the abbreviation used within this Environmental Statement

Table 1.2 Abbreviations used in the Environmental Statement

Abbreviation	Full term
AIES	Assessment of Implications on European Sites
ALC	Agricultural Land Classification
ASSI	Area of Special Scientific Interest
AQMA	Air Quality Management Areas
BAI	Bat Activity Index
BMV	Best and Most Versatile
BTO	British Trust for Ornithology
CCC	Carmarthenshire County Council
CCR	Climate Change Resilience
CCTV	Closed Circuit Television
CEMP	Construction Environmental Management Plan
CPO	Compulsory Purchase Act
CRoW	Countryside Rights of Way
CRTN	Calculation of Road Traffic Noise
D&B	Design and Build
DAT	Dyfed Archaeological Trust
DCfW	Design Commission for Wales
DEFRA	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
DTM	Digital Terrain Model
DWI	Drinking Water Inspectorate
EAR	Environmental Appraisal Report
ECAT	Environmental Co-ordination and Advice Team
ECoW	Environmental Clerk of Works
ECO	Environmental Co-ordinator
EFA	Environmental Function A from DMRB vol10
EFB	Environmental Function B from DMRB vol10
EIA	Environmental Impact Assessment
EMP	Environmental Master Plans
EMS	Environmental Management Systems

Abbreviation	Full term
EPS	European Protected Species
EQS	Environmental Quality Standards
ES	Environmental Statement
ESCR	Earth Science Conservation Review
GWDD	Groundwater Daughter Directive
GCR	Geological Conservation Review
GHG	Green House Gas
GLVIA	Guidelines for Landscape and Visual Impact Assessment
HAWRAT	Highways Agency Water Risk Assessment Tool
HEDPR	Handover Environmental Design Performance Report
HIA	Health Impact Assessment
HV	High Voltage
I&TP	Inspection & Test Plan
IAN	Interim Advice Note
ICCI	In-combination Climate Change Impact assessment.
IROPI	Imperative Reasons of Overriding Public Interest
ITS	Intelligent Transport Systems
JNCC	The Joint Nature Conservation Committee
LB	Listed Buildings
LCA	Landscape Character Area
LDP	Local Development Plan
LED	Light Emitting Diodes
LLFA	Local Lead Flood Authority
LV	Low Voltage
LVIA	Landscape and Visual Impact Assessment
MEMP	Maintenance Environmental Management Plan
NAPPA	Noise Action Plan Priority Areas
NCR	Non-Conformance Reporting
NDF	National Development Framework
NERC	Natural Environment and Rural Communities Act 2006
NGR	National Grid References
NMU	Non-Motorised Users
NNR	National Nature Reserve
NRW	Natural Resources Wales
NTS	Non-Technical Summary
OS	Ordinance Survey
PCC	Pembrokeshire County Council

Abbreviation	Full term
PCNP	Pembrokeshire Coast National Park
PCO	Pollution Control Officer
PIE	Public Information Exhibition
PLO	Public Liaison Officer
PMA	Private Means of Access
PMAs	Permanent Alternative Access Arrangements
PNTP	Prioritised National Transport Plan
PPW10	Planning Policy Wales Edition 10
PRoWS	Public Rights of Way
QA	Quiet Areas
RBMP	River Basin Management Plan
REAC	Register of Environmental Commitments and Actions
RSPB	Royal Society for the Protection of Birds
SAC	Special Areas of Conservation
SAM	Scheduled Ancient Monuments
SIA	Social Impact Assessment
SIAA	Statement to Inform an Appropriate Assessment
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SWTRA	South Wales Trunk Road Agency
TAN	Planning Guidance (Wales) Technical Advice Note
TREBAP	Trunk Road Estate Biodiversity Action Plan
UKAS	United Kingdom Accreditation Service
WCA	Wildlife and Countryside Act
WFD	Water Framework Directive
WelTAG	Welsh Transport Appraisal Guidance
WHO	World Health Organisation
WIIP	Wales Infrastructure Investment Plan
WSP	Wales Spatial Plan
ZoI	Zone of Influence
ZVT	Zone of Theoretical Visibility

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 2: The Project

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2 The Project

2.1 Chapter introduction

2.1.1 This chapter provides a description of the Scheme together with the process of construction, which forms the basis for the environmental assessment provided in this Environmental Statement (ES).

Location of the Scheme

2.1.2 The National Grid References (NGR) for the limits of the proposed new section of trunk road are as follows.

a) Western tie-in with the A40 (west of Penblewin Roundabout) NGR: E 211948, N 216632, (SS 1195 1663);

b) Eastern tie-in with the A40 (east of Llanddewi Velfrey) NGR: E 216232, N 216974, (SS1623 1697).

2.1.3 The location is shown in Volume 2 Figure 1.1.

2.1.4 The likely significant effects of the Scheme have been described throughout the ES taking account of the requirements of the EIA Directive 2011/92/EU, as amended by Directive 2014/52/EU. Several measures have been incorporated into the design of the Scheme to avoid or reduce potential adverse environmental effects. In some cases, these measures may result in enhancement of environmental conditions.

2.1.5 Chapters 2 and 3 of this ES, together with the subsequent topic chapters, provide the data and information required to identify and assess the likely significant effects of the Scheme in accordance with Annex IV of the EIA Directive (see Chapter 5 Legislation and Policy Context for further details). 'Chainage' (Ch) refers to a point in metres from the western (Penblewin) end of the new section of the A40. Thus chainage (Ch) 750 is located 750m (metres) east of the Penblewin tie-in, which is slightly to the west of the existing roundabout.

2.2 Context

2.2.1 The whole A40 Llanddewi Velfrey to Penblewin Scheme lies within the administrative area of Pembrokeshire County Council (PCC). The

eastern end, at Bethel Chapel is 1.3km away from the boundary with Carmarthenshire County Council (CCC) (refer to Volume 2 Figure 2.1).

2.2.2 The A40 is important to the economy of West Wales. It forms part of the Trans-European Transport Network, transporting people and goods to homes, industry and employment and it provides access to ports and serves the Welsh tourism industry.

Existing A40: environmental context

2.2.3 The scheme lies between Carmarthen (Carmarthenshire) and Haverfordwest (Pembrokeshire). The Preseli Hills lie 12km to the north and Carmarthen Bay is 10km to the south. Two kilometres to the west are the upper reaches of the Afon Cleddau, while the closest boundary of the Pembrokeshire Coast National Park (PCNP) lies 7km away to the south west. The setting of the existing A40 within the Pembrokeshire administrative area is shown on Volume 2 Figure 2.1. Volume 2 Figure 2.2 shows the statutory designations near the Scheme. Volume 2 Figure 2.3 shows the geographical characteristics and environmental constraints within which the scheme is set. Volume 2 Figures 2.4A and 2.4B show the total permanent land take of the Scheme. A series of photographs which illustrate the existing site are provided in Volume 2 Figures 2.5A and 2.5B. Volume 3 Appendix 2.6 shows the General Arrangement drawings for the Scheme. The Environmental Masterplan, which sets out the proposed landscape and environmental mitigation scheme, is shown in Volume 3 Appendix 2.5 Sheets A to F.

2.2.4 The Scheme is set in the rural, lowland agricultural setting of east Pembrokeshire with a mainly dispersed population in individual agricultural holdings and small villages. The land is rolling in character with the Preseli Hills lying some 12km to the north and Carmarthen Bay approximately 10km to the south. The fields are enclosed with hedges and hedge-banks with areas of woodland along watercourses and steeper slopes. There is some arable cultivation on better soils, generally on lower, shallower slopes. Wide views are possible from more elevated locations with the Preseli Hills and the intervening ridges visible to the north. The geographical characteristics and environmental constraints of the scheme are shown in Volume 2 Figure 2.3.

2.2.5 The existing A40 follows a route on more elevated ground by following a series of ridges and traversing valley slopes. The existing A40 and

the proposed Scheme are shown on a topographical plan in Volume 2 Figure 2.3. At Llanddewi Velfrey, the route follows the crest of a ridge with relatively steep slopes falling to the north and south. Here the north slopes of the ridge are broken by several narrow steep-sided and wooded valleys containing small northwards flowing watercourses fed by a line of springs along the ridge. These watercourses eventually flow west into the Afon Cleddau SAC or south into the Afon Taf. Further west, approaching Penblewin roundabout, the A40 passes through an area of more gently undulating farmland, close to the floor of the valley.

2.2.6 Settlements in the area are dispersed, mainly along the roads, while individual farms and houses are widely spaced and often hidden from each other and from roads by landform and vegetation. Houses coalesce into small groups along the A40. The village of Llanddewi Velfrey was originally a scattering of settlements centred around the medieval church which stands on the south-facing slope of the ridge. When the 18th century turnpike and then the current ridge-top road was made in the 19th century the centre of settlement migrated northwards to form a linear development, known as Commercial, along both sides of the A40 an important junction with the Llanfallteg Road. This linear settlement expanded north and south along side roads.

2.2.7 The modern village of Llanddewi Velfrey, which includes residential areas and recreational/community facilities, lies close to the existing A40. Immediately adjacent to the south side of the A40, in the centre of the study area is a triangle of land, formerly known as Cross Hands, formed between roads and occupied by a large group of properties. The second group, formerly called Commercial Cross, lies on the north side of the A40 less than 200m to the west. The third group, the old village of Llanddewi Velfrey, is gathered loosely around the church and lies approximately 1km to the south of the A40.

2.2.8 Because the existing A40 follows the crest of a ridge for much of its route between Pengawse and Robeston Wathen, it passes along the tops of the catchments of numerous small watercourses. The proposed Scheme, from the top of Pengawse Hill to Penblewin would follow the north slope of the ridge around Llanddewi Velfrey and so would cross the upper catchments of several watercourses. These receive water from a series of springs along the slopes of the ridge. The distribution of ‘Main Rivers’ are shown on Volume 2 Figure 2.3. To the east of Ffynnon, these watercourses flow north to discharge into the Afon Daulan and into the Afon Taf. To the west of Ffynnon, watercourses

flow north to tributaries of the Eastern Cleddau, or south into the Afon Marlais which in turn flows into the Afon Taf. The estuaries of both of these rivers are part of marine Special Areas of Conservation (SAC). Watercourses are considered further in Chapter 7 Road Drainage and the Water Environment.

Habitats and protected species

2.2.9 There are five SAC within 10km of the proposed Scheme and a further two SACs designated for bats within 30km of the site. There is one Special Protection Area within 10km of the site, but no Ramsar Sites are present within this 10km distance. There are no other Locally designated nature conservation sites. The locations of these designated sites are shown in Volume 2 Figure 2.2.

2.2.10 The habitats along the route support populations of European Protected Species (EPS), including bats, otter, dormouse and Barn Owl. There are populations of badger and reptiles.

Heritage Designations

2.2.11 There are a number of Listed Buildings (LB), for example the War Memorial (Grade II) beside the A40 in Llanddewi Velfrey and Ffynnon Baptist Chapel (Grade II) beside the A40 in Ffynnon Wood. In the wider setting there are several Scheduled Ancient Monuments (SAM) for example Llanddewi Gaer Promontory Fort which lies on higher ground to the south of the Scheme. There are also a wide range of non-designated archaeological sites that fall within the 600m wide corridor, for example there a number of burnt mounds, of Prehistoric origin along the Llanddewi Velfrey ridge, with some that are likely to be directly affected by the Scheme. Designated cultural heritage sites are shown in Volume 2 Figure 10.1.

Landscape Designations

2.2.12 Within the 5km study area there is one Registered Historic Park and Garden, Blackaldern, to the south of the scheme near Narberth. There are no Historic Landscape Areas. Designated landscapes are shown in Volume 2 Figure 9.4.

2.2.13 Pembrokeshire Coast National Park (PCNP), outside the study area, is made up of several different designated zones around the coast and the

location and extent of these is shown in Volume 2 Figure 9.4. An area of the park to the south-west of the Scheme includes the Aberdaugleddau estuaries, which are also designated as a SAC. The other areas of the PCNP are the coastal areas of Amroth and Saundersfoot. Further details of these areas are provided in Chapter 9 Landscape and the Visual Effects.

Prevailing weather conditions

2.2.14 The area receives a typical maritime climate characterised by weather that is often cloudy, wet and windy, but mild. Air quality is good and the Scheme does not pass through or near any Air Quality Management Areas (AQMA).

2.2.15 The Metrological Office data indicates that weather conditions are typical for the region, with an annual rainfall of 1,038mm, with November being the wettest month of the year. Over the year the mean annual temperature is 11°C ranging from a low of 4°C and a high of 19°C. The coldest month on average is February. The prevailing winds are from the west and southwest with wind speeds averaging 12mph over the year. The windiest month is December.

Noise Action Plan Priority Areas (NAPPA)

2.2.16 Llanddewi Velfrey is identified as a Noise Action Plan Priority Area. The NAPPA is considered in Chapter14 Noise and Vibration.

Existing Conditions

2.2.17 The A40 in West Wales is one of the lowest standard sections of the Trans-European Road Network in the UK. Between St Clears and Haverfordwest, the A40 is mostly single carriageway with few places for overtaking. The road has poor visibility and many accesses opening straight onto the road. A mix of traffic types use the A40, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents. There are occasional convoys of heavy goods vehicles from the ferry ports and slow-moving agricultural vehicles. In these circumstances, when combined with limited overtaking opportunity, this traffic flow can result in periods of platooning. A lack of strategic public transport connectivity in Pembrokeshire generally means there is a dependence on the private car for inter-urban connections.

2.2.18 During summer, traffic volumes can increase by over 30%, which further exacerbates the problems described above and leads to slow moving tourist traffic.

2.2.19 There is overtaking provision on both the eastbound and westbound directions, but this is inconsistently distributed along the A40 in west Wales. There is a total of 5.5km of overtaking provision in the westbound direction and 3.2km in the eastbound. In the context of the whole A40 corridor in Wales this is 13% of the total length of the trunk road which remains well below the 30% ratio advised for this type of route in the Design Manual for Roads and Bridges (DMRB)[1]. Where overtaking provision does exist, it is not spread along the length of the A40, so there are long lengths in each direction with no overtaking opportunities. This is the case for vehicles travelling east for at least 19km from Robeston Wathen towards St Clears roundabout and for vehicles travelling west for 9.5km from Canaston Bridge to Haverfordwest roundabout.

2.2.20 The Scheme includes the substandard section of existing road which passes through the centre of Llanddewi Velfrey, where there is a 40mph speed limit. The problems include numerous side road junctions and field and property accesses from the trunk road. Due to the amount of traffic, pedestrians have difficulty in crossing roads and drivers on the A40 face conflict with Non-Motorised Users, particularly along sections where footways are substandard. Severance of the village of Llanddewi Velfrey by the road and traffic is of particular concern to the local community.

2.2.21 Consultation with key stakeholders, including the Local Authority, Welsh Government Departments and the Regional Transport Planner has confirmed these problems:

a) The road is substandard and 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 safe overtaking opportunities.

b) Limited overtaking opportunities lead to poor journey time reliability and driver frustration.

c) Regular convoys of heavy goods vehicles from the ferry ports and slow-moving agricultural vehicles contribute to periods of

[1] Design Manual for Roads and Bridges, Volume 6 Section 1 Part 1, TD 9/93, Highway Link Design, The National Assembly for Wales, June 1993

platooning and journey time unreliability, which is exacerbated with limited overtaking opportunities.

d) Seasonal spikes in traffic volumes along the A40 especially during the summer months leads to slow moving traffic causing journey time unreliability, which is exacerbated with limited overtaking opportunities.

e) The community of Llanddewi Velfrey is severed by the A40, which reduces accessibility, increases risks of non-motorised user collisions and results in traffic noise and has the potential to cause localised air pollution.

f) There are many side road junctions and direct accesses to properties and agricultural fields off the A40, which contributes to operational problems along the road.

g) A mix of traffic types using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents.

h) A lack of strategic public transport connectivity in Pembrokeshire generally means there is a dependence on the private car for inter-urban connections.

Transport Planning Objectives

2.2.22 A number of transport planning objectives have been developed iteratively during previous development work and engagement on the A40 project, aiming to address one or more of the identified problems. During the early stages of Key Stage 3, the problems and objectives were refreshed during a focused workshop event with key stakeholders to take into account the WelTAG 2017 guidance and Well-being of Future Generations (Wales) Act 2015 well-being goals. The Scheme objectives are:

O1 To enhance network resilience and improve accessibility along the east-west transport corridor to key employment, community and tourism destinations.

O2 To improve prosperity and provide better access to the county town of Haverfordwest, the Haven Enterprise Zone and the West Wales ports at Fishguard, Milford Haven and Pembroke Dock.

O3 To reduce community severance and provide health and amenity benefits.

O4 To reduce the number and severity of collisions.

O5 To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles.

O6 To deliver a Scheme that promotes social inclusion and integrates with the local transport network to better connect local communities to key transport hubs.

O7 Deliver a project that is sustainable in a globally responsible Wales, taking steps to reduce or offset waste and carbon.

O8 Give due consideration to the impact of transport on the environment and provide enhancement when practicable.

Scheme Environmental Objectives

2.2.23 Working with the Statutory Consultees (Natural Resources Wales, Cadw, Pembrokeshire County Council, South Wales Trunk Road Agency and Welsh Government) the following Scheme Environmental Objectives were agreed:

We want to achieve

a) Avoid or mitigate impact to provide:

i. Minimise net loss of important habitat.

ii. Maintenance of existing habitat connectivity.

iii. No adverse impact on biodiversity.

iv. Protection of watercourses and water quality.

v. Effective landscape integration.

vi. Effective visual screening of the new road.

vii. An overall reduction in visual impact caused by through traffic.

viii. Safe carriageway crossings.

ix. Zero waste to landfill.

x. Minimal carbon footprint.

xi. Protect farms and other local businesses.

xii. Avoid or mitigate impact on cultural heritage to provide no permanent adverse impact on historic environment assets.

b) The benefits of the Scheme

Maximising delivery of added value:

i. Overall reduction in traffic noise for residential properties.

ii. Improved air quality for the residents of Llanddewi Velfrey.

iii. Habitat creation and improved habitat connectivity integrated effectively with the landscape through good design.

iv. Improve the impact of road drainage on water quality.

v. Improve access to and enhance enjoyment of the landscape and of any visible historic assets associated with the road corridor.

vi. Enabling walking, cycling and healthy lifestyles.

vii. Support education, learning and community involvement by maximising educational opportunities based on cultural and natural heritage assets.

viii. Research effective soil and vegetation management as a means of reducing whole life cost of the soft estate.

ix. Support community life and economic viability through enhanced cohesion and destination creation.

How we want to achieve it

a) Compliance with legislation.

b) Delivery of Welsh Government policy.

c) Work effectively together throughout the development of the project.

d) To offer a full and open exchange of information and views during project development to make sure that the right project for Wales is published.

e) To work together to develop deliverable and effective environmental mitigation.

2.3 The proposed Scheme

2.3.1 With the objective of maximising overtaking opportunities to relieve the kinds of problems identified in Section 2.2, and the environmental objectives, the Scheme will consist of two lanes in one direction, to allow overtaking, and one lane in the opposite direction. Overtaking provision will alternate so that both eastbound and westbound traffic have the opportunity to overtake. These will provide 1.4km extra overtaking opportunities for eastbound traffic and 1km extra of overtaking opportunities for westbound traffic. The Scheme includes a northern bypass of Llanddewi Velfrey from Bethel Chapel to Ffynnon Wood and an improvement to the existing road from Ffynnon Wood to

Penblewin Roundabout. The extent of land take for the Scheme is shown in two drawings in Volume 2 Figure 2.4, while the General Arrangement is shown in Volume 3 Appendix 2.6.

2.3.2 Where the proposed Scheme crosses or follows the existing A40, so that the footprint is the same, this is described as 'online'. Where the Scheme occupies an entirely different area of land this described as 'offline'.

Design speed and traffic flows

2.3.3 The Design Speed of the proposed Trunk Road is 100kmph and will be subject to national speed. Side Roads will be in keeping with the existing local road network.

2.3.4 Following the demise of Carillion in the design phase of the Scheme, traffic figures were reviewed to take account of the 7 months delay. As a result, the decision was taken to amend the original Opening Year and Design Year dates. The changes to traffic were small but Table 2.1 has been updated to summarise the total (all vehicles) for the Existing and Predicted traffic flows on the new trunk road in the **Base Year (2017)**, the amended **Opening Year (2021)** and the amended **Design Year (2036)**.

2.3.5 Table 2.2 provides a summary of the Existing and Predicted flows of heavy goods vehicles (HGVs) on the new trunk road in the Base Year (2017), the Opening Year (2021) and the Design Year (2036). Further details of traffic flows are provided in Volume 3 Appendix 2.1 Traffic Forecasting Report.

Table 2.1 Existing and Predicted Traffic Flows: A summary of the total annual average daily traffic flow (all vehicles) for new of the new trunk road in the Base Year, Opening Year and Design Year.

Location	Direction	Base Year 2016	Opening Year 2021		Difference from Do Minimum	Design Year 2036		Difference from Do Minimum
			Do Minimum	Do Something		Do Minimum	Do Something	
A40 west of Penblewin Roundabout	Eastbound	5,340	5,720	5,720	0%	6,500	6,500	0%
	Westbound	5,460	5,850	5,850	0%	6,660	6,660	0%
Proposed A40 between Penblewin Roundabout and Llanddewi Velfrey West Junction	Eastbound	-	-	6,110	-	-	7,110	-
	Westbound	-	-	5,960	-	-	6,950	-
Existing A40 between Penblewin Roundabout and Rest Area	Eastbound	5,820	6,260	490	-92%	7,250	550	-92%
	Westbound	5,700	6,140	530	-91%	7,140	600	-92%
Proposed A40 between Llanddewi Velfrey west junction and Llanddewi Velfrey Roundabout	Eastbound	-	-	5,790	-	-	6,750	-
	Westbound	-	-	5,580	-	-	6,540	-
Existing A40 west of Llanfallteg Road Junction	Eastbound	5,640	6,070	280	-95%	7,060	310	-96%
	Westbound	5,480	5,900	320	-95%	6,890	350	-95%
Existing A40 east of Llanfallteg Road Junction	Eastbound	5,700	6,140	350	-94%	7,160	410	-94%
	Westbound	5,450	5,880	300	-95%	6,890	350	-95%
A40 east of Llanddewi Velfrey (east of Bethel Chapel)	Eastbound	5,600	6,030	6,040	0%	7,040	7,050	0%
	Westbound	5,340	5,760	5,760	0%	6,750	6,750	0%

Table 2.2 Existing and Predicted Heavy Goods Vehicle Flows: A summary of the annual average daily HGV flow for new of the new trunk road in the Base Year, Opening Year and Design Year.

Location	Direction	Base Year 2016	Opening Year 2021		Difference from Do Minimum	Design Year 2036		Difference from Do Minimum
			Do Minimum	Do Something		Do Minimum	Do Something	
A40 west of Penblewin Roundabout	Eastbound	310	310	310	0%	330	330	0%
	Westbound	270	270	270	0%	290	290	0%
Proposed A40 between Penblewin Roundabout and Llanddewi Velfrey West Junction	Eastbound	-	-	300	-	-	320	-
	Westbound	-	-	280	-	-	300	-
Existing A40 between Penblewin Roundabout and Rest Area	Eastbound	300	300	20	-93%	320	20	-94%
	Westbound	290	290	30	-90%	310	30	-90%
Proposed A40 between Llanddewi Velfrey west junction and Llanddewi Velfrey Roundabout	Eastbound	-	-	300	-	-	320	-
	Westbound	-	-	280	-	-	300	-
Existing A40 west of Llanfallteg Road Junction	Eastbound	300	300	10	-97%	320	10	-97%
	Westbound	280	280	10	-96%	300	10	-97%
Existing A40 east of Llanfallteg Road Junction	Eastbound	300	300	10	-97%	330	10	-97%
	Westbound	280	280	10	-96%	300	10	-97%
A40 east of Llanddewi Velfrey (east of Bethel Chapel)	Eastbound	300	310	310	0%	330	330	0%
	Westbound	270	280	280	0%	300	300	0%

2.4 General arrangement including cuttings, embankments and false cuttings

2.4.1 The Scheme would include a 2.2km long bypass to the village of Llanddewi Velfrey, from Bethel Chapel to Ffynnon Wood, and 2.1km of improvements west of Ffynnon Wood as far as Penblewin Roundabout. A series of photographs to illustrate the existing situation are provided in Volume 2 Figures 2.5A and 2.5B. The General Arrangement of the Scheme is shown in the three drawings in Volume 3 Appendix 2.6. References to chainage (e.g. Ch. 1075) refer to the distance east of the western end of the scheme. The chainages are marked on the General Arrangement plans in 100m divisions.

2.4.2 At Penblewin, a new, larger roundabout would be required to accommodate the five legs (Ch. 0.00). To the east of the roundabout, the proposed road would descend on embankment on a roughly parallel alignment with the existing A40 to around Ch. 800. The gap between the old and proposed road would narrow towards Trefangor Farm (Ch. 750) with Trefangor Cottage (Ch. 1,070) being demolished. By Henllan Lodge (Ch. 1,250), the new road would be on the line of the old A40. This alignment would be maintained on the existing road embankment through Ffynnon Wood, although the wider carriageway would require some widening of the embankment. Towards the eastern edge of Ffynnon Wood (Ch. 1,950), the proposed road would begin to draw to the north of the old A40, on a straight alignment, roughly at grade, but extending onto sidelong slope. Between Ch, 1,950 and 2,100, there would be a staggered junction giving access to the settlement of Ffynnon Wood to the north and the old A40 to Llanddewi Velfrey, to the south.

2.4.3 Continuing east, the proposed road would pass to the south of Pen-troydin-fâch Farm (Ch. 2,300) in a cutting traversing the north-facing slope. The land becomes increasingly steep to the east, as the proposed road starts to climb the north slope of the Llanddewi Velfrey ridge. From cutting the proposed road would continue onto embankment (Ch. 2,400 to 2,700) and commence a long curve to the south to follow the north slope of the ridge around Llanddewi Velfrey. Then, in cutting, the road would pass under the Llanfallteg Road approximately 200m south of the Pen-troydin-fawr Farm. A proposed bridge at Ch. 2,830 would carry this side road.

2.4.4 The landform to the east of Llanfallteg Road becomes more rolling with the ridge slope divided by small valleys containing wet woodland. Each valley carries a minor watercourse. The proposed road would cross the watercourses on a proposed embankment extending from Ch. 2,950 to 3,360. The embankment would rise up to 17m above the surrounding land. From Ch. 3,360 there would be a deep cutting, nearly 15m deep, which would bring the proposed road back to meet the line of the old A40 at Bethel Chapel (Ch. 3,980). At Ch. 3,800, there would be a four-leg roundabout, with a proposed Private Means of Access provided on the north side of the roundabout to provide access to the chapel and several private properties. On the south side, a road link to the old A40 and Llanddewi Velfrey would be provided. The old and proposed roads tie-in at Ch. 4,300 at the top of Fron Hill.

Local Side Roads

2.4.5 The existing road network would be modified at a number of locations, where the proposed new section of trunk road would join or cross existing routes. Details are provided in Table 2.3.

Table 2.3 Local side roads

Approximate Chainage	Side road	Proposed works
1,100 to 1,220	Henllan Lodge to Llanddewi Velfrey	Tie-in of the retained existing A40 (to be detrunked) to the existing local road south of the A40.
0,000 to 1,220	Trefangor Burial Ground Access Road	Stopping up and tie-in of the local road leading to Trefangor Burial Ground. New road ties into Penblewin.
1,800 to 2,000	Ffynnon Lane, part of lay-by	Existing access to properties realigned to fit the proposed A40
2,820	Llanfallteg Road	Proposed trunk road passes beneath this road. Llanfallteg Road to pass over the proposed A40 on an overbridge.
3,750	Lane / track to Bethel Chapel off A40	Existing access to A40 to be realigned and tie back into junction onto the proposed A40.

Henllan Lodge side roads

2.4.6 The proposed improvements would retain the A40 on the existing alignment to the north of Henllan Lodge, but the existing junction that allows traffic onto and off the A40 from the unclassified road to

Llanbedr Velfrey and Tavernspite on the south side would be closed to traffic. The unclassified road would be reconnected with the A40 using via the existing road, which would be detrunked (lose trunk road status) and the Penblewin Roundabout. On the north side of the proposed road, a side road would be provided from Penblewin roundabout to allow access eastwards to Trefangor cemetery. This side road would also provide access for Pen-ca'rmaenau Farm, Bounty Farm and a number of fields. A connection to Public Bridleways, which cross the A40 at Henllan Lodge, would be diverted eastwards to follow the north and south sides of the proposed trunk road, to an underpass located in Ffynnon at Ch. 1,700 (approximately).

Junction west of Llanddewi Velfrey

2.4.7 A proposed junction would be provided between the west end of Llanddewi Velfrey and Ffynnon Wood to provide access to the proposed trunk road from the village. The proposed staggered junction would connect to the old road through the village of Llanddewi Velfrey on the south side and with existing access road on the north side that serves the residential properties in Ffynnon Wood, Ffynnon Chapel and several farms to the north.

Overbridge for the Llanfallteg Road

2.4.8 A proposed bridge would carry the unclassified Llanfallteg road across the proposed trunk road (Ch. 2,830), which at that point would be in a cutting. The bridge would be sufficiently wide to carry the existing road with hardened verges to be consistent with the existing road width. The bridge would be constructed from concrete with three spans formed with precast concrete beams.

Junction east of Llanddewi Velfrey

2.4.9 The Scheme has been designed with the minimum number of proposed junctions to separate local and through traffic. There are various improvements proposed to local road links to ensure that all properties would be able to access the A40 via the proposed junctions. A proposed junction near Bethel Chapel would provide access to the east end of Llanddewi Velfrey and with an unclassified lane serves Bethel Chapel and other properties on the north side. Because the proposed road would be in cutting, the proposed link into Llanddewi Velfrey would

have to climb sharply from the proposed junction to meet the old road to the north east of the former Cross Inn.

Road drainage and disposal of water

2.4.10 The Scheme surface water drainage system would be designed in accordance with DMRB (HD45) and would use conventional piped drainage to remove water from the carriageway which would discharge into four attenuation ponds located beside the proposed road. These ponds would be designed to store surface water and then slowly discharge it to the existing watercourses. The attenuation ponds and other drainage measures are set out in Chapter 7, Road Drainage and Water Environment. Consideration of Sustainable Urban Drainage (SUDs) is also addressed in Chapter 7. The attenuation pond locations are shown on the Environmental Masterplan drawings (which are included in Volume 3 Appendix 2.5) and listed below:

a) Ch. 300 north side;
b) Ch. 1,900 south side;
c) Ch. 3000 north side;
d) Ch. 4,100 south side;

Fencing

2.4.11 Fencing would be provided in the form of post and wire stock-proof mesh where there is a requirement to discourage access by farm stock from adjacent fields and to delineate the Welsh Government landownership. Post and wire stockproof fences are proposed because these have a much-reduced visual impact compared to post and rail stockproof fences, whilst still forming an effective stockproof barrier. Special forms of this fence would be required to discourage animals such as badger and otter from entering the road corridor and so reduce the risk casualties arising from collisions with vehicles. Further fences would be required to discourage access to hazardous locations, such as balancing ponds, the tops of retaining walls and steep slopes. Indicative alignments of proposed fences are shown in the Environmental Masterplan included in Volume 3 Appendix 2.5.

Signs and communications

2.4.12 The proposed section of trunk road would incorporate signage in relation to junctions, destinations and rest areas. The approximate

locations of signs are indicated on the General Arrangement drawings in Volume 3 Appendix 2.6. A symbol is used to show the location but does not indicate actual sizes of signs. There would be no proposed Intelligent Transport Systems (ITS) on the Scheme (these are signs that display an illuminated message than can be changed from a remote location).

2.4.13 Signs will conform with the national standards, regardingt materials, colours, dimensions and Welsh Language. These signs will be suitably placed on or at the back of the verge in accordance with standard requirements. There is only a limited possibility to vary the locations of these signs, but care will be taken to place trees, shrubs, hedges and other mitigation measures to avoid compromising visibility splays and sightlines. During detailed design of the scheme the placing of signs and mitigation will be considered carefully to ensure that signs do not cause unnecessary visual impact nor compromise the quality of mitigation.

Lighting

2.4.14 Road lighting is proposed around the two roundabouts at Penblewin and Bethel Chapel. The remainder of the proposed trunk road would not be illuminated.

2.4.15 Luminaires would be designed to emit no light above the horizontal level. LED Luminaires are proposed as these can be aimed more precisely, reducing light spill and thus causing less disruption to bats flying in the surrounding countryside

2.5 Existing features affected by the Scheme

2.5.1 The requirement to provide a safe road with good visibility for drivers sometimes means that features in the setting are adversely affected by the proximity of the new road and associated structures and earthworks. The route has been aligned to minimise the impact of the Scheme on adjacent property.

Demolitions

2.5.2 The proposed Scheme requires the demolition of Trefangor Cottage, which lies on the north side of the existing A40 located at approximately Ch. 1050, to the west of Ffynnon Chapel. A redundant

weighbridge in a layby to the west of Ffynnon Wood will also be demolished.

Public rights of way

2.5.3 Existing footpaths, bridleways and private means of access that would be affected by the Scheme would be suitably diverted. In summary, the public rights of way that would require modification are identified in the following paragraphs.

2.5.4 Access would always be maintained during construction. If temporary diversions are to be provided, they would be constructed to an appropriate standard and would be well maintained. The duration of temporary diversions would be kept to a minimum, taking account of the construction programme. Further details are provided in Chapter 15 All Travellers and are shown on Volume 2 Figure 14.1.

2.5.5 **Footpath SP19/31/3:** the southern end would be stopped up. The footpath will tie-in to the proposed Trefangor Burial Ground Side Road.

2.5.6 **Footpath SP19/37/1**: would have a new connection provided along the Ffynnon private means of access and would link to the proposed underpass which crosses the proposed A40 at approximately Ch. 1,700 and so connect with Footpath SP19/38/1.

2.5.7 **Footpath SP19/30/1**: a section would be diverted along the proposed batter of the new A40 to tie-in to the detrunked existing A40 and the diverted bridleway.

2.5.8 **Footpath SP19/38/1:** part would be stopped up and diverted along the existing footpath SP19/38/2. A crossing of the proposed A40 would provide a diversion to this footpath, extending along the south side of the proposed road cutting to tie-in to the existing SP19/38/1 footpath.

2.5.9 **Footpath SP19/38/2**: the eastern end would be stopped up and would tie-in to the existing Llanfallteg road north of the proposed A40 trunk road.

2.5.10 **Footpaths SP19/1/1, SP19/2/2, SP19/3/2**: parts would be stopped up and diverted along the north and south side of the proposed earthworks to a new underpass provided at Ch 3,300 to provide connectivity to these footpaths.

2.5.11 **Footpath SP19/4/5:** would be stopped up. No new provision to be provided as there is an adequate alternative route utilising footpath SP19/4/6. The latter would allow users to cross the A40 at the Penblewin roundabout or use the Footpath SP19/5/1.

2.5.12 **Footpaths SP19/17/1 and SP19/16/1:** connectivity to these routes would be provided via a proposed footpath that would extend along the south side of the proposed trunk road and would tie-in to the existing footway alongside the existing A40 to be detrunked from the grouped of properties between Croft House and Awelfa to tie-in to SP19/16/1, near Bryncoed.

Penblewin Rest Area

2.5.13 The existing rest area east of Penblewin Roundabout would be maintained via the existing detrunked A40from the remodelled Penblewin Roundabout. Proposed signs would direct drivers to the rest area from the roundabout. The rest area is located adjacent to the scheme at Ch. 300.

2.6 Landscape and Environmental Design Principles (Mitigation and Enhancement)

2.6.1 The purpose of the proposed Scheme is to provide a road in accordance with the Scheme objectives set out in Section 2.2 and with the requirements of highways design standards. Achieving a design that satisfies these objectives and standards requires the benefits of the Scheme to be balanced against adverse effects. Known environmental constraints, such as residential properties, designated heritage sites and nature conservation sites, terrain, watercourses and vegetation cover were taken into consideration during route selection. Numerous minor adjustments were made to avoid or minimise impacts during the design period, as more detailed environmental data about the area, and comments and advice from stakeholders in the community and consultees were obtained. The environmental and landscape design is shown in the Environmental masterplan drawings in Volume 3 Appendix 2.5.

Critical constraints

2.6.2 The most critical constraints are:

a) Minimising adverse effects such as traffic noise, and views on residential properties and areas by placing the Scheme to the north of Llanddewi Velfrey and retaining it on the existing route through Ffynnon Wood;

b) Minimising adverse effects of construction on watercourses by keeping the route high on the slopes of the ridge, but avoiding residential properties on the ridge top;

c) Avoidance of the Taf, Daulan and Marlais floodplains to minimise any adverse effects on flood capacity and ensure the road has flood resilience;

d) Retaining the existing road to provide local access and so improve community cohesion;

e) Where possible, avoiding adverse effects on woodland and trees;

f) Providing replacement habitat where areas are likely to be destroyed;

g) Providing crossings under the road for mammal species such as bats, badgers, otters and dormice;

h) Taking account of good and bad ground conditions to avoid unstable ground and avoid rock and soil that would need to be taken away from the site, and

i) Where feasible, avoiding farm severance.

2.6.3 Even after the route was finalised, small adjustments continued to be made within the strip of suitable land. The residual effects of the Scheme were then considered and measures to compensate or mitigate any adverse impacts were developed. Measures to enhance the Scheme, beyond the limits of mitigation were also developed in the interests of future generations. Some environmental design principles were developed to suit the landscape setting and so guide the design of mitigation, compensation and enhancement measures.

Environmental design principles

a) Minimise the loss of mature vegetation during the development of the alignment;

b) Provide replacement trees, woodland, scrub and grassland to reflect the patterns of the surrounding landscape using native and locally sourced seed and stock;

c) Minimising changes to existing watercourses, with new crossings designed to retain the existing capacity and avoid realignment;

d) Minimising and mitigating any adverse impacts on the quality of views to and from surrounding receptors;

e) Using opportunities to open-up views from the new road to the wider landscape;

f) Making minor modifications to the design of the new landform of embankments and cuttings to help incorporate the new road within the natural landform and to reduce the apparent scale of change in the landscape;

g) Design new hedges, hedge-banks and areas of scrub and new woodland planting to reinstate the locally distinctive landscape patterns of boundaries and vegetation;

h) To protect cultural heritage features, or to provide mitigation and enhancements of the setting, where opportunities fall within the boundary of the Scheme;

i) Unless specifically to serve a localised landscape pattern, to use locally indigenous species of trees and shrubs;

j) Using design of the carriageway, structures, earthworks and landscape to incorporate the connectivity requirements of indigenous native species. Where necessary to provide barriers to movement, or to reinstate safe routes across the proposed road so that natural patterns of movement are not unduly interrupted and casualties from collisions with vehicles are minimised;

k) Carefully consider the design and integration of proposed structures into a sensitive landscape throughout the design process with careful selection of materials and planting treatments;

l) Where possible, avoid or minimise lighting, using products that minimise light spillage / bat-friendly lighting

m) Carefully consider the design and siting of proposed road signs, environmental barriers and street furniture., and

n) In support of the purposes of the Well-being of Future Generations Act (2015) and the Active Travel (Wales) Act 2013, to use opportunities to incorporate measures that would maintain and enhance the existing network of routes available for non-motorised travellers including routes between and through settlements and interesting circular routes. Take opportunities to create new safe and useful routes within the boundaries of the new Scheme to encourage public use.

o) In support of the purposes of the Environment (Wales) Act 2016, Section 6 Duty, to use opportunities to incorporate measures that would seek to maintain and enhance biodiversity so far as consistent with the proper exercise of functions and in so doing promote the resilience of ecosystems

p) To support principles set out in any relevant Ministerial Initiatives, such as Green Corridors

2.7 Consultation on Design

2.7.1 The Design Commission for Wales (DCfW) promote the importance of good design for the built environment across all sectors, including infrastructure. The Design Commission reviewed the Scheme in June 2017, and then again in November 2018, and provided written responses which are included in Volume 3 Appendix 2.4.

2.7.2 The main points of the DCfW comments were:

a) That environmental surveys should inform the design process so that an environmental design strategy should be based on an overarching vision for the Scheme;

b) The landscape design should be an integral part of the design process that considers views of the road in a positive manner, ensures integration with landform and is appropriate to the setting. A Landscape Design Strategy should prompt early consideration of a range of matters including view, slopes, planting and boundary treatments;

c) That junction design, materials, planting and lighting should be considered

d) Bridge design is important with a more efficient bridge structure freeing-up resources for use in mitigation elsewhere on the Scheme.

e) A positive vision for the detrunking works should be considered to exemplify the New Ways of Working and Goals in the Well-being of Future Generations (Wales) Act, and to ensure that the old road is redesigned to be appropriate to the use as a village access road.

f) Measures to reduce community severance should be considered.

2.8 Existing land use

2.8.1 The Scheme would occupy land mainly in agricultural use. Part of the Scheme would be within boundary of the existing A40, or other public roads. Land uses that would be displaced by the Scheme include farmland and woodland. Details of existing agricultural land use are covered in Chapter 12 Community and Private Assets: Agriculture.

Land take

2.8.2 One property, Trefangor Cottage, would require demolition to accommodate the proposed Scheme road. A further demolition of a weighbridge to the west of Ffynnon Wood is already within Welsh

Government ownership. Land would be required along the proposed trunk road for junctions, works to local roads, Public Rights of Way, Private Means of Access and Attenuation Ponds. Volume 2 Figure 2.4 indicates the total permanent land take required.

2.8.3 The PCC Local Development Plan (LDP) of) identifies land allocated for future development in Llanddewi Velfrey. One area, on the northern edge of the settlement, is allocated for residential development. The northern boundary of the allocation would be around 80m from the southern boundary of the Scheme at around Ch. 2,800. The allocation can be seen in Volume 2 Figure 16.1.

2.9 Construction

2.9.1 The Welsh Government are likely to appoint a contractor to implement the improvements under a Design and Build contract. Bringing detailed design and construction under a single team ensures that the Contractor and Designer understand and address the problems of construction and would be better informed about the potential environmental impacts which could occur.

2.9.2 The design has followed an iterative process involving the key stakeholders and the Welsh Government to ensure that the most appropriate solutions have been identified and developed.

2.9.3 Carillion (contractor) provided construction advice up until their liquidation in January 2018. Since resumption of the contract by Arup and RML, construction experts within these firms have contributed to the production of the ES. Construction impacts have been based upon the advice of these experts regarding appropriate methods, programme and the environmental mitigation.

2.9.4 The bulk earthworks design has been optimised to balance cut and fill which in turn optimises plant movements on site. Apart from topsoil, all excavated material would be reused in the design and none would leave site. Some topsoil will be required within the scheme, but the surplus would be used in making-good of land temporarily taken for construction or made available for other uses such as agricultural improvement. Topsoil handling and storage on site should be in accordance with BS 3882:2015 Specification for topsoil, Annex A Recommendations for stripping, handling and preparing topsoil.

2.9.5 A risk management strategy has been developed to ensure that all key risks are identified and minimised early within the Scheme development process.

2.9.6 The essential temporary working space required outside the permanent land take has been identified and incorporated within the draft Compulsory Purchase Order. This land is included so that the Scheme can be built efficiently and safely, whilst minimising the environmental impacts.

2.10 Construction Programme

2.10.1 This section outlines the proposed construction sequence and the key construction activities based on advice of Carillion prior to their liquidation. The programme for design and construction assumes a potential Public Local Inquiry in 2019, with a decision to proceed early in 2020.

Overall Duration

2.10.2 Detailed design and construction works are considered likely to commence in 2020 and would continue for around 18 months. Maintenance and aftercare of the environmental aspects of the Scheme remain the responsibility of the Contractor for five years after the completion of construction.

Sequence of Operations

2.10.3 Following the issue of the Notice to Proceed to Construction, there would be a period when the detailed design would be developed. Prior to work starting on site, property precondition surveys and vegetation surveys would be carried out. Early construction activities would include:

a) Construction of the main site compound.
b) Construction of main site access points.
c) Topsoil stripping and stockpiling with archaeological monitoring.
d) Ongoing programme of seasonal ecological surveys.
e) Development of site haul roads.
f) Construction of a temporary road diversion to allow for the construction of Llanfallteg Road overbridge.
g) Surface water quality monitoring.

h) Statutory Undertakers service diversions.

i) Temporary and permanent fencing.

j) Site clearance of trees, hedges, fencing, walls and small structures.

k) Drainage operations including pre-earthworks drainage ditches and the installation of culverts on existing watercourses.

l) Earthworks operations.

m) Haulage of materials to and from the site on the existing road network.

n) Treatment of invasive species.

o) Side road works starting with Trefangor cemetery side road and Henllan Lodge equestrian underpass.

p) Accommodation works starting with Pen-troydin-fâch Farm access road and underpass

q) Construction of temporary diversions to existing footpath and bridleways.

2.10.4 The site would be made secure as early as possible by the erection of permanent fencing. Where this is not possible, temporary fencing would be erected. Site clearance work would commence with vegetation clearance.

2.10.5 Bulk earthworks would mainly be carried out in the summer season but would take advantage of any periods of dry weather in the other seasons. Pre-earthworks drainage would follow the earthworks sequence. Mainline pavement construction would continue intermittently through to completion.

2.10.6 Structures would be progressed throughout the construction period. The construction sequence has been determined to ensure that the Scheme would be built with minimum disruption to the local environment, local population and the travelling public. It is likely construction of the following structures would commence early in the construction programme.

a) **Llanfallteg Road overbridge**. Early temporary diversion of Llanfallteg road so that the bridge can be built online. Self-contained earthworks zones exist to the east and west of the proposed diversion therefore large bulk earthworks will not need to be moved across Llanfallteg Road. On completion allowing site bulk earthworks to be hauled underneath minimising the need for a plant crossing on the public road.

b) **Ffynnon Wood equestrian and pedestrian underpass**, designed to be constructed in two halves so that half can be built offline without disrupting use of the existing carriageway. Traffic can then be transferred onto the new structure allowing completion of the other half, minimising impact on road users.

c) **Pen-troydin-fâch farm underpass** built offline from the existing access minimising impact.

d) **Footpath underpass east of Llanfallteg Road** built offline from the existing paths minimising impact.

2.11 Contract Management Plan

2.11.1 Civil engineering contractors operate Environmental Management Systems (EMS) which are normally accredited to appropriate British and international standards and form part of a project management plan which would be drawn up to provide a coordinated approach to the management of construction and to clearly define policy, standards, processes, procedures, organisation, roles and responsibility and key performance indicators.

2.11.2 Under the overall control of the project management plan would be:

a) Health and Safety Management; (see Section 2.12);

b) Environmental Management (CEMP) (see Chapter 23 Conclusions and Volume 3 Appendix 2.2);

c) Quality management (see Section 2.14);

d) Public Relations (See Section 2.15).

2.11.3 The Register of Environmental Commitments and Actions (REAC) would be an appendix to the Construction Environmental Management Plan (CEMP). This is included in Volume 3 Appendix 2.3.

2.12 Health and Safety Management

2.12.1 A civil engineering contractor would normally be appointed as Principal Contractor and Principal Designer for the proposed Scheme by the Welsh Government, in accordance with the Construction (Design and Management) Regulations 2015.

2.12.2 In accordance with current Health and Safety legislation, approved codes of practice and our Health and Safety Policy, the civil engineering firm would:

a) Provide and maintain a place of work that is safe and without risk to the health and welfare of all its employees, subcontractors and the general public.

b) Provide and maintain plant and systems of work that are safe with minimum risk to health.

c) Provide appropriate information, instruction, training and supervision to ensure the health and safety at work for all employees.

d) Allocate sufficient resources to enable the policy to function effectively.

e) Seek to continually improve health and safety performance.

f) Consult with and maintain good relations with employees, trade unions representatives, the Health and Safety Executive and other relevant organisations.

g) Review operational performance using appropriate measures. Review accident investigation reports and audit information.

h) Make the management of health, safety and welfare an integrated part of the company.

2.12.3 Site specific risk assessments and method statements would be produced prior to any work activates commencing. Noise, manual handling, vibration and environmental assessments would be completed, and appropriate action would be taken to control these issues at site level. Permit to work procedures would be followed for any activities where the residual risk is classified as high.

2.13 Construction Environmental Management Plan

2.13.1 A Pre-Construction Environmental Management Plan (Pre-CEMP) is included in Volume 3 Appendix 2.2 in Volume 3. The CEMP is a live document that is developed and updated through the detailed design and construction stages. Development and implementation would be managed throughout by the Environmental Coordinator. The CEMP would ensure that construction activities are planned and managed in accordance with all the environmental requirements identified in the ES.

2.13.2 The key to effective environmental management during the construction phase lies in the comprehensive training of the workforce. This would be controlled by a full-time site-based Environmental Clerk of Works (ECoW).

2.13.3 The ECoW (managed by the Environmental Coordinator) would:

a) Administer the CEMP and assist in the production and review of environmental content of method statements.

b) Provide guidance to the site team in dealing with environmental matters.

c) Raise awareness of site environmental issues.

d) Assist with obtaining and programming any licences from regulatory authorities such as the Natural Resources Wales.

e) Monitoring site performance against the CEMP, raising standards and reporting to site management.

2.14 Quality Management

2.14.1 The onsite construction management team would ensure that proactive quality control is achieved by:

a) Defining and coordinating an agreed Inspection & Test Plan (I&TP) and regime for each element of work.

b) Setting the acceptance criteria for the I&TP to meet all the relevant design, specification and Employer's requirements.

c) Adopting an open Non-Conformance Reporting (NCR) process detailing corrective and preventative actions.

d) Monitoring timely close out of NCR to prevent jeopardising follow on work which would otherwise be compliant.

e) Maintain essential documentation plus sufficient documentation to demonstrate that the product has been installed in a compliant manner.

f) A materials testing laboratory, with UKAS Accreditation or similar, would carry out the defined compliance sampling.

2.15 Public Relations

2.15.1 Construction works on this scale would result in some inconvenience and disruption to residents. It is therefore very important that there are effective channels of communication in place to keep all interested parties informed of activities and to quickly address any complaints or queries.

2.15.2 A Public Liaison Officer (PLO) would keep the public and affected landowners informed of progress and advise on forthcoming activities. During the construction phase, they would be based in the site office. The PLO would be the first point of contact for any concerns or queries

and would be contactable through the project e-mail address, telephone number, by post or in person at the site office.

2.15.3 The contractor would be responsible for distributing information about the Scheme, including project information letters which would be delivered to specific residents. The contractor would work with all relevant stakeholders to ensure concerns are addressed through a process of providing information, listening, reviewing, taking action and seeking feedback.

Register of Environmental Actions and Commitments (REAC)

2.15.4 The REAC is a schedule of all environmental matters that have been agreed as part of the Scheme. These will include commitments to complete action that could include surveys, monitoring or reporting, or consulting with stakeholders; or commitments to provide mitigation or enhancements as part of the Scheme. A draft of the REAC is included in Volume 3 Appendix 2.3.

2.16 Construction Working Hours

2.16.1 Working hours would be subject to agreement with the PCC Environmental Health Officer and could vary by location and activity. Typically, there would be no normal working on Sundays or Bank Holidays and the working dates would start and finish at the timers set out in Table 2.4.

Table 2.4 Typical site working hours

Period	Day	Start time	Finish time
Summer	Monday to Friday	07:00	19:00
	Saturday	07:00	16:30
Winter	Monday to Friday	07:30	17:30

2.16.2 Where construction works could have significant impact on neighbouring properties, the affected parties would be advised of these works prior to their commencement.

2.17 Service Diversions

Utilities

2.17.1 Utility diversions are necessary where existing roads would be stopped-up or realigned. The diversions would generally be routed along existing service corridors, roads or footpaths. Where the service could be retained in its present location but would be affected by the proposed Scheme, appropriate protection measures would be agreed with the relevant authority.

2.17.2 The Scheme would affect several utilities and all owners and operators of the various utilities have been consulted to establish how their equipment would be affected by the proposed Scheme. The detailed design would take these into account and seek to minimise the impact. The following are known to be affected by construction.

2.17.3 **British Telecom:** equipment is located along the length of the existing A40. This will be diverted at several locations along the Scheme. The Penblewin Roundabout forms a junction for this utility and the new roundabout layout has been designed to minimise the impact. The utility will require a diversion at the eastern tie-in of the Scheme around the Llanddewi Velfrey East Junction. For the majority of the length it will remain on the detrunked existing A40.

2.17.4 **Western Power Distribution:** equipment along the route includes HV (11KV) and LV overhead cables. Several HV poles and overhead lines will be relocated along the route with a few LV poles and cables being diverted overhead or underground.

2.17.5 **EE Telecommunications:** a mast north of the existing A40, east of Llanddewi Velfrey is within the footprint of the proposed A40 and will therefore need relocating.

2.17.6 **Dwr Cymru Welsh Water:** several small diameter water mains will require diversion/protection works at approximately six locations. No sewer diversions are planned.

2.17.7 Key locations for service diversions include:

a) Penblewin Roundabout

b) Henllan Lodge equestrian underpass.

c) Ffynnon Wood.

d) Llanfallteg Road overbridge.

e) Bethel Chapel roundabout.

2.17.8 Through ongoing liaison appropriate protection measures and/or diversions would be implemented as part of the construction of the Scheme. These measures would comply with the relevant standards and codes of practice agreed nationally with Utilities companies.

2.18 Site Clearance and Topsoil Strip

2.18.1 All site clearance would be carried out under ecological supervision taking into account defined ecological seasonal constraints as identified in ES Chapter 8 Ecology and Nature Conservation.

2.18.2 During and after site clearance, the Archaeologist would carry out any recording of above-ground features. The details of any recording of above-ground features are set out in Chapter 10 Archaeology and Cultural Heritage.

2.18.3 Topsoil would generally be stripped from areas within the construction footprint. This process would be subject to archaeological supervision, which is set out in Chapter 10 Archaeology and Cultural Heritage. Topsoil would be stored in temporary stockpiles and re-used within the works. Topsoil will be stored close to the source wherever there is sufficient space over and above that required for construction movements so that it would be replaced in its original location.

2.18.4 Topsoil, which generally carries considerable fertility, will not be spread on embankments cuttings and verges. Low fertility in the roadside soils will reduce the intensity of long-term maintenance and encouraging greater biodiversity. Surplus topsoil will be removed from site for use in making-good any land taken on a temporary basis for construction and for agricultural improvement in the surrounding area, for example.

2.19 Bulk earthworks

2.19.1 The Scheme has been designed to re-use all excavated bulk earthworks material within the works with none imported or exported from the site.

Excavations from cuttings would be used to construct embankments, noise bunds and visual screens.

2.19.2 No contaminated materials were identified in the desk studies and ground investigations. There remains a low potential for localised contamination of excavated materials. This would be reviewed during construction, with a brief for a contamination watching brief added within the CEMP. If contamination was encountered during the construction stage, this material would be taken to a suitably licensed disposal facility or treated in accordance with the appropriate regulations.

2.19.3 Earthwork excavation would generally be carried out using hydraulic excavators loading articulated dump trucks that would transport material along internal site haul roads to identified filling locations. Filling operations would involve using bulldozers and vibrating rollers. Where no practicable site alternative is available, road lorries would be used to transport material on the public road. For example, some of the early fill material required east of Penblewin Roundabout might need to use the public road network to pass through Ffynnon Wood. Operations on public roads would be carefully controlled and monitored to minimise disruption to the travelling public.

2.19.4 The earthworks sequence would be coordinated with the structures programme to minimise the use of public roads by construction plant. The number of plant crossings and the length of time they would be required would be minimised with, where possible, permanent structure being completed early in the programme.

2.19.5 The Scheme requires the movement of approximately 399,000 m^3 of earthworks materials. Table 2.5 below shows the estimated breakdown of this quantity.

Table 2.5 Major earthworks quantities

Excavation	**Volume (m^3)**	**Deposition**	**Volume (m^3)**
Topsoil	58,700	Topsoil	58,700
Suitable clays and gravels	329,00	Structural fill	329,000
Unsuitable	11,500	Landscaping, noise and visual screens	11,500
Total excavated	399,200	Total deposited	399,200

2.19.6 Approximately 13,000m^3 of imported granular material would be required for drainage construction. Approximately 25,600m^3 of imported subbase would be required for pavement construction. Imported construction materials are set out in Table 2.6.

2.19.7 Earthworks activities are vulnerable to wet weather. Clay materials are susceptible to degradation when they get wet. To ensure that they remain suitable for reuse, it would be important to protect them from rainfall, surface and groundwater flows. Control and management of all water sources would be given particular consideration in the method statements for all earthworks activities.

2.19.8 In addition to safety and quality problems associated with carrying out earthworks operations in the wet, there are also environmental implications. These can include increased risk of silt entering watercourses, mud spreading onto local roads and subsequent dust as the mud dries. These environmental risks are managed by the CEMP.

2.19.9 West Wales presents challenging weather conditions with a high annual rainfall. The earthworks season normally lasts from April to October, but with the opportunity taken to extend the season as weather conditions permit.

2.20 Excavation in Rock

2.20.1 An assessment of the available geotechnical information indicates that mudstone is present in the proposed cuttings. The assessments of the ease of excavation undertaken indicate that the Bethel Cutting (Ch. 3,480 to 3,850) would require some ripping to excavate the mudstones. Ripping would be carried out by a large bulldozer with a ripper (a claw pulled behind to break up the material below). For detail work such as trimming slopes and drainage channels, hydraulic breakers would be required.

2.21 Drainage

2.21.1 Pre-earthworks drainage ditches would be installed along the periphery of excavated slopes. These would ensure that any surface runoff entering the site is directed away from the construction operations to suitable discharge points.

2.21.2 Construction of the permanent attenuation ponds would be carried out as part of the pre-earthworks process in order to serve as temporary settlement lagoons, to prevent silt entering watercourses.

2.22 Structures

2.22.1 The Scheme includes: a bridge to carry the Llanfallteg Road over the proposed Scheme at Ch. 2,800, three underpasses at Ch. 1,700, 2,600 and 3,270, and several smaller drainage underpass structures. They vary in size and form to suit the function. The outline structures design has taken buildability issues and ecological constraints into consideration.

2.22.2 Construction of the structures would vary in length up to typically eight months for Llanfallteg Road overbridge. Construction of structures would take place all-year-round as they are less weather susceptible than earthworks operations.

2.22.3 The proposed structures, including the underpasses and culverts would have an integral ecological function by assisting in maintaining routes used by native species, for example badger, bats, dormouse and otter. The proposed alignments of dedicated wildlife underpasses connect with known routes or corridors, while other underpasses and watercourse culverts would be oversized, or the alignment modified to enhance their secondary function as a wildlife route. The purpose and ecological mitigation provided by these structures is described in Chapter 8 Ecology and Nature Conservation.

2.23 Demolition

2.23.1 The Scheme would require the demolition of Trefangor Cottage and the weighbridge at Ffynnon Wood. A detailed method statement would be produced for each structure prior to demolition. In addition to identifying all the safety and environmental protection measures required, this would include investigation for the presence of any hazardous materials which may require special procedures for disposal. If protected species are present suitable licences will be obtained before demolition, if required. Most demolition materials would be recycled.

2.24 Roadworks

2.24.1 Roadworks activities would include pavement construction, carriageway drainage, kerbing, surfacing, safety fencing, signing, lighting, road markings, cycleway and footways. Pavement construction would be undertaken using conventional pavers and smooth wheeled rollers.

2.25 Landscaping and Planting

2.25.1 Subject to seasonal and construction constraints, grass seeding and planting would be undertaken as early as possible in the construction programme to ensure the maximum establishment, growth and coverage by the time the five-year aftercare period is completed. Where feasible, any planting that could be satisfactorily completed in advance of construction, would be carried out in the first available planting season. Other areas of planting and seeding would be completed when areas of the Scheme are made available.

2.25.2 The Contractor would carry out landscape and environmental maintenance in accordance with the Maintenance Environmental Management Plan (MEMP) for five years following completion of the works.

2.25.3 The details of the proposed landscape works are set out in Chapter 9 Landscape and Visual Effects and shown on the Environmental Masterplan in Volume 3 Appendix 2.5.

2.26 Water Pollution Control Measures

2.26.1 Watercourse protection measures would be needed throughout the construction phase and would be defined in the CEMP. Construction phase operations would be carried out in accordance with the Environment Agency's Pollution Prevention Guidelines PPG6. This guidance was withdrawn in 2015 but is still applicable because it represents good practice.

2.26.2 A Pollution Control Contingency Plan would be prepared as part of the CEMP, which will set out details of measures to protect watercourses would include the following:

a) Partial construction of the attenuation ponds would be carried out as an early activity to provide pollution control / silt settlement areas for site runoff during construction.

b) All fuel, oil and chemicals would be stored in bunded areas.

c) All plant and equipment would be stored and fuelled away from pollution sensitive areas.

d) An emergency spill team would be established onsite.

e) Designated washout bays would be established for concrete delivery lorries.

f) There would be no pumping into controlled waters without a Discharge Consent from Natural Resources Wales.

g) Areas of bare soil would be kept to a minimum and silt fences used to control runoff.

2.27 Dust and Air Pollution

2.27.1 Standard good practice mitigation measures would be adopted during construction. Pollution Control Contingency Plan will be prepared as part of the CEMP and would include:

a) Use of water bowsers during dry and/or windy conditions to damp down haul roads, material stockpiles and unsurfaced areas.

b) Restricting vehicle speeds on unsurfaced routes.

c) Regular use of road sweepers around access points to working areas.

d) Daily visual inspections of sensitive locations.

2.28 Construction Noise

2.28.1 All construction noise levels would be the subject of a Section 61 consent agreed with the Environmental Health Officer of PCC.

2.28.2 In order to minimise the disruption caused by construction noise, standard good practice mitigation measures would be adopted in accordance with BS 5228-1:2009 and BS 5228-2:2009 Code of Practice for noise and vibration on construction and open sites. They would be defined in the CEMP and would include:

a) Early erection of noise bunds and permanent screening where practicable.

b) Use of modern, silenced, well maintained plant.

c) Limitations on working hours

2.29 Temporary works and Facilities

Construction Workforce

2.29.1 During the construction phase, the number of people expected to be working onsite is anticipated to average 50 with an estimated peak of 100. This peak is predicted to occur when the construction works are at the greatest extent with a wide range of trades required to carry out earthmoving, rock excavation, construction of Llanfallteg Road bridge, drainage works, pavement construction, plant maintenance, surveying and office-based support staff. The site compound would be adequately sized to fully accommodate the welfare requirements office space and car parking capacity for this peak workforce.

2.29.2 It is anticipated that most of the labour force would be sourced locally. However, some specialist or skilled labour may be from outside the locality. Where possible, local subcontractors would be employed.

Site Compound

2.29.3 The site compound would be located centrally along the length of the Scheme with direct access off the existing A40, avoiding wooded areas. The location would be away from the main centre of the village to minimise disturbance to residents and taking account of environmental constraints to minimise or avoid environmental impacts. The compound would contain the main construction site office, stores, plant maintenance facilities, welfare facilities and car parking. All offices, compounds and storage areas would be secured against theft and vandalism through the provision of fencing, lighting, CCTV, mobile and fixed security personnel as appropriate to the location.

2.29.4 Site cabins would also be located adjacent to the various remote structures.

2.29.5 Following completion of the works, or a temporary site is no longer require, the contractor would remove all structures and restore ground profiles to match the original. All accesses from the public road will be restored to the original form. Soiling of restored surfaces would be carried out using the original topsoil stripped from the site and stored nearby. Additional topsoil would be available to provide an increased depth over the original, if the landowner approves. Subsoil cultivation,

topsoil spreading, drainage, planting and seeding will be carried out by the contractor.

Site Access and Site Traffic

2.29.6 Main site access points would be established where the proposed road corridor meets existing roads, at:

a) A487 north of Penblewin Roundabout
b) Existing weighbridge layby.
c) North-east of Ffynnon Wood.
d) Llanfallteg Road overbridge.
e) North-west of Bethel Chapel

2.29.7 Internal site haul roads would be developed to enable deliveries to access their destination within the site and minimise site traffic interface with the public. All site access points would be clearly signed on the road network.

2.30 Haulage of Materials

2.30.1 The following paragraphs summarise the categories of material and the approximate volumes. Chapter 16, Materials, provides the assessment of site-won and imported materials and waste.

Site-won materials

2.30.2 The intention is to maintain a balance between the volume of material excavated from cuttings and the volume used to form embankments. Haulage of the site-won material will be substantially contained within the construction site. The intention is to carry all site won material on haul roads formed within the site boundary with minimal use of local roads.

2.30.3 Approximately 38,500 m^3 of topsoil will be stripped from the site and as will be reused on areas where topsoil is to be replaced. The majority of grassed areas within the scheme will be seeded onto cultivated subsoil with no topsoil provided. Surplus topsoil, which is a valued resource, will be reused elsewhere for restoration of land taken for temporary use, or for agricultural land improvement. Surplus topsoil will be transported from site for reuse elsewhere.

2.30.4 Approximately 313,500m^3 of hard and soft materials would be excavated. All material is expected to be reused in the proposed earthworks, for example in the formation of embankments.

Demolition materials

2.30.5 Potential waste material would arise from the demolition of Trefangor Cottage and the weighbridge. The contractor responsible for demolition of these structures would recover materials for recycling or reuse to minimise the volume taken to landfill. Where feasible materials such as brick and concrete would be processed for use as fill or aggregate within the Scheme.

Materials brought to site

2.30.6 The main materials that would be transported onto site in bulk have been estimated following several preliminary design iterations. Table 2.6 summarises these bulk quantities.

Table 2.6 Bulk quantities to be transported to site

Material	Volume	Numbers of loads
Drainage Stone	13,000m3	975
Concrete	2,160m3	400
Subbase	25,600m3	2,880
Pavement	15,500m3	1,740

2.30.7 These preliminary quantities result in an estimated 6,000 loads delivering to the site over the 18 months construction period i.e. 12,000 vehicle movements (6,000 full and 6,000 empty). Based on 23 working days in a month, the average truck movements are estimated at 28 per day.

2.30.8 Imported materials would be delivered via the closest site access point to the point of work and from there proceed on site haul roads.

2.31 Traffic Management

2.31.1 The requirements for traffic management have been carefully considered to minimise the disruption to road users during construction. Throughout the construction period all the existing routes would remain open and access would be maintained to all properties along the route.

The locations mentioned in this section can be found on the General Arrangement drawing in 2.6 A, B and C.

2.31.2 During normal working, one lane would be maintained in both directions on the A40. During the creation of the tie-ins at each end and the on-line reconstruction through Ffynnon Wood, there would be short-term requirements for single lane working controlled by traffic lights. Where required, they would be manually operated to minimise delay.

2.31.3 A speed limit would be imposed on all sections of public road passing through a work site to ensure the safety of the road users and workforce.

2.31.4 There would be four main impact areas:

a) Online improvement of the A40 at Ffynnon Wood.
b) Reconfiguration of the Penblewin Roundabout at the western end of the Scheme.
c) Tie-in and reconstruction of the A40 near the new Bethel Chapel roundabout at the eastern end of the Scheme.
d) Llanfallteg Road crossing the offline improvement of the A40.

2.31.5 Llanfallteg Road would be transferred onto a temporary alignment to the west allowing the new overbridge to be built before transferring back onto its existing alignment.

2.32 Temporary requirement for land during construction

2.32.1 The draft Orders include some areas of land required for use on a temporary basis for the duration of construction and for a period after. These areas would be required to provide access and working space. This land is included to ensure that the Scheme would be built safely and efficiently, while minimising the environmental impacts.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 3: Alternatives Considered

A40LVP-RML-EGN-SWI-RP-LE-0011

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15/01/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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3.4 WelTAG Stage 2 Report

3 Alternatives considered

3.1 Introduction to the chapter

3.1.1 This chapter of the Environmental Statement (ES) outlines the main alternatives considered during the development of the Scheme. In addition, it sets out the main reasons for the selection of the key elements of the Scheme, including the following:

a) Selection of a suitable carriageway option that includes 2+1 overtaking opportunities;

b) Selection of the broad route corridor;

c) Selection of the junction options;

d) Local roads;

e) Selection of the design included within the Draft Statutory Orders.

3.1.2 The current 2014 EIA Directive requires that an ES should include '*A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.' A summary of the reasonable alternatives should be provided together with a comparison of the environmental effects*.'

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

3.2 Previous studies

3.2.1 A great deal of development work has been undertaken before work under the current contract commenced. This work informed both the location of planned improvements and the preferred design of highway improvements along the A40 between St Clears and Haverfordwest. A timeline of previous development work is provided in Figure 3.1.

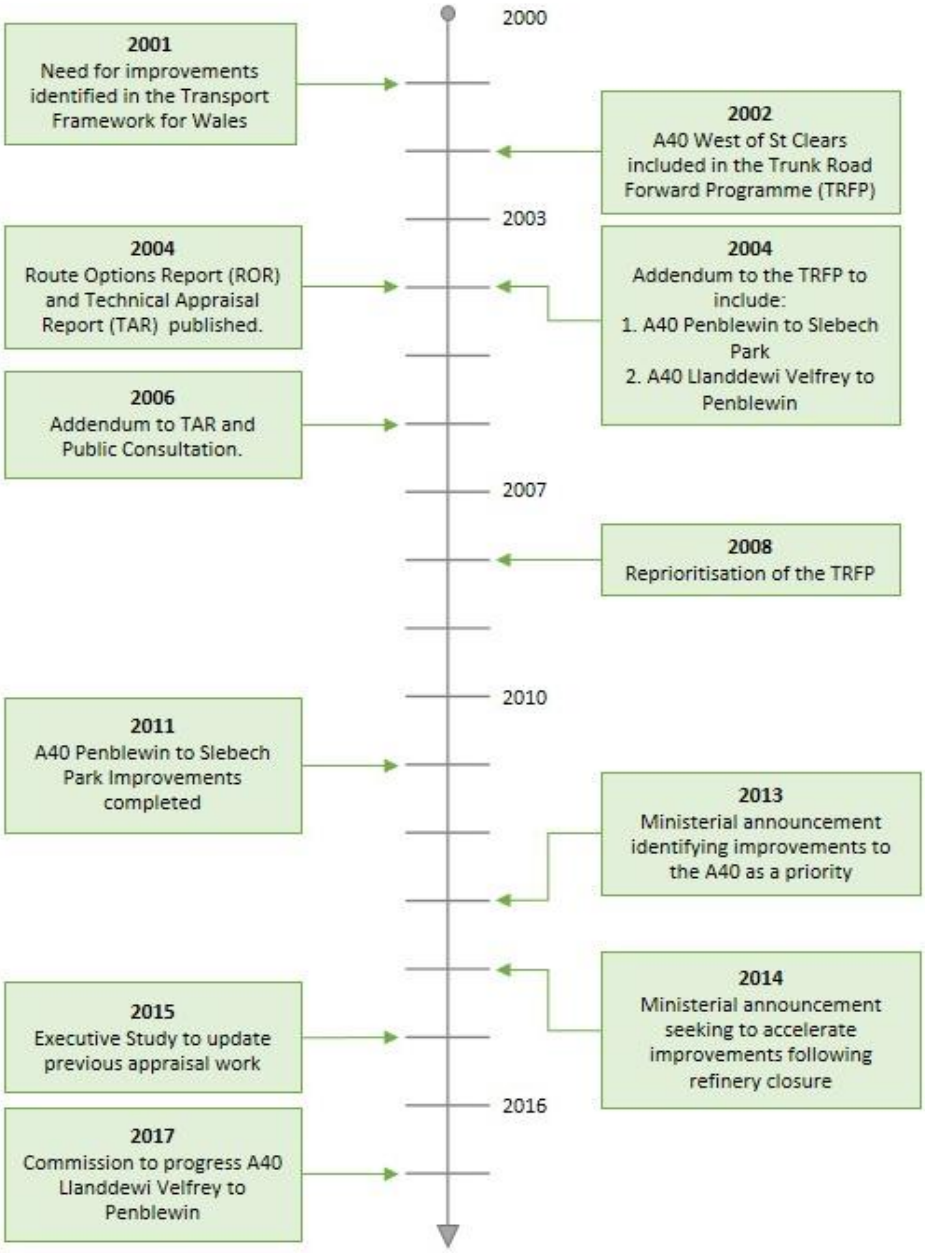

Figure 3.1 Timeline of previous development work

2001

3.2.2 Following the completion of a study looking at a range of transport options, the Transport Framework for Wales (2001) identified that the A40 west of St Clears was in need of improvements.

2002 to 2004

3.2.3 In March 2002, the Trunk Road Forward Programme (TRFP) outlined that '*Improvement of the A40 trunk road, whether it be to single or*

dual carriageway standard, is beneficial in economic terms' and stating that '*The A40 in West Wales forms the lowest standard section of the Trans-European Road Network in the United Kingdom'*. This early work steered the decision to pursue road-based enhancements on the A40 and a Route Options Report (ROR) was subsequently commissioned in 2004 to explore single and dual carriageway options for the entire route from St Clears to Haverfordwest. Within the overall study, a total of eight options were considered for a bypass the village of Llanddewi Velfrey with the section from Ffynnon Wood to Penblewin included as a maintenance scheme:

Option 1 a northern relief road passing to the north of the Blaen-pen-troydin Farm from Gwyndy Farm to Ffynnon Wood;

Option 2 a short relief road for the eastern half of the village;

Option 3 a minor realignment for the eastern half of the village;

Option 4 a northern relief road passing to the north of the Blaen-pen-troydin Farm from Bethel Chapel to east of Ffynnon Wood;

Option 5 a northern/southern relief road, which would cross the line of the existing road in the village centre;

Option 6 a northern relief road passing to the south of Blaen-pen-troydin Wood;

Option 7 a northern relief road passing to the north of the Blaen-pen-troydin Farm from Bethel Chapel to Ffynnon Wood;

Option 8 a northern relief road passing to the north of Blaen-pen-troydin Wood.

3.2.4 Each of the options were appraised using the Scottish Trunk Road Appraisal Guidance (STAG) and the 2004 ROR concluded that several options performed better in the appraisal process and these were taken forward for further consideration. Routes not considered further were discarded based on cost; failure to address the identified problems; or because they would have major adverse environmental effects on woodland habitat.

3.2.5 As part of the 2004 studies, a few horizontal alignments were developed to determine optimum routes that would minimise agricultural severance, avoid sensitive ecological features and large earthworks. In the same year, a DMRB Stage 2 Environmental Appraisal Report (EAR) was also completed and a Business Case was

developed and formed the basis of a submission to the Assembly Minister.

3.2.6 Following the findings of the appraisal within the 2004 studies, the Welsh Government announced the publication of an addendum to the 2002 Trunk Road Forward Programme and this included two major improvement schemes for the A40 west of St Clears:

A40 Penblewin – Slebech Park improvement: completed in March 2011;

and

A40 Llanddewi Velfrey to Penblewin improvement: focus of this ES.

2006

3.2.7 Following this announcement, an addendum to the 2004 Technical Appraisal Report was completed in 2006. Two further route options were considered with single carriageway and 2+1 carriageways considered. The two options considered further were:

a) **Option 5**, **The Central Route** – close to the existing trunk road network;

b) **Option 8**, **The Northern Route** – that took a route around the north of Blaen-pen-troydin Wood and Llanddewi Velfrey village centre.

3.2.8 The environmental impact of both options was concluded to be similar in magnitude but slightly different in type with Option 8, Northern Route, providing an effective bypass but having an adverse impact on land use and landscape. The Central Route might not be perceived as an effective bypass and could have an adverse impact on the structure and landscape of the village of Llanddewi Velfrey.

3.2.9 In addition, consideration was given to the section between Ffynnon Chapel and Penblewin Roundabout which would be the same for both schemes. The 2006 study explored:

a) **Online improvements** following the existing alignment;

b) **Online 2+1 standard**; and

c) **Offline 2+1 standard**.

3.2.10 The 2006 report recommended that all the above options should be taken forward for public consultation. A consultation process was subsequently completed in 2006 over an eight-week period with a public exhibition held in Llanddewi Velfrey on 13 and 14 September 2006. In summary, the consultation sought views on the following route options:

Blue Route: a bypass option to the north of Llanddewi Velfrey from Gwyndy Farm to Ffynnon Wood.

Red Route: an option which follows closely the existing trunk road.

Orange Route: online improvement of the existing trunk road between Ffynnon Wood and Penblewin Roundabout.

Purple Route: offline improvement between Ffynnon Wood and Penblewin Roundabout.

These routes are shown in the Design Options Report published in 2015; a copy of which is contained in Volume 3 Appendix 3.1.

3.2.11 The consultation showed clear public support for improving the section of the A40 between Gwyndy Farm and Penblewin Roundabout. There was a clear preference expressed for the Blue Route, however no clear preference emerged for either the Purple or Orange routes. The consultation showed there was strong support for the proposed bypass of Llanddewi Velfrey between Gwyndy Farm and Ffynnon Wood. Of the options presented, the Blue Route was preferred. Whilst there was also overall support for improvements to the section of A40 between Ffynnon Wood and the Penblewin Roundabout, there was no clear preference expressed on the routes presented.

2008

3.2.12 Following this consultation, the Llanddewi Velfrey to Penblewin scheme was included within the reprioritisation of the TRFP in 2008 and has since received continued ministerial support.

2010

3.2.13 Publication of Preferred Route occurred in 2010, with a report on the previous Public Consultation in 2006 published in February of 2010. The Deputy First Minister decided to adopt the Blue Route as the Preferred Route to bypass Llanddewi Velfrey and the Purple Route as

the Preferred Route between Ffynnon Wood and Penblewin. The TR111 Preferred Route Plan was published to protect the entire route for planning purposes under the Town and Country Planning (General Development Procedure) Order 1995. This means that the Local Planning Authority must refer to the Welsh Assembly Government all future planning applications that are near the Preferred Route. The TR111 plan was deposited at the Pembrokeshire County Council offices in Haverfordwest, in the Post Office in Narberth and the Welsh Government offices in Cardiff.

3.2.14 The TR111 Plan showing the line of the Preferred Route is included in Volume 3 Appendix 3.2.

2013

3.2.15 In July 2013, Edwina Hart, Minister for Economy, Science and Transport, published a written statement outlining her priorities for Transport. This statement included:

> *'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.'*

2014

3.2.16 A Strategic Outline Case for the A40 Llanddewi Velfrey to Penblewin Improvement was produced by the Welsh Government in June 2014. It concluded that the Scheme would be likely to provide benefits that outweighed its costs with a Benefit to Cost Ratio (BCR) of around 1.1[1]. It was suggested that the figure understated the level of benefits of the scheme as it only considered the scheme in isolation and, as the BCR is calculated at a UK level, underestimated the local benefits. It was set out that:

> *'The allocation of additional CRC funding would ensure increased certainty for the delivery of the A40 Llanddewi Velfrey to Penblewin scheme in accordance with the commitments made in the National Transport Plan. In addition, it would enable re-allocation of Transport Capital funding to other projects where budgetary constraints present a significant*

[1] Welsh Government A40 Llanddewi Velfrey to Penblewin Improvement Strategic Outline Case June 2014.

risk to the delivery of commitments made within the Prioritised National Transport Plan (PNTP).'

3.2.17 The proposals for A40 improvements were further expressed by the Welsh Government in November 2014 following the announcement of the closure of the Milford Haven Refinery. Reflecting on this announcement, the Minister made the following 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."

2015

3.2.18 A study in 2015 considered options for improvement of the A40 including the A40 Llanddewi Velfrey to Penblewin improvement, applying the WelTAG appraisal process. This included the committed scheme which had emerged through previous development work and was referenced within the Pembrokeshire LDP.

3.2.19 The study concluded:

'There remains a good case for proceeding with the A40 Llanddewi Velfrey to Penblewin improvement scheme, using the 2+1 configuration which is currently included in the National Transport Schedule.'

'The scheme includes unambiguous lengths for overtaking, would address community severance in the village of Llanddewi Velfrey and deliver small improvements to journey times, journey reliability and road safety on the A40'.

2017

3.2.20 In February 2017, the Welsh Government appointed Carillion, with Arup and RML as their technical advisors, to develop the design of the proposed A40 Llanddewi Velfrey to Penblewin Improvements up to publication of draft Orders. The contract was awarded on the basis of a northern bypass for Llanddewi Velfrey from Gwyndy Farm to Ffynnon Wood and an offline improvement from Ffynnon Wood to

Penblewin. The original contract required the team to build on the previous work, and to carry out a WelTAG Appraisal in accordance with the newly published WelTAG 2017. The WelTAG appraisal approach was applied to identify the problems on the existing A40, scheme objectives and solutions to be incorporated within the scheme.

2018

3.2.21 Since the liquidation of Carillion in January 2018, a new contract was awarded to Arup - supported by RML - to complete the WelTAG process and to continue with developing the scheme.

3.3 What is WelTAG?

3.3.1 Welsh Government adopted the Welsh Transport Planning and Appraisal Guidance (WelTAG) in 2008. This method of appraisal is for assessing proposed strategies, plans and schemes. It is intended to provide information about significant economic, environmental and social impacts so that decision makers can judge the merits of proposals using a consistent approach.

3.3.2 As stated in 3.2.20, the Welsh Government published an updated WelTAG in 2017, named WelTAG 2017. WelTAG 2017 was used for the appropriate appraisals for the Scheme.

3.3.3 The options for the A40 Llanddewi Velfrey to Penblewin Improvements were compared against the Transport Planning Objectives and the criteria of Welsh Impact Areas (the 'three pillars of sustainability') that underlie policy in Wales: the economy, the environment and society (including legal requirements and the desire to protect and enhance the condition of the built and natural environment). The Transport Planning Objectives and Welsh Impact Areas underpin the appraisal process by allowing each option to be appraised to see if it is likely to succeed in addressing problems and achieving the objectives. When a proposal performs poorly against Welsh Impact Areas it is unlikely to gain support from the Welsh Government.

The WelTAG Stage 1 Appraisal

3.3.4 The WelTAG Stage 1 built on previous development work, considering the outcome of the 2006 consultation work, along with a

do minimum option (to assess the current conditions in a future year taking into account planned and committed measures) and a public transport intervention. The WelTAG Stage 1 Report is included in Volume 3 Appendix 3.3.

3.3.5 The WelTAG Stage 1 Report recommended, from those described below, Highway Option 3 (Option A) for further consideration:

Option 1: Do Minimum: limited intervention reflecting the existing situation with the addition of any planned or committed measures as identified in the Pembrokeshire LDP.

Option 2: Public Transport Improvements: improvements to existing public transport services which would increase the frequency and operating hours of the bus service #322 between Carmarthen and Haverfordwest.

Option 3: Highway Option A: An offline option taking a route north of Llanddewi Velfrey (along a similar line to the previous Blue option) and reflecting previous public opinion, along with an offline improvement between Ffynnon Wood and Penblewin Roundabout (along a similar line to the previous (Purple option), offering maximum extents of 2+1 carriageway.

Option 4 – Highway Option B: An offline option taking a route north of Llanddewi Velfrey (along a similar line to the previous Blue option) and reflecting previous public opinion. The option would then re-join the existing A40 in the Ffynnon Wood area with limited interventions proposed between Ffynnon Wood and Penblewin (along a similar line to the previous Orange option).

WelTAG Stage 2 Appraisal

3.3.6 WelTAG Stage 2 involved the assessment of three different variations on Highway Option 3 (listed previously in paragraph 3.3.5). These were alternative alignments and junctions which are described below (shown in the WelTAG Stage 2 Report which is provided in Volume 3 Appendix 3.4):

a) A four-armed roundabout provided at either end of the Scheme, with no intermediate junction, but a parallel road from Penblewin to provide local access to Ffynnon and several access roads that would be severed by Highway Option A.

b) A four-armed roundabout would be provided at either end of the Scheme, with intermediate T-junctions to allow local traffic to join from the north (Ffynnon), and south (Llanddewi Velfrey). A parallel road from Penblewin would also provide local access to Ffynnon and several accesses that would be severed by Highway Option A.

c) A four-armed roundabout would be provided at the western end of the Scheme and T-junctions at the eastern end of the Scheme, with intermediate T-junctions to allow local traffic to join from the north (Ffynnon), and south (Llanddewi Velfrey). A parallel road from Penblewin would also provide local access to Ffynnon and several accesses that would be severed by Highway Option A.

3.3.7 A 'do minimum' option was also appraised. This reflecting the existing situation with only limited intervention on the A40, but also taking account of any planned or committed measures as identified in the Pembrokeshire LDP. The full assessment is set out in the published WelTAG Stage 1 and Stage 2 reports.

3.3.8 The WelTAG Stage 2 appraisal (report provided in Volume 3 Appendix 3.4) showed that Option 3 provided the best long term, sustainable solution. It met most of the objectives and, alongside Option 2, best addressed social and cultural criteria. All options performed badly against environmental criteria (see Table 3.1), but Option 3 performed better than the others regarding effects on air quality and noise. Option 3 also performed best on economic criteria. The WelTAG Stage 2 Report (provided in Volume 3 Appendix 3.4) recommended that Option 3 be taken forward for WelTAG Stage 3 appraisal. The Preferred Route is shown in Volume 3 Appendix 3.2.

Environmental considerations for route selection

3.3.9 A summary of the environmental effects of the options is set out in Table 3.1. These are broad descriptions of potential impacts based on information that was known at the time of the selection process. The details assume typical mitigation measures would be applied. Traffic modelling suggests that traffic will not increase as a result of the scheme.

3.3.10 Table 3.1 does not take account of the gradual conversion to electrically powered vehicles, a government policy measure which is likely to reduce air pollution, production of greenhouse gasses and traffic noise.

Table 3.1 WelTAG Stage 2 Appraisal: environmental effects of the options

Option:	**1: Do Minimum**	**2: Public Transport Improvements**	**3: Highway Option A**	**4: Highway Option B**
Impact type	**Outline description of environmental effects of options**			
Noise	No change to current undesirable traffic noise affecting people close to A40.		Reductions in noise at many properties along and near existing A40, but some increases at some properties near the proposed bypass. Proposed roundabout at eastern end could increase noise for nearby properties from breaking, waiting and accelerating vehicles. Traffic noise for some properties west of Ffynnon Wood could be slightly reduced with the A40 traffic moved away to the north of the existing road.	Reductions in noise at many properties along and near existing A40 in Llanddewi Velfrey, but some increases at properties near the proposed bypass. Proposed roundabout at eastern end could increase noise for nearby properties from breaking, waiting and accelerating vehicles. Traffic noise in properties in Ffynnon Wood and to the west would be like the current situation.
Air Quality	Current situation: undesirable air pollution from traffic affecting people close to the A40.		A40 traffic would no longer pass through Llanddewi Velfrey, reducing exposure to air pollution for residents. The new alignment would bring traffic closer to some properties to the north of Llanddewi Velfrey. Properties on the A40 west of Ffynnon Wood could also experience benefit from an increase in air quality with the A40 traffic moved away to the north of the existing road. Potential for local air quality to be adversely affected temporarily during construction. Proposed roundabout at eastern end could increase air	A40 traffic would no longer pass through Llanddewi Velfrey, reducing exposure for residents there. The new alignment will bring traffic closer to some properties to the north of Llanddewi Velfrey. Properties on the A40 west of Ffynnon Wood would not experience these benefits. Potential for local air quality to be affected temporarily during construction. Proposed roundabout at eastern end could increase air pollution from breaking, waiting and accelerating

Option:	1: Do Minimum	2: Public Transport Improvements	3: Highway Option A	4: Highway Option B
Impact type	**Outline description of environmental effects of options**			
			pollution from breaking, waiting and accelerating vehicles.	vehicles.
Greenhouse gases	No change		The route of the A40 will be longer and could carry more traffic on the additional lane. Additional traffic and increased distance to travel is likely to result in increased greenhouse gases production. The new road infrastructure will also produce embodied carbon in addition to the traffic emissions.	The route of the A40 will be longer and could carry more traffic on the additional lane. Additional traffic and increased distance to travel is likely to result in increased greenhouse gases production. The new road infrastructure will also produce embodied carbon in addition to the traffic emissions.
Landscape & visual	Minor changes would have insignificant effect on character and amenity.		The bypass on the north side of the Llanddewi Velfrey ridge would have adverse landscape and visual impacts on the typical moderate and high scenic quality rural Pembrokeshire landscape to the north. The alignment through Ffynnon Wood would require the widening on the existing A40 embankment and the clearance of some trees. The parallel arrangement of roads west of Ffynnon would increase the area of landscape affected and would require the loss of hedges and pastureland as far west as Penblewin.	The bypass on the north side of the Llanddewi Velfrey ridge would have significant adverse landscape and visual impacts on the typical rural Pembrokeshire landscape of moderate and high scenic quality to the north. The alignment through Ffynnon Wood would require the widening on the existing A40 embankment and the clearance of some trees. The limited interventions on the A40 west of Ffynnon could require the loss of roadside hedges and trees as far west as Penblewin, although the extent would likely be less than for Option 3.

Option:	1: Do Minimum	2: Public Transport Improvements	3: Highway Option A	4: Highway Option B
Impact type	**Outline description of environmental effects of options**			
Cultural Heritage	Minor changes would have insignificant effect on cultural heritage		The option would not directly impact on any designated sites but could directly affect non-designated sites. There is a high potential that intrusive works may uncover previously unrecognised archaeological deposits. This option affects a greater area than Option 4 and so the risk of discovering unknown sites is higher. Designated sites: Ffynnon Chapel and the War Memorial in Llanddewi Velfrey (listed buildings) would have an improved setting with traffic moved away from the site.	The bypass would not directly impact on any designated sites but could affect non-designated sites. There is a high potential that intrusive works may uncover previously-unrecognised archaeological deposits. This option affects a lesser area than Option 3 and so the risk of discovering unknown sites is lower. Designated sites: The War Memorial in Llanddewi Velfrey (listed building) would have an improved setting with traffic moved away from the sites.
Biodiversity	Minor changes would have insignificant effect on biodiversity		The scheme would result in the loss and fragmentation of habitats. During construction several badger setts would be closed, and a bat roost lost in a building to be demolished. The bypass would require clearance of woodland north of Llanddewi Velfrey and trees along the existing embankment through Ffynnon Wood. Habitat fragmentation, would adversely affect for horseshoe bats associated with nearby Special Areas of Conservation.	The bypass would result in the loss and fragmentation of habitats. During construction a number of badgers setts would be closed. The bypass would require clearance of woodland north of Llanddewi Velfrey and trees along the existing embankment through Ffynnon Wood. Limited interventions west of Ffynnon could affect a bat roost and vegetation and cause habitat fragmentation, adversely affecting horseshoe bats associated with nearby Special Areas of Conservation.

Option:	1: Do Minimum	2: Public Transport Improvements	3: Highway Option A	4: Highway Option B
Impact type	**Outline description of environmental effects of options**			
Water environment	No change unless road drainage were improved to reduce effects		There would be a detrimental effect on the catchment geomorphology because of direct impacts of new culverts on the Afon Daulan and 2 tributaries. Existing road culverts in Ffynnon Wood would be extended. There would be an impact on groundwater flows where cuttings are excavated with possible adverse impact on springs within proximity. The new road would increase the impermeable surface which could result in increases in the rates of surface water runoff with potential flooding downstream, unless the surface water is managed appropriately with suitable attenuation of flows. Petrol interceptors would be needed at roundabouts.	There would be a detrimental effect on the catchment geomorphology because of direct impacts of new culverts on the Afon Daulan and 2 tributaries. Existing road culverts in Ffynnon Wood would be extended. There would be an impact on groundwater flows where cuttings are excavated with possible adverse impact on springs within proximity. The new road would add impermeable surface which could result in increases in the rates of surface water runoff with potential flooding downstream, unless the surface water is managed appropriately with suitable attenuation of flows. Petrol interceptors would be needed at roundabouts.
Landuse	No change		Land would be permanently removed from agricultural use but none of this land is classified as ‘best and most versatile’. Some severance of land from farms would occur. No farm units would be made unviable.	Land would be permanently removed from agricultural use but none of this land is classified as ‘best and most versatile’. Some severance of land from farms would occur. No farm units would be made unviable.

Option:	1: Do Minimum	2: Public Transport Improvements	3: Highway Option A	4: Highway Option B
Impact type	**Outline description of environmental effects of options**			
Community	No change to current severance and disruption of community	No change to current severance and disruption of community, but an increase in connectivity using public transport	The scheme would remove traffic from Llanddewi Velfrey and reduce existing community severance. The same benefits would improve access to community facilities in Ffynnon and residential properties on the existing A40. Demolition of Trefangor Cottage would be required. There would be improved access to regional facilities such as hospitals and shops along the improved A40.	The scheme would remove traffic from Llanddewi Velfrey and so reduce the existing community severance and allow improved access to facilities. These benefits would be unlikely for the community from Ffynnon west to Penblewin. There would be improved access to regional facilities such as hospitals and shops along the improved A40.

Summary of the environmental effects that differentiate between Options 1 to 4.

3.3.11 Option 1 'Do Minimum' would result in no changes to the current situation.

3.3.12 Option 2 would provide better access to public transport, with no other changes to the existing situation.

3.3.13 Both Option 3 and 4 would include the bypass to Llanddewi Velfrey which would have the same adverse and beneficial effects.

3.3.14 Option 4 would only require limited interventions on the existing A40 from Ffynnon Wood to Penblewin. The potential effects of these could include some loss of roadside trees, hedges and grassland. Option 3 would require a new carriageway from Ffynnon Wood to Penblewin, which would include the loss of field hedges, hedgerow trees and grassland in a strip separated from the existing A40 road. Option 3 would also have a greater adverse effect on severance of habitats and on protected species (bats and badger). While Option 4 would need only small areas of land take for the limited interventions, Option 3 would take greater areas of agricultural land and have a greater adverse effect on farm businesses.

3.3.15 Option 4 would provide community benefits by reducing community severance and improving access to and around the village of Llanddewi Velfrey; improving access to and from the settlement at Ffynnon and to properties along the existing A40, and to regional facilities further afield. Option 3 would provide benefits limited to the immediate area around Llanddewi Velfrey and to regional facilities further afield. These benefits could potentially benefit Ffynnon with improved access to Llanddewi Velfrey.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 4: Environmental Impact Assessment Methodology

A40LVP-RML-EGN-SWI-RP-LE-0002

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12/03/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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4 Environmental Impact Assessment Method

4.1 Introduction to the chapter

4.1.1 This chapter of the Environmental Statement (ES) sets out the approach taken to the Environmental Impact Assessment (EIA) of the Scheme. The chapter sets out the overall approach to the assessment of the likely effects of the Scheme and includes details of the consultation undertaken. Further details of topic specific methodologies, such as survey methods, are provided in each topic chapter of this ES.

4.2 Legislative Framework

4.2.1 From May 2017 EIA Directive EC2014/52/EU amended the existing 2011 Directive 2011/92/EU and applies to all projects covered by the EIA process. The regulations to transpose the 2014 Directive for projects under the Highways Act came into force in December 2017 and are called the Harbours, Docks, Piers and Ferries Environmental Protection - The Environmental Impact Assessment (Miscellaneous Amendments Relating to Harbours, Highways and Transport) Regulations 2017 (EIA Regulations 2017). These regulations changed the way Screening and Scoping are carried out and require additional topics to be considered in the scope of the EIA.

4.2.2 As set out in Chapter 1 Introduction of this ES, there is no statutory provision to the form of an ES. Section 105A of the Highways Act states that the ES must contain the information referred to in Annex IV of the EIA Directive 2014/52/EU. Annex IV is included in Appendix 4.4.

4.2.3 In accordance with Regulation 61 of the Conservation of Habitats and Species Regulations 2010 and Regulation 63 of the Conservation of Habitats and Species Regulations 2017 and the Habitats Directive (92/43/EEC), an Assessment of Implications on European Sites (AIES) was also prepared to consider the possible effects of the Scheme on European sites. The findings of the AIES are reported separately.

4.2.4 In accordance with the Water Framework Directive, an assessment of effects on Water Framework Directive watercourses was undertaken and provided in Volume 3 Appendix 7.1 of this ES.

4.2.5 This ES provides the information required by the Highways Act 1980, as amended, together with other relevant information listed in the EIA Directive (as amended). Together, the information supplied within this ES is considered to provide a clear understanding of the main or likely significant effects of the Scheme on the environment.

4.2.6 The Scheme design development and publication of the ES and Draft Orders were delayed due to the demise of the contractor (Carillion) in January 2018. The delay - which continued from January until July 2018 - meant that this ES needed to be revised to take account of the new Directive and new 2017 EIA Regulations. The Screening and Scoping stages of the EIA process had previously been completed but to ensure compliance with the new legislation, both documents were retrospectively revised to take the ES content into consideration.

4.2.7 The scope of this ES has considered: the legislative requirements, the nature, size and location of the Scheme and the consultation responses provided. Table 4.2 sets out the agreed scope and chapter headings.

4.3 Screening (Determination)

4.3.1 An EIA is an iterative process that occurs in a series of stages, alongside a development proposal. The process includes the following sequence: screening, scoping, assessment and reporting.

4.3.2 An EIA is a means of identifying and collating information to inform an assessment of the likely significant environmental effects of a project. The process requires consideration of the likely changes to the environment, where these arise because of the proposed development, through comparison with the existing and likely future baseline conditions in the absence of the proposed development.

4.3.3 The requirement to complete a statutory EIA and publish an ES only applies to certain projects that are deemed to exceed certain thresholds and are predicted to have a significant effect on the environment. The process for deciding whether it is necessary to carry out an EIA and publish an ES is called Screening.

4.3.4 The screening exercise was carried out in April 2017 to decide whether the project falls below or above the thresholds stated within the EIA regulations. The conclusion was that an EIA would be required and that the Employer should be informed that a Record of Determination and Notice of Determination should be published alongside this ES, to ensure legal compliance. The Record of Determination was submitted to the Employer (Welsh Government) in October 2017.

4.3.5 Because of the liquidation of Carillion in January, there was a delay to the project of several months. In the meantime, the new EIA Regulations 2017 were published which changed the requirements of the Screening and Scoping process and reporting. In the interests of addressing these new regulations, the Screening Report and the Record of Determination were revised and resubmitted in October 2018. The effects of the new regulations on the EIA are set out in Section 4.5. The full Screening Report and Record of Determination are included in Volume 3 Appendix 4.3.

4.3.6 DMRB (2008) Volume 11 Environmental Assessment Section 2 Environmental Impact Assessment Part 3 'Screening a Project' sets out four steps to appropriate screening. These are summarised in Table 4.1.

Table 4.1 The steps to screening a project

Step	Requirements of screening	Result for this Scheme
1	Does the Project fall within Annex I or II of the EIA Directive?	The Scheme falls below the Annex II because it would not involve the construction of a motorway or express road of four or more lanes, nor would it constitute a realignment or widening of a two-lane road or less to provide four lanes over a continuous length of 10km.
2	Deciding if the Annex II Project is a 'Relevant Project'	The Scheme exceeded the Annex II threshold of 1 hectare and was therefore a 'Relevant project' for constructing or improving a highway where the area exceeds 1 hectare or where any such area is situated in whole or in part in a sensitive area.
3	The Determination of a 'Relevant Project' for the Purposes of the EIA Regulations	Based on the criteria set out in Annex III, an assessment of the Scheme indicated that the Scheme was considered likely to have significant effects on the environment.
4	Reporting the Determination	A Record of Determination was prepared based on the results of the screening assessment.

4.4 Scoping

4.4.1 With the results of the screening assessment demonstrating that an EIA should be carried out, a scoping assessment was completed.

4.4.2 The process of identifying the matters to consider within the EIA process is known as scoping. Scoping is an important preliminary procedure, which sets the context for the EIA.

4.4.3 A draft Scoping Report was issued to the statutory consultees - in August 2015 - who attend Environmental Liaison Group (ELG) meetings. These included Natural Resources Wales (NRW), Cadw, South Wales Trunk Road Agency (SWTRA), Pembrokeshire County Council and the Welsh Government Environmental Co-ordination and Advice Team (ECAT).

4.4.4 A copy is provided at Volume 3 Appendix 4.1 of this ES. The purpose of the Scoping Report was to identify the proposed scope of the EIA process and to set out the proposed assessment methodologies for comment. It also identified areas proposed to be scoped out of the assessment. Comments on the draft were considered in the production of the final Scoping Report. However, completion of the process was also affected by the Carillion liquidation (see paragraph 4.3.5).

4.4.5 In the interests of addressing the new regulations, the Scoping Reports was revised and distributed to the relevant statutory environmental consultees who are represented on the ELG in October 2018. The effects of the new regulations on the EIA are set out in Section 4.5.

Table 4.2 Scope of this Environmental Statement

Non-Technical Summary: Summary of the ES using non-technical terminology	
Volume 1 Environmental Statement	
Chapter 1	Introduction
Chapter 2	The Project
Chapter 3	Alternatives Considered
Chapter 4	Environmental Impact Assessment Methodology
Chapter 5	Legislation and Policy Context
Chapter 6	Geology and Soils
Chapter 7	Road Drainage and the Water Environment
Chapter 8	Ecology and Nature Conservation
Chapter 9	Landscape and Visual Effects
Chapter 10	Archaeology and Cultural Heritage
Chapter 11	Community and Private Assets (excluding agricultural land)
Chapter 12	Community and Private Assets: Agricultural Assessment
Chapter 13	Air Quality
Chapter 14	Noise and Vibration
Chapter 15	All Travellers
Chapter 16	Materials
Chapter 17	Population and Human Health
Chapter 18	Climate Change
Chapter 19	Assessment of Cumulative Effects: Introduction
Chapter 20	Assessment of Cumulative Effects: Same scheme effects
Chapter 21	Assessment of Cumulative Effects: different scheme effects
Chapter 22	Management of Environmental Effects
Chapter 23	Conclusions
Volume 2 Figures	
Including all figures and drawings to accompany the text	
Volume 3 Appendices	
Including specialist reports forming technical appendices to the main text in Volume 1	

Responses to the Scoping

4.4.6 Volume 3 Appendix 4.2 of this ES provides an overview of the key points raised by consultees during the scoping process. Chapters 6 to 22 of this ES also provide a summary of the key points raised during consultation with both statutory and non-statutory consultees.

Content of the ES

4.4.7 Based on the scoping report and the requirements of the Design Manual for Roads and Bridges (DMRB), the volumes and chapters that make up the content of the ES is set out in Table 4.2.

4.5 Increased scope for EU Directive EC2014/52/EU

4.5.1 From May 2017, the new EIA Directive EC2014/52/EU, which amended the existing 2011 Directive 2011/92/EU, must be applied to all projects covered by the EIA process. The new Directive and the new EIA Regulations, which came into force in December 2017, require additional topics to be considered in the EIA. Topics are addressed in the manner set out in the following paragraphs. Several the new topics were scoped out of the assessment.

Assessments of Health-related matters

4.5.2 The 2014 Directive states that an EIA should consider the effects of a project on Population and Human Health. An assessment of the health impacts associated with the Scheme was undertaken. This report is discussed in ES Chapter 17 Population and Human Health.

4.5.3 Health Impact Assessment (HIA) and Equality Impact Assessment (EqIA) are a key part of the appraisal process for major transport schemes in Wales. The Welsh Government has statutory duties to promote well-being and racial, disability and gender equality, and has set up a Public Health Strategic Framework to improve the quality and length of life for all members of the community. Social Impact Assessment (SIA) is often developed as an independent SIA report; however, social, health and equality impacts are intrinsically linked.

4.5.4 A combined Health, Social and Equalities Impact Assessment has therefore been undertaken for the Scheme. This assessment considers how the Scheme may influence public health and well-being in the

areas surrounding the proposed road improvement through environmental and socio-economic pathways. The assessment also considers, where possible, the distribution of impacts and any potential disproportionate impacts of the Scheme on sensitive community groups.

Assessments of Climate Change

4.5.5 The 2014 amendments to the EIA Directive place an emphasis on climate change. Although the provisions of Directive 2011/92/EU remain the relevant consideration for the Scheme, the requirements of the amended Directive in relation to climate change were considered, as a matter of best practice. Therefore, the following aspects of climate change were considered within this ES.

4.5.6 **Changes to Future Environmental Conditions and Climate Change Resilience:** climate change was considered during the Scheme design process. The design has considered future flood risk and resilience. The resilience of the Scheme to climate change was reported within ES Chapter 18 Climate Change.

4.5.7 **Effects of the Scheme on Climate**: atmospheric emissions associated with use of the Scheme are assessed within Chapter 13 Air Quality, but a carbon assessment was undertaken and is reported in Chapter 18 Climate Change. This report sets out carbon emissions associated with the construction and operation of the Scheme.

Assessments of Material Assets

4.5.8 Annex IV of the EIA Directive includes reference to ‘material assets’. The phrase ‘material assets’ has a broad scope, which may include assets of human or natural origin, valued for socio-economic/community or heritage reasons. Material assets are in practice considered across a range of topic areas within an ES, in the Chapter 10 Archaeology and Cultural Heritage; and Chapter 11 and 12, the Community and Private Assets chapters. Materials associated with construction are considered in Chapter 16 Materials, therefore, no separate consideration of material assets is considered necessary.

Assessments of Radiation and Heat

4.5.9 Given the nature of the Scheme, no significant radiation or heat effects are anticipated, and these effects were scoped out of the assessment.

Risk of Major Accident and Disaster

4.5.10 Given the nature of the Scheme, no significant effects on the environment, arising from risks of major accident or disaster, are anticipated. Scoping identified that if a serious road accident with fatalities or casualties resulted in the closure of the road, the effect would be of short duration and traffic diverted onto other roads. Closing the road and these effects were scoped out of the assessment.

4.5.11 If the major accident resulted in spillage of pollutants these would be contained by the road drainage and treated by the emergency services. The risk of the pollution not being contained is low and therefore not considered significant.

4.6 Environmental Assessment guidance

Relevant EIA Guidance

4.6.1 The EIA process has considered relevant guidance, including the following documents:

a) **Design Manual for Roads and Bridges (DMRB) Volume 11**, **Section 1** Aims and Objectives of Environmental Assessment HA 200/08 (Highways Agency et al., 2008a, as amended).

b) **DMRB Volume 11, Section 2** General Principles of Environmental Assessment, including HA 201/08, HA 202/08, HA 204/08, HA 205/08 and HD 48/08 (Highways Agency et al., 2008 b, c, d, e, f).

c) **DMRB Volume 11, Section 3** Environmental Assessment Techniques, (Highways Agency et al., 2008).

d) **Interim Advice Note 125/09(W)** Supplementary Guidance for Users of DMRB Volume 11 'Environmental Assessment'. Wales Only (Welsh Assembly Government, 2010).

e) **Guidelines for Environmental Impact Assessment 3rd Edition (GLVIA3)** (Institute of Environmental Management and Assessment, 2004 - updated 2006).

f) **The State of Environmental Impact Assessment Practice in the UK**. Special Report (Institute of Environmental Management and Assessment, 2011).

4.6.2 Other topic specific legislation and good practice guidance was considered and details of these can be found in the topic chapters within this ES.

4.7 Assessment for each environmental topic

4.7.1 The assessment of each environmental topic forms a single chapter within this ES, and will contain details of:

a) Legislation and policy relevant to the topic;
b) Assessment method used (Section 4.6);
c) Description of the baseline environmental conditions (Section 4.8);
d) Identification of potential effects (including those arising during the construction and operational phases) (Section 4.9 to 4.12);
e) Identification of mitigation and monitoring measures, where appropriate. (Section 4.13);
f) Evaluation and assessment of the significance of identified effects. (Section 4.14);

4.7.2 Each topic chapter provides details of the methodology for baseline data collection and the approach to the assessment of effects. Each environmental topic was considered by a specialist in that area. The identification and evaluation of effects was based on the information set out in the Scheme description and construction details contained within Chapter 2 The Project and Chapter 3 Alternatives Considered of this ES, EIA good practice guidance documents and relevant topic specific guidance where available.

4.7.3 Cumulative effects with other proposed developments and interrelationships between topic areas are assessed within Chapter 19 to 21 of this ES.

4.8 Identification of Baseline Conditions

4.8.1 An ES requires sufficient data to form the basis of the assessment. Each topic chapter includes a description of the current (baseline) environmental conditions. This is based on the study area identified for each topic chapter. Where appropriate, study areas were agreed in

consultation with statutory consultees (for example, the study areas for ecology survey were developed in consultation with Natural Resources Wales). In some instances, more than one study area was defined in accordance with relevant standards and guidance for that topic.

4.8.2 The following baseline scenarios were considered (without the Scheme), where relevant, for comparison against the situation with the Scheme in place:

a) The existing baseline conditions at the time of survey/writing (2016-2018) depending on the availability of existing data and new surveys.
b) Likely start of construction in 2020.
c) A future year when the A40 Llanddewi Velfrey to Penblewin Scheme would be open to traffic in 2021.
d) The design year - Autumn 2036.

4.8.3 Baseline data was obtained from existing sources (including desk study and previous surveys), from surveys commissioned specifically for the Scheme, or both. The identification of existing baseline conditions was informed by data from these sources.

4.8.4 A programme of ecological surveys and a ground investigation were commissioned by Welsh Government from Arcadis and Mott MacDonald in 2016 and the data from these were provided to the contractor at commencement of the previous Carillion contract. Further surveys were then carried out in 2017 to provide additional data for the design and the EIA. These included noise and air quality baseline surveys, further ecological surveys, summer and winter landscape and visual surveys, further ground investigation, an archaeological geophysical (magnetometer) survey, farm surveys and interviews, non-motorised users and traffic surveys and water resources surveys. All surveys were completed by November 2017.

4.8.5 Each topic chapter identifies the limitations of the assessment and whether there were any difficulties encountered in compiling the information that is presented in this ES.

4.9 Assessment of Effects

4.9.1 The EIA process requires the identification of the likely significant environmental effects of the Scheme. This includes consideration of the likely effects during the construction and operational phases of the Scheme.

4.9.2 Volume 11, Section 2 of the DMRB (HA 205/08) (Highways Agency et al., 2008e) provides guidance on the determination of significance of environmental effects for highway schemes. This includes consideration of the following.

a) Environmental value (or sensitivity) of a resource or receptor.
b) The level of impact.
c) The level of significance of an effect.

4.9.3 These aspects are discussed in the following sections.

4.10 Sensitivity or Value of Receptors

4.10.1 **Definition of 'Receptors'** are defined as individual environmental features that have the potential to be affected by a scheme (Highways Agency et al., 2008g). For each topic, baseline studies have informed the identification of potential environmental receptors. Some receptors will be more sensitive to certain environmental effects than others. The sensitivity or value of a receptor may depend, for example, on its frequency, extent of occurrence or conservation status at an international, national, regional or local level.

4.10.2 Sensitivity is defined within each ES topic chapter and considers factors including the following:

a) Vulnerability of the receptor to change.
b) Recoverability of the receptor (ability to recover from a temporary impact).
c) Importance of the receptor.

4.10.3 As a general guide, the definitions set out in Table 2.1 of HA205/08 were considered (except where topic guidance requires otherwise). This included a five-point scale for assigning environmental sensitivity as shown in Table 4.3.

Table 4.3 Criteria and DMRB Definitions of Sensitivity (or value)

Sensitivity/Value	Typical descriptors
Very High	Very high importance and rarity, international scale and very limited potential for substitution
High	High importance and rarity, national scale and limited potential for substitution.
Medium	High or Medium importance and rarity, regional scale, limited potential for substitution.
Low (or lower)	Low or medium importance and rarity, local scale.
Negligible	Very Low importance and rarity, local scale

Based on Table 2.1 of HA205/08 (Highways et al., 2008e)

4.11 Magnitude of Impact

4.11.1 The DMRB defines an 'impact' as: 'Change that is caused by an action; for example, land clearing (action) during construction which results in habitat loss (impact)' (Highways Agency et al., 2008g)

4.11.2 For each topic, the likely environmental impacts were identified. The likely environmental change arising from the Scheme was identified and compared with the baseline (the situation without the Scheme). Impacts are divided into those occurring during the construction and operation phases.

4.11.3 The categorisation of the magnitude of impact is topic specific but generally considers factors such as the following:

a) Extent;
b) Duration;
c) Frequency; and
d) Reversibility

4.11.4 When undertaking an EIA, environmental impacts are classified as either permanent or temporary, as appropriate. Permanent changes are those which are irreversible (e.g. permanent land take) or will last for the foreseeable future (e.g. noise from generated road traffic). With respect to temporary impacts, the following was used as a guide within this assessment, unless defined separately within the topic assessments.

a) Short-term: one to three years;
b) Medium-term: four to nine years;

c) Long-term: greater than nine years.

4.11.5 Where environmental impacts are episodic, the frequency of the events was predicted.

4.11.6 Impacts are also defined as either adverse or beneficial. Depending on discipline, they may also be described as follows:

a) **Direct:** Arise from activities associated with the Scheme. These tend to be either spatially or temporally concurrent.

b) **Indirect:** Impacts on the environment that are not a direct result of the Scheme, often produced away from the Scheme or as a result of a complex pathway.

4.11.7 As a general guide, the definitions set out in Table 2.2 of HA205/08 were considered (except where topic guidance requires otherwise). This includes a five-point scale for assigning impact magnitude as shown in Table 4.4.

Table 4.4 The five-point scale for assigning impact magnitude

Magnitude of Impact	Typical descriptors
Major	Adverse: loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements.
	Beneficial: large scale or major improvement of resource quality, extensive restoration or enhancement; major improvement of attribute quality
Moderate	Adverse: loss of resource but not adversely affecting integrity; partial loss or damage to key characteristics, features or elements.
	Beneficial to, or addition of key characteristics, features or elements; improvement of attribute quality.
Minor	Adverse: some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to key characteristics, features or elements.
	Beneficial: minor benefit to or addition of one or more key characteristics, features or elements; some beneficial impact on attribute, or a reduced risk of negative impact occurring.
Negligible	Adverse: very minor loss or detrimental alteration to one or more characteristics, features or elements.
	Beneficial: very minor benefit or positive addition of one or more characteristics, features or elements.
No change	Adverse/beneficial: no loss or alteration of characteristics, features or elements, no observable impact in either direction.

Based on Table 2.1 of HA205/08 (Highways et al., 2008e)

4.12 Significance of Effects

4.12.1 **Definition of 'Effect':** The DMRB defines an 'effect' as a 'term used to express the consequence of an impact (expressed as 'significance of effect'), which is determined by correlating the magnitude of the impact to the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria. For example, land clearing during construction results in habitat loss (impact), the effect of which is the significance of the habitat loss on the ecological resource' (Highways Agency et al., 2008g).

4.12.2 An 'effect' is therefore the consequence of an impact (expressed as the 'significance of effect'). This is identified by considering the magnitude of the impact and the sensitivity or value of the receptor.

4.12.3 The assessment process examines how the proposed Scheme will impact on environmental receptors (people, heritage, air, water soils and species). Each receptor was identified in baseline surveys and desk studies and is given a value based on rarity or sensitivity to change (see Table 4.3). For example, a designated Scheduled Ancient Monument (SAM) would be considered as more important than an undesignated heritage site.

4.12.4 The magnitude of the impact is ascribed to a receptor where it is influenced by the Scheme (see Table 4.4). For example, an area of habitat might be unaffected, partially affected or destroyed.

4.12.5 The magnitude of impact on a receptor is combined with the value/sensitivity/importance of that receptor to determine the significance (see Table 4.5). For example, a significant effect may arise as a result of a relatively modest impact on a resource of national value/sensitivity, or a large impact on a resource of local value/sensitivity. In broad terms, therefore, the significance of the effect can depend on both the impact magnitude and the value or sensitivity or importance of the receptor.

4.12.6 Each chapter defines the approach taken to the assessment of significance. Where appropriate, topic chapters have adopted the general approach set out in DMRB HA 205/08 (see Table 4.5). The evaluation of significance for each topic will consider industry and professional guidance; codes of practice; policy objectives regulations or standards; advice from statutory consultees and other stakeholders,

as well as expert judgement of the EIA practitioners, based on specialist experience. For some topics, a simplified or quantitative approach is considered appropriate.

The evaluation of significance.

Table 4.5 Approach to evaluating Significance of Effect

		Magnitude of Impact Degree of change)				
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
Sensitivity (or value)	**Negligible**	**Neutral**	**Neutral**	**Neutral or Slight**	**Neutral or Slight**	**Slight**
	Low	**Neutral**	**Neutral or Slight**	**Neutral or Slight**	**Slight**	**Slight or Moderate**
	Medium	**Neutral**	**Neutral or Slight**	**Slight**	**Moderate**	**Moderate or large**
	High	**Neutral**	**Slight**	**Slight or Moderate**	**Moderate or large**	**Large or Very Large**
	Very High	**Neutral**	**Slight**	**Moderate or Large**	**Large or Very Large**	**Very Large**

Based on Table 2.4 of HA205/08 (Highways Agency et al., 2008e

4.12.7 Where more than one significance level is provided, professional judgement was used to determine the significance of effect. Slight, moderate, large or very large effects may be beneficial or adverse.

4.12.8 Except where guidance requires otherwise, the significance of effect is described using the terms very large, large, moderate, slight and neutral. The broad definitions of these terms are provided in Table 4.6.

4.12.9 In terms of the EIA Regulations, significant effects are generally those where the significance of the effect is 'moderate' or greater. It should be noted however that, as described in Table 4.6, a significant effect in EIA terms simply means that the effect should be given careful consideration in the decision-making process.

Table 4.6 DMRB Descriptors of Significance of Effects Categories

Significance Category	Typical Descriptors of Effect
Very Large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of International, National or Regional Importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may enter this category.
Large	These beneficial or adverse effects are likely to be very important considerations and are likely to be material in the decision-making process.
Moderate	These beneficial or adverse effects may be important but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the project.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Based on Table 2.3 of HA205/08 (Highways Agency et all., 2008e

4.13 Mitigation and Monitoring Measures.

4.13.1 The development of mitigation and monitoring measures is part of an iterative EIA process. Measures included in the Scheme was developed throughout the EIA process in response to the findings of initial assessments. In some cases, these measures may result in enhancement of environmental conditions. Mitigation measures can include the following:

a) Measures included as part of the Scheme design, such as those measures shown on the Environmental Masterplans (included in Volume 3 Appendix 2.5;

b) Normal good practice measures to be adopted during construction to avoid and minimise environmental effects, such as pollution control measures;

c) Additional measures identified during the EIA process to further prevent, reduce and, where possible, offset any adverse effects on the environment.

d) Enhancement measures, these are not strictly mitigation because they go beyond what is required to mitigate. Enhancement is described in Section 4.15.

4.13.2 Some forms of mitigation require a controlling mechanism or legal undertaking to be implemented but are under the control of the

'Applicant' and therefore are regulated and have greater certain of delivery.

4.14 Assessment of Environmental Impacts

4.14.1 The purpose of an EIA is to identify and evaluate the environmental effects associated with the proposed development. These are assessed based on the magnitude of the effect (following mitigation) and the sensitivity of the receiving environment.

4.14.2 In Wales, HA 205/08 recommends assignment of significance before and after the consideration of mitigation measures is undertaken to allow for the case or reason for, and effectiveness of mitigation to be described (Highways Agency et al., 2008e).

4.14.3 The determination of impact significance will be undertaken against the environmental baseline and be based on the significance matrix included in Table 4.5 of this chapter.

4.14.4 Cumulative Impacts of the proposed Scheme and other developments will be covered in ES Chapters 19 to 21.

4.14.5 For the purposes of the assessment, certain measures are integral to the Scheme and are therefore taken into consideration in the 'without mitigation' assessment. The integral measures include small changes to the vertical and horizontal alignment, or the location of junctions, culverts and the extent of earthworks, for example, to avoid or minimise potential impacts.

Monitoring of proposed mitigation

4.14.6 The requirement for monitoring during construction or following completion of construction was considered. A description of proposed monitoring measures is provided within each topic chapter of this ES. Monitoring will be reported in Annual Environmental Monitoring Reports and on completion of the five-year aftercare a final environmental monitoring report will be prepared.

4.14.7 Mitigation and monitoring measures proposed during the construction phase are set out in the Pre-Construction Environmental Management Plan in Volume 3 Appendix 2.2. The Register of Environmental Actions and Commitments in Volume 3 Appendix 2.3 provides an

overview of the key mitigation and monitoring proposed for the Scheme.

4.15 Benefits of the Scheme

4.15.1 Enhancements of the Scheme would go further than the conventional approach to mitigation. Normally an ES will include measures such as avoidance of an impact, or if the impact cannot be avoided, it will include mitigation or replacement for the consequences. Enhancement goes further to improve on the circumstances that existed before the Scheme is implemented to provide benefits. The delivery of these benefits is encouraged by the following two items of legislation.

Environment (Wales) Act 2016

4.15.2 Central to this Act is the need to adopt a new, more integrated approach to managing natural resources in order to achieve long-term sustainability and improved resilience of natural systems. The Act provides an iterative framework that ensures that managing our natural resources sustainably will be a core consideration in decision-making.

4.15.3 The Act includes a new biodiversity duty (Section 6 Duty) intended to reverse the decline and secure the long-term resilience of biodiversity in Wales. The Environment Act replaces and enhances the Natural Environment and Rural Communities Act 2006 (NERC) duty to require all public authorities, when carrying out their functions in Wales, to seek to "maintain and enhance biodiversity" where it is within the proper exercise of their functions. In doing so, public authorities must also seek to "promote the resilience of ecosystems". This ensures that biodiversity is an integral part of the decisions that public authorities take in relation to Wales. The new duty requires public authorities to report on the actions they have taken to improve biodiversity and promote ecosystem resilience.

Well-being of Future Generations Act 2015

4.15.4 In Wales, the Well-being of Future Generations Act 2015 places a duty on public organisations to achieve seven sustainability goals.

4.15.5 Part 2, Section 2 of the Act defines the relevant meaning of 'sustainable development'; it means 'the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals.' Public Bodies are required to set objectives for their actions which should be 'in accordance with the 'sustainable development principle', which means the body 'must act in a manner which seeks to ensure the needs of the present are met without compromising the ability of future generations to meet their own needs'.

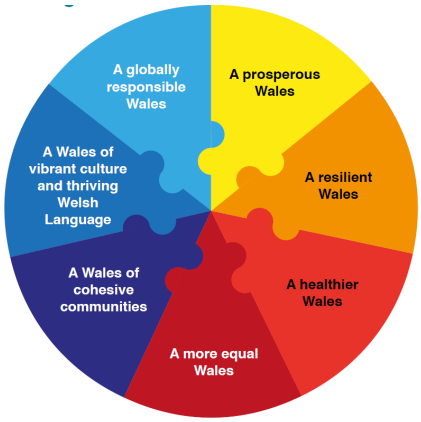

Figure 4 1 The Well-being Goals of the Future Generations Act 2015

4.15.6 The Scheme would include measures, that could contribute to achieving the goals of both acts of the Welsh Government. For example, improving the network of routes for non-motorised users in the local community and using habitats that would be provided for visual screening and landscape integration to benefit biodiversity.

4.16 Assessment of Cumulative Effects

4.16.1 EIA Directive 2011/92/EU, as amended by Directive 2014/52/EU, requires the EIA to consider cumulative effects. Cumulative effects result from multiple actions on receptors and resources over time and are generally additive or interactive (synergistic) in nature. Cumulative impacts can also be considered as: '*...impacts resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project.*'[1] The Directive 2014/52/EU requires that EIA should cover '*the cumulation of effects with other existing and/or approved projects, taking into account any*

[1] European Commission, 1999.

existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources;'.

4.16.2 Major developments for consideration within the cumulative effects assessment were identified within the following categories:

a) Development under construction.
b) Application(s) permitted but which are not yet implemented.
c) Submitted applications not yet determined, and which, if permitted, would affect the proposed development in the scoping request.
d) Development identified in the adopted and emerging development plan (with appropriate weight being given as they move closer to adoption), recognising that information on any relevant proposals will be limited.

4.16.3 A review of the following sources was undertaken to identify developments:

a) Local planning authority websites, with particular emphasis on proposed developments (including transport or minerals related developments) in closest proximity to the site located within the administrative boundaries of Pembrokeshire County Council and Carmarthenshire County Council.
b) Adopted and emerging Local Plans
c) Planning Inspectorate website, in order to identify any Nationally Significant Infrastructure Projects in the vicinity of the Scheme.

4.16.4 Advice and guidance on the assessment of cumulative effects is given in HA 205/08 and HD 48/08 (Highways Agency et al., 2008e and 2008f). Additionally, IAN 125/09(W) acknowledges that '*as yet there is no industry standardised approach*' to the assessment of cumulative effects. However, the cumulative assessment should nevertheless 'differentiate between permanent, temporary, direct, indirect and secondary effects, positive and negative' (Welsh Assembly Government, 2010).

4.16.5 Relevant guidance considered in the assessment of cumulative effects includes:

a) HA205/08 Principles of Environmental Assessment – Assessment and Management of Environmental Effects (Highways Agency et al., 2008).

b) Welsh Assembly Government (2010) Interim Advice Note 125/09(W) Supplementary Guidance for Users of DMRB Volume 11 'Environmental Assessment' Wales Only.

c) Advice Note 17: Cumulative effects assessment relevant to nationally significant infrastructure projects (Planning Inspectorate, 2015).

d) Advice Note 9: Using the Rochdale Envelope (Planning Inspectorate, July 2017). The Rochdale Envelope is an approach to consenting and environmental impact, named after a UK planning law case, which allows a project description to be broadly defined, within several agreed parameters, for the purposes of a consent application. This allows for a certain level of flexibility while a project is in the early stages of development. As development progresses and more detail and certainty are available, further information regarding potentially impactful elements of the project can be provided.

4.16.6 The cumulative effects of the Scheme in conjunction with other proposed developments were assessed and the findings are presented within Chapters 19, 20 and 21.

4.17 Interrelationships

4.17.1 Consideration of interrelationships is a requirement of the EIA Directive. Interrelationships refer to the combined effect on individual (or groups of) receptors or resources from more than one source or type of environmental effect (e.g. noise, loss of amenity, visual impact on a dwelling). Interrelationships are considered within Chapter 20 Assessment of Cumulative Effects: Same scheme effects.

4.18 Consultation

4.18.1 This section summarises the consultation undertaken with stakeholders at key stages during the development of the Scheme. Further details of the comments received (where relevant to the EIA process) are set out within each topic chapter of this ES and in the Volume 3 Appendix 4.2 Scoping Responses.

4.18.2 During development of the Scheme, consultation was undertaken with, or information requested from, several organisations including (but not limited to) Statutory and Non-Statutory consultees, interest groups, commercial, industrial and business operators, the general

public (mainly the local community of Llanddewi Velfrey and surrounding communities).

4.18.3 The process also centred on engagement with key stakeholders in order to establish the proposed scope and level of detail required for the draft assessments. Key stakeholders (listed in Table 4.7 and Table 4.8) included statutory consultees and those with a stake or significant interest in transport issues relevant to the economy, environment and society in south-west Wales.

Table 4.7 Statutory and public stakeholders

Organisation	**Representative or department**
Welsh Assembly	Local Assembly Member
Welsh Government	Technical Approvals Authority Technical Standards and Departures Lands and Orders Network Management Route Manager Environmental Science Advisor
Pembrokeshire County Council	Chief Executive Officer Head of Services Leader of the Council Infrastructure Cabinet Member Councillor for Llanddewi Velfrey Head of Highways Landscape Officer Transport Planner Ecologist
Llanddewi Velfrey Community Council	Clerk to the Council
Natural Resources Wales	Liaison Officer and Protected Species team
Cadw	Conservation Officer
South Wales Trunk Road Agency	Road and soft estate maintenance
Design Commission for Wales	Reviewers
Utilities	Various

Table 4.8 Other key stakeholders

Other key stakeholders
Farm businesses (affected by the Scheme)
British Horse Society
Ramblers Association
National Farmers Union Cymru
Preseli Service Station and Car Sales, Llanddewi Velfrey
Road Haulage Association
Freight Transport Association
Emergency Services
Silcox Coaches
Taff Valley Coaches
Businesses in Narberth and Whitland
Farm Businesses
Haven Waterways Enterprise Zone
Associated British Ports

4.18.4 A Public Information Exhibition (PIE) was undertaken over two days in May 2017, based in the community hall in Llanddewi Velfrey. A bilingual Information Leaflet about the Scheme was delivered in advance to residents. Exhibition boards were displayed and members of the project team, including technical experts, were available to answer any questions and explain how the public could express their opinions formally.

4.18.5 Feedback at the exhibition was invited from those who attended the exhibition through a questionnaire survey and enquiry forms provided. The feedback was taken into consideration during the design of the Scheme, which was then shown to the community at a Public Exhibition in September 2017. Further feedback was invited at the Public Exhibition and many were received.

4.18.6 In June 2017, an article about the Scheme was published in the community newsletter, which is widely distributed.

4.18.7 A public consultation was carried out in Autumn 2017, with a Public Exhibition in the community hall in Llanddewi Velfrey undertaken over three days in October. A bilingual Information Leaflet about the Scheme was delivered in advance to residents. Exhibition boards were displayed and members of the project team, including technical

experts, were available to answer any questions and explain how the public could express their opinions using the questionnaire.

4.18.8 An integral part of the Consultation process are the Environmental Liaison Group meetings. These were held with key environmental consultees during the evolution of the Scheme design. Those who attended were invited to comment on the Scheme Objectives and Environmental Objectives and subsequently to comment on the EIA Scoping Report. The Scoping Report sets out the proposed scope of the EIA, and the assessment methodologies.

4.18.9 Meetings with farm owners and tenants were organised throughout the process, including completion of a questionnaire relating to existing land uses. Many of these owners and tenants attended the PIE and were able to provide comments using the exhibition questionnaire and through discussions with technical staff who attended.

4.18.10 The approach to consultation during the EIA process built on the consultation undertaken at previous stages. Statutory bodies were consulted throughout the development of the Scheme and meetings held with key consultees. Comments in relation to EIA matters were considered in the preparation of this ES.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 5: Legislation and Policy Context

A40LVP-ARP-EAC-SWI-RP-LE-0001

P06 | S4

08/03/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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5 Legislation and Policy Context

5.1 Introduction

5.1.1 The purpose of this chapter is to provide an overarching and strategic legislative and policy context for the Scheme from an environmental perspective. As such it briefly describes key legislation and the main planning policies of specific relevance to the Scheme, at European, UK and Welsh levels. In addition, it lists the development planning policies at the local level. It focuses on Pembrokeshire County Council as the planning authority through which the proposed Scheme runs, and additionally the Pembrokeshire Coast National Park policies have been included, given that it is the nearest neighbouring planning authority and would be impacted by the Scheme.

5.1.2 Specific legislation and policy is considered further on a topic by topic basis within Chapters 6 – 18 of this Environmental Statement (ES). Individual chapters also provide further detail on how the design and assessment of the Scheme has been specifically developed considering the relevant policies and legislation introduced within this context chapter.

5.2 Legislation

Environment (Wales) Act 2016

5.2.1 Enacted in 2016 by the National Assembly for Wales, the Environment (Wales) Act 2016 provides an iterative framework that ensures that managing natural resources sustainably will be a core consideration in decision-making. Natural Resources Wales are the principle organisational body to help deliver the aims of the Act and are required to prepare a number of documents, which include:

a) State of Natural Resources Report;

b) National Natural Resources Policy; and

c) Area Statements.

5.2.2 These documents will help inform the design of road schemes so that they can be delivered in a way that manages natural resources sustainably. The Act also includes provisions to tackle climate change, through statutory emission reduction targets and carbon budgeting to support their delivery.

5.2.3 In particular, Section 6 under Part 1 of the Environment (Wales) Act 2016 introduced an enhanced duty (the S6 duty) for public authorities in the exercise of functions in relation to Wales. The S6 duty requires that public authorities must seek to maintain and enhance biodiversity so far as consistent with the proper exercise of their functions and in so doing promote the resilience of ecosystems. To follow the S6 duty public authorities should embed the consideration of biodiversity and ecosystems into their early thinking and business planning, including any policies, plans, programmes and projects, as well as their day to day activities.

Historic Environment (Wales) Act 2016

5.2.4 The Historic Environment (Wales) Act forms part of a suite of legislation, policy, advice and guidance that makes important improvements to the existing systems for the protection and sustainable management of the Welsh historic environment. In broad terms, the Act gives more effective protection to listed buildings and scheduled monuments, enhances existing mechanisms for the sustainable management of the historic environment, and introduces greater transparency and accountability into decisions taken on the historic environment.

Well-being of Future Generations Act (Wales) 2015

5.2.5 This 2015 Act is about improving the social, economic, environmental and cultural well-being of Wales with an overarching aim of creating a Wales we all want to live in, now and in the future. The Act puts in place seven well-being goals shown in Table 5.1.

5.2.6 The 2015 Act places a duty on public bodies in Wales and those listed in the Act to work to improve the economic, social, environmental and cultural well-being of Wales. To help do this they must set and publish well-being objectives and give greater consideration to the long term, work better with people and communities and each other, look to prevent problems and take a more joined-up approach.

5.2.7 The WelTAG Stage 1 and 2 Reports identify the problems, objectives and consider the possible solutions, arriving at a recommendation to progress the Scheme subject to this assessment. The objectives have been considered against and are aligned to the seven well-being goals set out within the 2015 Act. In addition, appraisal against the impact areas focus on the four pillars of sustainable development, those being: economic; social; cultural; and environmental impacts.

5.2.8 Such impacts are aligned to the sustainable development principle as set out in the 2015 Act and the proposed Scheme seeks to improve a key piece of infrastructure for future generations in Pembrokeshire, the wider region and those visiting from elsewhere.

Table 5.1 Well-being Goals

Goal	Description of Goal
A prosperous Wales	An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including acting on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.
A resilient Wales	A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).
A healthier Wales	A society in which people's physical and mental well-being is maximised and in which choices and behaviours that benefit future health are understood.
A more equal Wales	A society that enables people to fulfil their potential no matter what their background or circumstances (including their socio-economic background and circumstances).
A Wales of cohesive communities	Attractive, viable, safe and well-connected communities.
A Wales of vibrant culture and thriving Welsh Language	A society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts and sports and recreation.
A globally responsible Wales	A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.

Active Travel (Wales) Act 2013

5.2.9 Enacted in 2013 by the National Assembly for Wales, the Active Travel (Wales) Act 2013 sets a legal requirement for local authorities in Wales to map and plan for suitable routes for active travel, and to build and improve their infrastructure for walking and cycling every year. It creates new duties for highways authorities to consider the needs of walkers and cyclists and make better provision for them.

5.2.10 It also requires both the Welsh Government and local authorities to promote walking and cycling as a mode of transport so that local communities rely less on cars when making short journeys.

5.2.11 In the context of road schemes, there is significant opportunity to reconfigure existing infrastructure so that it better meets the needs of existing and new settlements and facilitates active travel. For example, bypass road schemes can address settlement severance and in doing so provide opportunities for active travel because pedestrians and cyclists would no longer need to compete with significant volumes of vehicular traffic for short journeys in the locality.

5.2.12 The Act sets out that where offline improvements are proposed, the new section of road will allow for existing roads to be declassified. This will allow governments and local authorities to explore opportunities to provide benefits to Non-Motorised Users (NMUs).

Conservation of Habitats and Species Regulations 2017

5.2.13 Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Flora and Fauna provides legal protection for habitats and species of European importance. The Directive is transposed into UK law by the Conservation of Habitats and Species Regulations 2017 (the 'Habitats Regulations').

5.2.14 The Habitats Regulations requires the competent authority to consider, inter alia, whether the plan or project is likely to have a significant effect on a European site. If there is a likely significant effect an 'appropriate assessment' of the implications of the project for that site must be undertaken. (either alone or in combination with other plans or projects).

5.2.15 The project can only proceed if it has been ascertained that it will not affect the integrity of the European site (unless there are no alternatives and there are imperative reasons of overriding public interest supporting the project ('IROPI')).

5.2.16 Given that it could not be concluded at screening stage that European sites would not be likely significantly affected by the Scheme, an appropriate assessment has been undertaken in the form of an Assessment of Implications on European Site (AIES) in accordance with the Conservation of Habitats and Species Regulations 2017. This considers the possible effects of the Scheme on European Sites. The findings of the AIES are reported separately and conclude that there would not be any likely significant effects.

Climate Change Act 2008

5.2.17 The Act imposes a duty on the Secretary of State to reduce UK wide greenhouse gas emissions in 2050 to a level which is at least 80% below the level of emissions in 1990. It also obliges the Secretary of State to set carbon budgets for successive five-year period and to prepare proposals and policies for meeting those carbon budgets. Part 2 of the Act establishes the Committee on Climate Change.

5.2.18 Parts 4 and 5 of the Act impose limited duties and confer limited powers on Welsh Ministers in terms of contributing towards meeting the UK wide carbon targets. The Environment (Wales) Act 2016, imposes specific carbon budgeting duties on Welsh Ministers similar to those to which the Secretary of State is subject.

5.2.19 Further information on climate change and how the Scheme would accord with the principles set out by relevant climate change policies and legislation is set out in chapter 18 of the ES.

5.2.20 The A40 improvements generally seek to avoid stop-start conditions and unsafe overtaking, which typically involves hard acceleration and deceleration. This will contribute to improved vehicle emissions.

Natural Environment and Rural Communities Act 2006

5.2.21 The Natural Environment and Rural Communities Act 2006 (NERC Act) was designed to help achieve a rich and diverse natural environment and thriving rural communities through modernised and

simplified arrangements for delivering UK Government policy. The Act implemented key elements of the (then) UK Labour Government's Rural Strategy published in July 2004 (Defra, 2004).

5.2.22 The NERC Act established Natural England and made amendments to both the Wildlife and Countryside Act 1981 and the Countryside and Rights of Way Act 2000. Section 40 sets out a duty to conserve biodiversity whereby 'every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity', whilst Section 42 requires the National Assembly of Wales to 'publish a list of the living organisms and types of habitat which in the Assembly's opinion are of principal importance for the purpose of conserving biodiversity'. 'Conserving biodiversity includes, in relation to a living organism or type of habitat, restoring or enhancing a population or habitat' (Section 40(3)).

Human Rights Act 1998

5.2.23 The Human Rights Act 1998 is relevant where there is a need for compulsory purchase to acquire the necessary minimum land to construct the Scheme. The Act outlines that a Compulsory Purchase Order (CPO) should only be made where there is a compelling case in the public interest. An acquiring authority, including Welsh Ministers, should be sure that the purposes for which it is making a CPO sufficiently justify interfering with the human rights of those with an interest in the land affected having regard, in particular, to the provision of Article 1 of The First Protocol to the European Convention on Human Rights and, in the case of dwellings, Article 8 of the Convention.

Wildlife and Countryside Act 1981 (as amended)

5.2.24 For more than three decades the Wildlife and Countryside Act 1981 (as amended) (WCA) has been, and remains, the principal mechanism for the protection of wildlife in the UK. The WCA comprises four parts. Part 1 covers the protection of wildlife, including birds, their nests and eggs; wild animals, mammals and wild plants. Part 2 makes provision for the countryside, national parks, the designation of protected areas including Sites of Special Scientific Interest (SSSIs), limestone pavements, National Nature Reserves, and grants by the national nature conservation bodies in England and Wales. Part 3 covers public rights

of way, including footpaths and bridleways whilst Part IV deals with miscellaneous provisions.

Highways Act 1980

5.2.25 The Scheme is being promoted and would be constructed using the powers of the Welsh Ministers as Highway Authority in accordance with the Highways Act 1980. These powers were transferred to them by virtue of the National Assembly for Wales (Transfer of Functions) Order 1999 and the Government of Wales Act 2006.

5.2.26 The powers to construct the new section of trunk road would be obtained through the statutory Orders which will be published alongside the application in addition to a CPO which would enable Welsh Ministers to acquire all land and rights over land necessary for the construction and operation of the proposals.

5.2.27 As part of the legal process, the Welsh Ministers would consider all the responses to the draft Scheme and Orders and then decide whether to hold a Public Local Inquiry.

5.3 Welsh Government Plans and Strategies

5.3.1 Other documents published by Welsh Government of direct relevance to the development and design of the Scheme can be grouped under the general headings of transport, economics, environment, and climate change. However, all have been written within the framework of sustainable development, and as such need to be considered collectively as well as individually.

Prosperity for All: The National Strategy (2017)

5.3.2 The Welsh Government's National Strategy outlines its long-term aim to build a Wales that is prosperous and secure, healthy and active, ambitious and learning, and united and connected. It's Programme for Government, Taking Wales Forward, sets out the headline commitments it will deliver between now and 2021. The National Strategy takes those key commitments, places them in a long-term context, and sets out how they fit with the work of the wider Welsh public service to lay the foundations for achieving prosperity for all.

5.3.3 The Strategy includes the commitment to deliver a significant improvement to the M4 around Newport, as well as enhancements to the A55, the A40 in West Wales and other trunk roads.

5.3.4 The Strategy Prosperity for All: Economic Action Plan, which was published later in 2017, is an action plan in line with the national strategy. It contains actions that will work to grow the economy and reduce inequality. It has been developed to meet the needs of today and to prepare for the challenges and opportunities of the future.

Taking Wales Forward 2016-2021

5.3.5 Taking Wales Forward sets out the government's programme to drive improvement in the Welsh economy and public services, delivering a Wales which is prosperous and secure, healthy and active, ambitious and learning, united and connected.

5.3.6 Taking Wales Forward 2016-2021 outlines this government's priorities for delivering those improvements. They are ambitious measures, aimed at making a difference for everyone, at every stage in their lives.

5.3.7 The measures include for improvements to the A40 in West Wales and part of its 'United and Connected' commitments.

5.3.8 Alongside the programme, the Welsh Government have published well-being objectives which set out how we will use the Well-being of Future Generations Act 2015 to help deliver its programme for government and maximise its contribution to the seven shared national well-being goals.

National Transport Plan for Wales (March 2010 and 2015)

5.3.9 Published in 2015 by the Welsh Government, the National Transport Finance Plan followed the National Transport Plan 2010 and lists the schemes the Welsh Government will deliver across the different areas of transport policy for which it is responsible. The 2015 Plan is not a policy document in itself but provides a framework of schemes pursuant to policy aims set out in the Wales Transport Strategy 2008.

5.3.10 A Scheme to improve the A40 between Llanddewi Velfrey and Penblewin is detailed in the plan under reference R15. The Scheme is described as;

a) 2km of new highway to the north of the village of Llanddewi Velfrey;
b) 2.5km of improved highway west of Ffynnon Wood; and
c) Improved facilities for non-motorised travel via new cycle tracks and new bridleway, with a means of crossing the new highway either over or beneath.

5.3.11 In July 2013, Edwina Hart AM CStJ MBE, then Minister for Economy, Science and Transport, published a written statement outlining her priorities for Transport. The statement included the following; *"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."*

5.3.12 On 12 November 2014, in providing an update on the closure of the Murco Refinery in Milford Haven, 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."*

5.3.13 In June 2015, in a written statement on the A40 Improvement Study the Minister noted *"It is my intention to progress delivery of the A40 Llanddewi Velfrey to Penblewin Scheme as soon as possible…"*

5.3.14 The strategic rationale for the Scheme is that it would help address road safety issues and improve accessibility to the Haven Waterway Enterprise Zone and employment sites on a TEN-T route.

Green Corridors on the Welsh Government Trunk Road and Motorway Network 2018 and Trunk Road Estate Biodiversity Action Plan 2004-2014

5.3.15 The Welsh Government, as the Highway Authority for Wales, has direct responsibility for the maintenance, improvement and development of the trunk road and motorway network for Wales. Under the Countryside and Rights of Way (CRoW) Act 2000, the Welsh Government has a duty to have a regard for the conservation of biodiversity in its work.

5.3.16 The Welsh Government Transport Directorate is already incorporating biodiversity into its work, and the Trunk Road Estate Biodiversity Action Plan (TREBAP) (Welsh Assembly Government, 2004b) contributed to this ongoing process.

5.3.17 The Objectives of the TREBAP, within the constraints of recourses and road safety, were to:

a) set practical and realistic actions and targets for the period 2004 – 2014;
b) link with other relevant Biodiversity Action Plan targets for habitats and species;
c) increase awareness of the Transport Directorate's staff and contractors, its environmental partners, and the general public, of the biodiversity interest of the trunk road and motorway network;
d) encourage the use, and dissemination, of best practice for biodiversity in the management and development of the trunk road and motorway network; and
e) reflect the requirements of the Assembly's Sustainable Development Scheme and Action Plan where relevant.

5.3.18 TREBAP set out a number of Habitat Action Plans and Species Action Plans some of which are directly relevant to the Scheme, further reference to which is provided in Chapter 8 (Ecology and Nature Conservation).

5.3.19 The Green Corridors on the Welsh Government Trunk Road and Motorway Network initiative will deliver against the Economic Action Plan Prosperity for All, creating a sustainable economy and promoting the economic, cultural, social and environmental well-being, and enhancing people's quality of life in Wales.

5.3.20 Over a five year period the initiative will deliver a programme of work and activities such as tree planting to improve structure and age range of the planted area, and introducing wildflower areas or improving the diversity of existing areas.

Wales Infrastructure Investment Plan (2012)

5.3.21 The Wales Infrastructure Investment Plan for Growth and Jobs (WIIP) is designed to prioritise, scope and coordinate delivery of the Welsh Government's major infrastructure investments, whilst improving the long term economic, social and environmental well-being of people and communities in Wales.

5.3.22 The Plan, through Chapter 1 sets a number of high level investment priorities including: *'Improving transport links, particularly East-West transport links in both North and South Wales'*. This priority is further explored through Chapter 2 of the Plan which outlines an aim to 'secure the most out of the existing road network through well planned maintenance and upgrades to ensure the road network operates more efficiently by:

a) Prioritising investments which contribute to economic growth – addressing urban congestion and improving access to key areas, and by improving the capacity and reliability of our key east-west corridors.

b) Being more agile in our approach to developing solutions to underlying problems to address problems that people face every day.

5.3.23 The A40 forms one of the key east-west corridors and the Plan recognises the importance of the route. Annex 2 of the Plan provides a 10 year indication of the 'direction of travel' for each sector. The A40 Llanddewi Velfrey to Penblewin is included under the transport sector with recognition of the strategic link to the first phase of improvements completed in 2011.

Economic Renewal, A New Direction (July 2010)

5.3.24 Economic Renewal, A New Direction was published in July 2010. It sets out the role that the Welsh Government can play in providing the best conditions and framework to enable the private sector to grow and flourish.

5.3.25 Part 3 of the document encourages investment in high quality and sustainable infrastructure to underpin economic growth. People, businesses and communities need to be well connected within and beyond Wales and to have access to the right facilities and services where they live and work. Investors and indigenous businesses must be able to count on communications, transport, energy and other infrastructure necessary for 21st century enterprise.

5.3.26 The document continues to state that people cannot work if they are not linked to their jobs, training and public services. Businesses cannot operate without access to the labour forces, materials and markets. Furthermore, faster physical connections, such as an efficient and reliable road network, increase productivity because they save time and therefore lower costs. Excellent infrastructure is also a prerequisite for creating the right conditions to enable businesses to locate and flourish.

One Wales: One Planet (May 2009)

5.3.27 One Wales: One Planet was first launched by the Welsh Government in May 2009. This document sets out the objectives to achieving the goal of sustainable development. One Wales: One Planet defines sustainable development as 'enabling all people throughout the world to satisfy their basic needs and enjoy a better quality of life without compromising the quality of life of future generations.'

5.3.28 In Wales this means achieving a better quality of life for this and future generations by:

a) promoting social justice and equality of opportunity; and
b) Enhancing the natural and cultural environment and respect its limits – using only a fair share of the earth's resources and sustaining our cultural legacy.

5.3.29 One Wales: One Planet also sets out sustainable development as a core principle of the Welsh Government's founding statute. The Welsh Government has a statutory duty to set out how it proposes to promote sustainable development.

5.3.30 Within the document, five main chapters demonstrate the actions that will be taken to deliver sustainability. They are set out under the following headings:

a) Sustainable Resource Use;
b) Sustaining the Environment;
c) A Sustainable Economy;
d) A Sustainable Society; and
e) The Wellbeing of Wales.

One Wales: Connecting the Nation – The Wales Transport Strategy (April 2008)

5.3.31 One Wales: Connecting the Nation is the Wales Transport Strategy, published in April 2008. The document establishes a national framework for transport planning in Wales and is therefore pertinent to the Scheme.

5.3.32 The main aim of One Wales: Connecting the Nation is 'to promote sustainable transport networks that safeguard the environment while strengthening our country's economic and social life.' The One Wales Programme is working towards promoting sustainable transport between communities in different parts of Wales to access services, jobs and facilities where travelling is both easy and sustainable, which will support the growth of the economy.

5.3.33 Connecting the Nation endorses the proposition that a good transport system is central to achieving a vibrant economy and social justice through equality of access and greater mobility. It sees transport as having a leading role to play in adapting to the impacts of climate change. Fundamentally, economic prosperity is at the forefront of Connecting the Nation in order to connect people with businesses for employment and businesses with their customers and suppliers. Chapter 4 of the strategy provides the focus for the national and regional plans. Table 5.2 sets out the long-term outcomes sought from transport within Wales.

Table 5.2 One Wales: Connecting the Nation Long-Term Outcome

One Wales: Connecting the nation long-term outcomes		
Social	**Economic**	**Environmental**
Improve access to healthcare	Improve access to employment opportunities	Increase the use of more sustainable materials
Improve access to education, training and lifelong learning	Improve connectivity within Wales and internationally	Reduce the contribution of transport to greenhouse gas emissions
Improve access to shopping and leisure facilities	Improve the efficient, reliable and sustainable movement of freight	Adapt to the impacts of climate change
Encourage healthy lifestyles	Improve access to visitor attractions	Reduce the contribution of transport to air pollution and other harmful emissions
Improve the actual and perceived safety of travel		Improve the impact of transport on the local environment
		Improve the impact of transport on our heritage
		Improve the impact of transport on biodiversity

Trunk Road Forward Programme, 2002, 2004 and 2008

5.3.34 The aim of the Welsh Government's 2002 Trunk Road Forward Programme was to improve the economic and social conditions in Wales, through increasing efficiency and accessibility in all areas.

5.3.35 The Forward programme indicated the Welsh Government's intentions for road schemes that were expected to cost £1 million or more.

5.3.36 The A40 St Clears to Haverfordwest was identified in the Forward Programme within the 'East – West (south) strategic corridor'. This identified two specific schemes:

a) A40 Llanddewi Velfrey to Penblewin; and

b) A40 Penblewin to Slebech Park.

5.3.37 Both these schemes were classified as 'Phase 2' schemes, which 'could be ready to proceed by April 2010. This position remained within the 2004 supplement to the 2002 Programme.

5.3.38 During a reprioritisation of the Programme in 2008, the two schemes were differentiated as follows:

a) Penblewin to Slebech Park Scheme – identified as a 'Phase 1' high ranking scheme (programmed ready to start between 2008 and April 2011); and

b) Llanddewi Velfrey to Penblewin Scheme – identified as a 'Phase 3' scheme meaning that further studies were needed to identify best solutions and the Scheme is unlikely to be ready to start before April 2014.

5.3.39 The Penblewin to Slebech Park Scheme was subsequently completed in March 2011 with a bypass of Robeston Wathen, to Slebech Park only.

5.3.40 Since then, the Llanddewi Velfrey to Penblewin Scheme received continued ministerial support and further desk-based work was completed.

5.3.41 The project team has now been asked to consider the Llanddewi Velfrey to Penblewin Scheme, and the preferred option which has emerged through WelTAG appraisal and Design Options Review forms the basis of this ES.

Environment Strategy for Wales (2006)

5.3.42 The Environment Strategy for Wales (Welsh Assembly Government, 2006) was published in 2006 and outlines the Welsh Government's long-term strategy for the environment of Wales for the next 20 years. It provides a framework within which to achieve an environment, which is clean, healthy, biologically diverse and valued by the people of Wales. The Strategy is supported by a series of regularly updated action plans which detail specific actions aimed at delivering the vision and outcomes set out in the Strategy.

5.3.43 The last Environment Strategy annual report for 2010 – 2011 (Welsh Government, 2011b) was published at the end of 2011 which coincided with the end of the second action plan. The action plan focuses on ten themes, of which seven – biodiversity, access and recreation, flood and water management, ecosystem services, the historic environment, people and the environment, and environmental quality – are relevant to the Scheme.

5.3.44 In addition to annual reporting, the Welsh Government published a State of the Environment report in July 2012 (Welsh Government, 2012) which presents data on the indicators monitoring progress against its Environment Strategy. Welsh Government is currently reviewing the Environment Strategy to ensure that it reflects the relevant commitments in the Natural Resource Management Programme which was designed to deliver:

a) new policy measures to manage the natural resources of Wales, including the setting of national priorities;
b) an Environment Bill for Wales (see above);
c) embedding the ecosystem approach;
d) working with Natural Resources Wales and coordinating performance management arrangements; and
e) communications and knowledge transfer work to help deliver the new approach.

Wales – A Vibrant Economy (November 2005)

5.3.45 Wales – A Vibrant Economy was published in November 2005 and is the strategic framework for economic development in Wales. The main vision of the document is to create; *'a vibrant Welsh economy delivering strong and sustainable economic growth by providing opportunities for all.'*

5.3.46 As part of the aims for economic development set out in Wales – A Vibrant Economy, one important part of allowing businesses to grow and flourish is by investing in networks and other forms of economic infrastructure whilst always ensuring sustainable development.

5.3.47 It is the view of the policy that more and more businesses are depending on fast, safe and reliable transport networks and services. Improving the productivity of Welsh businesses through reducing journey times for individuals and goods and encouraging international trade through larger and more connected markets provides an attractive investment environment.

5.4 National Planning Policy

5.4.1 Current national planning policy is contained within the Wales Spatial Plan (WSP), Planning Policy Wales (PPW10) and is supplemented by various Technical Advice Notes.

Technical Advice Note 24: The Historic Environment (2017)

5.4.2 TAN 24 provides guidance on how the planning system considers the historic environment. The TAN recognises that archaeological remains are a finite and non-renewable resource and the conservation of such remains forms a material consideration in determining an application.

5.4.3 The detail of the TAN and potential impacts on the historic environment are considered further in Chapter 10 of this ES, Archaeology and Cultural Heritage.

Planning Policy Wales (Edition 10, December 2018)

5.4.4 Planning Policy Wales establishes the national planning policy framework for guiding development throughout Wales and Edition 10 of the document (herein referred to as PPW10) was most recently updated in December 2018.

5.4.5 PPW10 provides out a planning framework linked to the Well-being of Future Generations Act and has been specifically structured to deliver the vision for Wales outlined by the goals within the Act. The principles of the 2015 Act have been set out earlier and will not be repeated here but in essence PPW10 reaffirms the importance of sustainable development in the context of the wellbeing of future generations. For further information as to how the Scheme has been designed in accordance with the Act and PPW10 please see the Scheme's WelTAG stage reports and the Sustainable Development Report.

5.4.6 In the context of transport schemes, PPW10 recognises that a prosperous Wales can be promoted through the development of modern and connected infrastructure and that in order for cohesive communities to be created they need to be well-connected.

5.4.7 Chapter 5 of PPW states that 'development plans should identify and include policies and proposals relating to the development of transport infrastructure and related services including areas safeguarded for future transport infrastructure/routes. Where possible, the route of the proposed new or improved infrastructure should be shown in the development plan'. This is the case with the A40 around Llanddewi Velfrey.

Technical Advice Note 23: Economic Development 2014

5.4.8 TAN 23 provides guidance on economic development, it states that the planning system should recognise the economic aspects of all development and that planning decisions be made in a sustainable way which balance social, environmental and economic considerations. PPW10 defines economic development broadly so that it can include any form of development which is necessary for economic activity.

5.4.9 Chapter 2 of TAN 23 covers the weighting of economic benefit. This states that where economic development would cause environmental or social harm which cannot be fully mitigated, careful consideration of the economic benefits will be necessary. The decision will depend on the specific circumstances and the local planning authority's priorities.

Technical Advice Note 5: Nature Conservation and Planning 2009

5.4.10 TAN 5 provides advice on how the land use planning system should contribute to protecting and enhancing biodiversity and geological conservation. TAN 5 brings together advice on sources of legislation relevant to various nature conservation topics which may be encountered by local planning authorities. The key principles of planning for nature conservation include:

a) Work to achieve nature conservation through partnerships;
b) Integrate nature conservation into all planning decisions;
c) Ensure the UKs international and national obligations for site, species and habitat protection are fully met in all planning decisions;
d) Encourage development that provides a net benefit for biodiversity conservation;

e) Development should not damage or restrict access to or the study of geological sites and features or impede the evolution of natural processes and systems;

f) Forge and strengthen links between the planning system and biodiversity action planning; and

g) Plan to accommodate and reduce the effects of climate change.

5.4.11 These points are explored in more detail through Chapter 8 of this ES, Ecology and Nature Conservation.

The Wales Spatial Plan (Update 2008)

5.4.12 Ultimately, through provisions in the Planning (Wales) Act 2015 the Wales Spatial Plan (WSP) will be replaced by the National Development Framework (NDF) when published, however the current programme suggests publication in 2020 and therefore the WSP remains relevant to this assessment.

5.4.13 The WSP was originally adopted by the Welsh Government in November 2004 and was updated in July 2008 (Welsh Assembly Government, 2008a). The overall role, purpose and principles of the WSP are set out at paragraph 1.2. They include the following.

a) Making sure that decisions are taken with regard to their impact beyond the immediate sectoral or administrative boundaries and that the core values of sustainable development govern everything the Welsh Government does.

b) Setting the context for local and community planning.

c) Influencing where money is spent by the Welsh Government through an understanding of the roles of and interactions between places.

d) Providing a clear evidence base for the public, private and third sectors to develop policy and action.

5.4.14 It is a principle of the WSP that development should be sustainable. Sustainable development is about improving well-being and quality of life by integrating social, economic and environmental objectives in the context of more efficient use of natural resources.

5.4.15 The Scheme is located in 'Pembrokeshire – The Haven' as defined by Chapter 18 of the WSP. The vision for this area is 'a network of strong communities supported by a robust, sustainable, diverse high value-adding economy underpinned by the Area's unique environment, maritime access and internationally important energy and tourism opportunities'.

5.4.16 Improvements to transport links and economic infrastructure is identified as a key strategic priority which will contribute to achieving the above vision. Furthermore, the WSP recognises that 'the A40 road link between the M4 and the Area's port is designated in the Assembly Government's forward trunk road programme. Improvements to the A40 are bring made with the current scheme of bypasses. The need for further investment will be kept under review.'

Technical Advice Note 18: Transport (March 2007)

5.4.17 TAN 18 (Welsh Assembly Government, 2007) encourages an efficient and sustainable transport system as a requirement for modern society. It states that to achieve a more sustainable pattern of development it is necessary to understand the interactions and linkages between land use and transport and devise integrated strategies, objectives and policies at the national, regional and local levels.

5.4.18 PPW10 and the Wales Transport Strategy both aim to secure the provision of transport infrastructure and services, which improve accessibility, build a stronger economy, improve road safety and foster more sustainable communities. This will be achieved through:

a) integration of transport and land use planning;
b) integration between different types of transport;
c) integration of transport policy with policies for the environment, education, social justice, health, economic development and wealth creation.

Technical Advice Note 15: Development and Flood Risk (2004)

5.4.19 TAN 15 (Welsh Assembly Government, 2004a) provides technical guidance which supplements the policy set out in Planning Policy Wales in relation to development and flooding. It advises on development and flood risk as this relates to sustainability principles and provides a framework within which risks arising from both river and coastal flooding, and from additional run-off from development in any location, can be assessed (section 1.2).

5.4.20 Key to the assessment of impact for the A40 will be the surface water run-off generated by the new road and this is considered in further detail in Chapter 7 of this ES, Road Drainage and Water Environment.

Technical Advice Note 11: Noise 1997

5.4.21 TAN 11 provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development. It offers measures that may be used to mitigate the impact of noise, these briefly include:

a) Engineering;
b) Layout; and
c) Administrative.

5.4.22 These points will be explored further through Chapter 14 of this ES, Noise and Vibration.

5.5 Regional Policy & Strategies

Joint Transport Plan for South West Wales 2015-2020

5.5.1 Published in 2015, the Joint Transport Plan for South West Wales is the culmination of collaborative working between Carmarthenshire County Council, Neath Port Talbot County Borough Council, Pembrokeshire County Council and the City and County of Swansea. This collaborative working is closely linked with wider initiatives under the Swansea Bay City Region concept.

5.5.2 The plan will provide the framework for improving connectivity to, from and within the region for the period 2015 – 2020.

5.5.3 The plan is targeted at addressing;

a) Economic growth: Supporting and Safeguarding jobs in the City Region;
b) Access to employment: Reducing economic inactivity by delivering safe access to major employment sites in the City Region;
c) Tackling poverty: Maximising the contribution that transport services can make to targeting improvements to tackling poverty and target improvements at the most disadvantaged communities;
d) Sustainable travel and safety: Encouraging safer, healthier and more sustainable travel; and
e) Access to services: Connecting communities and enabling access to key services.

5.5.4 The plan acknowledges the strategic road network, including the Trans-European Network which links Europe to the Republic of Ireland, as vital gateways to the region for freight and passenger movements and as the most commonly used entry/exit routes to South West Wales.

5.5.5 This is an important driver for the regional economy and supports growth at Haven Waterway Enterprise Zone in Pembrokeshire and other strategic growth zones such as that of Cross Hands in Carmarthenshire.

5.5.6 Key policies within the plan, in the context of this Scheme, include;

a) Policy KS1 - work collaboratively to develop improved public transport services, to link key settlements and their hinterlands with strategic corridors and employment sites.

b) Policy KS2 - seek to improve the journey time reliability between key settlements and strategic and local employment sites.

c) Policy KS3 - improve walking and cycling links within and between key settlements.

d) Policy IC1 - work with the WG through the NTP programme to improve the TENs and the Trunk Road network to facilitate journey time reliability and support the economic regeneration of the region.

e) Policy IC3 - work collaboratively to facilitate more reliable, effective and sustainable movement of people and freight to, from and through our ports. Also, to improve access to our ports.

f) Policy IC4 - work with the WG and other parties, to support the development of good access to regional and national airports in the UK, especially by public transport.

g) Policy SS1 - seek to reduce the number of road casualties and collisions through improvements to highways and traffic management.

5.5.7 The plan specifically addresses trunk road priorities setting out that; 'They are the life blood of the region and essential to connect, sustain and grow local and regional economies. Trunk roads also provide national and international connectivity and support road based public transport connections to and from communities, settlements and employment, training, health care and leisure facilities.'

5.5.8 Along with the M4, the A477 and the A48, the A40 in West Wales forms part of the Trans-European Road Network (TEN-T), an important strategic link between Europe, the rest of the UK and Ireland via the ferry ports of Fishguard and Pembroke Dock.

South West Wales Tourism Strategy, 2004 – 2008

5.5.9 Published in 2004 by the South West Wales Tourism Partnership, the South West Wales Tourism Strategy presents a plan to provide an inclusive and common focus along with a set of shared objectives which can help guide the future development and promotion of tourism throughout the region.

5.5.10 The overarching requirement of the Strategic Plan is the ongoing need to become 'less competitive internally and more competitive externally'. A key component of this is connectivity.

5.5.11 The countryside and coastal location is an important characteristic of the region and the remoteness of some areas in the region is a draw for many visitors. It is recognised in the tourism strategy that road links to and from South West Wales are generally excellent with high speed access as far west as St. Clears.

5.5.12 However, west of this point slow progress on the A40(T) and the A477(T) can lead to visitor frustration and presents a limiting factor when seeking to attract the competitive short break market. One of the key objectives of the tourism strategy is to create a year round quality experience and important in delivering this objective is to improve the ease of access to some of the region's more remote and less accessible attractions.

5.6 Local Planning Policy

5.6.1 The local planning context which the Scheme has regard to is set out within the Local Development Plan (LDP) for Pembrokeshire County Council. The Scheme is being taken forward via the Highways Act (1980) as amended and consequently the Scheme is not governed by local planning policy but does have regard to it.

5.6.2 In addition to the LDP, this section also considers other policy and guidance at the local level considered to be of relevance to the ES.

Pembrokeshire County Council Local Development Plan, 2013

5.6.3 The Pembrokeshire County Council LDP was adopted in 2013 and establishes the local policy framework to guide development in the area.

5.6.4 Llanddewi Velfrey to Penblewin Improvement Scheme is identified under Policy GN.39 'Transport Routes and Improvements'. The proposals map has identified sufficient land in order to safeguard a possible route for the Scheme to avoid potential land use conflicts over the plan period.

5.6.5 The plan identifies three key trunk roads whose routes run into Pembrokeshire, namely the A40 (T), A477 (T) and A487 (T). They link to the two ferry terminals, at Pembroke Dock (A477 (T)) and Fishguard Harbour (A40 (T) and A487(T)). The A4076 (T) is a further important Trunk Road, linking Haverfordwest with Milford Haven.

5.6.6 Pembrokeshire County Council identified a need for significant investment in transport infrastructure, for example dualling the A40 and improving the A477.

5.6.7 The LDP identifies a number of strategic economic priorities citing the tourist industry as the County's largest industry and employer alongside industrial and energy development at the Port of Milford Haven. Improving access to both tourist destinations and employment growth hubs will be important for the future prosperity of the area.

5.6.8 In terms of future growth, within Llanddewi Velfrey, the plan identifies a housing allocation to the north of the village hall for a minimum of 12 units and an area of open space which is afforded protection through the plan. The plan identifies a number of housing and employment allocations within and around Narberth, Clarbeston Road and Haverfordwest. The main strategic areas for growth are located within the settlements of Haverfordwest, Milford Haven, Pembroke and Fishguard. When these sites come forward and development is realised they will contribute to flows along the A40 corridor.

5.6.9 Wider strategic and general policies of relevance to the Scheme are listed below, further details of which are provided in the relevant technical assessment chapters (Chapters 6-18).

Strategic Policies

a) SP1 Sustainable Development
b) SP5 Visitor Economy
c) SP10 Transport Infrastructure and Accessibility
d) SP16 The Countryside

General Policies

a) GN.1 General Development Policy
b) GN.2 Sustainable Design
c) GN.3 Infrastructure and New Development
d) GN.37 Protection and Enhancement of Biodiversity
e) GN.38 Protection and Enhancement of the Historic Environment
f) GN.39 Transport Routes and Improvements

Pembrokeshire Coast National Park Local Development Plan, 2010

5.6.10 The Plan was adopted in 2010 and provides the framework for town and country planning decisions to be made up until 2021 on how land is used and developed in the National Park. In general, although not promoting large scale growth in the same way as the Pembrokeshire County LDP, the Plan is supportive of wider growth outside of the National Park and in turn recognises the importance of the A40 as a key east-west link.

Pembrokeshire Destination Management Plan 2013-2018

5.6.11 Published in 2013 by the Destination Pembrokeshire Partnership, the Pembrokeshire Destination Management Plan is designed to act as a development guide for all Pembrokeshire based organisations, businesses and employees in tourism related roles. The plan aims to improve the tourist offer in the region in order to stave off competition from elsewhere in the UK.

5.6.12 A key objective of the plan is to develop and sustain the tourism infrastructure, environment and cultural resources. A component of this is the improvement of countryside access and access to remote locations as well as transport options. The plan specifically identifies a geography and connectivity related barrier:

> *'Pembrokeshire's relative isolation and distance from visitor markets is a significant limiting factor, especially for encouraging short breaks outside peak summer months. Improved road and rail networks linking other destinations, especially those in south west England, will have a displacement effect on visits to Pembrokeshire.'*

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 6: Geology and Soils

A40LVP-ARP-EGT-SWI-RP-C-0001

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15/03/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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6.2 Ground Investigation Factual report, WYG, 2016

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6 Geology and Soils

6.1 Chapter Introduction

6.1.1 This chapter of the Environmental Statement (ES) describes and characterises the baseline geological setting of the proposed A40 scheme ('the Scheme') allowing for the assessment of the impact that the Scheme may have on soil and geological resources such as designated sites, geological features or mineral resources. The features referred to in this Chapter are shown on Volume 2 Figures 6.1A to 6.1C.

6.1.2 This chapter also sets out a baseline conceptual site model with respect to soil and groundwater contamination, and identifies plausible contaminant linkages that may be created as a result of the proposed Scheme during the construction and operational phases.

6.1.3 The assessments of potential effects lead to identification of mitigation measures to ensure that the proposed Scheme does not adversely affect geological resources or is adversely affected by land contamination.

6.1.4 The relevant site-specific information used for the derivation of the baseline and to support the assessments is presented in appendices:

Appendix 6.1 Preliminary Sources Study Report, Mott MacDonald, March 2016[1]

Appendix 6.2 Ground Investigation Factual report, WYG, 2016[2]

Appendix 6.3 Ground Investigation Report, Arup 2017[3]

Appendix 6.4 Soil chemical testing data. Criteria for human health and controlled waters risk assessments. Detailed Assessment Methodology

6.1.5 Potential impacts on groundwater associated with drainage and discharge proposals are considered within Chapter 7 (Road Drainage and Water Environment) of this ES. It should be noted that effects on the agricultural resource of soils are considered within Chapter 11

[1] Welsh Government, A40 Llanddewi Velfrey to Penblewin Improvement, Preliminary Sources Study Report, Mott MacDonald, December 2015.
[2] Welsh Government, A40 Llanddewi Velfrey to Penblewin, Ground Investigation Factual Report, WYG, June 2016.
[3] Welsh Government, A40 Llanddewi Velfrey to Penblewin Improvements, Ground Investigation Report, ref. A40LVP-ARP-VGT-SWI-RP-C-0001, Arup, July 2017

Community and Private Assets. Waste and management of materials are considered in Chapter 16 Materials.

6.2 Legislation

6.2.1 Geological sites of national importance are principally afforded protection under the Wildlife and Countryside Act 1981 (as amended) or the National Parks and Access to the Countryside Act 1949 by designation as SSSI or NNR. The Joint Nature Conservation Committee (JNCC) is a public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation. On the Defra website, the JNCC state that the aim of their Geological Conservation Review (GCR) for the selection of non-statutory designated Earth Science sites was "to identify the best, most representative, earth science sites in Great Britain, with a view to their long-term conservation. Geological Conservation Review (GCR) and Earth Science Conservation Review (ESCR) sites are non-statutory sites identified by the statutory nature conservation agencies as having national or international importance for earth science conservation on the basis of their geology, palaeontology, mineralogy or geomorphology. Although GCR/ESCR identification does not itself give any statutory protection, many GCR/ESCR sites have been notified as SSSIs/ASSIs"

6.2.2 Environmental legislation implemented as either Acts or Regulations provide separate legislative drivers to manage contamination. The main legislative drivers for managing risks to human health and the environment from land contamination are:

a) 1990 Part IIA of the Environmental Protection Act;
b) Contaminated Land (Wales) Regulations 2006 and Contaminated Land (Wales) (Amendment) Regulations 2012;
c) 1995 Environment Act; and
d) Environmental Permitting Regulations 2016.

6.2.3 In Wales, Part IIA of the Environmental Protection Act, as introduced by Section 57 of the Environment Act 1995, came into effect in September 2001 with the implementation of the Contaminated Land Regulations 2000 (now superseded by The Contaminated Land Regulations 2006/2012). Under Part IIA of the Environmental Protection Act, sites are identified as 'contaminated land' if they are causing, or if there is a significant possibility of causing significant

harm to human health or significant pollution of controlled waters (as defined by Section 104 of the Water Resources Act 1991).

6.2.4 The Environment (Wales) Act 2016 sets out a framework for the sustainable management of natural resources. An accompanying Natural Resources Policy Statement is currently awaited.

6.2.5 In general terms the legislation advocates the use of a risk assessment approach to the assessment of contamination and any remedial requirements.

6.2.6 A list of additional legislation and guidance considered within the assessment and relating to contamination and water environment includes:

a) Water Resources Act 1991 as amended in Wales by the Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009;
b) EU Water Framework Directive (WFD) 2000/60/EC (as amended by supplementary directives and decisions);
c) The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 which implement Water Framework Directive (2000/60/EC), and transpose aspects of the Groundwater Directive (2006/118/EEC) and the Priority Substances Directive (2008/105/EC).
d) Groundwater Regulations (England and Wales) 2009, which transpose the EC Groundwater Directive 80/68/EC into UK law;
e) Groundwater Daughter Directive (GWDD) (2006/118/EC);
f) The Water Framework Directive (Standards & Classification) Directions (England and Wales), 2015;
g) The Environmental Damage (Prevention and remediation) (Wales) Regulations 2009; and
h) Flood and Water Management Act 2010.

6.2.7 Chapter 6 Geology and Soils documents the assessments carried out in line with the requirements of DMRB Volume 11 Section 3 Part 11, which does not include assessment of waste production, disposal or management, which are included in Chapter 16 Materials.

6.3 Policy Context

National and Regional Policy

6.3.1 The 10th edition of Planning Policy Wales4 (PPW10) was published in December 2018. It sets out land use and planning policy for Wales. The new planning policy incorporates principles derived from the Well-being of Future Generations (Wales) Act 2015.

6.3.2 The policy document is set out into themes, geological features is addressed in the Distinctive and Natural Places theme. Section 6.3 Landscape of PPW10, highlights the importance that geological features have in the natural environment. Specific reference is made to the protection, conservation and enhancement of:

a) UNESCO Global Geoparks;
b) Regionally Important Geological and Geomorphological Sites (RIGS);
c) Sites of Special Scientific Interest (SSSIs).

6.3.3 In addition, PPW10 encourages planning authorities to promote opportunities for the incorporation of geological features within the design of development.

6.3.4 Section 6.9 Unlocking Potential by Taking a De-risking Approach of PPW10 covers both development on contaminated land and developments which may pose risks to the health and environment. Physical ground conditions and land instability are also considered within this section.

Local Planning Policy

6.3.5 The Pembrokeshire County Council Local Development Plan (LDP) was adopted in February 2013[5] . Pembrokeshire County Council commenced a review of the LDP in May 2017.

[4] Welsh Government (2018) Planning Policy Wales Edition 10 (PPW10)
[5] Local Development Plan. Planning Pembrokeshire's Future (up to 2021), Pembrokeshire County Council, Adopted 28th February 2013

6.3.6 The following policies are considered relevant to the proposed Scheme:

a) Strategic Policy (SP) 1 Sustainable Development: Requires all development proposals to demonstrate how positive environmental impacts will be achieved and adverse impacts minimised.

b) SP 6 Minerals: Mineral resources such as hard rock and sand and gravel will be maintained and where known to be present at outcrop locations these will be safeguarded from permanent development to ensure a continuous supply of minerals in support of local, regional and national development.

c) General Policy (GN) 1 General Development Policy: Development will be permitted on the condition that it would not cause or result in unacceptable harm to health and safety, and would not have a significant adverse impact on water quality.

d) GN 22 Prior Extraction of the Mineral Resource: Consideration for extraction of safeguarded mineral resources from an area of a new permitted development should be made, wherever appropriate in terms of economic feasibility and environmental and other planning considerations prior to the commencement of the development. The Good Practice Guidance Note on LDP policy GN.22[6] provides a list of considerations, where no extraction of mineral resources would be required.

e) GN 23 Mineral Working: Proposals for mineral working and extensions of existing sites will be permitted where the demand cannot be met from secondary or recycled materials, or existing reserves, or there is provision for landscaping, groundwater protection, a beneficial after-use, restoration and/or post-closure management of the site.

f) GN 25 Buffer Zones Around Mineral Sites: New mineral extractions will not be permitted within a Buffer Zone around mineral sites to avoid an adverse impact on one another because of their close proximity. Volume 3 Appendix 2 to the LDP provides a list of current mineral workings with the location presented on Proposal Maps (PM). PM covers the area of the proposed Scheme.

6.4 Relevant Guidance

6.4.1 The assessment will be undertaken with due consideration of the relevant general Environmental Impact Assessment guidance, as detailed in Chapter 4 Environmental Impact Assessment Methodology and of the following topic specific guidance:

[6] Good Practice Guidance Note. LPD policy GN. 22- prior extraction of the mineral resource, Pembrokeshire County Council

a) Geotechnics and Drainage, Earthworks, Managing Geotechnical Risks DMRB Volume 4, Section 1, Part 2 HD22/08[7];
b) Environmental Assessment, Environmental Assessment Techniques, DMRB Volume 11, Section 3, Part 11 Geology and Soils[8];
c) Model Procedures for the Management of Land Contamination (CLR11) [9];
d) Construction Industry Research and Information Association R132: A Guide for Safe Working on Contaminated Sites[10];
e) CIRIA SP73: Roles and Responsibility in Site Investigations[11];
f) BS5930: 2015: Code of Practice for Site Investigations including Amendment 2[12];
g) BS10175:2011 + A1 2013: Code of Practice for Investigation of Potentially Contaminated Sites[13];
h) The Environment Agency's approach to groundwater protection[14]
i) CIRIA 552: Contaminated Land Risk Assessment, A guide to good practice[15];
j) BS 8485:2015: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings[16];
k) CIRIA 665: Assessing risks posed by hazardous ground gas to buildings[17];
l) CIRIA 681: Unexploded ordnance (UXO) A guide for the construction industry[18];
m) CIRIA 733: Asbestos in soil and made ground: a guide to understanding and managing risks[19];

[7] Design Manual for Roads and Bridges, Volume 4, Section 1, Part 2, HD22/08, Highways Agency, Scottish Government, Welsh Assembly Government, Department for Regional Development Northern Ireland, 2008.
[8] Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11: Geology and Soils, Highways Agency, 1993.
[9] Model Procedures for the Management of Land Contamination (CLR11), Environment Agency and Defra, 2004.
[10] A Guide for Safe Working on Contaminated Sites (R132), Construction Industry Research and Information Association (CIRIA), 1996.
[11] Roles and Responsibility in Site Investigations (SP73), Construction Industry Research and Information Association (CIRIA), 1991.
[12] BS5930:2015 Code of Practice for Site Investigations including Amendment 2, British Standards Institution, 2015.
[13] BS10175:2011+A1 2013 Code of Practice for Investigation of Potentially Contaminated Sites British Standards Institution, 2011.
[14] The Environment Agency's approach to groundwater protection, Environment Agency, 2017
[15] Contaminated Land Risk Assessment, A guide to good practice (C552), Construction Industry Research and Information Association (CIRIA), 2001
[16] BS 8485:2015 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, British Standards Institution, 2015
[17] Assessing risks posed by hazardous ground gas to buildings (C665), Construction Industry Research and Information Association (CIRIA), 2007.
[18] Unexploded ordnance (UXO) A guide for the construction industry (C681), Construction Industry Research and Information Association (CIRIA), 2009
[19] Asbestos in soil and made ground: a guide to understanding and managing risks (C733), Construction Industry Research and Information Association (CIRIA), 2014

n) CIRIA 765: Asbestos in soil and made ground: good practice site guide[20];

o) Definition of Waste: Development Industry Code of Practice[21] sets out a framework for management of materials during construction. This is currently not obligatory for use in Wales, and therefore has not been referenced as a requirement that will be followed. Refer to Chapter 16 Materials for more details;

p) Eurocode 7 (BS EN 1997-1[22] & EN 1997-2[23]) and all relevant Normatives; and

q) Natural Resources Wales (formerly Environment Agency Wales) Pollution Prevention Guidelines of relevance in relation to protection of soils and waters (note that these PPGs have now been withdrawn and are currently being reviewed and updated).

6.5 Study Area

6.5.1 The study area for the contaminated land assessment covers the construction land take and permanent land take as presented on Volume 2 Figures 2.3A and 2.3B. The baseline study area includes all potential contaminated land sites that intersect the Scheme and those sites that have plausible pollutant linkages that may be intercepted by the proposed alignment, typically within approximately 250m of the route corridor[24], although potential pollutant linkages will be considered on a case by case basis.

6.5.2 The geology and geomorphology study area has been determined on the basis of the published information on geology for the area and the site-specific data gathered during investigations along the Scheme. The detailed study area for geology is therefore based along a corridor following the route.

6.5.3 The extent of the study area is shown on Volume 2 Figures 6.1A to 6.1C.

[20] Asbestos in soil and made ground: good practice site guide (C765), Construction Industry Research and Information Association (CIRIA), 2017
[21] Definition of Waste Development Industry Code of Practice. Version 2. In association with the Homes and Communities Agency, DEC UK and Hydrock. Contaminated Land: Applications in Real Environments (CL:AIRE), 2011.
[22] BS EN 1997-1: 2004 and Amendment 1: 2013: Eurocode 7 Geotechnical Design. General Rules British Standards Institution, 2013.
[23] BS EN 1997-2: 2007 UK National Annex to Eurocode 7 Geotechnical Design. Ground Investigation and Testing, British Standards Institution, 2007.
[24] Guidance for the Safe Development of Housing on Land Affected by Contamination, RD66, EA, NHBC and CIEH, 2008

6.6 Methodology

Scope of Baseline Studies

6.6.1 The identification of baseline conditions in relation to site geology, geomorphology and land contamination has been undertaken based on review of available desk study information included within the Preliminary Sources Study Report (PSSR) prepared for the Scheme by Mott MacDonald in March 2016[25] (enclosed in Volume 3 Appendix 6.1) and information obtained during the preliminary ground investigation that was undertaken on behalf of the Welsh Government by WYG Environment Planning Transport Ltd in June 2016. The ground investigation information is presented in the WYG factual report[26] (enclosed in Volume 3 Appendix 6.2) with the interpretation presented in the Arup Ground Investigation Report[27] (enclosed in Volume 3 Appendix 6.3).

6.6.2 The baseline conditions in relation to agricultural soils are presented in Chapter 11 Community and Private Assets of this ES and in relation to hydrogeology in Chapter 7 Road Drainage and Water Environment.

6.6.3 The information contained within the 2016 PSSR[28] will be validated and updated where appropriate in the following topic areas (as detailed in Appendix 6.4):

a) Geology. Based on published geological maps and memoirs;
b) Current and historical land use.
c) Hydrology and hydrogeology.
d) Mines and mineral deposits.
e) Natural cavities.
f) Soil survey information.
g) Ground conditions encountered during ground investigations completed to date (exploratory hole locations are shown on Volume 2 Figures 6.1A to 6.1C).
h) Consultation with statutory bodies and agencies.

[25] Welsh Government, A40 Llandewi Velfrey to Penblewin Improvement, Preliminary Sources Study Report, Mott MacDonald, December 2015.
[26] Welsh Government, A40 Llandewi Velfrey to Penblewin, Ground Investigation Factual Report, WYG, June 2016.
[27] Welsh Government, A40 Llanddewi Velfrey to Penblewin Improvements, Ground Investigation Report, ref. A40LVP-ARP-VGT-SWI-RP-C-0001, Arup, July 2017
[28] Welsh Government, A40 Llandewi Velfrey to Penblewin Improvement, Preliminary Sources Study Report, Mott MacDonald, December 2015.

Baseline assessment methodology

6.6.4 The baseline Conceptual Site Model has been based on the review of the information presented in section 6.6.3. From review of the information, geological or geomorphological features that have potential to be impacted by the Scheme have been identified. In addition, this information informed land contamination baseline Conceptual Site Model as detailed in Appendix 6.4.

Methodology for Assessments of Impacts from Construction and Operation

6.6.5 This section outlines the methodology for the assessment of construction or operational impacts. The assessment includes consideration of possible effects on statutory and non-statutory geological sites along the route of the Scheme. The assessment also considers general effects posed by potential contaminated land exposure along the proposed route.

6.6.6 Assessment of the likely impact on the geology/geomorphology and land contamination arising from construction has been undertaken by review of baseline conditions in a context of the proposed works. The detailed description of the Scheme proposals is presented in Chapter 2 the Project and Volume 2 Figure 2.4.

6.6.7 For the purpose of the assessments the following construction activities have been considered:

a) Construction of earth embankments;
b) Construction of cuttings; and
c) Structures and other features, such as culverts, attenuation ponds, underpasses, overbridge and footbridge.

6.6.8 A review of the baseline data described in Section 6.6.3 identifies and refines the extent of potentially contaminated land sites within the study area. The need for further focused assessment has been considered where existing or suspected contaminated land may be affected by the route, i.e. by creating or altering pollutant linkages between sources of potential contaminants and sensitive receptors such as humans, ecological receptors, surface water and groundwater bodies.

6.6.9 The baseline Conceptual Site Model has subsequently been revised to include for new pollution linkages. These Conceptual Site Models have been used to establish the risks posed to each location and the potential need for further assessment.

6.6.10 Those contaminated land and potentially contaminated sites identified fully outside of the zone of influence of the study area (including adjacent earthworks), have been scoped out and therefore require no further assessment. The study area is presented on Volume 2 Figures 6.1A to 6.1C.

Assessing Potential Effects Methodology

6.6.11 The assessment of the environmental effects on the geology and soils of the Scheme has been carried out in accordance with the requirements of DMRB Volume 11, Section 3, Part 11[29], whilst the detailed assessment on the magnitude of impacts and significance criteria for effects has been undertaken using the methodology outlined in HA205/08 Principles of Environmental Assessment – Assessment and Management of Environmental Effects[30].

6.6.12 Assessment of effects in relation to contamination has been undertaken in accordance with industry best practice as presented in CLR11[31]. The risk assessment process is underpinned throughout by the development of the Conceptual Site Model (CSM) which provides a schematic representation of the identified pollutant linkages. The baseline Conceptual Site Model has subsequently been revised to include new pollution linkages introduced by either construction activities or operation of the Scheme. These Conceptual Site Models have been used to establish the risks posed to each location and the potential need for further assessment. The risk assessment process is detailed in Volume 3 Appendix 6.4.

[29] Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11: Geology and Soils, Highways Agency, 1993.
[30] Design Manual for Roads and Bridges HA 205/08 Volume 11, Section 2, Part 5. Assessment and Management of Environmental Effects, Highways Agency, Scottish Government, Welsh Assembly Government, Department for Regional Development Northern Ireland, 2008.
[31] Model Procedures for the Management of Land Contamination (CLR11), Environment Agency and Defra, 2004.

6.7 Significance Criteria

Environmental Value (or Sensitivity) of Resource/Feature

6.7.1 The significance of impacts has been assessed by attributing a value or sensitivity to each receptor impacted, in combination with the magnitude of impact that would occur to it. The sensitivity of each receptor has been assessed based on Table 6.1, and the magnitude of impact in accordance with Table 6.2. The significance of impact has then been assessed by considering the combination of both the sensitivity of the receptor in combination with the magnitude of impact in accordance with Table 6.3.

Table 6.1 Criteria and DMRB Definitions of Sensitivity or Value (based on HA205/08[32])

Value (sensitivity)	Typical Descriptors
Very high	**Geology/ Mineral Resources:** Very rare and of very high national and regional geological/geomorphological importance with no potential for replacement (e.g. designated sites of national importance including SSSI, active quarries and mining activities of national importance). **Groundwater:** Groundwater with a high quality and rarity on a regional or national scale with limited potential for substitution (e.g. principal aquifer providing potable water to a large population). **Surface water:** European Community (EC) Designated Salmonid/Cyprinid fishery Water Framework Directive (WFD) Class 'High' Site protected/designated under EC or UK wildlife legislation (SAC, SPA, SSSI, WPZ, Ramsar Site, salmonid water)/species protected by EC legislation. **Land Contamination:** Human health (High sensitivity land use scenario e.g. residential with plant uptake). **UXO** Human health
High	**Geology/ Mineral Resources:**

[32] Design Manual for Roads and Bridges HA 205/08 Volume 11, Section 2, Part 5. Assessment and Management of Environmental Effects, Highways Agency, Scottish Government, Welsh Assembly Government, Department for Regional Development Northern Ireland, 2008

Value (sensitivity)	Typical Descriptors
	Of medium national and high regional geological/ geomorphological importance with limited potential for replacement (e.g. currently non-designated GCR site, regionally important site, active quarries and mining activities of regional or local importance). **Groundwater:** Groundwater with a high quality and rarity on a local scale with limited potential for substitution, or attribute with a medium quality or rarity on a regional or national scale with limited potential for substitution (e.g. principal aquifer providing potable water to a small population and/or large resource potential). **Surface water:** WFD Class 'Good' Major Cyprinid Fishery Species protected under EU or UK habitat legislation **Land Contamination:** Sensitive receptor which is the reason for SSSI designation. Human health (Lower sensitivity land use scenario e.g. residential without plant uptake, public open space)
Medium	**Geology / Mineral Resources:** Of low regional and high local geological/ geomorphological importance with some potential for replacement (e.g. allocated RIGS or recommended RIGS). **Groundwater:** Groundwater with a medium quality and rarity on a local scale with limited potential for substitution, or attribute with a low quality and rarity on a regional or national scale with limited potential for substitution (e.g. secondary aquifer unit supporting abstraction for agricultural or industrial use and/or moderate resource potential). **Surface Water:** WFD Class 'Moderate' **Contamination:** Receptor which is of regional importance. (Lower sensitivity land use scenario e.g. commercial, industrial)
Low (or Lower)	**Geology / Mineral Resources:** Of local geological/geomorphological importance with potential for replacement (e.g. non-designated exposure/former quarries and mining activities). **Groundwater:** Groundwater with a low quality and rarity on a local scale with limited potential for substitution (e.g. non-aquifer unit that does not afford protection to underlying water bearing units). **Surface Water:** WFD Class 'Poor' **Land Contamination:** Human health (Low sensitivity land use scenario e.g. highway construction). Receptor which is of local importance.

Value (sensitivity)	Typical Descriptors
Negligible	**Geology / Mineral Resources:** Of little local geological/geomorphological interest. **Land Contamination:** Receptor with low importance and rarity.

Table 6.2 Criteria and DMRB Definitions of Impact Magnitude (based on HA205/08[33])

Magnitude of Impact	Typical Criteria Descriptors
Major	**Geology / Mineral Resources:** The proposals are very damaging to the geological environment/soils resource of the area. May result in loss or damage to areas designated as being of regional or national geological interest. Loss of resource and/or quality and integrity of resource. Severe damage to key characteristics, features or elements. Impacts cannot be mitigated for (e.g. destruction of a designated site (SSSI or RIGS)). (Adverse) **Controlled Waters (aquifers/surface water):** Reduction of water quality rendering groundwater or surface water unfit to drink and/or substantial adverse impact on groundwater dependent environmental receptors. (Adverse) **Land Contamination:** Major effect upon receptor. Severe or irreversible effect on human health. Temporary severe or irreversible effect on ground/surface water quality. (Adverse).
	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).

[33] Design Manual for Roads and Bridges HA 205/08 Volume 11, Section 2, Part 5. Assessment and Management of Environmental Effects, Highways Agency, Scottish Government, Welsh Assembly Government, Department for Regional Development Northern Ireland, 2008.

Magnitude of Impact	Typical Criteria Descriptors
Moderate	**Geology / Mineral Resources:** The proposals may adversely affect the geological/hydrogeological conditions/soils resource existing at the site but would not result in the loss of, or damage to, areas designated as being of regional or national geological interest. Loss of resource, but not adversely affecting the integrity. Partial loss of/damage to key characteristics, features or elements. Some mitigation may be possible but would not prevent scarring of the geological environment, as some features of interest would be lost or partly destroyed. (Adverse) **Controlled Waters (aquifers/surface water):** Reduced reliability of a supply at a groundwater or surface water abstraction source. (Adverse) **Land Contamination:** Moderate effect upon receptor. Long term or short term moderate effect on human health. Moderate effect on ground/surface water quality, reversible with time. (Adverse)
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).
Minor	**Geology / Mineral Resources:** The proposals would not affect areas with regional or national geological interest/soils resource but may result in the loss of, or damage to, areas of local geological/soils resource interest. Cannot be completely mitigated for but opportunities exist for the replacement of lost or damaged areas which may be of similar local geological/soils interest. (Adverse) **Controlled Waters (aquifers/surface water):** Marginal reduced reliability of a supply at a groundwater or surface water abstraction source. (Adverse) **Land Contamination:** Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.). Slight effect on ground/surface water quality, reversible with time. (Adverse)
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).

Magnitude of Impact	Typical Criteria Descriptors
Negligible	**Geology / Mineral Resources:** The proposals would result in very minor loss or damage to local area of geological interest/soils resource such that mitigation is not considered practical. Very minor loss or detrimental alteration to one or more characteristics, features or elements. (Adverse) **Controlled Waters (aquifers/surface water):** Non-measurable change to quality, level and flow. (Adverse) **Land Contamination:** Results in no discernible change or an impact on attribute of sufficient magnitude to affect the use/integrity. (Adverse) E.g. Soil contaminants present, but risk assessment suggests negligible/ low risk to human health. (Adverse)
	Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

Significance of Effect

6.7.2 The criteria for assessing the significance of the impact takes account of the following factors:

a) The value of the resource (international, national, regional and local level importance).

b) The magnitude of the impact.

c) The duration involved.

d) The reversibility of the effect.

e) The number and sensitivity of receptors.

6.7.3 The level of significance that merits further consideration / mitigation has been determined following the procedures set out in Chapter 4 Environmental Impact Assessment Methodology. In terms of the EIA Regulations, significant effects are generally those where the significance of the effect is 'moderate' or greater.

6.7.4 The significance criteria used are summarised in Table 6.3.

Table 6.3 Approach to Evaluating Significance of Effect (based on HA205/08[34])

		Magnitude of Impact				
		No Change	**Negligible**	**Minor**	**Moderate**	**Major**
Value/ Sensitivity	**Very high**	Neutral	Slight	Moderate or large	Large or Very large	Very large
	High	Neutral	Slight	Slight or moderate	Moderate or Large	Large or Very large
	Medium	Neutral	Neutral or slight	Slight	Moderate	Moderate or Large
	Low	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or Moderate

6.8 Consultation

6.8.1 The Scoping Report has been issued to the Environmental Liaison Group that has been set up for the Scheme, which comprises a range of key Statutory Consultees. No comments have been received to date.

6.9 Limitations and Assumptions

6.9.1 Professional judgement has been applied where necessary in assignment of sensitivity and magnitude of effects in line with definitions provided in Table 6.1 and Table 6.2.

6.9.2 The 2016 investigations provide only preliminary information on ground conditions and detailed information will be obtained at Key Stage 6 detailed design stage.

6.9.3 This is in line with a standard practice, where the preliminary investigations are undertaken to create a ground model and identify the required mitigation measures. This is considered sufficient at the initial design stage and to inform the environmental impact assessments. Further detailed ground investigations are typically undertaken on confirmation of the design. The information obtained during these investigations will form the basis for a detailed design of the Scheme.

[34] Design Manual for Roads and Bridges HA 205/08 Volume 11, Section 2, Part 5. Assessment and Management of Environmental Effects, Highways Agency, Scottish Government, Welsh Assembly Government, Department for Regional Development Northern Ireland, 2008.

6.9.4 The assessment of pollution releases as a result of operational or construction activities and potential impacts on hydrogeology are covered in Chapter 7 Road Drainage and Water Environment.

6.9.5 Notwithstanding the limitations, sufficient information has been available for the completion of the assessment of geology, geomorphology and contaminated land.

6.10 Inbuilt Mitigation

6.10.1 Health and safety management based on best working practices will be implemented during construction, which will be informed by available information with respect to soil quality and any identified potential sources of contamination.

6.10.2 Pollution control measures based on best working practices will be implemented during construction. The management of environmental issues arising during construction e.g. groundwater management during excavations or dust generation as a result of transport of materials will be undertaken in line with best practice as outlined in the Preliminary Construction Environmental Management Plan (Pre-CEMP) presented in Volume 3 Appendix 2.2 and as such will not have an impact on identified receptors. Nonetheless, to reinforce the requirement for particular environmental management measures, these have been outlined within Section 6.13 Construction Mitigation.

6.10.3 In addition, the following principles will be applied:

a) Any discharge to the watercourse will only be carried out with an appropriate environmental permit or consent from NRW or Local Flood Authority, where required, following monitoring, and if needed, treatment to ensure it is of acceptable quality.

b) The reuse of site won or import of materials to the Scheme will be managed by a verification system applied via the Specification for Highway Earthworks Series 600, and only materials found suitable for use will be acceptable for construction works.

6.11 Baseline Environment

6.11.1 This section presents baseline conditions with respect to geological setting and resources within the study area as shown on Volume 2 Figures 6.1A to 6.1C. It also describes conceptual site model where the

link between potential sources, pathway and receptors of contamination are identified.

Site Topography

6.11.2 The current alignment of the A40 is generally located towards the top of a local west-easterly orientated ridge bounded in the northeast by the Afon Taf valley and in the south by the Afon Marlais valley. Ground levels vary between 80m Above Ordnance Datum (AOD) and 130m AOD. The length of the proposed route crosses undulating terrain primarily associated with valleys of streams (tributaries to the Afon Taf and the Afon Marlais) as described below. The topography of the area of the proposed Scheme is presented on Volume 2 Figures 6.1A to 6.1C.

6.11.3 The existing topography dips gently to the south in the western part of the Scheme (from Ch. 0+000 to 1+250). The ground level within this section of the proposed alignment lies approximately at 90m AOD. Immediately east of Ffynnon Chapel (Ch. 1+250), the ground levels drop sharply in the valley of an existing watercourse after which they rise again gently (to approximately 100m AOD) up to Pen-troydin-fach Farm (approximately Ch. 2+350). From there to Pen-troydin-fawr Farm (approximately Ch. 2+850), the ground levels drop sharply along the route alignment.

6.11.4 The bottom of the valley at the location of the two watercourses between approximate Ch. 3+000m and Ch. 3+120m is at around 75m AOD. Moving east, ground levels then step up to 85m AOD before gradually rising to 125m AOD at Ch. 3+600m. To the northwest of the Scheme alignment, the topography drops away along this length.

6.11.5 From Ch. 3+600m to the Bethel Roundabout, the topography drops sharply to the northeast perpendicular to the proposed route.

6.11.6 At the eastern end of the Scheme, the south side of the proposed route drops sharply to the south towards a valley.

Published Geology

Superficial deposits

6.11.7 Published geological maps generally show no superficial deposits across the proposed Scheme area, as presented on Volume 2 Figures 6.1A to 6.1C.

6.11.8 An isolated area of glaciofluvial deposits approximately 250m in length and 50m in width has been recorded at the western end of the Scheme crossing the proposed alignment between Ch. 0+430m and Ch. 0+510m. The county maps note a "pit in gravel 7ft+" within this area. An area of boulder clay is also indicated as encroaching on the Scheme alignment between Ch. 3+010m and Ch. 3+090m. The county map shows this area to extend 250m further to the south than on the 1:50,000 map.

6.11.9 An area of alluvium associated with the watercourse east of Ffynnon Chapel at Ch. 1+710m extends south for a distance of up to 200m from the proposed alignment. The county map shows the alluvium to extend 50m further to the south than shown on the 1:50,000 map. An additional area of alluvium east of the sewage works some 300m away from the proposed alignment is recorded on the county map.

6.11.10 It should be noted that other areas of superficial deposits that have not been recorded on the geological maps could be present.

Bedrock

6.11.11 The bedrock beneath the Scheme comprises three formations. Primarily the Slade and Redhill Formation, in the east and the Haverford Mudstone Formation with some discrete areas of the Portfield and Haverford Formation, in the west (see Volume 2 Figures 6.1 A to 6.1C).

6.11.12 The geological sequence of the three formations comprises the Haverford Mudstone Formation overlying the Portfield Formation and Haverford Mudstone Formation (undifferentiated) which in turn is underlain by the Slade and Redhill Formation. Refer to the Arup Ground Investigation Report (GIR)[35] (enclosed in Volume 3 Appendix 6.3) for more details regarding detailed descriptions of the abovementioned formations. The Haverford Mudstone and Slade and

[35] Welsh Government, A40 Llanddewi Velfrey to Penblewin Improvements, Ground Investigation Report, ref. A40LVP-ARP-VGT-SWI-RP-C-0001, Arup, July 2017

Redhill Formations predominantly comprise mudstones with occasional sandstone bands; whereas the Portfield and Haverford Mudstone Formation comprise layers of mudstone, sandstone and conglomerates.

6.11.13 There are two north-west to south-east trending faults crossing the site at Llanddewi Velfrey and at Penblewin. The most eastern fault is shown on a section on the 1:50,000 plan as an inversed fault, downthrowing to the north-east at an angle estimated to be approximately 15° from the horizontal. Between the faults, the Haverford Mudstone Formation that overlies the undifferentiated Portfield and Haverford Mudstone Formation is generally shown as being present from the ground surface beneath the Scheme, with the exception of an area north of Ffynnon Wood where the underlying formation is recorded due to the presence of an anticline, and the section between Caermaenau-fach farm and the service area.

6.11.14 A syncline trending in a north-west to south-east direction is shown to the north of Llanddewi Velfrey. Dip angles of 50 to 60 degrees and 10 to 30 degrees are recorded on the northern and the southern limb respectively.

6.11.15 Where the Haverford Mudstone Formation and Portfield and Haverford Formation sequence are absent, the mudstone of the Slade and Redhill Formation covers the site.

6.11.16 It is noted that some solid geology boundaries have been noted as ‘no evidence’ and ‘supposed’ on the county maps.

Geomorphology

6.11.17 The topography of the area, with valley features and watercourse, as well as presence of glacial till indicates the area has been shaped by glaciation and subsequent fluvial action.

Mineral Resources

6.11.18 The mineral resources map identifies resources of sand and gravel (sub-alluvial) within the Scheme area. The extent of these resources coincides with the outcrop of the Portfield and Haverford Formations, as shown on Volume 2 Figures 6.1A to 6.1C.

6.11.19 The aggregate safeguarding map identifies sandstone deposits as Category 2 Aggregates Safeguarding Area (ASA) in the area of the western part of the Scheme. These deposits are identified as the Portfield & Haverford Formation on Volume 2 Figures 6.1A to 6.1C. This shows that the Scheme generally runs adjacent to and only locally encroaching on these deposits at the proposed Scheme chainages 0+370 to 0+420, 0+510 to 0+700, Ch. 1+740 to 1+850 and 2+740 to 2+850. Category 2 resources are those resources that have a regional importance.

6.11.20 Sand and gravel deposits (Category 1 ASA) are shown on the aggregate safeguarding map to underlie the proposed Scheme between Scheme chainage 0+420 to 0+510. These areas are also identified in the Pembrokeshire County Council LDP. Category 1 resources are those resources that have a national importance in Wales or potentially in the UK.

6.11.21 No records of mines or mineral deposits have been identified for the Scheme area. However, a number of historical quarries and gravel pits have been identified as detailed in Section 2.6.67 (site history) and shown on Volume 2 Figures 6.1A to 6.1C.

Hydrology and hydrogeology

6.11.22 The 2016 Preliminary Sources Study Report (PSSR)[36] (enclosed in Volume 3 Appendix 6.1) provides an overview of the hydrology and hydrogeological setting of the Scheme. A summary is presented below. A further detailed hydrological and hydrogeological setting of the Scheme is presented in Chapter 7 Road Drainage and Water Environment.

6.11.23 The proposed Scheme is located within two main surface water catchments of the Eastern Cleddau (SAC) to the west and the Afon Taf to the east, with numerous direct and indirect tributaries (including the Afon Daulan, Afon Marlais, direct tributaries to the Afon Taf, and Longford Brook, a direct tributary to the Eastern Cleddau (SAC)) issuing directly to the south and north of the proposed alignment. Locally, the proposed route of the Scheme broadly follows the watershed between the Longford Brook, Taf and Marlais catchments

[36] Welsh Government, A40 Llandewi Velfrey to Penblewin Improvement, Preliminary Sources Study Report, Mott MacDonald, December 2015.

with areas south of the Scheme draining to the south and areas to the north draining northwards.

6.11.24 As detailed in Chapter 7 Road Drainage and Water Environment, the Water Framework Classifications of the watercourses and associated catchment areas indicate that the western section and eastern end of the Scheme both lie within the Afon Marlais catchment awarded a 'Good' WFD status in 2015. The remainder of the Scheme is split between the Longform Brook catchment (tributary to the Eastern Cleddau (SAC)) and the Afon Taf catchments, both of 'Moderate' WFD status.

6.11.25 The following watercourses transect the proposed alignment (from west to east):

a) Two unnamed watercourses, tributary to the Afon Daulan, currently culverted beneath the existing A40 at chainage between 1+700 and 1+800 of the Scheme ('Moderate' WFD status).
b) Unnamed watercourse, indirect tributary to the Afon Daulan, crosses the proposed alignment at chainage 2+640 ('Moderate' WFD status).
c) Two unnamed watercourses, indirect/direct tributaries to the Afon Daulan, crosses the proposed alignment at chainage 3+110 and 3+250 ('Moderate' WFD status).

6.11.26 Three ponds are located within the study area, as presented on Volume 2 Figures 6.1A to 6.1C:

a) A pond located approximately 150m to the west of the Penblewin Roundabout at chainage 0+000.
b) A pond located directly to the east of the Penblewin Roundabout at chainage 0+000.
c) A pond located approximately 110m to the north of the proposed Scheme at chainage 1+720.

6.11.27 The bedrock underlying the proposed Scheme is classed as a Secondary B aquifer. No superficial deposits have been identified to overlie the bedrock except for isolated deposits of Glaciofluvial Deposits at approximately chainage 0+500 and Glacial Till at approximately chainage 3+100. The Glaciofluvial Deposits comprise sands and gravels and are classed as a Secondary A aquifer. The Glacial Till deposits are classed as unproductive strata. The groundwater beneath the Scheme is of 'Poor' WFD status due to point source pollution from abandoned mines within the wider catchment area.

6.11.28 A number of groundwater abstraction wells are marked on the Ordnance Survey (OS) plan within the study area. Only one of these wells has been identified as a private water supply and it is possible that the remainder of the wells still may be used:

a) A well located approximately 10m north of the Scheme alignment at chainage 1+600.

b) A well located approximately 25m south of the Scheme alignment at chainage 1+630.

c) A well located approximately 90m north of the Scheme alignment at chainage 1+780.

d) A well located approximately 70m north of the Scheme alignment at chainage 2+220, location also registered as a private water supply.

e) Licensed abstraction (No. 356) at Blaen-Pentroydin from an enclosed well, at chainage 3+660, located approximately 250m south of the Scheme alignment.

6.11.29 There are a further four private water supplies within the study area, all registered at the same postcode location, located approximately 150m north of the Scheme alignment at chainage 3+660. No details are available on the nature of these abstractions.

6.11.30 The location of all identified features are marked on Volume 2 Figures 6.1A to 6.1C.

6.11.31 Based on a review of topography and location of surface water features (springs and watercourses) shown on the OS mapping, groundwater springs are present emanating from hillsides in the Scheme vicinity. The interrelation between springs and water bearing strata within the bedrock may be difficult to establish due to the geology of the area being relatively complicated as a result of the folding and faulting of the strata.

Ground Hazards

6.11.32 Based on information presented in the Envirocheck report, included in the 2016 PSSR report[37] (enclosed in Volume 3 Appendix 6.1), no significant ground hazards are present within the proposed alignment. Low or very low risk of shrinking or swelling clays, landslide or collapsible ground stability hazards have been identified.

[37] Welsh Government, A40 Llandewi Velfrey to Penblewin Improvement, Preliminary Sources Study Report, Mott MacDonald, December 2015.

Geological Designated Areas

6.11.33 No statutory designated areas of geological or geomorphological interest are present within the Study Area.

6.11.34 However, the proposed Scheme is located within the Narberth to Llanddewi Velfrey Special Landscape Area (SLA), a non-statutory designated area due to high geological landscape importance of lowland escarpment. The value of this SLA has been evaluated as high because a proposed geological SSSI at Pengawse Hill is located within this SLA. This proposed SSSI is located nearly 2km to the east of the proposed Scheme area.

Site history

6.11.35 The historical development of the area within the proposed alignment has been reviewed as part of the 2016 PSSR[38] (enclosed in Volume 3 Appendix 6.1). In summary, very little historical development occurred since the first published map dated 1888, with the existing A40 alignment, farm locations, open fields, field boundaries and wooded areas remaining unchanged.

6.11.36 Several historical, now disused and possibly partially or fully infilled, quarries and gravel/sand pits have been identified along the Scheme alignment. These are detailed in Table 6.5. Refer to Volume 2 Figures 6.1A to 6.1C for the location.

Completed Ground Investigations

6.11.37 A ground investigation was specified and supervised by Mott MacDonald in 2016 for the Phase 1 Scheme. The ground investigation was undertaken by WYG between April and May 2016. Details of the original scope and completed field works are presented in the Arup GIR[39] (enclosed in Volume 3 Appendix 6.3). In summary, the following ground investigations have been completed:

a) 19 machine excavated trial pits

b) 18 rotary percussive boreholes

c) 9 in situ California Bearing Ration (CBR) tests

[38] Welsh Government, A40 Llanddewi Velfrey to Penblewin Improvement, Preliminary Sources Study Report, Mott MacDonald, December 2015.
[39] Welsh Government, A40 Llanddewi Velfrey to Penblewin Improvements, Ground Investigation Report, ref. A40LVP-ARP-VGT-SWI-RP-C-0001, Arup, July 2017

d) 3 rounds of groundwater level monitoring

e) Geotechnical and geo-environmental sampling and laboratory testing.

6.11.38 The factual results from the ground investigation including exploratory holes logs and in-situ and laboratory test results are contained within the WYG factual report[40] (enclosed in Volume 3 Appendix 6.2). The exploratory hole positions are shown on Volume 2 Figures 6.1A to 6.1C.

Encountered Ground conditions

6.11.39 Based on the results of the ground investigation across the site, the ground conditions typically comprise topsoil overlying weathered bedrock, with the degree of weathering typically reducing with depth. Localised areas of made ground were encountered in some of the exploratory holes, as summarised in a table below. No other superficial deposits were encountered during the ground investigation, however, the geological map indicated localised areas of glaciofluvial deposits and till.

[40] Welsh Government, A40 Llandewi Velfrey to Penblewin, Ground Investigation Factual Report, WYG, June 2016

Table 6.4 Summary of encountered made ground

Scheme chainage	Exploratory hole	Depth of base (mbgl)	Description	Likely origin
1+300	TP20	0.25	Brown clayey gravel. Gravel is fine to medium angular to subangular mudstone, sandstone, tile, brick and metal wire.	Materials placed within a field. Likely to be localised.
	BH14	0.85	Dark grey brown sandy clayey gravel underlain by soft to firm brown silty slightly gravelly clay.	
1+780	BH12	4.1	Hardcore with dark grey clay underlain by brown clayey sandy fine to coarse sub-angular to angular gravel of mudstone and sandstone.	Possibly fill of a historical quarry
1+940	BH102	0.8	Soft brown slightly sandy clay with many gravel of mudstone.	Materials associated with construction of the layby.
Llanddewi Velfrey Roundabout	TP03	3.1	Soft brown sandy gravelly clay. Gravel is fine to coarse angular to sub-angular brick (including partial brick wall), metal, plastic, tile and concrete. Numerous cobble and boulder sized pieces.	Possibly fill of a historical quarry.
	TP01	0.5	Dark grey slightly sandy, slightly clayey angular to sub-angular fine to coarse mudstone gravel with some cobbles and boulders.	Materials associated with the road embankment
	BH01	1.5	Boulders of mudstone.	

6.11.40 The details including the descriptions of the encountered soils and rock, and geological cross sections are presented in the Arup GIR[41], enclosed in Volume 3 Appendix 6.3.

Groundwater

6.11.41 The detailed review of the groundwater monitoring has been undertaken in the Arup GIR (enclosed in Volume 3 Appendix 6.3) and summarised below.

[41] Welsh Government, A40 Llanddewi Velfrey to Penblewin Improvements, Ground Investigation Report, ref. A40LVP-ARP-VGT-SWI-RP-C-0001, Arup, July 2017

6.11.42 During the investigation, groundwater strikes were recorded in majority of the borehole locations between 1 and 6 m below ground level (74.9 to 126.5 mOD), primarily in the weathered rock or conglomerate strata. Refer to Appendix C of the GIR, enclosed in Volume 3 Appendix 6.3 of the ES.

6.11.43 Eight boreholes, namely BH01, BH04, BH08, BH10, BH11, BH12, BH17 and BH102, were equipped with groundwater monitoring instrumentation with the installation response zones within the Slade and Redhill Formation. Following the field works, three rounds of groundwater monitoring were undertaken in May and June 2016. The results of the groundwater monitoring are presented in the Arup GIR, enclosed in Volume 3 Appendix 6.3. The location of the monitoring wells is marked on Volume 2 Figures 6.1A to 6.1C.

6.11.44 In summary, groundwater monitoring recorded depths ranging from 0.2m to 4.4m and elevations ranging from 65.9mAOD and 95.9mAOD in BH01, BH08, BH11 and BH17. In each borehole, the installation response zone was within the Slade and Redhill Formation. No significant groundwater level variations were recorded during the monitoring period.

6.11.45 BH04, BH10, BH12 and BH102 remained dry during the three visits. With the exception of BH12, these boreholes were located at higher points in the topography and therefore it is anticipated the response zone of the installation may not have been within the main groundwater body.

6.11.46 Seepages were recorded when boring BH04, BH10 and BH102. In accordance with a standard practice, long term monitoring installations were placed to confirm the equilibrium groundwater levels. The long-term monitoring showed dry conditions over the installation response zones during the monitoring period, indicative of a low groundwater table. The seepages during boring have therefore been interpreted as being associated with pockets of perched water rather than a groundwater table. There are also a number of springs located on hillsides at higher points in the topography as indicated on Volume 2 Figures 6.1A to 6.1C. Based on the groundwater monitoring data and review of the hydrogeological model, it is anticipated that these seepages and springs are associated with groundwater flows through more permeable bands in the weathered bedrock and are not necessarily associated with the main groundwater body.

Unexploded Ordnance

6.11.47 The area of the Proposed Scheme has been reviewed for the potential presence of Unexploded Ordnance (UXO). No Ministry of Defence sites or strategic sites that may have been targeted during WWII have been identified. In the unlikely event that a bomb was dropped on the site during WWII, due to the general lack of superficial deposits and presence of rock from the ground surface, the bomb would have either detonated on impact or remained on the ground surface and would have been dealt with. Therefore, the UXO risk for the Scheme is low and the presence of UXO is considered to be very unlikely.

Land Contamination

6.11.48 This section presents the Conceptual Site Model for the existing baseline conditions and identifies potential sources, receptors and pathways and plausible pollution linkages that will allow the assessment of the likely impacts of land contamination.

Potential Sources

6.11.49 The potential sources of contamination identified in relation to the study area are summarised in Table 6.5. A review of chemical testing of soils and groundwater, and ground gas monitoring is presented in sections below. No past industrial uses and no petrol filling stations have been identified within the Scheme area.

Table 6.5 Summary of identified potential sources of contamination

Potential sources	Potential Contaminants
On-site (within Scheme footprint as shown on Volume 2 Figures 6.1A to 6.1C)	
Made ground associated with the existing road infrastructure; Encountered in TP01, BH01 and BH102 (2016). Refer to Table 6.4 for descriptions. Penblewin Roundabout to chainage 1+950 and Llanddewi Velfrey Roundabout	Metals, hydrocarbons, asbestos, ground gas
Activities associated with the operation of the existing road network and agricultural activities located within the proposed Scheme alignment and its close proximity. These activities may have resulted in accidental spillages or leakages of fuel; Penblewin Roundabout to chainage 1+950 and Llanddewi Velfrey Roundabout	Metals, hydrocarbons
Made ground possibly associated with agricultural activities; encountered in TP20 and BH14 (2016). Refer to Table 6.4 for descriptions. Scheme chainage 1+300.	Metals, hydrocarbons, asbestos, ground gas
Historical infilled quarries or gravel pits (fill of unknown origin) located within or adjacent to the proposed Scheme alignment: A disused possibly infilled gravel pit adjacent to the proposed alignment at approximate chainage 0+450m; An infilled disused quarry located adjacent to the proposed alignment from approximate chainage 1+750m to 1+800m; Encountered in BH12 (2016). Refer to Table 6.4 for description. Two disused possibly infilled gravel pits located adjacent to the proposed alignment at approximate chainages 2+850m and 3+250m; A disused possibly infilled quarry encroaching on the southern edge of the proposed alignment at approximate chainage 3+850; Encountered in TP03 (2016). Refer to Table 6.4 for descriptions.	Metals, hydrocarbons, asbestos, ground gas
Off-site (outside Scheme footprint as shown on Volume 2 Figures 6.1A to 6.1C)	
Sewage discharge to ground (via a soakaway) located approximately 140m north of the proposed alignment at approximate chainage 1+700m.	This may have resulted in groundwater becoming impacted by sewage and related contaminants such as metals and ammoniacal nitrogen.
Sewage treatment works located approximately 160m of the proposed alignment at chainage 2+180m.	

Potential sources	Potential Contaminants
Trefanor Burial Ground located approximately 210m north of the proposed alignment at approximate chainage 1+120m.	Contaminants including metals leaching into groundwater and migrating into the Scheme area.
Historical infilled quarries (fill of unknown origin) located in the vicinity of the proposed Scheme alignment (300m radius): A disused possibly infilled quarry located approximately 190m north of Penblewin Roundabout; A disused possibly infilled sand, gravel and clay pit approximately 250m north of Penblewin Roundabout; A disused possibly infilled gravel pit located approximately 260m south of the proposed alignment at approximate chainage 0+750m; A disused possibly infilled quarry located approximately 30m north of the proposed alignment at approximate chainage 1+300m; An infilled disused quarry located approximately 40m north of the proposed alignment at approximate chainage 1+700m; A disused possibly infilled gravel pit located approximately 100m south of the proposed alignment at approximate chainage 2+400m; A disused possibly infilled sand/gravel pit located approximately 50m south of the proposed alignment at approximate chainage 3+550; and In addition to the above, a possible disused pit has been identified at chainage 3+740m.	Metals, hydrocarbons, ground gas migrating into the Scheme area.

6.11.50 Made Ground materials were encountered in seven exploratory holes located across the Scheme alignment, as detailed in Tables 6.4 and 6.5.

6.11.51 No visual or olfactory evidence of contamination with hydrocarbons or asbestos was observed during the field works. The encountered Made Ground materials in the majority of the cases comprised reworked natural materials with low potential for significantly elevated levels of contaminants. However, unidentified isolated areas of hydrocarbon contamination, resulting from with the use of the existing road network e.g. accidental spillages and leakages of fuel, may be present.

6.11.52 Five soil samples were subjected to laboratory testing for the presence of contaminants. The samples were obtained from the Made Ground encountered in five exploratory holes (TP01, TP03, BH12, TP20 and BH102). The results are summarised in Table 6.6 below and presented

in Volume 3 Appendix 6.4. Laboratory certificates are enclosed in the 2016 WYG factual report[42] (enclosed in Volume 3 Appendix 6.2). The assessment of the risks to human health associated with the soil quality undertaken in accordance with the methodology set out in Section 6.6, is presented in Sections 6.10.63 to 6.10.67.

Table 6.6 Summary of chemical soil testing results (mg/kg)

Contaminant	Minimum concentration	Maximum concentration
Arsenic	11.5	22.5
Barium	63	245
Beryllium	1	1.6
Cadmium	<0.1	0.4
Chromium	42.6	54.8
Copper	15	39
Lead	8	48
Mercury	<0.1	0.2
Nickel	18.2	38.1
Selenium	<1	1
Vanadium	19	34
Water Soluble Boro	0.4	1
Zinc	41	371
Total aliphatics and aromatics(C5-35)	<38	583
pH	6.73	8.27
Asbestos	Not detected	Not detected

6.11.53 Groundwater level monitoring was undertaken as part of the investigation; however, no chemical laboratory testing was undertaken on samples of groundwater.

6.11.54 One round of ground gas monitoring was undertaken in June 2016 within the monitoring installations as detailed in Section 6.6.35.

6.11.55 The measured gases included methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide. Gas flow rates were also obtained. The ground gas monitoring results are presented in in WYG factual report[43] (enclosed in Volume 3 Appendix 6.2).

[42] Welsh Government, A40 Llanddewi Velfrey to Penblewin, Ground Investigation Factual Report, WYG, June 2016
[43] ibid

6.11.56 In summary, methane and carbon dioxide were measured at low concentrations (0.1 – 0.2 %v/v and 0.5 to 3.3%v/v respectively). The gas flow was measured below the detection level of 0.1 l/hr. The gas screening values (GSVs) were calculated using the maximum measured concentration of methane (0.2% w/w) and of carbon dioxide (3.3% w/w) with the maximum measured flow rate of 0.1 l/hr. The derived GSVs are 0.0002 l/hr for methane and 0.0033 l/hr for carbon dioxide. This indicates a very low risk from ground gases.

Potential Receptors

6.11.57 Potential receptors to the identified sources of potential contamination within the study area are as follows:

1. Human receptors:

a) Residents and workers of the farms located in the vicinity of the Scheme such as:

i. Penblewin, located at Penblewin Roundabout.

ii. Caermaenau-fach, located approximately 20m south of the Scheme at chainage 0+600.

iii. Trefangor Farm, located approximately 20m south of the Scheme at chainage 0+750 to 0+950.

iv. Trefangor Cottage, located within the Scheme at chainage 1+080.

v. Residential property, located adjacent to the Scheme at chainage 1+250.

vi. Ffynnon Farm, located adjacent to the Scheme at chainage 1+600 to 1+700.

vii. Pen-troydin-fach, located 50m north to the Scheme at chainage 2+220 to 2+400.

viii. Maes-y-ffynnon, located 50m south to the Scheme at chainage 2+320 to 2+400.

ix. Pen-troydin-fawr, located 80m north to the Scheme at chainage 2+750 to 2+850.

b) Users of the agricultural land.

c) Maintenance workers of the existing A40.

d) Users of the existing A40 road, including motorised and non-motorised users (such as cyclists, pedestrians, horse riders, etc).

2. Environmental receptors:

a) Surface watercourses and associated springs identified in Sections 6.5.21 to 6.5.22.

b) Ponds identified in Section 6.5.23.

c) Water abstraction points as listed in Sections 6.5.25 to 6.5.26.

d) Groundwater beneath the site (secondary aquifers).

6.11.58 Residents and workers of the farms, and the existing highway maintenance workers are considered the most sensitive receptors to be impacted by regular and long-term exposure to the areas of potential contamination. The users of both the road and agricultural land are considered less sensitive due to a likely short-term duration and infrequent exposure.

Potential Pathways

6.11.59 The preliminary pathways between identified sources of contamination and receptors are as follows:

1. Human health:

a) Ingestion of soils and dust.

b) Inhalation of dust, gases and volatile hydrocarbon contamination.

c) Dermal contact with soils, dust and groundwater.

d) Gas migration from made ground into near surface.

6.11.60 As regular maintenance works typically do not involve deep excavations, no direct exposure to groundwater or ground gas/vapours is likely to occur.

6.11.61 Risk of exposure to ground gas is considered to be low, as no elevated levels of ground gas were measured during the ground investigations.

2. Controlled waters:

a) Vertical and lateral and migration of contaminants released to the ground through spillage or leaks; particularly from the uses of the existing road infrastructure or agricultural land, and the potential for vertical or lateral migration through the underlying strata.

b) Soil leachate generation and migration from made ground materials.

c) Made ground materials that remain on-site may leach contaminants into the underlying groundwater resulting in contamination. The groundwater may flow towards the identified surface water features or abstraction points. There is potential therefore for the contamination present within the made ground materials to impact surface water or groundwater quality via lateral groundwater migration. Equally contamination that may be

present hydraulically up gradient of the Scheme may impact the quality of groundwater beneath the Scheme area.

Plausible Pollution Linkages

6.11.62 The plausible pollution linkages are summarised in Table 6.7 below.

Table 6.7 Identified Baseline Source-Pathway-Receptor Linkages within the study area

Sources	Pathways	Receptors	Comments
On-site (within Scheme footprint as shown on Volume 2 Figures 6.1A to 6.1C) a) Made ground associated with: b) Existing road network c) Agricultural activities Historical infilled quarries/ gravel pits Leaks and spillages from operation of the existing road network and agricultural activities. Groundwater impacted by off-site sources. *Off-site (outside Scheme footprint as shown on Volume 2 Figures 6.1A to 6.1C)* Sewage treatment works, sewage soakaway, burial ground, infilled quarries/ gravel pits	Direct exposure to soil and/or soil dust via ingestion, dermal contact and inhalation	Human health: Residents and workers of the farms; Existing A40 maintenance workers and users; Agricultural land users;	Maintenance workers and highway users may be directly exposed to soil and dust generated from made ground in areas of soft landscaping. The risk of significant levels of contaminants is low as no evidence of contamination has been observed during the completed ground investigations. Users of the existing A40 and surrounding agricultural land are unlikely to be significantly impacted by contamination due to short-term exposure only.
	Leaching and migration	Controlled waters: Surface water features (streams, springs and ponds); Groundwater secondary aquifers; Water abstractions;	Potential contaminants within the identified sources may leach to groundwater and via lateral migration have potential to impact the controlled waters quality.

Assessment of Potential Impact of Baseline Conditions on Human Health

6.11.63 The above indicates that for the current baseline conditions the potential plausible pollution linkage is:

a) Maintenance workers direct exposure to made ground materials.

6.11.64 Therefore, a Generic Quantitative Risk Assessment (GQRA) has been carried out to assess the risks in more detail, as presented below.

Generic Quantitative Risk Assessment (GQRA)

6.11.65 Following the methodology set out in Section 6.6, a GQRA has been carried out to assess the risks posed at the baseline conditions of the Scheme, as presented below. This has taken into account the results obtained from the ground investigation completed within the Scheme area, presented in the WYG factual report[44], enclosed in Volume 3 Appendix 6.2.

6.11.66 Considering the identified receptors, the maintenance workers of the existing A40, the available soil testing from the area of the proposed Scheme, have been screened against the assessment criteria for a commercial end use scenario, which is considered appropriate for the likely exposure scenario.

6.11.67 This indicated no exceedances of the applied assessment criteria and therefore the identified potential soil sources of contamination at baseline conditions are unlikely to pose a risk to the identified receptors.

Assessment of Potential Impact of Baseline Conditions on Controlled Waters

6.11.68 Localised areas of made ground were encountered during the 2016 ground investigations and a review of the Scheme area history indicates the presence of backfilled historical quarries/pits. Under the current baseline conditions, leaching of contaminants from the identified potential sources of contamination may be occurring, which may have a potential detrimental impact on controlled waters.

[44] Welsh Government, A40 Llanddewi Velfrey to Penblewin, Ground Investigation Factual Report, WYG, June 2016

6.11.69 No soil leachate testing has been undertaken on these made ground materials. However, considering the localised and isolated nature of the made ground and that no evidence of significant contamination has been encountered it is unlikely that made ground would significantly impact the quality of the underlying groundwater.

Future Baseline Conditions

6.11.70 Consideration has been given to the potential for changes in the baseline conditions in the medium to long-term as a result of climate change. The Climate Change Risk Assessment for Wales45 has been reviewed, together with other climate change prediction tools.

6.11.71 As a result of climate change it is considered that there would not be significant change to the baseline conditions with respect to geological conditions or soil quality (sources of contamination). Climate change may however impact to a certain extent the hydrological and to a lesser extent hydrogeological conditions, due to more extreme weather conditions resulting in wetter winters and dryer summers.

6.11.72 The Proposed Scheme area is underlain by relatively poor groundwater resources, which are limited to groundwater accumulating in more permeable bands of the bedrock. These support local water supplies or recharge to springs. Reduced precipitation may in the long term reduce the recharge of these bands and therefore impact the local water supply or reduce water flows within streams. This is addressed in more detail in the Road Drainage and Water Environment Chapter 7.

6.11.73 There is no planned in a foreseeable future remedial action with respect identified sources of contamination, therefore the baseline conditions in that respect remain unchanged.

6.12 Potential Construction Effects – Before Mitigation

6.12.1 This section presents assessment of impact that the construction may have on geology, geomorphology and land contamination. The potential effects of construction works on agricultural soils has been considered as part of Chapter 11 Community and Private Assets of this ES. Issues associated with on-site materials storage, hydrogeology,

[45] Welsh Government, A climate change risk assessment for Wales, HR Wallingford, January 2012

flooding and drainage discharge are considered in Chapter 16 Materials and Chapter 7 Road Drainage and Water Environment.

Geology and Geomorphology

Assessment of Potential Impact of Construction of Earth Embankments

6.12.2 The construction of the embankments (up to 24m height) can result in ground consolidation due to the applied load of the embankment materials onto the underlying ground impacting the ground permeability.

6.12.3 The construction of earth embankments is unlikely to result in significant consolidation of the soils. Some insignificant consolidation may occur in the upper layers of the weathered bedrock, near the surface, particularly where it consists of cohesive materials, or in localised areas of alluvium associated with the watercourses or made ground. Any soft materials prone to consolidation that are encountered during construction works would be removed and replaced with competent materials to prevent significant differential settlements.

6.12.4 Therefore, the construction of the embankments is unlikely to result in a reduction in permeability of the underlying materials, and therefore no impact on the groundwater movement is anticipated.

6.12.5 The sensitivity of the impacted geology/hydrogeology is considered low due its local importance with respect to potential resource for groundwater abstraction with a negligible magnitude of impact. Consequently, the significance of effect of the construction of the earth embankments on the geology is considered to be *neutral*.

Assessment of Potential Impact of Construction of Cuttings

6.12.6 The construction of the cuttings, as presented on Volume 2 Figures 6.1A to 6.1C, could result in removal of the underlying mineral resources, or locally impacting hydrological and hydrogeological regime within the Scheme area.

6.12.7 Mineral resources of regional importance are located within the footprint of Cutting 2. The construction of the cutting to depths of up to 15m, based on the interpretation of the ground investigation results, is likely to remove the resource from within the Scheme footprint and

would limit access to these resources in its direct vicinity. However. considering the limited extent of the impacted areas, access to the vast majority of these resources would not be affected.

6.12.8 The sensitivity of the impacted mineral resources is considered to be medium due to their regional importance with some potential for replacement. The magnitude of impact is considered to be minor. This is because although the Scheme may result in the partial loss of these resources of regional importance, the loss is not considered significant. Consequently, the significance of effect of the construction of the cuttings on the mineral resources is considered to be *slight adverse*.

6.12.9 The construction of the cuttings would require use of a groundwater control system to the base of the excavation. This may result in lowering of the groundwater level in proximity of the works. This may also lead to a reduction in water entering the catchment area of the local surface watercourses. Therefore, the construction of the cuttings may impact the quantity of water fed into springs and associated downstream watercourses. An assessment of potential impact of the three proposed cuttings on the identified surface water features and groundwater abstraction is presented in Chapter 7 Road Drainage and Water Environment.

Assessment of Potential Impact of Construction of Structures

6.12.10 The construction of the structures such culverts or underpasses will be undertaken as part of the embankment construction and therefore will have no additional impact on the underlying geology.

6.12.11 The construction of the attenuation ponds will require shallow excavations and will include removal of the weather bedrock. Considering the localised nature of these works and the extent of the proposed ponds their impact on the underlying geology is considered negligible.

6.12.12 Mineral resources of regional importance are located within the footprint of the proposed Pond A. The construction of the 2-4m deep pond, based on the interpretation of the ground investigation results, is unlikely to remove the resource from within the pond footprint and would limit access to the resources remaining beneath the pond and in its direct vicinity. However, considering the limited extent of the

impacted areas, access to the vast majority of these resources will not be affected.

6.12.13 The construction of the overbridge and a footbridge will require construction of the foundations. Considering the underlying ground conditions these structures are likely to require shallow foundations and therefore only localised excavations will be required. These also are likely to have a negligible impact on the underlying geology or mineral resources. The sensitivity of the local geology within the Scheme is low. Therefore, overall the construction of the structures is considered to have a *neutral* significance of effect on the Scheme geology.

Soils

6.12.14 The potential effects of construction works on agricultural soils has been considered as part of Chapter 11 Community and Private Assets.

Land Contamination

6.12.15 The construction works would introduce new pollution linkages into the baseline conceptual site model. The revised conceptual site model is detailed below and summarised in Table 6.8.

6.12.16 The review of the identified potential sources, receptors and pathways and plausible pollution linkages, as detailed in sections below, allows for assessment of the likely impacts of land contamination on the existing baseline conditions.

Potential Sources

6.12.17 The potential baseline sources of contamination identified in relation to the study area are presented in Section 6.10.49 and Table 6.5. The construction works would introduce the following additional sources as a result of construction activities:

a) Areas of unexpected contamination that would be encountered and excavated as a result of construction works.

b) Imported and site won construction materials e.g. for the construction of the earth embankments. However, as detailed in Section 6.10, the reuse of site won or import of materials to the Scheme will be managed by a verification system applied via the Specification for Highway Works, Series 600 – Earthworks, and only materials found suitable for use with respect to human health and controlled waters would be acceptable for construction works.

Consequently, construction materials are not considered to be a viable source of contamination and will not be considered further.

c) Dust derived from areas of made ground (including fill of infilled historical quarries) created during construction.

d) Groundwater removed as a result of dewatering of cuttings.

Potential Receptors

6.12.18 Potential baseline receptors to the identified sources of potential contamination within the study area are presented in Section 6.5.54 and Table 6.7. The construction works would introduce the following additional receptors:

a) Construction workers: It has been assumed that the construction workers include adults and also apprentices aged 16 and above. Based on Section 6.10, application of appropriate health and safety management during construction would mitigate exposure of construction workers to identified sources of contamination. Therefore, construction workers are not considered further in the assessment of effects.

Potential Pathways

6.12.19 The preliminary potential baseline pathways between identified sources of contamination and receptors are presented in Section 6.10.59 to 6.10.61 and Table 6.7. The construction works would introduce the following additional pathways:

a) Direct discharge of groundwater removed from ground as a result of dewatering operations. Based on Section 6.10, discharge of groundwater removed from ground would be regulated by appropriate permits/approvals. This would mitigate potential impact on the surface water quality. Therefore, this pathway is not considered further.

b) Direct exposure to soils/dust or groundwater (such as ingestion, dermal contact and/or inhalation of vapours) during excavation works. Based on Section 6.10, application of appropriate health and safety management and pollution control during construction would break the pathway of exposure to identified sources of contamination. Therefore, this pathway is not considered further in the assessment of effects.

Plausible Pollution Linkages

6.12.20 The plausible pollution linkages are summarised in Table 6.8 below.

Table 6.8 Identified Source-Pathway-Receptor Linkages during Construction within the study area

Sources	Pathways	Receptors	Comments
Baseline sources: *On-site (within Scheme footprint as shown Volume 2 Figures 6.1A to 6.1C)* a) Made ground associated with: b) Existing road network c) Agricultural activities Historical infilled quarries/ gravel pits Localised leaks and spillages of petroleum products from operation of the existing road network and agricultural activities. Groundwater impacted by off-site sources. *Off-site (outside Scheme footprint as shown on Volume 2 Figures 6.1A to 6.1C):* Sewage treatment works, sewage soakaway, burial ground, infilled quarries/ gravel pits Additional sources during construction Unexpected contamination Imported and site won construction materials Dust created during construction Groundwater removed from ground during dewatering	Direct exposure to soil and/or soil dust via ingestion, dermal contact and inhalation Inhalation of gas and volatile contamination	Human health: Residents and workers of the farms; Existing A40 maintenance workers and users; Agricultural land users; *Additional during construction works* Construction workers;	Construction workers, and also the existing A40 maintenance workers and highway users may be directly exposed to soil and potentially contaminated dust generated from made ground during construction. The risk of significant levels of contaminants is low as no evidence of contamination has been observed during the completed ground investigations. Application of appropriate health and safety management and pollution control during construction is considered sufficient to mitigate any impacts. Risk of exposure to ground gas is considered to be low, as no elevated levels of ground gas were measured during the ground investigations.
	Leaching and migration	Controlled waters: Surface water features (streams, springs and ponds); Groundwater secondary aquifers; Water abstractions;	Potential contaminants within the identified sources may leach to groundwater and via lateral migration have potential to impact the controlled waters quality. Surface run-off where made ground is exposed during excavation works may impact surface water receptors. However, no areas of made ground have been identified in the vicinity of the surface waters, and therefore no risk to surface water from potentially impacted made ground is anticipated. During dewatering, groundwater removed from the cuttings will require discharge, which may impact the quality of the surface watercourses. However, any discharge would be regulated by appropriate permits/approvals and therefore unlikely to pose risk to surface water quality.

Unexpected contamination

6.12.21 Considering the limited historical development within the proposed Scheme area, there is limited risk of encountering unexpected contamination at localised areas during the construction works. However, should unexpected contamination be encountered this may pose a risk to the construction workers and controlled waters.

6.12.22 The sensitivity of the receptors is considered to be medium (Secondary aquifer and moderate WFD surface water classification). The potential magnitude of impact is minor adverse due to the likely localised nature of the unexpected contamination (providing that best practice is implemented). Therefore, the significance of effect is considered to be *slight adverse*.

Assessment of Potential Impact of Construction Works on Human Health

6.12.23 Although the construction works would introduce new pollution linkages into the baseline conceptual site model as shown in Table 6.8 above with respect to human health, based on inbuilt mitigation measures presented in Section 6.10 such as health and safety management and pollution control measures, the impact on identified receptors is considered to be negligible. The sensitivity of a resident as a receptor is considered very high. Consequently, the significance of effect of the construction of the Scheme on land contamination is *slight adverse*.

Assessment of Potential Impact of Construction Works on Controlled Waters

6.12.24 Although the construction works would introduce new pollution linkages into the baseline conceptual site model as shown in Table 6.8 above with respect to controlled waters, based on inbuilt mitigation measures presented in Section 6.10 such as pollution control measures and the requirement to obtain regulatory consents/approvals with respect to discharge, the impact on identified receptors is considered to be negligible. Considering the high to medium sensitivity of the surface water as a receptor, construction of the Scheme would result in a *slight adverse* significance of effect.

6.12.25 Localised areas of made ground were encountered during the 2016 ground investigations and a review of the Scheme area history indicates

the presence of backfilled historical quarries/pits. However, none of these areas of potential made ground has been identified in a vicinity of the identified surface water receptors. Therefore, these areas of made ground are unlikely to impact the quality of the surface water receptor as a result of construction activities and would result in no change to the baseline scenario with a *neutral* significance of effect.

6.13 Potential Operational Effects - Before Mitigation

6.13.1 This section presents the assessment of impact that the operation of the Scheme may have on geology and geomorphology and land contamination. The potential effects of operation on agricultural soils has been considered as part of Chapter 11 Community and Private Assets of this ES. Issues associated with hydrogeology, flooding and drainage discharge are considered in Chapter 7 Road Drainage and Water Environment.

Geology and Geomorphology

Assessment of Potential Impact of Earth Embankments during Operation

6.13.2 The construction of the embankments could result in eliminating access to the underlying mineral resources, or further ground consolidation due to the applied load of the embankment materials unto the underlying ground impacting the ground permeability.

6.13.3 Mineral resources of regional importance are located directly to the north of the proposed Scheme, which locally encroaches on these deposits. The presence of the embankments would eliminate access to the deposits within the Scheme footprint and in its direct vicinity. However, considering the limited extent of the impacted areas, access to the vast majority of these resources will not be affected.

6.13.4 Mineral resources of national importance transect the western part of the Scheme. Access to these deposits is currently limited by the existing A40 and construction of Embankment 2 will further limit it. The estimated loss of resources has been estimated at 10% in surface.

6.13.5 The sensitivity of the impacted mineral resources is considered to be high due to their regional and national importance. The magnitude of impact is considered to be minor. This is because although the Scheme

may result in the partial loss of these resources of regional/ national importance, the loss is not considered significant. Consequently, the significance of effect of the presence of the earth embankments on the mineral resources is considered to be *slight adverse*.

6.13.6 During the operational phase, it is unlikely that the embankment would result in any further consolidation of the soils due to the applied load of the embankment materials. Therefore, there is unlikely to be a further significant reduction in the soils permeability and consequent localised changes to the groundwater movement. Consequently, the effect of the construction of the earth embankments on the geology is considered to be *neutral*.

6.13.7 However, the embankments may have an impact on water flow during flooding events. Issues associated with flooding are considered in Chapter 7 Road Drainage and Water Environment.

Assessment of potential Impact of Operation of Cuttings

6.13.8 The operation of the cutting would have no additional impact on the underlying geology with a *neutral* significance of effect. The operation of the cuttings could locally impact hydrological and hydrogeological regime within the Scheme area.

6.13.9 The Scheme areas where construction of cuttings was required would be equipped with drainage the purpose of which would be to control groundwater level and collect groundwater issues from the slopes formed within the rock. This is likely to impact the groundwater flow direction and levels. An assessment of potential impact of the three proposed cuttings on the identified surface water features and groundwater abstraction is presented in Chapter 7 Road Drainage and Water Environment.

Assessment of potential Impact of Operation of Structures

6.13.10 The operation of the structures such culverts or underpasses will have no additional impact on the underlying geology with a *neutral* significance of effect.

Soils

6.13.11 The potential effects of operational phase on soils has been considered as part of Chapter 11 Community and Private Assets.

Land Contamination

6.13.12 The operation of the Scheme would introduce new pollution linkages into the baseline conceptual site model. The revised conceptual site model is detailed below and summarised in Table 6.9. The assessment of individual pollution linkages is presented in the sections below.

6.13.13 This section presents the identified potential sources, receptors and pathways and plausible pollution linkages – in order to assess the likely impacts of land contamination for the existing baseline conditions.

Potential Sources

6.13.14 The potential baseline sources of contamination identified in relation to the study area are presented in Section 6.5.46 and Table 6.5. The operation of the Scheme would introduce the following additional sources:

a) Imported and site won construction materials e.g. for the construction of the embankment. Based on inbuilt mitigation presented in Section 6.10, any materials used within the Scheme construction would be subjected to verification with respect to suitability for reuse and therefore materials reused within the Scheme are not considered a potential source of contamination.

6.13.15 The assessment of pollution release as a result of operation is covered in Chapter 7 Road Drainage and Water Environment.

Potential Receptors

6.13.16 Potential baseline receptors to the identified sources of potential contamination within the study area are presented in Section 6.10.57 and Table 6.7. The operation of the Scheme would introduce the following additional receptors:

a) Maintenance workers.

b) Road users, including motorised and non-motorised users (such as cyclists, pedestrians, horse riders, etc).

Potential Pathways

6.13.17 The preliminary potential baseline pathways between identified sources of contamination and receptors are presented in Section 6.10.59 to 6.10.61 and Table 6.7. The operation of the proposed Scheme would introduce the following additional pathways:

a) Direct exposure to soils or dust (such as ingestion, dermal contact and/or inhalation of vapours).
b) Leaching of contaminants from materials used for the construction.

Plausible Pollution Linkages

6.13.18 The plausible pollution linkages are summarised in Table 6.9 below.

Table 6.9 Identified Source-Pathway-Receptor Linkages during Scheme Operation within the study area

Sources	Pathways	Receptors	Comments
Baseline sources: *On-site (within Scheme footprint as shown on Volume 2 Figures 6.1A to 6.1C):* a) Made ground associated with: b) Existing road network c) Agricultural activities Historical infilled quarries/ gravel pits Localised leaks and spillages of petroleum products from operation of the existing road network and agricultural activities. Groundwater impacted by off-site sources. *Off-site (outside Scheme footprint as shown on Volume 2 Figures 6.1A to 6.1C):* Sewage treatment works, sewage soakaway, burial ground, infilled quarries/ gravel pits Additional sources during Scheme operation Imported and site won construction materials.	Direct exposure to soil, soil dust and/or groundwater via ingestion, dermal contact and inhalation Inhalation of gas and volatile contamination	Human health: Existing A40 maintenance workers and users; Agricultural land users; *Additional during Scheme operation;* Maintenance workers; Scheme users;	Maintenance workers, and also the existing A40 (which will remain operational and will run in parallel to the new road) maintenance workers and highway users may be directly exposed to soil, soil dust generated from made ground during maintenance works and/or contaminated groundwater if deep excavations are undertaken. Materials used within the Scheme are not considered a source. There is a potential risk of ground gas upward migration into confined spaces e.g. manholes. However, the risk of exposure to ground gas is considered to be low, as no elevated levels of ground gas were measured during the ground investigations.
	Leaching and migration	Controlled waters: Surface water features (streams, springs and ponds); Groundwater secondary aquifers; Water abstractions;	Potential contaminants within the identified sources may leach to groundwater, which may have potential to impact the river quality via lateral migration.

Assessment of Potential Impact of Operation of the Scheme on Human Health

6.13.19 The operation of the Scheme would introduce potential pollution linkages into the baseline Conceptual Site Model.

6.13.20 Maintenance workers would undertake regular maintenance works within the Scheme area. They may therefore be exposed to sources identified within the baseline model, i.e. made ground that has not been removed as a result of construction. The exposure pathways would primarily include exposure to potentially impacted soil dust via ingestion, inhalation and dermal contact. Note that potential impacts caused by dust generation during construction is assessed by Chapter 13 Air Quality.

6.13.21 As discussed in Sections 6.11.17 and 6.11.18, although there is a potential for the groundwater beneath the proposed Scheme to be impacted by contamination it is considered unlikely that it would pose a significant risk to human health. Therefore, should exposure to groundwater occur during maintenance works, which may involve excavations, the risk of significant impact on human health is considered very low and therefore this pollution linkage will not be considered further.

6.13.22 The Scheme users are unlikely to be impacted by any potential contamination within the Scheme area, due to a very short-term exposure, and are therefore not considered further.

6.13.23 The Scheme neighbours such as residents and workers of farms located in the Scheme vicinity are unlikely to be exposed to sources within the Scheme area due to their distance from the sources and are therefore not considered further. The above indicates that the operation phase of the Scheme would create new potential plausible pollution linkages such as:

a) Maintenance workers direct exposure to made ground materials located outside the Scheme footprint.

6.13.24 Therefore, a Generic Quantitative Risk Assessment (GQRA) has been carried out to assess the risks in more detail, as presented below.

Generic Quantitative Risk Assessment (GQRA)

6.13.25 Following the methodology set out in Sections 6.6.24 to 6.6.25, a GQRA has been carried out to assess the risks posed by the operation of the Scheme, as presented below. This has taken into account the results obtained from the ground investigation completed within the Scheme area, presented in the WYG factual report[46] enclosed in Volume 3 Appendix 6.2.

6.13.26 Considering the identified receptors, the Scheme maintenance workers, the available soil test results from the area of the proposed Scheme have been screened against the assessment criteria for a residential end use scenario. This is considered appropriate for the likely exposure scenario, where as a result of intrusive works, direct exposure to soil and soil dust may occur.

6.13.27 The assessment indicated no exceedances of the applied assessment criteria and therefore the identified potential soil sources of contamination are unlikely to pose a risk to the identified receptors. The sensitivity of the receptor is considered medium. Based on the GQRA the identified sources of potential contamination are unlikely to pose a significant risk to human health and therefore the magnitude of impact is likely to be negligible. Consequently, the significance of effect of operation of the Scheme on land contamination is considered to be *neutral*.

Assessment of Potential Impact of Operation of the Scheme on Controlled Waters

6.13.28 During the Scheme operation new pollution linkages may be introduced in addition to the baseline conceptual site model as shown in Table 6.7 above with respect to controlled waters. These would be associated with the use of the site won materials within the construction of the embankment. However, as detailed in Section 6.10, it has been assumed that the reuse of site won or import of materials to the Scheme will be managed by a verification system applied via the Specification for Highway Works, Series 600 – Earthworks, and only materials found suitable for use would be acceptable for use as construction materials. Therefore, their application in the Scheme construction would result in no change to the baseline scenario with a *neutral* significance of effect.

[46] Welsh Government, A40 Llanddewi Velfrey to Penblewin, Ground Investigation Factual Report, WYG, June 2016

6.14 Mitigation and Monitoring

Construction Mitigation and Monitoring

6.14.1 Assessment of the impacts that construction of the Scheme may have on geology, geomorphology and land contamination identified a number of effects as summarised in Table 6.10.

Table 6.10 Summary of construction effects

Scheme element	Effect	Significance
Geology and Geomorphology		
Earth embankments	Soil consolidation	Neutral
Cuttings	Removal of mineral resources	Slight adverse
Structures and attenuation areas	Removal of mineral resources from footprint of attenuation ponds	Neutral
	Construction of shallow foundations	
Land contamination		
Across the Scheme	Potential impact on human health and controlled waters due to localised unexpected contamination	Slight adverse
Areas of made ground	Potential impact on human health (construction workers and Scheme neighbours) due to exposure to soils/dust impacted by contamination	Neutral to slight adverse
Dewatering during construction	Potential impact on surface water receptors due to direct discharge	Slight adverse
Areas of made ground	Potential impact on surface water receptors due to surface run-off during construction	Neutral

Geology and Geomorphology

6.14.2 The completed assessments identified a number of effects with respect to geology and geomorphology as summarised in Table 6.10. The assessment indicated the overall *neutral* to *slight adverse* significance of effect of the construction works on the site geology and geomorphology. Therefore, no mitigation measures are considered necessary.

Land Contamination

6.14.3 The completed assessments identified a number of effects with respect to land contamination as summarised in Table 6.10. The assessment indicated the overall *neutral* to *slight adverse* effect of construction works as a result of land contamination. Therefore, no mitigation measures are considered necessary.

6.14.4 The absence of the requirement for mitigation is based on the following as detailed in Section 6.10:

a) The environmental management of the construction activities would be undertaken in line with best practice as outlined in the Preliminary Construction Environmental Management Plan (Pre-CEMP) presented in Volume 3 Appendix 2.2 and as such would not have an impact on identified receptors.

b) Any discharge to the river would only be carried out with appropriate approval from NRW, following monitoring and if needed, treatment to ensure it is of acceptable quality.

c) The reuse of site won or import of materials to the Scheme will be managed by a verification system applied via the Specification for Highway Works, Series 600 – Earthworks, and only materials found suitable for use, assessed in terms of potential effects on human health and the water environment, would be acceptable for construction works.

6.14.5 In addition, the available soil and groundwater chemical testing results from such an action plan could be used to inform health and safety risk assessments for the construction works.

6.14.6 The applied environmental management best practice would as a minimum include the following considerations (refer to Volume 3 Appendix 2.2 Outline Construction Environmental Management Plan for details):

a) Adoption of a watching brief for identification of potential contamination. The discovery of any unexpected contaminated land would require appropriate measures to limit the risk to construction workers and controlled waters.

b) Dust control measures to ensure that dust generation and off-site migration is minimised. This may involve dust suppression measures during excavation works, wheel washing facilities and conveyance of materials in covered wagons. Details on the proposed dust mitigation and control measures are also set out in Chapter 13 Air Quality.

c) Water impacted by chemical contamination and/or cement would require the application of mitigation measures before discharge. Measures may include bunding around working areas to contain any overspill, the use of settlement lagoons, settlement tanks and/or silt busters.

d) Water with high concentrations of suspended solids can arise from dewatering excavations, exposed ground, stockpiles, plant and wheel washing, site roads and disturbance of watercourse beds. Sediment control measures and dust suppression techniques would be implemented where work is to be undertaken adjacent to or within a watercourse. Disposal of silty water would be undertaken in accordance with current best practice and measures developed and agreed with NRW prior to commencement of the works. This is in addition to the approval requirements with respect to the quality of the discharge water to the river.

e) Environmental monitoring would be undertaken through the construction period to ensure that environmentally sound working practices are adopted and maintained. NRW may require environmental sampling, particularly in relation to surface water and groundwater quality and would be consulted regarding monitoring programmes.

f) All contractors would have a briefing on environmental protection measures to protect the water environment during site induction training. This would highlight the methods and working practices employed.

Operational Mitigation and Monitoring

6.14.7 The assessment of impact that the operation of the Scheme may have on geology, geomorphology and land contamination identified a number of effects as summarised in Table 6.11.

Table 6.11: Summary of operational effects

Scheme element	Effect	Significance
Geology and geomorphology		
Earth embankments	Soil consolidation	Neutral
	Reduced access to mineral resources	Slight adverse
Cuttings	None identified	Neutral
Structures	None identified	Neutral
Land contamination		
Materials reuse	Impact on human health and controlled waters due to the presence of materials reused within the Scheme	Neutral
Areas of made ground	Impact on human health (maintenance workers) due to exposure to soils/dust impacted by contamination	Neutral

Geology and Geomorphology

6.14.8 The assessments identified a number of effects with respect to geology and geomorphology as summarised in Table 6.11. The assessment indicated the overall *neutral to slight adverse* significance of effect of the Scheme operation. Therefore, no mitigation measures are considered necessary.

6.14.9 As no significant impacts have been identified there is no requirement for future monitoring of geology and geomorphology as a result of the Scheme.

Land Contamination

6.14.10 The completed assessments identified a number of effects with respect to land contamination as summarised in Table 6.11. The assessment indicated a *neutral* effect of the Scheme operation presented by land contamination. Therefore, no mitigation measures are considered necessary.

6.14.11 The absence of the requirement for mitigation is based on Section 6.9 i.e. the reuse of site won or the import of materials to the Scheme will be managed by a verification system applied via the Specification for Highway Works, Series 600 – Earthworks, and only materials found suitable for use would be acceptable for construction works.

6.14.12 In addition, the available soil and groundwater chemical testing results would be used to inform health and safety risk assessments for the maintenance works.

6.14.13 As significant impacts have been identified, there is no requirement for monitoring of land contamination during the Scheme's operation.

Construction Effects - With Mitigation

6.14.14 No mitigation measures have been proposed over and above the current design proposals and therefore the construction effects, as summarised in Table 6.10, remain unchanged.

Operational Effects - With Mitigation

6.14.15 No mitigation measures have been proposed over and above the current design proposals and therefore the construction effects, as summarised in Table 6.11, remain unchanged.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 7: Road Drainage and Water Environment

A40LVP-ARP-EWE-SWI-RP-LE-0001

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15/01/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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7 Road Drainage and Water Environment

7.1 Introduction

7.1.1 The section describes and characterises the existing surface and groundwater resources in the vicinity of the Scheme. It sets out the methodology used for the assessment of potential impacts to water bodies, surface water drainage and flood risk as a result of the Scheme during the construction and operational phases. Potential impacts to groundwater resulting from the Scheme, including changes in groundwater level or resource and pollution as a result of road runoff, accidental spillage or construction activities are considered in this chapter. Potential impacts on groundwater due to the mobilisation of existing pollutants are considered within Chapter 6 Geology and Soils.

7.1.2 The assessment methodology follows the guidance set out in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10: HD45/09 Road Drainage and the Water Environment (November 2009), subsequently referred to in the report as HD45/09.

7.2 Policy Context

European Legislation

7.2.1 **Water Framework Directive (WFD) 2000/60/EC**: the WFD provides a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. The Directive requires Member States to establish river basin districts and for each of these a river basin management plan (RBMP), which are prepared, implemented and reviewed every six years. The current period from 2015-21 is Cycle 2 of these RBMPs.

7.2.2 **Groundwater Daughter Directive 2006/118/EC**: a daughter directive of the WFD, the Groundwater Directive establishes a regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. Amended by Directive 2014/80/EU to clarify groundwater information to be provided to the European Commission. Member States must provide information on groundwater bodies classified as being at risk and threshold values for the respective pollutants and indicators established.

7.2.3 **Floods Directive 2007/60/EC**: The Floods Directive requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. The Directive requires that flood risk management plans be prepared, implemented and reviewed every six years for each river basin district, in coordination with RBMPs prepared under the WFD.

7.2.4 **Habitats Directive 92/43/EEC & Birds Directive 2009/147/EC**: The Habitats Directive and Birds Directive ensure the conservation of a range of rare or threatened species. They establish the EU-wide Natura 2000 ecological network of protected areas to safeguard against potentially damaging developments.

7.2.5 **Priority Substances Directive 2013/39/EU**: The Priority Substances Directive amends WFD 2000/60/EC and the Directive on Environmental Quality Standards (Directive 2008/105/EC) by updating the list of priority substances that would apply to WFD assessment.

7.2.6 **Urban Wastewater Treatment Directive 91/271/EEC (as amended) (UWWT Directive (consolidated)):** this Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The objective of the Directive is to protect the environment from the adverse effects of the above-mentioned wastewater discharges.

National Legislation

7.2.7 **Environmental Protection Act 1990**: The Act makes provision to control pollution arising from industrial and other processes for waste management.

7.2.8 **Water Industry Act 1991**: The Water Industry Act relates to water supply and the provision of wastewater services in England and Wales.

7.2.9 **Land Drainage Act 1991 (as amended**): The Land Drainage Act 1991 requires that a watercourse be maintained by its owner. The Act provides functions to internal drainage boards and local authorities to manage watercourses and provide consenting powers for proposed works to watercourses associated with development.

7.2.10 **Water Resources Act (England and Wales) 1991 (Amended 2009):** The Water Resources Act 1991 (WRA) (as amended) sets out the responsibilities of Natural Resources Wales (NRW) and the Environment Agency (EA) in relation to water pollution, resource management, flood defence, fisheries, and navigation.

7.2.11 **Environment Act 1995**: The Environment Act sets new standards for environmental management, such as requiring national strategies for air quality and waste. It also deals with the establishment of an Environment Agency (including Natural Resources Wales and the Scottish Environmental Protection Agency).

7.2.12 **Water Act 2003:** The Water Act 2003 amends the Water Resources Act 1991 and the Water Industry Act 1991 to make provision with respect to compensation under Section 61 of the Water Resources Act 1991.

7.2.13 **Water Resources (Abstraction and Impounding) Regulations SI 2006/641**: These Regulations contain provisions relating to the licensing of abstraction and impounding of water in England and Wales in the light of amendments made by the Water Act 2003 to the Water Resources Act 1991.

7.2.14 **Flood Risk Regulations 2009:** The Flood Risk Regulations 2009 transposes the EC Floods Directive (Directive 2008/60/EC) on the assessment and management of flood risk into domestic law in England and Wales and implements its provisions. The regulations designate a Local Lead Flood Authority (LLFA) and imposes duties on NRW and Lead Local Flood Authorities to prepare a number of documents including:

a) Preliminary Flood Risk Assessments;
b) Flood hazard and flood risk maps; and
c) Flood Risk Management Plans.

7.2.15 **Environmental Damage (Prevention and Remediation) (Wales) Regulations 2009:** these regulations are based on the ‘polluter pays principle and impose obligations on operators of economic activities requiring them to prevent, limit or remediate environmental damage. They apply to damage to protected species, natural habitats, sites of special scientific interest (SSSIs), water and land and implement Directive 2004/35/EC, on environmental liability.

7.2.16 **The Groundwater (England and Wales) Regulations 2009:** These regulations implement parts of the WFD that apply to groundwater (such as the Groundwater Directive). They supplement the Environmental Permitting Regulations 2010 and existing water pollution legislation.

7.2.17 **Flood and Water Management Act 2010:** The Act makes provision for water, including provision about the management of risks in connection with flooding and coastal erosion.

7.2.18 **The Water Supply (Water Quality) Regulations 2010**: These regulations provide the framework for drinking water quality in England in respect of public supplies provided by water companies and licensed water suppliers. The Drinking Water Inspectorate, acting on behalf of the Secretary of State, enforces the legislation.

7.2.19 **The Water Framework Directive (Standards and Classification) Directions England and Wales 2015**: The Water Framework Directive (WFD) Directions presents the updated environmental standards to be used in the second cycle of the Water Framework Directive (2000/60/EC) river basin management planning process in England and Wales. Environmental standards help assess risks to ecological quality of the water environment.

7.2.20 **Well-being of Future Generations (Wales) Act 2015**: The Act strengthens existing governance arrangements for improving the social, economic, environmental and cultural well-being of Wales to ensure that present needs are met without compromising the ability of future generations to meet their own needs. The Act ensures that when making decisions public bodies take into account the impact they could have on people living in Wales in the future.

7.2.21 **The Groundwater (Water Framework Directive) (Wales) Direction 2016:** this sets out instructions to Natural Resources Wales (NRW) on obligations to protect groundwater, including requirements to monitor and set thresholds for pollutants, add new pollutants to the monitoring list and change the information reported to the European Commission.

7.2.22 **The Environmental Permitting Regulations 2016**: amend the Environmental Permitting (England and Wales) Regulations SI 2010/675 in order to extend the requirement for an environmental permit to flood risk activities in addition to polluting activities included

under the previous regulations. The new permitting requirements for flood risk activities replaces the current "flood defence consent Scheme", allowing the Environment Agency and NRW to concentrate on higher risk activities. NRW is identified out as the regulator for Wales.

7.2.23 **Environment (Wales) Act 2016:** The Act puts in place the legislation needed to plan and manage Wales' natural resources in a more proactive, sustainable and joined-up way. The Act clarifies the law relating to shellfisheries, marine licencing, flood risk management and land drainage in Wales.

7.2.24 **Water Environment (Water Framework Directive) (England and Wales) Regulations 2017**: The WFD was transposed into the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. WFD is delivered in England and Wales through a framework of River Basin Management Plans (RBMPs).

7.2.25 **The Water Abstraction and Impounding (Exemptions) Regulations 2017:** specify enactments in the Water Resources Act 1991 so that nothing in those provisions can prevent the grant of an abstraction licence. They provide for some further exemptions from the licensing restrictions under the Water Resources Act 1991.

National Planning Policy

7.2.26 **The Wales Spatial Plan (WSP)** sets out the planning agenda for Wales. Its main principle is that development should be sustainable and protect water resources and manage flood risk.

7.2.27 **Planning Policy Wales Edition 10 (December 2018):** (PPW) sets out the land use planning policies of the Welsh Government. It specifically outlines design approaches and techniques that improve water efficiency and minimise adverse impacts on water resources, surface water quality, the ecology of rivers and groundwater. It also ensures that new development is not exposed unnecessarily to flooding.

7.2.28 **Technical Advice Note (TAN) 5: Nature Conservation and Planning (2009):** TAN 5 gives advice as to the consideration of impacts on designated sites in relation to the water environment.

7.2.29 **Technical Advice Note (TAN) 15: Development and Flood Risk (2004):** TAN 15 provides technical guidance which supplements the policy set out in PPW in relation to development and flooding. It advises on development and flood risk and provides a framework for the assessment of flooding.

7.2.30 **Welsh Government: Taking Wales Forward 2016-2021**: sets out the priorities of Welsh Government. It includes priorities relating to reductions in carbon emissions, delivering improvements to trunk roads and investment in flood defence / water management.

Regional Management Plans

7.2.31 **Western Wales River Basin Management Plan (RBMP) 2015:** River Basin Management Plans (RBMPs) are drawn up for the 11 river basin districts in England and Wales as a requirement of the WFD. The plan for the Western Wales River Basin District is managed by NRW and sets out the programme of measures needed to achieve the objective of the WFD over the next six-year period (2015-2021).

7.2.32 **Western Wales Flood Risk Management Plan (FRMP) 2015**: The Western Wales FRMP was first published in 2015 by NRW. The plan gives an overview of the flood risk in the Western Wales River Basin District and set out intended priorities to manage and reduce flood risk over the next six years and beyond.

Local Planning Policy

7.2.33 **Pembrokeshire Local Development Plan (LDP) 2013-2021**: the following policies are considered relevant as part of this assessment:

GN1 General Development Policy, Point 8;

GN2 Sustainable Design, Point 3;

GN3 Infrastructure and New Development;

GN23 Minerals Working, Point 4; and

GN24 Recycled Waste Materials and Secondary Aggregates, Point 5.

7.2.34 **Pembrokeshire Local Flood Risk Management Strategy 2012**: as the lead local flood authority (LLFA), Pembrokeshire County Council has responsibility for 'local flood risks', which includes the risk of flooding from ordinary watercourses, surface runoff and groundwater. The

Council have published a draft Flood Risk Management Strategy that details responsibilities, measures, objectives and assessments of flood risk.

Relevant Guidance

7.2.35 The Environment Agency's Pollution Prevention Guidelines (PPGs) have now been revoked and in Wales are being replaced by the Guidance for Pollution Prevention (GPPs). These provide guidance on similar areas of practice and where GPPs have yet to be issued, PPGs are still promoted as best practice in order to minimise pollution impacts during construction. The relevant PPGs include:

PPG 1 Understanding your environmental responsibilities – good environmental practices;

GPP 2 Above ground oil storage tanks;

PPG 3 Use and design of oil separators in surface water drainage systems;

PPG 4 Treatment and disposal of sewage where no foul sewer is available;

GPP 5 Works and maintenance in or near water;

PPG 6 Working at construction and demolition sites;

PPG 7 Safe storage – The safe operation of refuelling facilities;

GPP 8 Safe storage and disposal of used oils;

GPP13 Vehicle washing and cleaning;

PPG18 Managing fire water and major spillages;

GPP21 Pollution incident response planning;

PPG22 Incident response – dealing with spills; and

PPG26 Safe storage – drums and intermediate bulk containers (PPG 26).

7.2.36 CIRIA Guidance used for the assessment includes:

Control of Water Pollution from Construction Sites – Guide to Good Practice (SP156);

Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors (C532);

Control of Water Pollution from Linear Construction Projects – Technical Guidance (C648);

Environmental good practice on site (C692); and

Groundwater control: design and practice (second edition) (C750).

7.3 Consultations

7.3.1 During the EIA process, a scoping report was produced which included the approach to the assessment of road drainage and the water environment. A draft version of the report was circulated for review, feedback and comment from both statutory and non-statutory consultees, see Volume 3 Appendix 4.1. The recommendations from the scoping report were incorporated into the assessment.

7.3.2 The following stakeholders were consulted throughout the assessment, both to gather baseline data and to inform the assessment:

a) Pembrokeshire County Council (PCC);
b) Natural Resources Wales;
c) Welsh Government; and
d) Landowners.

7.3.3 Consultation was undertaken with NRW regarding the geomorphological impacts and requirements for WFD assessment during a meeting and walkover of the Scheme, with a geomorphology technical specialist, on 30 June 2017. NRW and PCC have also been consulted on the risk of flooding to and as a result of the Scheme and the approach taken was agreed with both parties.

7.4 Surveys

7.4.1 The following surveys were undertaken:

Ground investigation undertaken by WYG in 2016 on behalf of the Welsh Government. Results are presented in their factual report[1]. These investigations included drilling of boreholes and installation of groundwater monitoring instrumentation. As part of these investigations three rounds of groundwater monitoring were undertaken in 2016;

A Preliminary Sources Study Report, prepared by Mott MacDonald in March 2016 to document the findings of the geotechnical and hydrogeological desk based studies carried out;

A desktop survey of available mapping and Envirocheck data[2];

[1] Welsh Government, A40 Llandewi Velfrey to Penblewin, Ground Investigation Factual Report, WYG, June 2016.
[2] Envirocheck report provided during the tender stage, dated 23rd November 2015.

An Initial Traffic and Accident Data Report[3], prepared by Arup in 2017 using data obtained from Welsh Government and Dyfed-Powys Police to document traffic numbers and accident rates;

A site walkover on 29 and 30 June 2017 by a suitably qualified geomorphologist; and

Questionnaire survey of landowners to identify features including private water supplies, abstractions and springs.

7.5 Study Area

7.5.1 The study area for the assessment includes the geographical extent of the full scope of the works, along with surface and groundwater bodies within 500m. Where effects are deemed to have the potential to extend beyond 500m (i.e. due to hydrological connections to sensitive or protected waters) the study area is extended to the point of potential effect from the Scheme. The furthest extent of the study area is limited to the point on a receiving watercourse or groundwater body whereby the significance of the effect of any potential impact is deemed to be neutral.

7.5.2 The 500m buffer was selected based on professional judgement of the potential impacts posed by the Scheme. It is in line with study areas for assessments of the impact on the water environment undertaken for other highway construction projects. Water bodies outside the 500m buffer were considered based on professional judgement of their value and connectivity to the Scheme area.

7.5.3 Water features outside of the 500m buffer that were considered but screened out of the assessment include three unnamed tributaries of Longford Brook (north of the Scheme), the Afon Marlais and seven of its unnamed tributaries (south of the Scheme). The potential for possible impacts on these water features was considered negligible based on the source – pathway – receptor basis as they would not receive flows or otherwise be affected by the proposed Scheme and therefore no pathway is present for potential impacts.

7.6 Assessment Methodology

7.6.1 The assessment was undertaken in accordance with DMRB guidance HD45/09 Road Drainage and the Water Environment (2009), which provides the methodology and criteria for identifying likely impacts of a proposed road Scheme on the water environment and predicting their

[3] Arup, Initial Traffic and Accident Data Report (2017).

magnitude and the significance of the resulting effects. There are four topic areas assessed as part of the HD45/09 approach:

1. Determining the effect from routine highway runoff on the quality of surface watercourses;
2. Determining the effect from routine highway runoff on the quality of groundwater resources;
3. Predicting the likelihood of an accidental spillage causing pollution to receiving water bodies; and
4. Assessing flood risks.

7.6.2 In addition to the topic areas set out in HD45/09 further assessment was carried out where other impacts were identified, including:

a) Assessment of the potential effects on the water environment due to construction related impacts, using a source – pathway – receptor based assessment; and
b) Assessment of effects on the groundwater resource due to the proposed excavation of highway cuttings, the creation of embankment and any potential impacts on groundwater levels; and
c) Consideration and inclusion of the findings of a standalone WFD compliance assessment, which considers any potential impacts on WFD quality elements (e.g. hydromorphology) that may cause a deterioration in the status of a quality element or prevent it from reaching good status in the future.

7.6.3 HD45/09 provides a standard methodology for the assessment of each topic area, which has four key steps:

Step 1 Identification of water features within the study area and an assessment of the importance/value/sensitivity of each of these receptors, using the criteria in Table 7.2;

Step 2 Identification of potential impacts to the water features identified in Step 1, from construction and/or operation. Under the WFD, an impact is defined as causing a deterioration in the status of a water body or preventing a water body from reaching Good status in the future;

Step 3 Assessment of the potential magnitude (Table 7.3) of any construction or operation impacts on the receptor; and

Step 4 Assessment of the overall significance of any effects to receptors due to impacts, using the matrix in Table 7.4.

7.6.4 Specific methods required by HD45/09, which only have relevance to particular construction or operation impacts, are detailed in following sections.

Baseline Methodology

7.6.5 The drainage and water environment baseline data for the study area was obtained from a combination of desktop study, walkover survey, a groundwater levels survey and consultation with relevant bodies.

7.6.6 For the surface and groundwater baseline description, information was obtained from the following sources:

a) NRW 'Water Watch Wales' (last accessed 11/09/2018)[4];
b) NRW (2015) Western Wales River Basin Management Plan;
c) Preliminary Sources Study Report, by Mott MacDonald (2016);
d) Envirocheck Report[2];
e) Online historical maps[5];
f) Lle: Welsh Government Geo-Portal (last accessed 11/09/2018)[6];
g) A site walkover with a NRW geomorphologist on 29th & 30th June 2017;
h) Consultation with relevant bodies;
i) Groundwater monitoring and ground investigation reports[7];
j) Ordnance Survey (OS) topographical maps[8];
k) The Coal Authority interactive map viewer[9];
l) The Mineral Resources Map for Wales[10];
m) Geological mapping[11]; and
n) The British Geological Survey (BGS) borehole records database[12];

7.6.7 The flood risk baseline was informed by NRW's fluvial flood mapping[13] and PCC's surface water flooding assessment[14].

[4] http://waterwatchwales.naturalresourceswales.gov.uk/en/
[5] https://www.old-maps.co.uk
[6] http://lle.gov.wales/home
[7] Welsh Government, A40 Llanddewi Velfrey – Penblewin, Ground Investigation Factual Report (June 2017).
[8] http://lle.gov.wales/home
[9] http://mapapps2.bgs.ac.uk/coalauthority/home.html
[10] http://www.bgs.ac.uk/mineralsuk/planning/resource.html#MRW
[11] http://mapapps.bgs.ac.uk/geologyofbritain/home.html
[12] http://www.bgs.ac.uk/data/boreholescans/home.html
[13] https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en
[14] Pembrokeshire County Council. 2010. Assessment of Surface Water Flooding: Local Development Plan, Adoption - 2021

7.6.8 Data for the accidental spillage risk baseline was obtained from the Initial Traffic and Accident Data Report[3].

7.6.9 The baseline describes the existing condition of surface and groundwater bodies, flood risk and road drainage layout within the study area. The importance or sensitivity to change is considered for each water feature. Table 7.1 sets out the attributes for each water feature considered in defining the baseline. This was adapted from HD45/09 to also take account of WFD attributes.

Table 7.1 Surface water features, their attributes and indicators of quality (adapted from HD45/09)

Feature	Attribute/Service	Indicator of quality	Possible measure
Watercourse	Water Supply/quality	Amount used for water supply (potable); Amount used for water supply (industrial/agricultural); Chemical water quality.	Location and number of abstraction points; Volume abstracted daily; Physio-chemical quality elements of WFD ecological status; Supporting hydrological regime element of WFD ecological status.
	Dilution and removal of waste products	Presence of surface water discharges and effluent discharges.	Daily volume of discharge (treated/untreated)
	Recreation	Access to watercourse; Use of watercourse for recreation.	Length of watercourse used for recreation (fishing, water sports) and number of clubs
	Biodiversity	Biological water quality	WFD ecological status class; NRW routine fish and/or invertebrate monitoring data
		Fisheries quality	Fish Status; Supporting hydromorphological element of WFD ecological status, includes geomorphology
	Value to economy	Value of use of watercourse	Length of watercourse used for recreation commercially; Number of people employed;

Feature	Attribute/Service	Indicator of quality	Possible measure
			Length of river bank developed; Length of watercourse fished commercially.
	Conveyance of flow	Presence of watercourses	Number and size of watercourses
Floodplain	Conveyance of flood flows	Presence of floodplain; Flood flows.	Developed area within extent of floodplain affected; Existing flood risk/flood return period; Location/importance of flood flow routes.
Groundwater	Water Supply/quality	Amount used for water supply (potable); Amount used for water supply (industrial/agricultural).	Location and number of abstraction points; Volume abstracted daily; Location and grade of source protection zone; WFD groundwater quantitative chemical status.
	Soakaway	Presence of soakaways or other discharges to the ground.	Location and number of discharge points; and daily volume discharged.
	Vulnerability	Groundwater vulnerability.	Classification of aquifer vulnerability.
	Economic value	Extent of use for abstractions.	Number of people employed.
	Conveyance of flow	Presence of groundwater supported watercourses; Potential for groundwater flooding; Groundwater interception by road structures or drainage.	Changes to groundwater recharge, levels or flows; Number and size of watercourses.
	Biodiversity	Presence of groundwater supported wetlands.	Changes to groundwater recharge, levels or flows; Status or classification of wetland.

Methodology for Construction Impacts

7.6.10 The assessment of construction impacts follows the guidance set out in HD45/09, which recommends that construction impacts are considered using the source – pathway – receptor approach and defers specific guidance of bridge/highway construction impacts to CIRIA 648 Control of Water Pollution from Linear Construction Projects.

7.6.11 The potential impacts of construction on surface water are assessed based on the planned construction methods and sequencing and after discussion with the contractor. Potential impacts that are considered include:

Potential surface water impacts: impacts to surface water quality from sediment runoff, spillages or discharges, impacts to flood risk, and impacts on fish or eel passage/spawning due to noise, light, vibration or physical modification.

Potential groundwater impacts: changes to groundwater levels (these impacts are assessed together with impacts due to operation of the Scheme because the operational impacts on groundwater levels largely relate to the 'as-built' physical infrastructure) and impacts on groundwater quality due to spillages and discharges during construction.

7.6.12 Where construction methods are not available, standard construction practices were assumed. Cumulative impacts as a result of construction phasing is also assessed.

7.6.13 Where measures to reduce construction impacts are considered standard practice, they are included in the Pre-CEMP (see Volume 3 Appendix 2.2). Measures above those typically used are detailed in Sections 7.10 and 7.12.

Methodology for Operational Impacts

7.6.14 An assessment of the potential impacts during operation was undertaken for the five assessment components as set out below.

7.6.15 **Surface Water Quality:** An assessment of the potential impacts of routine runoff on surface waters was undertaken to determine whether there is an environmental risk and if pollution mitigation measures are needed. The Highways Agency Water Risk Assessment Tool (HAWRAT) was used to assess short term risks from intermittent

discharge (i.e. first flush) and the tool outputs are also compared against Environmental Quality Standards (EQSs) to assess the potential for annual cumulative impacts.

7.6.16 The methodology assesses the impact of road drainage water with any pollutants it contains, based on the predicted traffic volumes, the carriageway surface area and the local climate conditions. The impact assessment methodology dealing with water quality considers potential dilution within the receiving watercourse, the morphology and sensitivity of the watercourse and any protected sites downstream of the discharge point. Baseline surface water quality monitoring is not required for the HAWRAT method, and this has therefore not been carried out.

7.6.17 **Geomorphology:** a qualitative assessment of possible impacts on the river geomorphology was undertaken based on a fluvial geomorphologist's understanding of the potential for impacts to the watercourse flow dynamics and sediment transport processes and the subsequent effects that this might have on the ecological potential of the water body. These types of impacts were assessed based on experience of previous schemes and a theoretical understanding of flow.

7.6.18 Potential geomorphological responses to any anticipated changes in flow dynamics were evaluated. The assessment was supported by consultation and a site visit with NRW officers with appropriate experience of fluvial geomorphology.

7.6.19 **Groundwater Quality:** Annex I of HD45/09 provides a methodology (Method-C) to assess the potential impact on the quality of groundwater resources from routine runoff discharges to the ground. This risk assessment procedure is based on the source-pathway-receptor (S-P-R) protocol. The principles of this approach were applied to the discharge of road drainage where:

a) The source comprises the road drainage water with any pollutants (quantified using HAWRAT) it contained as it enters any unlined ditch or watercourse, attenuation basin or soakaway discharge system that in accordance with HD45/09 has potential to transmit water through the ground to groundwater;
b) The pathway represents the processes that may modify the pollutants during transmission through the discharge system and the ground until the actual 'point of entry' to groundwater; and

c) The receptor is the groundwater.

7.6.20 For there to be a risk of impact to groundwater, all elements of the S-P-R model have to be present to create a pollutant linkage. In accordance with HD45/09, a pathway to the groundwater receptor is only considered to be feasible if the receiving watercourse at the proposed outfall has little flow during dry periods or the drainage is to a soakaway. In accordance with HD45/09 this is assessed as a Q95 flow of less than 0.001m^3/s, see Section 7.8.4, which corresponds to all four outfall locations for the proposed road drainage of the Scheme.

7.6.21 **Hydrogeology and Groundwater Resources:** a specific methodology for the assessment of potential effects of the Scheme on hydrogeology and groundwater resources is not covered by HD45/09. The method of assessment includes the following:

a) Use of desk study information, the findings from site walkover studies and ground investigations to develop a ground model, including the likely groundwater levels across the Scheme.
b) Identification of any sensitive receptors that are reliant on the current groundwater levels, such as NRW designated groundwater Source Protection Zones (SPZ), groundwater dependent terrestrial ecosystems (GWDTEs), existing abstraction wells, or spring lines that feed surface water courses.
c) Identification of potential features or activities that are proposed for the Scheme that may result in an impact on groundwater levels, such as the long-term dewatering of highway cuttings. Dependant on the rate and duration of any dewatering an abstraction licence may be required.
d) Assessment of the potential impacts on the receptors. For the proposed highway cuttings, this would include hydrogeological calculations of the likely drawdown of the water table.

7.6.22 **Accidental Spillage:** the operational pollution effects from accidental spillage were calculated using Method-D from the HD45/09 guidance. When considering the risk of spillages, the calculated spillage risk return period must not be greater than 1 in 100 years, or 1 in 200 years where spillage could affect protected areas for conservation such as Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs) and Special Area of Conservation (SACs).

7.6.23 For assessment of the risk posed by accidental spillage, in line with HD45/09 guidance, if the annual probability that a spillage would cause a serious pollution incident to a water body is less than 1%, then the

risk posed is considered acceptable and no further assessment was carried out.

7.6.24 The risk is assessed initially without any mitigation measures. If mitigation measures are needed to reduce the probability, a reduction factor is applied, depending on the type of mitigation applied.

7.6.25 **Flood Risk:** the assessment of potential flood impacts was undertaken in accordance with NRW flood mapping and TAN15. The design of the highway drainage has followed the principles of DMRB. A technical note identifying the risks imposed by the Scheme in relation to flooding was prepared and was agreed with NRW and PCC (Volume 3 Appendix 7.2).

7.7 Significance Criteria

7.7.1 The significance of effects on the water environment is based on the methodology contained within the HD45/09 guidance, Annex IV. The importance or sensitivity of the affected receptor is combined with the magnitude of any effects to define the significance of the effects. Potential effects not covered by this guidance - chiefly related to geomorphology and WFD compliance - were assessed using the supplementary methods explained in the sections above.

7.7.2 For risks posed to the water environment, the significance of the effects was assessed based on the importance/sensitivity of the affected receptor in combination with the magnitude of any effects.

Environmental Value (or Sensitivity) of Resource / Feature

Table 7.2 Criteria for estimating the importance of environmental attributes (adapted from HD45/09, Annex 1, Table A4.3)

Importance	Criteria	Examples
Very High	Attribute has a high quality and rarity on regional or national scale	**Surface Water:** EC Designated Salmonid/ Cyprinid fishery. WFD Class 'High' Site protected/designated under EC or UK habitat legislation (SAC, SPA, SSSI, WPZ, Ramsar site, salmonid water)/ Species protected by EC legislation **Groundwater:** Principal aquifer providing a regionally important resource or supporting site protected under EC and UK habitat legislation SPZ1 **Flood Risk:** Floodplain or defence protecting more than 100 residential properties from flooding

Importance	Criteria	Examples
High	Attribute has a high quality and rarity on local scale	**Surface Water:** WFD Class 'Good' Major Cyprinid Fishery, Species protected under EC or UK habitat legislation **Groundwater:** Principal aquifer providing locally important resource or supporting river ecosystem SPZ2 **Flood Risk:** Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding
Medium	Attribute has a medium quality and rarity on local scale	**Surface water:** WFD class 'Moderate'; **Groundwater:** Aquifer providing water for agriculture use. **Flood risk:** Floodplain or defence protecting 10 or fewer industrial properties from flooding
Low	Attribute has a low quality and rarity on local scale	**Surface water:** WFD class 'Poor'; **Groundwater:** unproductive strata; **Flood risk:** Floodplain with limited constraints and low probability of flooding.

Magnitude of Impact

7.7.3 The magnitudes of potential effects were assessed using the criteria set out below.

Table 7.3 Estimating the magnitude of an impact on an attribute (adapted from HD45/09, Annex 1, Table A4.4 to include geomorphological examples)

Magnitude	Criteria	Typical Example
Major Adverse	Results in loss of attribute and/or quality and integrity of the attribute.	Surface Water: Failure of both soluble and sediment bound pollutants in HAWRAT and compliance failure with EQS values. Calculated risk of pollution from accidental spillage >2% annually. Loss or extensive change to a fishery. Loss or extensive change to a designated Nature Conservation Site. Major impedance or disruption of natural geomorphological processes. Loss of, or permanent impacts to, in-channel geomorphological features. Likelihood of scour and/or bank erosion that would require installation of hard revetment during the design life of the Scheme over a significant stretch of river.

Magnitude	Criteria	Typical Example
		Expected deterioration in WFD status or prevention of achievement of 'Good' status. Permanent loss of critical or sensitive habitat. Groundwater: Loss of, or extensive change to, an aquifer. Potential high risk of pollution to groundwater from routine runoff (>250). Calculated risk of pollution from accidental spillage >2% annually. Expected deterioration in WFD status or prevention of achievement of 'Good' status. Flood Risk: Increase in peak flood level (1% annual probability) >100mm
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	Surface Waters: Failure of both soluble and sediment-bound pollutants in HAWRAT but compliance with EQS values. Risk of pollution from spillage >1% annually and <2% annually. Partial loss in productivity of a fishery. Effect on the integrity of the existing flora and fauna. Effects on the occurrence of natural geomorphological processes. Effects on the size and/or quality of geomorphological features. Risk of scour and/or bank erosion that would require installation of bioengineering during the design life of the Scheme at a localised level. Moderate impact on WFD quality element with no anticipated reduction in WFD status. Partial loss of critical or sensitive habitat. Groundwater: Partial loss or change to an aquifer. Potential medium risk of pollution to groundwater from routine runoff (score 150-250) Calculated risk of pollution from spillage >1% annually and <2% annually. Partial loss of the integrity of groundwater supported designated wetlands. Moderate impact on WFD quality element with no anticipated reduction in WFD status. Flood Risk: Increase in peak flood level (1% annual probability) >50mm.
Minor Adverse	Results in some measurable change in attributes	Surface Waters: Failure of either soluble or sediment-bound pollutants in HAWRAT. Risk of pollution from spillage >0.5%.

Magnitude	Criteria	Typical Example
	quality or vulnerability.	Low risk of scour and/or bank erosion. Minor impact on WFD quality element with no anticipated reduction in WFD status. Groundwater: Potential low risk of pollution to groundwater from routine runoff (risk score <150). Minor impact on WFD quality element with no anticipated reduction in WFD status. Flood Risk: Increase in peak flood level (1% annual productivity) >10mm.
Negligible	Results in effect on attribute but of insufficient magnitude to affect the use or integrity	Surface Water: No risk identified by HAWRAT (pass both soluble and sediment-bound pollutants). Risk of pollution from accidental spillages <0.5% annually. No change to geomorphological processes or forms and no new risks introduced. No change in WFD status, potential to achieve WFD objectives or habitat impacts. Groundwater: No predicted change in quality of any type of aquifer Risk of pollution from accidental spillages <0.5% annually. No change in WFD status or potential to achieve WFD objectives. Flood Risk: Negligible change in peak flood level (1% annual probability) <±10mm.
Minor Beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring	Surface water: HAWRAT assessment of either soluble or sediment-bound pollutants becomes a Pass from an existing site where the baseline was a Fail condition. Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually) (Method-D). Minor enhancements to geomorphological features or riparian habitat to support natural geomorphological processes. Delivery of WFD enhancements that provide ecosystems benefits but are unlikely to contribute directly to improving WFD status. Groundwater: - Calculated reduction in existing pollution risk from accidental spillages by 50% or more to an aquifer (when existing spillage risk is <1% annually) (Method-D). Delivery of WFD enhancements that provide some benefit but are unlikely to contribute directly to improving WFD status. Flood Risk: Reduction in peak flood level (1% annual probability) >10mm.

Magnitude	Criteria	Typical Example
Moderate Beneficial	Results in moderate improvement of attribute quality	Surface Water: HAWRAT assessment of both soluble and sediment bound pollutants Pass from an existing site where the baseline was a Fail condition. Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually) (Method-D). Significant enhancements to geomorphological features or riparian habitat to support natural geomorphological processes. Delivery of WFD enhancements that contribute to improving WFD status. Groundwater: - Calculated reduction in existing pollution risk from accidental spillages by 50% or more to an aquifer (when existing spillage risk >1%) (Method-D). Delivery of WFD enhancements that contribute to improving WFD status. Flood Risk: Reduction in peak flood level (1% annual probability) >50mm.
Major Beneficial	Results in major improvement of attribute quality	Surface Water: Removal of existing polluting discharge, or removing the likelihood of polluting discharge occurring to a watercourse. Restoration of natural geomorphological processes and forms where they are currently impeded or degraded. Improvement in WFD status. Groundwater: Removal of existing polluting discharges to an aquifer or removing the likelihood of polluting discharges occurring. Recharge of an aquifer. Improvement in WFD status. Flood Risk: Reduction in peak flood level (1% annual probability) >100mm.

Significance of Effect

7.7.4 The significance of potential effects was then determined using Table 7.4, by comparison of the identified importance/sensitivity of the receptors with the estimated magnitude of the effect. Effects were either beneficial or adverse, as defined in Table 7.5. It is considered that significance values of Moderate adverse and above are defined as significant potential effects, and mitigation measures are necessary.

Table 7.4 Estimating the significance of potential effects (extract from HD45/09, Annex 1, Table A4.5)

		Magnitude of Impact			
		Negligible	**Minor**	**Moderate**	**Major**
Importance of Attribute	**Very High**	Neutral	Moderate / Large	Large / Very Large	Very Large
	High	Neutral	Slight / Moderate	Moderate /Large	Large / Very Large
	Medium	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Slight	Slight / Moderate

7.7.5 The definitions of the significance values are further explained in Table 7.5.

Table 7.5 Definitions of significance values

Score	Comment
Very Large Adverse	Where the proposed Scheme would result in degradation of the water environment because it results in predicted very significant adverse impacts on at least one water attribute.
Large Adverse	Where the proposed Scheme would result in degradation of the water environment because it results in predicted highly significant adverse impacts on a water attribute.
Moderate Adverse	Where the proposed Scheme may result in the degradation of the water environment because it results in predicted moderate adverse impacts on at least one attribute.
Slight Adverse	Where the proposal may result in a degradation of the water environment because it results in a predicted slight impact on one or more attributes. More than one attribute may be affected.
Neutral	Where the net impact of the proposed Scheme is neutral, because it results in no appreciable effect, either positive or negative, on the identified attributes.
Slight Beneficial	All other situations where the proposed Scheme provides an opportunity to enhance the water environment or provide an improved level of protection to an attribute.
Moderate Beneficial	Where the proposed Scheme provides an opportunity to enhance the water environment because it results in a moderate improvement for an attribute.
Large Beneficial	It is unlikely that any proposed Scheme incorporating the construction of a new or improved trunk road would fit into this category. However, proposals could have a large positive impact if it is predicted that it would result in a 'very' or 'highly' significant improvement to a water attribute(s), with insignificant adverse impacts on other water attributes.

7.8 Limitations and Assumptions

7.8.1 Assessment of the drainage and the water environment aspects of the Scheme were carried out in accordance with HD45/09, and supplementary methods as explained in the above sections for potential impacts not covered by this guidance.

7.8.2 Limitations and assumptions associated with the recommended methods are discussed below.

Surface Water

7.8.3 The accuracy of the baseline condition described in the assessment is dependent upon the accuracy of information obtained from NRW and its 'Water Watch Wales' website.

7.8.4 For the HAWRAT model flow data is required. Due to the lack of flow data available for the watercourses in the study area, the Q95 flow was estimated using the method in the Institute of Hydrology (IOH) Report No. 108[15]. Where the Q95 estimated is < 0.001 m^3/s, in accordance with HD45/09 guidance, a Q95 of 0.001 m^3/s is used.

7.8.5 The water hardness parameter for HAWRAT was obtained from the Drinking Water Inspectorate (DWI) map which shows the rate of water hardness. This data is considered to be appropriate to use in the absence of chemical data for each watercourse. It is assumed that local potable water would have a similar hardness characteristic as the local surface water and the three water hardness levels used by the HAWRAT model are based on broad ranges.

7.8.6 The threshold limits for soluble zinc and copper and for sediments are based on the limits set by the HAWRAT model.

7.8.7 The Annual Average Daily Traffic (AADT) used for the HAWRAT model was based on data from the Initial Traffic and Accident Data Report[3].

7.8.8 The geomorphological assessment is a qualitative assessment of the risk, type and severity of potential geomorphological adjustment as a result of the development including construction activities.

7.8.9 In the absence of drawings, it was assumed based on evidence from the site walkover that the existing route of the A40 is drained via conventional kerbs and gullies that discharge to local water courses with no attenuation.

Groundwater

7.8.10 The Method-C assessment results in a significance of effect that is relevant to the specific locality of the point of discharge, which is not relevant to the wider groundwater body due to dilution effects.

[15] Institute of Hydrology Report No. 108: Low flow estimation in the United Kingdom. Available at: http://nora.nerc.ac.uk/6050/1/IH_108.pdf

Supplementary risk assessment is proposed to overcome this situation if it arises.

7.9 Baseline Conditions

Surface Water

7.9.1 Surface water features identified within the study area are shown on Volume 2 Figure 7.1 A&B and include:

a) Longford Brook and a number of its unnamed tributaries. Longford Brook and an unnamed tributary are crossed approximately midway along the proposed route at Ffynnon Farm and Pen-troydin-fach. Other tributaries, generally to the north and west of the Scheme, are within the 500m study area;

b) The Afon Daulan and a number of its unnamed tributaries. The Afon Daulan and an unnamed tributary are crossed by the proposed route to the north of Llanddewi Velfrey, near Pen-troydin-fawr. Another tributary to the northeast of the Scheme, is within the 500m study area;

c) The Afon Marlais and a number of its unnamed tributaries. The Afon Marlais itself is at its closest 80m from the Scheme's western edge. The catchment is parallel to the southern boundary of the existing route of the A40;

d) Two unnamed tributaries of the Afon Taf, which are not crossed by but are within 200m and 500m from the eastern boundary of the proposed route;

e) Seven ponds at grid references SN 14315 16763, SN 13051 16396, SN 12163 17049 (Caermaenau-Fawr), SN 13415 17249, SN13255 17346 (both Pen-ca'rmaenau), SN 15133 16968 and SN 120665 16574 (Pen-blewyn); and

f) Springs at multiple locations. As the proposed route spans the watershed between multiple catchments, the watercourses described above arise across the study area, with the majority indicated on OS mapping as being spring-fed.

7.9.2 Six ponds (labelled 1-6 on Volume 2 Figure 7.1 A&B) are excluded from the assessment as no pathways are known to exist that could result in a change to the quality or quantity of waters as a result of the Scheme. The pond immediately south of Penblewin roundabout (Pond 7 on Volume 2 Figure 7.1A) is retained in the assessment due to its proximity to the Scheme.

7.9.3 Flow data for the watercourses in the vicinity of the Scheme are not available from the National River Flow Archive[16] or the NRW river levels website[17].

7.9.4 Consented discharges to surface waters within the study area, as identified by the Envirocheck report, include:

a) Discharge from Llanddewi Velfrey Sewage Treatment Works into a tributary of Pont-Shan Brook, approximately 200m south of the Scheme; and

b) Discharge to the Afon Marlais from Pantygorphwys-Uchaf, 350m from the western end of the Scheme.

7.9.5 The proposed route of the Scheme broadly follows the watershed between the Longford Brook, Taf and Marlais catchments with areas south of the Scheme draining to the south and areas to the north draining northwards.

7.9.6 From site walkover, aerial imagery and mapping, the existing highway drainage is believed to discharge to local watercourses. No pollution control or attenuation measures are known to be present and none were encountered during the site walkover. The existing highway drainage is assumed to discharge to watercourses at the following locations:

a) The section from Penblewin roundabout to Henllan Lodge appears to drain to a low point approximately 350m to the east of the existing roundabout, with water discharged via an outfall to an existing watercourse to the south (NGR: SN123166), a tributary of the Afon Marlais.

b) The section between Henllan Lodge and the eastern edge of Llanddewi Velfrey (approximately 2km) appears to drain to a low point in Ffynnon Woods, prior to discharge into Longford Brook.

c) Following this, topography indicates the road drainage likely falls across an approximately 350m section of road towards a low point located near Glenfield, which looks likely to drain to the north to a tributary of the Afon Daulan.

d) The following section to the eastern tie in drains to a low point located mid-way between Bethel Cottage and Gwyndy Farm. From here, the highway drains into the adjacent watercourse to the south. Two existing headwalls were encountered at this location on site visits (NGR: SN161169).

[16] National River Flow Archive. Accessed at: www.nrfa.ceh.ac.uk on 28th July 2017.
[17] Natural Resources Wales: River Level Map. Accessed at: https://naturalresources.wales/riverlevels?lang=en on 28th July 2017.

Groundwater

7.9.7 Groundwater features identified in the study area are shown on Volume 2 Figure 7.2 A&B and described in Table 7.6.

Table 7.6 Groundwater features in the study area

Chainage	Feature	Location
0+200	Well at Caermaenau-Fawr	350m to the north of the western end of the Scheme
1+600	Well	10m north of the Scheme alignment
1+630	Well	25m south of Scheme alignment
1+780	Well	90m north of Scheme alignment
2+220	Well at Pentroydin Fawr, registered as a private water supply	70m north of Scheme alignment
3+150	Licensed abstraction (No. 356) at Blaen-Pentroydin from enclosed well	250m south of Scheme alignment
3+660	Four private water supplies; no further details available	150m north of Scheme alignment

7.9.8 The bedrock underlying the Scheme is classified as a Secondary B aquifer and with superficial deposits, present in the valley bottom of Longford Brook.

7.9.9 There are no mapped Source Protection Zones (SPZ) within the study area. Unmapped 50m SPZ1 exist around all potable water supplies.

7.9.10 Groundwater Dependant Terrestrial Ecosystems (GWDTE), defined as wetlands which critically depend on groundwater flows and/or chemistries[18], have not been identified within the study area.

7.9.11 The Scheme would require two significant areas of cutting to the north and east of Llanddewi Velfrey. Springs are marked in these areas, indicating the groundwater is likely to be present at a shallow depth. Groundwater monitoring data was obtained as part of the 2016

[18] Schutten, Verweij, Hall & Scheidleder, 2011. Common Implementation strategy for the Water Framework Directive (2000/60/EC). Technical report No. 6. Technical report on Groundwater Dependent Terrestrial Ecosystems. ISBN: 978-92-79-21692-3

investigation and is presented in the WYG factual report[19] and was assessed to confirm the hydrogeological model for the Scheme area.

7.9.12 Chapter 6 Geology and Soils contains a detailed discussion of the underlying geology and ground conditions of the Scheme.

Water Framework Directive

7.9.13 The study area includes three WFD river water bodies and two WFD groundwater bodies, shown on Volume 2 Figure 7.5 A&B. These are:

a) Taf – Felin Cwrt to Gronw river water body;
b) Longford Brook – Headwaters to confluence with Eastern Cleddau river water body;
c) Marlais – headwaters to confluence with Taf river water body;
d) Tywi, Taf and Gwendraeths groundwater body; and
e) Cleddau and Pembrokeshire groundwater body.

7.9.14 The current status, failing elements and reasons for failure of each of these WFD water bodies is summarised in Table 7.7.

7.9.15 A WFD Protected Area, the Cleddau Rivers SAC, is approximately 5km downstream of the proposed crossing of Longford Brook. The SAC is designated due to the presence of Bullhead, River Lamprey, Brook Lamprey, Otter and Sea Lamprey, along with rare habitats including rivers with floating vegetation often dominated by water-crowfoot, active raised bogs and alder woodlands on floodplains. This chapter considers the potential impacts to the waterbodies' WFD classification and the related quality criteria; potential impacts to the site and associated ecology are addressed in Chapter 8 Ecology and Nature Conservation and the Assessment of the Implications on European Sites (AIES).

7.9.16 A standalone WFD compliance assessment (Volume 3 Appendix 7.1) was completed for the Scheme.

[19] WYG, 2016 (as ref: 49 above)

Table 7.7 Summary of WFD water bodies in the study area. Information relevant for Cycle 2 of the WFD (2015-2021) and obtained from http://waterwatchwales.naturalresourceswales.gov.uk/en/ (Accessed on 11th September 2018).

WFD Waterbody	**Taf -Felin Cwrt to Gronw**	**Longford Brook - HW to confluence with E. Cleddau**	**Marlais - headwaters to confluence with Taf**	**Tywi, Taf and Gwendraeths**	**Cleddau and Pembrokeshire**
ID	GB110060036283	GB110061030680	GB110060029240	GB41002G200500	GB41002G200400
Type of Waterbody	River	River	River	Groundwater	Groundwater
Management Catchment	Carmarthen Bay and the Gower	Cleddau and Pembrokeshire Coastal Rivers	Carmarthen Bay and the Gower	WA South West	WA South West
Area (km^2)	41.42	14.54	26.63	1,947.43	1,115.63
HMWB/AWB?	No	No	No	No	No
Overall Status	Good	Moderate	Moderate	Poor	Poor
Objective	NA	Good by 2021	Good by 2021	Poor by 2015	Good by 2021
Chemical Status	Good	Good	Good	Poor	Poor
Ecological Status (river), Quantitative Status (groundwater)	Good	Moderate	Moderate	Good	Good
Driver of failure to achieve Good status	NA	Fish	Ammonia (Phys-Chem)	Chemical Dependent Surface Water Body Status	Chemical GWDTEs test
Reason for not achieving Good status	NA	Other (not on list)	Unknown	Point source pollution from abandoned mines.	Unknown
Other (including Mitigation Measures)	Dwr Cymru to investigate sources, transport and pathways of microbial pollution to Shellfish Waters as part of AMP 6 NEP programme. NRW to regulate.	Reduce diffuse source pollution at source by controlling or managing diffuse source inputs. Cleddau Rivers SAC at downstream end of catchment.			

Flood Risk

7.9.17 The route of the Scheme is not at risk of flooding from rivers and sea, based on NRW's flood map viewer[20].

7.9.18 Limited areas in the vicinity of watercourse crossings and along the proposed western section with the same alignment as the existing A40 are classified as having a low to medium surface water flood risk[21]. A low risk of surface water flooding equates to a chance of flooding of between 1 in 1000 and 1 in 100 years, whilst a medium risk equates to a chance of between 1 in 100 and 1 in 30 years. These areas are shown on Volume 2 Figure 7.4.

7.9.19 The Western Wales Flood Risk Management Plan and PCC's Flood Risk Management Strategy do not indicate any measures to reduce flood risk in the study area.

7.9.20 All areas of the Scheme route are designated as Zone A on Welsh Government's TAN15 mapping. Areas designated as Zone A are considered to be at little or no risk of fluvial or coastal/tidal flooding.

Accidental Spillage

7.9.21 Records of accidental spillage into the water environment from road accidents have not been identified.

7.9.22 As part of the Initial Traffic and Accident Data Report, an analysis of the Road Traffic Accidents in the area was undertaken to determine if there are any particular accident trends on the road network at or near the proposed Scheme location.

7.9.23 There were a total of 20 accidents recorded within the study area for the five-year period between 2011 and 2015 at various locations along the road. Accident rates along this section of the existing A40 are lower than the average default accident rate for this type of road[22].

[20] NRW Risk of Flooding from Rivers & Sea Map. Accessed at https://naturalresources.wales/our-evidence-and-reports/maps/flood-risk-map/?lang=en on 16th March 2017.
[21] NRW Surface Water Flood Risk Map. Accessed at https://naturalresources.wales/our-evidence-and-reports/maps/flood-risk-map/?lang=en on 16th March 2017.
[22] Arup, Initial Traffic and Accident Data Report, Table 4.9. Produced in September 2017.

Environmental Value of Water Features

7.9.24 Table 7.8 identifies the water features identified in the study and ascribes them a value for the assessment (see Table 7.2 for description of the values)

Table 7.8 Value of Water Features with the potential to be impacted. Features within the study area that have no potential to be impacted (e.g. those which are not hydrologically connected to the Scheme area) are excluded.

Feature Name	Chainage	Value	Justification
Surface Waters			
Pond at SN 12065 16574 (Penblewin Roundabout)	0+000	Low	No hydrological connections or known ecological importance. Included as <100m from Scheme area.
Unnamed tributary of Afon Marlais 2	0+290	Low	Drains to tributary of Afon Marlais (WFD status Moderate). Drain with limited ecological value.
Longford Brook	1+800	Medium	Drains to WFD waterbody of Moderate Status. Designated as SAC downstream and capable of supporting fish species.
Unnamed tributary of Longford Brook 1	2+050	Low	Drains to Longford Brook (Moderate WFD status). Drain with limited ecological value.
Unnamed tributary of Afon Daulan 1	2+640	Low	Drains to Afon Daulan (tributary of Taf - WFD status Good). Drain with limited ecological value.
Unnamed tributary of Afon Daulan 2	2+900	Low	Drains to Afon Daulan (tributary of Taf - WFD status Good). Drain with limited ecological value.
Afon Daulan	3+150	Medium	Drains to Taf (WFD status Good). Capable of supporting fish species.
Unnamed tributary of Afon Daulan 3	3+270	Low	Drains to Afon Daulan (tributary of Taf - WFD status Good). Drain with limited ecological value.
Unnamed tributary of Afon Daulan 4	3+400	Low	Drains to Afon Daulan (tributary of Taf - WFD status Good). Drain with limited ecological value.
Unnamed tributary of Afon Taf 1	3+800	Low	Drains to Afon Taf (WFD status Good). Minor stream with limited ecological value.
Unnamed tributary of Afon Taf 2	3+850	Low	Drains to Afon Taf (WFD status Good). Minor stream with limited ecological value.
Unnamed tributary of Afon Marlais 1	4+250	Low	Drains to tributary of Afon Marlais (WFD status Moderate). Drain with limited ecological value.
Groundwater			
Wells marked on OS mapping	0+200	Medium	Potential use for agricultural water supply.
	1+600		

Feature Name	Chainage	Value	Justification
	1+630 1+780		
Well at Pen-troydin-Fawr	2+220	High	Registered as private water supply.
Licensed abstraction at Blaen-Pen-troydin	3+150	Medium	Potential use for agricultural water supply.
Unnamed private water supplies	3+660	High	Registered as private water supply.
Tywi, Taf and Gwendraeths WFD water body	Eastern portion of route	Medium	Secondary B Aquifer
Cleddau and Pembrokeshire WFD water body	Western portion of route	Medium	Secondary B Aquifer
Flood Risk (water features receiving runoff or being physical modified by the Scheme only)			
Unnamed tributary of Afon Marlais 2	0+290	Low	There are no properties in the vicinity of the proposed culvert.
Longford Brook	1+800	Low	Nearby properties are not located in any flood zones.
Unnamed tributary of Afon Daulan 1	2+640	Low	There are no properties in the vicinity of the proposed culvert.
Unnamed tributary of Afon Daulan 2	2+900	Low	There are no properties in the vicinity of the proposed culvert.
Afon Daulan	3+150	Low	There are no properties in the vicinity of the proposed culvert.
Unnamed tributary of Afon Daulan 3	3+270	Low	There are no properties in the vicinity of the proposed culvert.
Unnamed tributary of Afon Marlais 1	4+250	Low	There are no properties in the vicinity of the proposed outfall.
Groundwater	N/a	Low	There is no history of groundwater flooding along the proposed alignment.

7.10 Mitigation Measures Forming Part of the Scheme Design

7.10.1 The design philosophy of the carriageway drainage includes a series of mitigations to ensure that flood risk in not increased in the vicinity of the Scheme and to ensure that soluble and suspended pollutants in carriageway runoff are reduced to acceptable levels prior to discharge to groundwater or local watercourses. These mitigations are described in the paragraphs below

and key features are shown on the General Arrangement drawings for the Scheme (Volume 3, Appendix 2.6).

7.10.2 Where possible, highway runoff would be infiltrated into the ground using attenuation/ infiltration basins. If infiltration is not possible, surface water runoff would be restricted to the 1-year return period Greenfield Runoff Rate and discharged into a local watercourse.

7.10.3 Attenuation would be provided in basins, sized to accommodate the 1 in 100-year event plus 30% to allow for climate change. This allowance was agreed with PCC.

7.10.4 Where a new drainage system is to be provided, or where an existing drainage network is to connect into the proposed network, the restricted flow would include the 1 in 1-year flow from the existing highway as well as the Greenfield Runoff Rate from the new highway.

7.10.5 Where the Scheme crosses watercourses flows would be maintained within their catchment through culverts where possible. These culverts would be designed to convey flow equivalent to the 100-year event plus 30% allowance for climate change beneath the proposed highway. Where the catchment area draining to the cross-drainage culvert is not readily defined, the minimum culvert diameter would be 1200mm in accordance with the DMRB.

7.10.6 The carriageway drainage would consist of a three-stage treatment train of filter drains, catch-pits and attenuation basins to remove and retain soluble and suspended pollutants to ensure discharges to groundwater or local watercourses are at acceptable levels.

7.10.7 A positive drainage system would be provided for the Scheme which would ensure that there is no surface water flooding for a 1 in 5-year return period event. This design standard is in accordance with DMRB which includes an allowance for climate change.

7.10.8 In cuttings, the surface runoff would be drained to combined surface water/ groundwater filter drains in the verge. Water drained in areas of cutting will be discharged via deep gravity systems.

7.10.9 Cut-off ditches at the top of cuttings and at the bottom of embankments would intercept natural runoff. If the natural topography falls away from the road alignment, cut-off ditches would not generally be provided other than to mitigate local flooding risk.

7.10.10 Any existing land drains encountered would be intercepted and diverted to cut-off ditches.

7.10.11 Attenuation/infiltration basins would be designed to ensure that groundwater would not impede their performance.

7.11 Assessment of Potential Effects

7.11.1 Linear construction projects, such as roads, have the potential to intersect a number of surface and groundwater features and create pollution sources or pathways that are not present under existing conditions.

7.11.2 Potential effects of roads on the water environment can be split into direct or indirect effects and occur as a result or construction, operation or a combination of construction and operation. Typically, these effects are grouped into temporary, short-term construction effects and permanent, long-term operational effects, although short and long-term effects can occur as a result of both construction and operation activities.

7.11.3 The mobilisation of existing contaminants is a potential effect during both construction and operation and is considered in Chapter 6 Geology and Soils.

7.11.4 The impact on designated sites with hydrological linkages are assessed in Chapter 8 Ecology and Nature Conservation.

Potential Effects during Construction

7.11.5 The assessment of the effects on the water environment considers possible changes to the water environment during the construction phase. In line with the DMRB methodology, the significance of the effects would depend on a combination of the potential for pollution and flooding and the sensitivity of the receptor.

Surface Water Quality

7.11.6 The most likely sources of water quality impacts to surface watercourses are:

a) Disturbance of silt/soil generating surface runoff with high sediment concentrations (mobilised suspended solids);

b) Accidental spillage of fuels, oils, chemicals and materials (e.g. concrete, plant fuels/oils, lubricants, hydraulic fluids and floating solids such as litter) resulting in pollution of watercourses and potential impacts on fish and downstream ecological designated features; and

c) Dewatering discharges containing high levels of suspended solids.

7.11.7 These risks of pollution impacts (silt/sediment and spills) are heightened during particular activities located in or near to watercourses or ponds, including but not limited to the construction of various culverts along the proposed route and the embankment in the vicinity of the Afon Daulan crossing.

7.11.8 These areas are most at risk when exposed soil is present, such as shortly before, during and after construction of culverts and embanked areas. Without control measures, the risk of runoff from exposed soil would remain until vegetation is established, which would take generally one growing season.

7.11.9 The risk of surface water flooding causing an uncontrolled release of sediments and/or waters from the surface water management system would be present over the construction sequence. Over much of the construction cycle, the potential for pollutants in these waters are limited to sediments from runoff and hydrocarbons spilled from vehicles, but during higher risk activities (e.g. concrete pouring), these impacts have the potential to be greater.

7.11.10 A common constraint of linear construction projects such as this is the limited area to store and, if needed, treat surface water runoff across the site. A potential impact of insufficient storage capacity is that the surface water management system could be overwhelmed during a rainfall event, causing an uncontrolled release of sediments and/or pollutants to surface watercourses.

7.11.11 The magnitude of these impacts would be moderate adverse and short term in timeframe. For all unnamed surface water features that would receive runoff from the Scheme, the significance of effect would be *slight adverse*, whilst the significance of effect on the Afon Daulan and Longford Brook would be *moderate adverse.*

Geomorphology

7.11.12 Plant trafficking, excavation or construction activities within or near to watercourses have the potential to cause bank failure, erosion or scouring and modification of geomorphological features.

7.11.13 Mobilisation of silts, during excavation, work on the river banks or by surface water runoff from bare areas, could result in washing of sediment into watercourses and cause siltation within any riverbed gravels. Clogging of river gravels by silt would reduce in-stream habitat quality. The effects of siltation could be medium term, as high flows are required to remobilise the silt and flush it downstream.

7.11.14 The potential magnitude of temporary geomorphological impacts is anticipated to be minor adverse, due to the potential impact on the water body WFD quality elements. This is because the impacts on morphological status within the water body are localised and wider impacts would be temporary. The significance of effect would therefore be *neutral* for all unnamed watercourses and *slight/moderate adverse* for the Afon Daulan and Longford Brook.

Groundwater

7.11.15 Sources of potential pollutants to groundwater include spills (e.g. fuel from vehicles/plant) or from water contaminated during specific activities, such as concrete pouring/washing. Potential pathways for these pollutants include direct infiltration at source or in the case of spillages, infiltration from the surface water management system during periods of low flow.

7.11.16 The potential magnitude of the risk of contamination is considered to be minor adverse due to a likely localised and temporary nature of potential impact (subject to good practice being implemented) and when combined with the classification of medium importance, the significance of effect associated with temporary activities is considered to be *slight adverse*.

7.11.17 The potential impact on groundwater quality resulting from land contamination is considered in Chapter 6 Soils and Geology.

7.11.18 Dewatering activities related to the construction of cuttings also have the potential to impact on groundwater. An assessment of this potential is presented in the WFD Compliance Assessment: Appendix B5. This showed a potential impact on the base flow of Unnamed tributary of Afon Daulan 1

at chainage 2+640 (Feature ID 22 on Volume 2 Figure 7.2 A&B) as a result of dewatering works at cutting at chainage 2+720 to 2+950. The potential magnitude of impact is moderate as groundwater recharge into that stream would be reduced, without a significant impact on the wider catchment of the Afon Daulan. Based on the low sensitivity of that watercourse, the significance of effect associated with dewatering works is considered to be *slight adverse*. No potential impacts upon private water supplies were noted.

Flood Risk

7.11.19 During construction, no effects on flood risk are expected provided that where works take place in the vicinity of watercourses, material and plant is stored beyond the areas potentially susceptible to flooding. New or extended culverts will be sufficiently sized to accommodate flood flows, as per Section 7.10.5.

7.11.20 Temporary works to divert watercourses during culvert construction, either by gravity flumes or over pumping will include suitable provisions to pass high flows.

7.11.21 The magnitude of the risk of flooding is negligible and when combined with the low importance (in terms of flood risk) of existing water features, the significance of effect is considered to be *neutral*.

Potential Effects during Operation

7.11.22 This section considers effects on the water environment when the Scheme is in operation. Similar to the assessment for the construction phase, the significance of the effects would depend on a combination of the potential for pollution and flooding as well as the sensitivity of the receptor.

Surface Water Quality

7.11.23 The most likely sources of water quality impacts to surface watercourses from the operation of the scheme are:

a) Pollution associated with routine runoff; and
b) Accidental spillage as a result of a road traffic collision.

7.11.24 The drainage design of the Scheme directs runoff from the carriageway to four attenuation basins prior to discharge into surface waters via four new outfalls. Wherever possible, runoff will be allowed to infiltrate to groundwater ahead of discharge to surface waters. The locations of the

outfalls and receiving water bodies are illustrated in Volume 2 Figure 7.3 and listed in Table 7.9. Water features that will not receive runoff are scoped out of this assessment.

Table 7.9 Discharge locations used for HAWRAT Assessments

Outfall	Chainage	Receiving Watercourse
Basin A	0+400	Unnamed tributary of Afon Marlais 2
Basin B	1+900	Longford Brook
Basin C	2+900	Unnamed tributary of Afon Daulan 1
Basin D	4+250	Unnamed tributary of Afon Marlais 1

7.11.25 Method-A of HD45/09 ('Simple Assessment') was used to assess the operational effects of the road surface runoff from the four proposed outfalls (Volume 2 Figure 7.3). A cumulative assessment of impacts has not been undertaken as the outfalls either discharge to separate waterbodies or are greater than 1km apart. The methodology, inputs and detailed results used in this assessment is presented in the WFD Compliance Assessment: Appendix B1.

7.11.26 The predicted traffic data for the proposed Scheme is 11,241 AADT in 2017 and 13,050 AADT in 2051[3], which is within the lowest range used in the HAWRAT assessment of between 10,000 and 50,000 AADT. On this basis, the assessments carried out for the Scheme are likely to overstate the potential risk to surface water quality.

7.11.27 The surface water quality of the undiluted runoff for all sections on the road fail Step 1 of the assessment because levels of sediment and dissolved metals in the runoff are above the threshold levels set in the HAWRAT model.

7.11.28 At Step 2, the surface water quality passes the HAWRAT assessment at Basin B and for zinc at Basin D but fails on all other counts for both sediment and dissolved metals.

7.11.29 At Step 3, the three stage treatment train included in the proposed drainage design (Section 7.10.6) is added to the assessment as a mitigation. With this included, all discharge locations pass the assessment for soluble pollutants and discharges from Basins B, C and D also pass for sediment but the discharge from Basin A marginally fails.

7.11.30 Following HD45/09, a Method-A assessment is not strictly necessary for discharges from Basins A, C and D as the Q95 of receiving watercourses is

<0.001m^3/s but was undertaken to address a worst case scenario. A Method-C assessment, which considers the impact of infiltration of road runoff to groundwater, is more appropriate. Method-C assessments were carried out for all four discharge locations (Section 7.11.46; WFD Compliance Assessment: Appendix B2) and have all passed at the additional assessment stage.

7.11.31 A long-term impact assessment of surface water runoff from the highway was undertaken (WFD Compliance Assessment: Appendix B1) by comparing the annual average concentrations of copper and zinc predicted in the HAWRAT results with the EQSs stated in the WFD (Standards and Classifications) Directions 2015.

7.11.32 The predicted concentrations are below the EQS thresholds for both copper and zinc at all locations, other than Basin's A and C, where the threshold for copper is exceeded. These failures are discounted as discharges of road runoff at these locations would likely be infiltrating into groundwater rather than entering surface waters, due to the low flow of the watercourses (Q95 < 0.001 m^3/s).

7.11.33 It is therefore considered that the magnitude of impact of sediment and dissolved metals discharging into surface watercourses is negligible with a significance of effect of *neutral*.

7.11.34 Traffic modelling[23] suggests a 96% reduction in traffic along the existing A40 in the village of Llanddewi Velfrey in design year 2035, falling from an estimated 15,430 AADT to 570 AADT. Given that the current drainage network is believed to discharge directly to local watercourses, this reduction in traffic will have a beneficial impact upon the quality of runoff being discharged from the existing highway.

Surface Water Quantity

7.11.35 The operational road drainage in areas of cutting has the potential to cause a localised reduction in surface water catchment area as surface run-off and shallow groundwater is intercepted.

7.11.36 The assessment of potential impact on surface water catchments resulting from the presence of cuttings and associated drainage that may intercept surface water run-off and shallow groundwater flow is presented in the WFD

[23] Arup, A40 Llanddewi Velfrey to Penblewin Improvements, Traffic Forecasting Report, 20135 Forecast Annual Average Daily Traffic Flows High Growth Scenario, November 2017.

Compliance Assessment: Appendix B5. This showed a potential impact on the base flow of a number of features as presented in Table 7.10.

Table 7.10 Identified features potentially impacted by construction of cuttings

ID (Figure 7.2 A&B)	Feature type	Approximate distance to cutting causing potential impact
19 (Unnamed tributary of Longford Brook 2)	Land drain	Cutting at chainage 2+050 to 2+450 60m NE
20 (Unnamed tributary of Longford Brook 1)	Collects (head of a watercourse)	Cutting at chainage 2+050 to 2+450 60m N
26 (Unnamed tributary of Afon Daulan 2)	Collects	Cutting at chainage 2+720 to 2+950 60m NE
36-38 (Unnamed tributary of Afon Daulan 4)	Collects	Cutting at chainage 3+440 to 3+848 130 - 150m N
44 (Tributary of Afon Taf 1)	Spring	Cutting at chainage 3+440 to 3+848 95m N
45 (Tributary of Afon Taf 1)	Collects	Cutting at chainage 3+440 to 3+848 240m NE

7.11.37 The potential magnitude of impact is moderate as surface water run-off recharge into these watercourses would be reduced, without a significant impact on the wider catchments. Based on the low sensitivity of the watercourses, the significance of effect associated with dewatering works is considered to be *slight adverse*.

Geomorphology

7.11.38 Potential impacts to the geomorphology of watercourses result from the installation of new culverts or drainage outfalls.

7.11.39 Three new culverts and two culvert extensions are proposed within the Scheme to enable to the proposed highway to cross existing watercourses, none of which are designated as main rivers. An existing culvert of Longford Brook beneath the existing A40 would remain. The culvert locations are shown in Table 7.11.

Table 7.11 Proposed drainage crossings

Culvert ID (Figure 7.3)	Approximate Culvert Chainage	Watercourse	Solution
Culvert 1	0+290	Unnamed tributary of Afon Marlais 2	Existing culvert to be extended.
Culvert 2	1+800	Longford Brook	Two culverts beneath existing A40 to remain. Western culvert to be extended (length to be determined in final design).
Culvert 3	2+640	Unnamed tributary of Afon Daulan 1	Proposed culvert 1.8m dia.
Culvert 4	3+150	Afon Daulan	Proposed culvert 1.8m dia.
Culvert 5	3+270	Unnamed tributary of Afon Daulan 3	Proposed culvert 1.8m dia.

7.11.40 New/extended culverts are likely to remove natural channel bed, banks and floodplain connectivity and if designed inappropriately, can also cause local scour, prohibit fish passage and impair downstream transport of sediment.

7.11.41 Four new outfalls would be installed to discharge treated carriageway runoff from the drainage system to surface watercourses. The discharges would be limited to the Greenfield Runoff Rate and would be located adjacent to the proposed attenuation basins. The outfalls would be located in the receiving watercourses listed in Table 7.9.

7.11.42 New outfall structures within a watercourse can alter local channel cross section and induce local bank or bed erosion, as well as reduce the available natural bank habitat area.

7.11.43 The effects of these structures on WFD quality elements are discussed in greater detail in the WFD Compliance Assessment, which is appended to this chapter as Volume 3 Appendix 7.1.

7.11.44 The magnitude of impact on features with potential geomorphological impacts (e.g. culverts/outfalls) is considered to be *moderate adverse* where culverts are proposed and *minor adverse* where outfalls are proposed (given the limited extent of modification for an outfall).

7.11.45 For the Afon Daulan, a significant length of culvert is proposed and when combined with its medium importance the significance of potential effect is

moderate adverse. Longford Brook is impacted by a new outfall, which when combined with its medium importance, gives a significance of potential effect of *slight adverse*. For unnamed tributary of Afon Marlais 2 and unnamed tributaries of Afon Daulan 1 & 3, new culverts are proposed, giving a significance of potential effect of *slight adverse*. New outfalls are the only proposed physical modification to unnamed tributary of Afon Daulan 2 and unnamed tributary of Afon Marlais 1, giving a significance of potential effect of *neutral*.

Groundwater

7.11.46 The most likely sources of impacts to groundwater from the operation of the scheme are:

a) Infiltration of road drainage from attenuation basins or at drainage outfalls; and
b) Localised reduction in groundwater level associated with drainage at cutting locations.

7.11.47 The proposed Scheme design is for routine runoff to be discharged from attenuation basins with some infiltration prior to discharge to surface watercourses. The anticipated flow during summer months in the receiving watercourses is likely to have a Q95 <= 0.001 m^3/s and would therefore discharge to groundwater. As a result, the potential impact on groundwater was considered at all attenuation basins (Basins A, B, C and D).

7.11.48 The predicted traffic for the proposed Scheme in 2017 is 11,241 AADT, which is at the lower end of the low risk range (0-50,000 AADT) used in the standard Method-C approach for providing the initial assessment of potential pollution impacts from routine runoff to groundwater. On this basis, the assessments carried out for the Scheme are likely to overstate the potential risk to groundwater quality.

7.11.49 The full Method-C assessments for the potential impacts to the groundwater body and specific receptors are provided in Appendix 7.1 WFD Compliance Assessment: Appendix B2.

7.11.50 The overall risk score for the HD45/09 Method-C assessment for all basins was in a range between 170 and 193. This is within the 150 to 250 suggested action class range. This indicates that based on this initial and generic assessment there is a potential for a ‘medium’ risk of impact as a result of discharge to groundwater from routine runoff at these locations.

7.11.51 In accordance with the HD45/09 Method-C initial and generic assessment, the potential 'medium' risk scenario warrants a higher level of assessment based on site specific data.

7.11.52 The result of the Method C assessment indicates that the hydrogeological situations at Basins A, B, C and D have a potential to present a 'medium' long term risk of impact to the groundwater body.

7.11.53 The HAWRAT modelling undertaken for each of the basin locations derived concentrations of the marker contaminants, copper and zinc.

7.11.54 As detailed in the WFD Compliance Assessment: Appendix B1, only the modelled concentrations of copper for Basin A and Basin C exceed the published EQS. Therefore, the routine runoff discharges may pose a risk to the groundwater contained within the Secondary A aquifer in the bedrock in these locations of discharge.

7.11.55 This risk would not be presented to the entire groundwater body, but rather a localised area around the attenuation basins because of the dilution and degradation behaviour of contaminants in groundwater. Consequently, an additional risk assessment was carried out to understand the extent of the impact. The assessment was undertaken in accordance with the Environment Agency's (England and Wales) Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination (see WFD Compliance Assessment: Appendix B3).

7.11.56 The results of the additional risk assessment demonstrate that the contaminant concentrations resulting from a long-term discharge of surface runoff diminish to the acceptable levels for copper at a distance of approximately 10m from the attenuation basins and outfalls. This is due to the anticipated dilution within the aquifer. Therefore, although the initial assessment indicated a potential 'medium' risk scenario of impact on groundwater, the detailed assessment indicated that the routine run-off discharge may only result in the localised impact limited to the proximity of the attenuation basin or outfall. Therefore, a minor adverse to negligible magnitude of impact is applicable to the wider groundwater body.

7.11.57 The groundwater body beneath the proposed Scheme area is classified as a secondary aquifer, which according to Table A4.3 of HD45/09, has a medium sensitivity in terms of groundwater vulnerability. Consequently, the significance of effect of discharge of routine runoff on the groundwater body is *slight adverse to neutral*. Therefore, no mitigation measures are necessary.

7.11.58 The assessment of potential impact on groundwater resulting from the proposed road drainage intercepting groundwater (i.e. in cuttings), is presented in WFD Compliance Assessment: Appendix B5. This showed a potential impact on the base flow of an unnamed tributary of Afon Daulan at chainage 2+640 (Feature ID 22 on Volume 2 Figure 7.2 A&BA) as a result of drainage intercepting groundwater at chainage 2+720 to 2+950. The potential magnitude of impact is *moderate* as groundwater recharge into that watercourse would be reduced, without a significant impact on the wider catchment of the Afon Daulan. Based on the low sensitivity of that watercourse, the significance of effect associated with the lowering of the groundwater it is considered to be *slight adverse*.

7.11.59 No potential impacts upon private water supplies were identified.

Flood Risk

7.11.60 The operational road drainage and the installation of culverts to cross existing watercourses present potential impacts to the level of flood risk to the wider area and to users of the new highway.

7.11.61 The Scheme is not expected to cause any detriment to fluvial, surface or groundwater flood risk. Additional detail regarding flood risk is included in Volume 3 Appendix 7.2, Flood Risk Note. Appropriate climate change allowances were agreed with PCC and incorporated into the design of the road drainage and culverts. This greater standard of flood protection for the new road over the old road would be a benefit to road users travelling through the area.

7.11.62 The magnitude of effect is therefore considered negligible and the significance of potential effect is *neutral*.

Accidental Spillage

7.11.63 The risk of an accident resulting in a serious pollution incident to surface or groundwaters was assessed for each proposed drainage outfall using the Method-D assessment outlined in the HD45/09 Volume 11, Section 3, Part 10. This assessment was carried out using vehicle numbers from the 2051 AADT flows to account for future growth.

7.11.64 On all roads, there is a risk that an accidental spillage or vehicle fire may lead to an acute pollution incident. It is generally accepted that the pollution risk on any road is linked to the risk of a HGV road traffic accident. Where

a spillage does reach a surface watercourse the pollution effect can be *severe,* but is usually of short duration.

7.11.65 The acceptable risk of a pollution incident is stated in HD45/09. The acceptable risk of pollution reaching a sensitive watercourse or groundwater is: an annual probability of less than 1%; or a return period of 100 years.

7.11.66 Using the HD45/09 assessment method, the risk of spillages was calculated for both the current and proposed situations. The results for 2051 are summarised in Table 7.12. The full assessment is provided in the WFD Compliance Assessment: Appendix B4.

Table 7.12 Spillage probability for design year 2051

Basin	Road Reference	Receiving water body	Spillage probability
A	Penblewin Roundabout	Unnamed tributary of Afon Marlais 2	0.007%
	A40 trunk road	Unnamed tributary of Afon Marlais 2	0.007%
B	A40 trunk road	Longford Brook	0.023%
	A40 Junction to old A40	Longford Brook	0.000%
C	A40 trunk road	Unnamed tributary of Afon Daulan 1	0.008%
	Bethel Chapel Roundabout W	Unnamed tributary of Afon Daulan 1	0.006%
	A40 slip road to Bethel Chapel Roundabout	Unnamed tributary of Afon Daulan 1	0.000%
D	A40 trunk road	Unnamed tributary of Afon Marlais 1	0.003%

7.11.67 The risks of accidental spillages are very low and well within the acceptable limits (i.e. 1%). Based on the spillage assessment, the magnitude of potential impact on surface or groundwaters is considered to be negligible. The significance of effect is therefore *neutral*.

7.12 Additional Mitigation and Monitoring

7.12.1 The following mitigation measures are required to protect water quality and the water environment and are to be included above and alongside the mitigation included in the initial design (Section 7.10).

Construction Mitigation

7.12.2 This section details mitigations required to reduce the significance of effect associated with construction. Measures that are considered as standard good

practice were included in a CEMP that will be implemented by the construction contractor, see Volume 3 Appendix 2.2: Pre-CEMP. Measures that are non-standard or site specific are detailed below and these should be incorporated into the contractor's construction method statement.

7.12.3 The standard measures included in the CEMP are based on the Guidance for Pollution Prevention (GPPs) and the Pollution Prevention Guidelines (PPGs; where they have yet to be replaced by GPPs), which includes the following relevant guidance:

a) GPP 5: Working in or near water;
b) PPG 7: Safe storage – the safe operation of refuelling facilities;
c) GPP 8: Safe storage and disposal of used oils;
d) GPP 13: Vehicle washing and cleaning;
e) PPG 18: Managing fire water and major spillages;
f) GPP 21: Pollution incident response planning;
g) PPG 22: Incident response - dealing with spills; and
h) PPG 26 Safe storage - drums and intermediate bulk containers.

7.12.4 Examples of the standard practice mitigations included in the Pre-CEMP include the provision of spill kits, restricting site traffic to dedicated haul roads and ensuring hard-standing areas are regularly swept and maintained.

7.12.5 Effective delivery of the measures set out here and, in the CEMP, will be monitored during the construction phase, by the Environmental Clerk of Works.

Surface Water Quality

7.12.6 To reduce the significance of effect associated with construction (moderate adverse without mitigation) the following mitigation measures should be implemented.

7.12.7 A surface water management system, using measures such as temporary silt fencing, cut-off ditches, settlement basins and bunds will be set up as early in the construction period as possible to capture all runoff within or traversing the construction corridor. The road drainage will be installed early in the construction period and used for site drainage. It will be designed for no flooding in a 1 in 5-year plus climate change event, with no flooding of the attenuation basins for a 1 in 100 year plus climate change event, which is in accordance with the requirements of the DMRB.

7.12.8 Discharge consenting requirements should be discussed and agreed with NRW prior to any construction works, with the quality of any discharges from the surface water management system monitored on a regular basis. A water quality monitoring programme prior to and during construction works will be agreed with NRW.

7.12.9 Further local measures (e.g. silt fencing / straw bales) to prevent ingress of sediments/contaminants into existing watercourses should be implemented.

7.12.10 Water with a higher risk of contamination, including groundwater pumped out of excavations during concrete pouring, will be contained and treated using appropriate measures such as coagulation of sediments, dewatering and pH neutralisation prior to discharge. There are various proprietary package treatment plants available that can provide these measures. Contaminated water that cannot be treated on site will, if necessary, be pumped to a suitably licenced tanker before being exported off site for treatment at an appropriately permitted facility.

7.12.11 All water pumped from excavations will be pumped via a pipe and gravel sump in order to prevent silt being agitated from the base of the excavation and to provide rudimentary filtration to the water prior to abstraction. For low volume pumping, water will either be pumped into a vegetated area remote from surface water drainage or into a small attenuation lagoon prior to being directed into the drainage system. For high volume pumping ($0.052m^3/s$ or above) water will be passed through an attenuation tank with a capacity of not less than $8m^3$. The outlet from the tank could be placed directly into site drainage, provided the water is free from silt contamination.

7.12.12 Activities such as concrete pouring for foundations and abutments, as well as washout of vehicles/equipment would create water contaminated with concrete. This water should be collected and pumped to an appropriate treatment solution, of water before it is returned to the surface water management system. Treatment may need to include a carbon dioxide adjustment system to neutralise high pH cement laden water and settlement of sediments to remove fines from wash waters. Settlement units use gravity to remove fines and can be combined with coagulants or flocculants to treat higher volumes of water. Any residual material (i.e. solids) from this process should be, where possible, re-used onsite under a Materials Management Plan or otherwise transported to an appropriately licenced waste facility.

7.12.13 Areas of exposed sediment deemed at risk of erosion during heavy rainfall or flood inundation should be protected using either temporary measures

(e.g. sheeting) or semi-permanent measures (e.g. coir matting) until vegetation is able to establish on these surfaces. The use of temporary or semi-permanent measures would vary based on the planned construction in that area. For example, the flood bund, once constructed, should be protected with semi-permanent erosion control until vegetation is established, whilst areas excavated for the haul road/laydown areas may only be exposed for a short period during construction and would therefore only require temporary erosion control.

7.12.14 During works, the Site Manager will regularly check river levels and the three-day weather/flood risk forecasts. Works in or near watercourses should be suspended during out-of-bank river flows and plant moved to a position of safety. Following a flood event any temporary works in watercourses or their floodplains will be checked for integrity prior to commencing works.

7.12.15 The process and procedure for responding to and reporting environmental incidents will be agreed with NRW and included within the CEMP.

Geomorphology

7.12.16 The significance of potential construction effects of the proposed Scheme on geomorphology is considered to be slight/moderate adverse. Mitigation measures should therefore be incorporated and are described below.

7.12.17 The amount of in-channel working should be minimised by using precast structures and working offline wherever possible.

7.12.18 The extent of the ground-works for the embankment crossing the Afon Daulan should be kept to a minimum. Vegetation removal to enable the work should be minimised and existing tree roots left in place wherever possible with no modifications made to the natural bank profile beyond the limits of the embankment.

7.12.19 Bare areas exposed during any works to river banks or by excavation or soil stripping on any floodplains should be protected with temporary measures to ensure no erosion or scouring during flood events prior to the installation of bioengineering and/or establishment of vegetation.

7.12.20 Defined plant trafficking routes should be located away from watercourses to prevent any further modification to in-channel features or loading of the banks which could cause bank failure.

7.12.21 Construction activities affecting the river banks or any in-channel features should be carried out under the supervision of a qualified geomorphologist.

Groundwater

7.12.22 The significance of potential construction effects of the proposed Scheme on groundwater quality and resource is considered to be slight adverse. Provided standard construction practices are followed (as detailed in the Pre-CEMP; Volume 3 Appendix 2.2), no further mitigation measures are proposed.

Flood Risk

7.12.23 The significance of potential construction effects of the proposed Scheme on flood risk is considered to be neutral provided that, where works take place in the vicinity of watercourses, material and plant is stored beyond the areas potentially susceptible to flooding. No further mitigation measures are proposed.

Operational Mitigation

7.12.24 This section identifies mitigation measures where adverse effects due to operation of the proposed Scheme were identified. For this assessment these include impacts on flood risk.

Surface Water Quality

7.12.25 The significance of potential operational effects of the proposed Scheme on surface water quality is considered to be neutral. Therefore, additional mitigation measures are considered unnecessary.

Surface Water Quantity

7.12.26 The significance of potential operational effects of the proposed Scheme on surface water quantity is considered to be slight adverse due to the modification of catchment areas as a result of multiple cuttings along the proposed alignment. The drainage of the cuttings is unable to mimic the natural drainage pathways in local groundwater but given the low importance/sensitivity of the watercourses involved, mitigation measures are considered unnecessary.

Geomorphology

7.12.27 The mitigation measures listed below are considered best practice for the design of outfalls and culverts and should be included for all structures, regardless of the significance of effect and to ensure that WFD objectives can continue to be met.

7.12.28 The design of any new or extended culverts should ensure that:

a) The base of the culvert is set >150mm below the existing bed of the watercourse with structures attached to the base of the culvert (e.g. wooden batons) to retain sediment within the full length of the culvert. This will help to retain habitat connectivity either side of the culvert and promote continued sediment transport downstream;
b) Culvert gradients are such that flow velocities within the culvert are suitable for fish passage across a range of flows; and
c) Any scour protection at the inlet or outlet uses bioengineering methods wherever practicable to maximise habitat potential.

7.12.29 The design of any new outfalls should ensure that:

a) The headwall structure is set back from or flush with the channel profile and does not protrude into the channel;
b) The outfall is angled to direct flow at an angle no greater than 60 degrees from the existing flow direction in the watercourse; and
c) Any scour protection surrounding the outfall headwall uses bioengineering methods wherever practicable to maximise habitat potential.

7.12.30 The design and construction supervision of these mitigation measures will be led by a qualified geomorphologist.

Groundwater

7.12.31 The significance of potential operational effects of the proposed Scheme on groundwater quality and resource is considered to be slight adverse to neutral. No receptors were identified within a 10m radius of the proposed drainage outfalls; therefore, mitigation measures are considered unnecessary.

Accidental Spillage Risk

7.12.32 The significance of potential operational effects of the proposed Scheme from accidental spillage is considered to be neutral. Therefore, mitigation measures are considered unnecessary.

Flood Risk

7.12.33 The significance of potential operational effects of the proposed Scheme from flood risk is considered to be neutral. Therefore, mitigation measures are considered unnecessary.

7.13 Assessment of Residual Effects

Construction Effects

Surface Water Quality

7.13.1 Following the implementation of mitigation measures and the CEMP during construction, the magnitude of any pollution incident is likely to be negligible. Therefore, the significance of effect would be reduced to *neutral*.

Geomorphology

7.13.2 Following the implementation of mitigation measures and the CEMP during construction, the magnitude of any geomorphological impacts is likely to be negligible. Therefore, the significance of effect would be reduced to *neutral*.

Groundwater

7.13.3 Following the implementation of standard practices included in the CEMP, the magnitude of impact to groundwater quality is reduced to negligible, leading to a significance of effect of *neutral*.

7.13.4 The significance of effects to groundwater quantity (levels and flows) remains *slight adverse* as no further mitigation measures were deemed necessary.

Flood Risk

7.13.5 The significance of effects remains *neutral* as no additional mitigation measures were deemed necessary.

Operational Effects

Surface Water Quality

7.13.6 The significance of effects remains *neutral* as additional mitigation measures were deemed unnecessary.

7.13.7 It is considered that the proposed Scheme would not cause a degradation in the status of any WFD surface water bodies in the vicinity of the Scheme and would not prevent them from attaining Good status in the future.

Surface Water Quantity

7.13.8 The significance of effect remains *slight adverse* as additional mitigation measures were deemed unnecessary.

Geomorphology

7.13.9 Following the implementation of mitigation measures to ensure the design of physical modifications retains natural processes and habitat area where possible, the significance of effect at locations where physical modifications are proposed is reduced to:

a) Afon Daulan (culvert) - *slight adverse*;
b) Longford Brook (outfall) - *neutral*;
c) Unnamed tributary of Afon Marlais 2 and unnamed tributaries of Afon Daulan 1 & 3 (culverts) - *neutral*; and
d) Unnamed tributary of Afon Daulan 2 and unnamed tributary of Afon Marlais 1 (outfalls) - *neutral*.

Groundwater

7.13.10 The assessment of effects on groundwater quality without mitigation measures in place concluded that any impacts would be limited to a 10m radius of the point source at each outfall. No receptors were identified within a 10m radius of the proposed outfalls; therefore, no additional mitigation was proposed, and the significance of effects remains *slight adverse to neutral*.

7.13.11 The significance of effects to groundwater quantity (levels and flows) remains *slight adverse* as additional mitigation measures were deemed unnecessary.

7.13.12 It is considered that the proposed Scheme would not cause a degradation in the WFD status of the Cleddau and Pembrokeshire or Twyi, Taf and Gwendraeths groundwater bodies and would not prevent either from attaining Good status in the future.

Flood Risk

7.13.13 The significance of effects remains *neutral* as no additional mitigation measures were deemed necessary.

Accidental Spillage Risk

7.13.14 The significance of effects remains *neutral* as no additional mitigation measures were deemed necessary.

Monitoring

7.12.34 No significant impacts were identified and therefore there is no requirement for future monitoring of the water environment as a result of the Scheme.

7.14 Conclusion

7.14.1 It was concluded that neither the temporary nor the operational impacts of the Scheme would have significant adverse impacts upon the water environment provided the mitigation measures as described above are implemented. Ongoing monitoring is not proposed because no likely significant impacts were identified, and the proposed mitigation measures are plainly established and uncontroversial.

7.14.2 The Scheme would not adversely affect the current status of the various WFD elements of the water bodies in question or prevent these or any other water bodies from reaching Good status (or potential) provided the outlined mitigation measures are implemented.

7.15 Summary

Table 7.13 Summary of construction phase impacts to the water environment (water features only included if potentially impacted by the Scheme)

Feature	Chainage	Sensitivity of receptor	Description of impact	Magnitude of impact without mitigation	Proposed Mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation
Surface Waters							
Pond 7 (SN 12065 16574)	0+000	Low	Degradation of water quality (inc spillage)	Moderate adverse	CEMP, GPP & additional requirements	Negligible	Neutral
Unnamed tributary of Afon Marlais 2	0+290	Low	Degradation of water quality (inc spillage)	Moderate adverse	CEMP, GPP & additional requirements	Negligible	Neutral
			Physical modification	Minor adverse	CEMP and additional requirements	Negligible	Neutral
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral
Longford Brook	1+800	High	Degradation of water quality (inc spillage)	Moderate adverse	CEMP, GPP & additional requirements	Negligible	Neutral
			Physical modification	Minor adverse	CEMP and additional requirements	Negligible	Neutral
		Low	Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral
Unnamed tributary of Afon Daulan 1	2+640	Low	Degradation of water quality (inc spillage)	Moderate adverse	CEMP, GPP & additional requirements	Negligible	Neutral
			Physical modification	Minor adverse	CEMP and additional requirements	Negligible	Neutral

Feature	Chainage	Sensitivity of receptor	Description of impact	Magnitude of impact without mitigation	Proposed Mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral
			Reduction in baseflow as a result of dewatering during construction of cutting from chainage 2+720 to 2+950	Moderate adverse	None required	Moderate adverse	Slight adverse
Unnamed tributary of Afon Daulan 2	2+900	Low	Degradation of water quality (inc spillage)	Moderate adverse	CEMP, GPP & additional requirements	Negligible	Neutral
			Physical modification	Minor adverse	CEMP and additional requirements	Negligible	Neutral
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral
Afon Daulan	3+150	Medium	Degradation of water quality (inc spillage)	Moderate adverse	CEMP, GPP & additional requirements	Negligible	Neutral
			Physical modification	Minor adverse	CEMP and additional requirements	Negligible	Neutral
		Low	Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral
Unnamed tributary of Afon Daulan 3	3+270	Low	Degradation of water quality (inc spillage)	Moderate adverse	CEMP, GPP & additional requirements	Negligible	Neutral
			Physical modification	Minor adverse	CEMP and additional requirements	Negligible	Neutral

Feature	Chainage	Sensitivity of receptor	Description of impact	Magnitude of impact without mitigation	Proposed Mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral
Unnamed tributary of Afon Marlais 1	4+250	Low	Degradation of water quality (inc spillage)	Moderate adverse	CEMP, GPP & additional requirements	Negligible	Neutral
			Physical modification	Minor adverse	CEMP and additional requirements	Negligible	Neutral
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral
Groundwater							
Wells marked on OS mapping	0+200	Medium	Contamination of groundwater (inc spillage)	Minor adverse	CEMP standard practices	Negligible	Neutral
	1+600		Change in groundwater resource due to temporary dewatering	Negligible	None required	Negligible	Neutral
	1+630						
	1+780						
Well at Pen-troydin-Fawr	2+220	High	Contamination of groundwater (inc spillage)	Minor adverse	CEMP standard practices	Negligible	Neutral
			Change in groundwater resource due to temporary dewatering	Negligible	None required	Negligible	Neutral
Licensed abstraction at	3+150	Medium	Contamination of groundwater (inc spillage)	Minor adverse	CEMP standard practices	Negligible	Neutral

Feature	Chainage	Sensitivity of receptor	Description of impact	Magnitude of impact without mitigation	Proposed Mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation
Blaen-Pen-troydin			Change in groundwater resource due to temporary dewatering	Negligible	None required	Negligible	Neutral
Unnamed private water supplies	3+660	High	Contamination of groundwater (inc spillage)	Minor adverse	CEMP standard practices	Negligible	Neutral
			Change in groundwater resource due to temporary dewatering	Negligible	None required	Negligible	Neutral
Groundwater (including WFD groundwater bodies)	Beneath Scheme	Medium	Contamination of groundwater (inc spillage)	Minor adverse	CEMP standard practices	Negligible	Neutral
		Medium	Change in groundwater resource due to temporary dewatering	Negligible	None required	Negligible	Neutral
		Low	Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral

Table 7.14: Summary of operational phase impacts to the water environment (water features only included if potentially impacted by the Scheme)

Feature	Chainage	Sensitivity of receptor	Description of impact	Magnitude of impact without mitigation	Proposed Mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation	Notes/ Comments
Surface Waters								
Pond 7 (SN 1206516574)	0+000	Low	Degradation of water quality from routine road runoff	Negligible	None required	Negligible	Neutral	
			Accidental spillage	Negligible	None required	Negligible	Neutral	
Unnamed tributary of Afon Marlais 2	0+290	Low	Degradation of water quality from routine road runoff	Negligible	None required	Negligible	Neutral	
			Accidental spillage	Negligible	None required	Negligible	Neutral	
			Physical modification	Moderate adverse	Design considerations	Minor adverse	Neutral	New outfall & culvert
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral	
Longford Brook	1+800	High	Degradation of water quality from routine road runoff	Negligible	None required	Negligible	Neutral	
			Accidental spillage	Negligible	None required	Negligible	Neutral	
			Physical modification	Minor adverse	Design considerations	Negligible	Neutral	New outfall
		Low	Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral	

Feature	Chainage	Sensitivity of receptor	Description of impact	Magnitude of impact without mitigation	Proposed Mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation	Notes/ Comments
Unnamed tributary of Longford Brook 1	2+050	Low	Reduction in baseflow	Moderate adverse	None proposed	Moderate adverse	Slight adverse	Result of cutting at chainage 2+050 to 2+450
Unnamed tributary of Afon Daulan 1	2+640	Low	Degradation of water quality from routine road runoff	Negligible	None required	Negligible	Neutral	
			Accidental spillage	Negligible	None required	Negligible	Neutral	
			Physical modification (culvert)	Moderate adverse	Design considerations	Minor adverse	Neutral	New culvert
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral	
Unnamed tributary of Afon Daulan 2	2+900	Low	Degradation of water quality from routine road runoff	Negligible	None required	Negligible	Neutral	
			Accidental spillage	Negligible	None required	Negligible	Neutral	
			Physical modification	Minor adverse	Design considerations	Negligible	Neutral	New outfall
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral	
			Reduction in baseflow	Moderate adverse	None proposed	Moderate adverse	Slight adverse	A result of drainage

Feature	Chainage	Sensitivity of receptor	Description of impact	Magnitude of impact without mitigation	Proposed Mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation	Notes/ Comments
								from cutting at chainage 2+720 to 2+950
Afon Daulan	3+150	Medium	Degradation of water quality from routine road runoff	Negligible	None required	Negligible	Neutral	
			Accidental spillage	Negligible	None required	Negligible	Neutral	
			Physical modification	Moderate adverse	Design considerations	Minor adverse	Slight adverse	New culvert
		Low	Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral	
Unnamed tributary of Afon Daulan 3	3+270	Low	Degradation of water quality from routine road runoff	Negligible	None required	Negligible	Neutral	
			Accidental spillage	Negligible	None required	Negligible	Neutral	
			Physical modification	Moderate adverse	Design considerations	Minor adverse	Neutral	New culvert
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral	
Unnamed tributary of	3+400	Low	Reduction in baseflow	Moderate adverse	None proposed	Moderate adverse	Slight adverse	A result of drainage from cutting at chainage

Feature	Chainage	Sensitivity of receptor	Description of impact	Magnitude of impact without mitigation	Proposed Mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation	Notes/ Comments
Afon Daulan 4								3+440 to 3+848
Unnamed tributary of Afon Marlais 1	4+250	Low	Degradation of water quality from routine road runoff	Negligible	None required	Negligible	Neutral	
			Accidental spillage	Negligible	None required	Negligible	Neutral	
			Physical modification	Minor adverse	Design considerations	Negligible	Neutral	New outfall
			Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral	
Tributary of Afon Taf 1	3+800	Low	Reduction in baseflow	Moderate adverse	None proposed	Moderate adverse	Slight adverse	A result of drainage from cutting at chainage 3+440 to 3+848
Groundwater								
Wells marked on OS mapping	0+200	Medium	Contamination of groundwater (inc spillage)	Negligible	None required	Negligible	Neutral	
	1+600		Change in groundwater resource due to road drainage	Negligible	None required	Negligible	Neutral	
	1+630							
	1+780							

Feature	Chainage	Sensitivity of receptor	Description of impact	Magnitude of impact without mitigation	Proposed Mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation	Notes/ Comments
Well at Pen-troydin-Fawr	2+220	High	Contamination of groundwater (inc spillage)	Negligible	None required	Negligible	Neutral	
			Change in groundwater resource due to road drainage	Negligible	None required	Negligible	Neutral	
Licensed abstraction at Blaen-Pen-troydin	3+150	Medium	Contamination of groundwater (inc spillage)	Negligible	None required	Negligible	Neutral	
			Change in groundwater resource due to road drainage	Negligible	None required	Negligible	Neutral	
Unnamed private water supplies	3+660	High	Contamination of groundwater (inc spillage)	Negligible	None required	Negligible	Neutral	
			Change in groundwater resource due to road drainage	Negligible	None required	Negligible	Neutral	
Groundwater	Beneath Scheme	Medium	Contamination of groundwater	Minor adverse to negligible	None required	Minor adverse to negligible	Slight adverse to neutral	Secondary aquifer
		Medium	Change in groundwater resource due to road drainage	Negligible	None required	Negligible	Neutral	
		Low	Increase in flood risk to surrounding properties	Negligible	None required	Negligible	Neutral	

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 8: Ecology and Nature Conservation

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08/03/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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8.43 2017 Static Bat Activity Monitoring July: Barbastelle Species
8.44 2017 Static Bat Activity Monitoring July: Myotis Species
8.45 2017 Static Bat Activity Monitoring July: Leisler's Bat
8.46 2017 Static Bat Activity Monitoring July: Noctule
8.47 2017 Static Bat Activity Monitoring July: Common Pipistrelle
8.48 2017 Static Bat Activity Monitoring July: Soprano Pipistrelle
8.49 2017 Static Bat Activity Monitoring July: Pipistrelle Species
8.50 2017 Static Bat Activity Monitoring July: Greater Horseshoe Bat
8.51 2017 Static Bat Activity Monitoring August: All Bat Species
8.52 2017 Static Bat Activity Monitoring August: Serotine
8.53 2017 Static Bat Activity Monitoring August: Myotis Species
8.54 2017 Static Bat Activity Monitoring August: Leisler’s Bat
8.55 2017 Static Bat Activity Monitoring August: Noctule Species
8.56 2017 Static Bat Activity Monitoring August: Common Pipistrelle
8.57 2017 Static Bat Activity Monitoring August: Soprano Pipistrelle
8.58 2017 Static Bat Activity Monitoring August: Pipistrelle Species
8.59 2017 Static Bat Activity Monitoring August: Long-Eared Bat Species
8.60 2017 Static Bat Activity Monitoring August: Greater Horseshoe Bat
8.61 2017 Static Bat Activity Monitoring September: All Bat Species
8.62 2017 Static Bat Activity Monitoring September: Barbastelle Species
8.63 2017 Static Bat Activity Monitoring September: Serotine
8.64 2017 Static Bat Activity Monitoring September Myotis Species
8.65 2017 Static Bat Activity Monitoring September: Leisler’s Bat
8.66 2017 Static Bat Activity Monitoring September: Noctule
8.67 2017 Static Bat Activity Monitoring September: Common Pipistrelle
8.68 2017 Static Bat Activity Monitoring September: Soprano Pipistrelle
8.69 2017 Static Bat Activity Monitoring September: Pipistrelle Species
8.70 2017 Static Bat Activity Monitoring September: Greater Horseshoe Bat
8.71 2017 Static Bat Activity Monitoring October: All Bat Species

8.72 2017 Static Bat Activity Monitoring October Myotis Species
8.73 2017 Static Bat Activity Monitoring October Noctule
8.74 2017 Static Bat Activity Monitoring October: Common Pipistrelle
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8.1 Schedule of surveys and weather conditions
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8 Ecology and Nature Conservation

8.1 Introduction

8.1.1 This chapter of the Environmental Statement (ES) assesses the likely effects of the Scheme on ecological resources within the study area and surrounding vicinity.

8.1.2 This chapter documents survey work undertaken in relation to habitats and species, the value of receptors identified and the predicted effects arising from the construction and operation of the Scheme. The chapter also documents measures to mitigate for these effects. Enhancement measures, where deemed necessary in relation to Welsh Government Policies, which go beyond mitigating effects are also identified. The residual effects following the inclusion of these measures are then assessed.

8.1.3 The ecological surveys of the study area were undertaken during 2016 with additional surveys in 2017 to inform this chapter.

8.2 Legislation, Policy Context and Guidance

Legislation

8.2.1 A framework of international, European, national and local legislation and planning policy guidance exists to protect and conserve wildlife and habitats. This is described in the following sections.

Conservation of Habitats and Species Regulations 2017

8.2.2 The Conservation of Habitats and Species Regulations 2017 (the 'Habitats Regulations') transpose the requirements of Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive) into law within England and Wales. These regulations provide for the designation and protection of sites of European importance know as European or Natura 2000 Sites.

8.2.3 European Sites comprise:

a) Special Areas of Conservation (SACs) designated under the Conservation of Habitats and Species Regulations 2017 (as amended) (known as the Habitats Regulations)[1];

b) Special Protection Areas (SPAs) designated under the Wildlife and Countryside Act 1981 (as amended)[2].

8.2.4 The Habitats Regulations require that consideration is given to the implications of plans and projects (developments) on European Sites. Specifically, Regulation 63(1) states:

a) "A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which -

(i) is likely to have a significant effect on a European site or European marine site (either alone or in combination with other plans or projects), and

(ii) is not directly connected with or necessary to the management of that site,

b) must make an appropriate assessment of the implications for that site in view of that site's conservation objectives.".

8.2.5 The formal consideration of effects on European Sites is therefore undertaken by the determining authority, such as Welsh Government, under the Highways Act 1980 (also known as the Competent Authority).

8.2.6 The Habitats Regulations also convey special protection to a number of species which are listed in Schedule 2 of the Regulations and are referred to as European Protected Species (EPS). Those relevant to the Scheme include:

a) All UK resident bat species;

b) Common dormouse (*Muscardinus avellanarius*);

c) Great crested newt (*Triturus cristatus*);

d) Otter (*Lutra lutra*);

e) Marsh fritillary butterfly (*Euphydryas aurinia*).

[1] The Habitats Regulations transposes the requirements on Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora in to UK law.

[2] The Wildlife and Countryside Act 1981 transposes the requirements of Directive 79/409/EEC on the Conservation of Wilde Birds (Birds Directive) in to UK law. The Birds Directive was updated through Directive 2009/147/EC on the Conservation of Wild Birds.

8.2.7 Regulation 43 makes it an offence to:

a) Deliberately capture, injure or kill any wild animal of a EPS;
b) Deliberately disturb wild animals of such a species;
c) Deliberately take or destroy the eggs of such a species;
d) Damage or destroy a breeding site or resting place of such an animal.

8.2.8 Disturbance in the context of the offences above is disturbance which is likely to impair the ability of the animals to survive, to breed or reproduce, to nurture their young, to hibernate, to migrate; or to affect significantly the local distribution and abundance of the species.

8.2.9 Licences can be granted by the relevant Statutory Nature Conservation Organisation (SNCO) for developments (sometime referred to as EPS Licences or Derogation Licences) providing the purposes of the licence is for "preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment".

Ramsar Convention 1971

8.2.10 Wetlands of International Importance (Ramsar Sites) declared under the Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971 are considered European Sites as a matter of UK and Local Government Policy.

Eels (England and Wales) Regulations 2009

8.2.11 This implements Council Regulation (EC No. 1100/2007) of 18 September 2007 establishing measures for the recovery of the stock of European Eel (*Anguilla anguilla*). The Regulation requires Member States to implement a number of short and long-term measures to achieve a target of ensuring that at least 40% of the potential production of adult Eels return to the sea to spawn on an annual basis.

Wildlife and Countryside Act 1981 (as amended)

8.2.12 A network of nationally designated sites was established through the designation of Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act 1981. The protection afforded by the Act means it is an offence to carry out or permit to be carried out any

operation listed within the notification without the consent of the Statutory Nature Conservation Organisation (Natural Resources Wales). The protection afforded to SSSIs is used to underpin the designation of areas at a European Level.

8.2.13 The Wildlife and Countryside Act also places obligations on Welsh Ministers and other public bodies with regard to the conserving and enhancing of the features of SSSIs in the exercise of their functions.

8.2.14 The Wildlife and Countryside Act 1981 provides protection to both EPSs and other species including wild birds, water voles and reptiles.

8.2.15 All wild birds, their nests and eggs are protected, with some rare species afforded extra protection from disturbance during the breeding season (these species are listed in Schedule 1 of the Act). It is illegal to take any wild bird or damage or destroy the nests and eggs of breeding birds. There are certain exceptions to this in respect of wildfowl, game birds and certain species that may cause damage.

8.2.16 Water vole (*Arvicola amphibius*) receive protection under the Wildlife and Countryside Act 1981 which prohibits the killing, injuring or taking by any method.

8.2.17 All native reptile species in the UK are subject to partial protection from intentional or reckless killing or injury only.

8.2.18 The Act also includes provisions for the control of invasive non-native species (INNS). Under these provisions it is an offence to:

a) release or allow to escape into the wild any animal which is not ordinarily resident or a regular visitor to Great Britain, or is included in Schedule 9 of the Act;
b) plant or otherwise cause to grow in the wild any plant which is included in Schedule 9 of the Act.

8.2.19 People undertaking works in proximity to invasive non-native plant species should take all reasonable steps and exercise all due diligence to avoid committing an offence.

National Park and Access to the Countryside Act 1949 (as amended)

8.2.20 Local Nature Reserves can be given protection against damaging operations through powers within the National Parks and Access to the Countryside Act 1949. However, this protection is usually conveyed through inclusion of protection within local planning policy relating to these sites and other non-statutory sites such as Sites of Importance for Nature Conservation.

The Protection of Badgers Act 1992

8.2.21 Badger (*Meles meles*) and their setts are protected under the Protection of Badgers Act 1992 which makes it an offence to kill, injure or take a badger, or interfere with a sett.

Hedgerow Regulations 1997

8.2.22 The Hedgerow Regulations 1997 set out a framework for the protection of hedgerows against removal where they are deemed to be important either due to their age, ecological or archaeological features. Approval is required from the local authority prior to the removal of hedgerows. Local authorities can enforce the retention of Important Hedgerows through the issuing of Retention Notices.

The Environment (Wales) Act 2016

8.2.23 The Environment (Wales) Act 2016 replaces the duties on public bodies in Wales to conserve and enhance biodiversity in the exercise of their functions. This duty includes consideration of the resilience of ecosystems in terms of their diversity, connectivity, adaptability, scale and condition, The Act also reinforces the duties in relation to the lists of species and habitats of importance and the duties to conserve and enhance those species and habitats. Interim lists were published following the introduction of the Act, which are subject to consultation. Within this chapter these are referred to as Section 7 Habitats and Species unless covered under other legal protections.

The Well-being of Future Generations (Wales) Act 2015

8.2.24 The Well-being of Future Generations Act requires public bodies in Wales to consider the long-term impacts of decision on the social, cultural, environmental and economic well-being of both current and future generations.

8.2.25 In particular the Act includes a number of goals including to maintain and enhance a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change.

Wild Mammals (Protection) Act 1996

8.2.26 This Act operates in parallel with the legislation listed above conferring specific protection on rare or threatened mammal species by protecting all wild mammals from any action intended to cause unnecessary suffering.

Policy Context

8.2.27 The Wales Transport Strategy[3] sets out a number of Environmental Outcomes relating to sustainable travel, greenhouse gas emissions, noise and water pollutions, climate change, heritage and biodiversity. The aim of the biodiversity outcome is to "improve the impact of transport on biodiversity", specifically by ensuring that biodiversity is protected or enhanced through the development of transport measures, and that mitigation and enhancement measures are included where significant negative effects are predicted. The effects of existing roads on biodiversity is also considered through the implementation of the Trunk Road Estate Biodiversity Action Plan[4].

8.2.28 The Scheme is listed within the Pembrokeshire County Council Local Development Plan as being a route that will be safeguarded against any developments that would prejudice their implementation.

8.2.29 Planning Policy Wales[5] sets the national policies in relation to development control through the Town and Country Planning Act 1990. This is supported by a series of Technical Advice Notes, of particular relevance is Technical Advice Note 5[6] which sets out the consideration of nature conservation in the determination of planning applications.

United Kingdom Biodiversity Action Plan (UK BAP)

8.2.30 In 1992, the UK signed the Convention on Biological Diversity at the Rio Convention, pledging the UK to develop national strategies for the conservation and sustainable use of biological diversity. The UK

[3] Welsh Government, 2008. The Wales Transport Strategy. Cardiff
[4] Welsh Assembly Government, 2004. Trunk Road Estate Biodiversity Action Plan 2004 – 2014. Cardiff
[5] Welsh Government, 2016. Planning Policy Wales, Edition 9. Cardiff
[6] Welsh Assembly Government, 2009. Technical Advice Note 5: Nature Conservation and Planning. Cardiff

Government subsequently produced 'Biodiversity: The UK Action Plan' in 1994 which described the biological resources of the UK as a whole and in turn led to the production of Biodiversity Action Plans for individual habitats and species.

8.2.31 Biodiversity policy within the UK was revised through the publication of the UK Post-2010 Biodiversity Framework[7] which covers the period from 2011 to 2020. A total of 65 Priority Habitats and 1150 Priority Species were identified as the most in need of protection. Such species and habitats present in Wales were included in the list of species and habitats under Section 7 of the Environment Wales Act.

Trunk Road Estate Biodiversity Action Plan 2004 - 2014 (TREBAP)

8.2.32 The National Assembly for Wales, as Highway Authority for Wales, has direct responsibility for the maintenance, improvement and development of the trunk road and motorway network for Wales. Under the Environment (Wales) Act 2016, the National Assembly for Wales has a duty to have a regard for the conservation of biodiversity in its work. The WG Transport Directorate is already incorporating biodiversity into its work, and the Trunk Road Estate Biodiversity Action Plan (TREBAP) is to contribute to this ongoing process.

8.2.33 There are eleven Habitat Action Plans and seventeen Species Action Plans within the TREBAP. There are also two Generic Action Plans covering Ecological Surveys and Education & Awareness.

Green Corridors on the Welsh Government Trunk Road and Motorway

8.2.34 This initiative in part supersedes the TREBAP and aims for the Trunk Road Network to be managed to provide a range of economic, environmental, social and cultural benefits. The initiative also aims to provide improved journey experiences and local environments through creating and enhancing beautiful, natural landscapes and contributing to a sense of place.

[7] Joint Nature Conservation Committee and Defra on behalf of the Four Countries' Biodiversity Group, 2012. UK Post-2010 Biodiversity Framework. Peterborough

Wales Action Plan for Pollinators (2013)

8.2.35 The 'Action Plan for Pollinators in Wales' recognises that: 'Pollinators are an essential component of our environment. Honey bees and wild pollinators including bumblebees, solitary bees, parasitic wasps, hoverflies, butterflies and moths and some beetles are important pollinators in Wales, for crops such as fruit and oil seed rape, clovers and other nitrogen fixing plants that are important to improving the productivity of pasture systems for livestock grazing, and wild flowers.'

8.2.36 The Welsh Government has worked with industry and stakeholders to look in more detail at the evidence and issues around pollinators and their conservation in Wales. Following consultation, an 'Action Plan for Pollinators in Wales' was launched setting the strategic vision, outcomes and areas for action to halt and reverse pollinator decline in Wales. This plan aims to reduce and reverse the decline in wild and managed pollinator populations, which includes bees, some wasps, butterflies, moths and hoverflies, some beetles and flies. A pollinator task force comprising of key stakeholders is now active and a draft implementation plan is in place.

Pembrokeshire Local Biodiversity Action Plan

8.2.37 The Pembrokeshire Local Biodiversity Action Plan[8] was published by the Pembrokeshire Biodiversity Partnership. It includes 50 Habitat Action Plans and over 200 Species Action Plans relating to the protection of biodiversity within the county.

Relevant Guidance

8.2.38 The main overarching guidance for the assessment of the environmental impacts of road Schemes is contained within Volume 11 of the Design Manual for Road and Bridges (DMRB). Specific guidance in relation to the assessment and reporting of impacts on ecological receptors is provided within Section 3, Part 4[9]. The assessment of the implications of road Schemes on European Designated Sites is set out within Section 4, Part 1[10].

[8] Pembrokeshire Biodiversity Partnership, 2011. A Local Biodiversity Action Plan for Pembrokeshire. Haverfordwest
[9] Highways Agency, 1993. Part 4 Ecology and Nature Conservation. In: Design Manual for Roads and Bridges.
[10] Highways Agency, 2009. HD44/09 Assessment of IMplications (of Highways and/or Road Projects) on European Sites (including Appropriate Assessment) . In: *Design Manual for Roads and Bridges*.

8.2.39 Species specific guidance, including survey methodology and mitigation measures (Environmental design) are mainly contained within DMRB Volume 10 or through Interim Advice Notes. The species-specific guidance from DMRB and other sources used within this chapter includes:

a) HD 44/09 Assessment of Implications (of Highways and/or Roads Projects) on European Sites (Including Appropriate Assessment);
b) HA 59/92 Mitigating Against Effects on Badgers;
c) HA 80/99 Nature Conservation Advice in Relation to Bats;
d) HA 81/99 Nature Conservation Advice in Relation to Otters;
e) HA 97/01 Nature Conservation Advice in Relation to Dormice;
f) HA 98/01 Nature Conservation Advice in Relation to Amphibians;
g) HA 116/05 Nature Conservation Advice in Relation to Reptiles and Roads;
h) The Bat Conservation Trust Good Practice Survey Guidelines (Collins, 2016).

8.3 Study Area

8.3.1 The study area for ecological field surveys included all land within 250m of the centre line of the TR111[11] Route as shown on Volume 2 Figure 8.1. Various search buffers were used within the desk study as set out in Section 8.4 below.

8.4 Methodology

8.4.1 The baseline ecological information for the Scheme was collated through a combination of a desk study, botanical surveys and species-specific surveys. The methodology for establishing baseline conditions is set out in the following sections.

8.4.2 Surveys during 2016 were undertaken by Mott MacDonald Limited and were overseen and coordinated by Joanne Bates (MCIEEM, CEnv) who has over 13 years' experience as a professional ecologist. The surveys were undertaken by qualified professional ecologists, considered to be competent in terms of their knowledge and experience to lead surveys for that particular species or habitat group.

[11] The TR111 route was announced (February 2010) by Welsh Government as their preferred option and is safeguarded in planning policy by Pembrokeshire County Council

8.4.3 Surveys during 2017 were undertaken by Ove Arup & Partners Limited (Arup) and their sub-consultants. These surveys were overseen and coordinated by Pete Wells (MCIEEM, CEnv) who has over 17 years' experience as a professional ecologist, who also authored this chapter.

8.4.4 Survey work was undertaken by a number of qualified professional ecologists employed by Arup along with employees of various sub-consultancies. Sub-consultants used are set out in the methodology sections below.

8.4.5 For the surveys undertaken by Arup and Mott MacDonald Limited, surveyors were assessed as being competent in terms of their knowledge and experience to lead surveys for that particular species or habitat group. In some cases, assistants were used who may not have been classed as competent under the CIEEM competency framework, however on these occasions, the second person was solely present to ensure compliance with Health and Safety procedures and was not undertaking the survey.

Desk study

8.4.6 An ecological desk study for the Scheme was undertaken in 2016. A biodiversity information request was submitted to the West Wales Biological Information Centre (WWBIC). The Multi-Agency Geographic Information for the Countryside (MAGIC) website and the Countryside Council for Wales Protected Sites and Landscapes Map[12] were reviewed for information on internationally and nationally designated sites of nature conservation importance. Information was also sought from the LANDMAP website in terms of the landscape habitats present in 2017.

8.4.7 In accordance with the relevant guidance, the ecology desk study area for the Scheme extends 10km for internationally designated sites (except for SACs designated for bat species where a 30km buffer was used in accordance with HD44/09), 2km for nationally designated SSSIs and 1km for locally designated non-statutory sites, such as Sites of Importance for Nature Conservation (SINCs).

[12] Please note that this information was transposed to the Natural Resources Wales website following the amalgamation of the Countryside Council for Wales, the Environment Agency Wales and Forestry Commission Wales in 2013.

8.4.8 For legally protected species the desk study area extends for 5km around the centre line of the Scheme and 1km for other species of conservation concern using the records supplied by WWBIC.

Extended Phase 1 Habitat Survey

8.4.9 An extended Phase 1 Habitat Survey was undertaken broadly in accordance with the guidance set out in Guidelines for Baseline Ecological Assessment[13], as part of the Preliminary Ecological Appraisal, by Mott MacDonald. This survey was undertaken in February 2016. Although outside of the optimal survey season the information from this survey was updated following observations made during other surveys undertaken during 2016 and 2017. A schedule of survey dates and weather conditions is provided in Volume 3 Appendix 8.1.

8.4.10 A Phase 1 habitat survey[14] is a standard technique for rapidly obtaining baseline ecological information over a large area of land. It is primarily a mapping technique and uses a standard set of habitat definitions for classifying areas of land on the basis of the vegetation present. The extended survey also provided an assessment of the potential for those habitats present to support legally protected species and species of principal importance for the conservation of biological diversity (known as Section 7 Species).

8.4.11 Incidental records of flora and fauna were also made during the survey, in the form of Target Notes.

National Vegetation Classification (NVC)

8.4.12 A NVC survey was undertaken on 19th August 2016 of two grassland and two woodland areas (shown on Volume 2 Figure 8.2 NVC Survey Locations, of Volume 2) identified during the extended Phase 1 survey. The objective of the survey was to map and describe the plant communities within the survey areas in terms of the NVC communities published by the Joint Nature Conservation Committee (JNCC)[15]

8.4.13 The survey was undertaken by an experienced botanist, which involved a walk-through method, supplemented by the use of quadrat sampling.

[13] Institute of Environmental Assessment, 1995. Guidelines for Baseline Ecological Assessment
[14] Joint Nature Conservancy Council, 2010. Handbook for Phase 1 Habitat Survey - a technique for environmental audit. Peterborough
[15] Rodwell, J. S. ed., Various (1991 - 2000). British Plant Communities. Peterborough

A plant species list was compiled for each vegetation type, and the broad characteristics of the habitat described. Each stand of vegetation was then examined in greater detail to describe it in terms of the plant communities present.

Hedgerows

8.4.14 All hedgerows within the study area were assessed to determine their ecological 'importance' with respect of Part II of Schedule 1 of the Hedgerow Regulations 1997. Hedgerow surveys were undertaken in May 2016.

Invasive species

8.4.15 As part of the Phase 1 Survey, the locations of invasive plant species included on Part II of Schedule 9 of the Wildlife and Countryside Act 1981 were mapped. During the course of other surveys, additional stands of invasive plants species were noted and recorded.

Amphibians

8.4.16 Ten ponds were identified within the study area during the extended Phase 1 Habitat Survey that were considered suitable to support great crested newts (*Triturus cristatus*). The location of ponds is shown on Volume 2 Figure 8.3.

8.4.17 Samples of water were taken from each of the ponds present within the Study Area in 2016 and sent for analysis for the presence of DNA of great crested newts. The testing of water samples for eDNA was shown to be a viable method for establishing the potential presence of great crested newts[16].

8.4.18 Following the positive eDNA test result for Pond 1, a limited presence absence survey was undertaken in May and June 2016, comprising three survey visits due to access restrictions. These surveys involved a combination of bottle trapping, torch surveys and egg searching.

8.4.19 The survey undertaken in 2016 recorded probable great crested newt eggs. However as this was not a complete presence/absence survey and did not include enough visits to determine the population size class

[16] Biggs, J. et al., 2014. *Analytical and methodological development for improved surveillance of the Great Crested Newt,* Oxford: Freshwater Habitats Trust.

(which would be required for any European Protected Species (EPS) Licence application) further surveys were undertaken in 2017. All suitable ponds were subject to presence/absence surveys for amphibians including all species of newts, frog and toad during 2017. These surveys were undertaken following the methodology for great crested newt presence/absence surveys[17] involving a combination of bottle trapping, torch surveys, netting and egg searching.

Bat Surveys

Roost Surveys

8.4.20 During the extended Phase 1 Habitat Survey undertaken 2016, an initial assessment was made of the potential for trees and buildings within the study area to support bat roosts. This bat assessment was undertaken in accordance with the guidance set out in the Bat Conservation Trust (BCT) Good Practice Guidelines[18].

8.4.21 Trees within the study area were assessed for the presence of natural holes, woodpecker holes, cracks and splits, loose bark and cavities. The presence of such features were considered in determining the potential for bat roosts to be present and assigning trees to four categories of potential: low, moderate, high, and Negligible, as recommended by the BCT Guidelines.

8.4.22 Buildings within the study area were also assessed for their potential to support bat roosts based on the presence of potential roost access points. Buildings were also categorised as high, medium or low potential in accordance with the guidelines.

8.4.23 Following the initial assessment of trees, an aerial inspection was carried out on trees which had potential roost features identified from the ground. This inspection was undertaken by a licensed bat ecologist and tree climber using a video scope during June and September 2016.

8.4.24 Emergence and re-entry surveys were undertaken on buildings within the study area during August and September 2016. As the surveys undertaken in September were outside of the optimum period to identify maternity roosts, further emergence and re-entry surveys were undertaken in July and August 2017 in accordance with the guidelines.

[17] English Nature, 2001. Great Crested Newt Mitigation Guidelines. Peterborough
[18] Collins, J., ed., 2016. Bat Surveys for Professional Ecologists: Good Practice Guidelines. 3rd ed. London: Bat Conservation Trust.

These 2017 surveys were undertaken by Thomson Ecology and included all buildings and trees within 50m of the Tender Alignment. A schedule of all the emergence and re-entry surveys is included in Volume 3 Appendix 8.1 and the locations are shown on Volume 2 Figure 8.4.

Bat Activity Transect Surveys

8.4.25 Walked transect surveys were undertaken to record bat activity and behaviour within the study area. Two surveyors undertook each transect using a Batlogger M bat detector.

8.4.26 Transect survey work was undertaken twice per month from April to October 2016 where access permitted, in line with the BCT Guidance. The transect routes are shown on Volume 2 Figure 8.5.

8.4.27 Each transect commenced at the time of sunset and continued for at least two hours targeting areas of potential foraging and commuting habitat. Approximately half of the surveys were also repeated at dawn, commencing two hours prior to sunrise.

8.4.28 Species identification was undertaken following the transects using AnalookW software to analyse bat calls.

8.4.29 Bat registrations from the detectors were plotted with points labelled with the time of the registration. A heat map showing the relative density of bat registrations across all of the transect surveys was produced to identify important foraging areas.

Static Bat Activity Monitoring

8.4.30 In addition to the walked transects, static bat detectors were used to record bat activity over a five-night period each month from April to October 2016 where access permitted. The locations used for these surveys were changed to provide a wide coverage of species abundance and diversity within the wider study area.

8.4.31 Following the appointment of the contractor team in 2017, further static activity surveys were undertaken to target specific areas along the proposed alignment to identify specific mitigation requirements. These were undertaken each month from June to October 2017. The locations used for the Static Activity Monitoring during 2016 and 2017 are shown on Volume 2 Figure 8.6.

8.4.32 During 2016, Anabat Express detectors were used for the surveys. Files recorded by the Anabat detectors were analysed using AnalookW software.

8.4.33 In 2017, Arup undertook the surveys using Wildlife Acoustic Song Meter 2 Ultrasonic Bat Detectors (SM2+ BAT) with SMX-U1 microphones for five consecutive nights each month.

8.4.34 The microphones used with the detectors during the course of the surveys were regularly checked and calibrated to ensure that they were functioning properly. Microphones which did not show a significant response to the output of the calibration unit were replaced.

8.4.35 The files from the Wildlife Acoustics detectors were downloaded and processed using Kaleidoscope Pro Software. The processing also included the automatic identification of bat species based on the classifiers developed by Wildlife Acoustics (Bats of Europe 4.3.0).

8.4.36 The files produced by the processing were then reviewed to ensure correct identification of species and to identify where possible the bat species for any calls which could not be recognised by the software. All calls identified as being either common pipistrelle (*Pipistrellus pipistrellus*) or soprano pipistrelle (*P. pygmaeus*) were not reviewed except where high levels of insect noise had been recorded leading to uncertainty over the accuracy of identification. All other calls were checked by Pete Wells, a bat specialist with over 25 years of experience in bat work and holder of significant experience in analysing bat calls for road Schemes and other developments.

8.4.37 The number of files (sound clips) recorded by the detectors each night was taken as a proxy value to the number of bat passes. The nightly average of files was used to allow comparison of the levels of activity across different seasons without being influenced by the number of hours of darkness when bats may be active.

8.4.38 This was then used to calculate a Bat Activity Index (BAI) for each species at each location during each session. The BAI was calculated on the first five nights recorded each month. In some cases, the detector also recorded data on additional nights. These additional nights were excluded from the BAI as it could not be certain that the detector had recorded data for the entire night. However, where rarer or more notable species were recorded on these additional nights, they were

included to ensure their representation within the data in terms of species diversity.

8.4.39 The BAI levels recorded were compared to the results of previous surveys undertaken by Arup to determine the likely importance of the activity recorded. This was done for common and soprano pipistrelle bats along with all species combined. The thresholds used to determine the different levels of activity are shown in Table 8 1 below and were determined as follows:

a) Very low – BAI values below the 25th percentile of accumulated data;
b) Low – between the 25th and 50th percentiles;
c) Medium – between the 50th and 66th percentiles;
d) High – between the 66th and 90th percentiles;
e) Very high – values above the 90th percentile.

8.4.40 Other species have not been recorded on sufficient number of previous occasions to enable statistical analysis and therefore such comparisons cannot be made.

Table 8.1 Categorisation of Bat Activity Levels

	All Species Combined		**Myotis**		**Common pipistrelle**		**Soprano pipistrelle**		**Noctule**	
	lower value	upper value	lower value	upper value	lower value	upper value	lower value	upper value	lower value	upper value
Very low	0	10	0	0	0	10	0	1.6	Not used	
Low	10	66.9	0	1	10	47.2	1.6	7.1	0	0.6
Medium	66.9	119	1	2	47.2	77	7.1	20.324	0.6	1.27
High	119.32	347	2	12	76.98	243	20.32	102.32	1.27	7.4
Very high	347.14		11.58		243.4		102.32		7.4	

Crossing Point Survey

8.4.41 Following the identification of calls from greater horseshoe bats (*Rhinolophus ferrumequinum*) on a detector at canopy height alongside the existing A40 in Ffynnon Wood during the July and August 2017 activity surveys and that of a lesser horseshoe (*Rhinolophus hipposideros*) in June 2017, a crossing point survey was undertaken on 18 September 2017. This survey was undertaken to determine if any key points within the section where plantation woodland is present either side of the road, were used by bats to cross the road. Similar surveys were not required at other locations as the location of crossing points could be identified where hedgerows and other linear corridors meet the road corridor.

8.4.42 The survey was undertaken using a four-camera infra-red CCTV system for approximately four hours from sunset. The cameras were trained on three places where the tree canopy extends out over the road creating narrower gaps where bats are likely to cross the existing road. Two surveyors were present monitoring bat activity in the area and noting potential activity recorded by the cameras. Following the survey, the footage from the cameras was reviewed to confirm activity.

Dormice Surveys

8.4.43 1450 dormouse nest tubes were erected in areas of suitable habitat within the Study Area as shown on Volume 2 Figure 8.7. These were installed in April and May 2016, where access permitted. The tubes were checked on three occasions in May/June, September and November, although access restrictions prevented some areas from being checked each time.

8.4.44 Following comments received from Natural Resources Wales (as documented in Table 8.4), further consideration of dormouse was undertaken in the form of a habitat suitability assessment and nut searching. This assessment was carried out by an experienced ecologist and dormouse survey licence holder and entailed the consideration of habitats present in terms of species composition and connectivity. Searches for characteristically chewed hazel nuts were also undertaken where fruiting hazel was found to be present during the assessment.

Otter Surveys

8.4.45 The water bodies within the Study Area were searched on two occasions during 2016 (as outlined in Volume 3 Appendix 8.1) by experienced ecologists for signs of activity and potential resting places which could potentially be used by otter. The survey was undertaken in accordance with authoritative sources[19,20,21]. The extent of the sections of water bodies surveyed are shown on Volume 2 Figure 8.8.

Water vole

8.4.46 The water bodies within the Study Area were searched on two occasions during 2016 by experienced ecologists for field signs of water voles. These surveys were undertaken in July and September 2016. The survey method for water voles was undertaken in accordance with best practice survey guidelines in the Water Vole Conservation Handbook[22] with the methodology reviewed following the publication of the Water Vole Mitigation Handbook[23].

Badger

8.4.47 The badger survey was undertaken in April 2016 for the whole of the study area. Surveys included a search for characteristic field signs (faeces, setts, paths, scratching posts, snuffle holes, day nests, hair traces, footprints and latrines). Where setts were identified, these were classified in terms of their type and level of activity in reference to available guidance[24].

8.4.48 A further survey was undertaken in October 2017 to confirm the location and type of setts within the corridor 50m either side of the Scheme design.

[19] Chanin, P., 2003. *Ecology of the European Otter. Conserving Nature 2000 Rivers, Ecology Series No 10.* s.l.:EN, CCW, EA, SEPA, SNH & SNIFFER.
[20] Crawford, 2003. *Forth Otter Survey of England 2000 - 2002.* Environment Agency.
[21] Strachan , R. & Jefferies, D. J., 1996. *Otter Survey of England 1991-1994: A report on the decline and recovery of otter in England and on its distribution, status and conservation.*
[22] Strachan, M., Moorhouse, T. & Gelling, M., 2011. *Water Vole Conservation Handbook.* 3rd ed. Oxford.
[23] Dean, Strachan, R., Gow, D. & Andrews, 2016. *The Water Vole Mitigation Handbook.* London: Mammal Society.
[24] Harris, S., Cresswell, P. & Jefferies, D., 1989. Surveying Badgers.

Breeding birds

8.4.49 The survey methods were derived from current best practice as described in Bird Census Techniques[25] and Bird Monitoring Methods[26], and conform to the recommendations of the Royal Society for the Protection of Birds (RSPB), British Trust for Ornithology (BTO) and the Joint Nature Conservation Committee (JNCC). Surveys consist of walking a predefined transect route in all accessible habitat types, as described within the Breeding Bird Survey methodology contained within the above references.

8.4.50 All breeding bird surveys were carried out by teams of two surveyors, with at least one experienced in undertaking ornithological survey work. The transect was walked at a slow pace, pausing briefly at intervals to listen for song and to scan for birds flying overhead or taking flight from the surrounding area.

8.4.51 All birds seen and heard were mapped in accordance with the BTO standard activity recording codes.

8.4.52 The transects were surveyed on three occasions where access permitted between April and June 2016. Additional surveys were undertaken in July where access had prevented surveys in earlier months. The transect route was walked in the morning, between dawn and 10am, when levels of avian activity (particularly singing) are likely to be at their highest. On one of the three visits, the route was walked in the opposite direction to the previous visit, to balance any temporal variation in behaviour levels.

8.4.53 Birds were considered to be breeding if any of the following applied:

a) Birds heard singing within areas of habitat suitable for that species to breed in;
b) Birds exhibiting territorial behaviour e.g. displaying or prolonged agitation;
c) Birds seen carrying food, nest material or the faecal sacs of young; or
d) Nests, eggs and/or young found to be present.

[25] Bibby, C. J., Burgess, N. D., Hill, D. & Mustoe, S., 2000. *Bird Census Techniques.* Second ed. RSPB, BTO, Birdlife International, Ecoscope Applied Ecologists.
[26] Gilbert, G., Gibbons, D. W. & Evans, J., 1998. *Bird Monitoring Methods - a manual of techniques for key UK species.* Sandy: Royal Society the Protection of Birds.

8.4.54 Where breeding signs were recorded, it was assumed that a 'breeding pair' were present and this term is used from this point forward within this chapter.

8.4.55 A barn owl survey was undertaken following the methodology outlined in Barn Owl Tyto alba Survey Methodology and Techniques for use in Ecological Assessment[27]. The survey encompassed both Stage 1 – Onsite Scoping and Stage 2 – Investigative Field Survey components. The surveys were undertaken by an experienced ornithologist during July 2016.

Reptile Surveys

8.4.56 The methodology used in this survey followed standard guidance for reptile surveys[28]. The methodology involved the placement of artificial refugia within suitable areas of habitat for reptiles. The refugia used during the survey were made from rectangles of roofing felt measuring approximately 1m x 0.5m with a placement density of approximately 5-10 refuges per hectare within areas of suitable habitat. Areas of suitable reptile habitat were targeted for survey and included south facing slopes, areas of short vegetation close to scrub and suitable hibernation habitat including rubble/wood piles and mounds of crushed aggregate where present.

8.4.57 1092 reptile refugia were placed in areas of suitable habitat within the Study Area as shown on Volume 2 Figure 8.9. Where access permitted, these refugia were checked at least five occasions during the period from June to September 2016, with areas where reptiles had been recorded being checked up to ten times. Further details of the limitations are provided below.

8.4.58 The artificial refugia were checked during early to late morning and/or early afternoon with a starting air temperature of between 13°C until a maximum of 19°C. The weather conditions for each survey visit are provided in Volume 3 Appendix 8.1.

8.4.59 In addition, any pre-existing suitable artificial or natural refugia on site were also checked as part of the survey. Each refuge was lifted carefully to search for reptile species and, where feasible, details of the reptile

[27] Shawyer, 2012. Barn Owl Tyto alba Survey Methodology and Techniques for use in Ecological Assessment: Developing Best Practice in Survey and Reporting. CIEEM, London.
[28] Froglife, 1999. Froglife Advice Sheet 10: Reptile Survey. London

species, sex, age class and condition of the reptiles encountered were recorded. Once the reptiles had been allowed to escape, the refugia were replaced.

8.4.60 Additional signs of reptile presence such as sloughed skins were also recorded where evident and any live animals observed away from refugia were also recorded.

Other Species Groups

8.4.61 The Preliminary Ecological Appraisal made various recommendations with regards to other species and species groups. These included the conclusions that no surveys were required for invertebrate species, wintering birds, or mammal species such as hedgehog (*Erinaceus europaeus*) and polecat (*Mustela putorius*). It has therefore been decided to assume that commonly occurring Section 7 mammal species and common assemblages of invertebrates and wintering birds are present within the Study Area.

Methodology for Assessment of Impacts

8.4.62 The assessment of impacts from construction and operation has followed the same methodology which is set out in the Guidelines for Ecological Impact Assessment in the UK and Ireland[29]. This represents the industry standard and provides the information required by the relevant sections of DMRB.

Zone of impact for ecological features

8.4.63 All plant and animal species, habitats and integrated plant and animal communities that occur within the 'zone of impact' of the Scheme are defined as potential 'ecological receptors'. The zone of impact for ecological features varies, depending on the nature and behaviour of the receptors, and also the type of impact that may affect them. In this chapter, the assessment of individual receptors is considered for the whole of the site and in addition, the distances from the site boundary listed in Table 8.2 below.

[29] Chartered Institute of Ecology and Environmental Management, 2016. Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. Winchester.

Table 8.2 Maximum Zone of Impact from Scheme Boundary for Ecological Features

Ecological feature	**Maximum zone of impact from the site boundary**
Internationally designated sites, e.g. Special Areas of Conservation (SACs)	10km (30km for sites designated for bats)
Nationally designated sites, including Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs)	2km
Locally designated sites - Local Nature Reserves (LNRs) and Site of Importance for Nature Conservation (SINCs)	1km
Fauna including amphibians, reptiles, mammals (excluding bats), birds and invertebrates.	2km
Bat species	5km (except where features of European Sites)

8.4.64 The maximum zone of impact for international sites was established at 10km due to potential hydrological impacts with the exception of effects on mobile bat populations where a 30km zone was used.

8.4.65 The zone of impact for nationally designated sites was considered to be 2km due to their importance and the inclusions of mobile species and hydrological connections which may give rise to affects.

8.4.66 For locally designated non-statutory sites, 1km was chosen as a maximum zone of impact given the non-statutory nature of their designation and the fact that these sites are generally designated for their habitat value rather than species which could be impacted upon over a larger area e.g. bats.

8.4.67 For fauna, it is largely the behaviour of species, including movement in the landscape combined with the nature of the development, which determines the 2km maximum zone of impact with the exception of bats where 5km was used to reflect the importance of foraging habitats within this distance of roosts.

8.4.68 The CIEEM guidelines[30] recommend that the value of ecological receptors or features is determined based on a geographic frame of

[30] Chartered Institute of Ecology and Environmental Management, 2016. Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. Winchester.

reference. For this assessment, the following geographic frame of reference is used:

a) International;
b) National (i.e. UK);
c) Regional (i.e. West Wales);
d) County;
e) Local (i.e. within circa 5km); and
f) Less than Local (i.e. within the context of the site and immediate vicinity).

Valuing habitat and species

8.4.69 In accordance with the CIEEM guidelines, in assigning a level of value to each habitat or species considered in the assessment, it is necessary to consider its distribution and status, including a consideration of trends based on available historic records. Rarity (including inclusion of lists of species of conservation importance, such as Red Data Lists, Birds of Conservation Concern, Biodiversity Action Plans and Lists of Habitats and Species of Principal Importance for the Conservation of Biodiversity (Section 7 Habitats and Species)) is an important consideration because of its relationship with threat and vulnerability; although since some species are inherently rare, it is necessary to consider rarity in the context of status. A habitat or species that is rare or declining should be assigned a greater level of importance than one that is rare but known to have a stable distribution or population.

8.4.70 Reference is also made to the biodiversity action plans listed in Section 8.2 above. The presence of a habitat or species on these lists reflects the fact that it is in a sub-optimal state; however, it does not necessarily imply any specific level of importance.

Predicting and characterising ecological impacts

8.4.71 In accordance with CIEEM guidelines[31], when describing impacts, reference is made to the following:

a) Magnitude - i.e. the size of an impact in quantitative terms where possible;
b) Extent - i.e. the area over which an impact occurs;
c) Duration - i.e. the time for which an impact is expected to last;

[31] CIEEM, 2016. Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. Winchester: Chartered Institute of Ecology and Environmental Management.

d) Reversibility - i.e. a permanent impact is one that is irreversible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it. A temporary impact is one from which a spontaneous recovery is possible; and

e) Timing and frequency - i.e. whether impacts occur during critical life stages or seasons and how often impacts occur.

8.4.72 Both direct and indirect impacts were considered: direct ecological impacts are changes that are directly attributable to a defined action, e.g. the physical loss of habitat occupied by a species during the construction process. Indirect ecological impacts are attributable to an action, but which affect ecological resources through impacts on an intermediary ecosystem, process or receptor, e.g. a pollution event reducing the food source for a species such as otter or water vole.

8.4.73 The integrity of a site is defined within the TAN5[32] as: '*...the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified*'.

Significance criteria

8.4.74 In accordance with the CIEEM guidelines, a significant impact, in ecological terms, is defined as 'an impact (whether negative or positive) on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographical area, including cumulative and in-combination impacts'. It is important to note however that in accordance with the CIEEM guidelines, the actual determination of whether an impact is ecologically significant is made irrespective of the value of the receptor in question. In this respect, the CIEEM methodology differs from some other EIA approaches.

8.4.75 The value of a feature that would be significantly affected is used to determine the geographical scale at which the impact is significant, e.g. an ecologically significant impact on a feature of county importance will be considered to represent a significant impact at a county level. This in turn is used to determine the implications in terms of legislation, policy and /or development management.

8.4.76 Any significant impacts remaining after mitigation (the residual impacts), together with an assessment of the likelihood of success of

[32] Welsh Assembly Government, 2009. Technical Advice Note 5: Nature Conservation and Planning. Cardiff

the mitigation, are the factors to be considered against legislation, policy and development management in determining the Scheme.

Mitigation and Enhancement

8.4.77 It is important as part of any environmental impact assessment, wherever possible, to clearly differentiate between mitigation and enhancement. These terms are used in this assessment as follows:

a) Mitigation is used to refer to measures to avoid, reduce or remedy a specific negative impact in situ; and

b) Enhancement is used to refer to measures that would result in positive ecological impacts but which do not relate to specific significant negative impacts or where measures are required to ensure legal compliance.

Cumulative Effects

8.4.78 The cumulative effects of the Scheme with other develops are set out in the Chapters 19 to 21 of this Environmental Statement.

Consultation

8.4.79 Key statutory environmental stakeholders in terms of ecology include:

a) Natural Resources Wales;

b) Pembrokeshire County Council; and

c) South Wales Trunk Road Agent.

8.4.80 Meetings were held with Natural Resources Wales (NRW) during 2016 in relation to the extent of the Study Area. Ecological issues were also discussed within the Environmental Liaison Group meetings.

8.4.81 A Scoping Report for the Environmental Impact Assessment was shared with the Environmental Stakeholders. The comments received relating to ecology are provided in Table 8.3 below.

Table 8.3 Summary of Scoping Consultation Responses Received 21th August 2017

Consultee	Comments	Response
Natural Resources Wales	We have no comment to make on the scoping document as we have previously informed the project team of the surveys which are required for the Scheme	The project team welcomes the engagement of NRW.
	We request to again be consulted following completion of surveys prior to the publication of the Environmental Statement (ES). We welcome ongoing discussions throughout the process and note that mitigation and enhancement measures will be discussed through the Environmental Liaison Group	The draft Environmental Statement Chapters will be provided to the stakeholders for comment prior to publication.
	We are satisfied with the level of surveys undertaken to date and note that the potential for effects on European designated sites will also be addressed in the Assessment of the Implications on European Sites (AIES).	Noted
	We would like to see a lichen survey undertaken that maps out what is there along the proposed route, what might be at risk of damage as a result of the Scheme (either through direct damage through felling or by impact from vehicular emissions). Consideration of any sensitive species that may require translocating and how you will mitigate loss.	Further clarification was sought from NRW regarding the need for a lichen survey to inform the EIA. NRW confirmed that the lichen survey was not essential to inform the assessment. Consideration will be given to lichens during the course of any preconstruction surveys.

8.4.82 A meeting was held with the Species Team within NRW in June 2017 to discuss the scope of the 2016 surveys and the additional surveys to be undertaken in 2017. Comments received during and following the meeting are summarised in Table 8.4 below.

Table 8.4 Summary of Comments on 2017 Survey Scope Dated 4th August 2017

Species Group	NRW Comment	Response
Otter	We note that the otter surveys undertaken to date were restricted to a search of water courses for field signs. We advise that further work is carried out to enable an informed assessment of use of the terrestrial habitat by otters to include identifying any resting places and in particular to assess the likelihood of natal use of the area.	Consideration of the potential for otters to use terrestrial habitat within the study area will be made during the assessment.
Bats	We welcome the intention to carry out additional emergence and re-entry surveys of relevant buildings and trees during the peak of the activity period. We welcome the intention to carry out further activity surveys to identify the locations and level of use of existing bat flight routes. At present this is proposed to comprise only static detector surveys. As discussed, we advise that this is supplemented with manual surveys to also provide direct observations by people particularly where automated surveys have identified significant activity.	Noted.
Dormouse	We understand that as dormouse nests were found at either end of the Scheme during the 2016 nest tube surveys you propose to assume dormouse presence in all suitable habitat throughout the Scheme. We consider this approach to be reasonable however we suggest that boxes could be installed within the woodlands on the Scheme and hazelnut surveys carried out if fruiting hazel is present to seek to gain a better understanding of dormouse use of the site to inform any mitigation strategy.	The assessment and mitigation design will be based on assumptions of a high dormouse population within areas of suitable habitat.

Limitations and Assumptions

8.4.83 The findings presented in this assessment represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of plants and animals, such as the time of year, migration patterns and behaviour. Nevertheless, these surveys were conducted at the optimal survey periods and using methodologies which are accepted by NRW and other statutory bodies. The results of the ecological survey allow evaluation of nature conservation value, assessment of the significance of potential impacts that may arise from the Scheme and consideration of appropriate mitigation measures. Every effort was made to ensure

that the findings of the study present as accurate an interpretation as possible of the status of flora and fauna located within the study area.

8.4.84 During the 2016 surveys access was limited in a number of areas which limited the ability to undertake survey visits for species including the great crested newt surveys, dormouse and reptile surveys.

8.4.85 Given the large number of bat passes recorded on the static detectors, Myotis bat calls have not been differentiated. This aggregation approach is not considered to be a limitation within the study given the similar behaviours and habitat requirements of these species with the exception of Bechstein's bat.

8.4.86 Due to the subjective nature of bat call analysis, it is possible that other ecologists may differ in opinion on the identification of calls, however current reference works[33,34] were used along with BatExplorer software which also includes species identification functions.

8.4.87 There is also the potential that some calls may have been overlooked principally due to the fact that the automatic species identification systems cannot identify multiply species within the same sound clip. However, with the exception of files identified as common or soprano pipistrelle by the software, all the other files were checked; all species recorded within those files included within the results are set out in this report.

8.5 Baseline Environment

Desk Study

8.5.1 There are five Special Areas of Conservation (SAC) within 10km of the Scheme and a further two SACs designated for bats within 30km of the site. There is one Special Protection Area within 10km of the site, but no Ramsar Sites are present within this 10km distance. A list of the sites is provided within Table 8.5 and they are shown on Volume 2 Figure 8.10.

[33] Russ, J., 2012. *British Bat Calls: A Guide to Species Identification.* Exeter: Pelagic Publishing.
[34] Middleton, N., Froud, A. & French, K., 2014. *Social Calls of the Bats of Britain and Ireland.* Exeter: Pelagic Publishing.

Table 8.5 Statutory Designated Sites

Site	Distance	Qualifying Features
Afonydd Cleddau / Cleddau Rivers SAC	2km	Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batracion* vegetation
		Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*
		Active raised bogs
		Brook lamprey (*Lampetra planeri*)
		River lamprey (*Lampetra fluviatilis*)
		Sea lamprey (*Petromyzon marinus*)
		Bullhead (*Cottus gobio*)
		European otter (*Lutra lutra*)
Yerbeston Tops SAC	8.7km	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
		Marsh fritillary butterfly (*Euphydryas aurinia*)
Pembrokeshire Bat Sites and Bosherston Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherston SAC	9.1km	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
		Greater horseshoe bat (*Rhinolophus ferrumequinum*)
		Lesser horseshoe bat (*Rhinolophus hipposideros*)
		European otter
Pembrokeshire Marine / Sir Benfro Forol SAC	9.8km	Estuaries
		Large shallow inlets and bays
		Reefs
		Sandbanks which are slightly covered by sea water all the time
		Mudflats and sandflats not covered by seawater at low tide
		Coastal lagoons
		Atlantic salt meadows (Glauco-Puccinellietalia maritimae)
		Submerged or partially submerged sea caves
		Grey seal (*Halichoerus grypus*)
		Shore dock (*Rumex rupestris*)
		Sea lamprey
		River lamprey
		Allis shad (*Alosa alosa*)
		Twaite shad (*Alosa fallax*)

Site	Distance	Qualifying Features
		European otter (*Lutra lutra*)
Carmarthen Bays and Estuaries / Twyni Bae Caerfyddin SAC	10km	Sandbanks which are slightly covered by sea water all the time
		Estuaries
		Mudflats and sandflats not covered by sea water at low tide
		Large shallow inlets and bays
		Salicornia and other annuals colonizing mud and sand
		Atlantic salt meadows (Glauco-Puccinellietalia maritimae)
		Twaite shad
		Sea lamprey
		River lamprey
		Allis shad
		European otter
Bae Caerfyrddin / Carmarthen Bay SPA	10km	Common scoter (*Melanitta nigra*)
Limestone Coast of South West Wales / Afordir Calchfaen de Orllewin Cymru SAC	17.8km	Vegetated sea cliffs of the Atlantic and Baltic coasts
		Fixed coastal dunes with herbaceous vegetation (grey dunes)
		European dry heaths
		Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (important orchid sites)
		Caves not open to the public
		Submerged or partially submerged sea caves
		Greater horseshoe bat
		Early gentian (*Gentianella anglica*)
		Petalwort (*Petalophyllum ralfsii*)
North Pembrokeshire Woodlands / Coedydd Gogledd Sir Benfro SAC	18.5km	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*
		Old sessile oak woods with Ilex and Blechnum in the British Isles
		Barbastelle (*Barbastella barbastellus*)

8.5.2 The Afon Cleddau Dwyreiniol / Eastern Cleddau River SSSI is located approximately 2km from the Scheme. This site is designated for the features of the Afonydd Cleddau SAC which it underpins.

8.5.3 There are no non-statutory designated sites within 1km of the Scheme.

Protected Species Records

8.5.4 A number of protected and notable species records were provided by the West Wales Biodiversity Information Centre. Records of protected and Section 7 species are summarised in Table 8.6 below.

Table 8.6 Protected and Section 7 Species Records Summary

Species	**Number of records**	**Closest record**
Birds		
Hobby (*Falco subbuteo*)	1	0.6km
Red kite (*Milvus milvus*)	6	1km
Redwing (*Turdus iliacus*)	5	1.2km
Fieldfare (*Turdus pilaris*)	1	1.2km
Barn owl (*Tyto alba*)	1	1.2km
Mammals		
Whiskered bat (*Myotis mystacinus*)	1	1.2km
Natterer's bat (*Myotis nattereri*)	1	1.2km
Noctule bat (*Nyctalus noctula*)	2	0.3km
Common pipistrelle (*Pipistrellus pipistrellus*)	3	0.6km
Soprano pipistrelle (*Pipistrellus pygmaeus*)	3	0.3km
Brown long-eared bat (*Plecotus auritus*)	3	0.9km
Greater horseshoe bat	1	1.2km
Lesser horseshoe bat	1	1.2km
Otter	1	0.9km
Eurasian badger (*Meles meles*)	22	0.1km
Polecat	2	0.1km SE (near Penblewin roundabout)
West European hedgehog	7	0.1km
Reptiles and Amphibians		
Slow-worm (*Anguis fragilis*)	1	0.2km
Grass snake (*Natrix natrix*)	1	0.2km
Common frog (*Rana temporaria*)	1	1.4km
Common lizard (*Zootoca vivipara)*	1	0.2km
Invertebrates		
Brown hairstreak (*Thecla betulae*)	2	1.4km
Flora		
Carolina hornwort *(Phaeoceros carolinianus)*	1	1.9km

Habitat Surveys

8.5.5 The habitats present within the study area are shown on Volume 2 Figure 8.11A-C, with further descriptions provided in the Preliminary Ecological Appraisal (Volume 3 Appendix 8.2).

8.5.6 The study area is dominated by areas of improved grassland used for cattle grazing. The fields are separated by large hedgerows with trees, with occasional stream corridors with larger areas of broad leaved woodland. The existing A40 corridor is lined with mature hedgerows and areas of mixed plantation woodland, most notably where it passes through Ffynnon Wood.

8.5.7 The present woodlands are dominated by ash (*Fraxinus excelsior*) with various mixtures of oak (*Quercus* sp.), silver birch (*Betula pendula*), hazel (*Corylus avellana*), willow (*Salix* sp.), holly (*Ilex aquifolium*), alder (*Alnus glutinosa*). Ground flora species varied with bramble (*Rubus fruticosus*), ground ivy (*Glechoma hederacea*), primrose (*Primula vulgaris*), wild garlic (*Allium ursinum*), bluebells (*Hyacinthoides non-scripta*), wood avens (*Geum urbanum*), hard fern (*Blechnum spicant*), bracken (*Pteridium aquilinum*) and hogweed (*Heracleum sphondylium*). Mixed woodland plantations contain similar species along with larch (*Larix decidua*) and /or Scots pine (*Pinus sylvestris*).

8.5.8 The grassland fields within the study area are dominated by perennial rye grass (*Lolium perenne*) with Yorkshire fog (*Holcus lanatus*), soft rush (*Juncus effuses*), thistle (*Cirsium sp*.) buttercup (*Ranunculus sp*.) and ribwort plantain (*Plantago lanceolata*). Marshy grassland areas are also present close to stream corridors where soft rush is the dominant species.

8.5.9 Several ponds and lakes were observed. Species associated with open water included long leaved pond weed (*Potamogeton crispus*), watermilfoil (*Myriophyllum aquaticum*), white water lily (*Nymphaea alba*), bulrush (*Typha latifolia*), water starwort (*Callitriche stagnalis*), water dock (*Rumex hydrolapathum*) and water-cress (*Nasturtium officinale*).

8.5.10 Field boundaries comprised of species poor hedges with trees that generally comprised of one or two woody species and up to four species

along the hedge. The main species varied and hedges contained the following; hazel, hawthorn, gorse, bramble, holly, oak, willow or ash.

8.5.11 The hedgerows within the site comprise of species-poor hedges, with only one qualifying as important under the ecological criteria within the Hedgerows Regulations 1997. The location of the hedgerow is shown on Volume 2 Figure 8.12.

8.5.12 Two areas of grassland and two areas of woodland were identified from the Extended Phase 1 Survey for NVC survey and are shown on Volume 2 Figure 8.13.

8.5.13 Both grassland samples were strongly characteristic of the MG5 *Cynosurus cristatus - Centaurea nigra* plant community. The southern grassland field is a wetter marshy example of this community with the presence of two rush species. Species composition tables are provided in the National Vegetation Classification data table in Volume 3 Appendix 8.3. Whilst these are more notable habitats with great ecological value, there are likely to be extensive areas of habitat within Pembrokeshire.

8.5.14 The two woodland areas were considered to be W8 *Fraxinus excelsior - Acer campestre - Mercurialis perennis* plant community which is a relatively common woodland community within the British Isles. Blaen Pen Troydin woodland is considered to be a restored ancient wet woodland with wet flush habitats. Such woodlands can be considered for selection as SSSIs, however there is likely to be other significant areas of such habitats within Pembrokeshire which are already designated given that there are at least six SSSIs designated for woodland habitats within the county.

8.5.15 Japanese knotweed (*Fallopia japonica*) was recorded in one location on the bridleway to the northeast of Llanddewi Velfrey.

8.5.16 The habitats present were considered to be of either local value or of value only within the context of the site.

Amphibians

8.5.17 Of the six ponds where samples were taken for great crested newt eDNA testing in 2016, one returned a positive result. This was the pond

located in the garden of the Caermaenau-Fawr B&B to the north of the existing Penblewin roundabout.

8.5.18 The three presence/absence surveys undertaken in 2016 recorded the presence of both adult and juvenile smooth newt (*Lissotriton vulgaris*), along with three eggs which were considered to be probable great crested newt eggs. Amphibian survey results are shown on Volume 2 Figure 8.14.

8.5.19 The surveys undertaken in 2017 recorded no great crested newts and it was therefore considered that this species was likely to be absent from the study area. The surveys recorded the presence of palmate newt (*Lissotriton helveticus*) in the ponds at Caermaenau-Fawr B&B, Caermaenau-fach and the Willow Tree School for Dogs. Common frogs were also recorded in a pond at Pencaermanau Farm. No smooth newts were recorded at Caermaenau-Fawr B&B. Full details of the survey results are provided in Volume 3 Appendix 8.4.

8.5.20 The County Ecologist also confirmed during an Environmental Liaison Group meeting in August 2017 that great crested newt were considered to be absent from Pembrokeshire.

8.5.21 Common toads were recorded using reptile mats as incidental species and were therefore considered to be present throughout the study area.

8.5.22 The population of smooth/palmate newts, common frog and common toad within the study area was considered to be of **local** importance.

Bats

Roost

8.5.23 Thirty-six buildings/properties were surveyed for bats during 2016 by external inspection and emergence/re-entry surveys. Further surveys were undertaken in 2017 to augment the 2016 surveys and confirm the potential presence of maternity roosts. The results of these surveys are summarised in Table 8.7 below and in Volume 3 Appendix 8.5.

Table 8.7 Summary of bat roost surveys of buildings

Reference	Property Name	Building description	2016 results	2017 results
1	Caermaenau-fach	main house	Soprano pipistrelle roost	1 unidentified bat using building
2		Barn	Possible roost	No bats recorded using the building
3		Workshop/Garage	Possible roost	Common pipistrelle – max count of 3
4		building to S of main house	Pipistrelle roost – max count of 8 bats	Soprano pipistrelle – max count of 3 bats Myotis species[35] – max count of 3 bats
5	Trefangor Cottage	Cottage	Soprano pipistrelle roost – single bat	No bats recorded using the building
6	Ffynnon Vestry	Vestry	Soprano pipistrelle roost	Soprano pipistrelle roost – max count 10 bats
7	Maes-y-Ffynnon	House	No bats recorded using the building	No bats recorded using the building
8		outbuilding		Possible soprano pipistrelle roost – single bat
9	Maes-y-Rhos	stone house	Common pipistrelle roost– max count 1 bat	Common pipistrelle roost– max count 2 bats
10		Garage	No bats recorded using the building	No bats recorded using the building
11		Farm house	Soprano pipistrelle	Soprano pipistrelle

[35] Considered likely to be a common species of Myotis bat: Natterer's bat, Daubenton's bat, whiskered or Brandt's bat

Reference	Property Name	Building description	2016 results	2017 results
	Pen-troydin-fach		roost – max count 2 bats Common pipistrelle roost – single bat	roost – max count 4 bats Common pipistrelle roost – 2 bats
12		Farm building 1	No bats recorded using the building	No bats recorded using the building
13		farm building 2	No bats recorded using the building	No bats recorded using the building
14		Farm building 3	No bats recorded using the building	No bats recorded using the building
15		Farm building 4	No bats recorded using the building	No bats recorded using the building
16		Farm building 5	No bats recorded using the building	No bats recorded using the building
17		Farm building 6	No bats recorded using the building	No bats recorded using the building
18	Bethel Cottage	house	No bats recorded using the building	No bats recorded using the building
19		outbuilding	No bats recorded using the building	No bats recorded using the building
20	Bethel Vestry	house	Not surveyed	No bats recorded using the building
21	barn behind Bethel Chapel	barn	Not surveyed	No bats recorded using the building
22	Penrhiw	house	Not surveyed	Soprano pipistrelle roost – max count 7 bats
23	Ffynnon Chapel	Chapel	Brown long-eared maternity roost – max count 30 bats	Soprano pipistrelle roost – max county 23 bats.

Reference	Property Name	Building description	2016 results	2017 results
			Soprano pipistrelle roost – max count 2 bats	Assumed maternity roost
24	Ffynnon Bridge	Bridge/culvert	Not surveyed	No bats recorded using the building
25	Henllan Lodge	lodge	Not surveyed	Soprano pipistrelle maternity roost – max count 68 bats
26	Brominau	house	Not surveyed	No bats recorded using the building
27		outbuilding	Not surveyed	No bats recorded using the building
28	Trefangor Farm	farmhouse	Not surveyed	Soprano pipistrelle roost – max count 12 bats
29		Outbuilding 1	Not surveyed	No bats recorded using the building
30		Outbuilding 2	Not surveyed	No bats recorded using the building
31		Outbuilding 3	Not surveyed	No bats recorded using the building
32		Outbuilding 4	Not surveyed	No bats recorded using the building
33		Outbuilding 5	Not surveyed	No bats recorded using the building
34	Bethel Chapel	chapel	Common pipistrelle roost – single bat	Soprano pipistrelle roost – max count 13 bats
35	Penblewin	House	No bats recorded using the building	No bats recorded using the building

Reference	Property Name	Building description	2016 results	2017 results
36		white barns	Common pipistrelle roost – single bat Soprano pipistrelle – single bat	No bats recorded using the building
37		barn 2	No bats recorded using the building	No bats recorded using the building
38		Stone Barn	No bats recorded using the building	Possible soprano pipistrelle roost – single bat

8.5.24 The inspection of 39 trees was undertaken by ground based and aerial climbing methods. Three confirmed roosts of brown long-eared bats were identified from either the presence of bats or droppings which were analysed for DNA identification. These were located in an ash tree in a hedgerow near Grovesner Court (T13), a beech tree within the avenue south of Henllan Lodge (T21), and an ash tree near to Henllan Farm. The locations of trees with potential for bats are shown on Volume 2 Figure 8.16.

8.5.25 No further bat roosts were identified in the trees located within 50m of the Scheme alignment during emergence and re-entry surveys (of trees with moderate or high potential to support bats). Refer to Volume 3 Appendix 8.5.

8.5.26 The roosts of soprano pipistrelle, common pipistrelle, brown long-eared bat and common Myotis species are considered to be of local importance as these are relatively common or widespread species in Wales.

Walked Activity

8.5.27 The locations of bat registrations are shown on Volume 2 Figures 8.23 – 8.29. Common and soprano pipistrelle bats were the most frequently recorded species during the walked transect surveys recorded using hedgerows and tree lines throughout the study area. Myotis species[36]

[36] Considered likely to be a common species of Myotis bat: Natterer's bat, Daubenton's bat, whiskered or Brandt's bat

and noctule were also frequently recorded although at much lower levels.

8.5.28 Other species such as long-eared species, Leisler's bat, serotine, lesser horseshoe and greater horseshoe bats were also recorded in very low numbers.

8.5.29 Lesser horseshoe bats were recorded in June, July, August and October 2016. In June, these were recorded near to the avenue of trees south of Henllan Lodge, at Pen-ca'rmaenau and between the existing A40 and Grosvenor Court. A single lesser horseshoe was recorded to the north west of the Penblewin roundabout during the July transects. In August, two lesser horseshoe passes were recorded near to Bethel Chapel, one on the edge of the exiting A40 and one to the south. A single lesser horseshoe bat pass was recorded during the October surveys to the north of Pen-troydin-fach Farm.

8.5.30 Greater horseshoe bats were recorded in June, July, August and September 2016. In June, a single recording of a greater horseshoe was recorded to the west of the A478 north of the Penblewin roundabout. Greater horseshoe bats were again recorded to the north-west of Penblewin roundabout during both July and August. During the August surveys, they were also recorded to the south-west of Penblewin and on the access lane to the Willow Tree School for Dogs. A single greater horseshoe bat pass was recorded on the south side of Ffynnon Wood during the September surveys.

8.5.31 It is assumed that the lesser and greater horseshoe bats recorded within the study area are intrinsically linked to the SAC populations of these species.

Static Activity Monitoring

8.5.32 The locations sampled during 2016 are shown on Volume 2 Figures 8.16 – 8.22, with data included in Volume 3 Appendix 8.5. Pipistrelle species were the most commonly recorded bats during the static activity surveys during 2016, although these were not identified to species level. Myotis species[37] were also frequently recorded along with noctule at lower levels.

[37] Considered likely to be a common species of Myotis bat: Natterer's bat, Daubenton's bat, whiskered or Brandt's bat

8.5.33 Other species recorded in low levels of activity included serotine, barbastelle, Nathusius' pipistrelle, long-eared species, lesser horseshoe and greater horseshoe.

8.5.34 Greater horseshoe bats were recorded throughout the study area in low numbers with particular areas of activity recorded on hedgerows either side of the A478 north of the Penblewin roundabout, south of Penblewin Farm, north of Pen-troydin-fach Farm and to the west of the footpath near the Willow Tree School for Dogs.

8.5.35 Lesser horseshoe bats were recorded on two occasions in July south-west of the Penblewin roundabout and to the south of Trefangor Farm. Barbastelle bat were also only recorded in two locations; to the north-west of the Penblewin roundabout and south of Trefangor Farm, both during the July sampling session.

8.5.36 The 2017 static monitoring focused on 15 locations where the proposed alignment intersects linear features likely to be used by bats. Soprano pipistrelle was the most frequently recorded species followed by common pipistrelle and Myotis species. High levels of bat activity were recorded in the eastern sections of the study area as shown on Volume 2 Figures 8.30 – 8.77 Other species were recorded at low or very low levels. Lesser and greater horseshoe bats were also recorded although in very low numbers. The average bat activity indices at the locations are shown in Table 8.9.

8.5.37 The data from the transect and static surveys was used to identify 12 key flight routes which are intersected by the Scheme. These are linear features, hedgerows and stream corridors, where significant amounts of bat activity, and or rarer species were recorded. These are shown on Volume 2 Figure 8.78.

8.5.38 The times that these three SAC species were recorded on static detectors during 2017 is compared to sunset and sunrise times in Table 8.8 below. The majority of recordings were over one hour after sunset or prior to sunrise. It is therefore considered unlikely that roosts of these species are located within the vicinity of the Scheme.

Table 8.8 Comparison of time of recording for SAC bat species with sunset and sunrise times

Night of recorded	Location	Species	Time of recording	Time post sunset	Time pre-sunrise
23/06/2017	Location 12	Greater horseshoe	01:56	---	03:04
25/06/2017	Location 12	Greater horseshoe	01:54	---	03:07
25/06/2017	Location 7	Lesser horseshoe	04:13	---	00:48
26/06/2017	Location 12	Barbastelle	23:41	01:59	---
18/07/2017	Location 2	Barbastelle	00:23	---	04:59
18/07/2017	Location 6	Greater horseshoe	03:39	---	01:42
18/07/2017	Location 6	Greater horseshoe	01:23	---	03:59
18/07/2017	Location 6	Greater horseshoe	03:37	---	01:44
18/07/2017	Location 6	Greater horseshoe	01:25	---	03:57
18/07/2017	Location 6	Greater horseshoe	01:23	---	03:59
18/07/2017	Location 6	Greater horseshoe	01:21	---	04:01
18/07/2017	Location 6	Greater horseshoe	01:24	---	03:58
18/07/2017	Location 6	Greater horseshoe	01:24	---	03:57
18/07/2017	Location 6	Greater horseshoe	01:22	---	04:00
21/07/2017	Location 14	Greater horseshoe	23:14	01:50	---
21/07/2017	Location 5	Greater horseshoe	01:16	---	04:10
21/07/2017	Location 6	Greater horseshoe	23:46	02:22	---
22/07/2017	Location 6	Greater horseshoe	04:37	---	00:51
23/07/2017	Location 6	Greater horseshoe	02:56	---	02:32
23/07/2017	Location 6	Greater horseshoe	03:00	---	02:28
23/07/2017	Location 6	Greater horseshoe	03:00	---	02:28
23/07/2017	Location 6	Greater horseshoe	03:01	---	02:28
23/07/2017	Location 6	Greater horseshoe	03:00	---	02:29
23/07/2017	Location 6	Greater horseshoe	02:52	---	02:36
23/07/2017	Location 6	Greater horseshoe	03:00	---	02:28
23/07/2017	Location 6	Greater horseshoe	03:01	---	02:28
23/07/2017	Location 6	Greater horseshoe	02:51	---	02:38
23/07/2017	Location 7	Greater horseshoe	02:28	---	03:01
15/08/2017	Location 13	Greater horseshoe	00:16	---	05:48
15/08/2017	Location 14	Greater horseshoe	01:57	---	04:08
15/08/2017	Location 3	Greater horseshoe	22:54	02:11	---
17/08/2017	Location 10	Greater horseshoe	00:45	---	05:23

Night of recorded	Location	Species	Time of recording	Time post sunset	Time pre-sunrise
18/08/2017	Location 12	Greater horseshoe	23:30	02:54	---
18/08/2017	Location 3	Greater horseshoe	04:07	---	02:03
18/08/2017	Location 6	Greater horseshoe	23:32	02:56	---
18/08/2017	Location 6	Greater horseshoe	23:33	02:57	---
18/08/2017	Location 6	Greater horseshoe	22:58	02:22	---
19/08/2017	Location 6	Greater horseshoe	04:51	---	01:20
16/09/2017	Location 4	Greater horseshoe	01:55	---	05:01
21/10/2017	Location 8	Lesser horseshoe	05:43	---	02:12
22/10/2017	Location 6	Lesser horseshoe	22:41	04:30	---

8.5.39 The lesser horseshoe and greater horseshoe bats recorded may be foraging from the Slebech Park Roost (9.1km from the Scheme) which forms part of the Pembrokeshire Bat Sites and Bosherston Lakes SAC, although it is noted that the core foraging areas around maternity roosts, for these species is approximately 4km.

8.5.40 The barbastelle bats present within the study area are unlikely to be from North Pembrokeshire Woodlands SAC due to the distance of this site from the study area, although they are highly likely to be from roosts which contribute to the SAC populations.

8.5.41 Therefore, the populations of these three species recorded within the study area are considered to be of International Importance.

8.5.42 The populations of other bat species recorded within the study area are considered to be of local importance.

Table 8.9 Bat Activity Indices for all bat species recorded in 2017

Location number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
June	226.2	No access	158.4	212	135.8	307.2	27.4	6.2	11.4	3.6	220.8	53.8	556.8	No Data	54.6
July	269	335.8	76	380.8	92	176.8	22.4	10	57.6	12.4	80.8	1.8	815.2	297.6	134.8
August	92.2	291.8	1.4	320.8	No access	104.8	29.6	29.2	8.4	25.2	6.8	4	1519.6	1426	6.2
September	5.2	0.2	10.2	355.8	158.8	2.4	2.4	4.8	97	2.2	15.4	86.4	0	7.8	16.8
October	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	148.15	209.3	61.5	317.35	128.87	147.8	20.45	12.55	43.6	10.85	80.95	36.5	722.9	577.13	53.1

Table 8.10 Bat Activity Indices for barbastelle recorded in 2017

Location number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
June	0	No access	0	0	0	0	0	0	0	0	0	0.2	0	No Data	0
July	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
August	0	0	0	0	No access	0	0	0	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0.05	0	0	0	0	0	0	0	0	0	0.04	0	0	0

Table 8.11 Bat Activity Indices for greater horseshoe bat recorded in 2017

Location number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
June	0	No access	0	0	0	0	0	0	0	0	0	0.4	0	No Data	0
July	0	0	0	0	0.2	2.2	0.2	0	0	0	0	0	0	0.2	0
August	0	0	0.4	0	No access	0.8	0	0	0	0.2	0	0.2	0.2	0.2	0
September	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	0.08	0.04	0.05	0.6	0.04	0	0	0.04	0	0.12	0.04	0.1	0

Table 8.12 Bat Activity Indices for lesser horseshoe bat recorded in 2017

Location number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
June	0	No access	0	0	0	0	0.2	0	0	0	0	0	0	No Data	0
July	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
August	0	0	0	0	No access	0	0	0	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0.2	0	0.2	0	0	0	0	0	0	0
Average	0	0	0	0	0	0.04	0.04	0.04	0	0	0	0	0	0	0

Dormouse

8.5.43 Dormice nests were found within tubes in two locations at either end of the Scheme (Volume 2 Figure 8.80). One was in a hedgerow adjacent to the Caermaenau-Fawr B&B and the other in Castell-Gwyndy Wood to the north of Bethel Chapel.

8.5.44 The hedgerows and woodland located within the study area are considered to provide high quality habitat for dormice, and it is considered likely that they were present throughout the study area. The dormouse population within the study area is considered to be of local importance.

Riparian Mammals

8.5.45 Relatively little otter activity was recorded during the surveys, although as the Scheme is located largely on a ridge line, the watercourses are relatively small and do not provide significant foraging areas for otters. Two potential otter holts were recorded, one on a stream in Castell-Gwyndy Wood to the north of Bethel Chapel, and the other within woodland adjacent to the stream to the south of Caermaenau-fach. These locations are shown on Volume 2 Figure 8.81.

8.5.46 The otter population present within the study area is considered likely to be part of or contribute to the population designated as part of the Carmarthen Bays and Estuaries and the Cleddau Rivers SACs. Otters within the study area are therefore considered to be of international importance.

8.5.47 No signs of water voles were recorded during the surveys and it is therefore considered that this species is likely to be absent from the study area.

Badgers

8.5.48 A total of 49 setts or possible setts were recorded within the study area during the 2016 surveys. A further six setts were recorded during 2017 surveys which were targeted to confirm sett location and type. The survey data from 2017 confirmed that six of the possible setts were not being used by badgers. The locations of setts is shown on Volume 2 Figure 8.82A - C. The 49 setts therefore comprise six main setts, one

annex sett, two subsidiary setts and 39 outliers (further information is supplied in Volume 3 Appendix 8.6).

8.5.49 Where possible, the potential arrangement of family groups (clans) were inferred based on the proximity to other setts and associated field signs. Six potential clans (shown as A to F on Volume 2 Figure 8.82A - C) were identified although not all setts could be attributed to a family group.

8.5.50 The habitats present within the study area provide optimum habitat for badgers and it is anticipated that population levels will be high with small territory sizes. As badgers are widespread and common throughout West Wales, the population of badgers was considered to be of local importance.

Breeding Birds

8.5.51 The breeding bird surveys recorded a total of 58 species. None of these species were Schedule 1 or Annex 1[38] species. Of the 58 species, it was considered that 48 species were breeding or likely to be breeding in the study area. Non-breeding species included overflying gulls, waterfowl and grey heron (*Ardea cinerea*) along with occasional records of migrant species such as yellow wagtail (*Moticilla flava*).

8.5.52 Of the species recorded, nine species are Section 7 priority species, which were bullfinch (*Pyrrhula pyrrhula*), dunnock (*Prunella modularis subsp. occidentalis*), linnet (*Linaria cannabina*), herring gull (*larus argentatus argenteus*), house sparrow (*Passer domesticus*), marsh tit (*Parus palustris subsp. palustris*), willow tit (*Parus montanus subsp. kleinschimdti*), song thrush (*Turdus philomelos*) and yellow wagtail (*Motacilla flava subsp.flavissima*).

8.5.53 Furthermore, eight of the likely breeding and confirmed breeding species are Birds of Conservation Concern[39] Red listed species and nine are Amber listed.

[38] Listed as rare or vulnerable under Annex 1 of Directive 2009/147/EC (Birds Directive) on the conservation of wild birds
[39] Eaton et al. (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. British Birds 108;708-746

8.5.54 Similarly, seven of these species are included on the Welsh Birds of Conservation Concern[40] Red list and nine on the Amber List. Details are provided in Volume 3 Appendix 8.7.

8.5.55 No particularly rare or unusual species were recorded. There was a single record of the declining willow tit (*Poecile montanus*) in July 2016, with small numbers of spotted flycatcher (*Muscicapa striata*) also recorded within the study area.

8.5.56 Furthermore, no particularly high concentrations of breeding passerines were noted. There were a number of species such as linnet, willow warbler and song thrush typical of such habitats within the region. Breeding bird survey results are shown on Volume 2 Figures 8.84 – 8.91.

8.5.57 Overall the breeding bird assemblage within the site was considered to be of local importance, comprising common species typical of the habitats present within the study area.

8.5.58 Twelve features were identified during the barn owl surveys as possible nest sites or roosting sites. These include one former nest site at the Caermaenau-Fawr B&B which was not being used by owls at the time of the survey. Potential nest sites in close proximity (50m) to the Scheme include a log pile adjacent to the access track to Parc-y-Delyn and two farm buildings at Pen-troydin-fach Farm, although none of these were actively being used by barn owls.

8.5.59 The majority of the habitats within the study area are of sub-optimal quality for foraging use by barn owls. Small areas of optimal foraging habitat are present at the eastern extent of the Scheme and near to Trefangor Farm. The results of the habitat suitability assessment and the locations of potential nesting and roosting sites are shown on Volume 2 Figure 8.92A.

8.5.60 The barn owl population is also considered to be of local importance as this species is relatively common and widespread in Pembrokeshire, although it is noted that this species is included in Schedule 1 of the Wildlife and Countryside Act and therefore subject to greater legal protection.

[40] Welsh Ornithological Society (2016): Birds in Wales: https://birdsin.wales/wp-content/uploads/2017/01/Birds-of-Conservation-Concern-Wales-3-2016.pdf

Reptiles

8.5.61 A population of common lizard (*Zootica vivpara*) were recorded within the western areas of the study area (Volume 2 Figure 8.92B), although in relatively small numbers with a maximum count of three animals including juveniles. Many parts of the study area within the vicinity of the proposed route are considered to be suitable for this species and other species such as slow worms and grass snake. It is considered likely that all three species are present in low numbers throughout the study area. The reptile population within the site was therefore considered to be of local importance.

Section 7 Species

8.5.62 Based on the habitats present within the study area it was assumed that the area supports a range of species included on the list of species of principal importance for the conservation of biodiversity published in response to Section 7 of the Environment (Wales) Act 2016. These were likely to include populations of mammal species such as brown hare (*Lepus europaeus*), polecat (*Mustula putorius*) and hedgehog (*Erinaceus europaeus*). The study area was also likely to support a range of common invertebrate species, mosses and lichens typically found within the habitats present.

8.5.63 The populations of Section 7 species were considered to be of local importance.

8.6 Impact Assessment

Construction Impacts

Designated Sites

8.6.1 An Assessment of the Implications on European Sites (AIES) was prepared for the Scheme to fulfil the requirements of the Habitats Regulations and is provided in the Statement to Inform an Appropriate Assessment (SIAA) which was produced for the Scheme.

8.6.2 The majority of the features of the European Sites can be scoped out of the assessment as no pathways, such as linking habitats or movement of species, existed to link the potential impacts from the Scheme to the features of the sites. This scoping exercise is summarised in Table 8.13.

Table 8.13 Scoping of European Sites and features potentially affected the Scheme

Site	Distance	Qualifying Features	Pathway	Scoping for further consideration
Afonydd Cleddau / Cleddau Rivers SAC	2km	Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batracion* vegetation	Potential for pollution to enter designated areas via watercourses	Yes
		Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*	Potential for pollution to enter designated areas via watercourses	Yes
		Active raised bogs	No pathway – feature separated by sufficient distance	No
		Sea lamprey	Potential for pollution to enter designated areas via watercourses	Yes
		Brook lamprey	Potential for pollution to enter designated areas via watercourses	Yes
		River lamprey	Potential for pollution to enter designated areas via watercourses	Yes
		Bullhead	Potential for pollution to enter designated areas via watercourses	Yes
		European otter	Potential for pollution to enter designated areas via watercourses	Yes
			Potential for otters to cross the Scheme moving between catchments	Yes
Pembrokeshire Bat Sites and Bosherston Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherston SAC	9.1km	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	No pathway – feature separated by sufficient distance	No
		Greater horseshoe bat	Potential for greater horseshoe bats to cross the Scheme	Yes
		Lesser horseshoe bat	Potential for lesser horseshoe bats to cross the Scheme	Yes

Site	Distance	Qualifying Features	Pathway	Scoping for further consideration
		European otter	No pathway – feature separated by sufficient distance approximately 25km from Bosherston Lakes component, where the otter feature is located.	No
Carmarthen Bays and Estuaries / Twyni Bae Caerfyddin SAC	9.7km	Sandbanks which are slightly covered by sea water all the time	Potential for pollution to enter designated areas via watercourses	Yes
		Estuaries	Potential for pollution to enter designated areas via watercourses	Yes
		Mudflats and sandflats not covered by sea water at low tide	Potential for pollution to enter designated areas via watercourses	Yes
		Large shallow inlets and bays	Potential for pollution to enter designated areas via watercourses	Yes
		Salicornia and other annuals colonizing mud and sand	Potential for pollution to enter designated areas via watercourses	Yes
		Atlantic salt meadows (*Glauco-Puccinellietalia maritimae)*	Potential for pollution to enter designated areas via watercourses	Yes
		Twaite shad	Potential for pollution to enter designated areas via watercourses	Yes
		Sea lamprey	Potential for pollution to enter designated areas via watercourses	Yes
		River lamprey	Potential for pollution to enter designated areas via watercourses	Yes
		Allis shad	Potential for pollution to enter designated areas via watercourses	Yes
		European otter	Potential for pollution to enter designated areas via watercourses	Yes

Site	Distance	Qualifying Features	Pathway	Scoping for further consideration
			Potential for otters to cross the Scheme moving between catchments	Yes
Limestone Coast of South West Wales / Afordir Calchfaen De Orllewin Cymru SAC	17.8km	Vegetated sea cliffs of the Atlantic and Baltic coasts	No pathway – feature separated by sufficient distance	No
		Fixed coastal dunes with herbaceous vegetation (grey dunes)	No pathway – feature separated by sufficient distance	No
		European dry heaths	No pathway – feature separated by sufficient distance	No
		Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (important orchid sites)	No pathway – feature separated by sufficient distance	No
		Caves not open to the public	No pathway – feature separated by sufficient distance	No
		Submerged or partially submerged sea caves	No pathway – feature separated by sufficient distance	No
		Greater horseshoe bat	Potential for greater horseshoe bats to cross the Scheme	Yes
		Early gentian	No pathway – feature separated by sufficient distance	No
		Petalwort	No pathway – feature separated by sufficient distance	No
North Pembrokeshire Woodlands / Coedydd Gogledd Sir Benfro SAC	18.5km	Old sessile oak woods with Ilex and Blechnum in the British Isles	No pathway – feature separated by sufficient distance	No
		Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*	No pathway – feature separated by sufficient distance	No
		Barbastelle	Potential for barbastelle bats to cross the Scheme	Yes

8.6.3 There is a hydrological pathway (through the watercourses crossed by the Scheme) which could convey pollution from construction activities (either surface water run-off or spillages from plant and machinery) to areas within Cleddau Rivers and Carmarthen Bays and Estuaries SACs and the SSSI underpinning the Cleddau Rivers SAC. Due to the dilution that could be expected to occur within the river, it is considered that these effects would be of low magnitude and reversible. However, in the absence of mitigation the effects from spillages would be considered to be a significant effect.

8.6.4 There is the potential for bats, in particular the two horseshoe species which were recorded crossing the Scheme in a number of locations and are less likely to cross open areas[41], to be discouraged from crossing the Scheme and therefore be prevented from accessing important foraging areas.

8.6.5 While the number of lesser and greater horseshoe bats likely to be crossing the Scheme is relatively low, given the importance of these two species (valued are Internationally important due to being associated with the Pembrokeshire Bat Sites and Bosherston Lakes SAC), the impacts are considered to be significant effects on the lesser and greater horseshoe bats populations taking a precautionary approach.

8.6.6 Barbastelle bats have only been recorded very occasionally during the course of the surveys; the bats encountered are less likely to be directly associated with the North Pembrokeshire Woodlands SAC population due to the distance between the SAC and the Scheme. Barbastelle bats are less likely to be deterred from crossing open areas and are therefore were not considered to be significantly affected by the Scheme.

Habitats

8.6.7 The construction of the Scheme would result in the loss of grassland habitat within the study area although the grasslands affected are considered to be of low ecological value due to their improved nature.

8.6.8 The woodland areas within the study area would largely be unaffected by the Scheme with the exception of Ffynnon Wood where trees will need to be removed on either side of the existing A40. The majority of

[41] Catherine Bickmore Associates, 2003. *Review of Work Carried out on the Trunk Road Network in Wales for Bats,* Cardiff: Welsh Government & Countryside Council for Wales.

the areas of woodland affected in Ffynnon Wood are mixed plantation and are therefore of lower value than more semi-natural woodlands. Semi-natural woodland will also be lost to the north of Blaen-Pen-Troydin wood where the woodland extends along the steeper slopes and stream corridors. The loss of woodland in this area is approximately 0.7ha.

8.6.9 Hedgerows are an abundant feature within the landscape. A large number of hedgerows and tree lines would be intersected by the Scheme resulting in sections being removed.

8.6.10 The areas and lengths of habitats to be lost are provided in Table 8.14 below.

Table 8.14 Areas and lengths of habitats removed during construction

Existing Features / Habitat Types	Quantity removed
Broad-leaved woodland	1.49ha
Broad-leaved plantation	0.23ha
Mixed plantation	1.66ha
Coniferous plantation	0.11ha
Scrub	0.67ha
Improved and poor semi-improved grassland	21.71ha
Semi improved neutral grassland	1.28ha
Marshy grassland	2.24ha
Bracken	0.37ha
Standing water	0.01ha
Hedgerows	5,594 linear m
Watercourses	792 linear m

8.6.11 The areas of habitats that would be removed for the construction of the Scheme are relatively small compared to the abundance of equivalent habitats with Pembrokeshire. Although small areas of semi-natural woodland would be affected by the construction activities, the larger blocks of woodland such as Blaen-Pen-Troydin would be largely unaffected.

8.6.12 The grasslands and areas of plantation are of low ecological value being of value within the context of the site. The semi-natural woodland is of local value. Given that the relatively low value of these habitats, the loss of habitats is not considered to be a significant effect.

8.6.13 There are a number of small watercourses that would be crossed by the Scheme. There is the potential for surface water run-off during construction to enter the streams crossed by the Scheme and temporarily affect water quality, although it is expected that the dilution that would occur within the river would reduce the scale of any effect.

8.6.14 The effects of the Scheme on water quality are assessed within Chapter 7 Road Drainage and the Water Environment. The effects of watercourses as an ecological receptor was considered to be of low magnitude but potentially significant in the absence of mitigation.

8.6.15 There are a number of areas of invasive plant of Japanese knotweed, which are likely to be affected by the construction of the Scheme. The release of material contaminated with plant material or seeds could result in adverse effects on other habitats where material is deposited. This is particularly vulnerable in the area around water courses.

8.6.16 The potential effect of any spread of these species was considered to be of low magnitude but was considered to be significant as there may be consequential effects on species composition within any habitats in to which material is spread, and would not be significant. However, in light of the legal control of these species, mitigation measures would be included to prevent the potential spreading of these species.

Amphibians

8.6.17 The proposed construction work has the potential for killing and injuring of amphibians along with the loss of breeding and terrestrial habitat through vegetation clearance and soil excavations. In addition, there is the risk of introducing biosecurity risks such as pathologies which could affect amphibians and other aquatic species. This would be considered to be a low magnitude impact and would not be significant on amphibian populations in the study area. Even though the effects were not considered to be significant, mitigation measures are included to avoid and reduce the impacts on this receptor and to ensure animal welfare is maintained.

Bats

8.6.18 The construction of the Scheme would result in the loss of a roost site within Trefangor Cottage. There are also a further 14 bat roosts located within buildings in close proximity to the proposed constructions areas,

which are likely to experience disturbance through noise or vibration caused by construction vehicles.

8.6.19 The loss of a roost site for a single soprano pipistrelle is considered to be low magnitude impact which is unlikely to be significant. The disturbance of other roosts is considered to be a moderate magnitude impact which would be a significant effect at a local scale if maternity roosts were subject to significant disturbance during the period when bats have dependent young. However, it is noted that the buildings containing roosts are located in close proximity to the existing road and therefore subject to noise and vibration from passing traffic.

8.6.20 In addition to their geographical valuation discussed in this chapter, as all bat species are protected as European Protected Species there is a legislative requirement to include measures for bats and potentially to obtain a licence for works that may destroy roosts or disturb bats within their roosts.

8.6.21 The clearance of vegetation along the Scheme has the potential to lead to the fragmentation of habitats and may prevent certain species - such as horseshoe bats - from crossing the gaps created and accessing foraging areas. The sections of the Scheme to the north of Llanddewi Velfrey provide areas of suitable foraging habitat for bats, which may be lost or disrupted as a result of the vegetation clearance for construction.

8.6.22 There is also the potential for construction activities undertaken at night which may require lighting, to give rise to further effects of fragmentation and the displacement of bats from existing flight lines and foraging areas.

8.6.23 The effects on horseshoe bat species and barbastelle bats is assessed above. In the absence of mitigation measures, the potential disruption of flight lines and foraging areas is considered to be a large magnitude affect which would be considered significant for all other bat species. As such, mitigation measures will be proposed (Section 8.7).

Dormice

8.6.24 The construction of the Scheme would result in the loss of 4.16ha of woodland and scrub, and 5,958m of hedgerow which is considered to be a significant area of dormouse habitat and could result in the death

or injury of dormice from plant or machinery. The cleared corridor of the Scheme is also likely to act as a barrier to the movement and dispersal of dormice leading to fragmentation of the population.

8.6.25 In the absence of mitigation measures, the potential effect on the dormouse population is considered to be of sufficient magnitude to be significant on the local population. Additionally, as dormice are legally protected as European Protected Species there is a legislative requirement to include mitigation and compensation measures for dormice and potentially to obtain a licence for works that may destroy habitat or disturb dormice.

Otter

8.6.26 Two potential holts were identified during the surveys; however, these are located a sufficient distance away from the construction areas such that it is considered unlikely that otters will be directly affected through the loss of habitats. However, there is the potential for otters to be moving through the area of the Scheme between river catchments, which could result in the death or injury of otters, if in collision with construction vehicles moving at night time or if they become entrapped within excavations.

8.6.27 The potential for otters to be killed or injured during construction is considered to be of moderate magnitude on an internationally valued receptor that would be significant. Additionally, as otter are protected as European Protected Species, there is a legislative requirement to include mitigation measures for otter. Mitigation measures are included in Section 8.7 below.

Badgers

8.6.28 Nine of the badger setts identified are located within the proposed footprint of the engineering layout for the Scheme. A further 13 setts are located with 30m of the areas required for the construction of the Scheme, including one main sett (as shown in Table 8.15). There is the potential for badgers to be killed or injured by construction activities in the vicinity of setts if the works result in the collapse of tunnels or chambers within the setts. Furthermore, there is the potential for badgers to be displaced from setts if subject to significant disturbance.

Table 8.15 Badger Setts and their proximity to the Scheme

Sett No	Type	Under footprint of Scheme	With 30m of proposed works	Outside zone of influence (30m)
A1	Main	×	✓	×
A2	Subsidiary	✓	×	×
A3	Outlier	✓	×	×
A4	Outlier	×	✓	×
A5	Outlier	×	✓	×
B1	Main	×	✓	×
B2	Subsidiary	×	✓	×
B3	Outlier	×	✓	×
B4	Outlier	✓	×	×
B5	Outlier	×	✓	×
B6	Annex	×	×	✓
B7	Outlier	×	×	✓
B8	Outlier	×	✓	×
B9	Outlier	✓	×	×
B10	Outlier	✓	×	×
C1	Main	×	✓	×
C2	Outlier	×	×	✓
C3	Outlier	✓	×	×
C4	Outlier	×	✓	×
C5	Outlier	✓	×	×
C6	Outlier	×	✓	×
C7	Outlier	×	✓	×
D1	Main	×	×	✓
D2	Outlier	×	×	✓
D3	Outlier	×	×	✓
D4	Outlier	×	×	✓
D5	Outlier	×	✓	×
D6	Outlier	×	×	✓
D7	Outlier	×	×	✓
D8	Outlier	×	×	✓
D9	Outlier	×	×	✓
E1	Main	×	×	✓
E2	Outlier	×	×	✓

Sett No	Type	Under footprint of Scheme	With 30m of proposed works	Outside zone of influence (30m)
E3	Outlier	×	×	✓
E4	Outlier	×	×	✓
F1	Main	×	×	✓
U1	Outlier	×	×	✓
U2	Outlier	×	×	✓
U3	Outlier	×	×	✓
U4	Outlier	×	×	✓
U5	Outlier	✓	×	×
U6	Outlier	✓	×	×
U7	Outlier	×	×	✓
U8	Outlier	×	×	✓
U9	Outlier	×	×	✓
U10	Outlier	×	×	✓
U11	Outlier	×	×	✓
U12	Outlier	×	×	✓

8.6.29 However, there is the potential for badgers to be moving through the area of the Scheme, which could result in the death or injury of badgers by collision with construction vehicles moving at night time or if they become entrapped in excavations.

8.6.30 The potential for badgers to be killed or injured during construction is considered to be a moderate scale effect which would be significant. However, as badgers are a Protected Species, there is a legislative requirement to include mitigation measures for badgers.

Breeding Birds

8.6.31 Overall, the assemblage of breeding birds recorded is typical of the habitats surveyed within the study area. The habitats supported a range of familiar bird species associated with hedgerows, farmland, scrub and woodlands.

8.6.32 The loss of nesting habitat within the footprint of the Scheme and the potential for further displacement of nesting birds from the vicinity of the Scheme, is considered to be a low magnitude impact which would not be significant for local populations of bird species. However, a

number of mitigation measures are discussed later to ensure legally protected active bird nests are not affected by the Scheme.

8.6.33 Barn owl survey results suggest no active roost sites are present, but some potentially suitable features occur and could be impacted by the Scheme. Even by taking a precautionary approach and assuming these may be used by barn owls, the potential impact on such birds is considered to be of minor magnitude and would not be significant at a population scale. However due to the legal protection of Schedule 1 species, mitigation measures are set out below.

Reptiles

8.6.34 The proposed construction work has the potential for killing and injuring of reptiles along with the loss of breeding and terrestrial habitat through vegetation clearance and soil excavations. As described above, the areas of habitats being lost to the Scheme are relatively low compared to the areas of habitat available within the study area as a whole and with the county of Pembrokeshire. This would be considered to be a low magnitude impact and would not be significant.

8.6.35 In order to ensure legislative compliance, mitigation measures will be provided.

Section 7 species

8.6.36 The proposed construction work has the potential for killing and injuring of Section 7 mammals along with the loss of habitat through vegetation clearance and soil excavations. There is also the potential loss of habitats that support Section 7 invertebrates.

8.6.37 Considering the habitat requirements of Section 7 mammals, such as hedgehog, brown hare and polecat and the availability of similar habitats in the area, it is predicted that the construction phase of the Scheme is unlikely to have significant impacts on the local populations of these species. However, mitigation measures are proposed to fulfil Welsh Government's obligations under the Environment Wales Act.

Operational impacts

8.6.38 Once operational, the effects of the Scheme would be limited to the effects of air quality changes, water quality changes from road drainage, fragmentation of habitats where animals are deterred from crossing the

road, the effects of vehicle collisions with animals and the effects of lighting around the roundabout junctions at either end of the Scheme. There is also the potential for amphibians to become trapped within the drainage system or on the road surface.

8.6.39 The air quality changes from the Scheme are documented in Chapter 13 Air Quality. The modelling of emissions from the operational Scheme showed a very small change in the amount of emissions although the location of emissions will be further to the north around Llanddewi Velfrey once the village is bypassed.

8.6.40 The DMRB only requires effects resulting from air quality emissions on designated sites to be considered within 200m of the Scheme. There are no designated sites within this distance of the Scheme. The effects of the very small-scale changes in emissions will be imperceptible in terms of the habitats and species within the study area.

8.6.41 During the operation of the Scheme, there is the potential for surface water run-off that would be contaminated with pollutants and particles from the road surface to enter watercourses. Furthermore, in the event of a traffic accident, spilled fuel or other pollutants could enter watercourses via the drainage network. This is considered to be a significant impact.

8.6.42 There is the potential for bats flying along the key flight routes identified by surveys to come into close proximity with road vehicles. Horseshoe bats (both species but especially lesser horseshoe) are particularly vulnerable to collision with vehicles as they will reduce their height to fly at ground level across open areas (Catherine Bickmore Associates, 2003). Given the high level of bat activity and importance of the horseshoe bat populations, the potential magnitude of this impact is considered to be moderate in the absence of mitigation. This is considered to be a significant impact.

8.6.43 There is the potential for dormice, badgers, otters and Section 7 mammals species to come in to contact with vehicles while crossing the Scheme, once it is operational. In the absence of mitigation, this is considered to be a low impact that would be not significant given the relatively low traffic volumes at night. The low traffic volumes at night along with the inclusion of oversized culverts with the engineering design mean that it is unlikely to give rise to long term barrier effects and the fragmentation of habitats. However, as badgers are a legally

protected species and given that the potential increased risk of traffic accidents as a result of trying to avoid hitting animals, mitigation measures are proposed below.

8.7 Mitigation

Design Mitigation

8.7.1 A number of culverts were included within the Scheme design to provide safe crossings for mobile animal species. This includes the oversizing of all stream culverts to 1.8m diameter to allow them to be used by bat species. The locations of culverts and underpasses is shown in Table 8.16 below and on the Environmental Master Plans.

Table 8.16 Culverts and underpasses included within the Scheme design with an ecological mitigation function

Chainage	Description	Provision
0+290	Mainline Cross Drainage Culvert	1.8m diameter pipe culvert approximately 31m in length with associated dry mammal underpass
1+680	NMU Underpass	Shared use bridleway underpass (unlit and suitable to be used bats and other mammals)
2+630	Pen-troydin-fach and Pen-troydin-fawr Farm Underpass	Shared Public Footway and Farm Underpass (Pen-troydin-fach and Pen-troydin-fawr) (unlit and suitable to be used bats and other mammals). This includes a watercourse. 3.2m wide with height of 2.7m above footway level. Approximately 55m in length.
3+000	Ecological Crossing point	1.8m diameter pipe for the crossing of Bats and badgers. 0.4m diameter pipe for the crossing of dormice. Approximately 48m in length
3+100	Watercourse crossing Culvert	1.8m diameter pipe culvert approximately 109m in length
3+115	Ecological Crossing Point	0.9m diameter mammal crossing approximately 85m in length
3+270	Watercourse crossing.	1.8m diameter pipe culvert approximately 108m in length with associated dry mammal underpass.
3+290	Pedestrian Underpass	3.3m wide, minimum 2.6m high public footpath underpass approximately 40m in length (unlit and suitable to be used bats and other mammals).
3+760	Mammal Underpass	0.6m diameter mammal underpass

8.7.2 Mammal underpasses for larger terrestrial mammals (otter, badger and Section 7 mammals) are provided through the inclusion of oversized stream culverts and underpasses set out in Table 8.16 above. The majority of these are located on existing stream corridors and hedgerows used by bats and other mammals within the landscape. The sizes of the culverts required for the water courses are considerably smaller than the sizes proposed. The larger sizes have been proposed so that these structures can provide safe passage for bat species beneath the Scheme.

8.7.3 In addition, a badger underpass designed in accordance with the advice provided in Volume 10 of the DMRB (specifically HA59/92) will be included at chainage 3+760. Mammal fencing has also been designed in accordance with DMRB to prevent mammals from accessing the carriageway and guide them to the underpasses and culverts. The arrangements of fencing and other associated planting is shown on the Environmental Management Plans. Planting will be used to guide bats and other mammal species to safe crossing points.

8.7.4 The proposed dormouse crossings are comprised of a 400mm diameter pipe buried within the embankment, through which branches and hemp ropes would be placed to provide a natural substrate to allow dormice to safely pass from one side to the other. Whilst it is not envisaged that these structures will be used on a regular basis, the are designed to provide a safe crossing for juvenile dormice dispersing from their parental territories. The indicative design of the dormouse crossings is shown in Image 1 below.

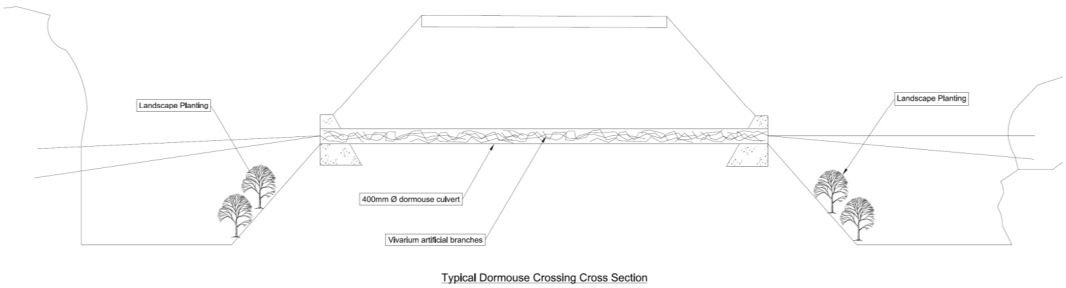

Image 1 Indicative design of dormouse crossings

8.7.5 The landscape planting design for the Scheme has aimed to provide replacement habitat for dormice within the Scheme footprint and maintain connectivity. The habitats proposed equate to over twice the area of dormouse habitat that will be lost during the construction of the Scheme as shown in Table 8.17.

Table 8.17 Comparison of dormouse habitat removed and proposed

Dormouse habitat removed	**Dormouse habitat proposed**
5.84ha	12.56ha
Compensation ratio 2.15:1	

8.7.6 Lighting proposals for the Scheme were restricted to the two roundabout junctions at Penblewin and Bethel Chapel, in order to avoid effects on ecological receptors such as bats, badgers and otter. Whilst the Bethel Chapel Junction will extend the area of existing road lighting to the east of Llanddewi Velfrey, the area of lighting at the Penblewin Junction will be reduced from its existing extent. The lighting proposed at the two junctions will include appropriate design features to limit the light spill from luminaires to avoid the lighting of vegetation within proximity to Scheme.

8.7.7 Fuel interceptors were included within the drainage network at the two roundabout junctions (where the risk of traffic accidents and therefore spills is greater) to allow pollution incidents to be contained. In addition, penstocks were included within the design of the attenuation ponds to allow pollution incidents to be contained. The inclusion of attenuation ponds will also allow particles from the road surface drainage to drop out of suspension reducing the amount that may be released to watercourses.

8.7.8 The landscape proposals for the Scheme (detailed in Chapter 9 Landscape and Visual Effects) were designed to provide replacement habitats both to compensate for the loss of woodland and grassland habitats, and to compensate for species such as dormice. As described above the planting will also encourage species such as the two horseshoe bat species towards underpasses and other safe crossing points. Existing trees will be retained where possible and larger specimens included to provide height to the vegetation on either side of the road and provide safe crossings for bats at each of the identified key crossing points as set out in Table 8.17 below. These safe crossing points are either underpasses or vegetation provisions located on either

side of the Scheme to provide similar crossing points to those being used by bats on the existing A40.

Table 8.18 Key bat flight routes (as shown on Volume 2 Figure 8.79) and mitigation provisions

Bat flight route	Chainage	Mitigation provision
A	0+500	Retained mature trees between existing A40 and Scheme. Inclusion of mature planting to north of the Scheme
B	1+020	Retain mature trees on south side of existing A40. Inclusion of mature planting to north of the Scheme
C	1+220	Retain mature trees on south side of existing A40. Inclusion of mature planting to north of the Scheme
D	1+510 – 1+820	Shared use bridleway underpass (unlit and suitable to be used bats and other mammals) at 1+680. Inclusion of planting to guide bats towards the underpass on both sides. Dimensions as per Table 8.16
E	2+210	Inclusion of planting on either side of the Scheme
F	2+320	Inclusion of planting on either side of the Scheme
G	2+620	Shared Public Footway and Farm Underpass (Pen-troydin-fach and Pen-troydin-fawr) (unlit and suitable to be used bats and other mammals). This includes a watercourse. Approximately 70m in length. Dimensions as per Table 8.16.
H	2+850	Llanfallteg Road Overbridge
I	3+000	1.8m diameter pipe for the crossing of Bats and Dormouse. Approximately 48m in length
J	3+100	1.8m diameter pipe culvert approximately 109m in length
K	3+270	1.8m diameter pipe culvert. Approximately 108m in length.
L	3+460	Inclusion of planting on either side of the Scheme

8.7.9 Lesser horseshoe bats were recorded using culverts as small as 1m in height[42], while some studies also suggest greater horseshoe will use structures of approximately 2m in diameter[40, 43]. Limpens et al. also report both lesser and greater horseshoe bats using vegetation to cross over road corridors[40].

[42] Limpens, H. J. G. A., Twisk, P. & Veenbaas, G., 2005. *Bats and Road Construction.* Delft, The Netherlands: Rijkswaterstaat.
[43] Catherine Bickmore Associates, 2003. *Review of Work Carried out on the Trunk Road Network in Wales for Bats,* Cardiff: Welsh Government & Countryside Council for Wales.

Construction Mitigation

8.7.10 The following mitigation principles and measures will be included within the Scheme during the Construction Phase through detailed design and the adherence to a Construction Environmental Management Plan (CEMP):

a) Pre-construction surveys will take place to ensure Schedule 1 birds species (notably barn owl) are not present within the construction area. If found, suitable mitigation measures/licences will be undertaken/obtained to allow the works to proceed. Such mitigation measures would include the timing of works to avoid disturbance along with an appropriate buffer around any identified nests

b) Licences will be required for bats, dormice and badgers (draft method statements are provided in Volume 3 Appendix 8.8);

c) The badger setts within 30m of the construction activities will be excluded, although where possible the exclusion will only be temporary;

d) Provision of one artificial badger setts (as shown on the EMPs) as a replacement for the main sett B1 which will require exclusion;

e) Pre-construction surveys including surveys of trees for bats, otter surveys and badger surveys;

f) Phased vegetation clearance to allow for the presence of amphibians, reptiles and dormice;

g) Where possible, vegetation clearance will take place outside of the bird breeding season and will be undertaken under the supervision of an ecologist;

h) If legally protected species are encountered during the clearance of the construction areas, work in that area will cease and relevant licenses obtained prior to the re-commencement of works;

i) The exclusion of bats from Trefangor Cottage at an appropriate time of year, under an appropriate licence;

j) Provision of a mix of bat box types on retained trees within the vicinity of Trefangor Cottage and along the length of the Scheme to compensate for the loss of the roost in Trefangor Cottage and disturbance to other roosts;

k) Pollution control measures in accordance with industry standards and the Pollution Prevention Guidelines published by the Environment Agency[44];

l) Measures to control and contain sediment and material arising from excavations in proximity to water courses, will be included

[44] It is noted that these Guidelines were withdrawn by the Environment Agency, however they are considered to still be relevant and applicable until such time as new guidance is available.

within the working method statements that will be developed as part of the agreed CEMP;

m) Implementation of an Invasive Species Management Plan, to be agreed with relevant statutory environmental bodies prior to construction, to ensure that legally controlled plant species are not spread outside of the working areas;

n) Restrictions on working hours to avoid night working and task lighting, such that no night working is undertaken in the vicinity of watercourses and key bat flight lines, and any task lighting elsewhere is restricted to ensure no light spill into adjacent habitats;

o) Excavations to be covered or a means of escape provided for animals;

p) Where possible, hedgerows affected by the construction works will be translocated to suitable receptor sites; and

q) Supervision by an Ecological Clerk of Works of vegetation clearance and the installation of any ecological mitigation incorporated within the Scheme design.

8.7.11 The proposed landscape planting within the Environmental Masterplans will provide compensation for the loss of dormouse habitat within the Scheme area. The provision of replacement habitat is subject to review however there currently will be no net loss of habitat area.

Enhancement Opportunities and Ecosystems Resilience

8.7.12 The downsizing of the existing A40 corridor between the parking area and Henllan Lodge has the potential to provide an area for the creation of wildflower grassland and other habitat types included within the TREBAP that will provide further habitat enhancement over and above the areas of grassland that will be lost to the Scheme during construction. Enhancement could also contribute to the objectives of the Green Corridors Initiative.

8.7.13 The inclusion of an oversized culvert at chainage 0+290m and ensuring that the pedestrian underpass at chainage 3+290m is unlit will provide additional features which can be used by bats and mammal species to safely cross the Scheme.

8.7.14 This grassland creation works will benefit pollinator populations in the area and thus contribute to the Action Plan for Pollinators[45]. The native woodland, scrub and hedgerow planting will also contribute to the aims

[45] Welsh Government, 2013. *Action Plan for Pollinators.* Cardiff: Welsh Government.

of this Action Plan by mitigating for the loss of and providing additional woodland habitats.

8.8 Monitoring Proposals

8.8.1 Monitoring (in addition to the supervision of the works outlined above and the auditing of mitigation measures) will be undertaken during the construction and aftercare periods. Monitoring should also be undertaken for five years post-construction, with any requirement beyond this, subject to agreement with the relevant statutory environmental bodies. The monitoring will include:

a) Monthly monitoring the effective use of underpasses by bats during the active period;
b) Quarterly monitoring the effective use of underpasses by badgers and otters;
c) Monitoring the use of replacement badger setts with motion activated cameras;
d) Quarterly monitoring of bat boxes;
e) Monitoring the use of dormouse crossings using motion activated cameras and hair tubes; and
f) Monitoring the effectiveness of landscape planting as documented in Chapter 9 Landscape and Visual Effects.

8.8.2 The results of the monitoring will be reported to NRW and other relevant statutory environmental bodies (including the local records centre) on an annual basis. In addition, the scope of the monitoring, methods and results will be discussed through further engagement with the Environmental Liaison Group during and post construction.

8.9 Residual Effects

8.9.1 The measures outlined above are considered sufficient to reduce the scale of construction impacts from the Scheme to levels which would not be considered significant for all of the receptors identified.

8.9.2 The creation of species rich grassland within Scheme will provide an enhancement in habitats within the local area for a range of species including foraging bats and Section 7 invertebrates. A comparison of the habitats to be lost and those created is shown in Table 8.19 below.

Table 8.19 Comparison of habitats lost and created during the construction of the Scheme

Habitat type	Area lost	Area created
Woodland habitats	3.49ha	6.66ha
Scrub and shrubs	0.67ha	2.83ha
Species rich grasslands	3.52ha	5.20ha
Improved grassland	21.71ha	6.19ha
Standing water	0.01ha	0.22ha
Watercourses and ditches	1.04km	4.95km
Hedgerows	5.59km	4.09km

8.9.3 The design measures outlined above are considered sufficient to reduce the predicted operation impacts to levels that would not be significant.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 9:
Landscape and Visual Effects

A40LVP-RML-ELS-SWI-RP-L-0001

P08 | S4

12/03/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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9 Landscape and Visual Effects

9.1 Chapter Introduction

9.1.1 This chapter presents the findings of the Landscape and Visual Impact Assessment (LVIA) for the Scheme.

9.1.2 The Scheme is described in Environmental Statement (ES) Chapter 2 The Project. Key issues, impacts and effects considered within this chapter include:

a) Direct physical changes to the landscape in terms of landform and surface elements, fragmentation of landscape features or designated areas and the introduction of moving vehicles;

b) Indirect effects on the character and quality of the landscape in terms of changes in the perception of the landscape through the introduction of new landscape elements;

c) Direct day and night-time effects on the amenity of visual receptors in terms of changes in views;

d) Indirect effects on views and visual receptors in terms of changes to public attitude and behaviour towards the use of a place.

9.1.3 This chapter presents the legislation and planning context, describes and evaluates the baseline landscape resource, views and visual amenity of visual receptors within a defined study area. The expected changes brought about by the Scheme during construction and operation, during day and night. The significance of the identified effect is identified in terms of change to land use, loss of landscape features, and the scale and duration of the Scheme within views.

9.1.4 The LVIA includes a combination of desk study review and field work during 2017. Field work was carried out when deciduous trees and plants were leafless during March 2017 and when the vegetation was in full leaf during July 2017. Further site visits were made to review specific receptor impacts and to take winter photographic records from key viewpoints.

9.1.5 An arboricultural survey of trees along the route was undertaken in July 2017. This provided the location, size, canopy spread and initial assessment of condition for individual trees and groups along the route. The arboricultural survey results are included in Volume 3 Appendix 9.3.

9.1.6 Mitigation was assessed as part of an iterative design and assessment process. The design approach is described in Section 9.7 of this chapter. This chapter should be read together with Figures 9.1 to 9.8 in Volume 2 and Appendices 9.1 to 9.6 in Volume 3 of this ES. The Environmental Master Plans (EMPs) are presented in Appendix 2.5.

9.2 Legislation and Policy Context

9.2.1 A review of topic specific published landscape policies and guidance was carried out to inform the LVIA and mitigation strategy. The following section summarises the relevant legislation and policy context.

Relevant Legislation

9.2.2 The following legislation is relevant to the Scheme and was considered:

a) National Parks and Access to the Countryside Act 1949;
b) The Countryside and Rights of Way (CRoW) Act 2000;
c) Wildlife and Countryside Act 1981;
d) The Natural Environment and Rural Communities (NERC) Act 2006;
e) Hedgerows Regulations 1997.
f) Well-being of Future Generations Act 2015.
g) Environment (Wales) Act 2016.

National Planning Policy

Planning Policy Wales

9.2.3 Landscape policy considerations and guidance are included in Planning Policy Wales (PPW) Edition 10 (Welsh Government, November 2016) and supplementary relevant Technical Advice Notes (TANs).

9.2.4 TANs relevant to the LVIA, and the environmental design of the Scheme and mitigation strategy include the following:

a) TAN 6 – *Planning for Sustainable Rural Communities* (2010), which provides guidance on how the planning system can support sustainable rural communities;

b) TAN 10 – *Tree Preservation Orders* (1997), which provides guidance on where local planning authorities are to make adequate provision for the preservation and planting of trees when granting planning permission through the process of making Tree Preservation Orders (TPOs);

c) TAN 12 – *Design* (2016), which provides guidance on how good design should be achieved through the planning process.

Welsh Government Circulars

9.2.5 Procedural guidance relevant to LVIA is given in Welsh Office and National Assembly for Wales Circulars include:

a) Welsh Office Circular 64/78 – *Trees and Forestry* (Department of the Environment, Welsh Office 1978);

b) Welsh Office Circular 5/93 – *Public Rights of Way* (Department of the Environment, Welsh Office 1993);

c) Welsh Office Circular 60/96 – *Planning and the Historic Environment: Archaeology* (Welsh Office 1996);

d) National Assembly for Wales (2002) Circular 31/01 – *Countryside and Rights of Way Act* (2000).

Local Planning Policy

Pembrokeshire County Council Local Development Plan

9.2.6 The *Local Development Plan* (adopted February 2013), includes the following relevant strategies and policies:

a) Plan Strategy 15 - *Rural Settlements* aims to encourage sustainable communities and a thriving rural economy;

b) Plan Strategy 16 - *The Countryside* aims to meet the requirements of people who live and work in the countryside whilst protecting the landscape and natural and built environment of Pembrokeshire and adjoining areas;

c) General Policy 22 – *Prior Extraction of the Mineral Resource* seeks to avoid inappropriate sterilisation of the mineral resource where the development is proposed;

d) General Policy 37 – *Protection and Enhancement of Biodiversity* is fundamental to Pembrokeshire and aims to ensure that species and their habitats are protected from potentially adverse effects of development;

e) General Policy 38 – *Protection and Enhancement of the Historic Environment* builds on national policy to draw attention to the

scale and significance of historic assets and protect, preserve and enhance them;

f) General Policy 39 – *Transport Routes and Improvements* safeguards planned road improvement schemes from development likely to prejudice their implementation.

Neighbouring Authorities: Carmarthenshire County Council Local Development Plan

9.2.7 The Scheme may be visible from parts of the neighbouring County of Carmarthenshire, with potential for distant views of significant earthworks across the undulating land to the north and north-east of Llanddewi Velfrey.

9.2.8 Carmarthenshire's *Local Development Plan* (adopted December 2014), includes the following relevant strategies and policies:

a) Strategic Policy 14 – *Protection and Enhancement of the Natural Environment* aims to protect, and wherever possible enhance the County's natural environment.

b) Environmental Quality Policy 1 – *Protection of Buildings, Landscapes and Features of Historic Importance* aims to preserve or enhance the built and historic environment.

c) Environmental Quality Policy 6 – *Special Landscape Areas* aims to permit only developments that enhance or improve Special Landscape Areas.

Neighbouring Authorities: Pembrokeshire Coast National Park Authority Local Development Plan

9.2.9 The Scheme may be visible from parts of the Pembrokeshire Coast National Park, with potential for distant views from high ground to the north and west.

9.2.10 Pembrokeshire Coast National Park's Local Development Plan (adopted September 2010), includes the following relevant policies:

a) Policy 13 – *Historic Landscape Parks and Gardens* refers to the introduction of the Heritage Protection Bill. Supplementary Planning Guidance is to be prepared.

9.2.11 Supplementary Planning Guidance to the Local Development Plan:

a) Landscape Character Assessment.

9.3 Assessment Methodology

Relevant Guidance

9.3.1 The assessment of landscape and visual effects was carried out in accordance with the methodology described within *Interim Advice Note 135/10 (W), · Landscape and Visual Effects · Wales Only* (Welsh Government, 2014), which replaces guidance in the *Design Manual for Roads and Bridges* (DMRB)*, Volume 11, Section 3, Part 5* (Highways Agency, 1993). IAN 135/10 (W) refers to Guidelines for Landscape and Visual Impact Assessment Third Edition (GLVIA3), published by the Landscape Institute and the Institute of Environmental Management and Assessment, 2013.

A. **Other relevant guidance documents include:**

a) LANDMAP, a formally adopted approach for landscape assessments, devised and maintained by Natural Resources Wales (NRW), and is available to view online at http://landmap-maps.naturalresources.wales/

b) Photography and Photomontage in Landscape and Visual Impact Assessment Advice Note 01/11 (Landscape Institute, 2011);

c) Roads in Lowland Areas Design Guide (Welsh Office, 1993);

d) Natural Resources Wales Guidance Notes on LANDMAP including GN4 LANDMAP and the Cultural Landscape (2016), and GN5 LANDMAP and the Geological Landscape (2016).

Study Area

9.3.2 In accordance with IAN 135/10 (W), an initial study area was identified for the assessment of landscape and visual effects that included the whole area from which the Scheme with traffic would theoretically be visible. This initial study area was based on a digital Zone of Theoretical Visibility (ZTV) created using GIS software and Ordnance Survey (OS) Terrain 50 height data, based on a 50m resolution Digital Terrain Model (DTM) and is presented in Volume 2 Figure 9.1.

9.3.3 A site survey in March and July 2017 was carried out to refine this initial study area to identify where potentially significant effects upon the existing landscape resource, views and visual amenity are likely to occur because of the Scheme.

9.3.4 13 representative viewpoints were selected to assess the effect of the Scheme on Landscape Character Areas (LCAs). Viewpoints are selected to assess the Scheme from a range of directions and distances. All viewpoints can be accessed from public roads, public rights of way, or open access areas. Undulating landform and surface features such as Pembrokeshire hedge-banks and areas of woodland limit locations with clear and uninterrupted views of the Llanddewi Velfrey ridge.

Approach to Identification of Baseline Conditions

Landscape Baseline

9.3.5 A review of the landscape resource and topography within the study area was carried out as part of the desk study with reference to the following relevant published sources to establish the national and regional landscape character:

a) Landscape Character Map for Wales (Countryside Council[1] for Wales and Land Use Consultants);
b) LANDMAP data system published by Countryside Council for Wales and maintained by Natural Resources Wales;
c) Landscape Character Assessment (Pembrokeshire Coast National Park Authority)
d) National and Local Planning Policy as outlined is Section 9.2;
e) Ordnance Survey 1:25,000 Explorer and 1:50,000 Landranger maps;
f) Aerial photography.

9.3.6 Information contained within LANDMAP's 5 aspect layers forms the basis for LCAs. This is combined with field work assessment to define the LCA boundaries. Local LCAs within the study area are identified by:

a) Organizing the landscape into areas of distinct, consistent and recognisable character.
b) Describing the key characteristics such as landcover and pattern, scale and appearance, human interaction and tranquillity, sense of place and scenic quality, seasonal interest and night time activities.
c) Assessing their condition and quality using criteria described in Table 9.1.

[1] Countryside Council for Wales is now called Natural Resources Wales

d) Considering their importance or value using criteria described in Table 9.1, which take into account any landscape, ecological or cultural heritage designations, and any assets of local significance without designation that may be valued by local communities.

e) Considering their ability to accommodate the Scheme without unjustifiable change to the baseline condition and/or the achievement of landscape strategies and policies.

9.3.7 Field work assessments were carried out during winter (early March) and summer (July) of 2017 to validate the findings of the desk study.

Visual Baseline

9.3.8 The visual baseline assessment describes and analyses people that may have specific or general views of the study area, which may be changed by the Scheme.

9.3.9 A desk study was carried out, with reference to the following technical sources:

a) Ordnance Survey 1:25,000 and 1:50,000 small scale maps;

b) Ordnance Survey 1:1,250 and 1:2,500 large scale maps;

c) Aerial photography;

d) Arboriculture survey carried out as part of the Environmental Impact Assessment process.

9.3.10 The following features were identified during this process:

a) Potential screening features, including substantial vegetation, buildings and urban areas;

b) Potential visual receptors such as residential properties, business properties, Public Rights of Way and recreation areas.

9.3.11 Field work was carried out during winter and summer of 2017. This has identified the number and type of properties from which people would experience a change in view, the nature of the view and the activity and sensitivity of the viewer.

9.3.12 To assess the change in view from locations without public access, or from specific dwellings, the terrain model used to generate a ZTV which was analysed and simple visualisations showing areas of cut, fill and road surface were created.

Consultations

9.3.13 During the LVIA process, consultation has taken place with stakeholders. Consultation includes the agreement of LVIA methodology, the extent of the LVIA study area, the identification of visual receptors, location of representative viewpoints and photomontages, and the requirements for mitigation.

9.3.14 During the consultation period no request for specific viewpoints were received. All viewpoint locations were based on professional judgment and are at locations accessible to the public.

Assessment Criteria and Assignment of Significance

Landscape Receptor Sensitivity: Overview

9.3.15 The sensitivity of a landscape is a combination of judgements of a landscape receptor's ability to accommodate change of the type proposed (in this case a new highway with its associated forms and infrastructure), and the quality of the landscape receptor established during the baseline assessment.

Landscape Receptor Sensitivity: Determining Quality

9.3.16 The criteria used to assess the quality (and condition), of the elements that make up the baseline landscape are set out in Table 9.1. Landscape Quality is a combination of judgements based on the physical condition of the landscape and the value attached to it, often based on designation or recognition as expressed by national or local consensus.

Table 9.1 Landscape Value Criteria and Descriptors[2]

Value	Criteria
Outstanding	Internationally recognised value and importance, e.g. World Heritage Site, National Park. Nationally recognised value and importance, e.g. Area of Outstanding Natural Beauty. Aesthetically pleasing areas with a strong sense of place and may be rare in terms of character type. Usually containing sites of historic, cultural, geological or natural habitat importance. These areas may be important tourist destinations.
High	Regionally recognised value and importance as defined by local authority designations, e.g. Special Landscape Area or Historic Landscape Area. Some picturesque attributes that are aesthetically pleasing, and some features that are fragmented and/or spoilt. The area may be associated with tourism although it would not be the main destination.
Moderate	Non-designated landscape with some features of value or a distinguishable landscape structure. The areas are unlikely to contain a coherent and aesthetically pleasing composition but may be appreciated locally.
Low	Non-designated landscape with limited aesthetically pleasing scenery, where characteristics are fragmented and/or spoilt. The areas are unlikely to contain tourist attractions and are unlikely to be rare in character type. Not likely to contain sites of local importance as defined by local authority designations.

9.3.17 The relevant LANDMAP character areas, including each of the five aspect layers, were identified in Volume 3 Appendix 9.2 for each local LCA. The values attached to the LANDMAP aspect areas are included and are used to inform the judgement of the value of the LCAs.

Landscape Receptor Sensitivity: Determining Sensitivity

9.3.18 Taking into consideration the Landscape Quality, the criteria to assess the landscape sensitivity is used to inform the assessment of Construction Effects (Section 9.5), and Operational Effects (Section 9.7), in a response to the nature of change caused by the Scheme. These were derived from the methodology and examples in IAN 135/10 (W), Annex 1, Table 2, which are presented in Table 9.2.

[2] Source: Based GLVIA 3 and developed in tabular form for use by Richards Moorehead & Laing Ltd

Table 9.2 Landscape Sensitivity and Typical Examples

Sensitivity	Typical example
High	Landscapes which by nature of their character would be unable to accommodate change of the type proposed. Typically, these would be: a) Of high quality with distinctive elements and features making a positive contribution to character and sense of place; b) Likely to be designated, but the aspects which underpin such value may also be present outside designated areas, especially at the local scale; c) Areas of special recognised value through use, perception or historic and cultural associations; d) Likely to contain features and elements that are rare and could not be replaced.
Medium	Landscapes which by nature of their character would be able to partly accommodate change of the type proposed. Typically, these would be: a) Comprised of commonplace elements and features creating generally unremarkable character but with some sense of place; b) Locally designated, or their value may be expressed through non-statutory local publications; c) Containing some features of value through use, perception or historic and cultural associations; d) Likely to contain some features and elements that could not be replaced.
Low	Landscapes which by nature of their character would be able to accommodate change of the type proposed. Typically, these would be: a) Comprised of some features and elements that are discordant, derelict or in decline, resulting in indistinct character with little or no sense of place; b) Not designated; c) Containing few, if any, features of value through use, perception or historic and cultural associations. d) Likely to contain few, if any, features and elements that could not be replaced.

Visual Receptor Sensitivity: Overview

9.3.19 The sensitivity of the visual receptor is a judgement of the type of change to views and visual amenity brought about by the Scheme and the activity of the viewer.

Visual Receptor Sensitivity: Determining Sensitivity

9.3.20 Visual amenity receptors are identified during the desk study and verified during field survey work. The extent and nature of their views are described, and the sensitivity of the receptors defined.

9.3.21 Criteria used to assess the visual sensitivity are derived from IAN 135/10 (W), Annex 2, Table 1, which are presented in Table 9.3.

Table 9.3 Visual Receptor Sensitivity and Typical Descriptors

Sensitivity	Type of visual receptor
High	Residential properties. Users of Public Rights of Way or other recreational trails (e.g. National Trails, footpaths, bridleways etc. Users of recreational facilities where the purpose of that recreation is enjoyment of the countryside (e.g. Country Parks, National Trust or other access land etc.)
Medium	Outdoor workers Users of scenic roads, railways or waterways or users of designated tourist routes. Schools and other institutional buildings, and their outdoor spaces.
Low	Indoor workers Users of main roads (e.g. trunk roads), or passengers in public transport on main arterial routes. Users of recreational facilities where the purpose of that recreation is not related to the view (e.g. sports facilities).

Magnitude of Impact

9.3.22 For the purpose of both landscape and visual impact assessment, impacts were graded according to their scale and magnitude. The following aspects are used to determine the magnitude of impact.

a) The size or scale of the impact, i.e. the quantity of landscape elements that would be affected and the proportion that this represents within the character area or the extent of views that would be changed, and whether the changes affect key characteristics of the landscape or views;
b) Geographical extent, i.e. the area which the Scheme would influence;
c) Duration and reversibility of impact, i.e. whether the impact is short term to long term and whether the impact is permanent or can be reversed to its original condition.

9.3.23 In accordance with IAN 135/10 (W), impacts are rated to a five-point scale of major, moderate, minor, negligible (adverse or beneficial), and no change.

9.3.24 Terms used to describe the magnitude of landscape impacts are derived from IAN 135/10 (W), Annex 1, Table 1, and presented in Table 9.4.

Table 9.4 Magnitude and Nature of Landscape Impact and Typical Descriptors

Magnitude	Typical descriptors
Major Adverse	Total loss or large-scale damage to existing character or distinctive features and elements, and/or the addition of new and uncharacteristic conspicuous feature and elements.
Moderate Adverse	Partial loss or noticeable damage to existing character or distinctive features and elements, and/or the addition of new and uncharacteristic features and elements.
Minor Adverse	Slight loss or damage to existing character or features and elements, and/or the addition of new and uncharacteristic features and elements.
Negligible Adverse	Barely noticeable loss or damage to existing character or features and elements, and/or the addition of new and uncharacteristic features and elements.
No Change	No noticeable loss, damage or alteration to character or features or elements.
Negligible Beneficial	Barely noticeable improvement in character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.
Minor Beneficial	Slight improvement of character by the restoration of existing features and elements and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic features.
Moderate Beneficial	Partial or noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic and noticeable features and elements, or by the addition of new characteristic features.
Major Beneficial	Large scale improvement of character by the restoration of features and elements, and/or the removal of uncharacteristic and conspicuous elements, or by the addition of new distinctive features.

9.3.25 Terms used to describe the magnitude of visual impacts are derived from IAN 135/10 (W), Annex 2, Table 2, and presented in Table 9.5.

Table 9.5 Magnitude of Visual Impact and Typical Descriptors

Magnitude	Typical descriptors
Major	The Scheme, or a part of it, would become the dominant feature or focal point of the view.
Moderate	The Scheme, or a part of it, would form a noticeable feature or element of the view, which is readily apparent to the receptor
Minor	The Scheme, or a part of it, would be perceptible but not alter the overall balance of features and elements that comprise the existing view.
Negligible	Only a very small part of the project would be discernible, or it is at such a distance that it would form a barely noticeable feature or element of the view.
No Change	No part of the project, or work or activity associated with it is discernible.

9.3.26 Criteria applies to both negative (adverse), and positive (beneficial), due to the nature of the change according to their scale or magnitude. Where the Scheme, or a part of it, would become a detracting feature or focal point of the view, this is assessed as negative. Where the Scheme, or part of it, would result in an improvement in the view, this is assessed as a positive.

Significance of Effect

9.3.27 The magnitude of impact and the sensitivity of the receptor are combined to establish the significance of effect, which is expressed as a scale ranging from neutral to very large. The scale can be positive and negative. This is in accordance with IAN 135/10 (W). The matrix used to determine the Significance of Effect is the same for both Landscape and Visual Impact. Derived from 1AN 135/10 (W), Annex 1, Table 3; and Annex 2, Table 3, the Significance of effect matrix is presented in Table 9.6.

9.3.28 Effects falling within the categories moderate to very large are considered to be significant for the purpose of this assessment.

Table 9.6 Significance of Effect Categories (Landscape and Visual Impact)

		Magnitude of Impact				
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
Sensitivity	**High**	Neutral	Slight	Moderate	Large	Very Large
	Medium	Neutral	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Neutral	Slight	Moderate

9.3.29 The terms used to describe the landscape and visual impact significance of effect categories are presented in Table 9.7 and Table 9.8. They are derived from IAN/135/10 (W), Annex 1, Table 4; and Annex 2, Table 4 respectively.

Table 9.7 Typical Descriptors of Landscape Significance of Effects Criteria

Effects	**Descriptors**
Very Large Beneficial Effect	The Scheme would: Greatly enhance the character (including quality and value), of the landscape; Create an iconic, high quality feature and/or series of elements; Enable a sense of place to be created or greatly enhanced.
Large Beneficial Effect	The Scheme would: Enhance the character (including quality and value), of the landscape; Enable the restoration of characteristic features and elements lost as a result of changes from inappropriate management or development; Enable a sense of place to be enhanced.
Moderate Beneficial Effect	The Scheme would: Improve the character (including quality and value), of the landscape; Enable the restoration of characteristic features and elements lost or diminished as a result of changes from inappropriate management or development; Enable a sense of place to be restored.

Effects	Descriptors
Slight Beneficial Effect	The Scheme would: Complement the character (including quality and value), of the landscape; Maintain or enhance characteristic features and elements; Enable a sense of place to be retained.
Neutral Effect	The Scheme would: Maintain the character (including quality and value), of the landscape; Blend in with characteristic features and elements; Enable a sense of place to be retained.
Slight Adverse Effect	The Scheme would: Not quite fit the character (including quality and value), of the landscape; Be at variance with characteristic features and elements; Detract from a sense of place.
Moderate Adverse Effect	The Scheme would: Conflict with the character (including quality and value), of the landscape; Have an adverse impact on characteristic features and elements; Diminish from a sense of place.
Large Adverse Effect	The Scheme would: Be at considerable variance with the character (including quality and value), of the landscape; Degrade or diminish the integrity of a range of characteristic features and elements; Damage a sense of place.
Very Large Adverse Effect	The Scheme would: Be at complete variance with the character (including quality and value), of the landscape; Cause the integrity of characteristic features and elements to be lost; Cause a sense of place to be lost.

Table 9.8 Typical Descriptors of Visual Impact Significance of Effects Criteria

Effects	Descriptors
Very Large Beneficial Effect	The Scheme would create an iconic new feature that would greatly enhance the view.
Large Beneficial Effect	The Scheme would lead to a major improvement in a view from a receptor of high sensitivity.
Moderate Beneficial Effect	The Scheme would cause obvious improvement to a view from a receptor of medium sensitivity, or perceptible improvement to a view from a receptor of high sensitivity.

Effects	Descriptors
Slight Beneficial Effect	The Scheme would cause limited improvement to a view from a receptor of medium sensitivity or would cause greater improvement to a view from a receptor of low sensitivity.
Neutral Effect	No perceptible change in view.
Slight Adverse Effect	The Scheme would cause limited deterioration to a view from a receptor of medium sensitivity or would cause greater deterioration to a view from a receptor of low sensitivity.
Moderate Adverse Effect	The Scheme would cause obvious deterioration to a view from a receptor of medium sensitivity, or perceptible to a view from a receptor of high sensitivity.
Large Adverse Effect	The Scheme would lead to a major deterioration to a view from a receptor of high sensitivity and would constitute a major discordant feature in the view.
Very Large Adverse Effect	The Scheme would cause the loss of views from a receptor of high sensitivity and would constitute a dominant discordant feature in the view.

9.3.30 Elements shown on the EMPs (presented in Volume 3 Appendix 2.5) are included as an integral and 'committed' part of the design of the Scheme and, as such, were taken into account in the initial assessment of potential effects. Measures included as part of the Scheme design are described in Section 9.5.

Essential Mitigation

9.3.31 Land identified in the Draft Orders includes land required for various engineering purposes and some further land required for environmental mitigation. Where possible mitigation has been provided within that permanent land take and is therefore within the Compulsory Purchase Order as 'Title'. All of the mitigation provided on land taken as 'Title is Essential for mitigation for landscape integration, visual screening or ecological purposes.

9.3.32 Further land is included within the CPO in several locations to provide some further environmental benefit; this is taken as Title for Mitigation. Principally this would be as extra land required as Essential Mitigation to provide compensation for areas of suitable habitat for dormouse or additional visual screening or landscape integration. Wherever possible this land is taken from severed portions of fields. Immediately west of Ffynnon Wood a strip of land would be taken on both sides of the proposed road for mitigation purposes to connectivity of habitat for bats and for landscape

integration. On the south side the established roadside strip of woodland is required to provide separation of the diverted bridleway and Non-Motorised User (NMU) route from the A40. On the north side providing similar mitigation would require two triangular plots of grassland land.

Limitations of the Assessment

9.3.33 The visual assessment was carried out from publicly accessible viewpoints without direct access to residential properties or business premises. To ensure a robust assessment, the following measures were taken:

a) Use of a digital terrain model for the ZTV that takes into account landform.

b) Use of large-scale OS maps and aerial photography to determine where a straight line of sight may be available to the Scheme, taking into account topography and large intervening features such as substantial vegetation and buildings.

c) Site surveys to verify the ZTV, and to assess the views available from footpaths, bridleways, local roads, open space and land with public access.

d) Assessing seasonal and night-time variations.

9.4 Baseline Environment

Landscape Designations

9.4.1 The landscape and visual study area overlap with some protected designations, which reflect the importance of the Taf and Cleddau Vales. The location of designated landscapes are presented in Volume 2 Figure 9.4.

Pembrokeshire Coast National Park

9.4.2 The National Park has a varied landscape and can be divided into four distinct sections. The preliminary ZTV overlaps a part of the Daugleddau Estuary section and the Preseli Hills section.

9.4.3 The Daugleddau Estuary section of the National Park is more than 5km west of Penblewin Roundabout at its nearest point in Canaston. The ZTV intersects a very small section to the north and west of the Eastern Cleddau where the A40 marks the boundary of the National

Park and an area of Picton Park and Slebech Park. A significant amount of woodland and hedgerows with trees interrupts eastward views. There would be no view of the proposal from the Cleddau Estuary section of the National Park.

9.4.4 The Preseli Hills Section of the National Park is more than 10km north of the Scheme at its nearest point near Llangolman. The ZTV intersects the ridge and south facing slopes of the Preseli Hills. The Hills provide a dramatic backdrop to northward views from Llanddewi Velfrey. From the Preseli Hills, the Llanddewi Velfrey ridge is not a prominent feature of southward views, the ridge from between Templeton and Tavernspite further south is higher and is more prominent. Predicted landscape and visual effects on the Preseli Hills section of the National Park are considered in Sections 9.5 and 9.7.

Blackaldern Registered Park and Garden

9.4.5 Blackaldern is a Grade II registered garden originating from the early 19th Century and is about 2.3km south of Penblewin Roundabout. A significant area of woodland separates the garden from the B4314 and the Lampeter Vale railway line. The garden is also located on a south facing slope of a small valley. A combination of terrain and surface features would interrupt any views of the Scheme.

Landshipping Registered Park and Garden

9.4.6 Landshipping is a Grade II* registered garden originating from the 17th Century is more than 1km south-west of Penblewin Roundabout. It does not intersect the ZTV as intervening terrain interrupts views. There would be no effect on Landshipping.

Picton Castle Registered Park and Garden

9.4.7 Picton Castle is a Grade II* registered park originating from the 18th Century and is located about 10km west of Penblewin Roundabout. The ZTV intersects an area referred to as the deer park that is located to the north and east of the Castle. The park is surrounded by woodland and plantations that direct views to those that feature the Eastern Cleddau south of the Castle and the Park. There would be no view of the Scheme.

Slebech Park Registered Park and Garden

9.4.8 Slebech is a Grade II* registered park originating from the 17th Century and is located more than 6km due west of Penblewin Roundabout. The ZTV intersects an area at the western edge of Slebech Park where it bounds Picton Park. A significant amount of woodland intervenes in eastward views and would interrupt views of the Scheme.

Molleston Baptist Chapel Registered Park and Garden

9.4.9 Molleston is a Grade II registered garden dating from the 18th Century and is located more than 5km south-west of Penblewin Roundabout. It does not intersect the ZTV as intervening terrain interrupts views. There would be no effect on Molleston.

Milford Haven Waterway Historic Landscape

9.4.10 Milford Haven Waterway is more than 5km due west of Penblewin Roundabout at its nearest point at Canaston bridge. It is divided into 48 historic LCAs. The ZTV intersects two of these.

9.4.11 Picton and Slebech is an estate-based area that includes parts of Picton and Slebech Parks and some ground to the north. Only a small part of the character area intersects the ZTV, and similarly to the registered parks, eastward views are limited by significant woodland and plantations.

9.4.12 Toch is an agricultural area that contains dispersed farms set within fields with hedgerow boundaries and woodland. The A40 crosses this character area. The ZTV intersects an area of high ground to the west of Toch. From higher ground distant views eastward are available where gaps in hedgerows allow. Views of the Scheme would be interrupted by surface features near to Robeston Wathen and Redstone Cross.

9.4.13 There would be no effect on the Milford Haven Waterway Historic Landscape.

Preseli Historic Landscape

9.4.14 Preseli is located about 7km due north of the Scheme at its nearest point at Efailwen. It is divided into 27 historic LCAs. The ZTV intersects those upland areas that are on the southern side of the

Preseli Mountain. Many of these upland areas have few trees and an open aspect with uninterrupted southward views.

9.4.15 Predicted landscape and visual effects on the Preseli Hills section of the National Park are considered in Sections 9.6 and 9.7.

Taf and Tywi Estuary Historic Landscape

9.4.16 Taf and Tywi Estuary is located more than 11km due east of Bethel Chapel. It is divided into 48 historic LCAs. The ZTV intersects only a very small part of one of these, namely Treventy.

9.4.17 Treventy is an agricultural area that features a very unusual field system. Farms are divided into large areas with straight line boundaries, but within these the field shapes are small in scale and irregular in shape. The ZTV intersects a moderate area of rolling farmland east of the Afon Taf. Due to the long distance and a combination of surface features there would be no effect on the Taf and Tywi Estuary Historic Landscape.

National and Regional Landscape Character and Context

9.4.18 Wales is divided into 48 regional scale LCAs that are presented as The Landscape Character Map for Wales. The Scheme is located within Landscape Character Area 44: Taf and Cleddau Vales, which describes at a regional level its visual and sensory, geological, habitats, historic and cultural influences.

9.4.19 The Taf and Cleddau vales are defined as a broad and undulating agricultural lowland. It forms a rural hinterland to settlements and populous areas. The area is dissected by numerous river valleys, often with wooded slopes, and is crossed by main roads and railways. Overall, the area is enclosed with mature hedgerows and Pembrokeshire hedge-banks. A network of narrow lanes connect the villages and rural settlements.

Landscape Character Areas (LCAs)

9.4.20 LCAs, each with consistent character, were identified within the study area and are shown on Volume 2 Figure 9.6. They are derived from the five LANDMAP aspect layers and are at a similar or finer level of

detail. The Visual and Sensory aspect areas are used as a starting point and then refined by the other four aspect layers and field survey work. LANDMAP aspect areas that overlap the LCAs are summarised in Volume 3 Appendix 9.1. LCA descriptions of physical and perceptual characteristics and assessment of sensitivity are described in Volume 3 Appendix 9.2.

Landscape Character Area 1: Llawhaden

9.4.21 LCA1 is a part of the large LANDMAP PMBRK-VS-042 Clarbeston Road aspect area to the north-east of Haverfordwest that lies between the Western Cleddau and Eastern Cleddau rivers. It extends south to the A40 and north to the Afon Syfni. Only a very small part of the character area within the community of Llawhaden falls within the 5km study area.

9.4.22 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of moderate scenic quality is judged as being of moderate landscape value. A rolling landform with an enclosed character that would be at a long distance from the Scheme suggests a landscape with a low susceptibility to change. Landscape sensitivity is judged as being low.

Landscape Character Area 2: New Moat

9.4.23 LCA2 is part of the large LANDMAP PMBRK-VS-044 aspect area that lies between the Carmarthen to Fishguard railway line and the Preseli Hills. It is made up of upland areas of pastoral farmland separated by wooded valleys. Only a small part of the LCA lies within the 5km study area, featuring parts of the community of New Moat.

9.4.24 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of high scenic quality is judged as being of high landscape value. A rolling landform with an open character that would be at a long distance from the Scheme suggests a landscape with a medium susceptibility to change. Landscape sensitivity is judged as being medium.

Landscape Character Area 3: Eastern Cleddau

9.4.25 LCA3 is the lowland valley of the Eastern Cleddau from Blackpool Bridge near Slebech Park to where it becomes an upland valley just

north-east of Llandissilio, and a main tributary the Afon Syfni from the confluence with the Eastern Cleddau to the dam at Llys-y-frân Reservoir. The Afon Syfni forms the boundary between the communities of Llawhaden and New Moat, whereas the Eastern Cleddau runs through Llawhaden and forms the boundary between New Moat and the communities of Llandissilio West and Clynderwen.

9.4.26 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of high scenic quality is judged as being of high landscape value. A valley landform with an enclosed character that would be at a long distance from the Scheme suggests a landscape with a low susceptibility to change. Landscape sensitivity is judged as being medium.

Landscape Character Area 4: Narberth

9.4.27 LCA 4 consists of the urban extent of the village of Narberth including Narberth Railway Station.

9.4.28 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of moderate scenic quality is judged as being of medium landscape value. A built-up area with an enclosed character that would be at an intermediate distance from the Scheme suggests a character area with a low susceptibility to change. Landscape sensitivity is judged as being low.

Landscape Character Area 5: Templeton

9.4.29 LCA 5 is a large aspect area between the Eastern Cleddau and the Afon Taf. To the north, it extends to the Carmarthen to Fishguard railway and to the south it extends to the A477 Trunk Road. It surrounds Narberth and the sides of the Lampeter Vale. It contains parts of the communities of Llawhaden to the east of the Eastern Cleddau, Templeton, Narberth Rural, Llanddewi Velfrey, Lampeter Velfrey, Ludchurch and Crunwere.

9.4.30 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of moderate scenic quality is judged as being of medium landscape value. A rolling landform with a mixed sense of enclosure that would be directly affected by the Scheme suggests a landscape with a medium susceptibility to change. Landscape sensitivity is judged as being medium.

9.4.31 The area that would be directly affected by the Scheme is undulating ground predominantly in agricultural use. Elements within the Scheme footprint include improved grassland fields, Pembrokeshire hedge-banks, woodland, roadside plantations, unmanaged hedgerows, mature trees, managed hedges, rush pasture grassland, main roads, tracks, agricultural building ruins at Penblewin Farm and one dwelling at Trefangor Cottage.

Landscape Character Area 6: Mid Tâf Vale

9.4.32 LCA 6 includes the Afon Tâf from Whitland to Llanfallteg and some tributary valleys, also a section of the Carmarthen to Haverfordwest railway line between Whitland and the Eastern Cleddau. It includes parts of the communities of Clynderwen, Cilymaenllwyd South, Henllanfallteg, Llanddewi Velfrey and Whitland.

9.4.33 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of high scenic quality is judged as being of high landscape value. A flat valley with a mixed sense of enclosure that would be at an intermediate distance from the Scheme suggests a landscape with a medium susceptibility to change. Landscape sensitivity is judged as being medium.

Landscape Character Area 7: Llandissilio

9.4.34 LCA7 is an upland aspect area located between the Eastern Cleddau and Afon Tâf rivers, it extends north to Efailwen and as far south as Clynderwen. The character area lies within the communities of Clynderwen and Llandissilio West.

9.4.35 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of high scenic quality is judged as being of high landscape value. A rolling/plateau landform with an open character that would be at a long distance from the Scheme suggests a landscape with a medium susceptibility to change. Landscape sensitivity is judged as being medium.

Landscape Character Area 8: Lampeter Vale

9.4.36 LCA8 is a small character area that is limited to the lowland valley of the Afon Marlais west of its confluence with the Afon Tâf. Afon Marlais forms the boundary between the communities of Llanddewi Velfrey and Lampeter Velfrey.

9.4.37 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of moderate scenic quality is judged as being of medium landscape value. A valley landform with an enclosed character that would be at an intermediate distance from the Scheme suggests a landscape with a low susceptibility to change. Landscape sensitivity is judged as being medium.

Landscape Character Area 9: Upper Cwm Tâf

9.4.38 LCA9 is a lowland valley section of the Afon Tâf and tributaries north of Llanfallteg. It overlaps parts of the communities of Cilymaenllwyd South and Henllanfallteg.

9.4.39 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of high scenic quality is judged as being of high landscape value. A valley landform with an enclosed character that would be at a long distance from the Scheme suggests a landscape with a low susceptibility to change. Landscape sensitivity is judged as being medium.

Landscape Character Area 10: Cwmfelin Boeth

9.4.40 LCA10 is an area of rolling lowland located in-between the upper Afon Tâf and Afon Gronw to the north of Whitland and the A40. It overlaps the communities of Henllanfallteg, Pontyfenni and a small part of Llanboidy.

9.4.41 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be moderate scenic quality is judged as being of moderate landscape value. A rolling landform with an open character that would be at an intermediate to long distance from the Scheme suggests a landscape with a medium susceptibility to change. Landscape sensitivity is judged as being medium.

Landscape Character Area 11: Whitland

9.4.42 LCA11 is the urban extent of Whitland and Trevaughan.

9.4.43 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of moderate scenic quality is judged as being of medium landscape value. A built-up area with an open character that would be at a long distance from the Scheme suggests a

character area with a low susceptibility to change. Landscape sensitivity is judged as being low.

Landscape Character Area 12: Brandy Hill

9.4.44 LCA12 is an area of rolling lowland to the south of Whitland and the Afon Tâf. It overlaps parts of the communities of Ciffig. The area is predominantly one of north facing slopes with views of rural Carmarthenshire and the Preseli Hills. The slopes are incised by wooded valleys that drain into the Afon Tâf.

9.4.45 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of moderate scenic quality is judged as being of medium landscape value. A rolling landform with an open character that would be at a long distance from the Scheme suggests a landscape with a medium susceptibility to change. Landscape sensitivity is judged as being medium.

Landscape Character Area 13: Cwm Gronw

9.4.46 LCA13 is a lowland valley of the Afon Gronw and tributaries north of the ruins of Whitland Abbey. It lies within the community of Pontyfenni.

9.4.47 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of high scenic quality is judged as being of high landscape value. A valley landform with an enclosed character that would be at a long distance from the Scheme suggests a landscape with a low susceptibility to change. Landscape sensitivity is judged as being medium.

Landscape Character Area 14: Ciffig Wooded Valleys

9.4.48 LCA14 is a series of wooded valleys that drain the northern slopes of Brandy Hill. They are mostly within the community of Ciffig.

9.4.49 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of moderate scenic quality, is judged as being of medium landscape value. A valley landform with an enclosed character that would be at a long distance from the Scheme suggests a landscape with a low susceptibility to change. Landscape sensitivity is judged as being low.

Landscape Character Area 15: Whitland to Pont-y-Fenni

9.4.50 LCA15 is an area of rolling lowland to the east of Whitland. It overlaps parts of the communities of Whitland North, Whitland South, Ciffig and Pontyfenni.

9.4.51 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of moderate scenic quality is judged as being of medium landscape value. A rolling landform with an open character that would be at a long distance from the Scheme, and one already influenced by the A40 road corridor, suggests a landscape with a low susceptibility to change. Landscape sensitivity is judged as being low.

Landscape Character Area 16: Hiraeth Upland

9.4.52 LCA16 is an area of rolling hills, a small section of the LANDMAP CRMRT-VS-259 aspect area that covers a large part of the Carmarthenshire hills between the Afon Tâf and Afon Gwili. It overlaps Henllanfallteg and small parts of Llanboidy and Cilymaenllwyd South communities.

9.4.53 On the basis of the information contained in Volume 3 Appendix 9.1 and 9.2, this LCA, deemed to be of moderate scenic quality is judged as being of medium landscape value. A rolling landform with an open character that would be at a long distance from the Scheme suggests a landscape with a medium susceptibility to change. Landscape sensitivity is judged as being medium.

Table 9.9 Summary of Landscape Character Areas

LCA Name	Landscape Value	Susceptibility to change	Landscape Sensitivity
01 – Llawhaden	Medium	Low	Low
02 – New Moat	High	Medium	Medium
03 – Eastern Cleddau	High	Low	Medium
04 – Narberth	Medium	Low	Low
05 – Templeton	Medium	Medium	Medium
06 – Mid Tâf Vale	High	Medium	Medium
07 – Llandissilio	High	Medium	Medium
08 – Lampeter Vale	Medium	Low	Medium
09 – Upper Cwm Tâf	High	Low	Medium
10 – Cwmfelin Boeth	Medium	Medium	Medium
11 – Whitland	Medium	Low	Low
12 – Brandy Hill	Medium	Medium	Medium
13 – Cwm Gronw	High	Low	Medium
14 – Ciffig Wooded Valleys	Medium	Low	Low
15 – Whitland to Pont-y-Fenni	Medium	Low	Low
16 – Hiraeth Upland	Medium	Medium	Medium

Visual Receptors

Receptors within LCA1 - Llawhaden

9.4.54 The ZTV intercepts a moderate part of this LCA, the summits, ridges and east facing slopes of the lowland hills between elevations of about 60-112 m AOD. Receptors include residents of Llawhaden village, small groups of dwellings, isolated farms, users of public roads and footpaths, and outdoor workers. Narrow lanes and public rights of way link the properties, many cross ridgelines and local high points. The visual amenity of this area is influenced by a moderate tree cover that limits views of neighbouring areas. Due to the long distance (2 to 5km or more), between the LCA and the Scheme, and the extent and density of the wooded areas there would be no view of the Scheme.

9.4.55 During hours of darkness, the A40 road lighting at Canaston Bridge is visible in southern part of this LCA.

Receptors within LCA2 – New Moat

9.4.56 The ZTV intercepts the majority of this LCA, including the summits, ridges, south and east facing slopes of the lowland hills between elevations of about 50-238 m AOD, but these are very long-distance views between 5-12km away from the Scheme. Receptors include residents of small hamlets such as Bletherston, Penffordd and New Moat, small groups of dwellings, users of public roads and public rights of way, and outdoor workers. Narrow lanes and public rights of way link the dispersed settlements, most following ridge-lines in-between the steep sided valleys.

9.4.57 During hours of darkness, there is very little light generated within the LCA, and the lighting at roundabouts and settlements along the A40 and A478 road corridors is visible.

Receptors within LCA3 – Eastern Cleddau

9.4.58 The ZTV intercepts a very small part of this LCA and is limited to areas of woodland on steep valley sides. There are no visual receptors within LCA3.

9.4.59 During hours of darkness, the A40 road lighting at Canaston Bridge is visible in southern part of this LCA.

Receptors within LCA4 – Narberth

9.4.60 The ZTV intercepts the north-eastern quadrant of this settlement. Being a built-up area, visual receptors with a possible view are limited to residents and workers at the outer edges of the settlement. The landscape between Narberth and the Scheme is one of pastoral fields bounded by hedgerows and lines of trees that interrupt views from Narberth itself. Narberth Station occupies an elevated position to the east of Narberth, there is inter-visibility with Penblewin Roundabout.

9.4.61 During hours of darkness, Narberth is the main source of light pollution. Lighting at Penblewin Roundabout is visible in north to north-eastward views from the settlement outskirts.

Receptors within LCA5 - Templeton

9.4.62 The ZTV intercepts a moderate part of this LCA. Near to the Scheme, within 0.5km, receptors that may experience a change in view are

residents living along the A40 corridor from west of Penblewin Roundabout to east of Llanddewi Velfrey, users of public roads and public rights of way and outdoor workers. Receptors near to the Scheme are likely to experience direct and significant changes to visual amenity, although areas of woodland and field boundary hedgerows and trees would limit the amount of change perceptible.

9.4.63 At an intermediate distance, between 0.5-2km, receptors include residents of scattered dwellings and farms on the north facing lower slopes of the Llanddewi Velfrey ridge, north-east of Narberth and south-east of Great Vaynor, users of public roads and public rights of way, and outdoor workers. A significant change to view would be limited by undulations in the terrain, areas of woodland and field boundary hedgerows and trees.

9.4.64 At long distance, between 2-5km, receptors within the ZTV include residents in the hamlets of Bethesda, Narberth Mountain, Cold Blow, Princes Gate, villages of Robeston Wathen, Lampeter Velfrey and Tavernspite. The ZTV takes no account of surface features such as the substantial amount of woodland, lanes and fields bounded by tall hedgerows on the upper slopes and summit of the Llanddewi Velfrey ridge. This accumulation of tree cover would interrupt views of the Scheme from Cold Blow, Lampeter Velfrey and Tavernspite. From parts of Bethesda, Narberth Mountain and Robeston Wathen, where there is a gap in vegetation, slight views of commercial vehicles and road traffic using the A40 near to Penblewin Roundabout are available if looked for. The Scheme would not cause a significant detrimental change to visual amenity here.

9.4.65 During hours of darkness, Oakwood leisure park, Canaston Bridge roundabout, Robeston Wathen roundabout, Penblewin Roundabout, Llanddewi Velfrey village and Blaencilgoed Quarry contribute to night time light pollution within the LCA, but Narberth and Whitland are the main sources.

Receptors within LCA6 - Mid Tâf Vale

9.4.66 The ZTV intercepts the majority of this LCA, the open valley floor, ridges and south facing slopes between elevations of about 25-130 m AOD. Receptors include residents of Clunderwen and Llanfallteg West, small groups of dwellings, isolated farms, users of public roads and public rights of way, and outdoor workers. Narrow lanes link the clusters of dwellings and tend to follow broad ridges in-

between small river valleys. Landcover is mostly pastoral farmland, but there is a significant amount of woodland and hedgerows with trees that interrupt southward views towards the Scheme from low lying areas north of the Carmarthen to Fishguard railway line. Views of the north-facing slopes of Llanddewi Velfrey ridge are available to dwellings and narrow lanes located on the broad ridges. To the south of the railway line, a view of the Scheme would be available to dwellings in the outskirts of Clunderwen with southward and westward aspects, the narrow road connecting the A487 to Llanfallteg Road and dwellings and public footpaths accessed from it.

9.4.67 During hours of darkness, there is a little light spill from Clunderwen and the A487 corridor, but most of the area is dark. Street lights at Penblewin Roundabout and Llanddewi Velfrey are noticeable.

Receptors within LCA7 - Llandissilio

9.4.68 The ZTV intersects the majority of this LCA, the rolling hills, ridges and south facing slopes between elevations of about 50-137 m AOD. Receptors include residents on the outskirts of Llandissilio, small groups of dwellings, isolated farms, users of public roads and public rights of way, and outdoor workers. There is a good degree of inter-visibility between Llandissilio and Llanddewi Velfrey as they both occupy relatively high-ground among the river valleys surrounding them. Distant views of the Scheme would be introduced to visual receptors in Llandissilio.

9.4.69 During hours of darkness, there is a little light spill from Llandissilio, the A487 corridor and small groups of settlements distributed along the minor roads. Street lights in Llanddewi Velfrey are noticeable.

Receptors within LCA8 - Lampeter Vale

9.4.70 The ZTV intersects a minor part of this LCA. A steep sided valley cuts through the Llanddewi Velfrey ridge to the south of Bethel Chapel and Gwyndy Farm at the eastern end of the Scheme, along which a theoretical view would be available. The head of the valley and the valley sides are well wooded and would interrupt the view of the Scheme. There would be no view available.

9.4.71 During hours of darkness, Lampeter Vale has very little light source. Light from isolated farms around the vale sides and Lampeter Velfrey village have a little night-time influence.

Receptors within LCA9 - Upper Cwm Tâf

9.4.72 The ZTV intersect the majority of this LCA, the valley of the Afon Tâf flows in a north to south direction and runs in a perpendicular direction to the Scheme. This is a well wooded and enclosed valley. Distant views of the Scheme would be limited to a small number of isolated locations where a gap in vegetation offers a glimpse out of the valley. The Scheme would not cause a significant detrimental change to visual amenity here.

9.4.73 During hours of darkness, there is very little light source within the valley, and very little night-time influence from neighbouring areas.

Receptors within LCA10 – Cwmfelin Boeth

9.4.74 The ZTV intersects the majority of this LCA, the rolling hills, ridges and south and west facing slopes between elevations of about 25-165 m AOD. Receptors include residents of small settlements of Llanfallteg, Rhydywrach, Henllan Amgoed, small groups of dwellings, isolated farms, users of public roads and public rights of way, and outdoor workers. Views of the Llanddewi Velfrey ridge from Cwmfelin Boeth feature Cwm-bryn, Cwmmau and Tre-wern woodland areas, which effectively screen the location of the Scheme from most of the LCA.

9.4.75 During hours of darkness, light sources at Whitland influence the south-east of the LCA. Elsewhere the LCA is generally dark, views of light glow from Llanddewi Velfrey and A40 corridor feature in night-time views.

Receptors within LCA11 – Whitland

9.4.76 The ZTV intersects the northern half of this built-up area. Buildings limit a potential view to all but those with eastward profiles on the western outskirts of North Road in Whitland. Receptors include occupiers of dwellings, workers in community buildings and users of sports facilities. Views eastward towards Llanddewi Velfrey are interrupted by an accumulation of woodland and roadside plantations alongside the existing A40.

9.4.77 During hours of darkness, Whitland and roundabouts on the A40 contribute a significant amount of night-time light pollution. The Scheme is unlikely to cause a noticeable addition to this.

Receptors within LCA12 – Brandy Hill

9.4.78 The ZTV intersects a moderate part of the north facing slopes, to the north of the A477. Small groups of dwellings, isolated farms and public roads and public rights of way with west to northward profiles would be included among visual receptors. Woodland near to the summit of the Llanddewi Velfrey ridge would interrupt views of the Scheme from this LCA.

9.4.79 During hours of darkness, the settlements along, and vehicles using the A477 and B4314 road corridors have influence over this LCA. The Scheme is unlikely to cause noticeable change.

Receptors within LCA13 – Cwm Gronw

9.4.80 The ZTV intersects a very small part of this LCA, hills and ridges between elevations of about 100-180 m AOD. Views from public roads would be a very long distance, beyond 5km, and would feature a significant amount of woodland on the slopes to the north-east of Llanddewi Velfrey.

9.4.81 During hours of darkness, lights at Whitland have a little influence on the southern parts of this LCA. The Scheme is unlikely to cause significant change.

Receptors within LCA14 – Ciffig Wooded Valley

9.4.82 The ZTV intersects a minor part of this LCA, wooded slopes between elevations of about 20-100 m AOD. Woodland within the LCA, and near to the summit of the Llanddewi Velfrey ridge would interrupt views of the Scheme from this LCA.

9.4.83 During hours of darkness, this LCA is influenced by light generated in Whitland and from clusters of dwellings along, and vehicles using the B4328 road corridor. The Scheme in unlikely to cause significant change.

Receptors within LCA15 – Whitland to Pont-y-Fenni

9.4.84 The ZTV intersects a moderate part of this LCA, gently undulating slopes rising from the Afon Tâf between elevations of about 20-140 m AOD. Visual receptors would include users of sport facilities, small clusters of dwellings and rural businesses, users of public roads

and public rights of way, and outdoor workers. An accumulation of field boundary hedgerows and built up areas of Whitland interrupt westward views for the majority. Views across to Lampeter Vale and the eastern part of the Llanddewi Velfrey ridge are available to users of the minor road that climbs towards the telecommunications mast, and dwellings accessed from it.

9.4.85 During hours of darkness, this LCA is influenced by light sources in Whitland and along the A40 corridor.

Receptors within LCA16 – Hiraeth Upland

9.4.86 The ZTV intersects a moderate part of this LCA, rolling hills, ridges and south-west facing slopes between elevations of about 50-200 m AOD. Receptors include residents of smalls clusters of dwellings, isolated arms, users of public roads and public rights of way, and outdoor workers. Distant views of the Llanddewi Velfrey ridge feature the wooded areas on the steep north-eastern slopes, which would be a visual barrier to views of the Scheme.

9.4.87 During hours of darkness, this LCA has very little night-time influence. A view of the glow caused by street lights at Llanddewi Velfrey is possible

9.5 Assessment of Potential Construction Effects

9.5.1 This assessment considers the effects of the Scheme during the construction phase, when existing vegetation would be cleared from the footprint of the scheme, and exposed earthworks and moving construction machinery would be visible. The assessment takes account of the predicted effect and the worst case, without mitigation. The assumption is that no advance mitigation would be carried out.

Potential Construction Landscape Effects

Pembrokeshire Coast National Park

9.5.2 The susceptibility to change of the Preseli Hills section of the National Park to the Scheme is low. This is based on being a long distance from the Scheme and the availability of panoramic views of large tracts of Carmarthenshire and Pembrokeshire. Llanddewi Velfrey ridge is not a prominent feature when viewed from the Preseli Hills.

9.5.3 The value of the Preseli Hills section of the National Park is outstanding. This is a designated landscape of national importance. Combining low susceptibility and outstanding value, the Preseli Hills is assessed as being of medium sensitivity.

9.5.4 Potential effects on physical aspects: The Scheme would not directly affect the National Park. There would be no physical change to the landform or landcover features within this section of the National Park.

9.5.5 Potential effects on perceptual aspects: Long distance views of the construction works would be available if looked for. The perception of an exposed upland landscape would not change due to new earthworks, construction activities or loss of surface features. During hours of darkness, task lighting may be visible, but change would be difficult to distinguish in such a broad view that takes in large settlements and industrial areas.

9.5.6 The magnitude of effect of the Scheme on the Preseli Hills is no change. This is based on a negligible size/scale of effect and short-term duration of construction works.

9.5.7 As a result, the significance of landscape effect is judged as neutral.

Preseli Historic Landscape

9.5.8 The Preseli Historic Landscape overlaps the National Park. The susceptibility to change of the Historic Landscape to the Scheme is low. This is based on being at a long distance away from the Scheme, and the varied landform of the area consisting of pastoral ridges, wooded river valleys, exposed moorland hills, and settlements and mineral excavations connected by a network of roads.

9.5.9 The value of the Historic Landscape is high. It is partly within a statutorily designated landscape. Combining low susceptibility and high value, the Preseli Historic Landscape is assessed as being of low sensitivity.

9.5.10 Potential effects on physical aspects: The Scheme would not directly affect this Historic Landscape. There would be no physical change to the landform or landcover features within this area.

9.5.11 Potential effects on perceptual aspects: Long distance views of the construction works would be available if looked for from ridges and the upper parts of south facing slopes. The perception of a mixed landscape consisting of settled and remote areas would not change due to new earthworks, construction activities or loss of surface features. During hours of darkness, task lighting may be visible, but change would be temporary and difficult to make out.

9.5.12 The magnitude of effect of the Scheme on the Preseli Historic Landscape is no change. This is based on combining a negligible size/scale of effect and short-term duration of construction works.

9.5.13 As a result, the significance of landscape effect is judged as neutral.

LCA1: Llawaden

9.5.14 The sensitivity of this LCA to the Scheme is low. This is based on the distance from the Scheme and the significant amount of surface features which would impede any views.

9.5.15 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.16 Potential effects on perceptual aspects: With no view of construction works available, the perception of a tranquil undulating rural landscape would not change due to new earthworks, construction activity and loss of surface features. During hours of darkness, task lighting at individual locations and security lighting at the site compound would not be visible.

9.5.17 As a result, there would be no change due to construction. Overall the LCA would experience a neutral significance of effect.

LCA2: New Moat

9.5.18 The sensitivity of this LCA to the Scheme is medium. This is based on an upland rural landscape of high value and scenic quality that has a visual connection with the lowland ridge of Llanddewi Velfrey.

9.5.19 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.20 Potential effects on perceptual aspects: The perception of a tranquil, undulating rural landscape would not change despite construction activity associated with earthworks to the north of Llanddewi Velfrey being visible in long distance views. During the hours of darkness, task lighting at individual locations would be visible, and the glow of security lighting at the site compound would contribute to the existing glow of street lights at Llanddewi Velfrey.

9.5.21 As a result, there would be a negligible adverse magnitude of effect. Overall the LCA would experience a neutral significance of effect.

LCA3: Eastern Cleddau

9.5.22 The sensitivity of this LCA to the Scheme is medium. This is based on a high landscape value, one already influenced by the existing A40, but with no visual connection to the Llanddewi Velfrey ridge.

9.5.23 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.24 Potential effects on perceptual aspects: With no view of construction works available, the perception of a tranquil lowland valley landscape would not change due to new earthworks, construction activity and loss of surface features. During hours of darkness, task lighting at individual locations and security lighting at the site compound would not be visible.

9.5.25 As a result, there would be no change due to construction. Overall the LCA would experience a neutral significance of effect.

LCA4: Narberth

9.5.26 The sensitivity of this LCA to the Scheme is low. This is based on a townscape of medium quality with little visual connection to the Llanddewi Velfrey ridge.

9.5.27 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.28 Potential effects on perceptual aspects: The perception of a bustling urban landscape would not change due to preparatory works, new

earthworks and construction activity. A view of construction works at Penblewin would be available to the Narberth Station area. During the hours of darkness, task lighting at Penblewin would not change the darkness levels of the landscape.

9.5.29 As a result, there would be negligible adverse magnitude of effect due to construction. Overall, the LCA would experience a neutral significance of effect.

LCA5: Templeton

9.5.30 The sensitivity of this LCA to the Scheme is moderate. This is based on the presence of trunk road infrastructure, power distribution and settlement within the area.

9.5.31 Potential effects on physical aspects: All the Scheme is located within this LCA. Construction activity would involve preparatory works such as the removal of surface features (i.e. buildings, trees, hedges), and construction activity associated with all earthworks and structures. Adjacent to the existing A40 to the west of Llanddewi Velfrey would be the main construction compound.

9.5.32 The construction of a new road would require a large amount of earthworks movement, cutting across north facing slopes and filling in steep sided valleys. The presence of construction plant and machinery would industrialise the rural landscape. The new bridge structure at Llanfallteg Road would create a new raised form within undulating landscape. The layout of the existing Llanfallteg road would change to enable construction of the bridge. The layout of the existing A40 would change from Henllan Lodge, through Ffynnon Wood, to the tie-in with the Scheme to the west of Llanddewi Velfrey, and also from the tie-in to the east of Llanddewi Velfrey through to Bethel Chapel.

9.5.33 The construction activity would change the mosaic of pastoral farmland and woodland, from one of agriculture and forestry to construction work areas. Vegetation along field boundaries and areas of woodland would be lost, resulting in an opening up of the landscape in places. The pattern of grassland and woodland would change to accommodate construction works.

9.5.34 One dwelling, Trefangor Cottage, would be lost.

9.5.35 Potential effects on perceptual aspects: The perception of an undulating, tranquil (in places away from the existing A40), rural landscape would change due to new earthworks, structures, construction activity and loss of surface features. During hours of darkness, task lighting at individual locations and security lighting at the main compound would result in a localised change to the darkness of the area.

9.5.36 As a result, there would be a major adverse magnitude of effect due to construction. Overall, the LCA would experience a large adverse significance of effect.

LCA6: Mid Tâf Vale

9.5.37 The sensitivity of this LCA to the Scheme is high. This is based on the absence of main roads within the area, the high landscape value, scenic quality and visual relationship between the lowland valley and the Llanddewi Velfrey ridge. This LCA does include a large-scale solar farm that contributes an element of industrial character to the area.

9.5.38 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.39 Potential effects on perceptual aspects: The perception of a tranquil gently undulating landscape would change due to preparatory works, new earthworks, new structures and construction activities. Works activities on the north facing slopes from Pen-troydin-fach through to Bethel Chapel would be visible to the settlements of Clunderwen, and Llafallteg West, to small groups of dwelling and isolated farms, public roads and rights of way. During hours of darkness, task lighting at individual locations would be visible, and where landform partially interrupts a direct view the glow would be visible.

9.5.40 As a result, there would be a moderate adverse magnitude of change. Overall, the LCA would experience a large adverse significance of effect.

LCA7: Llandissilio

9.5.41 The sensitivity of this LCA to the Scheme is moderate. This is based on the presence of main roads and settlements and its distance from the Scheme.

9.5.42 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.43 Potential effects on perceptual aspects: The perception of an undulating rural landscape would not change despite construction activity associated with earthworks to the north of Llanddewi Velfrey being visible in long distance views. During the hours of darkness, task lighting at individual locations would be visible.

9.5.44 As a result, the magnitude of impact would be negligible detrimental. Overall, the LCA would experience a neutral significance of effect.

LCA8: Lampeter Vale

9.5.45 The sensitivity of this LCA to the Scheme is moderate. This is based on a tranquil, low lying enclosed rural landscape directly to the south of the Llanddewi Velfrey ridge.

9.5.46 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.47 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

9.5.48 As a result, the magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA9: Upper Cwm Tâf

9.5.49 The sensitivity of this LCA to the Scheme is moderate. This is based on a tranquil and enclosed rural valley with little visual connection to the Llanddewi Velfrey ridge.

9.5.50 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.51 Potential effects on perceptual aspects: The perception of a tranquil and enclosed rural landscape would not change despite construction activity associated with earthworks to the north of Llanddewi Velfrey being visible in long distance views. During the hours of darkness, task lighting at individual locations would be visible from isolated locations in the area.

9.5.52 As a result, the magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA10: Cwmfelin Boeth

9.5.53 The sensitivity of this LCA to the Scheme is moderate. This is based on an active, undulating rural landscape with some element of industrial character, with visual links to the Llanddewi Velfrey ridge.

9.5.54 Potential effects on physical aspects: There would be no perceptual change to the character area due to the Scheme.

9.5.55 Potential effects on perceptual aspects: With a view of construction works interrupted by significant areas of woodland, the perception of the undulating rural landscape would not change. During hours of darkness, task lighting at individual locations and security lighting at the site compound may be perceived as a glowing effect.

9.5.56 As a result, the magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA11: Whitland

9.5.57 The sensitivity of this LCA to the Scheme is low. This is based on an active townscape with rural outskirts already affected by the existing A40, and no direct visual link with the Llanddewi Velfrey ridge.

9.5.58 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.59 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

9.5.60 As a result, the magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA12: Brandy Hill

9.5.61 The sensitivity of this LCA to the Scheme is moderate. This is based on an active rural landscape influenced by roads, telecoms and energy distribution structures, with a visual link to the south side of the Llanddewi Velfrey ridge.

9.5.62 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.63 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

9.5.64 As a result, the magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA13: Cwm Gronw

9.5.65 The sensitivity of this LCA to the Scheme is low. This is based on a tranquil and enclosed valley landscape at a long distance from the Scheme.

9.5.66 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.67 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

9.5.68 As a result, the magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA14: Ciffig Wooded Valley

9.5.69 The sensitivity of this LCA to the Scheme is low. This is based on a tranquil and enclosed rural and wooded valley landscape with no visual links to the Llanddewi Velfrey ridge.

9.5.70 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.71 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

9.5.72 As a result, the magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA15: Whitland to Pont-y-Fenni

9.5.73 The sensitivity of this LCA to the Scheme is low. This is based on an active rural landscape that is already influenced by the A40 road corridor and is at a long distance from the Scheme.

9.5.74 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.75 Potential effects on perceptual aspects: A view of construction works would be interrupted by significant areas of woodland. The perception of the undulating rural landscape would not change. During hours of darkness, lighting at nearby Whitland would stand out over other areas.

9.5.76 As a result, the magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA 16: Hiraeth Upland

9.5.77 The sensitivity of this LCA to the Scheme is moderate. This is based on a tranquil, undulating rural landscape with visual links to the Llanddewi Velfrey ridge from isolated locations.

9.5.78 Potential effects on physical aspects: The Scheme would not directly affect this LCA. There would be no physical change to the landform or landcover features within the character area.

9.5.79 Potential effects on perceptual aspects: With a view of construction works partially interrupted by significant areas of woodland, the perception of the undulating rural landscape would not change. During hours of darkness, task lighting at individual locations and security lighting at the site compound may be perceived as a glowing effect.

9.5.80 As a result, the magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Potential Construction Visual Effects During Day

9.5.81 The potential effects of the construction phase upon views from each of the representative viewpoints from LCAs, residential properties, Public Rights of Way (PRoWs), other land with public access, schools/community facilities and business properties identified by the study were assessed. The results of the assessment are presented in the schedules included in the Representative Viewpoints in Volume 3 Appendix 9.4. The schedules are accompanied by a series of visual receptor location plans (Volume 2 Figures 9.7 and 9.8), which are cross referenced to the Visual Effects Schedules (included in Volume 3 Appendices 9.5 and 9.6), by means of a unique number. The predicted significance of effect for each receptor for each phase of the Scheme is shown graphically on these plans.

Receptors within Pembrokeshire Coast National Park and Preseli Hills Historic Landscape Viewpoint A

9.5.82 Views of the Scheme are theoretically available, but the distance is such that earthworks would be very difficult to distinguish. There may be a glimpse of the changes if looked for in the view.

9.5.83 There would be a neutral significance of effect on visual amenity.

Receptors within LCA1 – Llawhaden

9.5.84 Receptors would have no views of the Scheme due to intervening vegetation and topography. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA2 – New Moat

9.5.85 Receptors would have long distance views of earthworks activities occurring at Pen-troydin-fach and Pen-troydin-fawr, between chainages 2+500 and 3+000. The extent of work visible would occupy a very small part of the overall view, and changes occurring would be very difficult to distinguish unless looked for in the view.

9.5.86 There would be a neutral significance of effect on visual amenity.

Receptors within LCA3 – Eastern Cleddau

9.5.87 Receptors would have no views of the Scheme due to intervening vegetation and topography. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA4 – Narberth

9.5.88 For the majority of the settlement, there would be no view of the Scheme available due to intervening landform and surface features. Residents of dwellings at Station Road and Station Approach that have northward aspects are able to see Penblewin Roundabout.

9.5.89 A glimpse of construction vehicles may be visible whilst works are carried out to the roundabout. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA 5 – Templeton Viewpoint B, C, E, F, G, H, I, J, K.

9.5.90 Viewpoint B represents the view from undulating farmland with dispersed settlement to the north of the A40 and west of the A478. The area is served by the B4313, from which narrow country lanes branch out and connect to neighbouring areas. The road-sides feature hedge-banks that limit outward views. Where there is a gap in these roadside boundaries, such as a field access gate, views across the pastoral landscape are available. From the ridges and hills the view of the existing A40 is screened by roadside hedges, although commercial vehicles and road junction signs are visible.

9.5.91 Penblewin Roundabout itself and the A40 to the east of it are screened from view, as would construction activities. There would be a neutral

significance of effect upon visual amenity to residents and outdoor workers.

9.5.92 Viewpoint C represents the view from the A40 west of Penblewin Roundabout. Change noticeable would include the removal of a small area of woodland, roadside trees and hedges to the north and west of Penblewin farmhouse as part of preparatory works, and the reconfiguration of the existing street lights during construction.

9.5.93 For road users the magnitude of visual impact would be a moderate detrimental one, and the significance of visual effect slight adverse. For countryside workers the magnitude of visual impact would be moderate detrimental, and the significance of effect moderate adverse.

9.5.94 Viewpoint E represents the view from a public footpath (SP19/31/3), and private access track north of the A40 and east of Penblewin Roundabout. Change visible would include the removal of parts of field boundary hedge-banks during preparatory works to accommodate the Scheme and the local access road to Trefangor Cemetery (ch 0+500 and 0+600). Earthworks activities would involve the removal of topsoil and excavation of a sidelong cutting. The footpath and track would be directly affected and shortened. Views to east and west are limited by Pembrokeshire hedge-banks.

9.5.95 For recreational users the magnitude of visual impact would be a moderate detrimental one, and the significance of visual effect large adverse.

9.5.96 Viewpoint F represents the view from a public footpath (SP19/36/3), and private access track east of Trefangor cemetery and north of Henllan Lodge. A similar view is available to the dwelling at Penca'rmaenau. Change visible during preparatory works would include the removal of a series of field boundary hedges and hedge banks in eastward views at Pen-troydin-fach and Pen-troydin-fawr (ch 2+200, 2+320, 2+450, 2+630). Earthworks activities visible would include the removal of topsoil, the excavation of Pen-troydin-fach cutting and Pen-troydin-fawr cutting, the construction of Pen-troydin-fach embankment, Llanfallteg Road overbridge, West Llanddewi Velfrey junction and Ffynnon Wood junction.

9.5.97 For recreational users and residents, the magnitude of visual impact would be a major detrimental one, and the significance of visual effect very large adverse.

9.5.98 Viewpoint G represents the view available to dwellings that reside on the unclassified road that connects Llanddewi Velfrey to Henllan, and a public footpath (SP19/23/1), that links to the A40. Changes visible during preparatory works would include the removal of part of a roadside plantation and hedgerow (ch 1+880 to 1+940 and 2+060 to 2+100). Earthworks activities visible would include the removal of topsoil, excavation of part of Penblewin-fach cutting, the construction of West Llanddewi Velfrey junction and Ffynnon Wood junction. The proposed site compound would also be visible.

9.5.99 For recreational users and residents, the magnitude of visual impact would be a minor detrimental one, and the significance of visual effect moderate adverse.

9.5.100 Viewpoint H represents the view available to road users travelling southward along Llanfallteg Road. Changes visible during preparatory works would include the removal of hedgerows and trees (ch 2+625 and 2+820 to 2+900). Earthworks activities visible would include the removal of topsoil, the excavation of Pen-troydin-fawr cutting, the construction of Llanfallteg road overbridge and Blaen-pentroydin embankment. Llanfallteg road would be directly affected and temporarily diverted during construction.

9.5.101 For road users, the magnitude of visual impact would be a major detrimental one, and the significance of effect moderate adverse.

9.5.102 Viewpoint I is representative of the view available to residents of Glan Preseli with northward aspects. The landform drops gently northwards which would limit the view of construction activities. Changes visible during preparatory works would include the removal of hedgerows and trees (ch 2+840 to 2+850). During the initial stages of earthworks activities construction vehicles may be visible whilst removing topsoil.

9.5.103 For residents, the magnitude of visual impact would be a minor detrimental one, and the significance of effect moderate adverse.

9.5.104 Viewpoint J represents the view from a public footpath (SP19/1/1), to the north of Blaen-pentroydin. The ground here drops steeply northward. The footpath would be directly affected by the Scheme and would be diverted through a culvert at ch.3+280 and connect with paths SP19/2/1 and SP19/3/2. Changes visible during preparatory works would include the removal of hedgerows with trees at ch.3+100, 3+260 to 3+300. Earthworks activities visible would include the removal of topsoil, the construction of stream and footpath culverts, and the construction of the Blaen-pentroydin embankment. The north-facing embankment slope would be higher than the south-facing slope.

9.5.105 For recreational users, the magnitude of visual impact would be major detrimental one, and the significance of visual effect very large adverse. For countryside workers, the significance of visual effect would be large adverse.

9.5.106 Viewpoint K represents the view from a private track and public footpath SP19/4/6 to the north of Bethel Chapel. Visible change brought about by construction activities would include the removal of a hedge and mature trees at ch.3+780 and part of a hedge-bank at ch.4+000 during preparatory works. Earthworks activities would include the removal of topsoil, the excavation of Bethel Roundabout and the construction of a new access road to Bethel Chapel, Bethel Cottage and the Vestry. There would be a significant change to the landform.

9.5.107 For recreational users and residents of dwellings nearby, the magnitude of visual impact would be a major detrimental one, and the significance of visual effect very large adverse.

Receptors within LCA6 Mid Tâf Vale

9.5.108 Viewpoint D represents the view from the southern outskirts of Clunderwen. A few dwellings with eastward or southward aspects would have a distant view of the Scheme where it bypasses the village of Llanddewi Velfrey and crosses the northern slopes of the ridge. Changes visible during construction would include the removal of field boundaries and areas of woodland between ch.2+400 and 3+600, the removal of topsoil, the excavation of Pen-troydin-fach cutting, Pen-troydin-fawr cutting, construction of Pen-troydin-fach embankment and Blaen-pentroydin embankment. Bethel Chapel cutting may also be visible as a notch cut in the line of the horizon.

9.5.109 For residents with a distant view of the major earthworks activities, the magnitude of visual impact during construction would be a negligible detrimental one, the significance of visual effect slight adverse.

Receptors within LCA7 Llandissilio

9.5.110 Receptors would have long distance views of earthworks activities occurring at Pen-troydin-fach and Pen-troydin-fawr, between chainages 2+500 and 3+000. The extent of work visible would occupy a very small part of the overall view, and changes occurring would be very difficult to distinguish unless looked for.

9.5.111 The magnitude of visual effect would be no change. There would be a neutral significance of effect on visual amenity.

Receptors within LCA8 Lampeter Vale

9.5.112 Receptors would have no views of the Scheme due to intervening vegetation and topography. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA9 Upper Cwm Tâf

9.5.113 The majority of receptors would have no views of the Scheme due to intervening vegetation and topography. Some isolated properties would have a glimpse of earthworks activities. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA10 Cwmfelin Boeth

9.5.114 Viewpoints L and M represent the view from narrow country lanes connecting the dispersed settlements and isolated dwellings throughout the area. The road-sides feature hedge-banks and hedges that limit outward views. Where there is a gap in these roadside boundaries, such as a field access gate, a view of the slopes to the north-east of Llanddewi Velfrey are available. The existing A40 is just visible at Bethel Chapel, a glimpse of commercial vehicles can be obtained, and the crests of cutting slopes where the A40 enters the east of Llanddewi Velfrey. Visible change brought about by construction activities would include the removal of field boundaries and mature trees between ch.3+780 and ch.4+000 during preparatory works. Earthworks activities would include the removal of topsoil, the

excavation of Bethel Roundabout and the construction of a new access road to Bethel Chapel, Bethel Cottage and the Vestry.

9.5.115 The magnitude of visual effect to road users would be a minor detrimental one. The Significance of visual effect would be neutral.

Receptors within LCA11 Whitland

9.5.116 Receptors would have no views of the Scheme due to intervening surface features. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA12 Brandy Hill

9.5.117 Receptors would have no views of the Scheme due to intervening landform and vegetation. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA13 Cwm Gronw

9.5.118 Receptors would have no views of the Scheme due to intervening landform and vegetation. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA14 Ciffig Wooded Valley

9.5.119 Receptors would have no views of the Scheme due to intervening landform and vegetation. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA15 Whitland to Pont-y-Fenni

9.5.120 Receptors would have no views of the Scheme due to intervening surface features. There would be a neutral significance of effect upon their visual amenity.

Receptors within LCA16 Hiraeth Upland

9.5.121 Receptors would have long distance views of earthworks activities occurring west of Bethel Chapel, between chainages 3+500 and 4+000. The extent of work visible would occupy a very small part of the overall view, and changes occurring would be very difficult to distinguish unless looked for.

9.5.122 The magnitude of visual effect would be no change. There would be a neutral significance of effect on visual amenity.

Potential Construction Visual Effects During Night

9.5.123 Temporary significant adverse effects are predicted for some representative viewpoints in the construction phase during day time. A number of the viewpoints represent public footpaths and minor roads. The frequency of use during hours of darkness is predicted to be very low.

Representative Viewpoint A

9.5.124 Night-time influence on the south-facing slopes and ridges of the Preseli Hills would be dominated by those sourced at Milford Haven and Haverfordwest. Night-time activities associated with the construction of the Scheme would not cause noticeable change.

Representative Viewpoint B

9.5.125 A glimpse of task specific lighting at Penblewin Roundabout may be available where gaps in roadside hedge-banks allow. The impact of construction lighting would be reduced by the presence of street lighting at Penblewin. The significance of effect on visual amenity would be neutral.

Representative Viewpoint C

9.5.126 Occasional views of lighting from construction works at Penblewin Roundabout would be experienced at this viewpoint. The impact of construction lighting would have a temporary slight adverse significance of effect.

Representative Viewpoint D

9.5.127 Views of task lighting at Pen-troydin-fach and Pen-troydin-fawr are likely to increase the night-time influence of Llanddewi Velfrey village and the scattered rural settlements, on the Afon Taf vale area. Influence from the A487 corridor and Clunderwen itself would affect the amount of visible light from sources outside of the settlement. The significance of effect on visual amenity would be neutral.

Representative Viewpoint E

9.5.128 A view of task lighting would be available to the public footpath. Night-time use is predicted to be very low. The significance of visual effect would be slight adverse.

Representative Viewpoint F

9.5.129 A view of task lighting and the site compound would be available to users of this path. Night-time use is predicted to be low, but a considerable area affected by the Scheme would be visible from this location. The significance of visual effect is predicted to be large adverse.

Representative Viewpoint G

9.5.130 A view of task lighting and the site compound would be available to this location. The significance of visual effect would be slight adverse.

Representative Viewpoint H

9.5.131 A view of task lighting would be available to this location, in particular lighting associated with the construction of Llanfallteg road overbridge, and temporary lighting required where the road would be diverted as it crosses the proposed road cutting. The significance of visual effect would be slight adverse.

Representative Viewpoint I

9.5.132 A view of task lighting would be available to this location, lighting associated with the construction of Llanfallteg road overbridge, and temporary lighting required where the road would be diverted as it crosses the proposed road cutting. The significance of visual effect would be slight adverse.

Representative Viewpoint J

9.5.133 A view of task lighting would be available to the public footpath. Night-time use is predicted to be very low. The significance of visual effect would be slight adverse.

Representative Viewpoint K

9.5.134 A view of task lighting would be available to the public footpath. Night-time use is predicted to be very low. The significance of visual effect would be slight adverse.

Representative Viewpoints L and M

9.5.135 A glimpse of task specific lighting at the proposed Bethel roundabout may be available where gaps in roadside hedge-banks allow. The impact of construction lighting would be reduced by the presence of street lighting at in Llanddewi Velfrey village. The significance of effect on visual amenity would be neutral.

Potential Construction Visual Effects on Residential Properties

Works at Penblewin Roundabout

9.5.136 Penblewin Farm would have a near view of construction activities at Penblewin Roundabout. The view westward would only be available from first floor windows, as those from the ground floor are interrupted by agricultural buildings.

9.5.137 Elements of the roundabout are visible in intermediate views from Station Approach and Station Road in Narberth. Construction activities would be barely noticeable.

Penblewin to ch.1+000

9.5.138 Penblewin Farm and Trefangor Farm have near and direct views of the existing A40, whereas Ca'rmaenau Fach has a near but indirect view. Hedges to the north of the existing A40 would be retained, which would help screen some construction activity.

ch.1+000 to 1+240 (Henllan Lodge)

9.5.139 Trefangor Cottage would be demolished. The garden at Bro-minau would be directly impacted by construction, lessening the visual screen provided by a small group of trees. Henllan Lodge has north-facing windows and is located immediately adjacent to the proposed works.

ch.1+240 to 1+650 (Ffynnon Chapel)

9.5.140 Henllan Lodge has a direct eastward view and Penrhiw Cottage has a direct southward view of the existing A40. Construction activities would be immediately apparent. Ffynnon, Ffynnon Vestry and Ffynnon Uchaf dwellings would not suffer any visual impact but there would be a view from the access road.

ch.1+650 to 1+850 (Ffynnon Wood)

9.5.141 Penrhiw Cottage may experience indirect views of construction activity within this section, although filtered by vegetation.

ch.1+850 to 2+100 (Llanddewi Velfrey western junction)

9.5.142 Construction activity would be visible to the dwelling at Pen-ca'rmaenau. There would also be a view available to Maes-y-caeau, Caerwen, Maes-y-llan and Pen-banc.

ch.2+100 to 2+440 (Pen-troydin-fach cutting)

9.5.143 Construction activity would be visible to Pen-ca'rmaenau, Maes-y-caeau, Caerwen, Maes-y-llan and Pen-banc. Near and direct views would be available to Maes-y-ffynnon and Maes-y-Rhos. The dwelling at Pen-troydin-fach would be screened from view of construction activities by agricultural buildings.

9.5.144 Distant views would be available to the southern outskirts of Clunderwen.

ch.2+440 to 2+730 (Pen-troydin-fach embankment)

9.5.145 Construction activity would be visible to first floor windows at 5 to 10 Glan Preseli and Awel Deg. Maes-y-Rhos overlooks this section also. Indirect views would be available to Pen-troydin-fach and Pen-troydin-fawr. Pen-ca'rmaenau would have an intermediate distance view.

9.5.146 Distant views would be available to the southern outskirts of Clunderwen and a number of isolated farms in the Afon Taf Vale.

ch.2+730 to 2+930 (Pen-troydin-fawr cutting)

9.5.147 Excavation of the cutting and construction of the Llanfallteg road overbridge would be visible in indirect views from Pen-troydin-fawr. Works to divert the existing Llanfallteg Road during the construction phase would directly impact the garden of Pen-troydin-fawr.

9.5.148 Awel Deg and Brynwylfa would experience a view of some construction activity. Pen-ca'rmaenau would have an intermediate distance view.

9.5.149 Distant views would be available to the southern outskirts of Clunderwen and some isolated farms in the Afon Taf Vale.

ch.2+930 to 3+460 (Pen-troydin-fawr embankment)

9.5.150 Castell would have a direct view of construction activity, the removal of areas of woodland may be visible to Pen-troydin-fawr.

9.5.151 Distant views would be available to the southern outskirts of Clunderwen and some isolated farms in the Afon Taf Vale.

ch.3+460 to 3+780 (Bethel Cutting)

9.5.152 Works here would be immediately apparent to Tir-bach. Distant views of the notch created by the cutting would be available to the southern outskirts of Clunderwen.

9.5.153 Distant views would also be available to upland areas of Henllanfallteg.

Bethel roundabout

9.5.154 Croft House, Penllan, Arfryn, Bryn Helog and Awelfa would have an indirect view of activity associated with the new roundabout.

9.5.155 Bethel Cottage and the Vestry would have a near and direct view of the new access road to Bethel Chapel.

9.5.156 Distant views would also be available to upland areas of Henllanfallteg.

Llanddewi Velfrey Link Road

9.5.157 Croft House, Penllan, Arfryn, Bryn Helog and Awelfa would have a direct view of activity associated with the new link road. Glenfield would have an indirect view.

Bethel Roundabout to Pencawse Hill

9.5.158 Bethel Cottage and Bryncoed have near views of the existing A40 filtered by vegetation. Construction activity would be immediately apparent. Gwyndy and Gwyndy Fach should be screened from views.

Potential Construction Visual Effects: Non-Residential Properties

ch.1+240 to 1+650 (Ffynnon Chapel)

9.5.159 The cemetery at Ffynnon Chapel has near views of the existing A40, partially filtered by self-sown vegetation. Construction activities would be immediately apparent from the cemetery.

ch.1+650 to 1+850 (Ffynnon Wood)

9.5.160 Views from the cemetery at Ffynnon Chapel would be indirect and filtered by vegetation.

Bethel roundabout

9.5.161 Views of works activities would be available from the car parking area of Bethel Chapel.

Bethel Roundabout to Pencawse Hill

9.5.162 Views of works activities would be available from the cemetery and car parking area of Bethel Chapel.

Potential Construction Visual Effects: Public Rights of Way (PRoW)

Penblewin to ch.1+000

9.5.163 Construction activities would have a direct impact on footpath SP19/31/3. Part of a Pembrokeshire hedge-bank would be removed

and a portion of the field next to the footpath south of Bounty Farm would be lost.

ch.1+240 to 1+650 (Ffynnon Chapel)

9.5.164 Construction activities would be visible to SP19/30/1 and have a direct impact on SP19/37/1. Footpath 19/37 would be stopped up at the toe of the new embankment and connect with a new bridleway that passes under the road at ch.1+680. The new alignment would place the Trunk Road further away from Footpath 19/30/1.

ch.1+650 to 1+850 (Ffynnon Wood)

9.5.165 Construction activities would be visible to SP19/37/1 and have a direct impact on SP19/30/1. Footpath 19/37 would be stopped up at the toe of the new embankment and connect with a new bridleway that passes under the road. A new connection would be available to Henllan Lodge and Llanddewi Velfrey.

ch.1+850 to 2+100 (Llanddewi Velfrey western junction)

9.5.166 Construction activities would be visible from public footpath SP19/23/1, SP19/36/3 and SP19/37/1.

ch.2+100 to 2+440 (Pen-troydin-fach cutting)

9.5.167 Construction activities would be visible from public footpath SP19/36/3 and SP19/37/2 and have a direct impact on SP19/38/1.

ch.2+440 to 2+730 (Pen-troydin-fach embankment)

9.5.168 Construction activities would be visible from public footpath SP19/36/3 and SP19/38/2.

ch.2+730 to 2+930 (Pen-troydin-fawr cutting)

9.5.169 Construction activities would be visible from public footpath SP19/36/3 and have a direct impact on SP19/38/2.

ch.2+930 to 3+460 (Pen-troydin-fawr embankment)

9.5.170 Construction activities would have a direct impact on footpath SP19/1/1, and be visible from SP19/2/2, SP19/3/2, SP19/1/2, SP19/4/1, SP194/2 and SP19/4/3.

ch.3+460 to 3+780 (Bethel Cutting)

9.5.171 Construction activities would have a direct impact on footpath SP19/2/1, SP/19/3/2 and be visible from SP19/3/1, SP19/4/3, SP19/4/4 and SP19/4/5.

Bethel roundabout

9.5.172 Construction activities would have a direct impact on footpath SP19/4/5 and be visible from SP19/4/4, SP19/4/6, SP19/4/7 and SP19/3/2.

Llanddewi Velfrey Link Road

9.5.173 Construction activities would be visible from SP/19/3/2 SP19/4/5 and SP19/4/6.

Bethel Roundabout to Pencawse Hill

9.5.174 Construction activities would have a direct impact on footpath SP/19/17/1 and be visible from footpath SP19/4/7, SP19/5/1, SP19/5/2 and SP19/16/1.

Potential Construction Visual Effects on Land with Public Access (LwPA)

Amenity Areas

9.5.175 No view of construction works predicted from Llanddewi Velfrey Cricket Ground.

Potential Construction Visual Effects on Roads and Transport Routes

A40

9.5.176 To the east of Penblewin Roundabout, construction activities would be visible to eastbound traffic where the A40 nears the crest of Blackmoor Hill. Construction works at the roundabout would directly affect traffic.

9.5.177 From Penblewin Roundabout to Trefangor Cottage, construction works would be visible in northward and views. Works would be

parallel to the existing A40. Views for cars would be restricted to gaps in roadside hedges.

9.5.178 From Trefangor cottage to Ffynnon Wood, construction work would be on the line of the existing A40, would directly affect traffic and be visible in eastward and westward views.

9.5.179 From Ffynnon Wood to Bethel Cutting, the Scheme would deviate from the line of the A40. Construction activities would directly affect traffic where the two roads would meet. Views of works and site compound would be available to road traffic travelling west from Llanddewi Velfrey, and also when approaching Llanddewi Velfrey at Gwyndy Farm.

9.5.180 From Bethel Roundabout to the eastern end of the Scheme, a view of major earthworks activities would be available to traffic.

A487

9.5.181 Roadside vegetation would screen construction activities from much of the northward approach to Penblewin Roundabout. Activities would come into view north of Pant-y-gorphwys,

9.5.182 A distant view of earthworks activities north of Llanddewi Velfrey would be available to travellers leaving Clunderwen on the southward approach to Penblewin Roundabout. The landform and significant vegetation would obscure views from Longford to Ca'rmaenau Fawr.

Carmarthen to Fishguard Railway

9.5.183 A distant view of earthworks activities would be available to travellers where gaps in rail-side vegetation allow. Views would be indirect.

9.6 Assessment of Potential Operational Effects

Potential Operational Landscape Effects

9.6.1 This assessment considers the effects of the Scheme during the operational phase. The assessment takes account of the predicted effect with and without measures proposed as part of the design that are shown on the EMPs contained in Volume 3 Appendix 2.5.

9.6.2 Winter Year 1 Assessment represents the worst-case of a Scheme without mitigation. Summer Year 15 Assessment represents the Scheme where mitigation planting has become established and is achieving the desired screening, integration and/or nature conservation function. Further details of the measures included in the Scheme design are provided in Section 9.5 of this chapter.

Pembrokeshire Coast National Park

9.6.3 A glimpse of the Scheme may be available if looked for from ridges and south facing slopes within the Preseli Hills. The views are panoramic and the ridges at Llanddewi Velfrey are not prominent features of the views available. The magnitude of effect is judged as no change. The significance of effect is judged as neutral.

Preseli Hills Historic Landscape

9.6.4 The Historic Landscape overlaps part of the National Park and extends southwards into the communities in the foothills and valleys on the south side of the Preseli Hills. A glimpse of the Scheme may be available if looked for from ridges and south facing slopes within the Preseli Hills. The views are panoramic and the ridges at Llanddewi Velfrey are not prominent features of the views available. The magnitude of effect is judged as no change. The significance of effect is judged as neutral.

9.6.5 **LCA1: Llawhaden**

9.6.6 Landscape Sensitivity: low. The Scheme would not have a direct effect on this LCA, nor would it have an indirect effect due to intervening surface features.

9.6.7 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.8 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

Winter Year 1 Assessment

9.6.9 As a result, the magnitude of impact would be 'no change' without mitigation. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.10 As a result, the magnitude of impact would be 'no change' without mitigation. Overall, the LCA would experience a neutral significance of effect.

9.6.11 **LCA2: New Moat**

9.6.12 Landscape sensitivity: moderate. The Scheme would not have a direct effect on this LCA, although it would have an indirect effect due to the availability of long-distance views.

9.6.13 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.14 Potential effects on perceptual aspects: A long distant view of north facing road embankments and cutting slopes from Pen-troydin-fach to Blaen-pentroydin would be available. The movement commercial vehicles could draw attention. Individual structures would be difficult to distinguish. With the establishment of vegetation, grassed slopes would resemble pastoral fields whilst trees and shrubs would soften the interaction between original ground and the Scheme, and screen structures. A fleeting glimpse of commercial vehicles may be available where the road is on embankment in-between cuttings at Pen-troydin-fach and Pen-troydin-fawr.

Winter Year 1 Assessment

9.6.15 There would be a negligible detrimental magnitude of change due to the Scheme. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.16 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA3: Eastern Cleddau

9.6.17 Landscape sensitivity: moderate. The Scheme would not have a direct effect on this LCA, nor would it have an indirect effect due to the intervening landform.

9.6.18 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.19 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

Winter Year 1 Assessment

9.6.20 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.21 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA4: Narberth

9.6.22 Landscape sensitivity: low. The Scheme would not have a direct effect on this LCA, although it would have an indirect effect due to the availability of distant views from the Narberth Station area.

9.6.23 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.24 Potential effects on perceptual aspects: A distant view of changes to Penblewin Roundabout would be available to an isolated part of this LCA. Changes would not introduce new surface elements to the view.

Winter Year 1 Assessment

9.6.25 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.26 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA 5: Templeton

9.6.27 Landscape sensitivity: moderate. All the Scheme is located within this LCA. The Scheme would pass through a mosaic of pastoral farmland and woodland and replace the existing A40 through Ffynnon Wood. The Scheme includes tall embankments in stream valleys, deep cuttings in rock, a structure for the Llanfallteg Road overbridge, culverts where rivers are crossed or where access is required, signage and lighting at roundabouts. Other elements include a link road to the east of Llanddewi Velfrey. Landscape treatment for the Scheme includes woodland planting to integrate with existing wooded areas, hedges and hedge-banks to screen sensitive visual receptors, and open grassland where views of the Preseli Hills are presented to provide driver interest. The link road to Llanddewi Velfrey would be planted as an avenue to provide an entrance feature to the village.

9.6.28 Potential effects on physical aspects: The existing A40 crosses the landscape by means of road cuttings and embankments and uses roadside plantations and hedges to integrate with the rural landscape. The Scheme cuttings and embankment would be of a larger scale due to the modern standards of road alignment design and the objective to bypass Llanddewi Velfrey village through a strongly undulating landscape. New road cuttings would be imposing to road users and new road embankments would be imposing to outdoor workers and users of public footpaths. The establishment of vegetation would soften the impact of the Scheme as well as replacing some surface features lost. The tree-lined avenue would have potential to provide a positive feature to the village of Llanddewi Velfrey.

9.6.29 Potential effects on perceptual aspects: Near to the Scheme, earthworks and structures would dominate the perception of the landscape. During hours of darkness, lighting would be introduced at the Bethel Roundabout, extending the existing street-lighting of Llanddewi Velfrey village to the east. Penblewin Roundabout would increase in size and the existing lighting extended northward. Vehicle headlights would be introduced to the northern slopes of the Llanddewi Velfrey ridge and would be a noticeable feature to the lower lying land in the Afon Tâf Vale further north.

Winter Year 1 Assessment

9.6.30 There would be a major adverse magnitude of change. Overall, the LCA would experience a large adverse significance of effect.

Summer Year 15 Assessment

9.6.31 There would be a moderate adverse magnitude of change. Overall, the LCA would experience a moderate adverse significance of effect.

LCA6: Mid Tâf Vale

9.6.32 Landscape sensitivity: high. The Scheme would not have a direct effect on this LCA, although it would have an indirect effect due to the availability of intermediate to distant views from locations in the floor of the vale.

9.6.33 Potential effects on physical aspects. There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.34 Potential effects on perceptual aspects: The presence of a new road on slopes uphill of the low-lying valley floor would change the perception of the area. The view of north facing road embankments and cutting slopes from Pen-troydin-fach to Blaen-pentroydin would be available. The movement commercial vehicles could draw attention. Llanfallteg Road overbridge would be distinguishable, and culverts noticeable. With the establishment of vegetation, grassed slopes would resemble pastoral fields whilst trees and shrubs would soften the interaction between original ground and the Scheme, and screen or integrate structures. A fleeting glimpse of commercial vehicles may be available where the road is on embankment in-between cuttings at Pen-troydin-fach and Pen-troydin-fawr. During hours of darkness, vehicle headlights would be introduced to the northern slopes of the Llanddewi Velfrey ridge and would be a noticeable feature to the lower lying land of this LCA.

Winter Year 1 Assessment

9.6.35 There would be a moderate adverse magnitude of change. Overall, the LCA would experience a large adverse significance of effect.

Summer Year 15 Assessment

9.6.36 There would be a minor adverse magnitude of change. Overall, the LCA would experience a moderate adverse significance of effect.

LCA7: Llandissilio

9.6.37 Landscape sensitivity: moderate. The Scheme would not have a direct effect on this LCA, although it would have an indirect effect due to the availability of distant views from locations on broad ridges and south facing slopes.

9.6.38 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.39 Potential effect on perceptual aspects: Distant view of north facing road embankments and cutting slopes from Pen-troydin-fach to Blaen-pentroydin would be available. The movement commercial vehicles could draw attention. Individual structures would be difficult to distinguish. With the establishment of vegetation, grassed slopes would resemble pastoral fields whilst trees and shrubs would soften the interaction between original ground and the Scheme, and screen structures. A fleeting glimpse of commercial vehicles may be available where the road is on embankment in-between cuttings at Pen-troydin-fach and Pen-troydin-fawr. During hours of darkness, vehicle headlights would be introduced to the northern slopes of the Llanddewi Velfrey ridge.

Winter Year 1 Assessment

9.6.40 The magnitude of impact would be negligible detrimental. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.41 The magnitude of impact would be ‘no change’. Overall, the LCA would experience a neutral significance of effect.

LCA8: Lampeter Vale

9.6.42 Landscape sensitivity: moderate. The Scheme would not have a direct effect on this LCA, nor would it have an indirect effect due to a combination of the intervening landform and surface features.

9.6.43 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.44 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

Winter Year 1 Assessment

9.6.45 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.46 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA9: Upper Cwm Tâf

9.6.47 Landscape sensitivity: moderate. The Scheme would not have a direct effect on this LCA. Indirect effects would be limited to isolated locations where uninterrupted views southward are available.

9.6.48 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.49 Potential effects on perceptual aspects: Distant view of north facing road embankments and cutting slopes from Pen-troydin-fach to Pen-troydin-fawr would be available to isolated locations. A glimpse of the movement commercial vehicles could draw attention. With the establishment of vegetation, grassed slopes would resemble pastoral fields whilst trees and shrubs would soften the interaction between original ground and the Scheme, and screen structures. A fleeting glimpse of commercial vehicles may be available where the road is on embankment in-between cuttings at Pen-troydin-fach and Pen-troydin-fawr. During hours of darkness, vehicle headlights would be visible crossing the landscape in-between cuttings.

Winter Year 1 Assessment

9.6.50 The magnitude of impact would be negligible detrimental. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.51 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA10: Cwmfelin Boeth

9.6.52 Landscape sensitivity: moderate. The Scheme would not have a direct effect on this LCA. Indirect effects would be limited as views of the Scheme would be interrupted by woodland.

9.6.53 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.54 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme. Lighting introduced at Bethel roundabout would increase the extent of lighting, but it is unlikely to noticeably affect the existing glow effect caused by Llanddewi Velfrey village.

Winter Year 1 Assessment

9.6.55 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.56 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA11: Whitland

9.6.57 Landscape sensitivity: low. The Scheme would not have a direct effect on this LCA, nor would it have an indirect effect due to an accumulation of intervening surface features.

9.6.58 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.59 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

Winter Year 1 Assessment

9.6.60 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Winter Year 15 Assessment

9.6.61 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA12: Brandy Hill

9.6.62 Landscape sensitivity: moderate. The Scheme would not have a direct effect on this LCA, nor would it have an indirect effect due to an accumulation of intervening surface features.

9.6.63 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.64 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

Winter Year 1 Assessment

9.6.65 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.66 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA13: Cwm Gronw

9.6.67 Landscape sensitivity: low. The Scheme would not have a direct effect on this LCA, nor would it have an indirect effect due to a combination of intervening landform and surface features.

9.6.68 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.69 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

Winter Year 1 Assessment

9.6.70 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.71 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA14: Ciffig Wooded Valley

9.6.72 Landscape sensitivity: low. The Scheme would not have a direct effect on this LCA, nor would it have an indirect effect due to a combination of intervening landform and surface features.

9.6.73 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.74 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

Winter Year 1 Assessment

9.6.75 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.76 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA15: Whitland to Pont-y-Fenni

9.6.77 Landscape sensitivity: low. The Scheme would not have a direct effect on this LCA. Indirect effects from isolated locations would be limited as views of the Scheme would be interrupted by woodland.

9.6.78 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.79 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme.

Winter Year 1 Assessment

9.6.80 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.81 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

LCA16: Hiraeth Upland

9.6.82 Landscape sensitivity: moderate. The Scheme would not have a direct effect on this LCA. Indirect effects from isolated locations would be limited as views of the Scheme would be interrupted by woodland.

9.6.83 Potential effects on physical aspects: There would be no physical change to the landform or landcover features within the character area due to the Scheme.

9.6.84 Potential effects on perceptual aspects: There would be no perceptual change to the character area due to the Scheme. Lighting introduced at Bethel roundabout would increase the extent of lighting, but it is unlikely to noticeably affect the existing glow effect caused by Llanddewi Velfrey village.

Winter Year 1 Assessment

9.6.85 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Summer Year 15 Assessment

9.6.86 The magnitude of impact would be 'no change'. Overall, the LCA would experience a neutral significance of effect.

Potential Operational Visual Effects During Day

Representative Viewpoint A · Winter Year 1

9.6.87 A view of the Scheme would be very difficult to distinguish. A glimpse may be available if looked for in the view.

9.6.88 The magnitude of visual impact would be 'no change'. The significance of visual impact would be neutral.

Representative Viewpoint A · Summer Year 15

9.6.89 A view of the Scheme would be very difficult to distinguish once earthwork slopes resemble pastoral farmland and woodland. A glimpse of commercial vehicles would theoretically be available.

9.6.90 The magnitude of visual impact would be 'no change'. The significance of visual impact would be neutral.

Representative Viewpoint B · Winter Year 1

9.6.91 A view of the Scheme would be interrupted by landform and vegetation.

9.6.92 The magnitude of visual impact would be 'no change'. The significance of visual impact would be neutral.

Representative Viewpoint B · Summer Year 15

9.6.93 A view of the Scheme would be interrupted by landform and vegetation.

9.6.94 The magnitude of visual impact would be 'no change'. The significance of visual impact would be neutral.

Representative Viewpoint C · Winter Year 1

9.6.95 The street-lighting columns would cover a larger area, and a view of cars would be available where hedges were removed. Commercial vehicles may be visible to the east of the roundabout.

9.6.96 The magnitude of visual impact would be a minor detrimental one for road users, and the significance of visual effect would be neutral. For

countryside workers, the significance of visual effect would be slight adverse.

Representative Viewpoint C · Summer Year 15

9.6.97 Hedges would screen a view of cars on the roundabout and the establishment of scattered trees and woodland would restore the view to one resembling the original.

9.6.98 The magnitude of visual impact would be a negligible detrimental one. For road users and countryside workers, the significance of visual effect would be neutral.

Representative Viewpoint D · Winter Year 1

9.6.99 The north facing cutting and embankment slopes would be visible, as would Llanfallteg Road overbridge. A glimpse of commercial vehicles would be available where the road crosses the Pen-troydin-fach embankment.

9.6.100 The magnitude of visual impact would be a negligible detrimental one. For residents, the significance of effect would be slight adverse.

Representative Viewpoint D · Summer Year 15

9.6.101 Cutting and embankment slopes would resemble the mosaic of pastoral farmland and woodland. A glimpse of vehicles would be available where the road crosses Pen-troydin-fach embankment. At Llanfallteg Road overbridge, mitigation planting to integrate the cutting and bridge into the landscape would screen views of traffic.

9.6.102 The magnitude of visual impact would be 'no change' one. For residents, the significance of effect would be neutral.

Representative Viewpoint E · Winter Year 1

9.6.103 A view of the Scheme and traffic including the local access road to Trefangor Cemetery would be available. Views eastward and westward would be limited by Pembrokeshire hedge-banks.

9.6.104 For recreational users the magnitude of visual impact would be a moderate detrimental one, and the significance of visual effect large adverse.

Representative Viewpoint E · Summer Year 15

9.6.105 There is no proposed planting to screen the Scheme from the footpath.

9.6.106 For recreational users the magnitude of visual impact would be a moderate detrimental one, and the significance of visual effect large adverse.

Representative Viewpoint F · Winter Year 1

9.6.107 A view of the road and traffic at Western Llanddewi Velfrey junction, the road in cutting Pen-troydin-fach and Pen-troydin-fawr, and on embankment in-between the two cuttings, and a view of the private means of access to Pen-troydin-fach would be available. This would be in addition to the view of the de-trunked A40 west of Llanddewi Velfrey village.

9.6.108 For recreational users and residents, the magnitude of visual impact would be a moderate detrimental one, and the significance of visual effect large adverse.

Representative Viewpoint F · Summer Year 15

9.6.109 Scattered trees and new areas of woodland would integrate the Scheme into the landscape and filter views of the road surface and traffic. Cutting and embankment slopes would resemble a mosaic of pastoral fields and hedgerows. There would be a view of commercial vehicles where the road is on embankment, and at the junction with the de-trunked A40.

9.6.110 For recreational users and residents, the magnitude of visual impact would be a minor detrimental one, and the significance of visual effect moderate adverse.

Representative Viewpoint G · Winter Year 1

9.6.111 A view of Western Llanddewi Velfrey junction would be available, and the tops of the slopes and commercial vehicles entering/emerging into/from the Pen-troydin-fach cutting.

9.6.112 For recreational users and residents, the magnitude of visual impact would be a minor detrimental one, and the significance of visual effect moderate adverse.

Representative Viewpoint G · Summer Year 15

9.6.113 Scattered trees and new areas of woodland would integrate the Scheme into the landscape and filter views of the road surface and traffic. Cutting and embankment slopes would resemble a mosaic of pastoral fields and hedgerows. Hedge-banks and linear belts of woodland would screen the view of commercial vehicles in Pen-troydin-fach cutting.

9.6.114 For recreational users and residents, the magnitude of visual impact would be a negligible detrimental one, and the significance of visual effect slight adverse.

Representative Viewpoint H · Winter Year 1

9.6.115 North-facing slopes of cuttings and embankments from Pen-troydin-fach to Blaen-pentroydin would be visible. Commercial vehicles would be visible where the road is on embankment.

9.6.116 For road users, the magnitude of visual impact would be a major detrimental one, and the significance of effect moderate adverse.

Representative Viewpoint H · Summer Year 15

9.6.117 Cutting and embankment slopes would resemble a mosaic of pastoral fields and hedgerows. A view of commercial vehicles on embankment would be a residual impact.

9.6.118 For road users, the magnitude of visual impact would be a minor detrimental one, and the significance of effect slight adverse.

Representative Viewpoint I · Winter Year 1

9.6.119 A view of the south-facing cutting and embankment slopes, and Llanfallteg Road overbridge would be available.

9.6.120 For residents, the magnitude of visual impact would be a minor detrimental one, and the significance of effect moderate adverse.

Representative Viewpoint H · Summer Year 15

9.6.121 New areas of woodland would screen views of Commercial vehicles where the road is on embankment. Scattered trees and shrubs would

integrate views of Llanfallteg Road overbridge into the original field boundary hedgerows.

9.6.122 For residents, the magnitude of visual impact would be a negligible detrimental one, and the significance of effect slight adverse.

Representative Viewpoint J · Winter Year 1

9.6.123 South-facing embankment slope and the view of traffic would be a dominant feature of this view, interrupting the view towards Henllanfallteg.

9.6.124 For recreational users, the magnitude of visual impact would be major detrimental one, and the significance of visual effect very large adverse. For countryside workers, the significance of visual effect would be large adverse.

Representative Viewpoint J · Summer Year 15

9.6.125 New woodland planting would contribute towards integrating the road into the landscape, but the residual effect of a new barrier in the landscape would remain.

9.6.126 For recreational users, the magnitude of visual impact would be major detrimental one, and the significance of visual effect very large adverse. For countryside workers, the significance of visual effect would be large adverse.

Representative Viewpoint K · Winter Year 1

9.6.127 A view of north facing slopes and vehicles using the roundabout and the access road to the chapel would be available.

9.6.128 For recreational users and residents of dwellings nearby, the magnitude of visual impact would be a major detrimental one, and the significance of visual effect very large adverse.

Representative Viewpoint K · Summer Year 15

9.6.129 The establishment of the north-facing slopes to resemble the mosaic of pastoral fields and hedges would integrate the slopes into the landscape and lessen the stark contrasts between the new and original features.

9.6.130 For recreational users and residents of dwellings nearby, the magnitude of visual impact would be a moderate detrimental one, and the significance of visual effect large adverse.

Representative Viewpoints L and M · Winter Year 1

9.6.131 The north-facing slopes and access road to Bethel Chapel would stand out from its surroundings.

9.6.132 The magnitude of visual effect to road users would be a minor detrimental one. The Significance of visual effect would be neutral.

Representative Viewpoints L and M · Summer Year 15

9.6.133 The establishment of the north-facing slopes to resemble the mosaic of pastoral fields and hedges would integrate the slopes into the landscape and lessen the contrast between the new and original features.

9.6.134 The magnitude of visual effect to road users would be a negligible detrimental one. The Significance of visual effect would be neutral

Potential Operational Visual Effects During Night

Representative Viewpoint A

9.6.135 Night-time influence on the south-facing slopes and ridges of the Preseli Hills would be dominated by those sourced at Milford Haven and Haverfordwest. Night-time activities associated with the traffic and lighting at roundabouts would not cause noticeable change.

Representative Viewpoint B

9.6.136 A glimpse of task specific lighting at Penblewin Roundabout may be available where gaps in roadside hedge-banks allow. The area of lighting would be doubled when compared to the existing street lighting at Penblewin. The significance of effect on visual amenity would be neutral.

Representative Viewpoint C

9.6.137 A view of lighting and traffic at the roundabout would be experienced at this viewpoint. The impact of construction lighting would have a temporary slight adverse significance of effect.

Representative Viewpoint D

9.6.138 Views of vehicles crossing the Pen-troydin-fach embankment are likely to increase the night-time influence of Llanddewi Velfrey village and the scattered rural settlements, on the Afon Taf vale area. Influence from the A487 corridor and Clunderwen itself would affect the amount of visible light from sources outside of the settlement. The significance of effect on visual amenity would be neutral.

Representative Viewpoint E

9.6.139 A view of vehicle headlights would be available to the public footpath. Night-time use is predicted to be very low. The significance of visual effect would be minor adverse.

Representative Viewpoint F

9.6.140 A view of vehicle headlights would be available to users of this path. Night-time use is predicted to be low, but a considerable area affected by the Scheme would be visible from this location. The significance of visual effect is predicted to be moderate adverse.

Representative Viewpoint G

9.6.141 A view of vehicle headlights would be available to this location. The significance of visual effect would be slight adverse.

Representative Viewpoint H

9.6.142 A view of vehicle headlights would be available to this location where the road is on embankment. The significance of visual effect would be slight adverse.

Representative Viewpoint I

9.6.143 A view of vehicle headlights would likely be beyond the view of the residential areas, but the glow may influence the night-time views. The significance of visual effect would be slight adverse.

Representative Viewpoint J

9.6.144 A view of vehicle headlights would be available to the public footpath. Night-time use is predicted to be very low. The significance of visual effect would be slight adverse.

Representative Viewpoint K

9.6.145 A view of vehicle headlights would be available to the public footpath. Night-time use is predicted to be very low. The significance of visual effect would be slight adverse.

Representative Viewpoints L and M

9.6.146 A glimpse of vehicle headlights and street lights at the proposed Bethel roundabout may be available where gaps in roadside hedge-banks allow. The impact would be increase the influence that street lighting in Llanddewi Velfrey village has on the area. The significance of effect on visual amenity would be slight adverse.

Potential Operational Visual Effects on Residential Properties

Penblewin Roundabout · Winter Year 1

9.6.147 Westbound view of roundabout from Penblewin Farm would be similar to the existing situation. The view of the northern extended part would be screened by agricultural buildings.

9.6.148 The view from Narberth Station area would not change.

Penblewin Roundabout · Summer Year 15

9.6.149 Establishment of hedges and scattered trees would help integrate the roundabout into the landscape.

9.6.150 There would be no change to views from Narberth Station.

Penblewin to ch.1+000 · Winter Year 1

9.6.151 Eastward view of embankment and sidelong cutting including road surface, road signs and traffic available to Penblewin Farm. Direct view of road in sidelong cutting from first floor windows at Trefangor Farm. Indirect view of road in sidelong cutting available from Ca'rmaenau fach.

Penblewin to ch.1+000 · Summer Year 15

9.6.152 Eastward view of Scheme screened by woodland planting from Penblewin Farm and Trefangor Farm. Indirect northward view from Ca'rmaenau fach limited by trees.

ch.1+000 to 1+240 (Henllan Lodge) · Winter Year 1

9.6.153 Direct view of road surface, traffic and boundary fence from Henllan Lodge. The view from Brominau would be indirect and filtered by vegetation.

ch.1+000 to 1+240 (Henllan Lodge) · Summer Year 15

9.6.154 Proposed hedge/headlight screen would interrupt views of Scheme cars and limit to view of commercial vehicles. Proposed linear belt of trees would screen views of Scheme from Brominau.

ch.1+240 to 1+650 (Ffynnon Chapel) · Winter Year 1

9.6.155 Direct eastward view from Henllan Lodge limited by woodland. View from Penrhiw Cottage would be similar to existing with dedicated access to property.

ch.1+240 to 1+650 (Ffynnon Chapel) · Summer Year 15

9.6.156 Establishment of roadside hedge would mitigate views of cars on A40 from Henllan Lodge. Residual view limited to one of commercial vehicles on A40 and occasional traffic using local access road. Proposed woodland planting would screen views of road and traffic from Penrhiw Cottage.

ch.1+650 to 1+850 (Ffynnon Wood) · Winter Year 1

9.6.157 Indirect views of traffic may be available to Penrhiw Cottage, but limited by woodland.

ch.1+650 to 1+850 (Ffynnon Wood) · Summer Year 15

9.6.158 Proposed woodland planting would screen views of road and traffic from Penrhiw Cottage.

ch.1+850 to 2+100 (Llanddewi Velfrey western junction) · Winter Year 1

9.6.159 A view of commercial vehicles using the junction would be available to Pen-ca'rmaenau. There would also be a view available to Maes-y-caeau, Caerwen, Maes-y-llan and Pen-banc.

ch.1+850 to 2+100 (Llanddewi Velfrey western junction) · Summer Year 15

9.6.160 The view of commercial vehicles would be filtered from view by scattered trees and woodland planting.

ch.2+100 to 2+440 (Pen-troydin-fach cutting) · Winter Year 1

9.6.161 A glimpse of commercial vehicles entering or emerging from the cutting would be available to Pen-ca'rmaenau, Maes-y-caeau, Caerwen, Maes-y-llan, Pen-banc, Maes-y-ffynnon and Maes-y-Rhos.

ch.2+100 to 2+440 (Pen-troydin-fach cutting) · Summer Year 15

9.6.162 The view of commercial vehicles would be filtered from view by scattered trees and woodland planting.

ch.2+440 to 2+730 (Pen-troydin-fach embankment) · Winter Year 1

9.6.163 Indirect views of commercial vehicles would be available to Pen-troydin-fach and Pen-troydin-fawr. Views of commercial vehicles available from first floor rooms at 5 to 10 Glan Preseli. Views also available from Maes-y-Rhos and Awel Deg.

ch.2+440 to 2+730 (Pen-troydin-fach embankment) · Summer Year 15

9.6.164 Indirect views of commercial vehicles would be available to Pen-troydin-fach and Pen-troydin-fawr. Views from first floor rooms at 5 to 10 Glan Preseli. Views also available from Maes-y-Rhos and Awel Deg screened by woodland planting.

9.6.165 Distant views of commercial vehicles available to the southern outskirts of Clunderwen and some isolated farms in the Afon Taf Vale.

ch.2+730 to 2+930 (Pen-troydin-fawr cutting) · Winter Year 1

9.6.166 North facing cutting slopes visible in indirect view from Pen-troydin-fawr. Pen-ca'rmaenau would have an intermediate distance view. Distant views would be available to the southern outskirts of Clunderwen and some isolated farms in the Afon Taf Vale.

ch.2+730 to 2+930 (Pen-troydin-fawr cutting) · Summer Year 15

9.6.167 Mosaic of grassland and scattered trees would resemble pastoral farmland with boundary hedgerows and integrate slopes into surrounding landscape.

ch.2+930 to 3+460 (Pen-troydin-fawr embankment) · Winter Year 1

9.6.168 Direct view of embankment slopes and commercial vehicles available to Castell.

ch.2+930 to 3+460 (Pen-troydin-fawr embankment) · Summer Year 15

9.6.169 Mosaic of woodland, grassland and hedges would break-up the embankment slopes and soften the impact on visual amenity. Residual view of commercial vehicles.

ch.3+460 to 3+780 (Bethel Cutting) · Winter Year 1

9.6.170 View of tops of north-facing slopes available to Tir-bach, and distant view available to parts of Henllanfallteg. Distant views of the notch created by the rock cutting would be available to the southern outskirts of Clunderwen.

ch.3+460 to 3+780 (Bethel Cutting) · Summer Year 15

9.6.171 Interface between rock cutting and original ground softened by weathering and natural colonisation by scrub and grassland species.

Bethel roundabout · Winter Year 1

9.6.172 Croft House, Penllan, Arfryn, Bryn Helog and Awelfa would have an indirect view of traffic using the roundabout. Bethel Cottage and the Vestry would have a near and direct view of the new access road to Bethel Chapel. Distant views of access road also available to upland areas of Henllanfallteg.

Bethel roundabout · Summer Year 15

9.6.173 Mosaic of grassland, scrub and hedges would integrate the slopes into the pastoral landscape, mitigating distant views.

Llanddewi Velfrey Link Road · Winter Year 1

9.6.174 Croft House, Penllan, Arfryn, Bryn Helog and Awelfa would have a direct view of traffic using the new link road, although the Scheme would be further away than existing A40 and would carry less traffic. De-trunked A40 used as local access road. Glenfield would have an indirect view.

Llanddewi Velfrey Link Road · Summer Year 15

9.6.175 Avenue trees would filter views of traffic on local link road and screen traffic on main road.

Bethel Roundabout to Pencawse Hill · Winter Year 1

9.6.176 View of main road from Bethel Cottage would remain filtered by vegetation. Bethel roundabout and access road to Bethel Chapel would be a major detractor to views from outdoor spaces.

Bethel Roundabout to Pencawse Hill · Summer Year 15

9.6.177 Scrub and hedges would screen views of the roundabout.

Potential Operational Visual Effects on Non-Residential Properties

ch.1+240 to 1+650 (Ffynnon Chapel) · Winter Year 1

9.6.178 The view of the Scheme from the Ffynnon Chapel cemetery would be direct and uninterrupted.

ch.1+240 to 1+650 (Ffynnon Chapel) · Summer Year 15

9.6.179 Woodland planting would screen the view of traffic and restore the view to one resembling the existing situation.

ch.1+650 to 1+850 (Ffynnon Wood) · Winter Year 1

9.6.180 Views from the cemetery at Ffynnon Chapel would be indirect and filtered by vegetation.

ch.1+650 to 1+850 (Ffynnon Wood) · Summer Year 15

9.6.181 Views from the cemetery at Ffynnon Chapel would be interrupted by vegetation.

Bethel roundabout · Winter Year 1

9.6.182 Views of road and traffic would be available from the car parking area of Bethel Chapel.

Bethel roundabout · Summer Year 15

9.6.183 Views of road and traffic would be available from the car parking area of Bethel Chapel. Cutting slopes having been colonised by grassland and scrub species would resemble the existing cutting slopes.

Potential Operational Visual Effects on Public Rights of Way (PRoW)

Penblewin to ch.1+000

9.6.184 Winter Year 1 - A direct and uninterrupted view of the Scheme and local access road to Trefangor Cemetery would be available to users of footpath SP19/31/3 from the ridge to the south of Bounty Farm to where it would meet the access road.

9.6.185 Summer Year 15 - A direct and uninterrupted view of the Scheme and local access road to Trefangor Cemetery would be available to users of footpath SP19/31/3.

ch.1+240 to 1+650 (Ffynnon Chapel)

9.6.186 Winter Year 1 - Road surface and traffic would be visible to SP19/30/1 and SP19/37/1.

9.6.187 Summer Year 15 - Native species planting on embankment slopes would screen views of road surface and traffic from these footpaths.

ch.1+650 to 1+850 (Ffynnon Wood)

9.6.188 Winter Year 1 - Road surface and traffic would be visible to SP19/37/1 and SP19/30/1.

9.6.189 Summer Year 15 - Native species planting on embankment slopes would screen views of road surface and traffic from these footpaths.

ch.1+850 to 2+100 (Llanddewi Velfrey western junction

9.6.190 Winter Year 1 - Road surface and traffic would be visible to public footpath SP19/23/1 and SP19/36/3.

9.6.191 Summer Year 15 – Native planting would integrate the Scheme into the landscape and reduce the significance of visual effect.

ch.2+100 to 2+440 (Pen-troydin-fach cutting)

9.6.192 Winter Year 1 - Road surface and traffic would be visible to public footpath SP19/36/3, SP19/37/2, and SP19/38/1.

9.6.193 Summer Year 15 -

ch.2+440 to 2+730 (Pen-troydin-fach embankment)

9.6.194 Winter Year 1 - Road surface and traffic would be visible to public footpath SP19/36/3 and SP19/38/2.

9.6.195 Summer Year 15 – Native species planting on embankment and cutting slopes would integrate them with sloping fields and partially screen visible structures from these footpaths.

ch.2+730 to 2+930 (Pen-troydin-fawr cutting)

9.6.196 Winter Year 1 - Road surface and traffic would be visible to public footpath SP19/36/3. SP19/38/2 would be to the downhill side of the Scheme. Where it would connect with Llanfallteg Road at the top of the cutting slope, there would be direct and uninterrupted views of the road surface and traffic.

9.6.197 Summer Year 15 - Native species planting on embankment and cutting slopes would integrate them with sloping fields and partially screen visible structures from these footpaths.

ch.2+930 to 3+460 (Pen-troydin-fawr embankment)

9.6.198 Winter Year 1 - Road surface and traffic would be visible to footpath SP19/1/1, SP19/2/2, SP19/3/2, which would be diverted and connect

at the proposed underpass. High sided vehicles would be visible to SP19/1/2, and SP19/4/3.

9.6.199 Summer Year 15 - Native species planting to integrate embankment slopes and for nature conservation would reduce the extent of slopes visible. Pen-troydin-fawr embankment would be a dominant feature in views from footpaths immediately to the north of it.

ch.3+460 to 3+780 (Bethel Cutting)

9.6.200 Winter Year 1 - Road surface and traffic would be visible to footpath SP/19/3/2 where it would be diverted to follow the top of the cutting slope. Cutting slopes would be visible to footpaths SP19/2/1, SP19/3/1, SP19/4/3 and SP19/4/4.

9.6.201 Summer Year 15 - View of road surface and traffic would lessen in magnitude due to the establishment of native planting on the cutting slopes. Long distance views of Preseli Hills and Carmarthenshire uplands retained in places.

Bethel roundabout

9.6.202 Winter Year 1 - Road surface and traffic would be visible to footpath, SP19/4/4, SP19/4/6, SP19/4/7 and SP19/3/2. Footpath SP19/4/5 would be stopped up.

9.6.203 Summer Year 15 - View of road surface and traffic would lessen in magnitude due to the establishment of native planting on the cutting and embankment slopes.

Llanddewi Velfrey Link Road

9.6.204 Winter Year 1 - Road surface and traffic would be visible to short sections of footpath SP/19/3/2 and SP19/4/6.

9.6.205 Summer Year 15 - View of road surface and traffic would lessen in magnitude due to the establishment of native planting on the cutting and embankment slopes.

Bethel Roundabout to Pencawse Hill

9.6.206 Winter Year 1 - Road surface and traffic would be visible to a short section of footpath SP/19/17/1 and SP19/4/7. View of traffic from

footpath SP19/5/1 and SP19/5/2 interrupted by vegetation and buildings. Glimpse of road surface and traffic available from footpath SP19/16/1.

9.6.207 Summer Year 15 – Establishment of native species planting would lessen the significance of visual effect.

Potential Operational Visual Effects on Land with Public Access (LwPA)

Amenity Areas

9.6.208 No view of Scheme or traffic predicted from Llanddewi Velfrey Cricket Ground.

Potential Operational Visual Effects on Roads and Transport Routes

A40

9.6.209 The majority of traffic using the existing A40 would be transferred onto the new alignment. The de-trunked A40 and new side roads would be used to access scattered rural dwellings and the villages of Llanddewi Velfrey and Llanfallteg, and to a lesser extent Lampeter Velfrey.

A487

9.6.210 Distant views of north facing embankment and cutting slope available to southbound travellers leaving Clunderwen.

Carmarthen to Fishguard Railway

9.6.211 Distant views of north facing embankments and cutting slopes would be available where gaps in rail-side vegetation allow.

9.7 Mitigation Measures Forming Part of the Scheme Design

Summary of Requirements

9.7.1 The designers followed an iterative design and assessment process, to meet the Scheme objectives. The design was developed and refined to support Welsh Government objectives, including the need to encourage active travel and support the sustainability objectives of the Well-Being of Future Generations (Wales) Act 2015. The design team sought to avoid and reduce the impacts of the landscape and visual effects, and to integrate the measures required by other environmental disciplines.

9.7.2 Mitigation and enhancement measures were designed to implement key objectives found in the EU, UK and Welsh legislative, policy and best practice guidance documents on landscape assessment, design and mitigation. Close liaison with other disciplines to reduce habitat fragmentation and prioritise habitat connectivity and facilitation of species dispersal was reflected in the mitigation measures.

Welsh Government Objectives

9.7.3 Welsh Government objectives, at the commencement of this project were set out in the Works Information. Those objectives that could influence the landscape and environmental design encourage the maintenance and promotion of cycling, horse riding and walking and provide opportunities for healthy lifestyles; encourage sustainable design solutions and minimises future maintenance and disruption to the network. The last objective includes a requirement that the project should consider the impact of the Scheme on the environment. The full list of objectives is taken as the starting point for the development of the Project Objectives through the WelTAG stages.

Transport Planning Objectives

9.7.4 Transport Planning Objectives (TPO) were developed, aiming to address one or more of the identified problems (refer to Chapter 2), and to take into account the Well-Being of Future Generations (Wales) Act well-being goals. The Scheme objectives that are relevant to the landscape and environmental design are:

O3 To reduce community severance and provide health and amenity benefits.

O5 To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles.

O7 Deliver a project that is sustainable in a globally responsible Wales, taking steps to reduce or offset waste and carbon.

O8 Give due consideration to the impact of transport on the environment and provide enhancement when practicable.

Scheme Environmental Objectives

9.7.5 The Scheme Environmental Objectives were developed and agreed with the Statutory Environmental Consultees. These objects are included in ES Chapter 2 The Project. The Landscape Design Objectives were developed from these.

Landscape Design Objectives

9.7.6 The objectives that have guided the development of the landscape and environmental design, which include mitigation and enhancements, are listed below, following the sequence of 'prevent', 'reduce' and 'replace':

a) To integrate the road and structures with the setting by refining the road alignment, earthworks, footpaths and cycleways and cuttings, planting and boundary treatments to reflect the character and quality of the surrounding landscape;

b) To respect the historic fabric of the landscape so that it will be retained for future generations;

c) To, where possible, retain and make best use of existing vegetation, considering translocation of coppiced vegetation wherever a suitable donor site is available within the Scheme;

d) Avoid loss or damage to landscape features (e.g. hedges/hedgerows/hedge banks, individual and veteran trees, woodland, water features, Public-rights -of-way and field systems where possible within the constraints of the design.

e) Consider the integration of new structures and measures for reducing the risk of pollution and associated impacts on local hydrology into the landscape setting of the Scheme.

f) Make the best use of structures such as underpasses and culverts to maintain connectivity across the road for people and wildlife.

g) Prioritise the early re-establishment of new vegetation and where possible use species of local provenance

h) Use locally appropriate boundary treatments.

i) Optimise protection for nearby houses or public areas to minimise visual intrusion by providing screening, using earthworks, planting and boundary treatments in critical locations;

j) To design the scheme of landscape mitigation to minimise the loss of foraging habitat for wildlife, avoiding increased habitat fragmentation and isolation and by maintaining connectivity across the landscape for protected species and other wildlife;

k) To integrate ecological mitigation with landscape measures and so add value as a refuge for local biodiversity;

l) Design for maintenance, giving due consideration to the maintenance costs and implications, liabilities and access arrangements for all landscape areas.

Scheme Mitigation and Enhancements

Landform

9.7.7 Cuttings and embankments are formed to allow the required vertical and horizontal alignments of the carriageway to be accommodated within the existing terrain. In the selection of a suitable route for the road, the need for cuttings and embankments is considered alongside a range of engineering and environmental criteria. The design of earthworks allows for some flexibility during detailed design and construction to assist in achieving the optimum use of excavated materials within the scheme. This approach should minimise the need for removal of surplus from site, or the import of extra to make up a shortfall.

Embankments

9.7.8 Placing a road on an embankment means that it will be raised above the landscape and so will be visible from the surrounding landscape. The embankments for the Scheme would mostly be formed on sidelong ground on the north side of the Llanddewi Velfrey ridge.

9.7.9 Most road embankments slopes are formed with gradients of around 1:2. The materials available to form embankments on this scheme were assessed and are considered suitable to form gradients of 1:2.5, which are shallower that 1:2 and are nearer to natural slopes in the setting. To mimic natural profiles, it is feasible to form embankment

slopes to blend better with the surrounding topography. Where there is sufficient space for an embankment, soil material can be used to form a more naturalistic profile to avoid artificially sharp transitions from natural to made-made gradients

9.7.10 Side slopes of large embankments, such as that required to the south of Llanddewi Velfrey, require large areas of land and so a balance has to be struck between taking enough land for pure engineering purposes and taking extra agricultural land and felling extra woodland to allow the formation of shallower slopes. For this Scheme the decision was taken not to take any more land than would be required to form the essential 1:2.5 slopes.

9.7.11 The proposed landscape design strategy to integrating these large embankments is to reinstate a pattern of hedges, grassland and woodland planting across slopes that would be similar to the original landscape. The completed, vegetated landform would be more effectively blended into the setting than if it was entirely planted with trees, for example.

Cuttings into soft material

9.7.12 Placing a road in a cutting means that the carriageway and traffic can potentially be screened in views from the surrounding landscape. A cutting 2m deep would conceal cars in most views, while a 4m deep cutting would screen high-sided vehicles in the same way. There are three cuttings of sufficient depth for high-sided vehicles to be contained.

9.7.13 The landscape created at cuttings must be sensitively designed to aid integration with the existing landform, particularly at the transition between natural and excavated slopes. Cuttings, which are cut into softer materials such as soil, can be ‘rolled-over’ to give the side slope a flowing ‘S’ profile that mimics natural slopes. Planting and hedges can also be used to screen views into a cutting.

Deep rock cuttings

9.7.14 Deeper cuttings often cut through softer material, which can vary with depth, into underlying bedrock. The profile of a cutting will therefore be determined by the character and bedding planes of the rock and the depth of softer overburden. Soft or unstable rock will be cut to shallow slopes, whilst harder and more stable rock can be cut to steep

profiles which can be treated to look more like natural rock exposures. The face can be worked to create a more natural appearance that will reflect the characteristics of the rock and the slope of the bedding planes, providing enhanced visual interest and biodiversity value.

9.7.15 Subject to detailed investigation of the rock, when construction commences, the cuttings would be excavated into soil-like, granular material, or into soft mudstone rocks. Where ground conditions allow, areas of the cutting slopes can be left as a natural exposure of rock or scree that will weather naturally and develop self-sown vegetation cover that can include grasses, wildflowers, mosses and lichen. These areas can be of ecological interest. Soil-like granular material will be seeded to develop as grassland.

9.7.16 Various techniques have previously been tried on rock cuttings to create a natural appearance. In practice, a combination of planting of small locally-native shrub plants at varied spacing into the better soils, and direct seeding with native shrub and wildflower species selectively over the loose and less soil-like material, will achieve good results. Vegetation will be allowed to colonise rock faces and the natural processes of weathering and soil development will create visual interest.

Boundaries and other linear features

9.7.17 In the rural landscape of the study area, boundaries and other linear features are important in providing visual containment, creating landscape character and diversity. The relatively restricted visual envelope of the Scheme is partly a consequence of the pattern and density of hedges. The effect of the proposed road will be to sever and disrupt the pattern of boundaries. For effective landscape integration it is appropriate to consider reinstating local styles of boundary to define the edge of the road.

9.7.18 Pembrokeshire hedge banks, formed with soil and planted with hedging species, are a traditional form of field boundary and are a useful form of landscape and ecological mitigation. Where hedge banks are not present or existing banks require reinforcement, simple agricultural stock-proof post and wire fences are frequently used. Timber post and wire stock-proof fences have a light appearance, have no visual screening effect and so can be used to create an open boundary. Ecological mitigation will include mammal fencing

intended to exclude Badgers and Otters from the road. This fence also has a light appearance and will be used, in places, in the same manner.

Habitat mitigation, connectivity and protected species

9.7.19 Chapter 8 Ecology and Nature Conservation, sets out proposed biodiversity mitigation, much of which is integral to the landscape design. Land taken for embankments, cuttings and drainage provides areas that can be restored to assist in achieving biodiversity objectives. Chapter 12 Community and Private Assets: Agriculture sets out the requirements for farm underpasses to reconnect farms with fields separated by the Scheme. Chapter 15 All Travellers sets out how public footpaths, bridleways and cycleways would be connected across the Scheme.

9.7.20 The following points will be adopted where possible in the design of landscape mitigation:

a) Planting and seeding to provide species-rich woodland, hedge, scrub, and grassland should, where appropriate, be carried out using local provenance native species;

b) Compensation for the loss of dormouse habitat would be provided with new woodland and scrub planting.

c) No lighting is required at any location other than at the roundabouts at Penblewin and Bethel. Some signs at junctions will require lighting would be designed to avoid unwanted light spill. The design of landscape mitigation would achieve some screening of vehicle and sign light spill in areas used by bat species.

d) Safe road crossings would be needed for protected species such as bats, badgers and otter. Where possible the established routes and flight lines that would be severed would be mitigated by providing planting and fencing. When a crossing point coincides with an embankment a culvert or underpass would be provided.

e) Mammal fences could be required to ensure that species such as otter and badger are directed to crossing points such as culverts. The alignment of these fences will be carefully considered so that they do not become visually intrusive features. Maintenance easements would be required to accommodate Protected Species fences if these are placed on the edges of land take;

f) In three locations public rights of way must cross the Scheme and so underpasses will be constructed to the dimensions that allow horse and rider, pedestrian, cyclist or farm animal to cross, as appropriate. The approaches to these underpasses will be incorporated into the landscape design.

g) Japanese Knotweed is found within the study area and an eradication programme would be implemented where it falls within the scheme boundary;

Planting density, layout and design for future maintenance

9.7.21 Planting would be designed to address the required Landscape Function (as set out in DMRB Vol 10). In some cases, an area of mitigation would serve two or three functions, such as Visual Screening and Nature Conservation, and the design would need to reflect this. One of the more critical factors in designing plantations is achieving a naturalistic appearance that is appropriate in the setting. In many cases the natural appearance is enhanced by vegetation management tasks to diversify the canopy using techniques such as selectively coppicing of shrubs and trees on the edges of the plantations to create variety and density in the height of the canopy or irregularity in the margin.

9.7.22 Table 9.10 shows Landscape Functions that are used and are applied.

Table 9.10 Landscape Functions as set down in DMRB Vol 10

Function		Description
EFA	Visual Screening	Dense, consistently spaced trees and shrubs with some use of evergreen plants or faster-growing plants to provide an adequate screen or filter to views by the Design Year (Year 15 after construction).
EFB	Landscape Integration	Low density and irregularly placed planting that would grow to adopt the character of existing vegetation in the surrounding landscape over a period of 15 or more years.
EFD	Nature conservation	Planting carried out with a particular nature conservation function.
Two or more of these together		The priority would be to satisfy both functions with the most important function given priority.

9.7.23 In the interests of sustainability of the roadside landscape, the cost and ease of vegetation management has to be considered. Maintenance of the roadside landscape cannot be reduced to nil without the quality of vegetation deteriorating. The greatest costs are grass cutting, hedge cutting and the thinning of established plantations. Measures included in this Scheme should reduce the cost of maintenance by minimising difficult or costly tasks and finding alternatives that reduce the frequency of tasks:

a) Using low-fertility soils that will slow down the growth of grass so that fewer visits to cut grass are required;
b) Planting trees at wide spacing where there is no need for dense screening to be formed.
c) Providing hedges as mitigation only where essential and where safe access for mechanical maintenance is possible.
d) Grazing of large areas of grass where conditions allow this to be achieved safely within secure parcels of land.

The selection of species for new planting and seeding

9.7.24 New planting and seeding will use in preference to others. The selection of species is based on those locally-indigenous species noted to grow in the area and on a small selection of non-native species or ornamental varieties to serve particular purposes. Sycamore, although it is common in Pembrokeshire, is not an indigenous native species and is not included. The lists of species that are considered appropriate are included in Table 9.11.

9.7.25 In some locations fast-growing trees, nurse species or bulky evergreens, including the use of indigenous or exotic and non-invasive species, will be considered to achieve visual screening. Nurse species will grow quickly to provide early visual screening and shelter for the other species and will then be removed when other species achieve adequate height.

Ash dieback disease

9.7.26 During autumn 2012 confirmed cases of Ash Dieback Disease were discovered in Britain. A number of these cases were in Wales. Ash forms a significant proportion of native woodland in Pembrokeshire and is also important as a component of hedges. In 2017, Ash Dieback had been found in over 70% of 10km grid squares in Wales. With the potential for around 98% of ash trees in Britain to die, it is likely that any proposed Ash planting undertaken in the next few years will suffer a similar fate. Until disease-resistant varieties of the species are found planting of Ash trees is unadvisable and so none are included in the proposed planting mixes.

Table 9.11 Proposed species for landscape planting (*suitable; ** locally appropriate)

Species	Woodland	Wet Woodland	Linear Belts or screening	Hedges	Scrub	Estate / avenue planting
Alder *Alnus glutinosa*	*	**	*			
Beech *Fagus sylvatica*	**	*	**			**
Beech (Copper) *Fagus sylvatica purpurea*						**
Birch *Betula pubescens*	*	*	*		*	
Blackthorn *Prunus spinosa*	**	**	**	**	*	
Cherry *Prunus avium*	**	*	**	*	*	*
Dog Rose *Rosa canina*			*	**	*	
Dogwood *Cornus sanguinea*	*	*	**	*	*	
Grey Willow *Salix cinerea*	*	**	*	*	*	
Hawthorn *Crataegus monogyna*	*	*	**	**		
Hazel *Corylus avellana*	**	**	**	**	*	
Holly *Ilex aquifolium*	**	*	**	**	*	
Honeysuckle *Lonicera periclymenum*	*		*	*	**	
Oak *Quercus robur*	**	*	**	*		**
Rowan *Sorbus aucuparia*	**	*	**	*	*	
Scots Pine *Pinus sylvestris*	**		**			**
White Willow *Salix alba*	*	**	**			
Yew *Taxus baccata*	**	*	**	*		**
Small-leaved Lime *Tilia cordata*	*		*			**

Specific Mitigation Measures

9.7.27 The proposed planting areas, together with other landscape and environmental mitigation measures, are shown on the EMPs in Volume 3 Appendix 2.5, and described below from west to east, starting at Penblewin Roundabout.

Penblewin Roundabout

9.7.28 The enlarged Penblewin Roundabout would cut into fields to the west and of the A478 Narberth to Clynderwen Road. Hedges would be planted along the field boundary to replace what would be lost. Some selective tree planting would be added to the retained trees in the middle of the roundabout where buried services and sightlines allow.

Penblewin to chainage 1000

9.7.29 From chainage (ch.) 0 to 1000 the proposed road would lie to the north of the existing A40, for the first 400m it would be descending on embankment up to 5m high, but then it continues east roughly at grade or in low sidelong cutting. To the north there would be a new local road which would provide field accesses and a route to properties such as Bounty Farm to the north. Mitigation on the north side of the scheme would be planting in place of the lost hedges, including new hedgerow and linear belts of trees and shrubs. Where the road cuts through a hedge a group of large trees would be planted to provide a visual link across the carriageway. These trees would help to reinstate bat flight lines along the hedges. The new hedge on the north side would develop into a visual screen for views from the north, to replace the hedgerow that currently screen traffic on the existing A40.

9.7.30 On the south side a narrow strip of land would be taken between the new and old A40 roads so that the existing hedgerows and large trees can be retained. The landscape treatment of the strip would vary depending on the immediate setting. Where there is an adjacent residential property on the old road trees would be planted to provide a visual screen. This would apply to Penblewin Farm, Ca'menau-fach Farm, Trefangor Farm and adjacent houses. In the remaining areas the land would be managed to encourage species-rich grassland and scattered trees would be planted.

9.7.31 The proposed balancing pond enclosure at ch.300 would be managed to encourage species-rich grassland and planting would be carried out to integrate the pond with the setting.

Chainage 1000 to 1240 (Henllan Lodge)

9.7.32 From ch.1000 to 1240 the new road would overlap the existing road. The local road to the north would link with the private means of access to Bronminau and Pencaermaenau Farm and the Trefangor Cemetery to the north. On the south side of the new road would be a short length of new local road to link the old A40 to the local road serving Henllan Farm and Henllan Lodge and extending to Llanddewi Velfrey. This minor local road is planted with a mature avenue of beech and other species. The route of the Scheme was designed to minimise the loss of trees in the avenue and to protect the setting of Henllan Lodge. A strip of planting would be added on the wide south verge side of the existing A40 near to Henllan Lodge.

Chainage 1240 to 1650 (Ffynnon Chapel)

9.7.33 From ch.1240 east to ch.1600 the new road will follow the line of the existing A40 as it approaches Ffynnon Wood. The plantation on the south side will be retained and tree planting carried out on both sides of the road to form a wooded setting. The bridleway which crosses the existing A40 at ch1240 will be diverted east along both sides of the road to a proposed underpass at approximately ch.1700. The bridleway would be set back from the new carriageway and would also serve as a footpath and cycleway. The realignment between ch.1590 to 1650 would allow the narrow strip of land on the north side to be increased slightly so that Penrhiw Cottage and the Grade II Listed Ffynnon Chapel would be further from the A40 carriageway with a local access road passing between. In this gap there would also be space to allow a linear belt of shrubs to be planted to filter views of traffic on the road. This proposed mitigation would marginally improve the setting of the listed building.

Chainage 1650 to 1850 (Ffynnon Wood)

9.7.34 From ch.1650 to ch.1850 the new road would follow the existing A40 embankment through Ffynnon Wood. The increased width of the carriageway would require the clearance of some trees to allow the embankment to be widened. A proposed bridleway underpass would be constructed under the road at approximately ch.1700. The

underpass would also serve as an important pedestrian and cycle link between Ffynnon Wood and Llanddewi Velfrey, and as a route for bats to cross safely beneath the road. The approaches to the underpass would include wide, hard surfaced paths and verges. the planting alongside the paths and the underpass would provide adequate headroom for equestrians.

9.7.35 Trees felled would be replaced by suitable planting in the available space with gaps in the canopy retained to allow daylight at either end of the underpasses. The scrub woodland between the existing A40 and the lane to Ffynnon Wood is over-mature self-sown scrub willow. This will be selectively coppiced and underplanted with native species such as oak and cherry to provide a more permanent woodland. The existing woodland and proposed additional trees would provide an element of screening to views from the residential properties in Ffynnon.

Chainage 1850 to 2100 (Llanddewi Velfrey western junction)

9.7.36 From ch.1850 the new road departs from the line of the existing A40 to continue on the north side. A redundant length of former A40 will be broken out, although an access track to the proposed balancing pond to the south would be retained. This length would be the location of a staggered junction with a local road to Ffynnon Wood on the north side and a link to the old A40, which would serve as a western road link into Llanddewi Velfrey and to Llanfallteg.

9.7.37 Landscape mitigation here would include woodland planting along both sides of the road on the redundant section of old road and around the proposed balancing pond. More tree planting would occupy land around the junction on the north side. A hedgerow would be planted along the field boundary on the south side. The new woodland would be an extension to the area of Ffynnon Wood and would help to integrate the changes to the landscape around the junction. The visual impact of these changes on residential properties to the north, including Parc-y-Delyn, Belli Bach, would be mitigated.

Chainage 2100 to 2440 (Pen-troydin-fach)

9.7.38 From ch.2100 the new road would continue east onto a gradually steepening north facing slope. As far as ch.2440 the road would be in sidelong cutting to pass between Maes-y-Rhos and Maes-y-ffynnon on the south side and Pen-troydin-fach on the north side. A new private

means of access would extend east to Pen-troydin-fach from the northern arm of the staggered junction at ch.1950. In this open hedged agricultural landscape, the approach to mitigation here is to use new hedges, hedge banks and narrow strips of planting to provide landscape integration and localised screening/filtering of views of traffic.

9.7.39 Residential properties to the south, Maes-y-Rhos and Maes-y-ffynnon, will be set back from the top of the cutting at a point where the road will be more than 4m below ground level, so traffic will not be visible. The proposed mitigation planting here will enhance the screening effect of the cutting and still allow the occupants of these two properties to enjoy the long view of the Preseli Hills. The other nearest property will be Pen-troydin-fach to the north, but here the house is to the north east of the farm buildings with views east north east. The proposed mitigation with existing hedges and trees will provide screening of the road and traffic from these views.

Chainage 2440 to 2730 (Pen-troydin-fawr)

9.7.40 From ch.2440 eastwards the new road will gradually rise onto embankment as the north-facing slope steepens. Traversing the slope means the south slope of the embankment will be around 7m at the highest, while the north slope will be rather higher at around 17m. This new landform will be visible in the open agricultural landscape from the north with long views towards Llanfallteg possible. However, the distance to that settlement and the pattern of intervening vegetation will screen or filter these long views of the embankment and traffic.

9.7.41 A proposed farm underpass is provided at approximately ch.2,600. The underpass would also provide a safe crossing for a public right.

9.7.42 The concave slope of the ridge here means that the road would be hidden from properties in northern and southern parts of Llanddewi Velfrey. The north slope of the embankment would be planted with trees and shrubs that would integrate the road with adjacent areas of vegetation in a prominent hedgerow.

9.7.43 From the north the road and embankment would be visible in some views from residential properties at considerable distances, although intervening vegetation along the Afon Daulan and field boundaries

further north will filter and screen these views. A hedgerow, or a narrow strip of trees and shrubs is proposed along the back of the verge on the north side of the road to provide a screen to reduce the visual impact of vehicles on the road. Planting on the south side will grow to provide a backdrop and cast a shadow that should reduce the visibility of vehicles in those same views.

9.7.44 The residential property of Pen-troydin-fawr lies on the east side of the farm buildings with views west blocked by a farm building. The embankment to the south west would be visible from the farmyard, but not from the residential building.

9.7.45 At ch.2600 a small watercourse will be culverted under the new road. The culvert will be accommodated in the same structure as a farm underpass and footpath. The planting scheme will reinstate the original hedgerow to near the entrances of the underpass and form a block of woodland on the north side to screen the culvert from longer views.

Chainage 2730 to 2930 (Pen-troydin-fawr Cutting)

9.7.46 From ch.2730 the new road continues east with the north facing slope becoming steeper and is dissected by small wet, wooded valleys. The road passes into a deep cutting to cross under the Llanfallteg Road over 200m north of the edge of Llanddewi Velfrey and approximately 100m south of Pen-troydin-fawr Farm. The cutting reaches a depth of 15m before tapering away to the east. The depth means that vehicles on the road would be concealed from views north and south, except at around ch.2730. Mitigation proposals here includes a combination of scattered shrubs and small trees planted on lower slopes within the cutting, with denser blocks planted on the east side of the abutments for the Llanfallteg Road Bridge.

Chainage 2930 to 3460 (Pen-troydin-fawr Embankment)

9.7.47 From ch.2730 eastwards the new road is on embankment traversing steep rolling north slopes of the ridge. A series of small watercourses flow south to north off the Llanddewi Velfrey Ridge and cross the line of the new road. The sidelong ground means that the north facing slopes of the embankment are typically around 20m high (up to 25m max.) and the south facing slopes are around 10m high (up to 8m max.). Construction will require felling of woodland and hedges, but the route was modified to retain as much as possible. The views from

Llanddewi Velfrey to the south will be concealed by the curve of the hill and by the large hedges and areas of woodland. Views from the north will be wide and open with long views from as far away as the Preseli Hills and closer potential views from residential properties such as Castell and Tir Bach, from public roads and footpaths. The scale of the embankment is such that it will be visible, but with the steep hillslope rising behind it to the south, it can be mitigated.

9.7.48 The approach to mitigation is to replace the hedges and woodland that will be cleared for the embankment so that the established landscape pattern is restored. Areas of grassland between the hedges would be seen from the north as fields continuing up the slope of the embankment. This pattern of planting will also aid in the reinstatement of routes (crossings under the road) used by wildlife, by linking woodland to the culverts and underpass that will cross under the embankment. The management of the slope will be carried out to maintain the character of hedged pastureland.

9.7.49 The north slope would be treated in a similar manner. At ch.3300 a proposed underpass would carry a public footpath under the new road. On the north side the existing sunken lane would be terminated at the foot of the new embankment. To reinstate the public footpath route, the sunken lane will be reproduced with banks and hedgerow trees extending down to the new underpass. This approach was taken, not only to avoid footpath users from crossing the busy carriageway, but also to guide bat species to follow the new alignment and encourage them to fly through the underpass. However, at the south portal of the underpass an area of open ground would be retained so that daylight can penetrate through the proposed planting once it reached maturity. On the south side a terrace would carry the footpath east towards its original route. Planting provided here would allow views north from the footpath, although the elevation of the path would not be enough to offer the long view to the Preseli hills.

9.7.50 On both the north and south sides of the road small corners of fields will be severed. These will be taken and planted to provide replacement woodland specifically as compensation for loss of dormouse habitat.

9.7.51 At the foot of the embankment, between ch.3000 and 3100 would be a proposed balancing pond. This area would be planted as woodland

and managed as mitigation and compensation habitat for protected species.

Chainage 3460 to 3780 (Bethel Cutting)

9.7.52 From ch.2460 the new road would pass into a deep cutting up to 20m deep to traverse the steepest slope on the Scheme, and on the Llanddewi Velfrey Ridge. The cutting is sufficiently deep that traffic on the new road would be hidden from northern and southern views. The cutting would form a notch seen from the A40 to the east and from Bethel Chapel and Vestry Cottage. The new link road connecting with the former A40 would also require a cutting and these two adjacent cut faces would form a sharp ridge where they meet.

9.7.53 Mitigation for the visual impact of the cuttings will include 'rounding off' the top of the cutting slope so that the hard transition from natural ground and the excavated face will be smoothed. This treatment will be continued southwest along the new link road to the old A40 so that the sharp ridge would be given a more natural profile. The additional 3m wide strip of land for this will be required for essential landscape mitigation.

9.7.54 The cutting face will be formed of soft soil-like or granular material at the top of the slope, but lower down mudstone rock will be encountered. The upper slopes would be seeded as grassland, but the mid slope would be retained as bare rock face, if the rock is sufficiently stable to remain unprotected by soil. The lower slopes would be soiled and planted with scattered shrubs. Two blocks of woodland would be planted on the south slope of the cutting to tie in with adjacent existing hedgerows.

The Bethel Roundabout

9.7.55 At ch.3780 the new road would meet the new Bethel roundabout which provides access onto the old A40, which would serve as the eastern route to Llanddewi Velfrey. It would also provide access to Bethel Chapel and a number of other farms and residential properties to the north. The junction would sit on the same steep slope as the adjacent cutting to the west and would be cut into the hillside to the south. The north side of the roundabout would be roughly at grade and so the cut face and vehicles using the junction would be visible from viewpoints to the north and from Bethel Chapel and the adjacent Vestry Cottage.

9.7.56 The approach to mitigation here is to plant the cutting face on the south side with scattered trees and shrubs that would grow to provide a backdrop to the view of vehicles so that they would be less visible from a distance. At the top of this slope there would be a diverted public footpath. Along the boundary between the path and the slope a strip of woodland would be planted. A westward bound branch of the public footpath traverses the cutting slope to descend towards the roundabout at a gentle gradient. The path would follow a terrace formed in the cutting slope to pass through the scattered trees and shrubs.

9.7.57 On the north side of the roundabout a small copse and a hedge would be planted to screen or filter views from the north. More planting to the west of Bethel Chapel and Vestry Cottage would provide similar mitigation for views from the east, including Vestry Cottage, Bethel Cottage and the Chapel car park. A Pembrokeshire hedgebank would be provided along the top of the cutting slope to provide a visual screen separating the chapel from the new A40.

Bethel Chapel access road

9.7.58 The short link would be a small single lane road which would have to traverse and descend the steep north-facing slope to meet with the existing private lane. The new road would take a winding course to follow the terrain and to minimise the requirement for cuttings and embankments. A hedge would be planted on the north side and a small copse of trees and shrubs would be planted on the south side. These would also form part of the mitigation provided for the roundabout.

The Link road to Llanddewi Velfrey

9.7.59 The new link road would have to ascend the steep north slope of the ridge for 200m in cutting to tie-in with the old de-trunked A40 road beside a property called Glenfield. The new A40 would also require a cutting and these two adjacent cut faces would form a sharp ridge where they meet. Mitigation will include ‘rounding off’ the top of the western cutting slope so that the hard transition from natural ground and the excavated face will be smoothed. This treatment will be continued west along the new A40 so that the sharp ridge would be given a more natural profile. The additional 3m wide strip of land for this will be required for essential landscape mitigation.

9.7.60 The link road would also be a gateway to Llanddewi Velfrey and to enhance the route a formal avenue of beech trees is proposed along both sides of the road. Beech trees are planted locally in estate plantations and on the Henllan avenue to the south of the new road at ch.1240. The remainder of the cutting would be seeded as grassland.

9.7.61 Properties along the south side of the old A40, between Croft

Bethel Roundabout to Pencawse Hill

9.7.62 From the Bethel Roundabout eastwards to the tie-in at the top of Pencawse Hill the new road would converge with and replace the existing carriageway. The new carriageway would be wider than the existing and requires a cutting on the south side as it passes Bethel Chapel but would fit within the existing land take as it approaches Gwyndy Junction. Mitigation includes tree and shrub planting on the southern cutting face and a hedge bank on the north side to provide a degree of screening for Bethel Chapel, Vestry Cottage and the Cemetery. This would be an enhancement on the existing situation.

9.7.63 A balancing pond is proposed on the south side of the new road. A belt of woodland around the edges of the pond enclosure would help to integrate the facility with the surrounding hedged landscape.

Construction

9.7.64 During construction, existing features to be retained would be protected through the implementation of the Construction Environmental Management Plan (CEMP).

9.8 Summary of Residual Effects

Penblewin Roundabout to Bethel Chapel Landscape Effects

Local Landscape Character Areas

Table 9.12 Significance of Effects on Landscape Character Areas

LCA Name	Significance of landscape effect		
	Construction	Winter Year 1	Summer Year 15
01 – Llawhaden	Neutral	Neutral	Neutral
02 – New Moat	Neutral	Neutral	Neutral

LCA Name	Significance of landscape effect		
	Construction	**Winter Year 1**	**Summer Year 15**
03 – Eastern Cleddau	Neutral	Neutral	Neutral
04 – Narberth	Neutral	Neutral	Neutral
05 – Templeton	Large adverse	Large adverse	Moderate adverse
06 – Mid Tâf Vale	Large adverse	Large adverse	Moderate adverse
07 – Llandissilio	Neutral	Neutral	Neutral
08 – Lampeter Vale	Neutral	Neutral	Neutral
09 – Upper Cwm Tâf	Neutral	Neutral	Neutral
10 – Cwmfelin Boeth	Neutral	Neutral	Neutral
11 – Whitland	Neutral	Neutral	Neutral
12 – Brandy Hill	Neutral	Neutral	Neutral
13 – Cwm Gronw	Neutral	Neutral	Neutral
14 – Ciffig Wooded Valleys	Neutral	Neutral	Neutral
15 – Whitland to Pont-y-Fenni	Neutral	Neutral	Neutral
16 – Hiraeth Upland	Neutral	Neutral	Neutral

9.8.1 A significant residual adverse landscape effect is predicted on Templeton and Mid Tâf ValeLCAs. The road alignment crosses a strongly undulating landscape of ridges and valleys with a pastoral and woodland cover. New road cuttings and embankments would cut across the north-facing side of the Llanddewi Velfrey ridge, which has a visual influence on the Mid Tâf Vale LCA.

Penblewin Roundabout to Bethel Chapel Visual Effects

Dwellings and Rural Businesses

Table 9.13 Significance of Visual Effects on Dwellings and Rural Businesses

Predicted Significance of Visual Effect	Number of properties		
	Construction	Winter Year 1	Summer Year 15
Very large adverse	1	0	0
Large adverse	2	6	1
Moderate adverse	7	13	7
Slight adverse	32	29	23
Neutral	80	41	55
Slight benefit	0	29	32
Moderate benefit	0	4	4
Large benefit	0	0	0
Very large benefit	0	0	0

9.8.2 Of the 258 properties assessed, 120 are predicted to experience a change in view. Of these, 10 properties are predicted to experience a temporary significant adverse visual effect during construction, and 19 during winter of Year 1.

9.8.3 Significant residual adverse visual effects are predicted for the following eight properties:

9.8.4 Trefangor Farm (Ref 7NY.5 at SN 12851670), planting to screen the Scheme and traffic would interrupt more distant northward views currently available from the property.

9.8.5 Brominau (Ref 7NY.7 at SN 13231694), the new alignment of the A40 and the new access road to Trefangor Burial Ground would bring the view of road and traffic nearer to the property.

9.8.6 Pen-ca'rmaenau Farm (Ref 7NY.9 at SN 13311729), would experience views of Scheme traffic in an eastward direction where the road bypasses Llanddewi Velfrey on the north-facing slopes of the ridge.

9.8.7 Bryn Dwyrain (Ref 7PL.3 at SN 13691850), and Castell Dwyrain (Ref 7PLJ.1 at SN 14381820), would experience a broad view of Scheme

traffic in a southward direction across the north-facing slopes of the Llanddewi Velfrey ridge.

9.8.8 Pen-troydin-fawr (Ref 7PE.3 at SN 14761735), would experience views of Scheme traffic in a westward direction in addition to the view of Llanfallteg Road overbridge from outdoor spaces.

9.8.9 Castell (Ref 7EG.1 at SN 15391746), would experience a broad view of earthworks and traffic in a south-westward direction across north facing wooded slopes of the Llanddewi Velfrey ridge. A view of part of Llanfallteg Road overbridge would also be available.

9.8.10 The Vestry (Ref 7EG.10 at SN 15921699), would experience a view of the new access road to Bethel Chapel, that would also be used by other scattered dwellings and rural businesses.

9.8.11 Significant residual beneficial effects are predicted for four properties. 19 Maes y Dderwen (7PL.5 at (SN 14971676), 1 to 2 Bryn Helog (Ref 7EG.4 at SN 15601686), and Awelfa (Ref 7EG.5 at SN 15631688) currently have direct and uninterrupted views of road and traffic on the A40. These properties would benefit from the reduction in traffic visible and screening of Scheme road surface and traffic.

Public Rights of Way

Table 9.14 Significance of Visual Effects on Public Rights of Way

Predicted Significance of Visual Effect	**Number of rights of way**		
	Construction	**Winter Year 1**	**Summer Year 15**
Very large adverse	2	2	2
Large adverse	2	7	3
Moderate adverse	8	8	8
Slight adverse	8	3	4
Neutral	6	5	7
Slight benefit	0	0	0
Moderate benefit	0	1	2
Large benefit	0	0	0
Very large benefit	0	0	0

9.8.12 Of the 69 byways, bridleways and footways assessed, 26 are predicted to experience a change in view. Of these, 12 properties are predicted

to experience a temporary significant adverse visual effect during construction, and 17 during winter of Year 1.

9.8.13 Significant residual adverse visual effects are predicted for the following 13 PRoWs.

9.8.14 Footpath SP19/31/3 connecting A40 at Ca'rmaenau-fach to fields north of Bounty Farm would experience uninterrupted views of the Scheme including Trefangor Burial Ground access road from the southern end of the path.

9.8.15 Footpath CA1/25/1 running from the community boundary with Llanddewi Velfrey at the Afon Daulas to the road connecting the A548 at Clynderwen to Llanfallteg Road would experience a broad southward view of the Scheme crossing the north facing slopes of the Llanddewi Velfrey ridge.

9.8.16 Footpath SP19/36/3 connecting the access road to Trefangor Burial Ground to Pen-ca'rmaenau Farm would experience views of Scheme traffic in an eastward direction where the road bypasses Llanddewi Velfrey on the north-facing slopes of the ridge.

9.8.17 Footpath SP/19/38/2 connecting Pen-troydin-fach to Pen-troydin-fawr would experience a view of an agricultural underpass and Llanfallteg Road overbridge. The dominant feature of Pen-troydin-fach embankment would interrupt southward views and traffic in Pen-troydin-fawr cutting would be visible.

9.8.18 Footpath SP/19/1/1 and 19/1/2 connects the A40 in Llanddewi Velfrey at Commercial Cross to Castell-fawr. The section that would be affected runs from north of Blaen-pentroydin to south of Castell. The path would be detoured through a new underpass and would experience a view of road surface and traffic. The Pen-troydin-fawr embankment would be a dominant feature.

9.8.19 Footpath SP 19/3/1 and 19/3/2 connects the A40 at Glenfield to a sunken lane (footpath SP19/2), would be detoured through a new underpass and would experience a view of road and traffic within Bethel Cutting and on Pen-troydin-fawr embankment.

9.8.20 Footpath SP 19/2/1 and 19/2/2 connects the A40 at Cross Inn Cottage to the access track from Bethel Chapel to Castell-mawr follows a

sunken lane and would be detoured through a new underpass. The path would experience a view of road and traffic on Pen-troydin-fawr embankment.

9.8.21 Footpath SP 19/4/3, 19/4/4 and 19/4/6 connect Bethel Chapel to Castell. The path would experience views of Llanfallteg Road overbridge, Pen-troydin-fawr cutting and embankment slopes, Bethel Cutting, Bethel Roundabout and Bethel Chapel access road.

9.8.22 Significant residual beneficial effects are predicted for 2 PRoWs. SP19/37/1 connecting Ffynnon Chapel to Parc-y-delyn would benefit from native species planting to screen views of the Scheme. SP19/17/1 connecting the A40 near to Bethel Chapel cemetery to the Landsker Borderlands Trail in the Lampeter Vale would benefit from native species planting to screen views of the Scheme and an attenuation pond to add visual interest. Currently the paths have direct and uninterrupted views of road and traffic on the A40 from a short section.

9.9 Monitoring of Scheme Landscape Proposals

9.9.1 Landscape planting becomes established and the trees and shrubs grow to form a mass such as a hedgerow or plantation, visual screening belt or scattered trees. There are three targets to be met by this form of mitigation and monitoring is required for each:

a) Monitoring of plants to determine whether adequate establishment of tree is occurring. Percentage targets should be set so that the established plants are considered sufficiently dense to satisfy the performance requirements of DMRB Volume 10 (2008).

b) Monitoring of planting proposed as mitigation for significant visual impact, to assess whether it will achieve the required height to satisfy visual screening requirements by the Design Year.

c) Firstly, this shall include annual monitoring during the five years of aftercare to determine whether sufficient grown is being achieved each year by faster growing plants to satisfy screening objectives by the Design Year. This will involve some prediction of future growth rates based on those achieved within the aftercare period.

d) Secondly, this will include a monitoring visit by the Maintaining Agent at the end of the growing season in the Design Year to review mitigation and to commence any ongoing management activity to thin, coppice or underplant as required in the soft estate management plan.

9.9.2 The purpose of monitoring will be to identify and undertake any management interventions are required to ensure mitigation satisfies objectives.

9.10 Cumulative impacts

9.10.1 Cumulative impacts on residential receptors and Public Rights of Way with other developments are covered in Chapter 21.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 10: Archaeology and Cultural Heritage

A40LVP-RML-EHR-SWI-RP-LH-0001

P07 | S4

15/04/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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10 Cultural Heritage

10.1 Introduction

10.1.1 This chapter considers the direct and indirect impact of the Scheme on cultural heritage assets, including buried archaeological features, historic buildings and historic landscapes. It identifies the likely impacts on these heritage assets in terms of the potential for direct physical disturbance and changes within the settings of the assets and assesses the overall significance of effect.

10.1.2 The following stages of the Scheme are likely to affect the historic environment:

a) **Construction (including land take)**: this is the phase where direct, physical impacts on built heritage assets and buried archaeological remains are most likely to occur.

b) **Operation:** this is the phase during which nearby heritage assets may experience impacts due to visual and acoustic changes within their settings, and there would also be changes to the character of the historic landscape.

10.1.3 Physical assets were considered within the 500m study area on either side of the Scheme boundary. Within this corridor, 125 assets were identified. Of these, 31 assets are found within the Scheme boundary and are potentially physically impacted. The remaining 94 assets are outside the Scheme and should not be impacted. The assets are listed in Table 10.9. Of these, 4 were designated sites, with a further 164 in the zone between the 500m boundary and 5km. These sites consisted of a total of 32 scheduled ancient monuments (SAM) and 127 listed buildings (LB).

10.1.4 Figure 10.1 shows the locations of the designated sites. Figure 10.2(A, B, & C) show the effects on cultural heritage assets, while 10.3 is a draft mitigation plan.

10.2 Legislation and Policy Context

Relevant Legislation

10.2.1 The primary legislation applicable to this chapter comprises the Ancient Monuments and Archaeological Areas Act 1979 and the Planning (Listed Buildings and Conservation Areas) Act 1990.

10.2.2 The Historic Environment (Wales) Bill was passed by the National Assembly for Wales on 9th February 2016. The Act makes changes to the Ancient Monuments and Archaeological Areas Act 1979 and the Planning (Listed Buildings and Conservation Areas) Act 1990. It also incorporates stand-alone provisions establishing: statutory historic environment records, a list of historic place names and an advisory panel for the historic environment.

National Planning Policy

10.2.3 The relevant national planning policy is Planning Policy Wales (Welsh Government, 2016) (PPW). Chapter 6 of PPW (Conserving the Historic Environment) establishes the Welsh Government objectives about the protection of the historic environment. It further explains that local planning authorities have an important role in this protection, whilst ensuring that the historic environment can accommodate and respond to the current needs of society.

10.2.4 PPW identifies Cadw as the historic environment division of the Welsh Government and '*has responsibility for protecting, conserving and promoting an appreciation of the historic environment of Wales*' (paragraph 6.2.1). It lays out the duties of Welsh Government with regard to the compilation of lists of buildings of special architectural or historic interest (i.e. listed buildings) and the scheduling of ancient monuments that are considered to be of national importance (i.e. scheduled monuments).

10.2.5 The roles of the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) and the four Welsh Archaeological Trusts are also defined. PPW goes on to provide advice with regard to the management of designated and undesignated heritage assets.

10.2.6 With regard to archaeological remains, Section 6.5 of PPW states that *'The desirability of preserving an ancient monument and its setting is a material consideration in determining a planning application, whether that monument is scheduled or unscheduled. Where nationally important archaeological remains, whether scheduled or not, and their settings are likely to be affected by proposed development, there should be a presumption in favour of their physical preservation in situ. In cases involving lesser archaeological remains, local planning authorities will need to weigh the relative importance of archaeology against other factors, including the need for the proposed development'* (paragraph 6.5.5).

10.2.7 The policy regarding listed buildings is presented in Section 6.5 of PPW: *'There should be a general presumption in favour of the preservation of listed buildings…. Where a development proposal affects a listed building or its setting, the primary material consideration is the statutory requirement to have special regard to the desirability of preserving the building, or its setting, or any features of special architectural or historic interest which it possesses'* (paragraph 6.5.11). The latter statement refers to the requirements under Section 66(1) of the Planning (Listed Buildings and Conservation Areas Act) 1990.

10.2.8 The Wales Transport Strategy identifies a number of key environmental challenges with regard to the impact of transport on the environment. One of these relates to the loss of landscape and heritage quality and distinctiveness. The Strategy aims to *'Reduce the negative impacts of transport on our heritage – landscape, townscape, historical environment and Wales' distinctiveness'* (Welsh Assembly Government, 2008b, Table 4).

10.2.9 Welsh Government advice regarding the importance of good design as a means of promoting sustainability (with regard to buildings and landscapes) is presented in Technical Advice Note (TAN) 12: Design (Welsh Government, 2016).

Local Planning Policy

10.2.10 The Pembrokeshire Local Planning Development Plan, adopted in February 2013, contains the following proposed policy relevant to the historic environment: *GN.38 Protection and Enhancement of the Historic Environment Development that affects sites and landscapes*

of architectural and/or historical merit or archaeological importance, or their setting, will only be permitted where it can be demonstrated that it would protect or enhance their character and integrity.

10.3 Assessment Methodology

Relevant Guidance

10.3.1 Historic Environment TAN 24, (Welsh Government, 2017) replaces Circular 60/96 Planning and the Historic Environment: Archaeology; 61/96 Planning and the Historic Environment; Historic Buildings and Conservation Areas; and 1/98 Planning and the Environment: Directions by the Secretary of State for Wales. TAN 24 forms a single document giving guidance for the planning system as it considers the historic environment during development plan preparation and decision making planning and listed building applications.

10.3.2 The historic environment is defined as: *'All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past activity, whether visible, buried or submerged, and deliberately planted or managed*.' A historic asset is: '*An identifiable component of the historic environment. It may consist or be a combination of archaeological site, a historic building or area, historic park and garden or a parcel of historic landscape. Nationally important historic assets will normally be designated.*

10.3.3 Taken together, and set within their cultural context, historic assets contribute to the character and sense of place of different parts of Wales. (TAN 24 1.7).

10.3.4 TAN 24 uses the *Conservation Principles for the Sustainable Management of the Historic Environment in Wales* (Conservation Principles), published in 2011 as a basis upon which Cadw discharges its statutory duties. Conservation Principles should be used to assess the potential impacts of a development proposal on the significance of any historic asset/assets and to assist in decision-making where the historic environment is affected by the planning process (TAN 24 1.10).

10.3.5 Six principles are used:

1. Historic assets would be managed to sustain their values
2. Understanding the significance of historic assets is vital
3. The historic environment is a shared resource
4. Everyone will be able to participate in sustaining the historic environment
5. Decisions about change must be reasonable, transparent and consistent
6. Documenting and learning from decisions is essential

10.3.6 TAN 24 shows that heritage impact assessment is a structured process to enable the significance of a designated asset to be taken into account when considering proposals for change.

10.3.7 Information on historic assets in Wales is included in TAN 24. This describes the sources of information on designated historic assets (scheduled monuments, listed buildings and protected wrecks) and areas on the register of historic parks and gardens and the register of historic landscape in Wales. The large majority of historic assets are not designated and the largest comprehensive set of data on all known archaeological sites, historic buildings and other components of historic landscape is found in the Historic Environment Records (HERs), maintained by the four Welsh archaeological trusts.

10.3.8 TAN 24 describes the importance of archaeological assets and their fragility and vulnerability to damage. The development management process maintains a presumption that preservation *in situ* is the preferred option for the management of assets that may be affected by development. TAN 24 outlines the procedures to be followed for the preservation, or where considered appropriate, the excavation and recording of archaeological features. This includes defining the scope of work and monitoring performance. The need to provide a contingency to deal with unexpected archaeological discoveries by the developer is also emphasised.

10.3.9 *Setting of Historic Assets in Wales* (Cadw 2017) gives guidance on measures to assess the potential visual impact of developments. The introduction to this makes it clear that all individual historic assets, irrespective of their designation, are affected by this guidance.

10.3.10 Section 4 of *Setting Historic Assets in Wales* lays out the stages of assessment that are to be followed:

Stage 1: *Identify the historic assets that might be affected by a proposed change or development.*

Stage 2: *Define and analyse the settings to understand how they contribute to the significance of the historic assets and, in particular, the ways in which the assets are understood, appreciated and experienced.*

Stage 3: *Evaluate the potential impact of a proposed change or development on that significance.*

Stage 4: *If necessary, consider options to mitigate or improve the potential impact of a proposed change or development on that significance.*

10.3.11 The document identifies criteria for the setting of a scheduled monument that Cadw must be consulted on by a planning application. This Scheme meets the following criteria:

"Development likely to be visible from a scheduled monument and which meets one of the following criteria:

it is within a distance of 5 kilometres from the perimeter of a scheduled monument and is 100 metres or more in height, or has an area of 1 hectare or more."

Therefore, this assessment considers the setting of all designated assets within 5km of the project boundary.

10.3.12 The overall assessment of impacts and effects presented in this assessment is in line with the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5 (HA205/08) (Highways Agency *et al.,* 2008). This provides guidance on the assessment and management of environmental effects, including advice on determining the magnitude of impacts and the significance of effects.

10.3.13 DMRB guidance specific to the historic environment is provided in the DMRB Volume 11, Section 3, Part 2 Cultural Heritage (HA208/07) (Highways Agency *et al.,* 2007). This splits the cultural heritage resource into three related sub-topics: Archaeological Remains; Historic Buildings and Historic Landscape. Annex 8 of HA208/07 provides guidance on how the processes described within this section of the DMRB may need to be adapted within the devolved administrations.

10.3.14 In addition to the above, the following Chartered Institute for Archaeologists' Standard and Guidance documents were utilised within the programme of baseline data gathering:

a) Standard and guidance for historic environment desk-based assessment (Chartered Institute for Archaeologists, 2017).
b) Standard and guidance for archaeological geophysical survey (Chartered Institute for Archaeologists, 2014a).

Study Area

10.3.15 The study area for historic asset collection was the land take itself and a corridor 500m beyond the boundary of the proposed Scheme. Where linear or historic landscape features extend beyond the 500m area, the study area was extended in order to provide sufficient context for the understanding of such features. The desk-based assessment for the Scheme is presented in Appendix 10.4.

10.3.16 For designated heritage assets (e.g. scheduled monuments and listed buildings) whose setting could be affected as a result of change, a further study area was used to include all such assets within a zone of 5km. The locations of Designated assets are shown in Figure 10.1 and listed in Appendix 10.3.

Approach to Identification of Baseline Conditions

10.3.17 A desk based assessment of the Scheme was prepared using various sources of data including a walk through survey. Full coverage of the regional HER for the main study area was acquired from the Dyfed Archaeological Trust (DAT), together with details of defined Historic Landscape Character Areas. Information regarding scheduled monuments, listed buildings and Registered Parks, Gardens and Landscapes of Special Historic Interest was obtained from Cadw and published sources.

10.3.18 A walkthrough survey was conducted in September 2017, together with secondary visits to specific locations associated with the geophysical survey during that Autumn. Additional visits were undertaken during the dry summer of 2018 to assess the degree to which the fields were developing parchmarks and cropmarks. The degree to which designated sites could be seen from the project boundary, or views from the designated sites affected were assessed during the site visits.

10.3.19 Geophysical survey in the form of a fluxgate gradiometer survey was undertaken at a number of locations on the Scheme. The areas were selected for survey on the basis of scheme design and impact; effect of land use on the magnetic survey and overall archaeological potential. A report on the results of this programme of magnetometer survey is presented as Appendix 10.1.

10.3.20 LiDAR information contained in the Lle website (lle.gov.wales) was examined and used to provide information on earthworks and topography across the study area.

10.3.21 Available satellite imagery covering the Scheme was acquired from commercial suppliers and examined along with other historic aerial photographs.

Assessment Criteria and Assignment of Significance

10.3.22 The assessment of impacts and effects on cultural heritage receptors was undertaken in accordance with the methodology described in DMRB Volume 11, Section 3, Part 2 (HA208/07) (Highways Agency *et al.,* 2007). This is a Detailed Assessment as described in paragraph 3.9 of HA208/07, which is the level required when there is the potential for significant effects on cultural heritage resources.

10.3.23 The overall approach to the assessment of the significance of effects is in line with DMRB Volume 11, Section 2, Part 5 (HA205/08) (Highways Agency *et al.,* 2008). This provides guidance on the assessment and management of environmental effects, including advice on determining the magnitude of impacts and the significance of effects.

Receptor Value

10.3.24 In order to reach an understanding of the level of any effect that a scheme may have on a heritage asset, it is necessary to understand the importance of that asset. For example, is it important at a national level or at a local level?

10.3.25 HA208/7 (Highways Agency *et al.,* 2007) provides the following tables for assessing the value (significance) of heritage assets.

Table 10.1 Factors for Assessing the Value of Archaeological Assets

Value (sensitivity)	**Factors**
Very High	World Heritage Sites (including nominated sites). Assets of acknowledged international importance. Assets that can contribute significantly to acknowledged international research objectives.
High	Scheduled Ancient Monuments (including proposed sites). Undesignated assets of schedulable quality and importance. Assets that can contribute significantly to acknowledged national research objectives.
Medium	Designated or undesignated assets that contribute to regional research objectives.
Low	Designated and undesignated assets of local importance. Assets compromised by poor preservation and/or poor survival of contextual associations. Assets of limited value, but with potential to contribute to local research objectives.
Negligible	Assets with very little or no surviving archaeological interest.
Unknown	The importance of the resource has not been ascertained.

Table 10.2 Criteria for Establishing Value of Historic Buildings

Value (sensitivity)	**Criteria**
Very High	Structures inscribed as of universal importance as World Heritage Sites. Other buildings of recognised international importance.
High	Scheduled Ancient Monuments with standing remains. Grade I and II* Listed Buildings. Other listed buildings that can be shown to have exceptional qualities in their fabric or historical associations not adequately reflected in the listing grade. Conservation Areas containing very important buildings. Undesignated structures of clear national importance.
Medium	Grade II Listed Buildings. Historic (unlisted) buildings that can be shown to have exceptional qualities in their fabric or historical associations. Conservation Areas containing buildings that contribute significantly to its historic character. Historic Townscape or built-up areas with historic integrity in their buildings or built settings (e.g. including street furniture and other structures).

Value (sensitivity)	Criteria
Low	'Locally Listed' buildings. Historic (unlisted) buildings of modest quality in their fabric or historical association. Historic Townscape or built-up areas of limited historic integrity in their buildings or built settings (e.g. including street furniture and other structures).
Negligible	Buildings of no architectural or historic note; buildings of an intrusive character.
Unknown	Buildings with some hidden (i.e. inaccessible) potential for historic significance.

Magnitude of Impact

10.3.26 The magnitude of an impact is assessed without regard to the value of the heritage asset. In terms of the judgement of the magnitude of impact, this is based on the principle that preservation of the asset is preferred, and that total physical loss of the asset is least preferred.

10.3.27 With regard to buried archaeological remains, it is not always possible to assess the physical impact in terms of percentage loss, and therefore it can be important in such cases to try to assess the capacity of the heritage asset to retain its character and significance following any impact. Impacts resulting from changes within the settings of buried archaeological remains may also be more difficult to assess as they do not involve physical loss of the resource – further information regarding the methodology for assessment of impacts and effects resulting from change within the settings of heritage assets is provided in Table 10.3 which is derived from HA208/07 (Highways Agency *et al.,* 2007).

Table 10.3 Factors in the Assessment of Magnitude of Impact - Archaeological Remains

Impact magnitude	Factors
Major	Change to most or all key archaeological materials, such that the resource is totally altered. Comprehensive changes to setting.
Moderate	Changes to many key archaeological materials, such that the resource is clearly modified. Considerable changes to setting that affect the character of the asset.
Minor	Changes to key archaeological materials, such that the asset is slightly altered.

Impact magnitude	Factors
	Slight changes to setting.
Negligible	Very minor changes to archaeological materials, or setting.
No change	No change.

10.3.28 For impacts on historic buildings, the following table for the assessment of magnitude of impacts on historic buildings from HA208/07 (Highways Agency *et al.,* 2007).

Table 10.4 Factors in the Assessment of the Magnitude of Impact – Historic Buildings

Impact magnitude	Factors
Major	Change to key historic building elements, such that the resource is totally altered. Comprehensive changes to setting.
Moderate	Changes to many key historic building elements, such that the resource is significantly modified. Changes to the setting of an historic building, such that it is significantly modified.
Minor	Change to key historic building elements, such that the asset is slightly different. Change to setting of an historic building, such that it is noticeably changed.
Negligible	Slight changes to historic building elements or setting that hardly affect it.
No change	No change to fabric or setting.

10.3.29 HA208/07 (Annex 7, para. 7.12.1) (Highways Agency *et al.,* 2007) explains that historic landscapes cannot be destroyed, but that impacts on them can change their character. Impacts should be assessed using evaluated historic landscape character units, not the elements/parcels/components that contribute towards that character. There may be impacts resulting from changes within the settings of identified units, especially with regard to designated historic landscapes. Factors to be used in the assessment of magnitude of change are identified in Table 10.5.

Table 10.5 Factors in the Assessment of Magnitude of Impact – Historic Landscape

Impact magnitude	Factors
Major	Change to most or all key historic landscape elements, parcels or components; extreme visual effects; gross change of noise or change to sound quality; fundamental changes to use or access; resulting in total change to historic landscape character unit.
Moderate	Changes to many key historic landscape elements, parcels or components; visual change to many key aspects of the historic landscape; noticeable differences in noise or sound quality; considerable changes to use or access; resulting in moderate changes to historic landscape character.
Minor	Changes to few key historic landscape elements, parcels or components; slight visual changes to few key aspects of historic landscape; limited changes to noise levels or sound quality; slight changes to use or access; resulting in limited changes to historic landscape character.
Negligible	Very minor changes to key historic landscape elements, parcels or components; virtually unchanged visual effects; very slight changes in noise levels or sound quality; very slight changes to use or access; resulting in a very small change to historic landscape character.
No change	No change to elements, parcels or components; no visual or audible changes; no changes arising from amenity or community factors.

Significance of Effect

10.3.30 The level or significance of an effect is a combination of the importance or value of the heritage asset and the magnitude of impact on that asset. Effects can be adverse or beneficial. Beneficial effects are those that mitigate existing impacts and help to restore or enhance heritage assets, therefore allowing greater understanding and appreciation.

10.3.31 HA208/07 (Highways Agency et al., 2007) provides the following matrix (Table 10.6 and 10.7) for use within all three sub-topics. As explained within HA208/07 (paragraph 5.38 and Annex 5, paragraph 5.13.3), the matrix is not intended to 'mechanise' the process of assessment of the significance of the effect but rather to act as a check that can ensure judgements of importance (value), impact magnitude and significance of effect are balanced. Where the matrix produces a level of effect significance that is clearly unreasonable, the judgements of importance (value) and impact magnitude should be reassessed to ensure that they can be justified.

10.3.32 Within this chapter of the ES, effects of moderate or greater significance are considered to be 'significant'.

10.3.33 Although HA208/07 (Highways Agency *et al.,* 2007) does not provide definitions of the significance of effects specific to the Cultural Heritage topic, the guidance set out in Table 2.3 of HA205/08 (Highways Agency *et al.,* 2008) was taken into account, see Table 10.6.

Table 10.6 DMRB Descriptors of Significance of Effect Categories

Significance category	**Typical Descriptors of Effect**
Very large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision- making process.
Moderate	These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Table 10.7 Significance of Effects Matrix

VALUE	**Very High**	Neutral	Slight	Moderate/ Large	Large or Very Large	Very Large
	High	Neutral	Slight	Moderate/ Slight	Moderate/ Large	Large/ Very Large
	Medium	Neutral	Neutral/ Slight	Slight	Moderate	Moderate/ Large
	Low	Neutral	Neutral/ Slight	Neutral/ Slight	Slight	Slight/ Moderate
	Negligible	Neutral	Neutral	Neutral/ Slight	Neutral/ Slight	Slight
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
		MAGNITUDE OF IMPACT				

Settings

10.3.34 As described above, HA208/07(Highways Agency *et al.,* 2007) refers to effects on the settings of heritage assets and explains (paragraph 4.19) that setting is a material consideration in government policy relating to the historic environment.

10.3.35 The existence of direct lines of sight between the heritage asset and a scheme is an important factor in judging the visual impact of the development. However, it is possible for changes within the setting to occur even when such a relationship does not exist. For example, views towards a listed building from a frequently visited location, such as a park or a public footpath, may be affected by the presence of a larger development, even if the development is not directly visible from the building itself.

10.3.36 Consideration has also been given to the sensitivity to change of the setting of a heritage asset. This is done through examination of the current setting with regard to identifying elements that contribute to the significance of the asset, elements that make a neutral contribution to the significance of the asset and elements that make a negative contribution (i.e. detract from) the significance of the asset.

10.3.37 Once the impact on the significance of the heritage asset was examined, this was then related to the magnitude of impact scales defined below. These are closely linked to the magnitude of impact scales used in HA208/07 (Highways Agency et al., 2007).

c) Major: Substantial change within the setting leading to considerable loss or enhancement of significance of the asset.
d) Moderate: Change within the setting leading to some loss or enhancement of significance of the asset.
e) Minor: Slight change within the setting leading to a slight loss or enhancement of significance of the asset.
f) Negligible: Very minor changes within the setting that hardly affect the significance of the asset.
g) No change: No substantive change within the setting.

10.3.38 The magnitude of impact was considered with the value/sensitivity of the asset within the overall matrix for identifying significance of effects (see Table 10.6 and 10.7).

Limitations of the Assessment

10.3.39 All readily available data required for the assessment were acquired and examined. Remote sensing methodologies (LiDAR, satellite imaging and geophysical survey) were utilised in order to gain as much potential evidence as possible.

10.3.40 No intrusive archaeological investigation within the Scheme boundary has been undertaken to date. This action was not a requirement of the original contract, where it was indicated as being required following the results of the geophysical survey. The assessment of impact and value of any historical asset may change once additional information has been collected by evaluation trenching work. Remote sensing has identified a number of locations that potentially contain buried archaeological evidence. Some appear to be of natural or very recent origin. These will need to be examined by a programme of evaluation trenching, the details of which need to be agree with the regional curator.

10.3.41 As there is not a construction contractor in place for the Scheme, it has not been possible to determine additional work areas, compounds etc. outside the boundary of the Scheme. These will require additional assessment as these are identified

10.4 Baseline Environment

10.4.1 The archaeological and cultural heritage assets contained within the area covered by the route option is varied. Most assets are from the last two hundred years, with a range of features stretching back through the medieval to the Prehistoric period. A Gazetteer of historical assets in the 500m study area is shown in Table 10.9 and detailed in Appendix 10.2. Designated sites within a wider 5km study area are presented in Appendix 10.3 and Figure 10.1. It should be remembered that there are two study areas: the 500m study area that includes all known assets and the 5km study area that lists designated sites only.

10.4.2 Assets identified in both study areas are discussed below. Each asset in the 500m study area is identified by an ID reference number in brackets, e.g. (**63**). Those identified in the 5km study area are not given a project specific number.

Palaeolithic, Mesolithic, Neolithic (to 2200 BC)

10.4.3 No assets of this period can be identified within the 500m study area.

10.4.4 A single designated site, the Neolithic Llan burial chamber is found in the 5km study area.

Bronze Age (2500 BC to 700 BC)

10.4.5 Within the 500m study area, seven locations are believed to be burnt mounds (**3, 9, 16, 20**, **37, 88** and **89**). These are collections of burnt fire shattered stone in a matrix of charcoal rich soil. They are typically found in close proximity to springs or small watercourses. Radiocarbon dating normally shows them to be of Bronze Age date, although some are earlier and they can be as late as the Post-Roman era. On excavation, they are often associated with a small water-filled trough. Experimental archaeology shows that water can be brought to boiling point by dropping heated stones into the troughs. This can then be used for cooking or possibly, some form of sauna. These occur frequently in Wales, Ireland and Scotland. All the features in the study area were found by Ordnance Survey surveyors T.C. Cantrill and OT Jones, who identified many in the region during fieldwork in the early 20th century.

10.4.6 A single mound (**92**) is thought to be a burial mound, while there are two stones that may originate from this period (**105** and **115**).

10.4.7 Five designated sites of the period are recorded in the 5km study area. These are all burial mounds.

Iron Age (800 BC to AD 43)

10.4.8 Within the 500m study area there is a single asset likely to originate in this period, a promontory fort, (**35**).

10.4.9 A total of 16 designated sites of this period are identified in the 5km study area. All relate to defended enclosures.

Roman, Early Medieval (AD 43 to AD 410)

10.4.10 No assets of the Roman period have been identified in the 500m study area.

10.4.11 Two designated sites of the Roman period are found in the 5km study area. Both relate to the road running westwards from the town of Carmarthen.

Early Medieval (AD 410 to AD 1066)

10.4.12 No assets of the early Medieval period have been identified in the 500m study area.

10.4.13 Two designated sites of the period are found in the 5km study area. Both are early Christian inscribed stones.

Medieval (1066 to 1540)

10.4.14 The period saw the early development of local market centres and some of the larger villages such as Lampeter Velfrey, Clunderwen and Llandissilio. The villages were set in a landscape of long rectangular fields, parts of which can be seen in the present-day landscape (**63**).

10.4.15 There are no assets directly identified to this period, the village of Llanddewi Velfrey and the field system (**63**) may have origins in the period, but no elements can be directly identified of that date.

10.4.16 Designated sites in the 5km study area include 12 sites. These include castles and churches.

Post-medieval (1540-1901)

10.4.17 Within the 500m study area, 82 assets relate to this period. These include chapels, Ffynnon, a Listed Building grade II (**5**) and Bethel (**29**); two blacksmith workshops are recorded (**17, 24**); buildings (**6, 21, 33, 46, 49, 59**); Trefangor Baptist burial ground (**48**); cottages (**4, 15, 18, 30, 34, 36**); dwellings (**11, 13, 14, 44, 45, 49, 53, 54, 55**); farmsteads and homesteads (**40, 42, 43, 56, 86**); gravel pits (**16, 27, 51**); possible leat (**60**); Lodge to Henllan mansion (**47**); old bridge under the original route of the A40 (**57**); poorhouse (**12**); post office (**26**); public houses (**22, 25**); quarries (**7, 8, 10, 28, 32, 38, 50, 52**); the turnpike road between Whitland and Penblewin operated by the Whitland Turnpike Trust (**39**); the war memorial in Llanddewi Velfrey, one of the earliest in Pembrokeshire is a Listed Building grade II (**23**); a well (**31**); at Gwindy, east of the Scheme there are two

Listed Buildings graded II, these are the farmhouse with walls and railings to the garden (**84**) and the old stable block (**85**).

10.4.18 The Post-medieval designated sites in the 5km study area include a total of 121 sites. Of these, 40 are found in the town of Narberth. All are listed buildings and cover a wide range of assets, such as town house, mansions, bridges, memorials and marker stones.

Features of Unknown Date

10.4.19 There are a number of assets identified as 'unknown' date. These probably date from the Post-medieval. The assets are cropmarks (**1, 61, 62**); a standing stone (**2**); soil marks (**41**) and a LiDAR feature (**58**).

10.4.20 The geophysical survey identified 20 features that are of possible archaeological origin. These are of unknown date, although some align with the field layout, so could be of similar age. The features are identified as possible enclosures (**64, 65, 66**); numerous features (**67**); curvilinear features (**68, 69**); multiple features (**70**); potential trackways (**71, 72**); possible ridge and furrow (**73**); linear features (**74, 75, 77, 78, 79**); possible burnt area (**76**); quarrying area (**80**) and possible ferrous material (**81, 82, 83**).

10.4.21 No assets of unknown date are listed as designated sites.

10.5 Assessment of Potential Construction Effects

10.5.1 Physical impacts of construction are described in section 10.5, while the assessment of potential operational impacts, which is chiefly concerned with settings is described in section 10.6.

10.5.2 The potential direct physical land take impacts on heritage assets that would occur at the start of the construction phase, along with the consequent effects, are described in this section.

Physical impact

10.5.3 In the 500m buffer zone on either side of the Scheme boundaries, identified as the study area, 125 assets were identified. 94 assets are not physically impacted by the Scheme, 31 appear to be physically impacted. These assets are listed in Table 10.9 and discussed below.

The effects of the Scheme on cultural heritage assets are shown in Figures 10.2 (A, B & C).

10.5.4 The assessment includes the entire Scheme footprint for permanent construction. Information is not available for areas of temporary land take, which will need to be assessed once they are identified once a construction contractor is appointed.

10.5.5 **9** *Burnt mound.* Burnt mound identified by Cantrill and Jones. No evidence is visible for this feature, although it lies in a typical location for such a feature. Further similar features could be located in the vicinity. The geophysical survey was unable to operate in this area due to wet conditions and high undergrowth.

10.5.6 The significance of this asset is derived from its archaeological value that may give additional information on the development, economy and environment of the prehistoric period in this area. This is regarded as a heritage asset of medium value.

10.5.7 Situated on the edge of the Scheme boundary, but possibly not correctly located. This area is intended as a balancing pond for drainage of the road. The scale of the impact on the site is assessed as moderate as the condition of the site cannot be determined, with a subsequent significance of effect assessed as moderate.

10.5.8 **19** *Burnt mound.* Burnt mound identified by Cantrill and Jones. No evidence is visible for this feature, although it lies in a typical location for such a feature. Further similar features could be located in the vicinity. The geophysical survey was unable to function in this area due to wet conditions and high undergrowth.

10.5.9 The significance of this asset is derived from its archaeological value that may give additional information on the development, economy and environment of the prehistoric period in this area. This is regarded as a heritage asset of medium value.

10.5.10 This area will lie under an embankment for the road. The scale of the impact on the site is assessed as moderate as the condition of the site cannot be determined, with a subsequent significance of effect assessed as moderate.

10.5.11 **20** *Burnt mound*. Burnt mound recorded on Pentroydin Fach, identified by survey in 1997. Reported to be heavily damaged then, while no evidence was seen during the field survey. It lies in a typical location for such a feature. Further similar features could be located in the vicinity. The geophysical survey was unable to operate in this area due to wet conditions and high undergrowth.

10.5.12 The significance of this asset is derived from its archaeological value that may give additional information on the development, economy and environment of the prehistoric period in this area. This is regarded as a heritage asset of medium value.

10.5.13 The given grid reference is outside the Scheme boundary, but lies in an area that was selected for an additional working area to allow access. Due to this, the area was subjected to a geophysical survey over a large part of the field to the south of the Scheme. No direct evidence for a burnt mound was seen in the geophysical survey, merely a set of linear anomalies that follow the line of historic field boundaries. To the north of this area, the geophysical survey did identify multiple anomalies that could represent burnt features, that could be the result of prehistoric activity (**70**).

10.5.14 The scale of the impact on the site is assessed as moderate as the condition of the site cannot be determined, with a subsequent significance of effect assessed as moderate.

10.5.15 **36** *Cottage.* Cottage shown on Tithe map and OS 1908. Some faint marks are visible on satellite images. The known extent is outside the Scheme boundary, but it is possible that features related to the site extend into the extent of the Scheme.

10.5.16 The asset is regarded as being of low significance. The magnitude of impact will be minor, if any, giving a significance of effects of neutral or slight.

10.5.17 **39** *Turnpike road.* The current A40 largely follows the line of the turnpike road. A toll bar was recorded at Penblewin. In places, particularly around Ffynnon, the road alignment varies as a result of improvements to the modern A40 route.

10.5.18 These road improvements have totally changed the character of the original road. There are currently no structures indicating a toll bar at

Penblewin. This area has also seen large scale disturbance from works relating to the roundabout. The scale of these changes can be seen from the 1946 RAF vertical air photographs. As much of the existing road has been removed by later improvements, it is unlikely that significant evidence remains under the modern road. The new Scheme will follow parts of the previous alignment in the Ffynnon area and to the west of that, and also, in the Penblewin roundabout area.

10.5.19 The asset is regarded as being of medium significance. The magnitude of impact will be moderate in areas where the existing road is found, with a significance of effects of moderate where remains do exist.

10.5.20 **44** *Trefangor Cottage.* Trefangor Cottage is shown on tithe map and OS 1908.It is currently an undesignated standing building, which has been vacated and will be demolished as part of the Scheme. The building is a two storey cottage with surrounding gardens and garden sheds.

10.5.21 The asset is regarded as being of low value significance. The magnitude of impact will be major as the asset will be totally removed. The significance of effects will be slight or moderate.

10.5.22 **45** *Dwelling.* Dwelling shown on tithe map, but is absent on all subsequent historic maps. This area lies in the wide verge of the existing A40, no features are visible. The field north of this location was subjected to geophysical survey, but no anomalies were recorded. Rectification of the tithe map against the modern map base suggests that the location of the cottage may be under the present route of the A40, although this is not clear.

10.5.23 The asset is regarded as being of low value significance. The magnitude of impact will be moderate, as there is no information on the current condition, although any remains will be totally removed. The significance of effects is assessed as slight.

10.5.24 **46** *Building.* Building shown on tithe map and absent on all subsequent historic maps. This structure lies in woodland east of the roadway to Henllan mansion. The later historic maps show that the woodland was present in the 1880's. The feature lies within woodland and was not accessible at the time of survey.

10.5.25 The asset is regarded as being of low value significance. The magnitude of impact will be moderate as there is no information on the current condition. The significance of effects is assessed as slight.

10.5.26 **55** *Cottage and garden.* Cottage and garden shown on tithe map, but not on subsequent historic maps. Nothing is visible on satellite images and the area was thickly covered by rushes at the time of the field visit. The asset lies on the edge of the Scheme land take. This area should be outside the main fill of the road in this area but could be included in landscaping and drainage works.

10.5.27 The asset is regarded as being of low value significance. The magnitude of impact is assessed as major as the asset could be well-preserved. The significance of effects is assessed as slight or moderate.

10.5.28 **56** *Standing building.* Standing building on the north side of the A40 at Penblewin. Shown on tithe map as a single enclosure, while first edition Ordnance Survey shows several buildings. The 1946 RAF vertical aerial photographs show that the southern building had been removed by the encroaching road. Building walls are extant, but totally derelict and overgrown with trees.

10.5.29 The asset is regarded as being of low value significance. The magnitude of impact will be major as the structures will be totally removed. The significance of effects is assessed as neutral.

10.5.30 **60** *Boundary*. Boundary, not shown on the tithe map, but present on the first edition Ordnance Survey. The features is visible on satellite images as a terraced feature leading towards Pentroydin Fach Farm. Possible leat.

10.5.30.1 The asset is regarded as of negligible significance. The magnitude of impact will be major as it will be totally removed. The significance of effects is assessed as slight or moderate.

10.5.31 **63** *Field system.* Field system that extends to the parishes to the north. The origin of the system may be from the early medieval period, but has continued to be used with modifications to the present day. Small components of the field system will be removed to allow construction. The bulk of the field system will continue to exist and form a living component of the landscape.

10.5.32 The asset is regarded as of low value for significance. The magnitude of impact will be minor as the bulk of the system will be retained. The significance of effects is assessed as slight.

10.5.33 **64-83** *Geophysical survey anomalies.* The geophysical survey identified multiple anomalies, these are all considered as a single group until further information is available for them. Some of these may be of archaeological origin such as the potential enclosures (**64**, **65**, **66**), or the areas of burning close to known locations of burnt mounds (**70**). Others, however, can be seen to co-align with removed elements of the field system shown on historic maps, or the 1946 RAF vertical aerial photographs. A programme of evaluation trenching is required to identify the significance of these features. At present, the significance of each is classed as unknown.

10.5.34 Because the geophysical survey was located within the Scheme limits, all the features will be impacted by construction activities. Consequently, the scale of impact on these features is assessed as major. In many cases, the features can be identified as the results of recent activity, or possibly geology. Their correct origin is uncertain, until confirmed by evaluation trenching. The significance of effects can currently only be defined as unknown.

Hedgerow Regulations 1997

10.5.35 The majority of hedgerows on site formed parts of a field system pre-dating the Inclosure Acts. Therefore, it is considered that they meet the archaeology and history criteria of the Hedgerow Regulations 1997, as important hedgerows(Criterion 5). Using GIS information matched to rectified tithe map information, the following impacts can be assessed as follows: 34 hedges with a combined total length of 2,674m. The affected portions range from 18 to 227m in length. No hedgerow will be totally removed, so the fieldscape will largely remain intact

Undiscovered Archaeology

10.5.36 There is a high potential that intrusive works on the Scheme may uncover previously unrecognised archaeological deposits. The potential for previously unrecorded archaeology has not been quantified at this stage but is likely to be adverse.

10.5.37 A construction contractor has not yet been appointed to the Scheme. Therefore, additional areas of temporary works that may have an impact such as construction yards, haul roads and borrow pits have not been identified. As these works will be contiguous to the Scheme, a preliminary view can be given once they are identified from the information in the 500m study area. Detailed assessment of any proposed temporary works will be conducted once they are identified.

Table 10.8 Summary of Impact on Assets in the 500m Study Area.

Impact	**No.**
Major	23
Moderate	6
Minor	2
Negligible	0
No Change	94
Total	*125*

Table 10.9 Gazetteer of Historical Assets Within 500m of the Scheme, Showing Assessment of Impact and Significance of effects

ID	Type	Date	Significance	Magnitude of Impact	Significance of effects
1	Cropmark	Unknown	Medium	No Change	Neutral
2	Standing stone	Unknown	Medium	No Change	Neutral
3	Burnt Mound	Bronze Age	Medium	No Change	Neutral
4	Cottage	Post medieval	Low	No Change	Neutral
5	Baptist Chapel	Post medieval	Medium	No Change	Neutral
6	Building	Post medieval	Low	No Change	Neutral
7	Quarry	Post medieval	Negligible	No Change	Neutral
8	Quarry	Post medieval	Negligible	No Change	Neutral
9	Burnt mound	Bronze Age	Medium	Moderate	Moderate
10	Quarry	Post medieval	Negligible	No Change	Neutral
11	Dwelling	Post medieval	Low	No Change	Neutral
12	Poorhouse	Post medieval	Low	No Change	Neutral
13	Dwelling	Post medieval	Low	No Change	Neutral
14	Dwelling	Post medieval	Low	No Change	Neutral
15	Cottage	Post medieval	Low	No Change	Neutral
16	Gravel pit	Post medieval	Negligible	No Change	Neutral
17	Blacksmith workshop	Post medieval	Negligible	No Change	Neutral
18	Cottage	Post medieval	Low	No Change	Neutral

ID	Type	Date	Significance	Magnitude of Impact	Significance of effects
19	Burnt mound	Bronze Age	Medium	Moderate	Moderate
20	Burnt mound	Bronze Age	Medium	Moderate	Moderate
21	Building	Post medieval	Low	No Change	Neutral
22	Public House	Post medieval	Low	No Change	Neutral
23	War Memorial	Post medieval	Medium	No Change	Neutral
24	Blacksmith workshop	Post medieval	Low	No Change	Neutral
25	Public House	Post medieval	Low	No Change	Neutral
26	Post Office	Post medieval	Low	No Change	Neutral
27	Gravel pit	Post medieval	Negligible	No Change	Neutral
28	Quarry	Post medieval	Negligible	No Change	Neutral
29	Chapel	Post medieval	Medium	No Change	Neutral
30	Cottage	Post medieval	Low	No Change	Neutral
31	Well	Post medieval	Negligible	No Change	Neutral
32	Quarry	Post medieval	Negligible	No Change	Neutral
33	Building	Post medieval	Low	No Change	Neutral
34	Cottage	Post medieval	Low	No Change	Neutral
35	Promontory Fort	Unknown	Unknown	No Change	Neutral
36	Cottage	Post medieval	Low	Minor	Neutral or Slight
37	Burnt Mound	Bronze Age	Medium	No Change	Neutral
38	Quarry	Post medieval	Negligible	No Change	Neutral

ID	Type	Date	Significance	Magnitude of Impact	Significance of effects
39	Road	Post medieval	Medium	Moderate	Moderate
40	Farmstead	Post medieval	Low	No Change	Neutral
41	Soil marks	Unknown	Unknown	No Change	Neutral
42	Farmstead	Post medieval	Low	No Change	Neutral
43	Farmstead	Post medieval	Low	No Change	Neutral
44	Dwelling	Post medieval	Low	Major	Slight or Moderate
45	Dwelling	Post medieval	Low	Moderate	Slight
46	Building	Post medieval	Low	Moderate	Slight
47	Lodge	Post medieval	Low	No Change	Neutral
48	Burial Ground	Post medieval	Medium	No Change	Neutral
49	Dwelling	Post medieval	Low	No Change	Neutral
50	Quarry	Post medieval	Negligible	No Change	Neutral
51	Gravel pit	Post medieval	Negligible	No Change	Neutral
52	Quarry	Post medieval	Negligible	No Change	Neutral
53	Dwelling	Post medieval	Low	No Change	Neutral
54	Dwelling	Post medieval	Low	No Change	Neutral
55	Dwelling	Post medieval	Low	Major	Slight or Moderate
56	Farmstead	Post medieval	Low	Major	Neutral
57	Old bridge	Post medieval	Low	No Change	Neutral
58	LiDAR Feature	Unknown	Unknown	No Change	Neutral

ID	Type	Date	Significance	Magnitude of Impact	Significance of effects
59	Building	Post medieval	Low	No Change	Neutral
60	Leat (Possible)	Post medieval	Negligible	Major	Slight or Moderate
61	Cropmark	Unknown	Unknown	No Change	Neutral
62	Cropmark	Unknown	Unknown	No Change	Neutral
63	Field System	Medieval?/Post medieval	Medium	Minor	Slight
64	Possible enclosure	Unknown	Unknown	Major	Unknown
65	Possible enclosure	Unknown	Unknown	Major	Unknown
66	Possible enclosure	Unknown	Unknown	Major	Unknown
67	Numerous features	Unknown	Unknown	Major	Unknown
68	Curvilinear feature	Unknown	Unknown	No Change	Neutral
69	Curvilinear feature	Unknown	Unknown	Major	Unknown
70	Multiple features	Unknown	Unknown	Major	Unknown
71	Potential trackway	Unknown	Unknown	Major	Unknown
72	Potential trackway	Unknown	Unknown	Major	Unknown
73	Possible ridge and furrow	Unknown	Unknown	Major	Unknown
74	Linear feature	Unknown	Unknown	Major	Unknown
75	Linear feature	Unknown	Unknown	Major	Unknown
76	Possible burnt area	Unknown	Unknown	Major	Unknown
77	Linear feature	Unknown	Unknown	Major	Unknown
78	Linear feature	Unknown	Unknown	Major	Unknown

ID	Type	Date	Significance	Magnitude of Impact	Significance of effects
79	Linear feature	Unknown	Unknown	Major	Unknown
80	Quarrying area	Unknown	Unknown	Major	Unknown
81	Possible ferrous	Unknown	Unknown	Major	Unknown
82	Possible ferrous	Unknown	Unknown	Major	Unknown
83	Possible ferrous	Unknown	Unknown	Major	Unknown
84	Gwindy Farmhouse with walls and railings to garden	Post medieval	High	No Change	Neutral
85	Old Stable Block at Gwindy	Post medieval	High	No Change	Neutral
86	Homestead	Post medieval	Unknown	No Change	Neutral

10.6 Assessment of Potential Operational Effects

Setting of Designated Sites

10.6.1 The likely impacts and consequent effects on heritage assets as a result of the operation of the Scheme are described below, with asset types (scheduled monuments and listed buildings) grouped together.

10.6.2 Designated assets within a 5km buffer zone of the borders of the Scheme were assessed for the impact on their settings, using the criteria set out in paragraph 10.3.14. The results show that there are 157 assets in the buffer zone (125 Listed Buildings and 32 Scheduled Ancient Monuments). A large number (40) of Listed Buildings are found in the town of Narberth, which is over 4km from the Scheme limits and are unlikely to be impacted by construction or operation of the Scheme.

10.6.3 Nine were deemed to have an impact upon their setting. Four of these assets (Llanddewi Velfrey war memorial, **23**, Ffynnon Baptist Chapel, **5,** Gwindy Farmhouse with walls and railings to garden, **84** and Gwindy Old Stable Block, **85**) are also included in the assets identified in the 500m Scheme study area. The full list is included in Appendix 10.3.

Table 10.10 Distribution in Study Areas of Identified Assets by Designation

Designation	500m Study area	5km buffer zone
Scheduled Ancient Monument	0	32
Listed Building	4	123
Undesignated Asset	121	Not counted

10.6.4 The following designated sites have a visual or settings interaction with the Scheme.

10.6.5 **5** *Ffynnon Chapel LBII 6056.* Ffynnon Baptist chapel was founded in 1720, with the existing building dating to 1832. The building is little changed since then and surrounded by a graveyard with an entrance and pathway to the south. The building is Listed grade II and is of high value to the local community. There is public access to the grounds at all times and inside the building when it is in use.

10.6.6 The chapel structure is 28m north of the edge of the current roadway. It is currently highly affected by noise and visibility of passing traffic, especially in winter when the tree belt sheds its leaves. The proposed Scheme will move the road away from the chapel to provide sufficient space to construct a single lane access road, a widening verge for the proposed Scheme and a narrow strip of embankment. The embankment slope will be available for a narrow strip of dense tree and shrub planting to form a visual screen. The setting will change slightly from the current circumstances. There will be an improvement to the approach to the chapel via the front gate, the distance between the chapel and the A40 will be increased and once the proposed planting has established and grown, there will be some screening of views of moving vehicles.

10.6.7 Current views from the site show the landscaping belt along the road from the southwest to southeast. The noise of traffic is clearly audible, so difficult to filter out. The final road as laid out by the Scheme will result in a similar setting.

10.6.8 As a designated site, the structure is assessed as having a medium value. There will be no physical impact on the structure, or enclosing walls. Given the proximity to the existing road and the potential for landscaping to reduce the impact of the Scheme on the asset, the significance of effects was assessed as being neutral. The impact on setting is also considered to be negligible in view of the existing impact.

10.6.9 **23** *Llanddewi Velfrey War Memorial LBII 18983.* A memorial to the fallen of the parish of Llanddewi Velfrey in the 1914-18 war. It is reputed to be the first in Pembrokeshire, and was unveiled by Sir Wilfrid Lewis in 1920. The memorial contains a Celtic cross, above local seven names. The memorial is situated at the junction of the A40 and the road to Llanfallteg. The memorial was Listed as a striking example of a memorial to the Great War, in Celtic Revival style. The memorial is publicly accessible at the crossroads.

10.6.10 The current views from the site face to the south, opening onto the existing A40, which is right in front of it. The proposed Scheme will be located about 360m to the north of the memorial and down a slope, so will be entirely out of sight.

10.6.11 As a designated site, the structure is assessed as having a medium value. There will be no physical impact on the structure. The significance of effects was assessed as being neutral. The impact on setting is also considered to be beneficial as the memorial will be located beside the former A40, now down-rated as an A class road and serving only local traffic.

10.6.12 **84** *Gwindy Farmhouse with walls and railings to garden LBII 6541.* This farmhouse carries the initials IM and the date of 1775. The structure is part of a group of farm buildings, all designated as listed buildings. There is no public access. The site is a few metres north of the existing A40 and separated from it by a line of trees that act as a visible barrier.

10.6.13 The location is 500m east of the start of the new Scheme, views towards this are concealed by further trees and standing buildings, including Bethel Chapel (29). It is possible that parts of the new road cutting will be glimpsed in profile at a distance of about 750m.

10.6.14 As a designated site, the structure is assessed as having a high value. There will be no physical impact on the structure. The significance of effects was assessed as being neutral. The impact on setting is also considered to be negligible. The future effects on setting will continue to be dominated by the existing A40 close to the site. These are principally, perception of road traffic and noise.

10.6.15 **85** *Old Stable Block at Gwindy LBII 6542.* Late 18th century stable block and coach-house, the coach-house has a slightly higher roof level but is evidently all of one build. The structure is part of a group of farm buildings, all designated as listed buildings. There is no public access. The site is a few metres north of the existing A40, and separated from it by a line of trees that act as a visible barrier.

10.6.16 The location is 500m east of the start of the new project, views towards this are concealed by further trees and standing buildings, including Bethel Chapel (29). It is possible that parts of the new road cutting will be glimpsed in profile at a distance of about 750m.

10.6.17 As a designated site, the structure is assessed as having a high value. There will be no physical impact on the structure. The significance of effects was assessed as being neutral. The impact on setting is also considered to be negligible. The future effects on setting will continue

to be dominated by the existing A40 close to the site. These are principally, perception of road traffic and noise.

10.6.18 *Glanrhyd House LBII 9729.* A Georgian 2½-storey house of coursed rubble, asbestos-slate roof on brick sawtooth eaves. Probably built by Evan Griffith in the 1770s, contemporary with the adjacent dated 'office' and other outbuildings. Listed for its architectural interest as an 18th century house retaining early character, and as part of a strong group of 18th century house and outbuildings at Glanrhyd. There is no public access. The site is 1.2km to 1.6km north of the proposed Scheme and surrounded by woodland. The existing road is partially visible from the asset, with traffic sounds perceptible at quiet periods.

10.6.19 The Scheme will be partially seen from the site showing the new road line and cutting and embankment to the north of Llanddewi Velfrey. This will be visible in an arc south to southeast from Glanrhyd. The view is intermittent with rising ground and large hedge banks with occasional trees acting as screens. Landscaping of the Scheme will reduce the visual impact.

10.6.20 As a designated site, the structure is assessed as having a high value. There will be no physical impact on the structure. The significance of effects was assessed as being neutral. The impact on setting is also considered to be negligible.

10.6.21 *Offices & Outbuildings to W of Glanrhyd House (also known as The Court House) LBII 9730.* Dated 1779 and built by Evan Griffiths of Glanrhyd, The office is contemporary with the house, a barn of 1778, and cow house. Listed as a well-preserved 18th century outbuilding retaining original character and detail, and as part of a strong group of 18th century house and outbuildings at Glanrhyd. There is no public access. The site is 1.2km to 1.6km north of the proposed Scheme and surrounded by woodland. The existing road is partially visible from the asset, with traffic sounds perceptible at quiet periods.

10.6.22 The Scheme will be partially seen from the site showing the new road line and cutting and embankment to the north of Llanddewi Velfrey. This will be visible in an arc south to south east from Glanrhyd. The view is intermittent with rising ground and large hedge banks with occasional trees acting as screens. Landscaping of the Scheme will reduce the visual impact.

10.6.23 The Scheme can be partially seen from the site showing the new road line and cutting and embankment to the north of Llanddewi Velfrey. Visible in an arc south to south east from Glanrhyd. The view is intermittent with rising ground and large hedge banks with occasional trees acting as screens.

10.6.24 As a designated site, the structure is assessed as having a high value. There will be no physical impact on the structure. The significance of effects was assessed as being neutral. The impact on setting is also considered to be negligible.

10.6.25 There are additional designated elements of Glanrhyd present at this location. They lie to the north of the main buildings and are entirely screened from the Scheme, by the buildings and heavy tree cover (Barn at Glanrhyd LBII 9731, Glanrhyd Farm LBII 15630 and Waterhouse at rear of Glanrhyd House LBII 82473).

10.6.26 *Roman Road 300m East of Bryn Farm Road SAM PE472.* The Roman road running west from Carmarthen is scheduled in places. The road is well preserved and measures 150m in length, covering a boggy field on a prominent grass-covered agger measuring circa 10m wide and up to 0.5m high. Trial excavations in 1993/94 showed that the full sequence of a two-phase road construction survives.

10.6.27 The monument is of national importance for its potential to enhance our knowledge of Roman military organisation/medieval transport systems. There is no public access. The site is 1.2km to 1.5km north of the proposed Scheme. The Scheme can be partially seen from the site showing the new road line and cutting and embankment to the north of Llanddewi Velfrey. The view is intermittent with rising ground and large hedge banks with occasional trees acting as screens.

10.6.28 As a designated site, the structure is assessed as having a high value. There will be no physical impact on the structure. The significance of effects was assessed as being neutral. The impact on setting is also considered to be negligible.

10.6.29 *Caerau Gaer Rath SAM PE176.* The monument comprises the remains of an earthwork enclosure. The date or precise nature of the enclosure is unknown, but it is likely to be later prehistoric or medieval. Caerau Gaer is situated on the slight slopes of a hilltop

north of the Afon Marlais and comprises an oval shaped enclosure with its entrance on the west with an annexe to the east side.

10.6.30 The monument is of national importance for its potential to enhance our knowledge of later prehistoric defensive organisation and settlement. The site forms an important element within the wider later prehistoric context and within the surrounding landscape. The site is well preserved and retains considerable archaeological potential. There is no public access, although the site can be observed from public footpaths and the minor road to the west.

10.6.31 The site is 960m south of the proposed Scheme. The site lies at the crest of a broad flat ridge separated from the Scheme by a wide valley. From the very top of the earthworks, it may be possible to obtain glimpses of the new Scheme, but this view is obstructed by at least four intervening Pembrokeshire hedge banks, each topped by mature trees. As such, the new Scheme will result in visual settings that are very similar with the existing views.

10.6.32 As a designated site, the structure is assessed as having a high value. There will be no physical impact on the structure. The significance of effects was assessed as being neutral. The impact on setting is also considered to be negligible.

10.6.33 The vast majority of designated sites (scheduled ancient monuments and listed building) identified in the 5km buffer zone will have no views of the Scheme when it is operational, due to hills and increasing distance. There are some sites with a theoretical view of the Scheme. Three SAMs have will have distant views of the Scheme over 1.5km away with many intervening hedge banks and trees, so are considered not to have an impact on their setting (Llangan Church cropmark enclosure CM264, St Canna's Chair inscribed stone, PE148 and Earthwork southeast of Clyn-Derwen, CM065). Three other SAM's were thought to have a potential view of the completed Scheme, but site visits showed that intervening ground and distance prevented any visual impact from the Scheme (Redstone Cross barrows, PE154, Llanddewi Gaer, PE086 and Pengawse Ring Cairn PE390).

Table 10.11 Impact on Setting of Designated Historical Assets

Name	Status	Reference	Setting
War Memorial	LBII	18983	Minor
Gwindy Farmhouse with walls and railings to garden	LBII	6541	Negligible
Old Stable Block at Gwindy	LBII	6542	Negligible
Ffynnon Baptist Chapel	LBII	6056	Negligible
Glanrhyd House	LBII	9729	Negligible
Offices & Outbuildings to W of Glanrhyd House (also known as The Court House)	LBII	9730	Negligible
Roman Road 300m East of Bryn Farm Road	SAM	PE472	Negligible
Caerau Gaer Rath	SAM	PE176	Negligible

10.7 Mitigation and Monitoring

10.7.1 As described in Section 10.5, specifically with regard to buried archaeological remains, a programme of archaeological evaluation is outlined. This also includes proposals for the archaeological recording of buildings and parts of the field system which would be demolished as part of the Scheme. Depending on the results of the evaluation, there may be a requirement for mitigation recording of archaeological deposits found at these locations.

10.7.2 The implementation of this programme of archaeological work will not result in the avoidance or reduction of the potential impacts and effects described above. It would rather serve to 'offset' the adverse nature of the effects through the provision of information which can be disseminated through appropriate media to the widest possible audience.

10.7.3 The scale and nature of archaeological evaluation trenching in all areas needs to be fully agreed with the regional curator. Following consideration of the results of the evaluation work, detailed

archaeological mitigation investigation may then be required at some of these locations.

10.7.4 A Draft Mitigation Plan is shown in Figure 10.3.

10.7.5 **9** *Burnt mound.* No evidence is visible for this feature, although it lies in a typical location for such a feature. Further similar features could be located in the vicinity. The geophysical survey was unable to operate in this area due to wet conditions and high undergrowth. Evaluation trenching of the site is required to determine if the asset is located within the impact zone and to determine an appropriate mitigation technique. This may be a form of strip and record excavation as in addition to the burnt stone material, there may be numbers of small isolated features such as pits or stake holes.

10.7.6 **19** *Burnt mound.* No evidence is visible for this feature, although it lies in a typical location for such a feature. Further similar features could be located in the vicinity. The geophysical survey was unable to function in this area due to wet conditions and high undergrowth. Evaluation trenching of the site is required to determine if the asset is located within the impact zone and to determine an appropriate mitigation technique. This may be a form of strip and record excavation as in addition to the burnt stone material, there may be numbers of small isolated features such as pits or stake holes.

10.7.7 **20** *Burnt mound*. Evaluation trenching of the site is required to determine if the asset is located within the impact zone and to determine an appropriate mitigation technique. This may be a form of strip and record excavation as in addition to the burnt stone material, there may be numbers of small isolated features such as pits or stake holes.

10.7.8 **36** *Cottage.* The known extent is outside the Scheme boundary, but it is possible that features related to the site extend into the extent of the Scheme. Further assessment is needed in this area to determine if the Scheme will impact on any part of the site. Due to the location of the site outside the boundary of the Scheme, it is likely that any impact will be slight and measures to ensure the feature is protected can be implemented.

10.7.9 **39** *Turnpike road.* Any opening of the existing road should be monitored as part of the project watching brief. If features are observed, they should be recorded.

10.7.10 **44** *Trefangor Cottage.* The structure will require building recording to level 2 standard as a minimum. It is likely that additional recording using 3 dimensional photography to create a scale model will need to be undertaken. Monitoring of demolition and earthmoving in the vicinity of the asset is recommended.

10.7.11 **45** *Dwelling.* Evaluation by trial trenching in this area to determine if features are present should be considered. The location on the edge of the existing road may make this difficult to undertake intrusive work. Either undertake a strip and record excavation during construction phases, or a watching brief.

10.7.12 **46** *Building.* Evaluation trenching is needed in this area to determine if features are present. Further action could be a form of strip and record excavation. It appears that construction work in this area will include drainage and landscaping. This could be modified to protect the asset if evidence is present.

10.7.13 **55** *Cottage and garden*. Further assessment is recommended to determine the extent of the site and location relative to the project design. Following this, the design options for this area should be reviewed to ensure that the asset can be protected.

10.7.14 **56** *Standing building*. The structure will require building recording to level 2 standard as a minimum. It is likely that additional recording using 3 dimensional photography to create a scale model will need to be undertaken. Monitoring of demolition and earthmoving in the vicinity of the asset is recommended.

10.7.15 **60** *Boundary.* Evaluation trenching of the asset is recommended. Further action could be a form of strip and record excavation.

10.7.16 **63** *Field system.* It is recommended that prior to construction the affected portions of the field system, namely the hedge banks and vegetation are recorded. This should also record the nature and construction of the earth banks during the site clearance phase of the construction works.

10.7.17 **64-83** *Geophysical survey anomalies.* As all the features lie within the Scheme boundary and will be impacted by construction activities, the scale of impact is assessed as major. The significance of effects can currently only be defined as unknown. A programme of intrusive evaluation trenching is recommended to provide additional information on this group. Further mitigation excavation may be required on some or all, of these depending on results.

10.7.18 An archaeological watching brief would be undertaken on construction activity within the Scheme boundary. This may lead to a requirement for further archaeological investigation of any buried archaeological remains that are identified during the watching brief. The watching brief will record any portions of the former turnpike road on the line of the A40 (**39**). Basic recording of hedgerows, part of the field system (**63**) will be undertaken as part of the watching brief.

10.7.19 The scale and intensity of the watching brief will be determined following the results of the evaluation trenching programme. If this is a thorough characterisation of the nature of subsoil deposits resulting in the majority of archaeological features being identified, then a less intense programme of monitoring may be approved. The scale of this will be agreed in conjunction with the regional curator.

10.7.20 As additional construction areas such as site compounds, are identified, archaeological assessment, evaluation or monitoring may be identified as the appropriate action to be undertaken. This will be agreed with the regional curator and implemented by the appointed construction contractor.

10.8 Assessment of Effects after Monitoring

10.8.1 The proposed mitigation will not result in the avoidance or reduction of the potential impacts and effects described above. Therefore, the magnitude of impacts and significance of effects described in Section 10.5 will remain the same. The assessment of land take, construction and operational effects would therefore remain as reported in these sections.

10.8.2 It is possible as details of archaeological sites are identified during the evaluation trenching programme, that changes can be made to the design of the Scheme to reduce damage, or preserve *in situ*, identified

features. If these are identified a programme of monitoring of the effectiveness of this mitigation will be required.

10.9 Assessment of Cumulative Impacts

10.9.1 No proposed projects have been identified in the vicinity of the Scheme with a joint impact on historic assets identified in this study. This applies to both physical impact and settings. The proposed extension of the Scheme from Penblewin to Redstone junction will have an impact on some of the assets discussed here, but that will be a direct impact from that project rather than a cumulative effect. One of the geophysical anomalies (**64**) is likely to have additional effects as a wider area will be affected. The nature of this assets is at present unknown, so further work will increase the quality of data available.

10.10 Summary of Effects

10.10.1 This assessment has identified that the implementation of the Scheme would result in an adverse effect on a number of heritage assets. This results from physical damage to some assets and a limited impact on the visual setting of some assets that are not physically affected.

10.10.2 There will be a major impact on 23 assets identified in this study. These are a cottage (**44**), a built structure (**56**) and a possible leat (**60**); in addition, 19 assets identified by the geophysical survey (**64-67** and **69-83**) will have a major impact from the Scheme. The geophysical anomalies at present, have an unknown significance, but they are located within areas that will receive a major impact.

10.10.3 Moderate damage will occur at four locations. These are two burnt mounds (**9** and **19**), the site of a cottage (**46**) and the line of the former turnpike road (**39**).

10.10.4 Four assets will receive some form of impact of an uncertain nature. The evidence is unclear at present, due to lack of detailed information on the surviving nature of the assets, or the potential for alteration of the design to avoid damage. The assets where the nature of the evidence is unclear are a burnt mound (**20**) and two possible cottage sites (**36** and **45**). A further cottage site (**55**) may be protected if landscape designs can be refined in detailed design to avoid the asset.

10.10.5 Seven designated assets will have a negligible impact on setting (**5**, **84**, **85**, **LB 9729**, **LB 9730**, **SAM PE472** and **SAM PE176**). The Llanddewi Velfrey War Memorial (**23**) will have an improved, minor setting impact.

10.11 Monitoring

10.11.1 No significant cultural heritage impact that requires future archaeological monitoring after the construction period is ended. Landscape and visual measures will provide mitigation of impacts on the settings of cultural heritage resources in the surrounding study area.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 11: Community and Private Assets

A40LVP-RML-EGN-SWI-RP-LE-0003

P05 | S4

09/05/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Figure 1.1 Scheme Location

11 Community and Private Assets

11.1 Chapter Introduction

11.1.1 This chapter of the Environmental Statement (ES) describes the assessment of effects on community and private assets resulting from the Scheme to improve the A40 between Llanddewi Velfrey and Penblewin Roundabout. This includes an assessment of effects on community facilities, including:

a) Doctor surgeries
b) Hospitals
c) Aged people homes
d) Schools
e) Shops
f) Post offices
g) Places of worship
h) Parks, play areas and other public open space
i) sports centres

11.1.2 This chapter also reports on the assessment of effects on some private assets, including the following:

a) Private property and associated land take
b) Land used by the community, including common land, village greens, garden allotments, war memorials and public open space
c) Development land.

Agricultural land and farm businesses

11.1.3 Because of the number of farm businesses and the predominance of agricultural land use, these private assets are assessed separately in Chapter 12 Community and Private Assets: Agriculture.

11.2 Legislation and Policy

Legislation

11.2.1 Chapter 5 Legislation and Policy Context of this ES provides an overarching and strategic legislative and policy context for the Scheme

from an environmental perspective. In addition, the following legislation is relevant to the community and private assets assessment:

a) The Highways Act 1980 in relation to compulsory purchase powers for the acquisition of land for highway schemes.
b) The Acquisition of Land Act 1981 in relation to the compulsory purchase of any land forming part of a common, open space or fuel or field garden allotment under Section 19 of the Act
c) The Countryside and Rights of Way Act 2000 in relation to the public right of access to countryside under Part 1 of the Act.

Planning Policy Context

National Policy

11.2.2 National policy is also relevant to the community and private assets assessment. The relevant policy documents include:

a) Planning Policy Wales (Edition 8) (Welsh Government, 2016). Planning Policy Wales sets outs the objectives for Community and Private Assets in Chapters 4, 5 and 11.
b) Technical Advice Note (TAN) 6: Planning for Sustainable Rural Communities (Welsh Assembly Government, 2010a).
c) Technical Advice Note (TAN) 16: Sport, Recreation and Open Space (Welsh Assembly Government, 2009).

Local Policy

11.2.3 The assessment has had regard to the Pembrokeshire County Council Local Development Plan.

11.3 Assessment Methodology

Scope of the Assessment

11.3.1 The community and private assets topic include an assessment of the effects on the community facilities listed in this chapter, and on the potential changes in journey length and travel patterns to these facilities. Changes to journeys by car, public transport and by non-motorised means are covered in Chapter 15 All Travellers. The assessment also addresses the impact on private assets of the kind listed in Section 11.1.2. Farm business and agricultural land is covered in Chapter 12 Community and Private Assets: Agriculture.

11.3.2 In relation to community facilities, the assessment has focussed on the loss of facilities and the potential changes in the duration and distance of journeys made by local people to access community facilities.

11.3.3 In relation to private assets, the assessment has focussed on:

a) Demolition of private property and associated land take. This includes the demolition of residential properties and effects on business, commercial properties.

b) Loss of land used by the community, which is defined by the Design Manual for Roads and Bridges (DMRB) for England and Wales as common land, town and village greens, fuel and field garden allotments and public open space (Highways Agency et al., 2001).

c) Loss of, or effects on development land, which is defined by the DMRB as land of any sites covered by local planning authorities' land use planning designations and identified within the relevant local planning documents e.g. the local plan or local development framework; and effects on land within the planning process (Highways Agency et al., 2001).

d) Loss of, or effects on, any areas of agricultural land and the effect of this on land holdings.

11.3.4 A commentary on changes in the amenity of community and private assets is assessed in Chapters 9 Landscape and Visual Effects, Chapter 14 Noise and Vibration and Chapters 19, 20 and 21 Cumulative Effects. Journeys by car, public transport and by non-motorised means are covered in Chapter 15 All Travellers.

11.3.5 The assessment of effects on community and private assets considers:

a) Permanent land take required for the Scheme.

b) Construction of the new section of road, including temporary land take areas e.g. construction compounds, soil storage areas.

c) Operation of the new section of road

d) Any measures taken to mitigate effects during construction and operation.

Relevant Guidance

11.3.6 Guidance documents are relevant to this assessment include:

a) Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5, HA 205,08 (Highways Agency et al., 2008) with respect to overarching assessment principles.

b) DMRB Section 11.3.6 'Land Use' (Highways Agency et al., 2001) for the assessment of effects on Community and Private Assets.

c) DMRB Section 11.3.8 'Pedestrians, Cyclists, Equestrians and Community Effects' (Highways Agency, 1993) for the assessment of effects on the Community.

d) DMRB Interim Advice Note IAN 125/09(W) Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment' (Wales Only) (Welsh Assembly Government, 2010).

Study Area

Community Assets

11.3.7 DMRB Volume 11, Section 3, Part 8 does not specify a study area for the assessment of effects on communities and community resources but references the need to establish local travel patterns and the identification of key community facilities and their catchment areas (Highways Agency, 1993). The study area for the Scheme must, therefore, take account of the manner in which community facilities are provided in a rural setting. For these reasons, the study area includes the settlement of Llanddewi Velfrey and its hinterland, as well as the adjacent settlements of Narberth, Llanfallteg, Whitland and Clynderwen (as highlighted in the shaded areas in Volume 2 Figures 11.1 and 11.2). The wider study area has account taken of the nearest available community facility where these are not available within these settlements (identified in Volume 2 Figure 11.1). The community facilities within or directly adjacent to the settlements of Llanddewi Velfrey, Narberth, Llanfallteg, Whitland and Clynderwen are detailed more closely in Volume 2 Figure 11.2.

Private Assets

11.3.8 DMRB Volume 11, Section 3, Part 6 does not specify a study area for the assessment of effects on private assets but references the need to establish the numbers of properties that would need to be demolished or from which land would be taken, including residential, commercial, industrial and other properties (Highways Agency et al., 2001). In relation to land used by the community, the DMRB states that the location, status and importance of such land that may be lost should be identified.

11.3.9 The private assets study area for the Scheme therefore includes all properties and land (non-agricultural), which have the potential to be

affected by demolition of property or loss of land or to experience changes to the amenity of properties or land as a result of the Scheme.

Approach to Identification of Baseline Conditions

11.3.10 A desk-based study has been undertaken to establish the existing provision of community resources, the existing land use pattern and existing private assets within the study area. This has utilised the following data sources.

a) Walking, Cycling, Horse Riding Assessment Report (extract provided at Volume 3 Appendix 15.1).
b) Ordnance Survey (OS) mapping.
c) OS MasterMap Address Layer data.
d) OS Points of Interest data.
e) Land ownership information available from the Land Registry.
f) Registers of Common Land, Town and Village Greens.
g) Soil Survey of England and Wales 'Soils of Wales' (1:250,000) (Sheet 2).
h) British Geological Survey Sheet Information 1:50,000.
i) Meteorological Data for Agricultural Land Classification (1989)
j) Pembrokeshire County Council at www.pembrokeshire.gov.uk
k) Wales NHS at www.wales.nhs.uk.
l) Care and Social Services Inspectorate of Wales.
m) Community data available from local authority and web resources.
n) Site surveys.

11.3.11 Site visits and surveys have confirmed the details from Ordnance Survey (OS) address layer (points of interest) data, identifying commercial and residential properties from OS MasterMap and features mapped from other desk top sources.

Consultation

11.3.12 Consultation was held through two Public Information Exhibitions and individual meetings with owners or those responsible for community facilities and private assets potentially affected by the proposed Scheme (either directly or indirectly), in order to achieve a design that contributed to both the business and design objectives of the proposed Scheme.

11.3.13 Exhibitions were held in April 2017 and October 2017in the Llanddewi Velfrey Village Hall. At the April 2017 exhibition, the initial Scheme design was presented, with areas highlighted for consideration and comment. At the October 2017 exhibition, updated designs were presented which incorporated improvements and amendments identified in the first consultation.

Assessment Criteria and Assignment of Significance

11.3.14 A qualitative assessment of impacts on community and private assets based on professional judgement was undertaken to indicate the significance of effects on identified receptors, based on the value or sensitivity of the receptor and the magnitude of the predicted impact.

11.3.15 The significance of an effect on community and private assets is a function of the value or sensitivity of the resource or receptor and the magnitude of the impact (taking into account the timescale involved - permanent or temporary). The criteria for assessing the significance of environmental effects on community and private assets take account of the guidance that is provided on this topic in the DMRB Volume 11, Section 2, Part 5 (HA 205/08) (Highways Agency et al., 2008), as set out in ES Chapter 4 Environmental Impact Assessment Methodology.

11.3.16 The assessment has placed emphasis on facilities which would be subject to direct land take or where impacts to access during construction and / or operation are likely.

Receptor Sensitivity

11.3.17 The receptors relevant to the community and private assets assessment comprise the community facilities, private property and land, land used by the community and development land which may be affected by the Scheme.

11.3.18 The value or sensitivity of these receptors relates to the importance of the resource or facility or receptor together with its sensitivity to change. The community and private assets assessment use the categories of sensitivity, value (i.e. very high, high, medium, low or negligible) described in Table 4.3 in Chapter 4 Environmental Impact Assessment Methodology.

Magnitude of Impact

11.3.19 The magnitude (or scale) of change (adverse or beneficial) on community and private assets resources or receptors has been described using the levels of impact set out in Tables 4.4 in Chapter 4 Environmental Impact Assessment Methodology. The impact on facilities has taken into account the availability of alternative facilities nearby.

Significance of Effect

11.3.20 The sensitivity of the receptor and the magnitude of impact were identified separately and contribute to the evaluation of the likely significance of the effect. This is set out in the significance matrix in Table 4.5 in Chapter 4 Environmental Impact Assessment Methodology.

11.3.21 The evaluation of significance is based on community and private assets objectives for the Scheme, outcomes of consultation to date with relevant stakeholders and professional judgement and has been assessed in accordance with the approach recommended by the DMRB Volume 11, Section 2, Part 5 (HA205/08) (Highways Agency et al., 2008) and supplementary advice in Interim Advice Note 125/09(W) (Welsh Assembly Government, 2010).

11.3.22 These levels of significance apply to both adverse and beneficial effects during the construction period and arising from the operation of the Scheme. For the community and private assets topic, these take account of the guidance set out in Table 2.3 of HA205/08 (Highways Agency et al., 2008) and Table 4.6 in Chapter 4 Environmental Impact Assessment Methodology.

11.3.23 For the purposes of this assessment those effects identified as being of 'Moderate' significance or greater were regarded as being significant in EIA terms. Effects of 'Slight' or lesser significance were identified but were not considered significant in EIA terms.

Limitations of the Assessment

11.3.24 There were no known limitations that would affect the robustness of the assessment for EIA purposes.

11.4 Baseline Environment

11.4.1 The Scheme is located within the eastern portion of the administrative area of Pembrokeshire County Council. This area of the county is sparsely populated with small village centres scattered across the rural landscape. Outside the urban and village centres, settlement is dispersed in the form of farms and isolated rural properties. The main commercial and retail centre, and the county town is Haverfordwest, which lies nearly 20km to the west. The towns and villages within the study area are detailed below.

Communities within the Study Area

Llanddewi Velfrey

11.4.2 Located approximately 3km north-east of Narberth, Llanddewi Velfrey is a historic village (pre-Norman in origin) in Lampeter Vale, Pembrokeshire. It is bisected by the A40 trunk road, with half of the village on each side of the road. The population is around 400. It consists of mainly private dwellings, a few small business premises and a number of farms. The closest schools are located in Narberth and Whitland.

11.4.3 Key features within the village include:

a) A War Memorial which was unveiled in the 1920s, located in the centre of the village.

b) St David's church, a 12th Century Grade II listed parish church, which is now rather remote from the village itself.

c) Bethel Chapel - erected in 1824, rebuilt in 1849 located to the east of the village centre.

d) Ffynnon Chapel - erected before 1800, rebuilt near the old site in 1850, located to the west of the village in Ffynnon Wood.

e) Fuel Station, Post Office and convenience store located on the A40 serving the local community and holiday commuter traffic travelling to and from West Wales.

Narberth

11.4.4 Narberth is a small town in Pembrokeshire with a population of around 2000 people of which a third are Welsh speaking. It is located approximately 5km west of Llanddewi Velfrey, approximately 2km south of the A40 trunk road (on the A478). Narberth's railway station

located to the east of the town is on the main line between Swansea and Pembroke.

11.4.5 The town is popular with tourists visiting Pembrokeshire, home to the Narberth Museum, Narberth Castle and a range of independent shops, art galleries, boutiques, gift and antiques shops. It is only approximately 6km from the popular tourist destinations of Bluestone Resort and Oakwood Theme Park.

11.4.6 The town is home to Castle Private School and two state primary schools.

Whitland

11.4.7 Whitland is a small town in Carmarthenshire with a population of around 1800 people. It is located on the River Taf, approximately 5km east of Llanddewi Velfrey to the south of the A40 trunk road.

11.4.8 Whitland was an important railway centre, being on the junction to four branch lines - to Pembroke Dock, Fishguard, Fishguard via Puncheston and Cardigan. Its main industry was a dairy, but it was closed in 1994.

11.4.9 The town is home to Ysgol Dyffryn Taf Secondary School and Ysgol Llys Hywel Primary School.

11.4.10 Whitland is home to a number of residential and holiday static caravan parks that provide housing to mature residents. There is also a camping site that is open all year round.

Llanfallteg

11.4.11 Llanfallteg is a parish within the Community of Henllanfallteg approximately 3km north of Llanddewi Velfrey on the River Taf. The ancient parish of Llanfallteg in Carmarthenshire was at one stage divided between Pembrokeshire and Carmarthenshire.

11.4.12 The parish consists of mainly residential properties and has a Community Hall (Millennium Hall) and Inn. The road linking Llanfallteg with the A40 passes through Llanddewi Velfrey.

Clynderwen

11.4.13 Clynderwen is a rural linear village and 'Community' in Pembrokeshire with a population of around 950 people. It lies on the A478 Tenby to Cardigan road, north of the town of Narberth.

11.4.14 The village is known as a camping destination with a Touring Park situated in the northern part of the village. There is a Post Office, and Hotel.

11.4.15 The West Wales railway line to London from the ports of Milford Haven and Fishguard passes through the village at Clynderwen railway station.

Community Facilities

11.4.16 The majority of community facilities with the potential to be affected by the Scheme are located within the settlements of Llanddewi Velfrey. These in addition to facilities within the wider study area are described below and shown on Volume 2 Figure 11.2. Each asset is identified with a unique reference.

Doctor Surgeries

11.4.17 No doctor surgeries would be directly affected by the Scheme. There are a number of surgeries in the study area including the following:

Table 11.1 Doctor surgeries within the study area that would not be impacted by the Scheme

Ref	Facility
DS1	Narberth Health Centre Surgery, Northfield Road, Narberth, Pembrokeshire SA67 7AA
DS2	Meddygfa Taf North Rd, Whitland SA34 0AU
DS3	Kilgetty Branch Surgery Carmarthen Rd, Kilgetty SA68 0YA
DS4	Kilgetty Medical Practice, Carmarthen Rd, Kilgetty SA68 0YA

11.4.18 Access to these services during construction and operation will be via the existing road network.

Hospitals

11.4.19 No hospitals would be directly affected by the Scheme. The nearest hospitals locations are listed below in Table 11.2.

Table 11.2 Hospitals within the study area that would not be impacted by the Scheme

Ref	Facility
H1	South Pembrokeshire Community Hospital, Fort Rd, Pembroke Dock SA72 6SY
H2	Withybush General Hospital Fishguard Rd, Haverfordwest SA61 2PZ
H3	Cardigan and District Hospital, Dolgwili Rd, Carmarthen SA31 2AF
H4	Pembrokeshire and Derwen NHS Trust, Yorke Street, Milford Haven SA73 2L
H5	Glangwili General Hospital Glangwili Carmarthen SA31 2AF

Access to these services during construction and operation will be via the existing road network.

Aged People Homes

11.4.20 No aged people or care homes would be directly affected by the Scheme but the facilities listed below in Table 11.3 are located within the main settlements around the study area:

Table 11.3 Aged people homes within the study area that would not be impacted by the Scheme

Ref	Facility
APH1	Castle View, Llawhaden, Narberth SA67 8HL
APH2	Woodfield Nursing Home, Coxhill, Narberth SA69 8EH
APH3	Ridgeway House, Llawhaden, Narberth SA67 8DG
APH4	Blaenmarlais, Redstone Road, Narberth SA67 7ES
APH5	Waungron Mansion Residential Care Home, Velfrey Road, Whitland, SA34 0QX
APH6	Dolyfelin Residential Care Home, Pentre Road, St Clears, SA33 4LR
APH7	Y Garreg Lwyd Residential Care Home, Salem Road, St Clears, SA33 4DH
APH8	Fronhaul Residential Care Home, Station Road, St Clears, SA33 4BQ

Schools

11.4.21 No schools would be directly affected by the Scheme but the facilities listed below in Table 11.4 and Table 11.5 are located in the main settlements within the study area.

Primary Schools

Table 11.4 Primary schools within the study area that would not be impacted by the Scheme

Ref	Facility
PS1	Narberth Community Primary School, Jesse Road Narberth, Narberth, SA67 7FE
PS2	Saundersfoot Community Primary School, Francis Lane, Saundersfoot, SA69 9HB
PS3	Tavernspite Community Primary School Tavernspite Pembrokeshire, Sir Penfro, SA34 0NL
PS4	Templeton Community Primary School, Templeton, Tredeml Narberth, Narberth SA67 8RS
PS5	Ysgol Llys Hywel Community Primary School, Stryd y Farchnad, Whitland, SA34 0QB
PS6	Ysgol Brynconin Community Primary School, Llandysilio, Clynderwen, SA66 7TF

Secondary Schools

Table 11.5 Secondary schools within the study area that would not be impacted by the Scheme

Ref	Facility
SS1	Castle Secondary School, Narberth, SA67 8HB
SS2	Dyffryn Taf Secondary School, North Road, Whitland, SA34 0BD

Shops

11.4.22 The shop facilities listed below in Table 11.6 would potentially be impacted by the Scheme.

Table 11.6 Shops within the study area that would potentially be impacted by the Scheme

Ref	Facility
SH1	Preseli Services Londis convenience store forms part of Preseli Services on the south side of the A40 close to the centre of Llanddewi Velfrey. The convenience store is used by local residents, businesses and passing commuters and tourists.

11.4.23 Other shopping facilities located in the main settlements within the study area are detailed in Table 11.7 below but would not be impacted by the Scheme.

Table 11.7 Shops within the study area that would not be impacted by the Scheme

Ref	Facility
SH2	Clynderwen Village Store, Clynderwen, SA66
SH3	There is a small shopping centre in Whitland and in St Clears.
SH4	Narberth is the largest of the local centres with a selection of shops as detailed in 11.4.5.
SH5	Saundersfoot is a small seaside town providing further shops.

Post Offices

11.4.24 The Post Office facilities listed in Table 11.8 below would potentially be impacted by the Scheme.

Table 11.8 Post Offices within the study area that would potentially be impacted by the Scheme

Ref	Facility
PO1	Limited Post-office services are provided from the Preseli Services fuel station on the A40 in Llanddewi Velfrey, SA67 7PG. The service station is located directly adjacent to the south of the existing A40 close to the centre of Llanddewi Velfrey.

11.4.25 Other Post Office facilities located in the main settlements within the study area are detailed in Table 11.9 below but would not be impacted by the Scheme.

Table 11.9 Shops within the study area that would not be impacted by the Scheme

Ref	Facility
PO2	Main Post Office at 9 High St, Narberth, SA67 7AR
PO3	Main Post Office at St John Street, Whitland, SA34

Places of Worship

11.4.26 There are two places of worship within the immediate vicinity of the Scheme, that would be potentially impacted by the Scheme, these are shown in Table 11.10 below.

Table 11.10 Places of worship within the study area that would potentially be impacted by the Scheme

Ref	Facility
PW1	Bethel Welsh Independent Chapel to the east of Llanddewi Velfrey (situated at the east end tie-in of the Scheme with the existing A40 – Ch. 4,000). Bethel Chapel holds church services at 2pm every Sunday, including joint services held with Tabernacle Whitland and Trinity Llanboidy. The Chapel is used for weddings and funerals with burials taking place in the cemetery to the east of the Chapel. An area of land (approximately 1050 square meters in area) to the south-west of the Chapel and north of the existing A40 is used for parking by the congregation. Vehicle currently access to the carpark directly from the A40. Pedestrian access from the village is currently along a narrow footpath to the south of the existing A40, which requires pedestrians to cross over two lanes of the A40 to access the Chapel to the north.
PW2	Ffynnon Baptists Church, Llanddewi Velfrey (a Grade II Listed Chapel) situated within Ffynnon Woods close to the middle of the proposed Scheme - (Ch. 1,620). There is a burial ground associated with the Chapel that is accessed from the A40 via a vehicle access track at Ch. 1,220. Church services take place every first and third Sunday of each month. The lane and turning area on the north of the A40 leading up to the Chapel (between Ch. 1,600 and Ch. 1,700) is used informally for congregation parking. This lane is accessed directly off the A40 at Ch. 1,830. Pedestrian access to the Chapel from the village is restricted, requiring pedestrians to walk through farm fields and tracks (utilising footpaths SP19/38/1, SP19/37/2 and SP19/37/1).

11.4.27 In addition, there are a number of nearby places of worship located within the study area that would not be impacted by the Scheme, these are listed in Table 11.11 below.

Table 11.11 Places of worship within the study area that would not be impacted by the Scheme

Ref	Facility
PW3	St David's Church, Llanddewi Velfrey
PW4	St Tysilio's Church, A478, Clynderwen, SA66 7TP
PW5	Whitland Congregation Church, West Street, Whitland, SA34 0AE
PW6	Bethesda Baptist Church, High St Narberth, SA67 7AS
PW7	Grace Church, Grace Court House, Market Square, Narberth, SA67 7AU
PW8	Nazareth Chapel, Market Street, Whitland SA34
PW9	St Marys Church, Station Road, Whitland, SA34
PW10	Tabernacle, Spring Gardens, Whitland, SA34

Parks, Play Areas, Sports Centres

11.4.28 There are a number of play areas, parks and sports centres within the study area. Table 11.12 below lists play areas and parks that would potentially be impacted by the Scheme.

Table 11.12 Parks and play areas within the study area that would potentially be impacted by the Scheme

Ref	Facility
P1	Children's play area facility is located at the rear of Llanddewi Velfrey Village Hall, SA67 7PA. The play area consists of playground facilities including swings, slides and climbing frames and is predominantly used by young children under the supervision of adults.
P2	Llanddewi Velfrey cricket pitch and pavilion, Llanddewi Velfrey located between the Village Hall and A40 (north side) is used as a community facility for village events, including the Summer Fete.

11.4.29 Table 11.13 below lists play areas, parks, libraries and sports facilities located within the study area or wider region would not be impacted by the Scheme.

Table 11.13 Play areas, parks, libraries and sports facilities within the study area that would not be impacted by the Scheme

Ref	Facility
P3	Haverfordwest Leisure Centre, St Thomas Green, Haverfordwest, SA61 1QX
P4	St Clears Leisure Centre, Station Road, St Clears, Carmarthen, SA33 4BT
P5	Narberth Swimming Pool, The Old School, Station Rd, Narberth, SA67 7DU
P6	Narberth Library, Kirkland Arms, 34 St James St, Narberth, SA67 7BU
P7	Haverfordwest Library, 13 Dew St, Haverfordwest, SA61 1ST
P8	Bloomfield Community Centre, Redstone Road, Narberth, SA67 7ES
P9	Parc Dr Owen, Market Street, Whitland SA34
P10	Narberth Cricket Club, The Hawthorns, Coxhill, Narberth, SA677UP
P11	Narberth Rugby Club, Spring Gardens, Narberth SA67 7BT
P12	Whitland Rugby Club, Whitland, SA34 0AW
P13	Whitland Cricket Club, Spring Hill, Spring Gardens, SA34 0HR
P14	Whitland Bowls Club, Market St, Whitland SA34 0QB
P15	Whitland Library, King Edward Street, Whitland, SA34

Tourist, Visitor Attractions

11.4.30 There are tourist and visitor attractions, with the potential to be impacted by the new Scheme located within the study area, these are listed in Table 11.14 below.

Table 11.14 Tourist and visitor attractions within the study area that would potentially be impacted by the Scheme

Ref	Facility
TA1	Oakwood Theme Park, Canaston Bridge, Narberth, SA67 8DE. Oakwood is Wales' biggest family adventure venue, with 35 attractions including a number of roller coasters and rides. It can attract over 400,000 visitors annually and located adjacent to Bluestone Resort. The most direct route for visitors travelling from the east of the Wales and the UK would be the A40 through Llanddewi Velfrey. Visitor numbers increase during school holidays and public Bank Holidays, particularly during the summer months.
TA2	Bluestone National Park Resort, Canaston Bridge, Narberth, SA67 8DE. Bluestone is a 500-acre woodland resort set in the Pembrokeshire National Park, with 280 lodges, cottages and apartments, a water park, indoor activity centre and Spa. It offers a range of indoor and outdoor family activities. The resort attracts approximately 150,000 guests each year. The most direct route for visitors travelling from the east of the Wales and the UK would be the A40 through Llanddewi Velfrey. Visitor numbers increase during school holidays and public Bank Holidays, particularly during the summer months.

11.4.31 The other significant tourist attraction in the region, Folly Farm located just to the south of the Study Area would not be affected by the Scheme.

Table 11.15 Tourist and visitor attractions within the study area that would potentially be impacted by the Scheme

Ref	Facility
TA3	Folly Farm Adventure Park and Zoo, Begelly, Kilgetty SA68 0XA. Folly Farm is one of Wales' leading visitor attractions, Folly Farm Adventure Park and Zoo, attracting more than 500,000 visitors a year. Located approximately 7km south of Narberth, the most direct route for visitors travelling from the east of the Wales and the UK would be along the A477 to Kilgetty before travelling north on the A478, rather than along the A40. Visitor numbers increase during school holidays and public Bank Holidays, particularly during the summer months.

Community and village halls

11.4.32 The village hall, located within Llanddewi Velfrey, would potentially be impacted by the Scheme.

Table 11.16 Community and village halls within the study area that would potentially be impacted by the Scheme

Ref	Facility
VH1	Llanddewi Velfrey Village Hall, SA67 7PA. Located approximately 150m to the north of the existing A40 on the eastern side of the Llanfallteg Road. The Village Hall is widely used by the community for social gatherings, dance classes, fund raising nights and community meetings. It also has a meeting room on the first floor which is used for Community Council meetings.

11.4.33 The village or community halls listed in Table 11.17 below, are located within the study area, but would not be impacted by the Scheme.

Table 11.17 Community and village halls within the study area that would not be impacted by the Scheme

Ref	Facility
VH2	Llanfallteg Community Hall (Millennium Hall) is located approximately 3km north of Llanddewi Velfrey and serves the communities of Henllanfallteg.

Private Assets - Settlements and Residential Property

11.4.34 Llanddewi Velfrey village consists of approximately 150 homes with a mix of agricultural holdings with a population of approximately 400 people. Any impacts on residential agricultural holdings are detailed in Chapter 12 Community and Private Assets: Agriculture.

11.4.35 The Scheme is predominantly located further away from residential property than the existing A40, however the private residential properties that would potentially be affected by the new Scheme are listed in table 11.18 below

Table 11.18 Settlements and residential property within the study area that would potentially be impacted by the Scheme

Ref	Facility
RP1	Trefangor Cottage located directly to the north of the existing A40 at Ch. 1,080, is located under the carriageway footprint of the proposed new Scheme.
RP2	Penrhiw Cottage located at Ch. 1,600 directly to the north of the existing A40 will be directly adjacent to the new access road which would link properties to the north of the new Scheme with the new A40 carriageway. Access into the driveway is currently directly off the A40 carriageway.

Commercial Property

11.4.36 There are a small number of commercial properties located within the Study Area. Businesses with the potential to be affected by the proposed Scheme are listed in Table 11.19 below:

Table 11.19 Commercial property within the study area that would potentially be impacted by the Scheme

Ref	Facility
CP1	Preseli Fuel Station, A40, Llanddewi Velfrey. Located adjacent to the southern side of the existing A40 to the east of Llanddewi Velfrey Village.
CP2	Preseli Car Sales, A40, Llanddewi Velfrey. Located within the forecourt of the Preseli Fuel Station.
CP3	Hank Marvin Fish and Chip take away and restaurant. Opened in 2018 and located adjacent to the north side of the existing A40 to the west of Llanddewi Velfrey village.

Development land: Pembrokeshire Local Development Plan

11.4.37 The area of development land detailed in Table 11.20 below is located within the Study Area and would potentially be affected by the Scheme.

Table 11.20 Development land within the study area that would potentially be impacted by the Scheme

Ref	Facility
DL1	An area of land in Llanddewi Velfrey is allocated for housing in the Local Development Plan. The plot (Reference HSG, 057, LDP, 01) is located at the north end of the village of Llanddewi Velfrey and to the east of the Llanfallteg Road.

11.4.38 An assessment of proposed commercial, housing and other development identified through consultation with Pembrokeshire and Carmarthenshire Planning departments is detailed in Chapter 21.

11.5 Mitigation measures forming part of the Scheme design

11.5.1 As set out in Chapter 2 The Project and Chapter 3 Alternatives Considered of this ES, a key aim of the Scheme has been to design a route for the new road that takes into account the locations of existing communities and reduces adverse effects of the A40 on them.

11.5.2 An iterative design and assessment process for the Scheme has been carried out to mitigate the visual, amenity and landscape impacts (e.g. woodland planting and other vegetation, boundary treatment). In addition, the design of the new section of road would include the provision of a thin road surface system, which is relatively low noise.

11.5.3 Additional mitigation measures that have been developed throughout the EIA process are detailed in Table 11.21 and 11.22. Details of measures to reduce effects on agricultural farm holdings are provided in Chapter 12 Community and Private Assets: Agriculture.

Table 11.21 Consultation Responses and Scheme mitigation (April 2017 Responses to the 2017 draft plans)

Consultee and issue raised	How and where addressed
Concerns over loss of parking to Bethel Chapel	Roundabout has been moved further west to reduce land take to the south of Bethel Chapel.
Concerns about impact on Bethel Chapel	
Concerns over access from Bethel Roundabout to property	The access has been relocated to the rear of Bethel Chapel.
Concerns over Ffynnon Chapel Parking	Relocation of roundabout has allowed more space to the south and west of the chapel.
Concern equestrian underpass is a waste of money	The horse underpass has been retained to maintain bridleway access under the new road. To maximise its value and use, the underpass has been relocated to Ffynnon Wood.
Concern that the loop road around Henllan Lodge would put it into an island	The main carriageway has been realigned to allow the side road to stay on its current alignment
Concerns about vehicle and safe pedestrian, cycling access to Ffynnon	The relocated equestrian underpass allows pedestrian and cycle crossing under the A40 at Ffynnon.
Preseli Fuel Station - Concern about impact on car sales and forecourt	A40 signing strategy includes for provision of 'local services'
Concern over destruction of land drains	Refer to Chapter 12 Community and Private Assets: Agriculture
Concern over impacts on habitats and species	Refer to Chapter 8 Ecology and Conservation
Concern over increased access track length to farm and fields	Refer to Chapter 12 Community and Private Assets: Agriculture
Local Resident - Concern over increased noise pollution	Refer to Chapter 14 Noise and Vibration
Pentroydin-fawr and Pentroydin-fach Farm owners - Concern over land severance	Refer to Chapter 12 Community and Private Assets: Agriculture
Pentroydin-fawr - Concern over loss of water supply to farm (Pentroydin-fawr)	Refer to Chapter 12 Community and Private Assets: Agriculture
Concern whether traffic flows will be maintained during construction	Refer to Chapter 2 The Project
Concerns over access track widths not being adequate for farming	Refer to Chapter 12 Community and Private Assets: Agriculture

Table 11.22 Consultation Responses and Scheme mitigation (October 2017 Responses to the 2017 updated plans)

Consultee and issue raised	How and where addressed
Concern over need for horse underpass as no usage of existing bridle path and no local horse clubs	The horse underpass has been relocated to Ffynnon Wood to maximise its use by pedestrians
A British Horse Society Representative visited the PIE. The feedback was that the proposed Equestrian Underpass provides an important link for the bridleways in the area.	Bridleway links to the relocated underpass (as described above) are provided so that the same level of provision to horse riders is provided.
Concerns that rest area will become a problem as lorries will go straight on leaving area open for use by itinerants.	Signs will be provided at the Penblewin Roundabout informing drivers of the rest area.
Concerned that access has been lost to another 25acres of farmland	Refer to Chapter 12 Community and Private Assets: Agriculture
Concern that the Scheme is not really necessary as traffic flows smoothly along the current road and delays are short	The Scheme provides benefits of improve journey time reliability, reduced community severance, improve safety and improved network resilience and accessibility along the east west corridor to key employment, community and tourist destinations.
Concern that the cost benefit of the Scheme is disproportionate and could have been better spent on other EU supported projects	The Scheme would add resilience to the trunk and local road networks, reducing severance caused by the trunk road through Llanddewi Velfrey and provide reliable access to employment and services for local communities and for tourists. The improvements would reduce the current actual and perceived barriers to investment in the region. It would provide an improved connection to key employment areas and communities in South-West Wales, forming part of the wider A40 enhancements, which is of strategic importance to the Welsh Government.
Concern about the ability of school children getting off the bus opposite Parc-y-Delyn (on westbound carriageway) to cross the road over to Ffynnon.	The horse underpass has been relocated to Ffynnon Wood to maximise its use by pedestrians
Concerned about the weak mitigation for the protection of Barn Owls - like to see more being done or at least tried.	Refer to Chapter 8 Ecology and Nature Conservation
Concern as to whether there is enough tree screening	Refer to Chapter 9 Landscape and Visual Effects
Concern that it will be a long drive to Penblewin Roundabout from Pen-ca'rmaenau Farm	Direct access via a proposed new side road, to the north of the proposed A40 carriageway will be for local access.

11.5.4 A number of new public rights of way have been introduced to improve east to west pedestrian access in addition to a new underpass at Ch. 1,680 to provide safe crossing of the new carriageway at Ffynnon Woods. Further detail is provided in Chapter 15 All Travellers.

11.6 Assessment of potential land take effects

11.6.1 There are two community assets that will be affected by land take. An assessment of impact on these community assets is detailed below.

Places of worship

11.6.2 Bethel Chapel would lose approximately 675m^2 of the 1,050m^2 parking area (described in 11.4.15 above) that it currently uses for congregation parking. This will reduce the parking capacity and therefore require the congregation to find alternative parking or travel to and from the Chapel using alternative means.

Private Assets - Residential Property

11.6.3 Trefangor Cottage located at Ch. 1,080 would require demolition as the property and adjoining garden are entirely within the footprint of the carriageway of the new Scheme.

11.7 Assessment of potential construction effects

11.7.1 The potential effects for the construction phase would be temporary. Access to community and private assets would be via the existing road network, which would largely be kept open during the construction phase, with traffic management along some roads as required. Traffic management would be phased to reduce impact on road users. No doctor surgeries, hospitals, aged people homes, primary schools, secondary schools, shops, parks or play areas would be directly affected by construction.

11.7.2 There would be potential impacts on places of worship, tourist and visitor attractions and private residential property.

Places of worship

11.7.3 Bethel Chapel and Ffynnon Baptist Chapel are located directly adjacent to the proposed Scheme. Access to both places of worship would potentially be affected during construction during realignment of their

access roads, in addition to potential impacts from noise, dust and vibration. Disruption to normal Sunday services will be limited construction works is less likely to be carried out on these days.

Tourist and visitor attractions

11.7.4 Temporary traffic management on the A40 would potentially delay journeys to visitors travelling from east Wales and England to both the Bluestone Resort and Oakwood Theme Park. Further commentary is provided in Chapter 15 All Travellers.

Private Assets - Residential Property

11.7.5 During the construction phase, essential access would be maintained, or new access would be provided to private residences. Residential residences located adjacent to the proposed Scheme would potentially be impacted during construction through noise dust and vibration. The significance of this impact would depend on the proximity to construction activity and is detailed further under the 'Assessment of Environmental Effects' within Chapter 17 Population and Human Health

11.8 Assessment of potential operational effects

11.8.1 No doctor surgeries, hospitals, aged people homes, primary schools, secondary schools would be directly affected during operation of the new Scheme. There would be potential indirect impacts on shops, Post Offices, play areas, tourist attractions, village halls, and commercial properties. There would be potential direct impacts on private assets and places of worship.

Shops and Post Offices

11.8.2 The existing A40 Trunk Road currently restricts pedestrian access between the residential properties to the north of the A40 and the Londis Convenience Store and Post Office located adjacent to the south of the A40 at Preseli Service Station. The existing A40 would be detrunked resulting in a reduction in traffic flows of greater than 95% on the existing A40 through the village. This would improve accessibility between the residential properties and the Londis Convenience store and Post Office particularly for pedestrians and cyclists. There would potentially be a negative impact on the store due to a reduction in direct access for passing trade currently using the existing A40.

Places of worship

11.8.3 Bethel Chapel located to the east of the Scheme would lose some of the existing parking area used by the congregation as detailed in 11.6.2. which would have a negative impact on large services particularly weddings and funerals. Vehicle access to the Chapel would be relocated to the rear of Bethel Cottage, directly off a junction from the new A40 eastern roundabout. The new access will improve safety of vehicles leaving the Chapel to travel west as it would avoid the need to cross eastbound traffic flows.

11.8.4 Pedestrian access to Bethel Chapel from the village would be improved with dedicated footway access provided along the existing A40 south of the carriageway before crossing at the eastern side of the new A40 roundabout at Chainage (Ch.). 3,800. Details of the proposed detrunking of the existing A40 and resulting improvement in accessibility for pedestrians and cyclists are provided in Chapter 15 All Travellers.

11.8.5 Ffynnon Baptist Chapel would be affected by a change of route for funeral vehicles travelling from the Chapel to the Trefangor burial ground located to the west. Currently vehicles can travel east from the Chapel at Ch. 1,620, turn right onto the A40 at Ch. 1,830 and then turn right onto the access road to the burial ground directly off the existing A40 trunk road at Ch. 1,220. The proposed new road would not permit this. The route would require funeral vehicles to travel east from the Chapel before turning right onto the A40 at a new junction at Ch. 1,930. Vehicles would then travel westbound to the Penblewin roundabout at Ch. 0,000 and turn right to head north on the A478 Clynderwen Road. After approximately 100m they would turn right onto the new field access road which heads south and then east along the north of the A40 carriageway back towards the burial ground access road at Ch. 1220.

11.8.6 Pedestrian access to Ffynnon Baptist Chapel from Llanddewi Velfrey Village would be significantly improved as a result of the new public footpath to the south of the detrunked A40 and the new A40 before crossing through an underpass to the north adjacent to Ffynnon Chapel at Ch. 1,680. Details of the proposed detrunking of the existing A40 and resulting improvement in accessibility for pedestrians and cyclists are provided in Chapter 15 All Travellers.

Play areas

11.8.7 The existing A40 Trunk Road currently restricts pedestrian access between the residential properties to the south of the A40 and the play area and cricket pitch located to the rear of the Llanddewi Velfrey Village Hall. The existing A40 would be detrunked, resulting in the reduction of traffic flows previously detailed would improve accessibility between the residential properties to the south of the road and these play areas for walkers and cyclists.

Tourist attractions

11.8.8 During operation, there would be a beneficial effect on road users visiting Oakwood and Bluestone travelling from east Wales and England (as detailed further in Chapter 15 All Travellers).

Village Halls

11.8.9 The existing A40 Trunk Road currently restricts pedestrian access between the residential properties to the south of the A40 and the Llanddewi Velfrey Village Hall located adjacent to the north of the A40. During operation, the new road would reduce traffic using the existing A40 which would improve accessibility between these residential properties and the Village Hall. Consultation with Llanddewi Velfrey residents has identified this as being a positive benefit of the proposed Scheme.

Private Assets

11.8.10 Trefangor Cottage would be demolished and therefore not exist once the Scheme is in operation

11.8.11 Penrhiw Cottage would be located to north of the access road running to the north of the new A40 rather than being located directly adjacent to the A40 carriageway. Vehicle access to the property would be gained via the new junction at Ch. 1,940. Pedestrian access would also be available to the Llanddewi Velfrey Village via the new underpass at Ch. 1,680 and new public footpath running to the south of the new road.

Commercial property

11.8.12 The Preseli Fuel Station would potentially be impacted negatively due to the reduction in passing vehicles once the existing A40 is detrunked and through traffic will be using the new A40. Use by the local

community would not be impacted as access from both the east and west off the new A40 will be maintained, in addition to direct access from Llanddewi Velfrey Village along the detrunked A40. It is possible that a "quieter" service area may in fact be more attractive to some local users however the overall impact on the facility would not be significant.

11.8.13 The Preseli Car Sales would potentially be impacted in a similar way to Preseli Fuel station, however to a lesser extent as it is expected to be less reliant on passing holiday trade as potential customers.

11.8.14 The Hank Marvin Fish and not be significant restaurant would be potentially affected in a similar manner to the fuel station, due to a reduction in customers from travelling along the A40, however with local custom being maintained.

Complementary Measures

11.8.15 Detrunking of the existing A40 Trunk Road on completion of the Scheme would further improve non-motorised user access and connectivity between the north and south of Llanddewi Velfrey. Refer to the Community Severance Assessment in Chapter 15 All Travellers.

11.9 Additional mitigation

11.9.1 There would be no direct effects on community facilities as a result of land take, construction works or the operation of the Scheme and therefore no mitigation measures are required.

11.9.2 The owners and occupiers of residential properties that would be demolished within the permanent land take for the Scheme would be financially compensated for their loss.

11.9.3 Throughout construction of the proposed Scheme, nuisance from noise, dust and vibration would be mitigated as best as possible through considerate construction management, including phasing of works, use of screening, appropriate routeing of construction haul routes and use of low-noise equipment. In addition, temporary traffic management would be used wherever necessary to maintain access to communities.

11.10 Assessment of cumulative effects

11.10.1 Cumulative effects on potentially impacted community assets have been assessed using the criteria set out in Tables 4.3, 4.4, 4.5 and 4.6 in Chapter 4 Environmental Impact Assessment Methodology, based on the impacts identified through land take, construction and operation. These effects are described below and are summarised in Table 11.23.

Shops

11.10.2 The impacts on the Londis Convenience Store within the Preseli Service Station would be most significant during operation of the new Scheme. Although access would be improved for villagers from the north of the A40, there would potentially a more significant reduction in passing trade. The sensitivity of this resource which serves the surrounding local communities and travelling public, is assessed to be medium, i.e. of high or medium importance and rarity, at a regional scale with limited potential for substitution. The magnitude of the impact on the convenience store during operation is assessed to be negligible beneficial with regard improved access for villagers however the potential reduction in passing trade would be minor adverse. Taking these factors into account, the potential operational effects are assessed to be slight significance.

Post Offices

11.10.3 The impact on the Post Office within the Preseli Services would be most significant during operation of the new Scheme. Access would be improved for villagers from the north of the A40, and the potential reduction in passing trade is unlikely to have an effect on the use of the Post Office facilities. The sensitivity of this resources which predominantly serves the surrounding local communities, is assessed to be medium, i.e. of high or medium importance and rarity, at a regional scale with limited potential for substitution. The magnitude of the impact is assessed to be negligible beneficial with regard improved access for villagers. Taking these factors into account, the potential operational effects are assessed to be of neutral or slight beneficial significance.

Places of worship

Bethel Chapel

11.10.4 Bethel Chapel will be impacted by land take, during construction and when the Scheme is in operation. The sensitivity of Bethel Chapel which serves the surrounding local communities, is assessed to be medium, i.e. of high or medium importance and rarity, at a regional scale with limited potential for substitution. The magnitude of the impact on the Chapel from loss of parking facility during operation is assessed to be moderate negative i.e. some loss of resource, but adversely affecting the integrity. The magnitude of impact during construction is assessed to be minor adverse. Taking these factors into account, the potential operational effects are assessed to be moderate.

Ffynnon Baptist Chapel

11.10.5 The sensitivity of Ffynnon Chapel which serves the surrounding local communities, is assessed to be medium, i.e. of high or medium importance and rarity, at a regional scale with limited potential for substitution. The magnitude of the impact on this resource during operation is assessed to be minor negative i.e. some measurable change in attributes. Taking these factors into account, the potential operational effects are assessed to be of slight adverse significance.

Play areas

11.10.6 The play area and cricket pitch located at the rear of the Village Hall are important facilities for the community. The sensitivity of this resources which serves the surrounding local communities, is assessed to be medium, i.e. of high or medium importance and rarity, at a regional scale with limited potential for substitution. The magnitude of the impact on these play areas is assessed to be negligible beneficial i.e. some beneficial impact on attribute. Taking these factors into account, the potential cumulative effects are assessed to be slight significance.

Tourist attractions

11.10.7 Bluestone and Oakwood are considered nationally significant and are popular with visitors from Wales and the rest of the UK. The sensitivity of these resources is assessed to be high, i.e. of high importance and rarity, at a regional scale with limited potential for substitution. The magnitude of the impact on these play areas is assessed to be negligible beneficial i.e. some beneficial impact on attribute. Taking these factors

into account, the potential cumulative effects are assessed to be of slight beneficial significance.

Village Halls

11.10.8 The Llanddewi Velfrey Village Hall is seen as an important meeting point for the community and improving access to people living to the south of the existing A40 would be beneficial. The sensitivity of this resource which serves the surrounding local communities, is assessed to be medium, i.e. of high or medium importance and rarity, at a regional scale with limited potential for substitution. The magnitude of the impact on the Village Hall is assessed to be minor beneficial i.e. some beneficial impact on attribute. Taking these factors into account, the potential cumulative effects are assessed to be of slight beneficial significance.

Private Assets

11.10.9 Trefangor Cottage would be demolished to make way for the Scheme. The sensitivity of this resource is assessed to be low, i.e. of low rarity and local scale. The magnitude of the impact is assessed to be major adverse as it would require demolition. Taking these factors into account, the potential cumulative effects are assessed to be of slight or moderate adverse significance.

11.10.10 Penrhiw Cottage would be impacted negatively during construction due to its close proximity to the Scheme and potential for some temporary land loss. There would be benefits during operation in the long term due to the realignment of the new A40 away from the property, introduction of the new access track and improve pedestrian accessibility into Llanddewi Velfrey. The sensitivity of this resources is assessed to be low, i.e. of low rarity and local scale. The magnitude of the impact is assessed to be minor beneficial. Taking these factors into account, the potential cumulative effects are assessed to be of neutral or slight beneficial significance.

Commercial Property

11.10.11 The potential loss of passing trade from commuters and tourists that would use the new A40 once the Scheme is in operation, would negatively impact the Preseli Fuel Station. The sensitivity of the Fuel Station is assessed to be medium due to local rarity and limited potential for substitution. The magnitude of the impact is assessed to be

moderately adverse. Taking these factors into account, the potential cumulative effects are assessed to be of moderate adverse significance.

11.10.12 The impacts of reducing the potential passing trade would likely be less significant on the Preseli Car Sales than Preseli Fuel station. The sensitivity of the Car Sales business is assessed to be low due to its medium importance and rarity and local scale. The magnitude of the impact is assessed to be minor adverse. Taking these factors into account, the potential cumulative effects are assessed to be of neutral or slight adverse significance.

11.10.13 The Hank Marvin Fish and Chip restaurant would be potentially affected in a similar manner to the fuel station, due to a reduction in customers from travelling along the A40, however with local custom being maintained. The sensitivity of this restaurant and takeaway business is assessed to be low due to its medium importance and rarity and local scale. The magnitude of the impact is assessed to be moderate adverse. Taking these factors into account, the potential cumulative effects are assessed to be of slight adverse significance.

11.11 Monitoring of mitigation

11.11.1 There would be no direct effects on community facilities as a result of land take, construction works or the operation of the Scheme and therefore no mitigation measures are required.

11.11.2 Throughout construction of the proposed Scheme, nuisance from noise, dust and vibration, and impacts on public rights of way, private and public roads, equestrian routes would be mitigated as best as possible through considerate construction management, including phasing of works, use of screening, appropriate routeing of construction haul routes and use of low-noise equipment. In addition, temporary traffic management would be used wherever necessary to maintain access to communities. The contractor will monitor the effectiveness of these measures and modify the approach as necessary to maximise effectiveness.

11.12 Summary of residual effects and conclusions

11.12.1 Community facilities would be affected in a variety of ways. There would be no impact on doctor surgeries, hospitals, aged people homes, primary or secondary schools.

Community Connectivity

11.12.2 In Llanddewi Velfrey, there would be improved access to local facilities as a result of: the relocation of the proposed A40 to the north of the village, and detrunking of the existing A40. This would be enhanced by the proposed new public rights of way along the Scheme, which would improve connectivity between the wider community and the centre of the village. The Scheme would reduce the severance currently experienced between the north and south of the village, providing benefits to the Village Hall, convenience store, Post Office and play areas in Llanddewi Velfrey.

Places of Worship

11.12.3 Bethel Chapel would be negatively impacted due to the reduction in parking area available on land used by the congregation, particularly during larger services for weddings and funerals.

Tourist Attractions

11.12.4 The Oakwood and Bluestone visitor attractions in the vicinity of the Scheme would benefit from the improved journey time reliability when the Scheme is in operation.

Private Assets

11.12.5 Trefangor Cottage would be the only private residence to be demolished as part of the Scheme. The majority of private residences would experience some adverse impacts during construction which would be mitigated through good construction practice, but on the whole, would benefit once the Scheme is in operation due to new road being relocated.

Shops and Commercial Property

11.12.6 Business premises including the Preseli Fuel Station, Londis Convenience Store, Preseli Car Sales and Hank Marvin Restaurant would potentially be impacted negatively due to passing trade being moved onto the new A40.

Table 11.23 Assessment of Effects on Community and Private Assets

Reference to Figure 11.2	Community Facility	Land Take	Direct or Indirect impact on use during construction	Direct or Indirect impact on use in operation	Value (Sensitivity)	Magnitude of Impact	Significance
Doctor Surgeries							
	No Doctor surgeries would be impacted by the Scheme						
Hospitals							
	No Hospitals would be impacted by the Scheme						
Aged people homes							
	No Aged people homes would be affected by the Scheme						
Primary Schools							
	No Primary Schools would be impacted by the Scheme						
Secondary Schools							
	No Secondary Schools would be impacted by the Scheme						
Shops							

Reference to Figure 11.2	Community Facility	Land Take	Direct or Indirect impact on use during construction	Direct or Indirect impact on use in operation	Value (Sensitivity)	Magnitude of Impact	Significance
SH1	Preseli Services convenience store on the A40 in Llanddewi Velfrey SA67 7PG	Nil	Nil	✓ Indirect	Medium	Minor negative	Slight adverse
Post Offices							
PO1	Limited range of Post-office services provided from the Preseli Services fuel station on the A40 in Llanddewi Velfrey.	Nil	Nil	✓ Indirect	Medium	Negligible positive	Neutral or Slight positive
Places of worship							
PW1	Bethel Welsh Independent Chapel to the east of Llanddewi Velfrey (at the east end of the Scheme).	Nil	✓ Indirect	✓ Indirect	Medium	Moderate adverse	Moderate adverse
PW2	Ffynnon Baptists Church, Llanddewi Velfrey (a Grade II Listed Chapel) (close to the middle of the proposed Scheme).	Nil	✓ Indirect	✓ Indirect	Medium	Minor adverse	Slight adverse
Parks, Play Areas, Sports Centres							
P1	Children's play area facility is located at the rear of Llanddewi Velfrey Village Hall / SA67 7PA.	Nil	Nil	✓ Indirect	Low	Minor beneficial	Slight beneficial

Reference to Figure 11.2	Community Facility	Land Take	Direct or Indirect impact on use during construction	Direct or Indirect impact on use in operation	Value (Sensitivity)	Magnitude of Impact	Significance
P2	Llanddewi Velfrey cricket pitch and pavilion / Llanddewi Velfrey is also used as a community facility for village events.	Nil	Nil	✓ Indirect	Low	Minor beneficial	Slight beneficial
Tourist/Visitor Attractions							
TA1	Oakwood Theme Park / Canaston Bridge / Narberth / SA67 8DE	Nil	Nil	✓ Indirect	High	Negligible beneficial	Neutral or Slight beneficial
TA2	Bluestone Resort / Canaston Bridge / Narberth / SA67 8DE	Nil	Nil	✓ Indirect	High	Negligible beneficial	Neutral or Slight beneficial
Village Halls							
VH1	Llanddewi Velfrey Village Hall, SA67 7PA	Nil	Nil	✓ Indirect	Medium	Minor beneficial	Slight beneficial
Private Assets							
RP1	Trefangor Cottage, Llanddewi Velfrey, SA67 7NY	Yes	Yes	Yes	Low	Major adverse	Slight or Moderate adverse
RP2	Penrhiw Cottage, Llanddewi Velfrey, SA67 7PA	Temporary	Yes	Yes	Low	Minor beneficial	Neutral or slight beneficial

Reference to Figure 11.2	Community Facility	Land Take	Direct or Indirect impact on use during construction	Direct or Indirect impact on use in operation	Value (Sensitivity)	Magnitude of Impact	Significance
Commercial Property							
CP1	Preseli Fuel Station	Nil	No	Yes	Medium	Moderate adverse	Moderate adverse
CP2	Preseli Car Sales	Nil	No	Yes	Low	Minor adverse	Neutral or Slight adverse
CP3	Hank Marvin Fish and Chip Shop	Nil	No	Yes	Low	Moderate adverse	Slight adverse

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 12:
Community and Private Assets: Agriculture

A40LVP-RML-EGN-SWI-RP-LE-0009

P04 | S3

18/01/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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12 Effects on Agricultural Land

12.1 Introduction

12.1.1 This chapter addresses impacts in relation to the effects on agricultural land and businesses associated with the Scheme. It was undertaken in accordance with the methodology within DMRB Volume 11, section 3, Part 6 and follows guidelines outlined in IAN 125/09(W).

12.2 Legislation and Policy Context

12.2.1 In relation to agricultural land, national planning policy on the development of land is set out in Planning Policy Wales Edition 10 (PPWE10) (December 2018)[1] [12.1] and the accompanying Technical Advice Note 6 (TAN 6, 2010)[2] [12.2].

12.2.2 Agricultural land is graded according to its long-term physical limitations for agricultural use. Land is divided into grades 1 to 5, with Grade 3 further subdivided into two Subgrades 3a and 3b. PPWE10 advises in paragraph 3.54 that agricultural land of Grades 1, 2 and 3a of the Agricultural Land Classification (ALC)[3] [12.3] is the 'best and most versatile' (BMV) and should be conserved as a finite resource for the future. In development management decisions, considerable weight should be given to protecting such land from development, because of its special importance. Such land should only be developed if there is an overriding need for the development and either lower grade agricultural land is unavailable or has a recognised environmental value that outweighs the agricultural considerations.

12.2.3 TAN 6 advises on factors to consider when assessing the effects of development on agricultural land (section 6.2) including:

a) The effects on farm size and structure;

b) The effects on the efficient use of buildings, fixed equipment and capital investment; and

c) The effects on drainage, both surface water and land drainage systems.

[1] Planning Policy Wales (Edition 10, December 2018)

[2] Technical Advice Note 6 "Planning for Sustainable Rural Communities" (July 2010)

[3] Agricultural Land Classification of England and Wales: revised guidelines and criteria for grading the quality of agricultural land, MAFF (1988)

12.2.4 The Pembrokeshire County Council Local Development Plan (2013)[4] [12.4] notes at 3.16 that "*agriculture, tourism, energy and public services dominate the current economy of Pembrokeshire*". There is no particular policy governing agricultural land or businesses.

12.3 Assessment Methodology

12.3.1 The assessment was carried out in accordance with the methodology within the DMRB Volume 11, section 3, Part 6. As per the DMRB and national and local policy, the agricultural assessment covers loss of land and soil resources, the type of land management and farming practices currently operated and the potential impacts on these. The assessment covers matters such as severance, disturbance and disruption. The assessment covers direct and indirect, secondary, short, medium and long-term, permanent and temporary, beneficial and adverse impacts of the Scheme.

12.3.2 The assessment considers the severity of the impact for two different scenarios:

a) Where no mitigation is provided;
b) Where mitigation is provided. Mitigation is built into the Scheme, and accordingly this represents the assessment of the proposed Scheme.

Data collection and sources of information used

12.3.3 In terms of land use and ownership, a combination of desk-based research, questionnaire surveys and meetings with affected parties was undertaken. This includes:

a) Searches of Land Registry information;
b) Issuing of questionnaires to affected parties;
c) Meetings held with affected parties.

12.3.4 From this work, a detailed knowledge of land ownership interests affected by the Scheme was collated.

12.3.5 In relation to the effects on agricultural land and businesses, the assessment work included:

[4] Local Development Plan: Planning Pembrokeshire's Future, PCC (2013)

a) A study of the available published soil, geology and climate data, land quality records and topographic information;

b) A study of the Predictive Agricultural Land Classification Map (2017)[5] [12.5] and the Predictive ALC Map Guidance Note (November 2017);

c) A study of the engineering layout plans and land referencing information;

d) Interviews with affected farmers, landowners and occupiers mostly during August 2017.

Assessment criteria for agricultural land and business

12.3.6 The process of EIA requires various thresholds to be set to determine the levels of significance of impact. There are no universally recognised definitions of what constitutes "significant"; this will differ according to the perspective of the stakeholder(s). However, for the purposes of this technical assessment, and to assist in its interpretation, common assessment criteria and terminology were developed for the analysis of predicted impacts.

12.3.7 The assessment criteria for impacts on agricultural soil resources and businesses, as set out below, were agreed previously with the Regional Planning Advisor from the Technical Services Department of the Welsh Government. The criteria were based on the formulaic approach proposed in the revised DMRB guidance HA 205/08.

Receptors: agricultural land resources

12.3.8 Agricultural land, particularly the best and most versatile quality (Grades 1, 2 and 3a), is recognised as being a finite resource of national importance. There are no defined thresholds for assessing the magnitude of the impact, so thresholds were agreed in consultation with the Welsh Government (as set out in the Environmental Scoping Report, March 2017).

12.3.9 Therefore, in respect of effects on agricultural land, land of the best and most versatile agricultural quality is a resource of national importance and the thresholds reflect both the quantum and quality of the agricultural land affected.

[5] Predictive Agricultural Land Classification (ALC) Map and Guidance Note, Natural Resources Wales (November 2017)

Receptors: farm businesses

12.3.10 Farm and land-based rural businesses, whether run by owner-occupiers, tenants, licensees or contractors, and whether affected directly or indirectly, are a key receptor. The assessment considered the physical effects, including land loss, severance, the potential effects on the movement of livestock, field accesses, drainage and the use of farm buildings. It also considered, taking a long-term view, the potential effects on the medium to long-term ability for the remaining holding to continue in a beneficial agricultural use.

12.3.11 The effect on occupying and neighbouring land-based businesses was a more transient impact to assess. Such businesses vary from year to year, and even from day to day, affected by many external influences such as management wishes and decisions, market prices, illnesses and diseases, the weather and monetary exchange rates.

12.3.12 Whilst the quality and quantity of agricultural land does influence the farming and other land management practices operated over it, the effect on those businesses is assessed as being of local importance, due to their transient nature. That distinction is not intended to denigrate the important role of land managers in providing food for the nation and other opportunities and services.

Assessment criteria

12.3.13 The assessment of impact on land resources was carried out in three stages: first the magnitude, secondly the importance/sensitivity of the receptor, and thirdly the significance of impact. The magnitude of impacts was determined against the criteria set out in Table 12.1.

12.3.14 The methodology for determining the sensitivity of the receptors is set out in Table 12.2. There are four identified receptors. Best and most versatile agricultural land is considered to be a receptor of high sensitivity. Land of poorer quality and full-time farm businesses are considered to be of medium sensitivity. This reflects the transient nature of farm businesses and the lesser weight given to protecting poorer quality agricultural land. Part-time farm businesses are considered to be of low sensitivity.

12.3.15 A combination of the magnitude and sensitivity allows an assessment of the significance of the impact, as defined in Table 12.3.

Table 12.1 Agricultural Magnitude of Impact Assessment Criteria

Impact Magnitude	Definition	
	Impact on Soils	**Impact on Local Agriculture**
Major	The proposed development would directly lead to the loss of over 20ha (hectares) of "best and most versatile agricultural land" (Grades 1 / 2 / 3a).	The impact of the development would render a full-time agricultural business non-viable.
Moderate	The proposed development would directly lead to the loss of between 5 and 20ha of "best and most versatile agricultural land" (Grades 1 / 2 / 3a).	The impact of the development would require significant changes in the day to day management of a full-time agricultural business.
Slight	The proposed development would directly lead to the loss of less than 5ha of "best and most versatile agricultural land" (Grades 1 / 2 / 3a) or the loss of any quantity of non BMV land (Grades 3b, 4 or 5).	Land take would require only minor changes in the day to day management / structure of a full-time agricultural business or land take would result in the loss or a significant impact on a part-time business.
Negligible	No direct impact upon agricultural land.	Land take would require only negligible changes to an agricultural business.

Table 12.2 Agricultural Receptor Sensitivity

Sensitivity	Receptor
High	Land resources are matters of potentially national importance, as identified in PPWE10[6]. The BMV agricultural land (Grades 1, 2 and 3a) is of national importance. The effect on land resources is a combination of the quantum and quality of agricultural land affected, relative to both the national resource and the relative availability of land of that quality locally. Land resources of BMV quality should therefore be classified as being of high environmental value (sensitivity).
Medium	Land that is of poorer quality, Grades 3b, 4 and 5, is of lower sensitivity and is afforded no special protection in PPWE10. It is nevertheless a finite resource of local importance and so is regarded as of moderate sensitivity. Full-time farm businesses are of medium sensitivity, as the way that farms are operated will vary over time according to ownership, security of tenure and local and international economic factors. Farm businesses are tolerant of some change without detriment to their character.
Low	Part-time farm businesses are of low sensitivity. The way that farms are operated will vary over time according to ownership, security of tenure and local and international economic factors. Farm businesses are tolerant of some change without detriment to their character.

[6] Planning Policy Wales (Edition 10, December 2018)

Table 12.3 Agricultural Significance of Impact

Magnitude	Sensitivity		
	High	**Medium**	**Low**
Major	Major Adverse / Beneficial	Moderate Adverse / Beneficial	Minor Adverse / Beneficial
Moderate	Moderate Adverse / Beneficial	Minor Adverse / Beneficial	Minor Adverse / Beneficial
Slight	Minor Adverse / Beneficial	Minor Adverse / Beneficial	Minor Adverse / Beneficial
Negligible	Negligible	Negligible	Negligible

Limitations and assumptions

12.3.16 Farm management can change in short periods of time, so whilst the data used was correct at the time of survey (summer 2017), this may change with time. It was assumed that the general farming practices assessed would continue, and as this assessment takes a long-term view such changes in farming practice would not generally affect the conclusions set out below.

12.4 Baseline conditions

12.4.1 In relation to agriculture, baseline conditions can be divided into two categories:

a) Inherent conditions such as soils and land quality, which are not influenced to any significant degree by man;

b) Land-use conditions, such as farming occupation and management, which are transient.

Inherent conditions

12.4.2 **Agricultural Land Quality**. In November 2017, the Welsh Government produced Predictive Agricultural Land Classification Maps for Wales. These replaced the "provisional" ALC maps from the 1970s.

12.4.3 As advised in the Guidance Note (November 2017), the map is intended to assist the user in targeting survey work to the most appropriate locations. It is noted that planning applications are expected to be supported by survey evidence "*where BMV agricultural land is an issue for consideration*".

12.4.4 The flowchart at section 4 of the Guidance Note sets out the decision process. Where the predictive map shows that the site does not contain predicted BMV grades, the flowchart directs that survey is not required. The Predictive ALC Map shows the great majority of the area around Llanddewi Velfrey and affected by the Scheme to fall within Subgrade 3b. There are a few small areas shown as Grade 4. See Figure 12.1.

12.4.5 The land quality affected by the Scheme is typical of the land quality of the wider area, as shown on Figure 12.1. In Figure 12.2, an even wider area is considered and shows that most of the land in the wider area is Subgrade 3b and Grade 4. Some Subgrade 3a and Grade 2 land is shown to the north, but most of the land in the wider area is of similar quality to that affected by the Scheme.

12.4.6 Based on the Guidance Note for the Predictive ALC Map, no field survey for this particular route was required.

12.4.7 The majority of the land along the route of the Scheme is farmed and forms part of privately owned or occupied farm businesses. Seven farm and land-based rural units are directly affected. These comprise a mixture of part-time and full-time farm units and mostly beef and dairy units with little arable land, or blocks of land let to others to farm. Table 12.4 provides a summary of the affected farms.

Table 12.4 Summary of the main farm units affected

Plot Ref	Farm Unit	Description
4 and 6	Henllan Estate	The Henllan Estate comprises a substantial block of land split between a number of family members. Most of the land is let out on various mostly short-term tenancies. The parcels of land bordering the A40, labelled unit 6, extend to approximately 72 ha, and unit 4 is considerably larger. There are different ownerships within these areas. At the centre of the main part of the estate, which lies to the west of Llanddewi Velfrey, is a substantial dairy unit based at Henllan Farm. This unit occupies land on the south side of the A40 and some land on the northern side. Other land on the northern side, and Penblewin Farm, is let to a large dairy farm operating from Longford Farm. The eastern part of the estate, to the north-east of Llanddewi Velfrey, is let to Pen-troydin-fawr Farm (unit ref 67).
13 and 14	Pen-ca'rmaenau	This farm is let out to a substantial dairy farm operating from Longford Farm. The parcels labelled 13 and 14 extend to over 90 ha.
68/2	Parc-y-delyn	Parc-y-delyn is a 46ha beef breeding and rearing unit, mostly owned. The breeding and rearing takes place on the land around the buildings, with some off-lying rented land used for the production of silage. The farm is run by family labour. Within the farm is a firewood business which seasons, saws and splits timber for delivery locally.
68/1	Pen-troydin fach	Pen-troydin-fach is a 45ha dairy unit centred on the buildings at Pen-troydin-fach, north of the A40. The farm runs about 90 milking cows and rears its own replacements. Calves are reared to store or finished sizes. Land is rented locally for silage production.
67	Pen-troydin-fawr	Pen-troydin-fawr is a beef breeding and rearing unit, extending to 96 ha. The farm runs a breeding herd of about 60 continental cross bred cows and rears all offspring to finished, together with bought-in calves. The farm is run by two generations of the same family.
66	Henglos	Henglos Farm lies approximately 3.5km east of Llanddewi Velfrey. The farm extends to approximately 142ha of owned and rented land. The farm runs a dairy herd of about 130 cows and rears all followers. The land at Llanddewi Velfrey comprises the western edge of the farm and is used for silage and grazing dry cows or beef animals.
38	Glenfield	Glenfield is a 45ha grassland farm. It is currently understocked, with some land let. The farmer runs a small beef cattle rearing herd, buying in weaned calves and rearing them on to finished. The farm has land both sides of the A40. Given the size of the farm it is treated as a potentially full-time farm unit.

12.5 Predicted Environmental Effects

12.5.1 The potential impacts are described in terms of the construction phase and the operational phase. Most agricultural impacts would commence at the start of the construction phase (e.g. land loss, severance) and therefore most agricultural impacts are described under the construction phase impacts. Hence the permanent loss of agricultural land starts at the construction phase and continues throughout the operational phase. In addition, some land may be affected for the duration of the construction phase.

Construction

Agricultural Land Resources

12.5.2 The Scheme would require the acquisition of 31.5ha of land for construction, of which 4.1ha would be required only temporarily for the construction phase. This does not include construction camps, the details of which are not yet known.

12.5.3 Within the main farms identified, 0.5 ha is identified as required for the construction phase only. This land would be returned to agricultural use on completion. The temporary effects of construction are therefore limited to the loss of use of the land for the duration of the construction period.

12.5.4 The land to be taken permanently will be taken at the construction phase and thereafter represents a permanent loss to those farms from which the land is acquired.

12.5.5 As shown on the Predictive ALC Map at Figure 12.1, all of the land is predicted to comprise of subgrade 3b and Grade 4. None therefore falls within the category of Best and Most Versatile (BMV) and so no breakdown between grades is necessary.

12.5.6 The quantum of land by holding is shown in Table 12.5, with an indication of overall farm size and proportionate impact. It should be noted that the severity of impact will depend upon the location of the land in relation to the farm and buildings, and those effects are assessed later.

12.5.7 The effects of the permanent land loss, and any short-term construction-only land loss, on each farm is identified in Table 12.5, using the magnitude criteria set out in Table 12.1.

Table 12.5 Land take by Holding (rounded to nearest 0.1ha)

Holding No.	Holding Name	Area farmed locally (ha)	Permanent land take (ha)	Temporary land take (ha)	Proportion of land farmed (%)
4/6 (excl. 6/11 – 14)	Henllan Estate	>200 [7]	8.8	0	<5
13/14	Pen-ca'rmaenau	90	1.1	0	1
68/2	Parc-y-delyn	46	1.5	0	3
68/1	Pen-troydin-fach	45	2.1	0	5
67 (+ 6/11 – 14)	Pen-troydin-fawr	96	7.8	0.4	8
66	Henglos	142	3.0	0	2
38	Glenfield	45	3.1	<0.1	7

[7] But the estate locally is much larger, so the overall proportionate effect is smaller.

Table 12.6 Impact on Affected Farms

Holding No	Holding Name	Full/ Part-time	Effects of Proposals
4/6	Henllan Estate	Full	The affected land is farmed by different enterprises. Mostly the effect will be along field edges and overall a moderate magnitude.
13/14	Pen-ca'rmaenau	Full	The affected land forms the edge of the farm, which is occupied by a large dairy farm unit. The overall effect is fairly limited but of moderate magnitude.
68/2	Parc-y-delyn	Full	The affected land includes access to the farm and causes some severance (see below). The quantum of land loss of itself is modest, but in combination with the location of the affected land the overall effect is of moderate magnitude.
68/1	Pen-troydin fach	Full	The affected land is close to the farm buildings and causes some severance (see below). It requires altered accesses. The combination of quantum and location leads to a moderate level of impact.
67 (+ 6/11 – 14)	Pen-troydin-fawr	Full	The affected land is close to the farm buildings and causes some severance (see below). The combined effect is a moderate impact.
66	Henglos	Full	The affected land is remote from the main part of the farm but forms important fodder and off-lying grazing land. The effect overall is considered to be fairly limited, given the off-lying nature of the land, but still of moderate magnitude.
38	Glenfield	Full	Whilst currently understocked, the farm has potential and the affected land runs through the centre of the farm. As a result of the proportion and location of the land loss the effect will be moderate.

12.5.8 It is not considered that any farms will be so adversely affected by the additional loss of land taken only temporarily during construction that they would have to close enterprises for the duration of construction. There will be additional costs, such as the need to purchase additional forage or renting additional grazing or forage land, but these will be matters for compensation.

12.5.9 None of the farms losing land permanently will be so affected that they would be rendered non-viable, either financially or physically, as a result of the proposals. Accordingly, none of the farms are considered to experience a major adverse impact as set out in Table 12.1. However, all of the farms will experience a moderate adverse impact, which will mean significant changes in day-to-day farm management.

12.5.10 Soil fulfils several functions, as set out in the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites[8] [12.6]. These include environmental interaction with water and air, support for ecological habitats and biodiversity, and as a habitat for living organisms. The Code advises on pre-construction planning, soil management during construction and the use of soils in landscape creation.

12.5.11 The soils along the route comprise soils developed over shales, variably affected by springs or fluctuating ground water. It will be important to handle these soils when they are not saturated, and any soils being stripped for re-use should be stripped when they are dry and stored in accordance with best practice, for example as set out in the Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra 2009), which sets out good practice for stripping, handling and storing of soils.

12.5.12 With good practice, the topsoil will be capable of restoration without structural damage. Accordingly, their wider benefits will be unaffected.

Severance During Construction

12.5.13 Short-term severance of accesses into farmland could, without mitigation, cause significant short-term impacts on all the holdings, especially the Henllan Estate, Pen-ca'rmaenau, Parc-y-delyn and Pen-troydin-fach which are all accessed direct off the current A40. The effect, without mitigation, would potentially be that additional areas of land, and in some cases the farmhouses and buildings, would not be capable of beneficial use until alternative accesses proposed as part of long-term mitigation are provided.

Crop Loss and Timing

12.5.14 Most of the affected land is in grassland use, but some is used to produce silage. Much is grazed. The loss of areas planned for winter forage production could affect the ability to overwinter livestock, but this would be a matter for compensation.

[8] Construction Code of Practice for the Sustainable Use of Soils on Construction Sites, Defra (September 2009)

Disease Transmission

12.5.15 There is the potential, without good practice, for agricultural weeds and diseases to be spread between farms. There is very limited potential for animal diseases to spread during construction, even without mitigation, unless a particularly contagious outbreak (e.g. Foot and Mouth Disease) occurs.

Field Drainage

12.5.16 Where fields have the benefit of a man-made below-ground land drainage system, severance of that system during construction could affect wider areas of land either where located above (through impaired drainage) or below (through increased run-off) the Scheme.

Water Provision

12.5.17 The provision of water to fields being used for the grazing of livestock, and in the case of Pen-troydin-fach and Pen-troydin-fawr, the provision of spring water serving the farm buildings, could be affected during construction. Without mitigation, this could affect the ability of these farms or fields to carry livestock.

Noise and Dust

12.5.18 Although no enterprises particularly sensitive to noise and dust were identified, there is potential for short-term impacts during construction.

Operational

Agricultural Land Resources

12.5.19 The Scheme would require the permanent loss of approximately 27.4ha of agricultural land from the principal farm businesses.

Severance

12.5.20 Long-term severance could, without mitigation, have significant effects on most of the farms affected by the Scheme.

Other Effects

12.5.21 Other impacts that are identified and commence at the construction phase could have long-term implications, including impacts on drainage and water provision. No long-term impact on disease transmission is considered likely.

12.6 Proposed Mitigation

Construction Mitigation

Agricultural Land Resources

12.6.1 The Scheme involves the permanent land take of the minimum amount of land necessary. The Scheme design includes land required for construction and essential mitigation only. Wherever possible, land required for use only in the construction phase will be returned to an agricultural quality comparable to that which existed before the Scheme, such that long-term agricultural use of that land will be possible.

Severance during Construction

12.6.2 During the early stages of construction there would be a period when proposed Private Means of Access (PMA), underpasses or overbridges to address severance, are being constructed. For that temporary period alternative access may not be possible. New permanent alternative access arrangements (PMAs) are incorporated into the Scheme to reduce severance on the farm units, as set out in Table 12.7, and these permanent measures will be brought into use as soon as feasible within the construction programme.

Crop Loss and Timing impacts

12.6.3 The impact of crop loss could be reduced by giving advance warning to enable farmers to plan for the year ahead. The timing of entry could minimise the localised impacts e.g. to delay entering a few weeks before a field is to be cut for silage and entering straight after harvest.

Disease Transmission

12.6.4 During construction care to avoid spreading soil and materials, which could potentially carry disease pathogens, between different farms

when the fencing is being erected at the start of the entry process, would minimise the limited risk of spreading diseases. Once the route is fenced, there should be limited opportunity for contact with animals and accordingly limited risk for potential disease transmission. Care would need to be taken with any crossing points used by livestock to avoid mixing of herds during the construction process.

Field Drainage

12.6.5 Parts of the route are understood to have the benefit of historic below-ground land drainage systems, but in many cases the details are not known due to their age. Care would be taken during construction to identify any drainage schemes affected and to provide collection or header pipes so that these drainage systems can continue to work effectively under the surrounding land during construction. The drainage of surrounding land would be monitored during construction and if drainage conditions are noted to have altered, remedial works would be carried out.

Water Provision

12.6.6 The provision of water would be maintained wherever possible. Water supplies to some areas could potentially be severed. In those circumstances, the owners would either be compensated or provided with other temporary water supplies.

Noise and Dust

12.6.7 Noise and dust would be kept to a minimum and within acceptable working limits, as described in Chapters 13 and 14 of this ES, and as set out in the REAC within the CEMP.

Operational Mitigation

Agricultural Land Resources

12.6.8 Permanent land loss cannot be mitigated. The Scheme requires land for construction, and the design would take the minimum necessary to construct and operate the Scheme. Severance impacts are mitigated where possible and feasible. In many cases, a balance was struck between mitigation and design/cost. Mitigation considerations for each holding affected by severance are summarised in Table 12.7.

Table 12.7 Severance Mitigation Proposals

Plot Ref	Farm Unit	Alternative Access Proposals
4 & 6	Henllan Estate	A new PMA is proposed to serve the land north of the existing A40. This PMA will enable field accesses, which currently open onto the A40, to be accessed from the much more lightly used PMA.
13 & 14	Pen-ca'rmaenau	This farm is currently accessed via a drive off the A40. The continued access would be provided from a PMA which would connect to the A478 just north of Penblewin roundabout.
68/2	Parc-y-delyn	The access to Parc-y-delyn farm will connect onto the new junction serving Ffynnon Lane and numerous other properties.
68/1	Pen-troydin-fach	Access to this farm also runs from the new junction with the A40. It will then connect into the back of the farmyard along the existing track. A cattle-only underpass is proposed to provide access to severed land south of the Scheme. This will include a 2.3m wide by 2.7m tall cattle underpass, in a box profile. Whilst the underpass is a considerable length due to the contours and embankments, it will alleviate severance and will allow cattle to access the severed land.
67	Pen-troydin-fawr	The farm access from the Llanfallteg Road will not be affected. Access from the farm to severed fields north of the Scheme will be possible using the Llanfallteg Road and bridge.
38	Glenfield	Continued access, including past the proposed balancing pond, will be provided.

Field Drainage

12.6.9 Parts of the route are understood to have the benefit of historic below-ground land drainage systems which would be identified, and header and collection systems continue to work effectively under the surrounding land. The drainage of surrounding land would be monitored and if drainage conditions are noted to have altered, remedial works would be carried out.

Water Provision

12.6.10 The provision of water would be maintained wherever possible. Water supplies to some areas could potentially be severed. In those circumstances, the owners would be compensated to provide other temporary or permanent water supplies.

12.7 Residual Environmental Effects Following Mitigation

12.7.1 The significant effects of the Scheme are summarised in Table 12.7.

Agricultural Land Resources

12.7.2 Approximately 27.4ha of agricultural land would be lost permanently to the Scheme. This is all shown on the Predictive ALC maps to fall within subgrade 3b and Grade 4. Accordingly, none of the land is of BMV quality.

12.7.3 This would be an impact of slight magnitude and medium sensitivity, and accordingly of minor adverse significance.

12.7.4 The additional land required temporarily during construction will not be lost, and its management and restoration will be governed as set out in the CEMP.

Farm Business and Severance

12.7.5 This assessment considers the cumulative impact of the construction phase impacts on the farms affected. It assesses the impacts after the mitigation described in Section 12.7 is embedded into the Scheme.

12.7.6 The magnitude of the impacts, and the significance, is assessed against the criteria set out in Section 12.3.

12.7.7 All seven farms that would lose land to the Scheme would experience disruption that would require significant changes to their day-to-day land management. None, however, would be rendered unviable. Therefore, whilst in all cases the effect will be significant, in that the changes to day-to-day farm management will be more than minor, no farm business will be so affected that they will not adapt and continue. Farms are medium sensitivity receptors (see Table 12.2) and because of the moderate magnitude of impact, and the medium sensitivity of full-time farm holdings, the effects in all cases are defined to be of minor adverse significance. Hence farms are significantly affected but the effect, in terms of agricultural impacts within the Environmental Assessment methodology, are minor.

12.7.8 No agricultural enterprises would be significantly adversely affected by operational impacts that have not been described above.

12.8 Monitoring of Mitigation

12.8.1 Monitoring of mitigation measures for significant effects will be undertaken following completion of construction to demonstrate effectiveness.

12.9 Summary and Conclusions

Impacts on Land Resources

12.9.1 The Scheme will involve the permanent loss of approximately 27.4ha of agricultural land. None of this is shown to be of the best and most versatile agricultural quality. This is an impact of slight magnitude on a resource of medium sensitivity, leading to an overall impact of minor adverse significance.

12.10 Impacts on Farm Business

12.10.1 There are seven farms affected. All will experience significant changes in day-to-day operations, but the viability and continued function of the holdings is not threatened. Accordingly, in all cases, the effect is of moderate adverse magnitude on an interest of medium sensitivity, leading to an impact of minor adverse significance.

12.11 Other Impacts

12.11.1 There are no other significant adverse impacts.

Table 12.8 Summary of Significance of Effects

Plot Ref	Farm Unit	Area taken ha (%)	Magnitude of Impact (Post Mitigation)
4 and 6	Henllan Estate	8.8 (<5)	The Henllan Estate would lose of the order of 8.8ha, in two different family ownerships. The effect of such land loss would have a limited impact on the overall size of the estate, or the viability of occupying farms. Access to all severed land would be available post construction. Overall however, due to the quantity of land involved, this would be an impact of moderate adverse magnitude and medium sensitivity, and accordingly of minor adverse significance.
13 and 14	Pen-ca'rmaenau	1.1 (1)	This holding would lose of the order of 1.1ha. Access would not be adversely affected. Overall the magnitude of impact would be moderate and, with the sensitivity and the receptor being medium, the overall impact would be of minor adverse significance.
68/2	Parc-y-delyn	1.5 (3)	This farm would lose of the order of 1.5ha of land. There would be severance of approximately 0.2ha of land, access to which would only be possible by crossing over the A40. The utility of that land would, as a result, be greatly reduced for this farm holding. The overall effect would be moderate magnitude on a full time holding of medium sensitivity, and accordingly an impact of minor adverse significance.
68/2	Pen-troydin-fach	2.1 (5)	The land loss from this farm unit would be of the order of 2.1ha, or 5% of land occupied. Whilst access for cattle would be possible via the proposed farm underpass, there would still be disruption to the working practices of the farm. The provision of the underpass would mitigate successfully the worst of the impact. The farm is provided with water from a spring, and this supply would be continued, or alternate supplies provided. Overall, therefore, with the mitigation the impact would be of moderate magnitude on a farm of medium sensitivity, an overall impact of minor significance.

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Plot Ref	Farm Unit	Area taken ha (%)	Magnitude of Impact (Post Mitigation)
67 and 6/11 - 14	Pen-troydin-fawr	7.8 (8)	This beef unit would lose approximately 4.8ha from their owned land and 3.0ha from land they rent. Whilst the rented land is held on a short-term basis, the farm has occupied that land for many years. The farm is supplied by spring water and this would be available post construction or alternate supplies provided. The impact of severance would be mitigated by the provision of field gates onto the Llanfallteg Road, which would reduce the need that currently exists for cattle to be run along the road, which would not be possible otherwise post construction. Overall the impact would be of moderate magnitude on a holding of medium sensitivity, an impact of minor adverse significance.
66	Henglos	3.0 (2)	The farm would lose 3.0ha of land. This is off-lying land and at the periphery of the farm. A small amount of land would be severed without access. The overall impact would be of moderate magnitude on a farm of medium sensitivity, and accordingly of minor adverse significance.
38	Glenfield	3.1 (7)	This farm is currently not farmed to its full extent due to the age of the farmer, but an assessment was made based on the farm's potential. The farm would lose of the order of 3.1ha of land, and some land to the north would only be accessible via a lengthy detour. The access to land south of the A40 would also become more difficult due to the attenuation pond. The overall impact would be of moderate magnitude. The farm is sufficiently large to comprise a full-time unit, and accordingly be of medium sensitivity. The impact is one of minor adverse significance.

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Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 13: Air Quality

A40LVP-ARP-EAQ-SWI-RP-LA-0001

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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13 Air Quality

13.1 Introduction

13.1.1 This chapter details the potential effects of the Scheme on local air quality during both construction and operational phases.

13.1.2 There is the potential for local air quality to be affected during the construction of the Scheme by exhaust emissions from construction vehicles and machinery used on-site and fugitive dust emissions from site activities.

13.1.3 During the operational phase, local air quality would be affected as a result of the Scheme redistributing vehicles across the network. Emissions from vehicle exhausts contain a number of pollutants, including oxides of nitrogen (NOx), carbon monoxide (CO), hydrocarbons, carbon dioxide (CO_2) and particulate matter (PM). The quantities of each pollutant emitted depend on the type of vehicle, quantity and type of fuel used, engine size, speed of the vehicle and abatement equipment fitted. Once emitted, the pollutants are diluted and dispersed into the ambient air.

13.2 Legislation, Policy Context and Guidance

Legislation

13.2.1 In Wales, objectives for specified air quality pollutants are set in national legislation. Additionally, limit values (pollutant concentrations not to be exceeded by a certain date) are set by the European Union and are used to determine the UK's compliance with EU legislation.

EU Limit Values

13.2.2 In May 2008, the Council Directive (2008/50/EC) on Ambient Air Quality and Cleaner Air for Europe (European Commission, 2008), came into force. The Directive sets ‘limit values’ and ‘target values’ for ambient concentrations of pollutants for both the protection of human health and designated sites. The limit values defined in the Directive are legal requirements and compliance with these is reported on an annual basis by the Department for Environment, Food and Rural

Affairs (Defra). The Directive requires the UK to be divided into zones for the purposes of air quality management and assessment.

13.2.3 The EU Directive was transposed into national legislation in Wales by the Air Quality Standards (Wales) Regulations 2010 (National Assembly for Wales, 2010).

13.2.4 The Scheme is located in the South Wales Zone (UK0041), which is covered by an Air Quality Plan (Defra, 2017) for the achievement of EU limit value for NO_2. Consideration has been given to the EU limit values to determine the air quality effects of the Scheme in the South Wales Zone. The assessment has taken consideration of policies and measures set out in this new plan where any have been identified to be relevant to the Scheme and South Wales Zone.

National Objectives

13.2.5 The current Air Quality Strategy for England, Scotland, Wales and Northern Ireland was published in 2007 (Defra et al., 2007). This set the strategy for meeting the air quality objectives. The Local Air Quality Management (LAQM) system, required to be undertaken by local planning authorities under the Environment Act 1995, assesses where the UK objectives may be exceeded. Where exceedances are recorded an Air Quality Management Area (AQMA) must be declared by the local authority and an Air Quality Action Plan (AQAP) prepared to implement measures to improve air quality in these areas. The impact of the Scheme upon air quality objectives has been used to inform the overall significance of the effect of the Scheme as set out in IAN 174/13 (Highways Agency, 2013).

Air Quality Standards

13.2.6 The air quality EU limit values and Welsh air quality objectives applicable to the Scheme are shown in Table 13.1. Some pollutants have standards expressed as annual mean (long-term) concentrations due to the chronic way in which they affect health or the natural environment (i.e. effects occur after a prolonged period of exposure to elevated concentrations). Others have standards expressed as 24-hour, 1-hour or 15-minute (short-term) mean concentrations due to the acute way in which they affect health or the natural environment (i.e. after a relatively short period of exposure). Some pollutants have standards expressed in terms of both long-term and short-term concentrations.

Table 13.1 Air quality standards

Pollutant	Averaging Period	EU Limit Value / Welsh Objective
Human Health		
Nitrogen Dioxide (NO_2)	Annual mean	40µg/m^3
	1-hour mean	200µg/m^3 not to be exceeded more than 18 times a year (99.8th percentile)
Fine Particulate Matter (PM_{10})	Annual mean	40µg/m^3
	24-hour mean	50µg/m^3 not to be exceeded more than 35 times a year (90. 4th percentile)
(a) The Air Quality Standards (Wales) Regulations 2010, No. 1433 (b) Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe		

13.2.7 In addition to limit values to protect human health, the EU has set NOx limit values for the protection of vegetation. The annual mean limit value for NOx for the protection of vegetation is 30 µg/m^3. The limit values for the protection of vegetation apply to locations more than 20km from towns with more than 250,000 inhabitants or more than 5km from other built-up areas, industrial installations or motorways. As stated in the EU Directive, monitoring sites need to be representative of an area of 1,000 square kilometres. The limit does not have a statutory basis in micro-scale environments such as those close to a road or other pollution source.

13.2.8 The United Nations Economic Commission for Europe (UNECE) and the World Health Organisation (WHO) have set a critical level for NOx (30µg/m^3), for the protection of vegetation. Therefore, the statutory nature conservation agency's (Natural Resources Wales) policy is to apply the 30 µg/m^3 criterion as a benchmark, on a precautionary basis, in internationally designated conservation sites and in Sites of Special Scientific Interest (SSSIs).

13.2.9 In addition, critical loads for nitrogen deposition have been set that represent (according to current knowledge) the exposure below which there should be no significant harmful effects on sensitive elements of the ecosystem.

13.2.10 No locations where the limit value for NOx or critical loads would apply have been identified within the study area of the assessment, therefore compliance with the EU limit value for NOx has not been considered further within this chapter.

13.2.11 There are watercourses within 200m of the Scheme that flow into the Cleddau Rivers Special Area of Conservation (SAC) which is 3.8km away from the Scheme. These habitats are not considered to be sensitive to nitrogen or particulate pollution which may be deposited in the watercourse as a result of the Scheme therefore any possible effects upon the SAC from air quality pollutants will be negligible.

Policy Context

Well-being of Future Generations (Wales) Act 2015

13.2.12 The act has a number of well-being goals to achieve through implementation of sustainable development. Whilst none of the goals specifically mention air quality, changes in air quality can have an impact on the health of habitat and humans. As such, the goals to create 'a resilient Wales' and 'a healthier Wales' are applicable.

13.2.13 In order for Welsh Ministers to understand the progress being made to achieving the well-being goals, national indicators have been set. One of these national indicators relates to levels of NO_2 in the air. The Well-Being of Future Generations Act aims to reduce pollution exposure by assessing a weighted population average to NO_2 on an annual basis.

Planning Policy Wales, Edition 10, December 2018

13.2.14 The 10th edition of Planning Policy Wales[1] (PPW10) was published in December 2018. It sets out land use and planning policy for Wales. The new planning policy incorporates principles derived from the Well-being of Future Generations (Wales) Act 2015.

[1] Welsh Government (2018) Planning Policy Wales Edition 10 (PPW10)

13.2.15 The policy document is set out into themes, air quality is predominantly addressed in the Distinctive and Natural Places theme. Section 6.7 Air Quality and Soundscape of PPW10, highlights the importance that air quality has in a positive experience of place, public health, amenity and well-being. Specific reference is made to the contribution the planning system should make to achieving a healthier Wales through reducing population exposure to air pollution, whilst also tackling high pollution hotspots. Additionally, preventing the creation of any new or worsening of existing air quality pollution problems is also important.

Local Planning Policy

13.2.16 The study area of the air quality assessment, as discussed later in this chapter, covers two local authority areas. Planning Policy relating to air quality for each of the local authorities covered by the study area is outlined below.

Pembrokeshire County Council Local Development Plan (2013-2021)

13.2.17 The Pembrokeshire County Council (PCC) Local Development Plan (LDP) (Pembrokeshire County Council, 2013) adopted in 2013 sets out relevant local planning policy.

13.2.18 Policies relevant to air quality include:

a) **GN1: General Development Policy**, Point 2 – developments will be permitted where they will not result in a significant detrimental impact on local air quality;

b) **GN3: Infrastructure and New Development**- provision must be made for mitigation of potential adverse impacts upon air quality.

Carmarthenshire County Council Local Development Plan

13.2.19 The Carmarthenshire County Council (CCC) was adopted in 2014, and sets out the spatial vision for the future of Carmarthenshire. Policies relevant to air quality include:

a) **EP2: Pollution** – Proposals for development should wherever possible seek to minimise the impacts of pollution. New developments will be required to demonstrate that they do not

conflict with National Air Quality Strategy objectives or adversely affect to a significant extent, designated AQMAs.

13.3 Relevant Guidance

13.3.1 The method for assessing the likely operational air quality effects of the Scheme will follow the guidance described in DMRB Volume 11, Section 3, Part 1: HA 207/07. In addition, the associated Interim Advice Notes will be considered:

a) **IAN 170/12v3** Updated Air Quality Advice on the Assessment of Future NOx and NO2 Projections for Users of DMRB Volume 11, Section 3, Part 1 'Air Quality' (Highways Agency, 2012);

b) **IAN 174/13** Updated Advice for Evaluating Significant Local Air Quality Effects for DMRB Volume 11, Section 3, Part 1 'Air Quality' (HA 207/07) (Highways Agency, 2013).

13.3.2 The IANs listed above have not yet been adopted in Wales, however, it is considered that these IANs reflect current best practice guidance and as there is no suitable Welsh equivalent guidance, these have been used to inform the proposed method of assessment. It has been acknowledged that references to the National Planning Policy Framework (NPPF) set out in the above IANs are not relevant in the Welsh context.

13.3.3 It has been noted that Highways England have produced IAN 175/13 to assess compliance with the EU Directive. This IAN assesses the effect of a scheme on road links included in the Pollution Climate Mapping (PCM) model. Defra uses the PCM model to report compliance with the EU Directive. IAN 175/13 has been withdrawn and is currently pending update. Therefore, no assessment has been undertaken following the IAN 175/13 assessment methodology. In any event, there are no PCM road links within the study area of the assessment which would be affected by the Scheme.

13.3.4 It is also noted that Highways England have produced IAN 185/15 'updated traffic, air quality and noise advice on the assessment of link speeds and generation of traffic data into speed-bands' which provides an assessment methodology for assessing the impact of congestion on local air quality. The study area does not suffer from congestion therefore an assessment using IAN 185/15 has been scoped out.

13.3.5 It should be noted that DMRB HA 207/07 provides limited guidance regarding assessing air quality during construction. Therefore, industry standard guidance published by the Institute of Air Quality Management (IAQM) will be used to provide a more robust technical assessment.

Dust Guidance

13.3.6 Dust is the generic term used in the British Standard document BS 6069 (Part Two) to describe particulate matter in the size range 1–75 µm in diameter. Dust nuisance is the result of the perception of the soiling of surfaces by excessive rates of dust deposition. Under provisions of the Environmental Protection Act 1990, dust nuisance is defined as a statutory nuisance.

13.3.7 There are currently no formal standards or guidelines for what constitutes dust nuisance in the UK, nor are formal dust deposition standards specified. This reflects the uncertainties in dust monitoring technology and the highly subjective relationship between deposition events, surface soiling and the perception of such events as a nuisance. In law, complaints about excessive dust deposition would have to be investigated by the local planning authority and any complaint upheld for a statutory nuisance to occur. However, dust deposition is generally managed by suitable on-site practices and mitigation rather than by the determination of statutory nuisance and/or prosecution or enforcement notice(s).

13.3.8 The IAQM has published guidance on the assessment of dust from demolition and construction. This provides a risk-based qualitative approach for determining the potential for dust impacts during the construction phase of the Scheme.

13.4 Study Area

13.4.1 The study area of the air quality assessment is defined by the guidance used to assess potential air quality effects. Air quality effects during the construction phase have been assessed within 350m of the site boundary within which all associated works will occur and is shown in Volume 2 Figure 13.1 in Volume 2 of this ES.

13.4.2 For the local air quality assessment, the Affected Road Network (ARN) is defined in the DMRB HA 207/07 as those roads within the study area

of the traffic model that meet any of the criteria set out below. The criteria are change-based, where change is based on the difference in traffic data or highway design between the do-minimum (without Scheme) and do-something (with Scheme) scenarios for both the opening and future assessment year (opening year +15 years). The criteria are presented in Table 13.2.

Table 13.2 Criteria for determining the local road network

Criteria	Threshold
Road alignment will change	by 5m or more; or
Daily traffic flows will change	by 1,000 Annual Average Daily Traffic (AADT); or
Heavy Duty Vehicles (HDV[2]) flows will change	by 200 AADT or more; or
Daily average speed will change	by 10km/hr or more; or
Peak hour speed will change	by 20km/hr or more.

13.4.3 The local assessment encompasses a 200m corridor (Highways Agency et al., 2007) either side of the roads included in the ARN. The study area of the local air quality assessment is shown in Figure 13.1 in Volume 2 of this ES. Receptors, such as residential properties have been considered within the corridor. No international or nationally designated ecological sites have been identified within the study area of the local air quality assessment.

13.4.4 The criteria used to define the study area for the assessment of regional air quality effects are also set out in the DMRB. However, these differ from those set out for the local air quality assessment. The criteria for determining the regional road network considered are presented in Table 13.3.

Table 13.3 Criteria for determining the regional air quality network

Criteria	Threshold
Changes of more than	10% in AADT; or
	10% to the number of heavy duty vehicle; or
	daily average speed of more than 20 km/hr.

13.4.5 The Scheme would result in a redistribution of traffic from the existing A40 through Llanddewi Velfrey to the new section of road but would

[2] Heavy Duty Vehicles include heavy goods vehicles, buses and coaches and any vehicle with a gross weight greater than 3.5 tonnes.

not result in a change to overall traffic movements or average speeds on the road network. Whilst the DMRB criteria for a regional assessment are not met, an assessment of the change of CO_2 emissions as a result of the operation of the Scheme has been undertaken to allow the potential effect of the Scheme on climate change to be understood. In addition to the assessment of operational CO_2 emissions, a full carbon assessment has been undertaken for all phases of the Scheme.

13.5 Methodology

13.5.1 The following two assessments have been undertaken to determine the likely significant air quality effects arising as a result of the Scheme:

a) A construction phase dust assessment; and

b) A local air quality assessment for the existing A40 section from Llanddewi Velfrey to Penblewin roundabout, the new section of road and any other roads which are included in the ARN.

13.5.2 The operation of site equipment, vehicles and machinery during the construction of the Scheme would result in emissions to atmosphere of exhaust gases, but such emissions are not considered to be significant, particularly in comparison to levels of emissions of the same pollutants from vehicle movements on the local road network. Site equipment and machinery emissions will be intermittent and, in most cases, further away from sensitive receptors than the local road network, which will continue to be the main source of pollutants during the construction phase of the Scheme. As such, the impacts of site equipment have been scoped out of this assessment.

13.5.3 The emissions from Heavy Goods Vehicles (HGVs) associated with the construction of the Scheme have been scoped out of the assessment due to the temporary nature of the works and the minimal impact the additional vehicles would have on overall pollutant concentrations. The construction period is anticipated to be approximately 18 months long during which time the existing carriageway will be subject to speed restrictions. Additionally, where works are being carried out adjacent to the existing carriageway lane widths will be narrowed to maximise working space. Temporary traffic signals may also be used for specific activities; however, these will be limited as much as possible to off peak periods to minimise disruption to road users.

13.5.4 It is envisaged that the Scheme could generate up to approximately 50 total workforce trips using cars and vans (to site) per day, and approximately 65 construction vehicle trips using HGVs (to site) per day. Additional vehicles during construction do not trigger the DMRB HA 207/07 criteria of more than 200 additional HGV movements per day or 1,000 vehicle movements (including cars) per day.

Identification of Baseline

13.5.5 Existing or baseline ambient air quality refers to the concentration of relevant substances that are already present in the environment. These are present from various sources, such as industrial processes, commercial and domestic activities, and natural sources.

13.5.6 A desk-based review of the following data sources has been undertaken to determine baseline conditions of air quality in this assessment:

a) PCC and CCC review and assessment reports and local air quality monitoring data;

b) The Welsh Air Quality Forum;

c) The Defra website; and

d) Natural Resources Wales (NRW) website.

13.5.7 In addition to air quality information available from the above sources, a Scheme specific air quality monitoring survey has been undertaken using NO_2 diffusion tubes at seven locations across the Scheme area. Locations of the monitoring sites are shown in Figure 13.2 of Volume 2 of this ES and details provided in Table 13.4. Air quality monitoring has been undertaken for a period between May and December 2017.

13.5.8 Tubes are exposed in duplicate (i.e. two tubes at the same location) with the exception of those co-located with the Princes Gate automatic monitor which are exposed as triplicate to establish a local bias-adjustment factor.

13.5.9 In order to compare the results of the monitoring survey with the air quality standards, the average concentration for each site over the monitoring period was annualised[3] following the method described in

[3] The monitored concentrations need to be annualised in order to compare them with the air quality standards which are presented as annual means (12-month period).

Local Air Quality Management Technical Guidance (Defra, 2016) (LAQM.TG16).

13.5.10 The use of diffusion tubes is a cost-effective method of assessing pollutant concentrations, however there is a level of uncertainty associated with this method. Bias refers to the possibility of the diffusion tubes systematically over or under-reading the concentrations. A bias adjustment factor is derived from either co-location with an automatic monitor (which has been undertaken by co-locating diffusion tubes with the automatic monitor at Princes gate) or from the national database on co-location studies available from Defra[4].

13.5.11 The results of the monitoring survey have been processed (annualised and bias-adjusted) to allow for comparison against the annual mean NO_2 objective.

Table 13.4 NO_2 diffusion tube monitoring locations

DT Number	Site ID	Type	X	Y
1	AURN – Princes Gate	Background	214376	212776
2	Blackmore Hill	Roadside	211430	216592
3	Penblewin Roundabout	Roadside	212055	216635
4	Maes-y-Rhos (Public Footpath)	Roadside	214356	217009
5	Llanfallteg Junction	Roadside	214741	216897
6	Penllan	Roadside	215562	216855
7	Willow School for Dogs	Background	215100	217030

13.5.12 Detailed modelling of NOx and PM_{10} has been undertaken using the ADMS Roads (version 4.1.1) atmospheric dispersion model from Cambridge Environmental Research Consultants (CERC) to predict baseline pollutant concentrations and verify the air quality model to provide confidence in opening and future year predictions. Details relating to model inputs, including traffic data, receptors and meteorological data are described in more detail below.

[4] Defra, The National Diffusion Tube Bias Spreadsheet, Available from: http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

Methodology for Construction Impacts

13.5.13 Fugitive dust emissions arising from construction and demolition activities are likely to be variable in nature and would depend upon the type and extent of activity, soil type and moisture, road surface conditions and weather conditions.

13.5.14 Since the publication of DMRB HA 207/07, further guidance has been released by the IAQM regarding local air quality effects during construction. Effects arising from the construction phase of the Scheme have therefore been assessed using the qualitative approach described in the IAQM Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2016), which provides a more robust technical assessment than the DMRB HA207/07 method. This approach is considered to represent contemporary best practice for assessment of the construction phase.

13.5.15 The IAQM guidance considers the potential for dust emissions from the following activities:

a) Earthworks i.e. soil stripping, ground levelling, excavation and land capping;

b) Trackout i.e. incidental movement of dust and dirt from the construction or demolition site onto the public road network;

c) Demolition; and

d) Construction.

13.5.16 For each of these activities, the guidance considers three separate dust effects:

a) Annoyance due to dust soiling;

b) Harm to ecological receptors; and

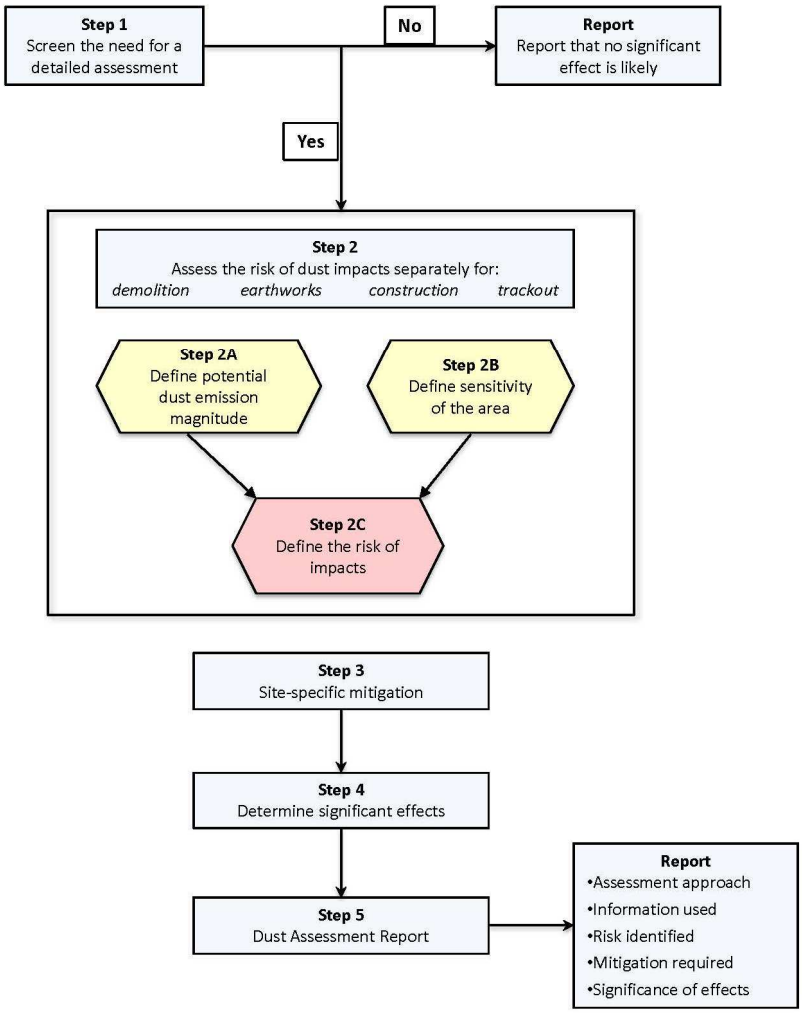
c) The risk of health effects due to a significant increase in PM_{10} exposure.

13.5.17 The methodology takes into account the scale to which the above effects are likely to be generated (classed as small, medium or large). Also, the distance of the closest receptors and background PM_{10} concentrations are taken into account in order to determine the sensitivity of the surrounding area. This is then taken into consideration to derive an overall site risk and identify suitable mitigation measures. The receptors

can be both human and ecological and are chosen based on their sensitivity to dust soiling and PM_{10} exposure.

13.5.18 The four assessment steps are summarised in Figure 13.3, with further descriptions of each step in the following sections.

Figure 13.3 Construction dust assessment



Step 1: Screen need for assessment

13.5.19 The first step is the initial screening for the need for an assessment. According to the IAQM guidance, an assessment is required where

there are sensitive receptors within 350m of the site boundary and/or within 50m of the route(s) used by the construction vehicles on the public highway and up to 500m from site entrance(s). There are no ecological receptors sensitive to dust within the defined study area for the construction phase therefore the construction dust assessment has focussed on human health receptors only.

Step 2: Assess the risk of dust impacts

13.5.20 This step is divided into three sections, 2A, 2B and 2C, details of which are provided below.

Step 2A - Identifies the scale and nature of the works, which determines the potential dust emission magnitude as small, medium or large

13.5.21 For this step, a description of the site and its surroundings has been collated to inform the overall significance and professional judgement. Each of the construction activities has been given a dust emission magnitude, based on the criteria shown in Table 13.5.

Table 13.5 Categorisation of dust emission magnitude

Dust Emission Magnitude		
Small	**Medium**	**Large**
Demolition		
• total building volume <20,000m^3 • construction material with low potential for dust release (e.g. metal cladding or timber) • demolition activities <10m above ground • demolition during wetter months	• total building volume 20,000 - 50,000m^3 • potentially dusty construction material • demolition activities 10 - 20m above ground level	• total building volume >50,000m^3 • potentially dusty construction material (e.g. concrete) • on-site crushing and screening • demolition activities >20m above ground level
Earthworks		
• total site area <2,500m^2, soil type with large grain size (e.g. sand) • <5 heavy earth moving vehicles active at any one time • formation of bunds <4m in height • total material moved <20,000 tonnes • earthworks during wetter months	• total site area 2,500m^2 - 10,000m^2, moderately dusty soil type (e.g. silt) • 5-10 heavy earth moving vehicles active at any one time • formation of bunds 4m - 8m in height • total material moved 20,000 - 100,000 tonnes	• total site area >10,000m^2 potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) • >10 heavy earth moving vehicles active at any one time • formation of bunds >8m in height • total material moved >100,000 tonnes
Construction		
• total building volume <25,000 m^3 • construction material with low potential for dust release (e.g. metal cladding or timber)	• total building volume 25,000m^3 - 100,000m^3 • potentially dusty construction material (e.g. concrete) • piling • on-site concrete batching	• total building volume >100,000m^3 • piling • on-site concrete batching • sandblasting
Trackout		
• <10 HDV (>3.5t) trips in any one day • surface material with low potential for dust release • unpaved road length <50m	• 10-50 HDV (>3.5t) trips in any one day • moderately dusty surface material (e.g. high clay content) • unpaved road length 50m – 100m;	• >50 HDV (>3.5t) trips in any one day • potentially dusty surface material (e.g. high clay content) • unpaved road length >100m

Step 2B – defines the sensitivity of the area to dust impacts which is defined as low, medium or high sensitivity.

13.5.22 This step takes into account a number of factors:

a) The specific sensitivities of receptors in the area;

b) The proximity and number of those receptors;

c) In the case of PM_{10} the local background concentrations; and

d) Site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

13.5.23 The sensitivity of an area is based on the guidance and professional judgement. The general principles to assess sensitivity are provided in Table 13.6.

13.5.24 Once the specific receptors have been identified the sensitivity of these receptors is determined based on the sensitivity of the area to dust soiling effects on people and property and on the sensitivity of the area to human health. The tables used in assessing these sensitivities are shown in Table 13.7 and Table 13.8.

Table 13.6 Examples of factors defining sensitivity of an area

Sensitivity of Surrounding Area	**Examples**	
	Sensitivity of People to Dust Soiling Effects	**Sensitivities of People to the Health Effects of PM_{10}**
Low	Enjoyment of amenity would not reasonably be expected; There is property that would not reasonably be expected to be diminished in appearance, aesthetics or values by soiling; There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land; Indicative examples include playing fields, farmland (unless commercially sensitive horticulture), footpaths, short term car parks and roads.	Locations where human exposure is transient; Indicative examples may include public footpaths, playing fields, parks and shopping streets.
Medium	Users would expect to enjoy a reasonably level of amenity, but	Locations where people exposed are workers, and exposure is

Sensitivity of Surrounding Area	Examples	
	Sensitivity of People to Dust Soiling Effects	**Sensitivities of People to the Health Effects of PM_{10}**
	would not reasonably expect to enjoy the same levels of amenity as in their home; The appearance, aesthetics or value of their property could be diminished by soiling; Indicative examples include parks and places of work.	over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objective, a relevant location would be one where individuals may be exposed for eight hours or more in a day); Indicative examples may include offices and shops but will generally not include workers occupationally exposed to PM_{10} as potential is covered by Health and Safety at Work legislation.
High	Users can reasonably expect an enjoyment of a high level of amenity; The appearance, aesthetics or values of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land; Indicative examples include dwellings, museum and other culturally important collections, medium and long-term car parks and car showrooms.	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objective, a relevant location would be one where individuals may be exposed for eight hours or more in a day); Indicative examples include residential properties. Hospitals and schools and residential care homes should also be considered as having equal sensitivity to residential areas.

Table 13.7 Sensitivity of the area to dust soiling effects on people and property

Receptor Sensitivity	Number of receptors	Distance from the Source (m)			
		<20	**<50**	**<100**	**<350**
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 13.8 Sensitivity of the area to human health impacts

Receptor Sensitivity	Annual Mean PM_{10} concentration	Number of receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<300
High	>32 µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m^3	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28–32 µg/m^3	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Step 2C – takes the results from step 2A and 2B and combines these to define the risk of impacts.

13.5.25 The guidance provides the matrices with which the risk of dust impacts can be defined from the results of both the dust magnitude and sensitivity of the area. The matrices for assessment are provided in Table 13.9.

Table 13.9 Risk of dust impacts

Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Step 3: Determine site specific mitigation (if required)

13.5.26 Following assignment of a risk rating to each of the activities, appropriate mitigation measures should be identified. Where the risk is assessed as negligible, no mitigation measures beyond best practice are necessary and no significant effects would be anticipated.

Step 4: Define risks of effects and their significance

13.5.27 For all construction activity, the aim should be to prevent significant impacts on receptors through the use of effective mitigation. IAQM guidance indicates that once mitigation measures are applied, in most cases the dust effects will be reduced to negligible levels.

Step 5: Prepare a dust assessment report

13.5.28 The last step of the assessment is the preparation of a Dust Assessment Report which is covered in paragraphs 13.9.1 to 13.9.11 of this Chapter.

Methodology for Operational Impacts

13.5.29 The assessment of local air quality effects associated with the operation of the Scheme has been undertaken following the detailed level DMRB assessment methodology.

13.5.30 The change in pollutant concentrations has been assessed at receptors within 200m of the affected road network. The assessment focuses primarily on NO_2 and PM_{10} as these are the pollutants of concern for human health in relation to road vehicle emissions.

Assessment Scenarios

13.5.31 The opening year is 2021 and the design year is 2036.

13.5.32 Modelling was undertaken in 2018 and therefore the following modelling scenarios have been used in the assessment:

a) 2017 baseline scenario;

b) 2021/2036 projected baseline scenario[5];

c) 2021 Do-Minimum (DM) scenario; the traffic scenario at the year of opening without the Scheme;

d) 2021 Do-Something (DS) scenario: the traffic scenario at the year of opening with the Scheme;

e) 2036 Do-Minimum (DM) scenario: the traffic scenario at the future year without the Scheme; and

f) 2036 Do-Something (DS) scenario: the traffic scenario at the future year with the Scheme.

13.5.33 Background pollutant concentrations and vehicle emissions are predicted to improve with time, in most cases this improvement will outweigh air quality impacts of potential future traffic growth, and

[5] The 2021 and 2036 projected baseline scenarios are required as part of the IAN 170/12 methodology. This allows the lack of improvement of NOx emissions from vehicles for the future assessment years to be taken into account. These scenarios use 2017 baseline traffic but with opening year (2021) and future year (2036) background pollutant concentrations and vehicle emissions.

therefore the worst case with regards to air quality would be the opening year 2021 of the Scheme.

Traffic Data

13.5.34 The DMRB method requires 24hr Annual Average Daily Traffic (AADT) flows, the percentage of Heavy Duty Vehicles (HDVs) and the daily average speed (kph) for all assessment scenarios discussed above. Traffic data used in the assessment are shown in Volume 3, Appendix 13.1. Figure 13.4 and Figure 13.5 in Volume 2 of the ES show the modelled road links for the baseline and DM scenarios and the DS scenario respectively.

13.5.35 Baseline traffic data was provided for the year 2016 by the transport consultants. Scheme specific monitoring was undertaken during 2017. In order to verify the model, baseline year and monitoring should align. It is expected that a 2017 baseline traffic year would have an increase in traffic volumes of less than 1% and therefore the 2016 traffic data can be considered representative of a 2017 baseline for the air quality assessment.

13.5.36 Emissions for each of the road sources have been determined using the Emission Factor Toolkit v8.0 (EFT) published by Defra. The EFT provides emission data up to 2030, emissions for the assessment of the future year of the Scheme (2036) were held constant from 2030 levels.

13.5.37 Research undertaken by Defra (Defra, 2012) has shown that there is a gap between projected vehicle emission reductions for NOx and the observed annual rate of air quality improvement. Highways England (formerly the Highways Agency) has therefore provided a set of guidance for carrying out sensitivity analysis for future year NOx and NO_2 concentrations to determine a range of likely NO_2 concentrations for the future years of assessment.

13.5.38 This guidance is provided in IAN 170/12v3 (Highways Agency, 2012). This note provides long term annual projection factors for NOx and NO_2. Research (Highways Agency, 2014) has shown that the projection factors provided in this document are likely to be conservative from 2017 onwards and as such an interim set of projection factors (Long Term Trends Euro 6) has been provided by Highways England to reflect the introduction of vehicles manufactured to Euro 6 emission standards

into the fleet. This set of future projections has been used to determine likely future NOx and NO_2 concentrations.

13.5.39 Modelling predictions for the opening year and future years using both a standard approach and IAN 170/12v3 methodologies have been reported, as required by IAN 170/12v3. As IAN 170/12v3 represents a more pessimistic future scenario prediction, these results have been used in the assessment of significance.

Meteorological Data

13.5.40 Hourly sequential meteorological data for the latest year of complete data (2017) from Milford Haven (located approximately 25km south-west of the Scheme) were used in this assessment.

13.5.41 A wind rose derived from data obtained from the Milford Haven meteorological station area is shown in Figure 13.6 below. The wind rose shows that the predominant wind direction in the area is south-westerly/westerly.

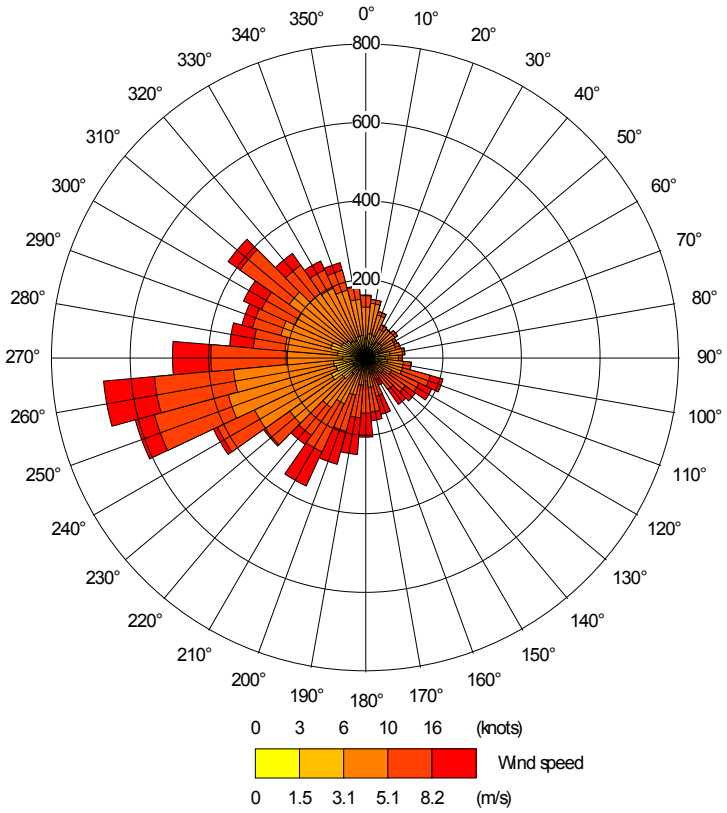


Figure 13.6 Wind Rose for Milford Haven Meteorological Station, 2017

Receptors

13.5.42 The study area of the air quality assessment comprises 200m each side of the road from those routes affected by the Scheme. All receptors, sensitive to changes in air quality, have been assessed, however only those receptors where the greatest change in air quality is anticipated as a result of the Scheme have been presented. The selected receptors are shown in Figure 13.7, Volume 2 and details provided in Table 13.10. Receptors have been modelled at a height of 1.5m above ground which is representative of respiration height.

Table 13.10 Assessed receptors for local air quality

Receptor ID	Name	X	Y
1	Blackmore Hill	211408.7	216581.4
2	Penblewin Farm	212091.1	216626.8
3	Trefangor Farm	212838.4	216698.5
4	Henllan Lodge	213275.4	216829.7
5	Penrhiw Cottage	213621.3	216867.0
6	Maes-y-fynnon	214326.9	217033.8
7	Brynalan	214353.3	216962.9
8	Flats	214792.9	216883.0
9	Ael y Bryn	214701.3	216880.1
10	Pen-troydin-fawr Farm	214772.8	217345.1
11	Ivy Cottage	215347.6	216746.5
12	Penllan	215561.5	216854.3
13	Bethel Chapel	215926.1	216978.8
14	Gwyndy	216287.1	217014.8

NOx to NO_2 Conversion

13.5.43 The ADMS modelling method predicts NOx concentrations and these need to be converted to NO_2 for comparison with air quality standards. The Defra NOx to NO_2 conversion spreadsheet (v6.1) (Defra, 2017) available from the Defra website has been used to calculate total and road NO_2 concentrations from modelled road NOx concentrations.

Background Pollutant Concentrations

13.5.44 Background pollutant concentrations are added to the modelled road contribution of NO_2 and PM_{10}. Mapped background concentration data (Defra, 2015a) available from the Defra website for each 1km x 1km grid square of the UK, have been used to determine the background pollutant concentrations at each of the assessed receptors. The Defra background maps provide data up to 2030, for the assessment of the future year of the Scheme (2036), background pollutant concentrations have been held constant at 2030 levels.

13.5.45 A comparison of Defra mapped background concentrations with the monitored background concentrations at the Princes Gate and the Willow School for Dogs background monitoring locations for 2017 has

been undertaken. Table 13.11 shows the mapped and monitored annual mean NO_2 and PM_{10} concentrations for both locations.

Table 13.11 Comparison of mapped and monitored background concentrations

Location	**2017 Monitored Annual mean NO_2 (µg/m^3)**	**2017 Defra Mapped Background Annual mean NO_2 (µg/m^3)**	**2017 Monitored Annual mean PM_{10} (µg/m^3)**	**2017 Defra Mapped Background Annual mean PM_{10} (µg/m^3)**
Objective	**40µg/m^3**			
Princes Gate AURN	2.7[a)]	3.0	11.1[b)]	9.4
Willow Tree School for Dogs	4.0	3.2	-	9.4
a) Annualised diffusion tube monitoring data undertaken for the Scheme itself b) PM_{10} data obtained from the Princes Gate continuous monitor				

13.5.46 Monitored annual mean NO_2 concentrations are within 25% of the Defra mapped concentrations. Monitored PM_{10} concentrations and Defra mapped concentrations are similar. As the monitored concentrations are within 25% of the Defra mapped concentrations the Defra mapped concentrations have been used in the assessment for all pollutants assessed.

13.5.47 Annual mean background NO_2 and PM_{10} concentrations used at each of the assessed receptors are shown in Table 13.12 and Table 13.13.

Table 13.12 Annual mean NO_2 background concentrations at assessed receptors

Receptor ID	**2017 Background NO_2 (µg/m^3)**	**2021 Background NO_2 (µg/m^3)**	**2036 Background NO_2 (µg/m^3)**
Objective	**40µg/m^3**		
1	3.9	3.3	2.5
2	4.0	3.4	2.6
3	4.0	3.4	2.6
4	3.9	3.3	2.5
5	3.9	3.3	2.5
6	3.3	2.8	2.2
7	3.9	3.3	2.5
8	3.9	3.3	2.5
9	3.9	3.3	2.5
10	3.3	2.8	2.2
11	3.9	3.2	2.5
12	3.9	3.2	2.5
13	3.9	3.2	2.5
14	3.2	2.8	2.2

Table 13.13 Annual mean PM_{10} background concentrations at assessed receptors

Receptor ID	**2017 Background PM_{10} (µg/m^3)**	**2021 Background PM_{10} (µg/m^3)**	**2036 Background PM_{10} (µg/m^3)**
Objective	40µg/m^3		
1	9.7	9.5	9.3
2	9.8	9.5	9.3
3	9.8	9.5	9.3
4	9.9	9.7	9.5
5	9.9	9.7	9.5
6	10.2	10.0	9.8
7	10.2	9.9	9.7
8	10.2	9.9	9.7
9	10.2	9.9	9.7
10	10.2	10.0	9.8
11	10.1	9.9	9.7

Receptor ID	2017 Background PM_{10} (µg/m^3)	2021 Background PM_{10} (µg/m^3)	2036 Background PM_{10} (µg/m^3)
12	10.1	9.9	9.7
13	10.1	9.9	9.7
14	9.5	9.3	9.1

Model Verification

13.5.48 As part of the assessment, a comparison of estimated and measured NO_2 concentrations has been undertaken for the baseline year. This process is known as model verification. Verification has been undertaken using the principles laid out in Section A3.223 of LAQM.TG16 (Defra, 2016). Additional receptor points have been included within the baseline modelling to represent the location of air quality monitoring locations within 200m of the ARN to provide information for the verification exercise.

13.5.49 The objectives of the model verification are to evaluate model performance, determine whether model adjustment is required and to provide confidence in the assessment of opening and future years.

13.5.50 LAQM.TG16 (Defra, 2016) suggests that if the majority of modelled annual mean NO_2 concentrations are within ±25% and preferably within ±10% of the monitored concentration and there is no systematic under or over prediction, then model adjustment is not considered necessary to further improve modelled results. IAN 174/13 (Highways Agency, 2013) notes the desirability of achieving ±10% verification where concentrations are close to or above the limit values.

13.5.51 Modelled results may not compare as well at some locations for a number of reasons including the following:

a) Errors/uncertainties in traffic flow and speed data estimates;
b) Model setup (including street canyons, road widths, receptor locations);
c) Model limitations (treatment of roughness and meteorological data);
d) Uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors); and
e) Uncertainty in emissions/emission factors.

13.5.52 The above factors were investigated as part of the model verification process to minimise the uncertainties as far as practicable. The outcome of the model verification exercise is detailed in section 13.10.

13.6 Significance Criteria

13.6.1 The significance of local air quality effects as a result of dust impacts arising during construction has been assessed using professional judgement having regard to the IAQM guidance. The guidance states that with appropriate mitigation, where required, no significant effects would be anticipated during construction.

13.6.2 Evaluation of the significance for the local air quality assessment of the operational phase has been undertaken in accordance with IAN 174/13 (Highways Agency, 2013). This requires evaluation of significance for NO_2 and PM_{10} concentrations. The estimated levels of pollution in the opening year of assessment, and the change due to the Scheme, have been compared with the air quality objectives.

13.6.3 Section 2 of IAN 174/13 (Highways Agency 2013) describes the approach to formally describe a quantified change in NO_2 or PM_{10} concentrations at a particular receptor between the Do-Minimum and Do-Something scenarios. Table 13.14 presents the definition for the magnitude of change for NO_2 and PM_{10} concentrations. This has been considered for each of the assessed receptors.

13.6.4 Terminology has been adjusted for consistency with other topics in this ES.

Table 13.14 Descriptors for Magnitude of NO_2 and PM_{10} Impacts on Human Health

Magnitude of Impact	**Change in Annual Mean NO_2 and PM_{10} Concentrations (µg/m^3)**
Major (large)	>4
Moderate (medium)	>2 to 4
Minor (small)	>0.4 to 2
Negligible (imperceptible)	≤0.4

13.6.5 Section 3 of IAN 174/13 (Highways Agency, 2013) describes the approach to determine overall significant local air quality effects. The guidance in Section 3 and Table 3.1 of IAN 174/13 (Highways Agency,

2013) has been taken into account within the assessment (see Table 13.15).

Table 13.15 Overall evaluation of local air quality significance

Key Criteria Questions
Is there a risk that environmental standards will be breached?
Will there be a large change in environmental conditions?
Will the effect continue for a long time?
Will many people be affected?
Is there a risk that designated sites, areas, or features will be affected?
Will it be difficult to avoid, or reduce or repair or compensate for the effect?
On balance is the overall effect significant?
Evidence in support of the professional judgement

13.7 Consultation

13.7.1 Consultation on the proposed methodology was carried out as part of the formal EIA Scoping conducted for the Scheme. Feedback from Local Authorities was sought. No specific comments were made with regards to air quality therefore the methodology followed for this assessment was agreed.

Limitations and Assumptions

13.7.2 There are a number of limitations and uncertainties associated with air quality modelling. Predictions for the opening and future assessment years are based on best available information and forecasts available at the time of writing.

13.7.3 The traffic model is carried out using methodology prescribed in WebTAG Unit M3.1 and is considered to be the most accurate method available for the purposes of air quality assessment.

13.7.4 There is uncertainty regarding predictions of future emission factors used within air quality assessment. Sensitivity testing of opening and future year predictions has been undertaken using the IAN 170/12v3 assessment methodology (which has been developed by Highways England to account for this uncertainty). The results of which are

reported and have been used as part of this assessment to determine the significance of effect.

13.7.5 The air quality assessment has been undertaken using national standards appropriate for EIA assessment and therefore the limitations do not affect the robustness of the air quality assessment for EIA purposes.

13.8 Baseline Environment

13.8.1 This section describes the baseline air quality conditions in the surrounding area of the Scheme. Baseline ambient air quality refers to the concentrations of relevant substances that are already present in the atmosphere - these are present from various sources such as industrial processes, commercial and domestic activities, agriculture, traffic and natural sources.

Industrial Processes

13.8.2 Industrial air pollution sources are regulated through a system of operating permits or authorisations, requiring stringent emission limits to be met and ensuring that any releases are minimised or rendered harmless. Regulated (or prescribed) industrial processes are classified as Part A or Part B processes. Part A processes are regulated through the Pollution Prevention and Control (PPC) system (EC Directive 96/91/EC on Pollution Prevention and Control originally implemented into law via the Pollution Prevention and Control Act (1999)) which was superseded in 2007 by the Environmental Permitting Regulations (HMSO, 2007) which were subsequently amended in 2010 (HMSO, 2010). Generally, the larger, more polluting processes are regulated by NRW and smaller, less polluting ones by the local authorities.

13.8.3 There are no industrial processes with emissions to air identified within 2km of the Scheme.

Review and Assessment

13.8.4 All local planning authorities in Wales are required by the Environment Act 1995 Part IV to carry out a review and assessment of air quality. This involves examining current pollutant concentrations and comparing concentrations with the objectives in the National Air Quality Strategy.

13.8.5 Where the objectives are not likely to be achieved in all relevant locations, the local planning authority must designate these areas as AQMAs.

PCC Air Quality Progress Report 2016

13.8.6 The most recent Air Quality Progress Report (Pembrokeshire County Council, 2016) presents the PCC review and assessment of air quality within its area.

13.8.7 PCC has identified two AQMAs, one in Haverfordwest and one in Pembroke. These AQMAs are located 15km west and 18km south west of the Scheme respectively. These AQMAs would not be affected by the Scheme as changes in traffic would be negligible at this distance from the Scheme.

CCC Updating and Screening Assessment 2015

13.8.8 The Updating and Screening Assessment (Carmarthenshire County Council, 2015) presents the CCC review and assessment of air quality within its area.

13.8.9 There is an AQMA in Llandeilo and plans for a further two AQMAs in Carmarthen and Llanelli. Carmarthen is the nearest of these to the Scheme at 25km to the east. These AQMAs would not be affected by the Scheme as changes in traffic would be negligible at this distance from the Scheme.

Air Quality Monitoring

Pembrokeshire County Council

13.8.10 PCC undertakes air quality monitoring using automatic and passive diffusion tubes throughout its area. No monitoring is undertaken by PCC in the vicinity of the Scheme.

13.8.11 The nearest air quality monitoring location is an automatic monitor in Princes Gate, 4km south of the Scheme. The monitoring data for this location is presented in Table 13.16 and Table 13.17. Monitored data for 2013-2015 has been taken from the 2016 progress report produced by PCC. Data for 2017 has been taken from the Welsh Air Quality Forum website. It should be noted that data capture for NO_2 was low throughout 2016 and as such no data is available for this pollutant.

13.8.12 Monitoring data shows that the relevant air quality objectives are met which is to be expected given the rural nature of the location.

Table 13.16 Continuous monitoring results for NO_2 at Princes Gate

NO_2	Objective	2013	2014	2015	2016	2017
Annual Mean µg/m^3	40µg/m^3	6	4	3	-	3
Max Hourly Mean µg/m^3	-	152	70	52	-	51
No. of hours where the hourly mean is greater than 200µg/m^3	18 hours	0	0	0	-	0
Data Capture (%)	-	99	98	99	55	97

Table 13.17 Continuous monitoring results for PM_{10} at Princes Gate

PM_{10}	Objective	2013	2014	2015	2016	2017
Annual Mean µg/m^3	40µg/m^3	16	3	12	12	11
Max Daily Mean µg/m^3	-	64	10	47	50	43
No. of days where the daily mean is greater than 50µg/m^3	35 days	3	1	0	0	0
Data Capture (%)	-	87	98	87	95	94

Carmarthenshire County Council

13.8.13 CCC undertakes air quality monitoring using automatic and passive diffusion tubes throughout its area, however no monitoring is undertaken by CCC in the vicinity of the Scheme. The closest monitoring is in Carmarthen located 25km east of the Scheme.

Scheme Air Quality Monitoring

13.8.14 Additional NO_2 monitoring has been carried out in order to help establish baseline conditions in the area of the Scheme. The monthly and processed results for the monitoring survey are shown in Table

13.18. Volume 3, Appendix 13.2 explains the process used to annualise and bias-adjust the short-term monitoring survey.

Table 13.18 NO_2 diffusion tube monitoring results

DT ID	Period Mean NO_2 Concentrations (µg/m^3)							Bias-adjusted Annual mean NO_2 Concentration (µg/m^3)
	P1 (11/05/17 – 14/06/17)	P2 (14/06/17 – 18/07/17)	P3 (18/07/17 – 15/08/17)	P4 (15/08/17 - 15/09/17)	P5 (15/09/17 – 16/10/17)	P6 (16/10/17 – 17/11/17)	P7 (17/11/17 - 18/12/2017)	
1	3.2	4.2	2.9	2.5	2.2	4.4	3.1	2.7
2	21.1	23.0	22.5	24.1	23.0	28.1	24.2	19.9
3	19.5	24.7	23.4	24.3	20.6	26.1	29.1	20.1
4	8.7	10.7	8.2	5.6	7.8	11.6	9.0	7.4
5	19.3	26.1	19.5	20.9	16.8	24.4	24.1	18.2
6	18.1	28.6	19.8	20.3	17.7	24.7	24.8	18.5
7	4.1	7.4	3.7	3.7	2.9	6.1	5.1	4.0

Future Baseline Conditions

13.8.15 Air quality is predicted to improve over time due to the introduction of cleaner vehicle technologies in the UK vehicle fleet, therefore pollutant concentrations in the opening and future assessment years are predicted to be lower than baseline conditions.

13.8.16 An assessment of pollutant concentrations at receptors included in the assessment of air quality effects has been undertaken for the opening and design year without the Scheme in place. This represents the future baseline air quality conditions to inform the assessment of the operational phase and confirms that pollutant concentrations would be lower than the existing scenario. The improvements to vehicle technologies outweigh potential traffic growth in the opening and future years.

13.8.17 As air quality is strongly correlated with meteorological conditions, there is the potential for climate change to affect future baseline conditions. It is likely there will be an increased prevalence of hotter and drier conditions which may affect dispersion of pollutants. Changes in wind speed and direction can also affect dispersion. The potential effect of climate change on future air quality conditions is however very uncertain and will vary depending on pollutant and location. Given the

short construction period and the opening year of 2021, it is not considered that climate change will significantly affect future baseline air quality conditions assessed as part of this ES. Future improvements in vehicle emissions through new fuel technologies will help ensure the Scheme is not significantly affected by climate change over the extended lifetime of the road.

13.9 Potential Construction Effects – Before Mitigation

13.9.1 The Scheme has the potential to generate dust during the construction phase. Dust-generating activities would occur along the length of the Scheme and include: demolition of Trefangor Cottage, earthworks to create attenuation ponds, embankments and cuttings and construction of the proposed new section of road, proposed roundabouts at either end of the Scheme and Llanfallteg Road bridge.

13.9.2 The effects of demolition, earthworks, construction and track out activities are considered in the following sections.

Sensitive Receptors

13.9.3 Sensitive receptors are defined as those properties that are likely to experience a change in pollutant concentrations and/or dust nuisance due to the construction of the Scheme as well as those inhabitants that may be sensitive to changes in dust. No ecological receptors are identified within the study area of the construction assessment which would be sensitive to dust.

13.9.4 There are sensitive receptors within 350m of the Scheme and within 50m of the routes to be used by construction vehicles. All receptors within 350m of the site boundary where dust generating activities would take place are shown in Figure 13.8, Volume 2. These receptors are likely to receive the greatest impact due to their proximity to the construction site.

Dust Emission Magnitude

13.9.5 Following the methodology outlined in section 13.5 and the criteria presented in Table 13.5, each dust-generating activity has been assigned a dust emission magnitude as shown in Table 13.19. For track out, it has been assumed that construction vehicles would use the existing A40

to access the site and would use haul roads aligned to the offline section of the Scheme.

Table 13.19 Dust emission magnitude for construction activities

Activity	Dust emission magnitude	Reasoning
Demolition	Small	Demolition of weigh station at Ffynnon Woods, Trefangor Cottage and farm out buildings; Total building volume to be demolished would be less than 20,000m^3 and demolition activities would occur less than 10m above ground level.
Earthworks	Large	The total amount of material to be moved is approximately 600,000 tonnes; Earthworks will be required to construct cutting, embankments, attenuation ponds and an equestrian underpass; The majority of earthworks would occur on the offline section of the Scheme; Variable made ground
Construction	Large	Dusty construction material to be used (concrete). Construction works would include laying the hardstanding for the road as well as construction of the bridge for Llanfallteg Road.
Trackout	Medium	It is likely that additional HGVs movements during the construction phase would be less than 50 outward movements per day.

Sensitivity of the Area

13.9.6 The sensitivity of the area has been considered for each activity separately. The sensitivity of the area to demolition focussed on a 350m radius from Trefangor Cottage and the weighbridge at Ffynnon Woods. The sensitivity of the area to earthworks and construction has been assessed across the length of the Scheme. For trackout, the sensitivity of the area includes consideration of sensitive properties along the road network within 500m of the Scheme itself.

13.9.7 The closest properties to Trefangor Cottage are approximately 150m to the east. The closest properties to the weighbridge are approximately 160m to the east. Therefore, the sensitivity of the study area for dust soiling as a result of demolition is considered to be low.

13.9.8 There are five residential properties within 20m of the site boundary, therefore the sensitivity of the area for dust soiling as a result of earthworks and construction is considered to be medium.

13.9.9 It is likely that construction vehicles will travel along the A40 and any offline haul roads required for the Scheme. It is not anticipated that vehicles leaving site would pass more than ten properties within 20m of the highway. Therefore, the sensitivity of the area to dust soiling as a result of trackout is considered to be medium.

13.9.10 The projected background PM_{10} concentrations in the 1km by 1km grid squares where the Scheme is located is on average 6µg/m^3 (see Table 13.13), which falls well below the 24µg/m^3 threshold stated in the IAQM guidance. The sensitivity of the area to human health impacts has therefore been assigned as low. The overall sensitivity has been summarised as shown in Table 13.20.

Table 13.20 Sensitivity of the surrounding area to impacts on dust soiling and human health

Potential Impact	Sensitivity of the surrounding area			
	Demolition	**Earthworks**	**Construction**	**Trackout**
Dust Soiling	Low	Medium	Medium	Medium
Human Health	Low	Low	Low	Low

Risk of Dust Impacts

13.9.11 Using the criteria set out in the overall risk of dust impacts, Table 13.9, the impacts for each dust generating activity without mitigation are defined in Table 13.21. Taking into consideration the dust emission magnitude and the sensitivity of the area, the site has been classified as medium risk for dust soiling for all activities at worst. Specific mitigation is described in Section 13.11.

Table 13.21 Summary dust risk prior to mitigation

Activity	Dust risk prior to mitigation for dust soiling	Dust risk prior to mitigation for human health
Demolition	Negligible	Negligible
Earthworks	Medium Risk	Low Risk
Construction	Medium Risk	Low Risk
Trackout	Low Risk	Low Risk

13.10 Potential Operation Effects – Before Mitigation

Model Verification

13.10.1 As discussed in section 13.5, model verification refers to the comparison of modelled and measured pollutant concentrations at the same location to determine the performance of the model.

13.10.2 The model verification exercise used data from five monitoring locations undertaken as part of the Scheme-specific monitoring survey. Monitoring results from the short-term monitoring survey have been processed (see Volume 3, Appendix 13.2.) to be representative of a 2017 annual mean. Model verification was undertaken following the methodology contained within LAQM.TG16. A comparison of monitored and modelled annual mean NO_2 concentrations for 2017 is shown in Table 13.22.

Table 13.22 Comparison of modelled and monitored annual mean NO_2 concentrations

ID	Monitored NO_2 Concentration (µg/m^3)	Background NO_2 Concentration (µg/m^3)	Modelled NO_2 Concentration (µg/m^3)	% Difference between Modelled/ Monitored NO_2
2	19.9	3.9	10.1	-49%
3	20.1	4.0	11.2	-44%
4	7.4	3.3	4.7	-37%
5	18.2	3.9	8.5	-53%
6	18.5	3.9	10.2	-45%

13.10.3 Table 13.22 shows that the model is under-predicting concentrations at all locations, particularly at locations adjacent to the road. Monitoring location 4 is set back from the road by a distance of approximately 40m. It has therefore been removed from the verification process due to this large distance.

13.10.4 An adjustment factor of 2.5 has been calculated by plotting the monitored and modelled NOx road contribution and calculating the equation of the trend line based on linear regression through zero. The adjustment factor has been applied to the modelled outputs and therefore verified road NOx contributions output from the model have been used to determine annual mean NO_2 concentrations for comparison with the annual mean NO_2 objective.

13.10.5 Table 13.23 and Figure 13.9 show the comparison of modelled and monitored NO_2 concentrations following adjustment. These show that the model continues to under-predict at three locations (locations 2 and 5) however the difference between modelled and monitored concentrations is within 15% at all locations.

13.10.6 Any under-prediction or over-prediction of the model has been taken into account when determining the significance of the assessment.

Table 13.23 Comparison of modelled and monitored annual mean NO_2 concentrations following adjustment

ID	Monitored NO_2 Concentration ($\mu g/m^3$)	Background NO_2 Concentration ($\mu g/m^3$)	Adjusted Modelled NO_2 Concentration ($\mu g/m^3$)	% Difference between Modelled/ Monitored NO_2
2	19.9	3.9	19.3	-3%
3	20.1	4.0	21.5	7%
5	18.2	3.9	15.4	-15%
6	18.5	3.9	19.4	5%

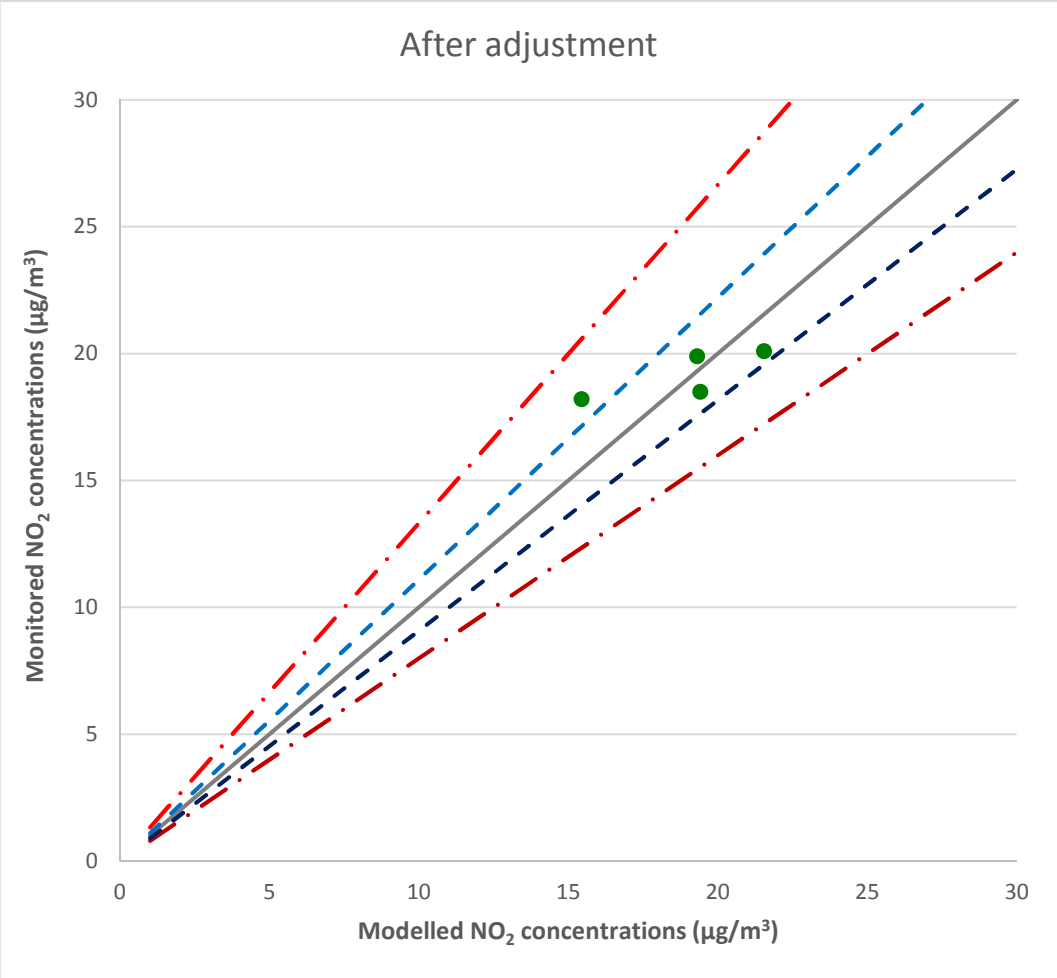


Figure 13.9 Comparison of modelled and monitored annual mean NO_2 concentrations (µg/m3) following adjustment

13.10.7 The model performance statistics both with and without adjustment are shown in Table 13.24. The paragraphs below discuss the various performance statistics which are considered during model verification and the ideal values for each aspect.

13.10.8 The correlation coefficient shown in Table 13.24 is used to measure the linear relationship between monitored and modelled data. A value of 1 means an absolute relationship. A correlation coefficient of 0.79 has been derived for the model showing a good relationship between monitored and modelled concentrations.

13.10.9 Ideally an RMSE within 10% of the annual mean NO_2 objective would be derived which equates to 4µg/m^3. As shown in Table 13.24, the RMSE is well below 4µg/m^3 following adjustment of the modelled concentrations.

13.10.10 Fractional Bias (FB) is used to identify if the model shows a systematic tendency to over or under predict. An ideal value for FB would be 0. Table 13.24 shows that following adjustment, the FB is 0.

13.10.11 As the model performance statistics are close to the ideal values for each aspect, the model following adjustment is fit for purpose.

Table 13.24 Model performance statistics

Summary Table	**No adjustment**	**With adjustment**
Within +- 10%	0	3
Within +- 10 to 25%	0	1
Greater than +-25%	4	0
Uncertainties Assessment		
Correlation	0.79	0.79
Root Mean Square Error (RMSE) (µg/m³)	8.2	1.5
Fractional Bias	0.6	0.0

13.10.12 No monitoring of PM_{10} or $PM_{2.5}$ has been undertaken at the roadside by the local authority in the vicinity of the Scheme. Therefore, a verification exercise and any subsequent adjustment has not been possible for these pollutants, therefore the raw model outputs have been used for PM_{10} and $PM_{2.5}$. This is not considered to be a limitation of the assessment.

Predicted NO_2 Concentrations

13.10.13 Annual Mean NO_2 concentrations were predicted at the assessed receptor locations for each scenario and are summarised in Table 13.25. The results shown in Table 13.25 are based on the IAN 170/12v3 method as these produce the highest concentrations for the opening and future years, taking account of the uncertainty of vehicle emission improvements into the future. Receptor results using the standard approach are reported in Volume 3 Appendix 13.3 for comparison.

13.10.14 Figure 13.10, Volume 2, shows the impact of the Scheme on NO_2 concentrations at assessed receptors.

Table 13.25 Predicted annual mean NO_2 concentrations

Receptor ID	Predicted Annual Mean NO_2 Concentration (µg/m^3)				
	2017 Base	2021 DM	2021 DS	2036 DM	2036 DS
1	17.7	16.0	16.1	15.2	15.2
2	12.4	11.2	7.5	10.2	7.5
3	13.6	12.3	7.0	11.6	7.1
4	11.5	10.3	9.7	9.7	9.2
5	10.3	9.3	7.7	8.7	7.4
6	5.5	4.8	5.5	4.4	4.9
7	12.2	11.0	5.6	10.5	5.9
8	11.9	10.8	5.0	10.2	5.4
9	9.3	8.3	4.7	7.8	4.9
10	4.3	3.8	4.4	3.4	3.8
11	19.3	17.6	4.8	17.2	5.5
12	18.1	16.4	4.7	16.0	5.4
13	10.5	9.4	9.2	8.9	8.7
14	6.5	5.8	5.9	5.3	5.4
Objective	**40µg/m^3**				

13.10.15 As shown in Table 13.25, there are no exceedances of the annual mean NO_2 objective predicted in any of the scenarios assessed. The majority of receptors experience a large decrease in annual mean NO_2 concentrations as the Scheme moves traffic away from the village of Llanddewi Velfrey. Those receptors closer to the Scheme do experience an increase in annual mean NO_2 concentrations, however due to their distance from the Scheme this increase is less than 2% of the annual mean NO_2 objective.

13.10.16 As noted during the verification exercise, in some locations the model under-predicts concentrations by up to 15%. If predicted concentrations in Table 13.25 were increased by 15%, concentrations would still be well below the annual mean NO_2 objective and therefore the under-prediction of the model is not a material consideration when determining the impact or significance of the Scheme.

13.10.17 The Scheme does not result in traffic generation, and traffic flows and speed on the sections of A40 adjoining the Scheme remain the same between the Do-Minimum and Do-Something scenarios. Traffic flows on the proposed new section of the A40 are slightly lower than the

existing route, as local traffic for Llanddewi Velfrey will continue to use the declassified road. Vehicle speeds are higher on the new section of the A40 compared to the existing route as the new road will be national speed limit, whereas the speed limit on the existing A40 through Llanddewi Velfrey is restricted to 40mph.

13.10.18 The magnitude of change in NO_2 concentration at each receptor is shown in Table 13.26. For NO_2, the impact as a result of the Scheme ranges between minor adverse and major beneficial, in both the opening and future years. The majority of receptors experience a beneficial impact as a result of the Scheme.

13.10.19 Given the improvement in annual mean NO_2 concentrations in the more populated area of Llanddewi Velfrey, the Scheme is likely to contribute towards the national indicator of a reduction in NO_2 levels as required as part of the Well-Being of Future Generations Act.

Table 13.26 Magnitude of change for annual mean NO_2 concentrations

Receptor ID	Change in Annual Mean NO_2 Concentration ($\mu g/m^3$)			
	2021 Magnitude of Change	Impact Descriptor	2036 Magnitude of Change	Impact Descriptor
1	0.1	Negligible	<0.1	Negligible
2	-3.7	Moderate Beneficial	-2.7	Moderate Beneficial
3	-5.3	Major Beneficial	-4.5	Major Beneficial
4	-0.6	Minor Beneficial	-0.5	Minor Beneficial
5	-1.6	Minor Beneficial	-1.3	Minor Beneficial
6	0.7	Minor Adverse	0.5	Minor Adverse
7	-5.4	Major Beneficial	-4.6	Major Beneficial
8	-5.8	Major Beneficial	-4.8	Major Beneficial
9	-3.6	Moderate Beneficial	-2.9	Moderate Beneficial
10	0.6	Minor Adverse	0.4	Negligible
11	-12.8	Major Beneficial	-11.7	Major Beneficial
12	-11.7	Major Beneficial	-10.6	Major Beneficial
13	-0.2	Negligible	-0.2	Negligible
14	0.1	Negligible	0.1	Negligible

Predicted PM_{10} Concentrations

13.10.20 Annual Mean PM_{10} concentrations were predicted at the receptor locations for each scenario and are summarised in Table 13.27. The IAN 170/12v3 method applies only to NO_2 concentrations therefore only one set of predicted PM_{10} concentrations is provided.

13.10.21 Figure 13.11, Volume 2, shows the impact of the Scheme on PM_{10} concentrations at assessed receptors.

Table 13.27 Predicted annual PM_{10} concentrations

Receptor ID	Predicted Annual Mean PM_{10} Concentration (µg/m^3)				
	2017 Base	2021 DM	2021 DS	2036 DM	2036 DS
1	10.4	10.1	10.1	10.0	10.0
2	10.1	9.8	9.7	9.7	9.5
3	10.2	10.0	9.7	9.8	9.5
4	10.3	10.0	10.0	9.9	9.8
5	10.2	10.0	9.9	9.8	9.7
6	10.3	10.1	10.1	9.9	10.0
7	10.6	10.3	10.0	10.2	9.8
8	10.5	10.3	10.0	10.1	9.8
9	10.4	10.2	10.0	10.0	9.8
10	10.3	10.0	10.1	9.9	9.9
11	10.9	10.6	9.9	10.5	9.7
12	10.8	10.6	9.9	10.4	9.7
13	10.4	10.2	10.2	10.0	10.0
14	9.6	9.4	9.4	9.2	9.2
Objective	**40µg/m^3**				

13.10.22 As shown in Table 13.27 there are no exceedances of the annual mean PM_{10} objective predicted in any of the scenarios assessed. The majority of receptors experience a decrease in annual mean PM_{10} concentrations.

13.10.23 The magnitude of change in PM_{10} concentration at each receptor is shown in Table 13.28. For PM_{10}, the impact at the majority of receptors is predicted to be negligible, however minor beneficial impacts are predicted at two receptors in the opening year and three receptors in the future year.

Table 13.28 Magnitude of change for annual mean PM_{10} concentrations

Receptor ID	Change in Annual Mean PM_{10} Concentration (µg/m^3)			
	2021 Magnitude of Change	Impact Descriptor	2036 Magnitude of Change	Impact Descriptor
1	<0.1	Negligible	<0.1	Negligible
2	-0.1	Negligible	-0.2	Negligible
3	-0.3	Negligible	-0.3	Negligible
4	<0.1	Negligible	-0.1	Negligible
5	-0.1	Negligible	-0.1	Negligible
6	<0.1	Negligible	0.1	Negligible
7	-0.3	Negligible	-0.4	Negligible
8	-0.3	Negligible	-0.3	Negligible
9	-0.2	Negligible	-0.2	Negligible
10	0.1	Negligible	<0.1	Negligible
11	-0.7	Minor Beneficial	-0.8	Minor Beneficial
12	-0.7	Minor Beneficial	-0.7	Minor Beneficial
13	<0.1	Negligible	<0.1	Negligible
14	<0.1	Negligible	<0.1	Negligible

Assessment of Significance

13.10.24 IAN 174/13 provides guidance on evaluating overall Scheme significance. The overall significance of the Scheme is based on all elements of the Scheme that have been assessed and the results discussed above.

13.10.25 No exceedances of the air quality objectives are predicted with or without the Scheme in place in any of the scenarios assessed. As such, it is not necessary to complete Table 2.2 from IAN 174/13 (Highways Agency, 2013b), as this is only concerned with receptor locations at which the objectives are predicted to be exceeded.

13.10.26 The key criteria questions for evaluating significance are set out and results for each summarised in Table 13.29. The answers to these questions show that the Scheme is not predicted to have a significant effect on local air quality. The use of the IAN 174/13 methodology for assessing significance does not allow a significant beneficial effect to be determined unless there is removal of an exceedance of a relevant

air quality objective. Whilst the Scheme does not result in a significant beneficial effect overall, the Scheme would deliver improvements in air quality at the majority of receptors in the study area.

Table 13.29 Evaluation of significance

Key Criteria Questions	Yes/No	Reasoning
Is there a risk that environmental standards will be breached?	No	No exceedances of air quality objectives are predicted as a result of the Scheme
Will there be a large change in environmental conditions?	Yes	The Scheme does result in a large beneficial change (>4µg/m^3) in annual mean NO_2 concentrations at some receptor locations on the existing A40 corridor.
Will the effect continue for a long time?	Yes	The effect of the Scheme would be permanent, however the effect of the Scheme on local air quality whilst beneficial is not considered to be significant.
Will many people be affected?	No	There are few receptors given the rural location of the Scheme. At the majority of receptors, the Scheme would have a beneficial impact.
Is there a risk that designated sites, areas, or features will be affected?	No	There are no designated sites present within the study area.
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	No	No adverse effects have been identified which would require mitigation.
On balance is the overall effect significant?	No	

13.11 Mitigation and Monitoring

Construction

13.11.1 The dust emitting activities assessed in Section 13.9 can be greatly reduced or eliminated by applying the site-specific mitigation measures for medium risk sites according to the IAQM guidance. The following measures from the guidance are relevant and should be included in a Construction Environmental Management Plan (CEMP) for the site.

General

13.11.2 Develop and implement a stakeholder communications plan that includes community engagement before work commences on site;

13.11.3 Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager;

13.11.4 Display the head or regional office contact information; and

13.11.5 Develop and implement a Dust Management Plan, which will include measures to control other emissions, approved by the local authority.

Site management

13.11.6 Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner and record the measures taken;

13.11.7 Make the complaints log available to the local authority when asked; and

13.11.8 Record any exceptional incidents that cause dust and/or air emissions, either on-site or off-site and the action taken to resolve the situation in the log book.

Monitoring

13.11.9 Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, monitor dust, record inspection results, and make the log available to the local authority when asked;

13.11.10 Carry out regular site inspections to monitor compliance with the Dust Management Plan, record inspection results and make an inspection log available to the local authority, when asked;

13.11.11 Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions; and

13.11.12 Liaise with the local authority to determine if instrumented monitoring of dust is required.

Site maintenance

13.11.13 Plan the site layout so that machinery and dust causing activities are located away from receptors, as far as possible;

13.11.14 Avoid site runoff of water or mud;

13.11.15 Keep site fencing, barriers and scaffolding clean using wet methods;

13.11.16 Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site; and

13.11.17 Cover, seed or fence stockpiles to prevent wind whipping.

Operating vehicle/machinery and sustainable travel

13.11.18 Ensure all vehicles switch off engines when stationary – no idling vehicles;

13.11.19 Minimise the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable;

13.11.20 Impose and signpost a maximum speed limit of 15mph on surfaced and 10mph on un-surfaced haul roads and work areas;

13.11.21 Require vehicles entering and leaving the site to be covered to prevent escape of materials during transport;

13.11.22 Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; and

13.11.23 Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling walking and car-sharing).

Operations

13.11.24 Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques, such as water sprays or local extraction;

13.11.25 Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate;

13.11.26 Use enclosed chutes and conveyors and covered skips;

13.11.27 Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use the fine water sprays on such equipment wherever appropriate; and

13.11.28 Ensure equipment is readily available on site to clean and dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Measures specific to earthworks

13.11.29 Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;

13.11.30 Use hessian, mulches and trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable; and

13.11.31 Only remove the cover in small areas during work and not all at once.

Measures specific to construction

13.11.32 Avoid scabbling (roughening of concrete surfaces) if possible;

13.11.33 Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place; and

13.11.34 Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in soils with suitable emission control systems to prevent escape of material and overfilling during delivery.

Measures specific to trackout

13.11.35 Use water-assisted dust sweepers on the access and local roads, to remove, as necessary, any material transferred out of the site. This may require the sweeper being continuously in use;

13.11.36 Avoid dry sweeping of large areas;

13.11.37 Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport;

13.11.38 Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable;

13.11.39 Record all inspections of haul routes and any subsequent action in a site log book;

13.11.40 Install hard surfaces haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned;

13.11.41 Implement and wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site were reasonably practicable);

13.11.42 Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits; and

13.11.43 Access gates to be located at least 10m from receptors where possible.

Waste management

13.11.44 Avoid bonfires and burning of waste materials.

Operation

13.11.45 The operational assessment has shown that there are no significant effects, therefore no mitigation is required or proposed.

13.12 Construction Effects - With Mitigation

13.12.1 Following implementation of the proposed mitigation in Section 13.11, no significant effects are anticipated during the construction phase.

13.13 Operational Effects - With Mitigation

13.13.1 As discussed in Section 13.10, the operation of the Scheme does not result in any significant effects on local air quality and therefore mitigation is not required. Consequently, the operational effects would be as predicted and would remain not significant.

13.14 Assessment of Cumulative Effects

13.14.1 No other developments have been identified which could generate cumulative effects with the Scheme during the construction phase.

13.14.2 The traffic data that informs the air quality assessment includes a growth factor to account for new developments and increased use of motorised vehicles in the local area. This was applied to the opening and future year traffic data used in the assessment. No developments have been identified that could cause cumulative effects during the operational phase.

13.15 Mitigation

13.15.1 No significant impacts have been identified and therefore there is no requirement for future mitigation of air quality as a result of the Scheme.

13.16 Summary

13.16.1 A review of current relevant legislation and planning policy, a baseline assessment describing the current air quality conditions in the vicinity of the Scheme and an assessment of the likely air quality impacts associated with the construction and operation of the Scheme have been undertaken.

13.16.2 Existing pollutant concentrations in the study area are low, and air quality objectives are currently met. There are no AQMAs close to the Scheme.

13.16.3 The construction effects have been assessed using the qualitative approach described in the latest IAQM guidance and it was concluded that with mitigation measures appropriate for a medium risk site in place, there is likely to be no significant effect from the dust-generating activities on site.

13.16.4 Potential impacts during the operational phase of the Scheme have been assessed to be not significant as modelled pollutant concentrations are well below the air quality objectives. However, many receptors would experience a beneficial impact as a result of the Scheme.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 14: Noise and Vibration

A40LVP-ARP-ENV-SWI-RP-LA-0001

P06 | S4

08/03/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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14 Noise and Vibration

14.1 Introduction

14.1.1 This chapter describes the assessment work that was undertaken by Arup to determine the impacts and effects of the Scheme during both the construction and operational phases.

14.1.2 The assessment has included a baseline noise survey, calculation of construction noise and vibration impacts and detailed 3D computer modelling to determine the operational noise and airborne vibration impacts in line with the 'Detailed' methodology of Design Manual for Roads and Bridges (DMRB) (Highways Agency et al, 2011) (HD 213/11 Revision 1). An assessment of ground-borne vibration was scoped out (see 14.3.73).

14.1.3 The following figures in Volume 2 relate to this chapter:

a) Figures 14.1A and 14.1B Noise study area (including baseline noise survey and construction noise assessment locations) and baseline noise levels ($L_{A10,18hr}$).

b) Figure 14.2 Noise changes ($L_{A10,18hr}$) in the future year without the Scheme (2036).

c) Figure 14.3 Noise changes ($L_{A10,18hr}$) as a result of the Scheme in the baseline year (2021).

d) Figure 14.4 Noise changes ($L_{A10,18hr}$) as a result of the Scheme in the future year (2036).

14.1.4 The following appendices of Volume 3 relates to this chapter:

a) Appendix 14.1 Glossary of noise and vibration

b) Appendix 14.2 Baseline noise survey results

c) Appendix 14.3 Construction noise and vibration data

d) Appendix 14.4 Operational noise results

14.2 Potential Effects

14.2.1 The construction of the Scheme has the potential to give rise to temporary short-term increases in noise and vibration at sensitive receptors which include residential properties, community facilities,

educational facilities and commercial premises which are sensitive to noise and vibration.

14.2.2 The operation of the Scheme may give rise to changes in noise levels (both adverse and beneficial) due to the proposed changes to the alignment which would introduce traffic noise into new areas whilst reducing traffic noise impacts for a larger number of sensitive receptors around Llanddewi Velfrey.

14.3 Assessment Methodology

Legislation, Policy Context and Guidance

Legislation Framework for Construction

14.3.1 The Environmental Protection Act[1] describes the duty of the Local Authority to take steps to abate any noise impact, including that from a construction site, deemed to be causing a statutory nuisance. Noise is outlined in Part III of the Act in relation to noise as a nuisance or that is prejudicial to health.

14.3.2 The Control of Pollution Act[2] gives the Local Authority powers to serve a notice to the developer requiring the control of site noise under Section 60 of the Act. This may include specific controls to restrict certain activities identified as causing particular problems. Conditions regarding hours of operation will generally be specified and noise and vibration limits at certain locations may be applied in some cases. All requirements must adhere to established guidance and be consistent with best practicable means to control noise only as far as is necessary to prevent undue disturbance.

Legislation Framework for Operational Noise

14.3.3 The Environmental Noise (Wales) Regulations 2006[3] (as amended 2009[4]) provide the mechanism for enacting the requirements of Directive 2002/49/EC[5] of the European Parliament (the Environmental Noise Directive) in Welsh law. Under the regulations, the Welsh Government was required to publish strategic noise maps and a Noise

[1] Environmental Protection Act 1990, Chapter 43 (HMSO, 1990)
[2] Control of Pollution Act 1974, Chapter 40 (HMSO, 1974)
[3] The Environmental Noise (Wales) Regulations (National Assembly for Wales, 2006)
[4] The Environmental Noise (Wales) (Amendment) Regulations (National Assembly for Wales, 2009)
[5] Directive 2002/49/EC of the European Parliament and of the Council (The European Parliament and the Council of the European Union, 2002)

Action Plan for Wales which identify noise Priority Areas (Noise Action Plan Priority Areas - NAPPA) and Quiet Areas (QA) to be considered in development decisions and long-term planning for noise reduction from transportation noise sources including roads.

14.3.4 The Land Compensation Act Part 1[6] entitles property or land owners to compensation if their property was reduced in value as a result of a public project such as a new or improved highway.

14.3.5 The Noise Insulation Regulations[7] (1975, amended 1988[8]) define the conditions under which dwellings are eligible for noise insulation to control internal noise levels. The conditions relate to the level of traffic noise at the façade, the increase in noise levels as a result of the highway and the contribution of the new or altered project to the noise level received at the façade. In summary, noise insulation qualification criteria require that:

a) the façade noise threshold of 68dB$L_{A10,18h}$ is met or exceeded;
b) there must be a noise increase of at least 1dB(A) compared to the prevailing noise level immediately before the construction of a highway or an additional carriageway were begun;
c) the noise caused by traffic on new or altered roads makes an effective contribution of at least 1dB(A); and
d) the property is 300m or less from the nearest point on the carriageway of a highway to which the Regulations apply.

14.3.6 An estimation of the number of properties that may qualify for statutory insulation is provided as part of the assessment.

National and Regional Policy

14.3.7 Planning Policy Wales Edition 10[9] describes the planning development policies of the Welsh Government. Of particular relevance to road infrastructure schemes are sections within Chapter 5 'Productive and Enterprising Places' and Chapter 6 'Distinctive and Natural Places' of this policy.

14.3.8 Section 5.3.4 discusses issues to be considered to minimise adverse effects from transport infrastructure on the natural, historic and built

[6] Land Compensation Act 1973, Chapter 26, Part 1 Compensation for depreciation caused by use of public works (HMSO, 1973)
[7] The Noise Insulation Regulations 1975 (HMSO, 1975)
[8] The Noise Insulation (Amendment) Regulations 1988 (HMSO, 1988)
[9] Planning Policy Wales Edition 10 (Welsh Government, 2018)

environment and on local communities. It also sets out the policy objectives with regard to noise from new development. In particular is the consideration of planning new routes to take advantage of existing landforms which can assist in providing natural screening, and where necessary, provide additional mitigation measures to minimise any negative impacts:

> *'Great care must be taken to minimise the adverse impacts of new or improved transport infrastructure on the natural, historic and built environment and on local communities, including on public health resulting from community severance and airborne pollution. Green infrastructure measures to mitigate negative effects and enhance environmental quality and connectivity should be considered at an early stage. Routes should make the best use of existing landforms and other landscape features to reduce noise and visual effects, subject to safety and other environmental considerations. Where no other alternative routes or options are practicable, transport infrastructure schemes should provide mitigation measures to minimise the negative impacts and enhance the positive ones caused by their construction and operation, including reducing exposure to airborne pollution.'*

14.3.9 Section 6.7 'Air Quality and Soundscape' promotes the ideas and ethos to achieving desired objectives of contributing to beneficial and positive benefits from improvements in soundscapes to enhance public health, amenity and well-being, as well as on biodiversity and ecosystems.

14.3.10 Section 6.7.3 discusses the negative impacts noise can have upon public health, amenity and well-being, and the importance of consideration given to reducing these effects as far as possible, and enhancement of natural and tranquil areas. This section also discusses the importance of consideration given to high priority areas as highlighted in the noise action plans (NAPPA):

> *'Certain sounds, such as those created by trees, birds or water features, can contribute to a sense of tranquillity whilst others can be reassuring as a consequence of their association with the normality of everyday activities. Problematic forms of sound are generally experienced as noise pollution and can affect amenity and be prejudicial to health or a nuisance. Noise action plans[147] drawn up by public bodies aim to prevent and reduce noise levels where necessary and preserve soundscape quality where it is good. Noise*

levels used to identify priority areas contained in noise action plans are usually set quite high in order to focus resources on the most polluted areas and noise must meet a number of tests before it qualifies as a statutory nuisance. Lower levels of noise, however, can still be annoying or disruptive and impact on amenity and as such should be protected through the planning process wherever necessary. The planning system must protect amenity and it is not acceptable to rely on statutory nuisance under the Environmental Protection Act 1990 to do so'.

14.3.11 Sections 6.7.4, 6.7.5, 6.7.10, 6.7.16, 6.7.17 and 6.7.25 reiterate and reinforce the statement of intent in 6.7.3 and section 6.7 with respect to ambient sound character and exposure to new noise sources. This is particularly in regard to known NAPPA sites (otherwise defined as pollution hot spots), and including areas such as landscape, historic and cultural value, as well as biodiversity and ecosystem resilience.

14.3.12 TAN 11[10] provides technical guidance on noise generating development including transportation projects. In relation to highway projects TAN 11 makes reference to the Noise Insulation Regulations as described above.

14.3.13 The Well-being of Future Generations (Wales) Act 2015[11] has a number of well-being goals to achieve through implementing sustainable development. Changes in noise levels can have an impact on the health of habitat and humans, as such the goals to create 'a resilient Wales' and 'a healthier Wales' are applicable.

Local Planning Policy - Pembrokeshire County Council (PCC)

14.3.14 Local Development Plan 2013-2021[12] Policies relevant to noise include:

a) GN.1: General Development Policy – Point 2 – developments will be permitted where they will not result in an increase in noise and vibration levels; and

b) GN.3: Infrastructure and New Development – provision must be made for mitigation of potential adverse impacts including noise intrusion.

[10] Planning Guidance (Wales) Technical Advice Note 11 (Welsh Assembly Government, 1997)
[11] Well-being of Future Generations (Wales) Act 2015 (Welsh Assembly Government, 2015)
[12] Local Development Plan, Planning Pembrokeshire's Future (up to 2021), Adopted 28th February 2013 (Pembrokeshire County Council, 2013)

c) GN.37: Protection and Enhancement of Biodiversity - policy to ensure that species and their habitats are protected from the potentially adverse effects of development, and where possible enhanced. Potentially adverse effects may include disruption to species and habitats prior to, during and/or after construction for example unacceptable noise.

Relevant Guidance

14.3.15 The Design Manual for Roads and Bridges (DMRB) is the regulatory standard for the design of a new road or improvements to an existing road. In particular, Volume 11 Section 3 Part 7: HD 213/11 Revision 1 (Highways Agency et al, 2011) (HD 213/11)[13] sets out the method for assessing noise and vibration associated with road traffic. HD 213/11 provides guidance on the selection of the Scheme assessment area and the relevant assessment years. This procedure was adopted for the purpose of this assessment.

14.3.16 HD 213/11 requires that road traffic noise is calculated under the method described in Calculation of Road Traffic Noise[14] (CRTN). This describes a procedure for determining the level of noise from the highway based upon the traffic flow parameters, road surface, propagation distance, screening, intervening ground cover and topographical features between the highway and receptor. This is the accepted methodology to quantify traffic noise levels for use with highway noise assessment procedures.

14.3.17 The British Standard BS 5228 Code of Practice for noise and vibration on construction and open sites – Part 1[15] and Part 2[16] provide guidance on the assessment and control of noise and vibration from construction activities. Part 1 of the Standard contains detailed information on noise reduction measures and promotes the 'best practicable means' approach to control noise and vibration to minimise the impact on local residents and construction workers. Part 2 of the Standard provides criteria for vibration with regard to perception and disturbance to residents and the onset of potential cosmetic or structural damage to buildings.

[13] Design Manual for Roads and Bridges, Environmental Assessment, Volume 11, Section 3, Part 7, HD 213/11 Revision 1 Noise and Vibration (Highways Agency et al, 2011)
[14] Calculation of Road Traffic Noise (Welsh Office, 1988)
[15] BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise (British Standards Institution, 2014)
[16] BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration (British Standards Institution, 2014)

14.3.18 Part 1 of BS 6472[17] provides guidance on the assessment of vibration from a variety of sources (including general construction) and its potential to cause disturbance to people. It does not cover vibration from blasting.

14.3.19 BS ISO 4866[18] provides guidance and methodologies for the measurement and effects of vibration upon buildings.

14.3.20 The World Health Organisation (WHO)[19] provides guidance in respect to community noise and recommends for outdoor living areas a criterion of 50 $dBL_{Aeq,T}$ *"to protect the majority of people from being moderately annoyed…"* and 55 $dBL_{Aeq,T}$ *"to protect the majority of people from being seriously annoyed…"* during the daytime. The new 'WHO environmental noise guidelines 2018' identifies the latest research on health issues (carried out between 1999 and 2015), which relates adverse health impacts to various sources of noise, including road transportation noise. This latest guidance has also been considered in the assessment. However, it should be noted that these new WHO guidelines align well with the recently published PPW 10 policy (Section 6) which also addresses and takes account of the 'negative impacts' that undesirable noise can have on public health, and strongly supports the importance when considering high priority NAPPA locations and also provision of 'Tranquil Areas', as discussed in section 6.7.3. In addition to this, the latest WebTAG analysis undertaken now takes account of health impacts such as Sleep Disturbance, Stroke, Dementia and AMI as part of its overall assessment.

14.3.21 BS 8233[20] provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

Consultation

14.3.22 The Pollution Control Officer (PCO) at Pembrokeshire County Council was contacted via email and telephone on 23 and 24 May 2017 respectively regarding the methodology for the noise survey, and to

[17] BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting (British Standards Institution, 2008)
[18] BS ISO 45866:2010 Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures (British Standards Institution, 2010)
[19] World Health Organisation, Guidelines for Community Noise (World Health Organisation, 1999)
[20] BS 8223:2014 Guidance on sound insulation and noise reduction for buildings (British Standards Institution, 2014)

establish the presence of existing noise issues and any particularly sensitive noise and/or vibration receptors. The PCO highlighted the issue of the existing low levels of background noise in the area due to its rural nature and agreed with the methodology and approach used in choosing the noise survey locations, undertaking the noise measurements, and carrying out the assessment to quantify the impacts and effects as set out in this chapter.

Approach to Identification of Baseline Conditions

14.3.23 Noise or vibration sensitive buildings were identified for inclusion in the assessment, as discussed in principle with the PCO. Baseline noise surveys were carried out at sufficient locations to represent all identified noise-sensitive areas either by use of a logger over a full day (>24 hours) or via sample measurements. Full details of the survey procedures and locations are provided in Volume 3 Appendix 14.2.

14.3.24 The measured baseline noise survey data was used for the construction noise assessment to represent baseline ambient noise levels at representative receptor locations. It is assumed that local noise conditions would not change substantively between the survey period and the commencement of proposed works.

14.3.25 The future baseline noise conditions for the operational traffic assessment were determined by the CRTN noise prediction model for a forecast traffic scenario prior to construction of the Scheme. This has provided detailed coverage across the entire study area. HD 213/11 makes clear that this is the preferred approach for establishing baseline noise conditions, which are then directly comparable with the noise levels predicted in the same way with the Scheme in operation for future assessment years. The future baseline noise level predictions are supplemented by the data obtained during the baseline noise measurement survey.

Study Area

14.3.26 The determination of study area is based on the DMRB HD 213/11 guidance. For the Detailed level of assessment used for this study, HD 213/11 requires that a quantitative noise impact study is made for all noise-sensitive properties within 600m of all Scheme roads, by-passed roads and sections of existing roads within 1 km of the Scheme that are predicted to be subject to a change in noise level of more than

1dB$L_{A10,18hr}$ in the short term as a result of the Scheme in the baseline year. Existing roads subject to a change of 1dB(A) or more were identified by forecast traffic changes arising from the Scheme. HD 213/11 notes that a change in noise level of 1dB(A) is associated with an increase in flow by at least 25% or decrease by 20%, assuming other factors remain unchanged.

14.3.27 The study area also includes affected routes beyond 1km from the Scheme. However, for these routes an assessment of noise change is carried out using 'Basic Noise Levels' (BNLs) where dwellings lie within 50m of affected routes. The Basic Noise Level is the noise level at a reference distance of 10m from the carriageway edge, derived using the CRTN methodology.

Methodology for Construction Impacts

14.3.28 Construction noise and vibration is temporary and cannot be assessed in the same way as more permanent operational impacts such as traffic noise.

14.3.29 Noise and vibration from the construction of the Scheme was determined using BS 5228 (Parts 1 and 2). This standard provides information on the prevention and control of construction noise and vibration and includes a procedure for predicting construction noise. Calculations of noise levels at selected receivers were based on typical source noise levels (mainly taken from BS 5228-1), propagation distance and details of the intervening ground cover.

14.3.30 Construction noise predictions are based on the anticipated programme and construction methods. Nevertheless, it was necessary to make assumptions with the advice of the construction planning manager. The details of the assumed equipment and programme are in Volume 3 Appendix 14.3 and are considered to provide a sufficient level of accuracy for this assessment.

Construction noise impact evaluation

14.3.31 Assessment of the significance of construction noise was carried out based upon noise change as outlined in BS 5228-1. The Standard provides a number of methods for the assessment of significant effects. The 'ABC' assessment method described in BS 5228-1 was used to

establish the threshold of potential significant effect for construction noise at residential receptors.

14.3.32 Under this approach, the adverse impact threshold is determined at a dwelling using the existing ambient noise level, rounded to the nearest 5dB(A). This is then used to determine the assessment category: A, B or C, which then defines the adverse noise impact threshold, as described in Table 14.1.

14.3.33 The predicted construction noise level is then compared to the appropriate noise impact threshold level. If the $L_{Aeq,T}$ construction noise level exceeds the appropriate noise impact threshold level shown in Table 14.1, then an adverse impact with the potential to cause a significant effect is identified.

Table 14.1 Threshold of potential significant effect at dwellings according to ABC method in BS 5228–1:2009 + A1:2014

Assessment category and threshold value period	**Threshold value, dBL_{Aeq}**		
	Category A	**Category B**	**Category C**
Night-time (2300 – 0700)	45	50	55
Daytime (0700 – 1900) and Saturdays (0700 – 1300)	65	70	75
Other: Weekday evenings (1900 – 2300) Saturdays (1300 – 2300) Sundays (0700 – 2300)	55	60	65
Category A: threshold value to use when ambient noise levels (rounded to the nearest 5dB(A)) are less than these values Category B: threshold value to use when ambient noise levels (rounded to the nearest 5dB(A)) are the same as Category A values Category C: threshold value to use when ambient noise levels (rounded to the nearest 5dB(A)) are higher than Category A values.			

14.3.34 For example, for a site exposed to an existing daytime ambient noise level of 68dB(A), this would be rounded to 70dB(A). An ambient level of 70dB(A) is higher than the Category A value of 65dB(A), therefore the Category C value of 75dB(A) would apply in this case as a threshold for potentially significant effects.

14.3.35 Having established if there is a potentially significant effect using the ABC method, the final assessment of significance is made using

professional judgement. This is evaluated by considering various other factors such as the expected duration of the activity as described under Significance of Effect later on in this section from paragraph 14.3.74.

14.3.36 For non-residential receptors, significant effects would be evaluated on a receptor-by-receptor basis, using established noise impact criteria for the type of receptor and professional judgement based on the factors described under Significance of Effect.

Construction vibration impact evaluation

14.3.37 BS 5228-2 indicates that the threshold of perception in residential environments corresponds with a Peak Particle Velocity (PPV) of 0.3mm/s. The standard also states that a complaint is likely where levels occur above 1.0mm/s PPV at residential properties but this exposure can be tolerated if prior warning and explanation was given to residents. Levels of vibration of 10mm/s PPV and above are likely to be intolerable for any more than a very brief exposure to this level.

14.3.38 The overall significance of the effect is assessed using professional judgement by considering not only the criteria above but also other factors, as discussed under Significance of Effect.

14.3.39 Ground-borne vibration during the construction of the proposed carriageway may arise due to breaking out surfaces and foundations, excavation, and the use of compactors or rollers. Impacts at sensitive receptors will be dependent on their proximity to the works and the intervening ground conditions.

14.3.40 The effects in terms of community response are expected to be governed mainly by the time of day that the works are undertaken and whether prior notice was given. Effects in terms of cosmetic or structural damage to buildings may also be of concern where they are exposed to levels of vibration much higher than the lowest perceptible levels.

14.3.41 Table 14.2 defines the no observed adverse effect levels for ground-borne vibration with regard to risk of building damage. The background and evidence for these criteria is set out in the report 'Impacts of Tunnels in the UK'[21] and the criteria are derived from BS 7385 Part 2 Evaluation and measurement for vibrations in buildings –

[21] Impacts of Tunnels in the UK (High Speed Two (HS2) Limited, September 2013)

Guide to damage levels from ground-borne vibration (British Standards Institution, 1993).

Table 14.2 Impact criterion for damage to buildings from vibration

Category of building	**Vibration impact criteria for buildings (conservation criteria below which there is no risk of cosmetic damage)**	
	Transient[1] vibration	**Continuous[2] vibration**
Potentially vulnerable buildings[3]	6mm/s	3mm/s
Structurally sound buildings	12mm/s	6mm/s

[1]Transient vibration relative to building response such as impulsive vibration from percussive piling.

[2]Continuous vibration relative to building response such as vibrating rollers

[3]BS 7385-2 highlights that the criteria for aged buildings may need to be lower if the buildings are structurally unsound. The standard also notes that criteria should not be set lower simply because a building is important or historic (listed).

14.3.42 BS 5228-2 provides a methodology for predicting typical levels of vibration from certain types of construction activities based on case study data and empirical models. This was used to assess the likelihood that vibration from the works may exceed the thresholds for perception and disturbance.

Methodology for Operational Impacts

14.3.43 Geographical Information Systems (GIS) were used to construct a three-dimensional noise model of the calculation area for the Scheme. The model includes terrain data, buildings and other structures that might screen or reflect noise, ground cover types and road links. Three-dimensional models of the Scheme design and groundworks were incorporated to ensure an accurate representation of the Scheme and existing roads.

14.3.44 For each road link in the model, data on traffic flow, speed, proportion of heavy goods vehicles (HGVs) and road surface type were obtained from the project traffic and highways engineers for inclusion into the model. Noise level calculations according to CRTN were carried out using proprietary noise modelling software. Traffic noise levels were calculated across a grid of receptor positions over the study area, and contours of noise level exposure were established. Additional

calculations were also conducted at each property façade to establish noise and nuisance change at each dwelling. In accordance with HD 213/11, the façade which is predicted to experience the least beneficial change as a result of the Scheme was used for the assessment. In some cases, this leads to a receptor on a façade facing away from the existing A40 being chosen and therefore the highest noise levels in the baseline situation are not always represented.

14.3.45 The traffic data used in the model were those forecasted under the Do-Something and Do-Minimum scenarios both in the Scheme opening year (baseline year), in this case 2021; and those in the future assessment year i.e. the year of maximum projected traffic flow within 15 years of opening, in this case 2036.

14.3.46 These traffic data were included in the noise model to produce the following scenarios:

a) Do-Minimum (without the Scheme) in the baseline year (2021);
b) Do-Minimum (without the Scheme) in the design year (2036);
c) Do-Something (with the Scheme) in the baseline year (2021); and
d) Do-Something (with the Scheme) in the design year (2036).

14.3.47 The study area and HD 213/11 calculation area are defined under Study Area above.

14.3.48 The noise prediction model was used to calculate noise contour levels within the noise study area, at a height of 4m above local ground level, in terms of the free-field $L_{A10,18h}$ index in accordance with CRTN methodology, as required by HD 213/11, for each of the four Scheme scenarios as listed above. In addition, façade corrected noise predictions were undertaken at each dwelling and other noise sensitive receptors, at ground floor and 1st floor levels, 1.5m and 4.0m above local ground level respectively.

14.3.49 The $L_{A10,18h}$ index represents the arithmetic mean of all the hourly values of L_{A10} during the period between the hours of 0600 and 2400. The CRTN procedure is based upon empirical data with a slightly positive wind vector component blowing downwind from source to receptor. The CRTN prediction therefore assumes an adverse wind component to represent a typical worst-case scenario. The additional advice given in HD 213/11 was adopted regarding CRTN procedures.

These include revisions to vehicle classification, traffic data and corrections due to road surface.

14.3.50 Baseline noise survey results (as outlined in Section 14.4 and detailed in Volume 3 Appendix 14.2 were used as a general means of providing indicative information to assist in the validation of predicted noise climates across the study area.

14.3.51 As part of the procedure for a Detailed Assessment, HD 213/11 requires that the magnitude of the noise impact is reported using a suggested scale of magnitude to describe the increase or decrease in noise level associated with the Scheme. The magnitude scale is described in more detail later in this Section.

14.3.52 Following the HD 213/11 procedures, noise difference contour maps were produced using the results from the calculations to graphically represent the noise changes within the noise study area. The required assessment of impact magnitude is presented in Volume 2 Figures 14.2 to 14.4, for the following scenarios:

a) Do-Minimum scenario in the 2021 baseline year against the Do-Minimum scenario in the 2036 future year (long term);
b) Do-Minimum scenario in the 2021 baseline year against the Do-Something scenario in the 2021 baseline year (short term); and
c) Do-Minimum scenario in the 2021 design year against Do-Something scenario in the 2036 future year (long term).

14.3.53 HD 213/11 Detailed Assessment also requires that a night-time noise assessment is carried out. The $L_{night,outside}$ descriptor is used to represent the noise level at dwellings between the hours of 2300 and 0700. Method 3 from the Transport Research Laboratory (TRL) report *'Converting the UK traffic noise index $L_{A10,18hr}$ to EU noise indices for noise mapping'* was used for predicting L_{night} noise levels. Method 3 uses daily traffic flow data converting predicted daytime noise levels ($L_{A10,18h}$) to night-time noise levels. This method was appropriate as there was nothing considered to be unusual in the proportionate traffic flow volumes for this route between daytime and night-time.

14.3.54 For the night-time noise assessment, only dwellings with a noise level over 55dB$L_{night,outside}$ are considered (as specified in HD 213/11). The assessment of impact magnitude for night-time noise follows the same method as the daytime and is required for the following scenarios:

a) Do-Minimum scenario in the 2021 baseline year against the Do-Minimum scenario in the 2036 future year (long term); and
b) Do-Minimum scenario in the 2021 design year against Do-Something scenario in the 2036 future year (long term).

14.3.55 HD 213/11 requires tabulated results of noise level changes, which summarise the number of dwellings and other noise-sensitive receptors subject to noise changes corresponding to each magnitude of impact in both the short term (baseline year) and long term (future year), for the daytime period. To evaluate the night-time effects, only the long-term impacts need to be considered. In accordance with the method, these tables are completed with noise levels calculated for the façade with the least beneficial change in noise.

14.3.56 In addition, traffic noise nuisance reporting tables are also required. The noise nuisance level is calculated at the least beneficial facade of each dwelling in accordance with HD 213/11 methodology and is presented in percentage bands relating to the change in percentage of people bothered by the noise change.

14.3.57 For the Do-Minimum scenario the change in 'steady-state' nuisance between the baseline and future years is reported. For the Do-Something scenario, it is the highest increase in nuisance that occurs between the opening and future assessment years that is reported.

14.3.58 The determination of study area is based on the HD 213/11 guidance and detailed under Study Area above.

14.3.59 This assessment has also taken into consideration NAPPA. These are existing noise-sensitive areas, i.e. residential, where noise exposure is shown to be particularly high, and where ameliorative measures should be considered a high priority. Residential areas around the A40 passing through the village of Llanddewi Velfrey are identified as a NAPPA.

Traffic noise impact evaluation

14.3.60 There is no established UK guidance which clearly defines criteria for the assessment of significant effects arising from road traffic noise. The response of people to noise is subjective and sensitivity to changes in traffic noise is therefore variable across the population. Given the variability of response and the potential for non-acoustic factors to influence perceptions of noise, any assessment of significance can only represent the general community response to traffic noise.

14.3.61 It is common practice to use the change in noise level climate brought about by a Scheme as the basis for evaluating noise impacts (i.e. the impact of the Scheme on the pre-existing noise environment and the effects this may have on the receptors in that environment).

14.3.62 The scale or severity of any noise change, positive or negative, requires description to indicate the degree of impact. This leads to the common practice of defining noise change impact categories with an associated semantic scale.

14.3.63 HD 213/11 assigns magnitude of impact descriptors associated to different levels of noise change in the short and long term. These magnitude of impact descriptors are shown in Table 14.3 (short term) and Table 14.4 (long term). The different scales describe the more sensitive response described in HD 213/11 for short-term changes in traffic noise, as opposed to the long-term response to differences in steady-state traffic noise.

Table 14.3 Classification of magnitude of noise impact in the short term under HD 213/11

Noise Change [dB(A)]	Magnitude of Impact in the short term
0	No change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0 +	Major

Table 14.4 Classification of magnitude of noise impact in the long term under HD 213/11

Noise Change [dB(A)]	Magnitude of Impact in the long term
0	No change
0.1 – 2.9	Negligible
3.0 – 4.9	Minor
5.0 – 9.9	Moderate
10.0 +	Major

14.3.64 The research cited by HD 213/11 states that even for those most sensitive to short-term change in noise, a change of less than 1dB(A) is imperceptible and hence is a negligible impact on the environment.

Equally, in the long term, a change of less than 3dB(A) is imperceptible and hence is a negligible impact on the environment.

Traffic noise significance – general

14.3.65 As discussed above, the effect of an impact on the noise environment would depend on the type of receptor subject to the impact.

14.3.66 Historically, the assessment of significant noise effects was often based on exceeding the Noise Insulation Regulations (NIR) qualification level (i.e. 68dB$L_{A10,18h}$). This is accepted as a very high level of external noise where the noise insulation provided by a closed, single-glazed window is insufficient to maintain internal noise levels that are consistent with quiet enjoyment of a property and restorative sleep.

14.3.67 HD 213/11 states that, following a change in traffic flow, perceptible changes were reported in the short term for traffic noise changes as small as 1dB(A). This is based on research of community response to noise indicating that people can be more sensitive to the abrupt noise change soon after opening of a new or altered road. The guidance notes that this heightened sensitivity to noise change is a temporary effect and the longer-term noise nuisance level after a number of years reverts to the 'steady-state' level.

14.3.68 Other research suggests that the reported sensitivity to small changes in noise levels (less than 3dB(A)) may be coloured by factors other than noise (Baughan & Huddart, 1993).

14.3.69 As required by HD 213/11, an assessment of the short-term and long-term change in noise levels comparing the Do-Minimum condition in the baseline year against the Do-Something condition, will be undertaken.

14.3.70 Whilst HD 213/11 does not advocate use of absolute noise levels as a means of assessing noise impact or effects on receptors, the IEMA, Guidelines for Environmental Noise Impact Assessment (Institute of Environmental Management and Assessment, 2014) notes that relying solely on noise change may not be always appropriate. There are two sets of circumstance that in particular warrant some further consideration:

a) Already very noisy locations: Receptors may already be exposed to very high levels of noise from other sources and hence any

increase in noise may be considered unsatisfactory and hence additional effort may need to be made to reduce the projected noise increase; and

b) Tranquil areas: In areas formally recognised for their tranquillity because of low noise levels, small increases in noise may again be considered significant.

Proposed traffic noise potential significance criteria

14.3.71 Arup has developed potential significance criteria for changes in road traffic noise at sensitive receptors based on the long-term impact tables in HD 213/11. These are given below in Table 14.5. The aim of this criteria are to clearly identify those receptors where a "potential "significant effect occurs. However, other factors specific to the individual receptors and the character of the noise impact are also considered in reaching a final assessment decision. Therefore, if potentially significant effects are identified, the overall assessment of significance is evaluated using professional judgement based on the additional factors described in Section 14.3.78.

Table 14.5 Assessment of magnitude and potential significance of impact

Change in Noise Level in the long Term (dB(A))	Initial Indicator of Significance
+5 or greater	Potentially significant increase
+3 to +4.9	
+1 to +2.9	Unlikely to be significant
+0.9 to -0.9	Not significant
-1 to -2.9	Unlikely to be significant
-3 to -4.9	Potentially significant decrease
-5 or less	

14.3.72 For residential receptors, the overall significance of the effect is assessed using professional judgement by considering not only the HD 213/11 noise impact criteria to determine potential significance, but also other factors, as discussed from paragraph 14.3.75 on Significance of Effect.

Road traffic vibration

14.3.73 HD 213/11 recommends that the effects of vibration should also be considered where appropriate. In the case of ground-borne vibration, the likelihood of perceptible vibration being caused is particularly

dependent upon the smoothness of the road surface. Research has shown that vibration levels caused by heavy vehicles travelling at 110kph over a 25mm hump (i.e. a large discontinuity consistent with poorly backfilled trench) could cause perceptible vibration at up to 40m from the road (Watts, 1990). This would infer that it is unlikely that significant levels of vibration would be generated at distances greater than this.

14.3.74 Also, with a newly laid road surface it is a requirement of new highway construction specification that the surface would be smooth and free from any discontinuities of this magnitude. Paragraph A5.26 of HD 213/11 states: *'Such vibrations are unlikely to be important when considering disturbance from new roads and an assessment would only be necessary in exceptional circumstances'*. No such exceptional circumstances are envisaged for the Scheme and hence no impacts or effects from ground-borne vibration are predicted.

14.3.75 HD 213/11 covers the potential for airborne noise, from heavy goods vehicles, to cause vibration nuisance close to main roads. As an indication of the scale of impact relative to noise effects, the guidance in HD 213/11 paragraph A6.21 states that for a given level of traffic noise exposure the percentage of people bothered very much or quite a lot by airborne vibration is 10% lower than the corresponding amount for noise nuisance. It is also noted in paragraph A6.21 that airborne vibration is expected to affect a very small percentage of people at exposure levels below $58dBL_{A10,18h}$. Also, the significance of any change in airborne traffic vibration can be considered proportional to the significance of changes in traffic noise. As such, the assessment of airborne vibration can be included within the assessment of airborne noise.

14.3.76 The impact of vibration effects is discussed further in Section 14.6.63.

Significance of Effect

14.3.77 All of the identified sources of noise and vibration will be evaluated to determine if there would be adverse impacts and the potential to cause significant effects according to the criteria described above.

14.3.78 If potentially significant effects are identified, the overall assessment of significance is evaluated using professional judgement based on the following factors:

Residential:

a) the magnitude of the impact and effect identified (based on overall noise level and noise change);

b) the number and grouping of adversely affected dwellings and shared open areas;

c) the level and character of the existing noise environment;

d) any unique features of the source or receiving environment in the local area, such as other ambient noise sources in the vicinity that might affect the perception of traffic noise changes;

e) combined exposure to noise and vibration;

f) duration of impact and effect (for construction); and,

g) the effectiveness of mitigation measures that could avoid or reduce the adverse effects.

Non-residential:

a) the generic use (e.g. outdoor amenity, educational, healthcare, religious buildings or community uses) and hence relevant guidance on noise;

b) the times of use;

c) the design of the receptor (especially windows, doors and ventilation systems) and hence ability of receptor to experience changes in external noise environment without significant change in internal noise conditions);

d) the layout - whether the most sensitive parts of the building are closest to and face the Scheme, or are located further from the Scheme and are on the opposite side of a building;

e) duration of impact and effect (for construction); and,

f) the effectiveness of mitigation measures that could avoid or reduce the adverse effects.

14.3.79 The sensitive receptors considered for this assessment are shown in Volume 2 Figure 14.1.

Receptor Sensitivity

14.3.80 The closest residential receptors to the north of the Scheme are some 20m or more away and include Blackmoor, Bro Minau, Penrhiw Cottage, Pen-troydin-fawr Farm, and Bethel. Trefangor Cottage lies within the proposed Scheme and is to be demolished. The closest residential receptors to the south of the Scheme is Henllan Lodge some 13m away. Other nearby southern residential receptors include Penblewin Farm, Caermaenau-fach Farm, Trefangor Farm, Henllan

Lodge, Awel Deg, Maes-y-ffynnon and Blaen-pentroydin. Residential receptors are categorised as high sensitivity with regard to noise.

14.3.81 Non-residential receptors include Bethel Chapel some 20m to the north of the Scheme which is categorised as high sensitivity. Llanddewi Velfrey Village Hall and Llanddewi Velfrey Cricket Club are over 200m to the south and are categorised as medium sensitivity.

Limitations of the Assessment

Construction

14.3.82 The assessment considers construction noise and vibration on a month-by-month basis; this is based on representative construction methods suitable for this assessment (equipment details are provided in Volume 3 Appendix 14.3). Noise levels would vary day-to-day; the highest daily levels may sometimes be around 5dB(A) higher than the monthly average levels but would then be substantially lower on other days in that month. Noise and vibration from all construction activities, including short duration activities, is subject to control under the Construction Environmental Management Plan (CEMP) (Volume 3 Appendix 2.2: Pre-CEMP). Hence minimisation of noise as far as practicable is agreed with the relevant local authority by consent under the *Control of Pollution Act 1974* before the works can commence on site.

Operation

14.3.83 The effects of noise and vibration from the operation of the Scheme were assessed based on traffic modelling (Traffic Forecasting Report Volume 3 Appendix 2.1). Other committed or planned developments may affect the predicted traffic using the Scheme and these have, as far as possible, been included within the Scheme traffic data on the basis of assumed dates for committed developments to be operational. It is likely that the changes in impact associated with any variability in programme for committed developments would be negligible in terms of predicted traffic noise levels.

14.3.84 There would be regular planned maintenance work along the route. Given the infrequent, irregular and short duration of works likely to cause appreciable noise or vibration, maintenance work is considered unlikely to give rise to significant noise or vibration effects.

14.4 Baseline Conditions

14.4.1 A noise survey was undertaken to establish baseline noise levels in the vicinity of A40 Llanddewi Velfrey to Penblewin. A baseline noise survey is recommended as part of the HD 213/11 detailed assessment procedure. The guidance also notes that:

> *'During the assessment process, measurements should not routinely be compared with calculations for the purpose of predicting changes in noise level. There is currently no methodology available to take account of the potential errors associated with comparing measurements with calculations, especially when the receptor is some distance from the noise source.'*

14.4.2 The purpose of the baseline noise survey was to provide data on noise climates at a sample of locations to supplement the traffic noise predictions and to provide baseline data for the construction noise assessment. The survey was also considered important to determine if any parts of the study area are dominated by noise from sources other than traffic noise, in which case the prediction results would not accurately reflect noise levels in that area.

14.4.3 It should be noted that, even where the noise climate is dominated by roads, some variance between existing measured noise levels and predicted noise levels for the future baseline year prior to opening of the Scheme would be expected. This might be due to differences in traffic flow levels between the present and the baseline year or meteorological conditions at the time of the survey.

14.4.4 Tables 14.6-14.8 show the range of measured baseline noise levels. Detailed results and the survey method are reported in Volume 3 Appendix 14.2 along with a plan of the survey locations.

14.4.5 The survey locations were selected to represent the nearest residential receptors. Noise loggers were used in selected locations to capture baseline noise over a period of more than 24 hours. There were 13 measurement locations, summarised as follows:

a) Location 1 (attended) – on the south side of Bethel Cottage;
b) Location 2 (attended) – on the pavement to the north side of Arfryn alongside the existing road;

c) Location 3 (attended) – to the south of the main residence at Valley View;
d) Location 4 (attended) – to the south of Castell;
e) Location 5 (attended) – to the north-eastern side of the main residence at Willow Tree School for Dogs (Blaen-pentroydin);
f) Location 6 (unattended logger) – to the south of Pen-troydin-fawr Farm at approximately the same level as the bedroom windows of the farmhouse;
g) Location 7 (attended) – on the south-western side of Awel Deg;
h) Location 8 (attended) – to the northern side of Maes-y-ffynnon;
i) Location 8a (attended) – to the southern side of Maes-y-ffynnon;
j) Location 9 (attended) – to the southern side of Penrhiw Cottage;
k) Location 10 (attended) – to the northern side of Henllan Lodge;
l) Location 11 (unattended logger) – to the north of Trefangor Farm;
m) Location 12 (attended) – to the eastern side of the farmhouse at Penblewin Farm.

14.4.6 Attended measurements at locations 1-8 and 12 followed the shortened measurement procedure described in CRTN to obtain the $L_{A10,18hr}$. Sample measurements made at locations 9 and 10 were compared with the 18-hour noise levels recorded at Location 11, which was subject to the same dominant noise source, to derive the 18-hour noise levels at these locations. See Volume 3 Appendix 14.2 for further information.

14.4.7 The dominant noise source at the attended measurements was road traffic on the A40. Other notable noise sources were distant farm vehicles and aircraft.

14.4.8 Low noise surfacing has recently been applied along a short length of the existing A40 within a speed restricted 40 mph zone, where it passes immediately to the north of the village of Llanddewi Vestry, which lies within a recognised NAPPA area. This has been taken into account and incorporated into the road noise calculation model. This will provide a small noise reduction over the previous Hot Rolled Ashphalt (HRA) road surfacing to dwellings within this village due to the 64kph (40mph) speed-controlled zone. This is explained in more detail in section 14.5.5.

Table 14.6 Measured daytime baseline noise levels (attended)

Location	Sound level, dB (façade)			
	$L_{A10,18h}$[1]	Range of $L_{A10,15min}$	Range of $L_{A90,15min}$	Range of $L_{Aeq,15min}$
1	68	69-70	40-46	64-66
2	79	79-80	47-52	75-77
3	52	52-53	44-46	49-50
4	52	49-56	42	46-52
5	44	43-46	34-39	41-43
7	43	43-46	35-39	41-44
8	51	52-53	41-44	49-50
8a[2]	64	65-66	47-51	61-63
9	72	74	51	69
10	75	77	45	72
12	61	62-63	52-54	59-60

Notes:

[1] $L_{A10,18hr}$ values are derived as the arithmetic average of the three consecutive $L_{A10,1hr}$ values (based on 15-minute samples) for each location minus 1dB(A) except at locations 9 and 10 where a comparative procedure with the logger at location 11 was used.

[2] Measurements taken at location 8a were five minutes in duration

Table 14.7 Summary of logger measurements taken at location 6

Time period	Sound level, dB (free field)		
	L_{Aeq} (range)	L_{A10} average (range)	L_{A90} range
Day (0700-1900)	56 (41-69)	56 (41-74)	30-57
Evening (1900-2300)	50 (35-58)	49 (36-63)	24-46
Night (2300-0700)	45 (19-58)	40 (21-63)	17-47

Notes:

Overall L_{Aeq} values are the logarithmic (energy) average of the five-minute measurements for the respective time periods

Daytime measurements at this location were affected by non-typical events at the nearby farm and hence are not considered to be representative of the noise climate at this location. For this reason, an overall $L_{A10,18hr}$ is not presented

Table 14.8 Summary of logger measurements taken at location 11

Time period	**Sound level, dB (façade)**		
	L_{Aeq} (range)	**$L_{A10,18hr}$**	**L_{90} (range)**
Day (0700-1900)	74 (70-77)	77	50 (36-60)
Evening (1900-2300)	71 (67-73)		45 (25-54)
Night (2300-0700)	67 (22-74)		27 (15-50)

Notes:
Overall L_{Aeq} values are the logarithmic (energy) average of the five-minute measurements for the respective time periods
The $L_{A10,18hr}$ was derived from the arithmetic average the $L_{A10,5min}$ values for the period 0600-2400 hours.

14.5 Mitigation Measures

Construction

14.5.1 Best Practicable Means mitigation methods will be implemented to control construction noise. The use of low noise emission plant and processes (as specified in BS 5228-1 Annex B - Noise sources, remedies and their effectiveness) will be used. In addition, and wherever possible, the maximising of interveening distances between construction plant sources and the closest noise-sensitive receptors will also be sought. Where it is not possible to reduce noise levels enough by the methods already described above, then further noise mitigation would be sought by implementation of carefully considered and designed screening methods (to be determined by the Main Contractor, once construction methods and constrainst are clarified).

14.5.2 Some of the equipment with particularly high noise levels such as the chipper used during the site clearance and mobilisation activity should be located as far away as possible from noise-sensitive receptors to minimise the noise exposure. Localised screening around these construction plant operations where practicable, should also be used to provide additional noise mitigation measures which would further protect and minimise noise exposure to the nearest noise-sensitive receptors.

14.5.3 Vibratory rollers should not be used within 90m and 125m of sensitive receptors for steady and start-up/run down operations respectively. Alternatively - or in addition to this - vibration monitoring should be carried out, and acted upon, to minimise adverse effects and avoid

significant effects during the works. These distances were determined assuming the worst case 18 tonne vibratory roller as stated in Volume 3 Appendix 14.3 and assuming a cautious 5% probability of the predicted value being exceeded. There would be variability due to the ground type and the vibratory process used, however this is considered to be a robust, worst case assessment for typical conditions.

Operation

14.5.4 The Scheme was designed to minimise noise impacts by putting the proposed new road into cutting where possible, creating natural screening of the noise source. Where the Scheme will follow the alignment of the existing A40, it was designed to be further away from the closest properties to the road wherever possible.

14.5.5 The Scheme would be surfaced with a Thin Surface Course System (TSCS) which is a low noise surface. A -3.5dB(A) correction (i.e. reduction) is applied in the modelling to account for this as compared with a -0.5dB(A) CRTN correction which is applicable to the existing A40 based on a HRA surface with an assumed 1.5mm texture depth. This benefit is only counted where traffic speeds are expected to be above 75kph as per the advice in HD 213/11; however, where average speeds were predicted to be between 70kph and 75kph, an interim allowance of -2.5dB(A) was allowed for to avoid an unrealistic step change in noise benefit. For TSCS, a -1dB(A) correction is assumed where traffic speeds are less than 75kph (or in this case, 70kph).

14.6 Assessment of Environmental Impacts

Construction Impacts

Construction Noise

14.6.1 For the purposes of assessment, the site preparation and construction works were divided into the following stages for the Scheme works. Volume 3 Appendix 14.3 describes the plant machinery assumed for the assessment:

a) Site clearance and mobilisation

b) Earthworks

c) Drainage

d) Structures; and

e) Pavement.

14.6.2 The assumed timetable and phasing of works is in Volume 3 Appendix 14.3; the works proposed to take place between February 2019 and March 2020. The proposed hours for noise and vibration producing activities are Monday to Friday, daytime only for six hours a day based on information provided by the Contractor.

14.6.3 At the present time, it is not known exactly where the site compound will be located, however, it is considered likely to be situated centrally along the length of the Scheme, which would enable quick and direct access to and from the existing A40. The location will be away from the main centre of the village to minimise disturbance to residents. There is likely to be some noise from construction plant within the compound, for example, from mobile plant starting up and leaving the compound in the mornings, and then returning in the evenings. These events will only occur for a short duration during the start-up and shutdown periods. There will also be noise generated by occasional material delivery vehicles to the site compound. Any generator(s) situated within the site compound should be located away from noise-sensitive receptors.

14.6.4 In relation to noise and vibration, it was assumed that standard construction management measures (Best Practicable Means – BPM) would be implemented as part of the construction works. This requires that all reasonable measures are taken to minimise construction noise and vibration (as specified in Annex B of BS 5228-1). In particular, the contractor would be required to operate in accordance with the provisions of a CEMP for the works for agreement with the local authority. This will include measures which would be adopted to minimise the likelihood of significant disturbance to neighbouring properties. The construction noise assessment was based on such Best Practicable Means assumptions.

14.6.5 Night-time construction would be avoided for the majority of the proposed works; however, night-time working may be required for specific activities. An example of a specific activity would be tie-in works, i.e. joining existing to new road, where night-time working is likely to be required for road traffic management reasons to avoid daytime road closures. Such works are considered exceptional and would likely only occur for one or two contiguous nights at intervals throughout the works. Any such night-time works would not be

considered a significant effect due to their short-term impacts. Any noise effects arising from these short-term construction activities would be controlled by the management processes set out in the CEMP.

14.6.6 Daytime construction noise levels at a selection of the nearest sensitive receptors were predicted based on the relevant construction plant, propagation distances, on times and programme. The receptor locations included in the predictions are as follows:

a) Bethel Cottage
b) Blaen-pentroydin
c) Pen-troydin-fawr Farm
d) Maes-y-ffynnon
e) Penrhiw Cottage
f) Henllan Lodge
g) Trefangor Farm; and
h) Penblewin Farm.

14.6.7 The locations were based on the baseline survey locations shown in the Volume 2 Figure 14.1 however were adjusted to be positioned on the worst-case façade.

14.6.8 The results of the assessment of construction noise of the Scheme are presented in Table 14.9. The table shows the predicted range of monthly construction noise levels for the construction stages described above.

Table 14.9 Predicted noise levels at residential locations

Receptor	Assumed worst-case distance to nearest centre of works, metres	Baseline				Construction noise assessment		
		Equivalent noise survey location	Ambient noise level, $L_{Aeq,daytime}$	ABC method category (BS 5228-1)	ABC threshold, $L_{Aeq,daytime}$	Range of monthly predicted construction façade noise level, $dBL_{Aeq,daytime}$	Number of months monthly construction noise levels exceed ABC threshold	Construction activities resulting in construction noise levels exceeding ABC threshold
R1 Penblewin Farm	54	12	59-60	A	65	59-72	10	West roundabout & west section – Site clearance and mobilisation, Earthworks, Pavement
R2 Trefangor Farm	43	11 (logger)	70-77 (74)*	C	75	59-68	-	-
R3 Henllan Lodge	13	10	72	C	75	73-82	12	Centre (Underpass & Ffynnon Woods) and west section – Site clearance and mobilisation, Earthworks, Pavement, Structures

Receptor	Assumed worst-case distance to nearest centre of works, metres	Baseline				Construction noise assessment		
		Equivalent noise survey location	Ambient noise level, $L_{Aeq,daytime}$	ABC method category (BS 5228-1)	ABC threshold, $L_{Aeq,daytime}$	Range of monthly predicted construction façade noise level, $dBL_{Aeq,daytime}$	Number of months monthly construction noise levels exceed ABC threshold	Construction activities resulting in construction noise levels exceeding ABC threshold
R4 Penrhiw Cottage	19	9	69	C	75	67-76	1	Centre (Underpass & Ffynnon Woods) – Site clearance and mobilisation
R5 Maes-y-ffynnon	57	8 8a	49-50 61-63	A	65	56-65	1	Ch. 1900-2850 – Site clearance and mobilisation, Earthworks, Pavement
R6 Pen-troyden-Fawr Farm	112	6 (logger)	41-69 (56)*	A	65	49-63	-	-
R7 Blaen-pentroydin	218	5	41-43	A	65	42-52	-	-
R8 Bethel Cottage	25	1	64-66	B	70	65-80	7	East roundabout - Site clearance and mobilisation, Earthworks, Pavement, Drainage
*Overall L_{Aeq} values are the logarithmic (energy) average of the five-minute measurements for the time period 0700-1900 hours								

14.6.9 The results show the BS 5288-1 ABC threshold for potential significant effects is not exceeded at receptors R2 Trefangor Farm, R6 Pen-troyden-Fawr Farm and R7 Blaen-pentroydin. As such, likely effects are assessed as **not significant** at these properties.

14.6.10 The BS 5228-1 ABC threshold is exceeded in some of the months at receptors R1 Penblewin Farm, R3 Henllan Lodge, R4 Penrhiw Cottage, R5 Maes-y-ffynnon and R8 Bethel Cottage. Table 14.9 shows the number of months the value is exceeded as well as providing an indication of the construction activities causing exceedance.

14.6.11 The predicted construction noise levels do not take into account screening either from the natural landform, the formation of cuttings as work progresses or from purpose-built noise barriers. Screening effects could reduce the predicted noise levels by around 5 to 10 dB. The provision of purpose-built noise barriers will be considered further in the CEMP.

14.6.12 In cases where the noise level would seriously affect the enjoyment of an eligible building for a substantial period of time, and no other form of mitigation is reasonably practicable, noise insulation under the Noise Insulation Regulations (1975) could be considered subject to further assessment. There is no set method for determining eligibility however, BS 5228-1 sets out an example which makes reference to a level of 75 $dBL_{Aeq,10hrs}$ being exceeded between the hours of 0800 and 1800 for a total number of days exceeding 40 in any 6 consecutive months amongst other criteria. Due to the small number of properties affected and the potential to mitigate these effects with noise insulation at individual properties, the likely effects are assessed as **not significant** in EIA terms.

14.6.13 The site clearance and mobilisation stage which takes place over the duration of a month results in the highest predicted noise levels. This stage includes tree felling and chipping. Other activities including high noise levels include the breaker during the pavement works and the larger bulldozer and dump truck associated with some sections of the earthworks.

Construction Vibration

14.6.14 There are no piling activities proposed however compaction will be required in the construction process within a few metres from some

sensitive receptors. Typical vibratory rollers which may be used are 4 tonne and 18 tonne Bomag Single Drum Rollers. Model types BW124 DH and 216 DH-5 were assumed respectively for the assessment.

14.6.15 As noted in Section 14.3.37 a complaint is likely where levels occur above 1.0mm/s PPV at residential properties but this exposure can be tolerated if prior warning and explanation was given to residents (BS 5228-2).

14.6.16 Assuming a cautious 5% probability of the predicted value being exceeded, the distance beyond which the vibration level from steady-state operation of the worst case 18 tonne roller is predicted to be below 1.0mm/s is 90m.

14.6.17 For start-up and run-down operation, the equivalent distance is 125m however these operations would be of relatively short duration. Beyond these distances the construction vibration effects are not likely to result in a complaint.

14.6.18 Prior warning and explanation should be given to residents of vibratory compaction activities to reduce the potential impact.

14.6.19 To avoid significant effects, work within these distances will need to be carried out via alternative methods (i.e. a static drum) and/or vibration monitoring would be required. Further assessment of the risk should be undertaken. Assuming that this can be adhered to the construction vibration effects are assessed as **not significant.**

Operational Impacts

14.6.20 Daytime and night-time traffic noise levels within the Scheme study area were predicted in accordance with the methodology set out under Methodology for Operational Impacts. Noise level predictions were made for the Do-Something and Do-Minimum scenarios in both the baseline year (2021) and future year (2036).

14.6.21 Volume 3 Appendix 14.4, lists the noise levels and noise level changes predicted at all dwellings and sensitive receptors within the study area for all scenarios. The following tables are presented:

14.6.22 Table A14-20 shows the predicted noise levels and noise changes for the 18-hour day at all residential receptors.

14.6.23 Table A14-21 shows the predicted noise levels and noise changes during the night-time at all residential receptors.

14.6.24 Table A14-22 shows the predicted noise levels and noise changes during the 18-hour day at other sensitive receptors.

14.6.25 The magnitude of noise change is also shown graphically in the noise level difference contours described below. T he noise change magnitude bands correspond to the classification of magnitude of impact shown in Tables 3.1 and 3.2 of HD 213/11. The magnitude of noise change classifications is also described for the Scheme for the baseline and future years as part of the assessment text later in this section.

14.6.26 The following Volume 2 Figures show predicted daytime traffic noise levels and noise level changes represented in noise level contour maps:

14.6.27 Figure 14.1: Do-Minimum scenario in the 2021 baseline year;

14.6.28 Figure 14.2: Do-Minimum scenario in the 2021 baseline year against the Do-Minimum scenario in the 2036 future year (long-term Do-Minimum);

14.6.29 Figure 14.3: Do-Minimum scenario in the 2021 baseline year against Do-Something scenario in the 2021 baseline year (short-term Do-Something); and

14.6.30 Figure 14.4: Do-Minimum scenario in the 2021 baseline year against Do-Something scenario in the 2036 future year (long-term Do-Something).

14.6.31 The following assessment considers noise impacts and effects for both daytime and night-time periods in accordance with HD 213/11 procedure.

14.6.32 The assessment of the magnitude of daytime-noise change impact was made based on changes in the noise climate between baseline year (2021) without the Scheme and the baseline year with Scheme and baseline year without the Scheme and the future year (2036) with the Scheme.

14.6.33 The assessment of the magnitude of night-time noise change impact was made based on changes in the noise climate between baseline year without the Scheme (2021) and the future year (2036) with and without the Scheme where noise levels are predicted to be above $55dBL_{night,outside}$ in any scenario.

14.6.34 Subsequently an assessment of the effects for both daytime and night-time was made. This describes whether the noise effects in an area affected by the Scheme are rated as significant or not, based on the criteria described under Significance of Effect (from paragraph 14.3.74).

14.6.35 Based on the noise modelling results, Table 14.10 to Table 14.12 give a summary of noise level changes as a result of the Scheme at dwellings and other sensitive receptors in the short and long term across the entire study area. The noise change bands shown in each table correspond to the DMRB HD 213/11 classification of magnitude of impact at each receptor shown in Table 14.3 and Table 14.4. The noise change bands are presented based on first floor results at a height of 4m above local ground as these represent the worst case in most situations.

Table 14.10 Short-term noise reporting table (HD 213/11 Table A1.1) with Scheme

Project/Option: A40 Llanddewi Velfrey to Penblewin				
Scenario/Comparison: Do-Something 2021 compared to Do-Minimum 2021				
Change in noise Level		DMRB Impact category (short term)	Daytime	
			Number of Dwellings	Number of 'other' sensitive receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 – 0.9	Negligible	7	0
	1 – 2.9	Minor adverse	6	0
	3 – 4.9	Moderate adverse	4	0
	5 +	Major adverse	3	1
No Change	0	Negligible	12	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 – 0.9	Negligible	30	1
	1 – 2.9	Minor beneficial	29	0
	3 – 4.9	Moderate beneficial	20	2
	5 +	Major beneficial	43	2

Table 14.11 Long-term noise reporting table (HD 213/11 Table A1.2) with Scheme

Project/Option: A40 Llanddewi Velfrey to Penblewin					
Scenario/Comparison: Do-Something 2036 compared to Do-Minimum 2021					
Change in noise Level		DMRB Impact category (long term)	Daytime		Night-time
			Number of Dwellings	Number of 'other' sensitive receptors	Number of Dwellings
Increase in noise level, $L_{A10,18h}$ dB	0.1 – 2.9	Negligible	32	1	0
	3 – 4.9	Minor adverse	1	0	0
	5 – 9.9	Moderate adverse	6	1	0
	10 +	Major adverse	1	0	0
No Change	0	Negligible	2	0	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	58	1	1
	3 - 4.9	Minor beneficial	13	1	0
	5 - 9.9	Moderate beneficial	27	1	0
	10 +	Major beneficial	14	1	1

Table 14.12 Long-term noise reporting table (HD 213/11 Table A1.2) Do-Minimum

Project/Option: A40 Llanddewi Velfrey to Penblewin					
Scenario/Comparison: Do-Minimum 2036 compared to Do-Minimum 2021[22]					
Change in noise Level		DMRB Impact category (long term)	Daytime		Night-time
			Number of Dwellings	Number of 'other' sensitive receptors	Number of Dwellings
Increase in noise level, $L_{A10,18h}$ dB	0.1 – 2.9	Negligible	106	5	1
	3 – 4.9	Minor adverse	0	0	0
	5 – 9.9	Moderate adverse	0	0	0
	10 +	Major adverse	0	0	0
No Change	0	Negligible	6	0	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	43	1	1
	3 - 4.9	Minor beneficial	0	0	0
	5 - 9.9	Moderate beneficial	0	0	0
	10 +	Major beneficial	0	0	0

[22] Note: the number of dwellings for the Do-Minimum 2036 scenario includes a property which would be demolished with the Scheme (hence not included in tables above for Do-Something scenarios).

14.6.36 In general, the tables show that most dwellings will experience a noise decrease with the Scheme in both the short term and long term. There is an additional increase in noise level as a result of traffic growth on the existing A40 by 2036; predicted to be around +0.5dB(A), leading to more properties moving into the negligible noise increase band.

14.6.37 There are major beneficial impacts predicted at 43 properties in the baseline year including a number of properties currently experiencing very high noise levels in an area which was identified as a NAPPA around Llanddewi Velfrey. In the future year assessment major beneficial impacts are predicted at 14 properties.

14.6.38 In total, 92 residential properties in the baseline year and 54 in the future year are predicted to experience minor to major decreases in noise impact as a result of the Scheme. Two other (non-residential) sensitive receptors are predicted to experience a moderate noise decrease.

14.6.39 There are major adverse impacts predicted at three isolated residential properties and one other sensitive receptor in the short term on opening of the Scheme. In the future year there is only one remaining major impact

14.6.40 In total 13 residential properties in the baseline year and eight in the future year are predicted to experience minor to major adverse noise impacts as a result of the Scheme. One other sensitive receptor is predicted to experience a major adverse noise impact in opening and a moderate noise impact in the long term.

14.6.41 In the absence of the Scheme, 106 residential properties and five other sensitive receptors were predicted to experience a negligible noise increase between 2021 and 2036, six were predicted to experience no change and 43 residential receptors and one other sensitive receptor were predicted to experience a negligible noise decrease. The noise decreases would result from assumed resurfacing by the future year of the remaining section of the Scheme which is currently surfaced with HRA.

14.6.42 The noise level difference maps, Volume 2 Figures 14.2 to 14.4, show the changes in the noise levels between the Do-Something scenarios for years 2021 and 2036 and Do-Minimum scenario 2021 and 2036. Using the information from these figures, the following is a detailed

assessment identifying specific noise impacts and effects around the Scheme. It should be noted that in some cases the noise contours do not pick up the fine detail of the calculations and in this case results shown in Volume 3 Appendix 14.4 may be referred to, to provide further accuracy. The results given in Volume 3 Appendix 14.4 are presented for the façade with 'least beneficial change' for each receptor. This presents the worst-case noise change impact but may not pick up the highest absolute noise impact experienced at a property. Where an understanding of how alternative façades are affected aids understanding of the impacts, a description has been included in the following paragraphs. Further information on the predicted noise levels at all façades of each property is available on request.

14.6.43 Volume 2 Figure 14.2 shows the effects of traffic growth, along with the inclusion of low noise surfacing that would occur in the absence of the Scheme by the future year. This shows that there would be negligible noise increases or decreases (0.1 to 2.9dB(A) bands[23]). Noise increases of typically around 0.5dB(A) are predicted due to traffic growth in the baseline year. It should be noted that the low noise surface will provide -3dB(A) benefit where traffic speeds are predicted to be in excess of 75 km/h (47 miles/hour). Below this speed the noise benefit gradually reduces down to -1.0dB(A). Therefore, negligible noise increases are predicted through the village of Llanddewi Velfrey where traffic speeds are predicted to be below this. This sets the context against which the future year noise increases with the Scheme are considered below.

Scheme Bypass Section

14.6.44 Major noise increases are predicted in the Do-Something baseline year (short-term effects) to both the north and south of the Scheme bypass section (see Table 14.10). This affects a total of three residential properties and one non-residential property in the short term. The affected properties are to the north of the new A40 bypass around Llanddewi Velfrey at Valley View and Castell; properties at the northern extent of Glan Preseli (Brynwylfa and Llanddewi Village Hall) and Maes-y-ffynnon situated to the east of the new junction, equidistant at around 50m from the new bypass and the existing A40 through Llanddewi Velfrey. In the future year (long-term effects, see Table 14.11) there is only one remaining major impact predicted, on the north facing façade of Maes-y-ffynnon. Note that this would to some extent

[23] Note that HD 213/11 specifies different ranges of noise change band for opening (baseline) and future years.

be offset by minor to moderate noise reductions on the remaining façades of this property.

14.6.45 For the same affected properties to the north of the bypass (Castell and Valley View), noise increases affect all façades and lead to noise levels of around 44-45dB$L_{Aeq,16hr}$ (equivalent to 46-47dB$L_{A10,18hr}$ [24]) facing the Scheme in the future year. Although there is a large noise increase at these properties, the predicted absolute noise levels are still low and would be likely to lead to acceptable noise levels inside the properties even with windows open for natural ventilation (i.e. below BS8233 criterion of 35dB$L_{Aeq,16hr}$). Noise levels would also be below the WHO guidelines threshold for moderate annoyance of 50dB$L_{Aeq,16hr\ outside}$. Given that these are two isolated properties and not a larger community of dwellings, and the resulting noise exposure is relatively low, the noise impact is assessed as a not significant effect, based upon the significance criteria parameters defined in both Table 14.5 and Sections 14.3.75 and 14.3.76.

14.6.46 At Brynwylfa and Llanddewi Village Hall on Glan Preseli, to the south of the new bypass section but north of the existing A40, moderate and major noise impacts are forecast respectively in the baseline year. These impacts only affect very small areas of the eastern and northern façades of the two properties respectively which would be well screened from the existing A40 in the baseline situation hence magnifying the impact of noise from the new Scheme. In the future assessment year (long term) these impacts would be minor and moderate.

14.6.47 At the remainder of properties on Glan Preseli impacts range from minor adverse at the northern extents of the residential area to major beneficial at the southern extents in the short term; the majority of impacts on Glan Preseli would be negligible in the long term with just one additional moderate impact on the north-western façade of Awel Deg. Given that in the long term there would be just one moderate adverse noise impact on a non-residential receptor (medium sensitivity), along with one minor and one moderate adverse noise impact on residential properties coupled with absolute noise levels being low (< 55dB$L_{Aeq,16hr}$), effects on the area around Glan Preseli are considered to be not significant. This decision is based upon the significance criteria parameters defined in both Table 14.5 and Section

[24] Note this result is the highest overall predicted result which is different from the least beneficial change result shown in Volume 3 Appendix 14.4 in accordance with HD213/11.

14.3.75 and 14.3.76. The same significance decisions have also been applied to those other properties discussed in Sections 14.6.48 to 14.6.57.

14.6.48 At Maes-y-ffynnon, major adverse noise impacts are predicted in both the short and the long term on the north facing façade; however, there would be an overall reduction in the highest noise levels (>60dB$L_{Aeq,16hr}$[25] currently) experienced at the property (west, south and east façades) to around 48 to 56 dB $L_{Aeq,16hr}$ (on any façade). The bypass section would be in cutting here providing reasonable screening of the property. At the adjacent property Maes-y-Rhos, impacts are predicted to be negligible beneficial. As a result of all these factors, the impacts at these two properties are predicted to be not significant.

14.6.49 There would be a moderate adverse noise impact at Pentroydin fawr Farm as a result of the Scheme in the baseline year, which would also remain as a moderate adverse noise impact in the long term. Although the property is only around 90m from the new bypass, it is well screened by the natural landform and due to the A40 bypass being in deep cutting at this point, such that is passes beneath the existing local road to Llanfallteg. This local road also contributes to the noise climate at Pentroydin fawr Farm. Absolute noise levels are predicted to rise from around 51dB$L_{Aeq,16hr}$ to 56dB$L_{Aeq,16hr}$[26] which would still result in an acceptable external noise climate but may result in a little increased noise intrusion inside the property when windows are open for ventilation. Due to the minor adverse long-term impact being for an individual property and taking into account the relatively low absolute level of noise, this effect is considered to be not significant.

14.6.50 There would be a moderate adverse noise impact at Blaen-pentroydin, situated to the east of Glan Preseli, in the baseline year and future year with the Scheme. Absolute noise levels would remain below 50dB$L_{Aeq,16hr}$ and therefore this effect is assessed as being not significant.

Llanddewi Velfrey Village (South of Existing A40)

14.6.51 Receptors to the south of the existing A40 in and around the village of Llanddewi Velfrey are predicted to experience major beneficial noise impacts reducing to moderate and minor beneficial impacts with

[25] Note this result is different from the least beneficial change result reported in Volume 3 Appendix 14.4.
[26] Note this result is different from the least beneficial change result reported in Volume 3 Appendix 14.4.

distance from the existing A40 in the baseline year with the Scheme in operation. Several properties that are currently subjected to noise levels in excess of 70dB$L_{Aeq,16hr}$ (72dB$L_{A10,18hr}$) on façades facing the existing A40 will experience decreases of 15 to 20dB(A) which will significantly improve the external and internal noise environment within these properties. Moderate to major beneficial effects will remain at a number of properties in the future year (long term).

14.6.52 As the beneficial changes are of moderate to major impact for the community of Llanddewi Velfrey, this is considered to be a significant beneficial effect.

End of Bypass Section to Penblewin Roundabout

14.6.53 At the western end of the bypass section, the Scheme follows the route of the existing A40 approximately, up to Henllan Lodge. The closest property to this section of the Scheme is Penrhiw Cottage at around 20m. This cottage is currently exposed to high levels of road traffic noise (around 68dB$L_{Aeq,16hr}$[27]). Due to a slight movement of the alignment of the A40 away from the property coupled with the inclusion of a low noise surface, Penrhiw Cottage is predicted to experience a moderate noise decrease in the Scheme baseline year and a negligible noise decrease in the future year. This is based on the north facing façade of the property which is predicted to experience the least beneficial change. Changes on the southern façade of the property will result in noise level reductions from 72dB$L_{Aeq,16hr}$ in the baseline situation to 70dB$L_{Aeq,16hr}$[28] with the Scheme in the baseline year.

14.6.54 Similar impacts will apply at Ffynnon Chapel and surrounding properties. As there are only around five properties in this area, this effect is considered to be not significant.

14.6.55 Moving further west are the isolated properties of Henllan Lodge and Bro Minau. These properties are predicted to experience a minor noise reduction in the baseline year, largely due to the inclusion of the low noise surface with the Scheme. Noise changes at these properties are negligible in the long term.

14.6.56 There are three further properties to the south of the existing A40 between Henllan Lodge and Penblewin Roundabout; Trefangor Farm,

[27] Note this result is different from the least beneficial change result reported in Volume 3 Appendix 14.4.
[28] Note this result is different from the least beneficial change result reported in Volume 3 Appendix 14.4.

Cae'rmaenau-Fach and Penblewin Farm. Trefangor Farm is predicted to experience major noise decreases in the baseline year with the Scheme in operation and moderate noise decreases in the future year whilst Cae'rmaenau-Fach is predicted to experience moderate noise decreases in the baseline year and minor noise decreases in the future year. Penblewin Farm is predicted to experience moderate noise decreases in the short term on Scheme opening and minor noise decreases in the long term.

14.6.57 Given the isolated nature of these properties this is considered to be a not significant effect.

14.6.58 Based on the assessment undertaken no dwellings are likely to be eligible for noise insulation under the Noise Insulation Regulations; however, there are differences in the method of assessment for HD213/11 and NIR and hence this will need to be confirmed within six months of the Scheme opening to traffic via a dedicated NIR assessment.

Night-time

14.6.59 DMRB HD 213/11 requires an assessment of the long-term noise impacts at night restricted to properties experiencing noise levels in excess of $55dBL_{night,outside}$ as impacts below this level are considered to be not significant. This decision is again based upon the significance criteria parameters defined in both Table 14.5 and Section 14.3.75 and 14.3.76.

14.6.60 Based on the assessment undertaken using the least beneficial change receptors, only one receptor which is directly affected by the Scheme was predicted to be exposed to noise levels in excess of $55dBL_{night,outside}$ in the baseline Do-Minimum situation. This receptor is predicted to experience a decrease in night-time noise levels. In reality many more receptors close to the existing A40 are likely to be exposed above $55dBL_{night,outside}$ on the façade facing the road and will see benefits of night-time noise reduction as a result of the Scheme.

Indirect Effects

14.6.61 Receptors to the west of Penblewin roundabout at Blackmoor Hill were included in the detailed calculation area as they are within 600m of the physical end of the Scheme. Effects at these properties are negligible in both the short and long term. The inclusion of a low noise surface in

both the Do-Minimum and Do-Something future year scenarios would result in a decrease in noise of 2.5dB(A). No.2 Blackmoor Hill is currently exposed to a noise level just over 55dB$L_{night,outside}$ and therefore will experience a not-significant indirect negligible benefit as a result of a low noise surface with or without the Scheme in the future year at night-time.

14.6.62 All other indirect effects have also been assessed as being negligible.

Nuisance Assessment

14.6.63 As part of the HD 213/11 Detailed Assessment, noise nuisance and airborne vibration nuisance reporting tables are required. Nuisance level is presented as the percentage of people bothered by traffic noise. The method of calculating nuisance level is described in the HD 213/11. The tables show the change in the percentage of people bothered by traffic noise at dwellings for the Do-Minimum and Do-Something scenarios. This has been reproduced in this assessment as Table 14.13 for noise and Table 14.14 for airborne vibration.

14.6.64 Again, it should be noted that no significant effects were assessed.

14.6.65 Within Table 14.13, in the Do-Minimum column the nuisance level presented represents the change in percentage of people bothered by 'steady-state' traffic noise calculated for Do-Minimum opening (baseline) and future years. In the Do-Something column the nuisance level presented is the greatest change in percentage of people bothered by traffic noise relating to either; the change in 'steady-state' noise levels between the Do-Minimum opening and Do-Something future years; or the short-term change in noise levels between Do-Minimum and Do-Something opening scenarios.

Table 14.13 Traffic noise nuisance reporting table (DMRB Table A1.3)

Change in Nuisance Level		**Do-Minimum**	**Do-Something**
		Number of Dwellings	**Number of Dwellings**
Increase in nuisance level	< 10%	106	27
	10 < 20%	0	4
	20 < 30%	0	6
	30 < 40%	0	5
	> 40%	0	2
No Change	0%	6	8
Decrease in nuisance level	< 10%	43	93
	10 < 20%	0	8
	20 < 30%	0	0
	30 < 40%	0	1
	> 40%	0	0

14.6.66 HD 213/11 notes that the relationship between the percentage of people bothered very much or quite a lot by airborne vibration is similar to that for noise nuisance, except that the percentage of people bothered by vibration is lower at all exposure levels by 10%. It is also noted that on average, traffic induced vibration affects a very small percentage of people at exposure levels below 58dBL_{A10} and therefore 0% should be assumed in these cases.

14.6.67 Table 14.14 gives the change in percentage of people bothered by airborne vibration at all dwellings within the study area for Do-Minimum and Do-Something scenarios.

Table 14.14 Traffic noise nuisance reporting table (DMRB Table A1.3)

Change in Nuisance Level		Do-Minimum	Do-Something
		Number of Dwellings	Number of Dwellings
Increase in nuisance level	< 10%	29	11
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0
No Change	0%	125	143
Decrease in nuisance level	< 10%	0	0
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

Ground-borne Vibration

14.6.68 No ground-borne vibration impacts are forecast. This is because, in accordance with highway construction standards, the surface of the proposed upgraded roads would be smooth with no surface irregularities of sufficient size to generate significant levels of ground-borne vibration. It is a standard requirement under the specification for new highways that the new road surfaces would be free of significant discontinuities. The size of irregularities necessary to cause perceptible ground-borne vibration is only expected in 'exceptional circumstances' as discussed in Section 14.3.73. It is not considered that any such exceptional circumstances would arise during operation of the Scheme.

Cumulative Impacts

14.6.69 No other developments were identified which could generate cumulative effects with the Scheme during the construction phase.

14.6.70 The traffic data that informs the noise assessment includes a growth factor to account for new developments and increased use of motorised vehicles in the local area. This was applied to the opening (baseline) and future year traffic data used in the assessment. No developments

were identified that could cause cumulative effects during the operational phase.

14.7 Monitoring

14.7.1 Noise and/or vibration monitoring may need to be undertaken during the construction period (as described in the Pre-CEMP, Section 7.2.21) to verify adequate controls of exposure levels at sensitive receptors.

14.7.2 Welsh Government has a duty under Regulation 6 of the NIR to assess noise levels following the opening of the Scheme to traffic. The purpose of this is to establish the buildings which previously did not qualify for an original offer of carrying out or making a grant in respect of carrying out noise insulation work, but which would have become eligible by virtue of increased traffic flow. Assessments would be carried out in accordance with the obligations set out in the NIR.

14.8 Summary

14.8.1 This chapter has described the standard methodologies applied to assess the noise and vibration effects associated with the Scheme according to the guidance given in DMRB noise assessment method HD 213/11. Significance criteria were established for construction and operational noise and the noise effects quantified across the study area.

14.8.2 Construction noise levels during the proposed works were assessed as not significant. Construction vibration levels during the proposed works were assessed as not significant. This is providing either the distance at which vibratory rollers operate is limited and/or construction vibration monitoring is undertaken along with a further assessment of the risk of impact.

14.8.3 Significant permanent direct beneficial effects were identified for the community of Llanddewi Velfrey as a result of the Scheme in the short and long term. No significant adverse operational noise effects were indicated from the assessment.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 15: All Travellers

A40LVP-ARP-ENM-SWI-RP-C-0001

P05 | S4

17/01/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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15.1 WCHR Assessment Report

15 All Travellers

15.1 Introduction

15.1.1 This chapter of the Environmental Statement (ES) describes the assessment of effects for All Travellers resulting from the proposed new A40 bypass of Llanddewi Velfrey and the new section of the A40 Trunk Road from Ffynnon Wood to Penblewin Roundabout. All Travellers include walkers, cyclists and horse-riders (WCHRs). This assessment considers proposed changes and improvement measures for WCHRs and the opportunities provided by detrunking the existing length of the A40 (which will be bypassed by the proposed new section of A40).

15.2 Legislation and context

Relevant Legislation

15.2.1 Chapter 5 Legislation and Policy Content provides the legislative context for this Environmental Impact Assessment. Relevant legislation to this All Travellers assessment includes the Active Travel (Wales) Act, 2013. This legislation requires

> *'…Welsh Ministers and local authorities to take reasonable steps to enhance the provision made for, and to have regard to the needs of, walkers and cyclists; for requiring functions under the Act to be exercised so as to promote active travel journeys and secure new and improved active travel routes and related facilities; and for connected purposes'.*

15.2.2 The Active Travel Act is supported by the proposed Active Travel Action Plan (Welsh Government, 2014a). The Transport Act 2000 (as amended by the Transport (Wales) Act 2006) is also relevant.

Planning Policy Context

15.2.3 Chapter 5 Legislation and Policy Content provides an overarching policy context for the Scheme. In addition, this assessment takes into account local policy documents relevant to provision for WCHRs. It should be noted that whilst these documents provide context, they are not determinative.

15.2.4 The following national and local policy documents are relevant to this All Travellers assessment:

National Policy

15.2.5 **Prosperity for All: The National Strategy (2017):** The strategy supports the Programme for Government up to 2021 and sets out the Welsh Government's commitment to deliver improvements to the A40.

15.2.6 **Planning Policy Wales Edition 10 (2018)** emphasises the need to prioritise the safeguarding and delivery of active travel networks as part of development schemes. The fundamental aim should be to create walkable neighbourhoods, where streets are safe, comfortable and enjoyable to walk and cycle. A range of facilities should also be within walking distance. Active travel networks can also help to mitigate the impact of new development, by providing an alternative mode of travel to the private car, particularly for shorter journeys.

15.2.7 Developments should be designed in accordance with the sustainable transport hierarchy of which places walking and cycling at the top followed by public transport, ultra-low emissions vehicles, and finally other private motor vehicles. It is nonetheless acknowledged that different approaches to sustainable transport will be required for rural areas in particular, and that proposals will need to reflect local circumstances. Additional car movements should not be encouraged by transport proposals or contribute to neighbourhood severance.

15.2.8 **National Transport Plan and Finance Plan (2010 and 2015):** The plan sets out investment for transport and services from 2015 and beyond. Scheme Ref R15 commits to improvements to the A40 Llanddewi Velfrey to Penblewin.

15.2.9 **Sport, Recreation and Open Space Technical Advice Note (TAN) 16 (2009):** The TAN discusses development management issues regarding the design of facilities and spaces, and noise and accessibility. It also considers how planning agreements can help to ensure the provision and maintenance of facilities.

15.2.10 **Transport Technical Advice Note (TAN) 18 (2007):** The TAN includes advice on walking and cycling, public transport, planning for transport infrastructure, assessing impacts and managing implementation.

15.2.11 **One Wales: Connecting the Nation (2008):** This is the Wales Transport Strategy and it sets out how the Welsh Government aims to provide sections of segregated cycleway next to the A40 in West Wales.

Local policy

15.2.12 **Pembrokeshire County Council Local Development Plan (LDP) (2013):** The Plan establishes a vision based development strategy and policies to guide the development and use of land in Pembrokeshire from adoption to 2021. The Pembrokeshire Coast National Park is subject to a separate LDP that is the responsibility of the National Park Authority. It provides the policy context for directing development to appropriate locations, conserving the natural, built and historic environment and providing a basis for rational and consistent decision-making on planning applications. The vision of the plan is:

> *"To ensure that Pembrokeshire is prosperous and that it remains vibrant and special by creating: a network of strong urban and rural communities in Hub Towns, Service Centres, Service and Local Villages supported by a robust, sustainable, diverse high value-adding economy underpinned by the Area's unique environment, maritime access to the Milford Haven Waterway and Fishguard Harbour and internationally important energy and tourism opportunities."*

15.2.13 **The Joint Transport Plan for South West Wales (2015-2020):** This Local Transport Plan (LTP) replaces the Regional Transport Plan up to 2015 and the four authorities in South West Wales have worked collaboratively to create an overarching City Region LTP, with four local programmes of projects.

15.2.14 **Pembrokeshire Rights of Way Improvement Plan (2008)**: Pembrokeshire County Council and the Pembrokeshire Coast National Park Authority agreed to prepare jointly the Rights of Way Improvement Plan for Pembrokeshire (ROWIP). The plan identifies, prioritises and plans for improvements to the rights of way network in Pembrokeshire. It also addresses the need to improve access opportunities for groups with special needs.

15.3 Assessment Methodology

Scope of the Assessment

15.3.1 This All Travellers assessment considers the effects on the following resources.

a) Public rights of way (footpaths, bridleways and restricted byways).
b) Cycle routes.
c) Permissive walking, cycling and horse-riding (WCHR) routes.
d) Public highways.
e) Public transport.
f) Overbridge and underpass crossings.

15.3.2 And the assessment takes into account the following matters:

a) Permanent land take required for the Scheme.
b) Construction of the proposed new section of trunk road.
c) Operation of the proposed new section of trunk road.
d) Detrunking of the existing A40 trunk road, both during construction and operation.

15.3.3 In addition, changes in amenity, effects on community severance, and driver stress are described.

15.3.4 The assessment of effects on 'Views from the Road' is set out in Chapter 9 Landscape and Visual Effects.

Relevant Guidance

15.3.5 The following guidance documents are relevant to this assessment:

a) **Design Manual for Roads and Bridges (DMRB) Volume 11**, Section 2, Part 5, HA 205/08 (Highways Agency et al., 2008);
b) **DMRB Volume 11, Section 3, Part 8 'Pedestrians, Cyclists, Equestrians and Community Effects'** (Highways Agency, 1993a) in respect of the potential effects on pedestrians, cyclists and equestrians;
c) **DMRB Volume 11, Section 3, Part 9 'Vehicle Travellers'** (Highways Agency, 1993b) in respect of the potential effects on driver stress; and

d) **DMRB Interim Advice Note 125/09(W) Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment'** (Wales Only) (Welsh Assembly Government, 2009).

15.3.6 With respect to walkers, cyclists and horse-riders the requirements of the DMRB Volume 11, Section 3, Part 8 (Highways Agency, 1993a) are as follows.

a) Provide a qualitative assessment of the existing provision of, and proposals for, walking, cycling and horse-riding facilities which may be affected by the Scheme, including the existing usage of these facilities.

b) Provide a qualitative assessment of the potential changes in the type and level of provision of walking, cycling and horse-riding facilities as a result of the Scheme.

c) Provide a qualitative assessment of the effects on non-vehicular movements resulting from the Scheme, including any changes to journey lengths, amenity or safety, and any likely changes to community severance.

15.3.7 For the purposes of this assessment, amenity is defined as the relative pleasantness of the environment or journey. Various criteria are employed to assess the effect on amenity including levels of visual intrusion and noise, which are assessed in detail in Chapter 9 Landscape and Visual Effects, and 14 Noise and Vibration. In accordance with DMRB methodology in relation to changes in amenity, a commentary of the relevant sections of those assessments is set out in relation to changes in amenity for All Travellers during construction and operation of the Scheme.

15.3.8 Community severance is defined as 'the separation of residents from the facilities and services they use within their community' (DMRB Volume 11, Section 3, Part 8 (Highways Agency, 1993a, paragraph 5.2)).

Study Area

15.3.9 DMRB Volume 11, Section 3, Parts 8 and 9 (Highways Agency 1993a, 1993b) do not specify a study area for the assessment of effects on walkers, cyclists, horse-riders and vehicle travellers, although Part 8 references the need to identify existing and proposed Public Rights of Way (PRoWs) that may be affected by the route corridor, particularly those used for visiting important community facilities (paragraph 9.4(i)).

15.3.10 The All Travellers study area for the Scheme therefore includes those routes in the area between Penblewin Roundabout and east of Llanddewi Velfrey, as shown on Volume 2 Figure 15.1.

Approach to Identification of Baseline Conditions

15.3.11 A desk-based study to identify baseline conditions has been undertaken to establish the existing provision of walking, cycling and horse-riding facilities, vehicle routes and the existing travel patterns and use of these resources. This has utilised the following data sources:

a) Walking, Cycling and Horse Riding Assessment Report. (Extract provided at Volume 3 Appendix 15.1)
b) Ordnance Survey (OS) mapping.
c) OS MasterMap Address Layer data.
d) Definitive map of PRoWs.
e) OS Points of Interest data.
f) Pembrokeshire County Council at www.pembrokeshire.gov.uk.
g) Sustrans web-based data at www.sustrans.org.uk.
h) Data from public transport operators.
i) Recreational data available from local authority and web resources.

15.3.12 The walking, cycling and horse-riding baseline conditions have also been established by undertaking site visits and PRoW condition and user surveys. The user surveys provided data on WCHR flows and the nature of WCHRs, which is set out in the Walking, Cycling and Horse Riding Assessment Report for the Scheme (Volume 3 Appendix 15.1).

15.3.13 A number of site surveys and visits were undertaken in 2017, as listed in Table 15.1 below.

Table 15.1 Site Survey and Visit Dates

Date	Purpose
17 May 2017	To carry out a WCHR User Survey.
18 May 2017	To carry out a WCHR User Survey.
20 May 2017	To carry out a WCHR User Survey.
21t May 2017	To carry out a WCHR User Survey.
24 May 2017	To carry out a WCHR User Survey.
25 May 2017	To carry out a WCHR User Survey.
21 November 2017	To assess the condition of existing PRoWs.

15.3.14 The purpose of these surveys and visits was to ascertain the nature and condition of the routes crossing or proximate to the Scheme and to check for obstructions and indications of evidence and level of use. Discrepancies regarding the alignment of routes or incidences where there is no evidence of the route on the ground were also noted and subsequently discussed with Pembrokeshire County Council.

15.3.15 The PRoW user survey was undertaken during 2017 to ascertain the level of walking, cycling and horse-riding use of the PRoWs and other linear resources within the study area. This survey was undertaken on two separate occasions that included weekdays and weekends, so that a fair estimation of public use could be made.

15.3.16 The following survey locations were selected taking account of popular walking, cycling and horse-riding routes. These are shown on Volume 2 Figure 15.1.

a) Site 1 - Penblewin Roundabout (National Grid reference (NGR 211996, 216658).
b) Site 2 – Footpath SP 19/31/3 Bounty Manor (National Grid reference (NGR 212566, 217046).
c) Site 3 – Trefangor Burial Ground access road at junction with Footpath SP 19/36/3 (National Grid reference (NGR 213244, 217095).
d) Site 4 - Ffynnon Chapel on footpath SP19/37/1 (National Grid reference (NGR 213657, 216874).
e) Site 5 - Pen-troydin-fach Farm, at junction between footpaths SP19/37/2, SP 19/38/2 and SP19/38/1 (National Grid reference (NGR 214292, 217144).
f) Site 6 – Public Footpath SP19/1/1 (National Grid reference (NGR 215128, 217201).

g) Site 7 – Public Footpath SP19/2/2 at junction SP19/3/1, SP19/3/2, SP19/2/1. (National Grid reference (NGR 215456, 217177).

h) Site 8 – Public Footpath SP19/4/5 at junction with the A40 (National Grid reference (NGR 215745, 216949).

i) Site 9 – A40 layby adjacent to Bethel Chapel (National Grid reference (NGR 215951, 216975).

j) Site 10 - A40-Llanfallteg Road Junction (National Grid reference (NGR 214762, 216892).

Consultation

15.3.17 A summary of consultations with stakeholders and consultees is provided in Table 15.2.

Table 15.2 Consultation Responses Relevant to this chapter

Date	Consultation and Issue Raised	How/Where Addressed
2017	Scoping report sent to consultees. Responses received but none relating to All Travellers.	No action required.
2017	Public Information Exhibition (PIE) April 2017 The feedback identified that WCHR provision was of interest to a number of local residents with many interested in how the old A40 could be modified to improve connectivity and WCHR recreational use.	These matters are dealt with in the Land Take, Construction and Operational Effects section of this chapter.
2017	A British Horse Society Representative visited the PIE. The feedback was that the proposed Equestrian Underpass provides an important link for the bridleways in the area.	These matters are dealt with in the Land Take, Construction and Operational Effects section of this chapter.
2017	Public Information Exhibition (PIE) October 2017 – concerns were raised over the need for the equestrian underpass due to little minimal usage of existing bridle path and no local horse clubs	The horse underpass has been relocated to Ffynnon Wood to maximise its use by pedestrians. The British Horse Society has been consulted with on the revised proposal with the response being positive.

Date	Consultation and Issue Raised	How/Where Addressed
2017	Pembrokeshire County Council 1st meeting. Design should retain and enhance convenience and amenity for users. Initial layouts were presented- consideration of the eastern junction form was discussed with respect to WCHRs.	Maintenance of the PRoW network arising from the Land Take, Construction and Operation of the Scheme are covered in those sections of this chapter. Issues associated with amenity are covered under Construction and Operational Effects sections of this chapter.
2017	Design Commission for Wales "An integrated approach to detailed design should include consideration of … … underpass design for footpaths etc…" They encourage a positive vision for village and existing road.	These matters are dealt with in the Land Take, Construction and Operational Effects section of this chapter.
2017	Llanddewi Velfrey Community Council. The community council raised concerns over the potential option of providing a T Junction arrangement at the eastern junction. It was felt that users, often large agricultural vehicles would struggle with the layout. A common movement is also turning right out of the village towards St. Clears, which it was felt a roundabout would be easier to make this manoeuvre.	The Community Council's views were taken into account in the decision-making process of the junction form at the Llanddewi Velfrey Eastern Junction.
2017	Pembrokeshire County Council 2nd meeting A meeting to present the Scheme proposals and to discuss measures to be incorporated into the Scheme to ensure that connectivity of the highway network (including PRoWs and other WCHR routes) was maintained during construction and operation. Discussion on the provision of the Detrunked Carriageway showed the importance of the consideration of the options.	These matters are dealt with in the Land Take, Construction and Operational Effects section of this chapter.
2017	Public Information Exhibition (PIE) October 2017 Upon presenting the scheme proposals to the public, the suitability of the location of the equestrian underpass near Henllan Lodge raised. WCHR provision was also raised, with the provision of new routes to encourage WCHR use, especially in relation to the detrunked A40, considered important.	The underpass has been moved away from near Henllan Lodge and is now located at the intersection of SP19/30/1 and SP19/37/1. WCHR provision has formed the core of the detrunking proposals, with a new shared pedestrian and cycle track proposed through Llanddewi Velfrey.

Date	Consultation and Issue Raised	How/Where Addressed
2018	Pembrokeshire County Council 3rd meeting. A meeting to present the latest Scheme proposals, with a particular focus on the detrunking design. The designs were well received with no issues raised.	No action required.

Assessment Criteria and Assignment of Significance

15.3.18 A qualitative assessment of impacts on All Travellers based on professional judgement has been undertaken to indicate the significance of effects on identified receptors, based on the value or sensitivity of the receptor and the magnitude of the predicted impact.

15.3.19 The significance of a potential effect is a function of the value or sensitivity of the resource or receptor and the magnitude of the impact (including the timescale involved - permanent or temporary). The criteria for assessing the significance of environmental effects on all travellers take account of the guidance that is provided on this topic in the DMRB Volume 11, Section 2, Part 5 (HA 205/08) (Highways Agency et al., 2008) as set out in Chapter 4 Environmental Impact Assessment Methodology.

Receptor Sensitivity

15.3.20 The receptors relevant to the All Travellers assessment comprise the walking, cycling and horse-riding facilities that may be affected by the Scheme, the users of those facilities, and vehicle travellers along the existing A40, the proposed new section of trunk road and other roads within the area.

15.3.21 The value or sensitivity of these receptors relates to the importance of the resource, facility or receptor together with its sensitivity to change, and the All Travellers assessment uses the categories of sensitivity/value (i.e. high, medium, low or negligible) in Table 15.3 and as set out in Chapter 4 Environmental Impact Assessment Methodology.

Table 15.3 Definitions of Sensitivity or Value for All Travellers

Value (sensitivity)	Typical Descriptors
Very high	Very high importance and rarity, international scale and very limited potential for substitution.
High	High importance and rarity, national scale, and limited potential for substitution.
Medium	High or medium importance and rarity, regional scale, limited potential for substitution.
Low (or Lower)	Low or medium importance and rarity, local scale.
Negligible	Very low importance and rarity, local scale.

15.3.22 The sensitivity/value of each resource, facility or receptor is set out in the assessment section of this chapter. For example, local PRoWs would generally be of 'low' importance and therefore 'low' sensitivity. However, where such routes are promoted regionally or nationally, such as a National Cycle Route, they would have an increased level of importance/sensitivity.

Magnitude of Impact

15.3.23 The magnitude (or scale) of change (adverse or beneficial) on All Travellers resources or receptors is described using the levels of impact in Table 15.4 and as set out in Chapter 4 Environmental Impact Assessment Methodology.

Table 15.4 Definitions of Impact Magnitude for All Travellers

Magnitude of Impact	Typical Criteria Descriptors
Major	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse).
	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).
Moderate	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements (Adverse).
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).
Minor	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse).
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse).
	Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).
No Change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

Significance of Effect

15.3.24 The sensitivity of the receptor and the magnitude of impact have been identified separately and contribute to the evaluation of the likely significance of the effect. The evaluation of significance is based on the All Travellers objectives for the Scheme, outcomes of consultations to date and professional judgement, and has been assessed in accordance with the approach recommended by the DMRB Volume 11, Section 2, Part 5 (HA 205/08) (Highways Agency et al., 2008) and supplementary advice in Interim Advice Note 125/09(W) (Welsh Assembly Government, 2010) as presented in Chapter 4 Environmental Impact Assessment Methodology. That uses the following terminology: Very Large, Large, Moderate, Slight and Neutral, as set out in the significance matrix in Table 15.5.

Table 15.5 Significance of Effect for All Travellers

Value/ Sensitivity	**Magnitude of Impact**				
	No Change	Negligible	Minor	Moderate	Major
Negligible	Neutral	Neutral	Neutral or slight	Neutral or slight	Slight
Low	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or Moderate
Medium	Neutral	Neutral or slight	Slight	Moderate	Moderate or Large
High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
Very high	Neutral	Slight	Moderate or Large	Large or Very Large	Very Large

15.3.25 Those levels of significance apply to both adverse and beneficial effects during the construction period and arising from the operation of the Scheme. For the All Travellers topic these take account of the guidance set out in Table 2.3 of the DMRB Volume 11, Section 2, Part 5 (HA 205/08) (Highways Agency et al., 2008) as set out in Chapter 4 Environmental Impact Assessment Methodology and Table 15.6.

Table 15.6 Significance of Effect Categories for All Travellers

Significance category	**Typical Descriptors of Effect**
Very Large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	These beneficial or adverse effects may be important but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the project.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

15.3.26 For the purposes of this assessment those effects identified as being of 'Moderate' significance or greater are regarded as being significant in EIA terms. Effects of 'Slight' or lesser significance have been identified but are not considered significant in EIA terms.

Changes in Amenity

15.3.27 Amenity is defined in DMRB Volume 11, Section 3, Part 8 (Highways Agency, 1993a) as 'the relative pleasantness of a journey' (paragraph 4.1) and changes to the amenity of journeys undertaken by pedestrians, equestrians and cyclists may include exposure to and distance from traffic, visual and noise intrusion, together with the quality of WCHR routes including street furniture, planting and signage.

15.3.28 In accordance with the methodology set out in the DMRB, a description of the overall change in amenity for WCHR journeys is provided taking account of the assessments set out in Chapter 9 Landscape and Visual Effects and Chapter 14 Noise and Vibration.

Community Severance Assessment

15.3.29 Community severance is defined in DMRB Volume 11, Section 3, Part 8 (Highways Agency, 1993a) as 'the separation of residents from facilities and services they use within their community caused by new or improved roads or by changes in traffic flows'.

15.3.30 The methodology adopted for the assessment of community severance follows the guidance set out in this section of the DMRB. The DMRB Volume 11, Section 3, Part 8 states that the assessment of community severance should be undertaken for the opening year of the Scheme and should take into account the following.

a) The direct effects of the Scheme and any increases in traffic levels on other roads.
b) The number of people whose journey will be affected, their location and the community facilities from which they will be severed.
c) The presence of particularly vulnerable groups such as children, the aged and the disabled.
d) The type of road involved.
e) The provision of mitigation.

15.3.31 These guidelines apply specifically to any increases in the length of journeys of pedestrians. The DMRB states that 'cyclists and equestrians are less susceptible to severance because they can travel more quickly than people on foot, although they may still be deterred from making journeys which require them to negotiate additional roads and especially junctions'.

15.3.32 The guidance states that new severance should be described using a three-point scale of Slight, Moderate or Severe severance as follows:

a) *Slight:* In general, the current journey pattern is likely to be maintained, but there will probably be some hindrance to movement.

b) *Moderate:* Some residents, particularly children and elderly people, are likely to be dissuaded from making trips. Other trips will be made longer or less attractive.

c) *Severe:* People are likely to be deterred from making trips to an extent sufficient to induce a re-organisation of their habits. This would lead to a change in the location of centres of activity or in some cases to a permanent loss to a particular community. Alternatively, considerable hindrance will be caused to people trying to make their existing journeys.

View from the Road Assessment

15.3.33 The assessment of 'View from the Road' which the DMRB defines as 'the extent to which travellers, including drivers, are exposed to different types of scenery through which a route passes' is set out in Chapter 9 Landscape and Visual Effects, of this ES.

Driver Stress Assessment

15.3.34 The methodology adopted for the assessment of driver stress follows the guidance provided in the DMRB Volume 11, Section 3, Part 9 (Highways Agency, 1993b).

15.3.35 Driver stress is defined for the purposes of environmental assessment as 'the adverse mental and physiological effects experienced by a driver traversing a road network' (Highways Agency, 1993b, paragraph 3.1).

15.3.36 A variety of factors including traffic speed and flow, road layout, signage, and evenness of road surfacing can influence stress levels and induce 'feelings of discomfort, annoyance, frustration or fear

culminating in physical and emotional tension that detracts from the value and safety of a journey' (Highways Agency, 1993b, paragraph 3.1).

15.3.37 The DMRB states that driver stress has three main components:

1. Frustration;
2. Fear of potential accidents; and
3. Uncertainty relating to the route being followed.

15.3.38 The definitions of these terms and some of the criteria contributing to them, as stated in the DMRB (Highways Agency, 1993b), are as follows:

1. 'Frustration is caused by a driver's inability to drive at a speed consistent with his or her own wishes in relation to the general standard of the road. It increases as speed falls in relation to expectations and may be due to high flow levels, intersections, roadworks or difficulties in overtaking slower traffic. Congestion can lead to frustration by creating a situation in which the driver does not feel in control…….'
2. Fear of potential accidents results from the 'presence of other vehicles, inadequate sight distances and the likelihood of pedestrians stepping out into the road'. Additional factors such as 'inadequate lighting, roadworks, narrow roads and poorly maintained surfaces' are also contributing factors. According to the DMRB fear is highest where traffic speeds, flows and the percentage of HGVs are all high and these factors are of more importance during adverse weather conditions. A new scheme may increase driver stress because of increased traffic speeds and flows, although the superior driving standards of a new scheme often offset this.
3. Uncertainty is defined by DMRB as being primarily caused by signing 'that is inadequate for the individual's purposes'.

15.3.39 The DMRB maintains that 'available research evidence does not permit the use of finely graded assessments of driver stress'. Consequently, as an indicator of driver stress, the DMRB tabulates the relationship between average peak hourly vehicle flow per lane and average journey speed in kilometres per hour to describe levels of driver stress on a three-point descriptive scale: Low, Moderate or High.

15.3.40 The DMRB (Highways Agency, 1993b) provides separate guidance depending on the design standard of the road being assessed. Guidance relevant to single carriageway roads is set out in Table 15.7.

Table 15.7 Single Carriageway Roads

Average peak hourly flow per lane, in flow Unit*/1 hour	**Average Journey Speed (kph)**		
	Under 50	50 to 70	Over 70
Under 600	High**	Moderate	Low
600 to 800	High	Moderate	Moderate
Over 800	High	High	High

15.3.41 The DMRB requires an assessment to be made for the existing situation and also for the worst case in the fifteen years after opening. Traffic data for the year 2015 has been used to assess the degree of driver stress in the existing situation between Penblewin Roundabout and Llanddewi Velfrey. Predicted traffic flows and design speeds for 2035 have been used to assess the situation in the fifteenth year after the opening of the Scheme.

Limitations of the Assessment

15.3.42 The assessment relies, in part, on data provided by third parties (e.g. local authorities) which are the most up to date available at the time of the assessment. No significant changes or limitations in these datasets have been identified that will affect the robustness of the assessment for EIA purposes.

15.4 Baseline Environment

15.4.1 The proposed new section of trunk road is located within the administrative area of Pembrokeshire County Council. Outside of the settlement of Llanddewi Velfrey, the land is mainly farmland and woodland. The area is sparsely populated with small community of Ffynnon to the west of Llanddewi Velfrey.

PRoWs

15.4.2 In addition to the road network linking the small settlements of Llanddewi Velfrey, Ffynnon and Penblewin, pedestrians, cyclists and equestrians have access to a network of PRoWs. These predominantly comprise public footpaths, with fewer public bridleways and no restricted byways as shown on Volume 2 Figure 15.1.

15.4.3 These PRoWs are predominantly used for informal recreation, as well

as for providing WCHR access within and between settlements and to the adjacent countryside. Some already cross the existing highway network, at at-grade crossings. Some of these allow for a variety of circular walks of varying distances.

Public Footpaths

15.4.4 The following public footpaths either cross the proposed scheme or directly link with it, as shown on Volume 2 Figure 15.1: SP19/31/3; SP19/37/1; SP19/30/1; SP19/38/1; SP19/38/2; SP19/1/1; SP19/2/2; SP19/3/2; SP19/4/5; SP19/4/7; and SP19/17/1.

15.4.5 The following public footpaths are in the close vicinity of the proposed trunk road and link to the footpaths noted above:

a) SP19/36/3 – North of the A40 and links to the unnamed Public Road that leads from the existing A40 to Trefangor Burial Ground;
b) SP19/37/2 - Runs parallel with the proposed Scheme and links to footpaths SP19/38/1 and SP 19/38/2 that are affected by the proposed Scheme; and
c) SP19/4/6 – to the north of the proposed Scheme, links footpaths SP19/4/5 and SP19/4/7 that are affected by the proposed Scheme.

Public Bridleways

15.4.6 No public bridleways cross the proposed new section of trunk road.

15.4.7 The following public bridleways are in the close vicinity of the Scheme, but are not directly affected by the proposals:

a) Bridleway SP19/34/4 is north of the existing A40 and links to the unnamed Public Road that leads from the existing A40 to Trefangor Burial Ground.
b) Bridleway SP19/29/3 is south of the existing A40 and links to the unnamed Public Road that leads from the existing A40 to Henllan Farm and Llanddewi Velfrey.

Restricted Byways

15.4.8 No Restricted Byways cross the proposed new section of trunk road.

Long Distance Paths

15.4.9 No long-distance paths cross the proposed new section of trunk road or are in the vicinity of the scheme.

Cycle Routes

15.4.10 No cycle routes cross the proposed new section of trunk road or are in the vicinity of the scheme.

Other Routes Used by WCHRs

15.4.11 There are a number of unclassified county roads, together with undesignated informal routes within the study area that are used or could be used by walkers, cyclists and horse-riders as follows:

a) Unnamed Public Road that leads from the existing A40 to Trefangor Burial Ground;
b) Unnamed Public Road that leads from the existing A40 to Henllan Farm and Llanddewi Velfrey;
c) Layby and access to Ffynnon, forms part of the A40 Trunk Road; and
d) Unnamed road that leads from Llanddewi Velfrey to Llanfallteg.

PRoW Surveys

15.4.12 Surveys were carried out to determine the usage of PRoWs surrounding the site. Survey locations were chosen based upon the new Scheme highway alignment, and are shown on Volume 2 Figure 15.1, with more information available in the WCHR Assessment Report found in Volume 3 Appendix 15.1.

15.4.13 The PRoW surveys identified that none of the surveyed routes were well used. In the majority of cases no counts were recorded. The results of the survey can be found in the WCHR Assessment Report at Volume 3 Appendix 15.1.

15.4.14 The surveys were undertaken in May 2017 to observe trends in WCHR activity within the vicinity of the proposed new section of trunk road for a variety of route types, including trunk road, local roads and PRoWs. Each route was surveyed on a single weekday, and a Sunday, between 0700 and 1900.

15.4.15 The WCHR Assessment Report concludes that, based on the results of the surveys, it can be observed that there is minimal WCHR activity on all routes. This corresponds with information gathered at Public Information Exhibitions and through discussions with the local land owners.

Public Highways

15.4.16 The local highway network between Penblewin and Llanddewi Velfrey is limited. The main route is the existing A40 Trunk Road. Small unnamed local routes have been described in the "Other WCHR Routes Used by WCHRs".

15.4.17 The existing A40 Trunk Road is a two-lane single carriageway, generally subject to the national speed limit. However, this reduces to 40mph within the village of Llanddewi Velfrey. There are no restrictions for any user groups.

15.4.18 Generally, there are grass verges on either side of the carriageway and several public footpaths connect to the A40 carriageway. Connectivity between these public footpaths requires crossing the carriageway with no formalised crossing points.

15.4.19 The existing A40 that passes through the village of Llanddewi Velfrey has a footway on the southern verge. This extends from the junction between the A40 and "Llanfallteg Road" to the top of Fron Hill. The footway is very narrow in places and not inviting for users. There is a single uncontrolled pedestrian crossing located near to the war memorial.

15.4.20 Land adjacent to the highway is generally used for farming, with a number of farm accesses joining the carriageway. Some residential and commercial properties also front the carriageway.

Overbridge and Underbridge Crossings

15.4.21 There are no Public Highways and PRoWs crossing the existing A40 between Penblewin Roundabout and Llanddewi Velfrey on overbridges or underpasses.

Public Transport and Bus Stops

Local Buses

15.4.22 There is one bus service that stops at Llanddewi Velfrey. The 322 service operates six days a week from Monday to Saturday and travels between Haverfordwest and Carmarthen. The bus stops at the War Memorial at the junction between the A40 and "Llanfallteg Road". The bus stops have shelters.

15.4.23 First Cymru, Edwards Coaches, Alun Phillips and Taf Valley Coaches currently operate the local bus services in and around south-east Pembrokeshire. Services operate six days a week.

15.4.24 Pembrokeshire County Council, in conjunction with several other organisations, operate a "Bwcabus" demand responsive service within central and north Pembrokeshire. The bus service interchanges at Clunderwen to connect with strategic route service 430 and the National Rail network. Bwcabus services operate between Monday – Friday, 0700 - 1430 and Saturday 0900 - 1700.

15.4.25 Bus stops in and around south-east Pembrokeshire generally have no cycle parking facilities nearby. Some have shelters, but most are a standard pole and flag bus stop. None have real time travel information displays and timetable display boards are attached to the poles. Buses also do not permit the carriage of cycles.

National Rail

15.4.26 Rail services are available from the following stations in and around the study area:

a) Whitland;
b) Narberth; and
c) Clunderwen.

15.4.27 All of these stations offer direct rail services to Carmarthen along the South Wales mainline. Whitland serves direct trains travelling to Pembroke Dock, Milford Haven and Fishguard Harbour. Many services connect to Carmarthen where additional services to Swansea, Cardiff, Bristol, South West England and Manchester are available.

Traffic Data

15.4.28 A Transport Model has been produced to prepare traffic forecasts for the Scheme. A base year SATURN traffic model representing 2016 was developed based on traffic counts and roadside interview data. Traffic forecasts were then prepared using traffic growth projection from Department for Transport's National Trip End Model (NTEM) for cars and the National Transport Model (NTM) for goods vehicles. These are further documented in the Traffic Forecasting Report.

15.4.29 The model represents the AM, inter peak and PM peak periods on an average weekday for the opening year of 2021 and the design year of 2036, as follows:

a) The peak hour (0800 – 0900);
b) The average Inter Peak hour (1000 – 1600); and
c) The PM peak hour (1700 – 1800).

15.4.30 The peak hourly flows for the design year are set out under the Assessment of Operational Effects below.

15.4.31 The model also considers the 12-hour, 18-hour, Average Annual Weekday Traffic (AAWT) and Average Annual Daily Traffic (AADT) flows on roads adjoining the proposed new section of highway, with the latter (including HGVs) presented in Table 15.8.

Table 15.8 Traffic flows (including HGVs) on roads adjoining the proposed new section of highway.

Location	2-Way AADT			
	Base Year (2016)	Design Year (2036)		
		Do Minimum	Do Something	Difference
Existing A40 between Penblewin and Rest Area	11,520	14,390	1150	-92%
Existing A40 between Rest Area and Henllan Lodge	11,150	14,180	130	-99%
Existing A40 East of Llanfallteg Road	10,940	13,780	520	-96%
Proposed A40 Between Penblewin Roundabout and Llanddewi Velfrey West Junction	-	-	14,070	-
Proposed A40 Between Llanddewi Velfrey's eastern and western junctions	-	-	13,300	-

Future Baseline Conditions

15.4.32 The following baseline scenarios have been taken into consideration during the assessment of the Scheme, where appropriate.

a) Construction stage: The start of construction – Spring 2020.

b) Operational stage: A future year when the new A40 route will be open to traffic – Winter 2021.

c) A design year, 15 years after opening – Spring 2036.

15.4.33 Potential changes to the baseline conditions may arise, for example, from changes to the definitive maps of PRoWs in Pembrokeshire, initiatives coming forward arising from the Active Travel (Wales) Act 2013, other public transport proposals and new walking, cycling and horse-riding routes incorporated into new development schemes.

15.4.34 As discussed fully in Chapter 2 The Project, the additional flow due to construction traffic is expected to be an average of 28 vehicles per day.

15.5 Mitigation Measures Forming Part of the Scheme Design

15.5.1 As set out in Chapter 2 The Project and in Section 15.6 below, the Scheme includes permanent diversions for a number of routes that will be affected by the proposed new section of trunk road. In addition, two new public bridleways and two new public footpaths will be created as part of the Scheme. A new bridleway will be created that will run from the public highway leading to Trefangor Burial Ground, east along the highway boundary to Ffynnon Chapel, where it intersects with footpath SP19/30/1. At this location, the new northern bridleway will pass beneath the proposed A40 in a new underpass.

15.5.2 A new combined equestrian, cycling and pedestrian link will be provided along the southern highway boundary of the A40, running east from just south of Henllan Lodge to meet the detrunked A40 at Llanddewi Velfrey Western Junction. This route will link to the proposed bridleway described in the previous paragraph.

15.5.3 Measures such as junction arrangements, signage and lighting form part of the design of the Scheme to minimise driver stress. The measures forming part of the Scheme (embedded mitigation) to maintain connectivity are described in Chapter 2 The Project and in Sections 15.6, 15.7 & 15.8 below.

15.5.4 Landscape and visual mitigation has been addressed as part of an iterative design and assessment process for the Scheme (e.g. woodland planting and other vegetation, boundary treatment.). This is assessed in Chapter 9 Landscape and Visual Effects.

15.6 Assessment of Potential Land Take Effects

15.6.1 The assessment of effects provided in this section takes into account the mitigation measures that are integral to the design of the Scheme, including the embedded mitigation measures described in this section.

PRoWs

15.6.2 The following PRoWs, or sections thereof, that fall within the permanent land take area for the proposed new section of trunk road will be permanently stopped up (see Table 15.9). This will be

undertaken during the construction stage, with diversions that have been developed as part of the design of the new section of trunk road put in place to maintain the connectivity of the local network (see Volume 2 Figures 15.2A and 15.2B). These diversions have been developed in consultation with Pembrokeshire County Council.

Table 15.9 PRoWs within Permanent Land Take

PRoW Reference	Location	Land Take Effect
SP19/31/3	Bounty Farm Access Road	A section of this public footpath will be stopped up. A new public highway is proposed to run parallel with the proposed new trunk road. The footpath will link to this route to maintain connectivity.
SP19/30/1	Ffynnon Wood. South of A40.	A section of this public footpath will be within an area of earthworks and will be stopped up. A diversion will be put in place, running along the southern toe of the embankment in an easterly direction to tie-in with the de-trunked section of carriageway.
SP19/38/1	Pen-troydin-fach Farm. North of the A40.	A section of the footpath will be stopped up from its junction with footpaths SP19/372 and SP19/38/2 to the southern boundary of the proposed trunk road. A diversion will be put in place to with the new footpath running along the southern boundary of the new highway in an easterly direction. It will pass under the proposed trunk road through a new underpass and tie-in to footpath SP19/38/2, to the east of Pen-troydin-fach Farm.
SP19/38/2	South of Pen-troydin-fawr Farm. West of Llanfallteg Road.	A section of this public footpath will be stopped up as it is under the footprint of the proposed trunk road. A short diversion will run the footpath along the northern highway boundary to its junction with Llanfallteg Road.
SP19/1/1, SP19/2/2 & SP19/3/2	North of Blaen-pentroydin	Sections of these public footpaths will be stopped up as they are under the footprint of the proposed carriageway. Diversions along the northern and southern boundaries of the proposed highway will lead to a new pedestrian underpass to the east of the stopped-up footpath. This underpass will provide connectivity for all the stopped-up footpaths. The footpath diversions will provide circular walking routes to both the north and south of the proposed A40 Trunk Road.
SP19/4/5	North of A40, west of Bethel Chapel.	Footpath SP19/3/5 will be stopped up in its entirety. This footpath provides a link between the A40 and a farm lane, footpath 19/4/6. No diversion is proposed.
SP19/17/1	South of Bethel Chapel, south of the A40.	A section of this public footpath will be within an area of earthworks and will be stopped up. This footpath will tie-in to a new footpath to be provided along the southern boundary of the proposed highway.

PRoW Reference	Location	Land Take Effect
Footway alongside A40.	A40 between proposed tie-in of new side road and the eastern tie-in of the scheme.	The footway that runs along the southern side of the A40 will be stopped up. No new footway along the new side road, roundabout or new trunk road is proposed. A new footpath that partly utilises the detrunked carriageway will be provided. This will provide the same extents as the existing footway.

15.6.3 In addition to these permanent diversions, the following new routes will be created as part of the Scheme as an overall improvement of active travel measures:

a) A new bridleway will be created that will run from the public highway leading to Trefangor Burial Ground, east along the highway boundary to Ffynnon Chapel, where it intersects with footpath SP19/37/1, partially utilising the existing A40 layby that will be stopped up. At Ffynnon Chapel, the new northern bridleway will pass beneath the proposed A40 in a new underpass.

b) A new combined equestrian, cycling and pedestrian link will be provided along the southern highway boundary of the A40, running east from just south of Henllan Lodge to meet the detrunked A40 at Llanddewi Velfrey Western Junction. This route will link to the proposed bridleway described in the previous paragraph.

c) A new public footpath will be created at the east Llanddewi Velfrey Junction. The footpath will cross the proposed A40 carriageway at the proposed roundabout, at an at-grade crossing. This provides connectivity between the village of Llanddewi Velfrey and Bethel Chapel and the properties to the north of the A40.

15.6.4 The PRoWs located within the permanent land take for the Scheme will be permanently diverted along new alignments to maintain the connectivity of the network, with the exception of one public footpath (SP19/4/5), whereby the existing network and proposed network already provides alternative, equally advantageous routes.

15.6.5 A number of new routes are proposed that will improve the network for all WCHRs, including horse riders and cyclists. The sensitivity of the local PRoW network is assessed to be low (i.e. of low or medium importance and rarity, local scale).

15.6.6 The magnitude of the impact on these resources is assessed to be minor beneficial as all affected routes, bar one, will be permanently diverted

to maintain the connectivity of the local network and the network will also be improved by the addition of new lengths of public footpaths and bridleways that will provide new active travel facilities.

15.6.7 Taking these factors into account, the predicted environmental land take effects arising from the permanent stopping up and diversion of local PRoWs, and the provision of new routes are assessed as permanent and of slight beneficial significance.

15.6.8 Any changes in the experience of those using routes that have been affected by the Scheme are described under 'Changes in Amenity' in Sections 15.6 and 15.7 of this chapter relating to construction and operational effects respectively.

Cycle Routes

15.6.9 There are no cycle routes affected by the Scheme. Therefore, there is no impact.

Other Routes Used by WCHRs

15.6.10 Of the unclassified county roads and informal paths used by walkers, cyclists and horse-riders, the following will be permanently stopped up (see Volume 2 Figures 15.2A and 15.2B):

a) Part of the access to the properties and chapel at Ffynnon will be stopped up as part of the construction of the new trunk road. The access currently forms part of the A40 as a "layby". Private Means of Access will be provided for access from a new junction to the east of Ffynon. A new footpath will provide connectivity, described above, to the existing footpath SP19/37/1.

b) The private access leading to Pen-troydin-fach Farm will be stopped up in order to construct the new trunk road and junctions. The access provides informal connectivity between the existing A40 and the footpath SP19/37/1 and SP19/37/2, although there is no evidence of its use.

15.6.11 The sensitivity of these routes is assessed to be low (i.e. of low or medium importance and rarity, local scale). Overall, the magnitude of the impact on these resources is assessed to be minor adverse considering the proposals that have been incorporated into the design to maintain the connectivity of WCHR routes. Taking these factors into account, the predicted environmental land take effects on other routes used by WCHRs are assessed to be permanent and of slight adverse

significance.

Public Highways

15.6.12 The following local highways that fall within the permanent land take area for the proposed new section of trunk road will be permanently stopped up, diverted or improved (see Volume 2 Figures 15.2A and 15.2B):

a) The southern section of the unnamed public road leading to Trefangor Burial Ground will be stopped up as the land is required for the construction of the new trunk road. A diversion will be provided that runs parallel to the proposed A40, from a new junction off the A487 north of Penblewin roundabout. It will tie-in to the existing road to south of the property known as Brominau. This road will have light use, mainly for property and farm access and will provide an attractive WCHR route, tying into several existing and proposed PRoW.

b) The northern section of the unnamed public road leading to Henllan Farm and to the south of Llanddewi Velfrey will be stopped up as the land is required for the construction of the new trunk road. A diversion will be provided that will utilise the existing A40, which will be detrunked, from the existing Rest Area to the property known as Henllan Lodge. A short diversion will be constructed around the north of Henllan Lodge to tie-in to the existing unnamed road. This road will have light use, mainly for property and farm access and will provide an attractive WCHR route, tying into several existing and proposed PRoW and linking back into Llanddewi Velfrey village.

c) The public road that leads from Llanddewi Velfrey to Llanfallteg (Llanfallteg Road) will be severed by the proposed Scheme. A new overbridge shall be provided, along the line of the existing road, to maintain connectivity. A temporary diversion of the public highway will be required to construct the new road. This is discussed further in section 15.7.

15.6.13 The existing A40 is a strategic route of major importance in South Wales, linking Carmarthen, St. Clears and Haverfordwest with key settlements to the east via the M4 motorway including Swansea, Cardiff and ultimately London. The sensitivity of these strategic routes is therefore assessed to be high (i.e. of high importance and rarity, national scale).

15.6.14 The other public highways linking to the strategic network are important at a local level and the sensitivity of these routes is therefore

assessed as low (i.e. of low to medium importance and rarity, local scale).

15.6.15 The potential magnitude of the impact on these resources takes into consideration the maintenance of public access along the strategic network and the provision of diversions for most local roads, or parts thereof, that will be permanently stopped up, in accordance with measures that have been incorporated into the design of the proposed new section of trunk road.

15.6.16 The magnitude of the impact is therefore assessed to be minor adverse i.e. vehicular and WCHR access along the strategic network and most local roads, including diverted sections, will be maintained to ensure the connectivity of journeys for all travellers.

15.6.17 Taking these factors into account, the predicted environmental land take effects on public highways are assessed to be permanent and of slight adverse significance.

Overbridge and Underbridge Crossings

15.6.18 There are no existing overbridges or underbridges effected by the Scheme. Therefore, there is no impact.

15.6.19 There are several new crossing points that will be delivered as part of the proposed new trunk road to maintain connectivity of the local highway and PRoW networks:

a) A new underpass, which a new bridleway will pass through, providing north/south connectivity between SP19/30/1 and SP19/37/1.

b) A new pedestrian underpass will be provided for diverted footpath SP19/38/1. This underpass will also provide farm access to severed land.

c) A new overbridge to carry the public road that leads from Llanddewi Velfrey to Llanfallteg.

d) A new pedestrian underpass to carry a new footpath that is the diversion for several stopped-up footpaths (SP19/1/1, SP19/2/2 & SP19/3/2).

15.6.20 There are no existing structures affected by the proposed Scheme, therefore there is no adverse impact. New structures will be constructed to provide safe vehicular and WCHR access across the new carriageway

and maintain links between local roads and PRoW. Most of these are to be constructed off-line or with diversions to enable access to be maintained until the new structures are operational.

15.6.21 The sensitivity of All Travellers using these crossings is assessed to be low in relation to the local network. The magnitude of the impact on these receptors is assessed to be minor adverse. There will be limited impacts on local journeys.

15.6.22 Taking these factors into account, the predicted land take effects arising from the construction of new overbridge and underpasses crossings are assessed to be permanent and of slight adverse significance.

Public Transport and Bus Stops

15.6.23 No land take effects on public transport services are predicted. The two bus stops within the village of Llanddewi Velfrey (one west-bound, one east-bound) will be by-passed as part of the Scheme. A junction will be provided at both the east and west side of the village, allowing access for the bus services.

15.6.24 The bus stops will no longer be on the A40 Trunk Road and buses will need to negotiate the junctions when entering and exiting the village. This may add some journey time to the bus route, but this is deemed to be negligible. Taking these factors into account, the predicted land take effect arising from the construction of new Trunk Road are assessed to be permanent and of neutral to slight significance.

Community Severance

15.6.25 The DMRB methodology for assessing community severance specifically relates to any increases in the length of journeys of pedestrians using PRoWs, cycle routes and public highways during the opening year of the Scheme. However, it is noted here that during the development of the design for the new section of trunk road, measures have been incorporated to ensure that the network of WCHR resources will be maintained, where possible, and improved as a result of the Scheme.

15.6.26 Potential land take effects on community severance are therefore limited, with the exception of one public footpath (SP19/4/5), whereby the existing network and proposed network will already provide

alternative, equally advantageous routes.

15.6.27 The proposed A40 will bypass the village of Llanddewi Velfrey. The following section describes this in further detail. As through traffic will be removed from the village there will be significant enhancements to the community severance currently encountered within the village.

Detrunking

15.6.28 The proposed A40 will bypass the existing A40 carriageway in several sections. The existing A40 will be detrunked with the road to remain Public Highway and responsibility to revert to the Local Authority, Pembrokeshire County Council. The detrunking proposals for the Scheme include:

a) A section of Carriageway from the existing Rest Area to the junction at Henllan lodge will be bypassed by the proposed Scheme, which will run to the north and parallel to the existing. A small section of new highway will tie the existing A40 into the unnamed road leading to Henllan Farm.

b) The Scheme bypasses the village of Llanddewi Velfrey. The section of existing carriageway from the proposed Western Llanddewi Velfrey junction to the proposed East Llanddewi Velfrey junction will be detrunked. This includes the village of Llanddewi Velfrey.

15.6.29 As these roads will be retained as Public Highway, with the through traffic removed, the detrunked lengths of carriageway will become more attractive to WCHRs.

15.6.30 These measures do not require any additional land take areas over and above those discussed for the new section of trunk road assessed. Therefore, there will be no additional potential land take effects that will affect All Travellers.

15.7 Assessment of Potential Construction Effects

15.7.1 The assessment of effects provided in this section takes into account the mitigation measures that are integral to the design of the Scheme, including the embedded mitigation measures described in this section.

PRoWs

15.7.2 Those PRoWs that fall within the footprint of the proposed new section of trunk road, junctions and associated earthworks that will be permanently stopped up during the construction phase are set out in Section 15.6. In addition, some PRoWs will need to be temporarily stopped up or diverted to allow for works on the carriageway, junctions, bridge and WCHR crossings to be undertaken, or where they fall within temporary construction storage areas and site compounds or within temporary construction traffic arrangements and haul roads. These are discussed below.

Temporary Effects on PRoWs

15.7.3 The PRoWs that will be temporarily stopped up or subject to traffic management during the construction stage are listed in Table 15.10 and shown on Volume 2 Figures 15.2A and 15.2B.

Table 15.10 PRoWs Temporarily Affected During Construction.

PRoW Reference	Location	Temporary Effect
SP19/31/3	Bounty Farm Access Road	The footpath will remain open with a localised temporary diversion during construction. Once the new side road leading to Trefangor Burial Ground is complete, the footpath leading to the existing A40 will be stopped up.
SP19/30/1	Ffynnon Wood. South of A40.	The public footpath will be diverted early on during construction, along the line of the proposed permanent diversion. This will lead to the existing A40, which will be under traffic management.
SP19/38/1	Pen-troydin-fach Farm. North of the A40.	The public footpath will be locally diverted during construction, within the site extents. Controlled haul road crossing points maybe required. The footpath will then move to the route of the proposed permanent diversion once the underpass is constructed.
SP19/38/2	South of Pen-troydin-fawr Farm. West of Llanfallteg Road.	The public footpath will be diverted onto the proposed temporary diversion of the Llanfallteg Road (in order to construct the overbridge). Once construction of the bridge is complete, the short permanent footpath diversion will be instated.

PRoW Reference	Location	Temporary Effect
SP19/1/1, SP19/2/2 & SP19/3/2	North of Blaen-pentroydin	The permanent diversions along the highway boundaries will be instated early on during construction. All the footpaths will link to and utilise the footpath SP19/2/2 in order to cross the scheme, with footpaths SP19/3/2 and SP19/1/1 stopped up. Controlled haul road crossing points maybe required. When the proposed underpass is complete all the footpaths will then be diverted to the permanent route. Footpath SP 19/2/2 will then be stopped up.
SP19/4/5	North of A40, west of Bethel Chapel.	This footpath will be permanently stopped up at the beginning of the construction of the Scheme.
SP19/17/1	South of Bethel Chapel, south of the A40.	The permanent footpath diversion, to replace the existing footway along the A40, will be carried out early on during construction. Footpath SP19/17/1 will then tie-in to this footpath.

15.7.4 The PRoWs affected by the construction works comprise local routes. The sensitivity of the PRoWs affected by the construction works is therefore assessed to be low for local routes (i.e. of low or medium importance and rarity, local scale for the local routes). The magnitude of impact of the local PRoWs is assessed to be moderate adverse i.e. there will be some temporary impacts that will affect the public's ability to access some local routes. Alternatives are available but generally require lengthy diversions.

15.7.5 Taking these factors into account, the predicted effects arising from the temporary stopping up of PRoWs during construction are assessed to be temporary and medium term and of slight adverse significance in relation to local routes.

Cycle Routes

Temporary Effects on Cycle Routes

15.7.6 There are no cycle routes affected by the Scheme. Therefore, there is no impact during construction.

Other Routes Used by WCHRs

Temporary Effects on Other Routes Used by WCHRs

15.7.7 There are no temporary effects on other routes used by WCHRs crossed

by the proposed new section of trunk road during construction.

Public Highways

Temporary Effects on Public Highways

15.7.8 The existing strategic highway network including the A40 will remain open during the construction phase under traffic management where required, except for overnight lane closures that may be required for traffic management installations, utility diversions and new road tie-ins and surfacing. At these times diversion routes will be put in place.

15.7.9 The Llanfallteg Road, which leads from Llanddewi Velfrey to Llanfallteg, will need to be temporarily stopped up, in order to construct the new overbridge to carry this road over the proposed A40. A temporary diversion will be constructed alongside the existing road, which will maintain connectivity, whilst the new bridge is constructed. The land required for the temporary diversion is included within the Orders and will be reinstated and handed back to the land owner once construction is complete.

15.7.10 The magnitude of the impact on these resources takes account of the maintenance of public access along the strategic network and some local roads throughout the construction stage, except for some overnight weekend lane closures when traffic flows are lower, and diversions will be in place.

15.7.11 Taking these factors into account, the predicted effects on public highways during the construction phase are assessed to be temporary, medium term and of slight to moderate adverse significance in relation to the strategic network and temporary, medium term and of slight significance for the local road network.

Overbridge and Underpass Crossings

15.7.12 There are no public highways or PRoWs intersecting the existing A40 on overbridge or underpass crossings. Therefore, there will be no impact during the construction phase.

15.7.13 However, a number of new crossings will be delivered as part of the proposed new section of trunk road as described in Section 15.6. The following overbridges and underbridges will be constructed with the

potential effects on All Travellers minimised by providing diversions during construction:

a) A new underpass, which a new bridleway will pass through, providing north/south connectivity between SP19/30/1 and SP19/37/1.

b) A new Pedestrian Underpass will be provided for diverted footpath SP19/38/1. This underpass will also provide farm access to severed land.

c) A new overbridge to carry the public road that leads from Llanddewi Velfrey to Llanfallteg.

d) A new pedestrian underpass to carry the new footpath that forms the diversion for several stopped-up footpaths (SP19/1/1, SP19/2/2 & SP19/3/2).

15.7.14 The magnitude of the impact on these resources takes into consideration the programming of construction works to ensure that public access is available during the construction phase. It is therefore assessed to be minor adverse.

15.7.15 Taking these factors into account, the predicted effects on underpass and overbridge crossings during the construction works is assessed to be temporary, medium term and of slight adverse significance in relation to crossings of the strategic network and the local road network.

Public Transport and Bus Stops

15.7.16 Public transport between Haverfordwest and St. Clears and other local settlements is provided by national and local bus companies. Only one bus service stops at Llanddewi Velfrey (including the surrounding area). No regular bus services will be disrupted during the construction phase since the A40 carriageway will remain in operation during the construction of the Scheme. There may be minor delays during peak traffic flows.

15.7.17 Taking these factors into account, the predicted environmental effects on public transport and bus stops during the construction phase is assessed to be temporary, medium term and of slight adverse significance.

Changes in Amenity

15.7.18 Changes in the overall amenity of journeys made by All Travellers

during the construction phase are largely a factor of changes to the visual and noise environments, which are assessed in detail in Chapters 9 Landscape and Visual Effects and 14 Noise and Vibration respectively of this ES. In accordance with DMRB methodology in relation to changes in amenity, a commentary of the relevant sections of those assessments is set out below.

15.7.19 The landscape and visual assessment describes the potential construction visual effects on PRoWs along the route of the new road. By considering the route of the scheme carefully the loss of trees and woodland will be minimised. During construction stage the changes to the landscape setting of the paths will be most visible to users as a consequence of tree felling, removal of hedges and soil stripping. Once construction is complete, the proposed woodland and hedge mitigation planting will grow to repair the landscape setting and to screen views. As the planting scheme matures over the 5 to 15 years after construction, users of public footpaths in the study area will be gradually less and less aware of the changes brought about by the Scheme. Fully effective mitigation will mean that users of most public footpaths will be unaffected by the Scheme, except where these PRoWs are diverted, or the route has to cross changes to landform. Further away from the Scheme, users on PRoWs will find that views are screened or filtered due to intervening topography and vegetation.

15.7.20 The assessment also describes visual changes experienced by road users during the construction phase, which are generally predicted to be more limited, due to traffic speeds and screening vegetation.

15.7.21 Temporary changes to the noise environment during construction are set out in Chapter 14 Noise and Vibration and will predominantly be experienced by WCHRs. This assessment shows that for daytime work, when most WCHR journeys take place, the level of impact from a range of construction activities will reduce with distance from the activity. Significant effects could occur within close proximity of the construction activity, which will be temporary and occur only during the most intense periods of construction. Therefore, walking, cycling and horse-riding journeys along PRoWs to the construction activities will be subject to increased noise levels over the baseline environment, although these will change as journeys progress due to the transient nature of the activity.

Driver Stress

15.7.22 The DMRB driver stress methodology does not specifically include a consideration of the potential effects on drivers resulting from the construction activities associated with a highway project, including road closures, diversions and disruption to journeys and journey times.

15.7.23 However, there are likely to be increased levels of driver stress during this period, compared to the baseline situation. This may be due to frustration i.e. by a driver's inability to drive at a speed consistent with his or her own wishes; as a result of traffic congestion and delays caused by traffic management; or because of uncertainty relating to the route being followed where temporary construction diversions are in place.

Community Severance

15.7.24 During the construction phase for the proposed new section of trunk road, measures will be put in place to maintain the connectivity of the highway network used by WCHRs. However, there will be temporary impacts on PRoWs and cycle routes that will hinder pedestrian journeys and potentially increase journey lengths during the construction phase, as set out in Table 15.9 and Table 15.10.

15.7.25 Taking these factors into account, the predicted environmental construction effects on community severance are assessed, using the DMRB three-point scale, as moderate i.e. some residents may be dissuaded from making trips and some trips will be made longer or less attractive.

Detrunking

15.7.26 The detrunking of the existing A40 will not require any additional temporary land take during construction. Most of the works will be undertaken within the existing highway boundary or utilising areas of permanent and temporary land take already identified for the Scheme. The construction works associated with the remainder of the detrunking will only commence once the Scheme is operational.

15.7.27 Carriageway modifications are required as part of the detrunking works. This includes: Narrowing of the carriageway between Penblewin and Henllan Lodge; widening of the existing pedestrian walkway between the proposed East and West Llanddewi Velfrey Junctions; widening of

the carriageway into the verge at Cross Cottage; modification of the area surrounding the war memorial; and the narrowing of side road junctions within Llanddewi Velfrey.

15.8 Assessment of Potential Operational Effects

15.8.1 The assessment of effects provided in this section takes into account the mitigation measures that are integral to the design of the Scheme, including the embedded mitigation measures described in this section.

PRoWs

15.8.2 On completion of the construction phase, PRoW that are to be fully stopped up on a permanent basis will have already been diverted, with the exception of one public footpath (SP19/4/5), whereby the existing network and proposed network already provide alternative, equally advantageous routes.

15.8.3 Those PRoW that were only being temporarily, either partly or fully, stopped up during the construction phase will have already been reinstated along their original alignment. In addition, the new routes created as part of the Scheme will be operational.

15.8.4 The PRoWs within the local network around the proposed new section of trunk road comprise a mixture of local routes, including footpaths and bridleways. The sensitivity of these PRoWs is therefore assessed to be low (i.e. of low or medium importance and rarity, local scale) for the local routes.

15.8.5 The impacts will be minor beneficial for local routes i.e. all affected PRoWs, except for one, will be permanently diverted and additional PRoWs will be available for WCHRs, which will improve the connectivity of the local network and provide additional active travel opportunities.

15.8.6 Taking these factors into account, the predicted effects arising from the operation of the Scheme will be of slight beneficial significance in relation to local PRoW.

Cycle Routes

15.8.7 There are no cycle routes affected by the Scheme. Therefore, there is

no impact during operation.

Other Routes Used by WCHRs

15.8.8 The only identified 'Other Route Used by WCHRs' is the existing access to Ffynnon that is to be stopped up as part of the works as described in Section 15.6. As such there is no operational impact, as the route is permanently stopped up.

Public Highways

15.8.9 The strategic highway network including the proposed new section of A40 trunk road will be fully open during the operational phase, together with local roads linking to those routes (including Llanfallteg Road) and serving the population of Llanddewi Velfrey, Llanfallteg and Ffynnon settlements.

15.8.10 Sections of the A40 remaining between Penblewin and Llanddewi Velfrey, will be detrunked and will become local highway, as described under the section entitled 'Detrunking'.

15.8.11 A full Scheme description is provided in Chapter 2 - The Project, of the ES.

15.8.12 The existing A40 is a strategic route of major importance in South Wales, linking Carmarthen, St. Clears and Haverfordwest with key settlements to the east via the M4 motorway including Swansea, Cardiff and ultimately London. The sensitivity of these strategic routes is therefore assessed to be high (i.e. of high importance and rarity, national scale). The other public highways linking to the strategic network are important at a local level and the sensitivity of these routes is therefore assessed as low (i.e. of low to medium importance and rarity, local scale).

15.8.13 The potential magnitude of the impact on these resources takes into consideration the operation of the new section of trunk road, which will predominantly serve a strategic role; the maintenance of public access along the rest of the strategic network; improvements in access to destinations along the A40; and reduced journey times. It also takes account of the provision of permanent diversions for those local roads that will be permanently stopped up or affected during the construction phase. The magnitude of the impact is therefore assessed to be moderate

beneficial i.e. vehicular and WCHR access along the strategic network and most local roads, including diverted sections, will be maintained to ensure the connectivity of journeys for all travellers and, the new section of trunk road and connecting new highways will result in reduced journey times.

15.8.14 Taking these factors into account, the predicted operational effects on public highways are assessed to be permanent and of moderate beneficial significance, which is significant in EIA terms.

Overbridge and Underbridge Crossings

15.8.15 There are no underpass and overbridge crossings of the existing A40, with a single uncontrolled pedestrian crossing found close to the war memorial within Llanddewi Velfrey. However, new structures will be constructed to provide safe vehicular and WCHR access across the new carriageway to maintain links between local roads and settlements and for travellers.

15.8.16 The sensitivity of All Travellers using these crossings is assessed to be low i.e. they will generally be used by people accessing the local road network. The magnitude of the impact on these receptors, is assessed to be negligible.

15.8.17 Taking these factors into account, the predicted operational effects on all travellers using existing and new overbridges and underbridges is assessed to be permanent and of neutral significance.

Public Transport and Bus Stops

15.8.18 The only public transport that currently operates in the vicinity of the Scheme is a bus service. The bus stops will be located on the section of bypassed existing road that will be detrunked. The bus services will need to leave the proposed A40 and travel through the village using the proposed junctions. It is envisaged that the bus services will continue to function as they do presently and therefore there will be no effects arising from the operation of the proposed new section of trunk road.

Changes in Amenity

15.8.19 Changes in the overall amenity of journeys made by All Travellers during the operational phase is largely a factor of changes to the visual

and noise environments, which are assessed in detail in Chapters 9 Landscape and Visual Effects and 14 Noise and Vibration respectively of this ES. In accordance with DMRB methodology in relation to changes in amenity, a commentary of the relevant sections of those assessments is set out below.

15.8.20 The landscape and visual assessment describes the potential visual effects on PRoWs along the route of the new section of trunk road during operation. These views will return to baseline conditions by year 15 when mitigation planting will have matured and will largely screen and integrate this part of the Scheme into its surroundings.

15.8.21 By considering the route of the scheme carefully the loss of trees and woodland is minimised. During operation of the Scheme the changes to the landscape setting of the paths will be most visible to users soon after construction is complete, when mitigation planting will not have grown. Fully effective mitigation after 15 years will mean that users of most public footpaths will be unaffected by the Scheme. Further away from the Scheme users on PRoWs will find that views of the Scheme are screened or filtered due to intervening topography and vegetation.

15.8.22 Changes to the noise environment during the operation of the Scheme are set out in Chapter 14 Noise and Vibration. This assessment shows that in operation, both beneficial and adverse noise effects are predicted as a result of the Scheme. The new section of trunk road will remove through traffic from the village of Llanddewi Velfrey, therefore there will generally be a reduction in noise impacts on WCHR receptors around the village. Conversely, the proximity of a new trunk road to WCHR resources to the north of the village will result in higher noise levels over the baseline environment being experienced by the users of those resources, although these will change as journeys progress due to the transient nature of the activity. Noise mitigation to reduce those impacts has been incorporated into the Scheme by the provision of a thin road surface system, which results in relatively low noise.

Driver Stress

15.8.23 As set out in Section 15.4, the Transport Model has been developed to prepare traffic forecasts for the Scheme, which is documented in the Traffic Forecasting Report. The model represents the AM and PM peak periods on an average weekday for the design year of 2036, as follows:

a) The AM peak hour (0800 – 0900).
b) The PM peak hour (1700 – 1800).

15.8.24 The modelled peak hourly vehicle flows along the most heavily trafficked new section of road for the design year (2036) are as follows.

Eastbound

a) AM peak hour: 560 vehs/hour
b) PM peak hour: 590 vehs/hour

Westbound

a) AM peak hour: 640 vehs/hour
b) PM peak hour: 580 vehs/hour

15.8.25 The peak hourly flow in each direction ranges from approximately 610 to 700 units per hour. The DMRB guidance in relation to driver stress on single carriageway roads indicates that average peak flows of under 800 units per hour at an average journey speed of over 70kph will lead to a moderate level of driver stress, increasing to a high level of stress above 800 units per hour.

15.8.26 The improvements to the strategic highway network will, however, reduce driver stress as a result of the following:

a) Reduced frustration, with fewer delays, due to the new section of overtaking provision, leading to more overtaking opportunities.
b) Reduced frustration as a result of improved road surfacing with reduced spray and noise generation along the new section of trunk road.
c) Reduced frustration of not being constrained by speed limits and substandard road geometry.

15.9 Additional Mitigation and Monitoring

Construction

15.9.1 The maintenance of access along public highways and traffic management commitments during the construction stage of the Scheme to manage driver and public safety are set out in Chapter 2 The Project. No additional construction mitigation measures are required in relation to public highways.

15.9.2 Mitigation measures during the construction period will be detailed in, and delivered through, the Construction Environmental Management Plan (CEMP) and Construction Transport Management Plan (CTMP) for the Scheme. This will include traffic management measures to manage driver and public safety and minimise disruption to the public and the local and strategic road networks. It will also include measures to keep the public informed on the programming and length of construction works affecting local highways and WCHR routes. A Pre-Construction Environmental Management Plan (Pre-CEMP) is provided at Volume 3 Appendix 2.2.

15.9.3 Mitigation has been addressed as part of an iterative design and assessment process in relation to landscape and visual impact and no additional or further mitigation measures during construction have been proposed. Likewise, noise mitigation has been incorporated into the Scheme.

Operation

15.9.4 Measures such as junction arrangements, signage and lighting form part of the design of the Scheme to minimise driver stress. The measures forming part of the Scheme (embedded mitigation) to maintain connectivity are described in Chapter 2 The Project and in Sections 15.6 and 15.7 above. No further operational mitigation measures are proposed in relation to All Travellers in addition to those incorporated into the Scheme.

15.9.5 As stated above, landscape and visual mitigation have been addressed as part of an iterative design and assessment process for the Scheme (e.g. woodland planting and other vegetation, boundary treatment) and no further measures are proposed. In relation to noise, mitigation has also been incorporated into the Scheme design.

Monitoring

Construction

15.9.6 Monitoring of mitigation measures that have been developed in relation to All Travellers will be undertaken via the suite of pre-construction documents that will be prepared for the Scheme, including the CEMP and the CTMP. Permanent changes to the highway network including PRoWs and other WCHR routes will be implemented through the Side

Road Orders.

Operation

15.9.1 No significant adverse impacts have been identified and therefore there is no requirement for future monitoring of as a result of the Scheme.

15.10 Assessment of Land Take Effects

15.10.1 The design of the new section of trunk road includes permanent diversions for most of the PRoWs and other WCHR routes affected by the new section of trunk road. Highway diversions and new or replacement overbridges have also been considered. The assessment of land take effects with mitigation in place will therefore remain as set out in Section 15.6 above.

15.11 Assessment of Construction Effects

PRoWs

15.11.1 Further mitigation measures will be put into place to provide temporary diversions for those PRoWs affected during the construction of the new section of trunk road. The magnitude of impact on these resources with these measures in place is therefore assessed to be negligible.

15.11.2 Taking these factors into account, the predicted residual environmental effects on PRoWs from the construction works are assessed to be temporary, medium term and of neutral significance.

Cycle Routes, Other Routes Used by WCHRs, Public Highways, Overbridge & Underbridge change. Crossings and Public Transport and Bus Stops

15.11.3 There are no cycle routes affected by the Scheme.

15.11.4 No further mitigation measures will be put in place for these resources during the construction phase, in addition to those incorporated into the design of the new section of trunk road. Therefore, the assessment of effects set out in Section 15.7 above will not change.

Community Severance

15.11.5 The further mitigation measures for PRoWs and cycle routes during the construction phase set out above will help to mitigate for temporary impacts on pedestrian journeys, although there will still be some hindrance to movement, particularly for north-south journeys across the existing A40 including those using the local roads. This may dissuade some residents, particularly children and elderly people from making trips. Taking these factors into account, the predicted residual effect on community severance during construction is assessed to be slight to moderate.

Driver Stress

15.11.6 There will be no change to the assessment of driver stress set out in Section 15.7.

Detrunking

15.11.7 There will be no additional construction effects resulting from the provision of WCHR friendly infrastructure, other than those described above for the Scheme. The construction of the other detrunking works will not commence until the Scheme is operational and a construction strategy for these works has yet to be developed.

15.12 Assessment of Operational Effects

Proposed New Trunk Road

15.12.1 No further mitigation measures will be put in place in relation to All Travellers resources or driver stress during the operation phase. The assessment of operational effects is therefore unchanged from those set out in Section 15.8.

Detrunking

15.12.2 There will be no additional operational effects resulting from the provision of WCHR friendly infrastructure, other than those described above for the Scheme. The operation of the other detrunking works will not commence until the Scheme is operational.

15.13 Assessment of Cumulative and Inter-Related Effects

15.13.1 The assessment of cumulative effects relating to All Travellers and of inter-relationships between topics is presented in Chapter 19 to 21 of this ES.

15.14 Summary of Effects

15.14.1 In addition to the local road network linking Llanddewi Velfrey, Llanfallteg and Ffynnon, walkers, cyclists and horse-riders have access to a network of PRoWs. The proposed new section of trunk road will affect a number of these routes, predominantly used for informal recreation by pedestrians.

15.14.2 Consultation has been undertaken with Pembrokeshire County Council and the local community, in relation to these resources and measures that have been incorporated into the Scheme to minimise the impacts on them.

15.14.3 A number of site visits, together with user surveys, were undertaken to establish the baseline conditions for this range of resources used by walkers, cyclists and horse-riders.

15.14.4 Some routes used by WCHRs will require stopping up on a temporary basis during construction, or on a permanent basis where they fall within the permanent land take for the Scheme. During both phases diversion routes will be established for most routes to enable users to access other parts of the local network and to maintain connectivity between routes.

15.14.5 Taking into account the measures incorporated into the Scheme for the diversion of permanently affected routes and the mitigation measures proposed to provide temporary diversions for those PRoWs affected during construction, no significant adverse effects on PRoWs or other routes are predicted.

15.14.6 During construction, the existing A40, together with most local roads crossing the Scheme or linking to it, will remain open under traffic management, where required, except for some overnight weekend road and lane closures during works such as utility diversions and tie-in

works. Llanfallteg road will be temporarily stopped up during construction with a temporary diversion put in place to allow for the construction of a new overbridge. This, together with the temporary impacts on PRoWs used by pedestrians, will result in a construction effect on community severance i.e. some residents may be dissuaded from making trips and some trips will be made longer or less attractive. However, this effect will be temporary and for the duration of construction only.

15.14.7 Following the completion of the construction works, the connectivity of the PRoWs network will be maintained. Those routes that were partly or fully stopped up on a permanent basis will have been diverted, with the exception of one public footpath (SP19/4/5), whereby the existing network and proposed network already provide alternative, equally advantageous routes. Those that were partly or fully stopped up temporarily during the construction phase will have been reinstated along their original alignment or their permanent diversion alignment. In addition, the new public bridleways and two new public footpaths created as part of the Scheme will be operational. These include:

a) A new bridleway will be created that will run from the public highway leading to Trefangor Burial Ground, east along the highway boundary to Ffynnon Chapel, where it intersects with footpath SP19/30/1. At this location, the new northern bridleway will pass beneath the proposed A40 in a new underpass.

b) A new combined, equestrian, cycling and pedestrian link will be provided along the southern highway boundary of the A40, running east from just south of Henllan Lodge to meet the detrunked A40 at Llanddewi Velfrey Western Junction. This route will link to the proposed bridleway described in the previous paragraph.

c) A new public footpath will be created at the east Llanddewi Velfrey Junction. The footpath will cross the proposed A40 carriageway at the proposed roundabout, at an at-grade crossing. This will provide connectivity between the village of Llanddewi Velfrey and Bethel Chapel, and the properties to the north of the A40.

d) The existing A40 Carriageway will be detrunked as part of the proposals. This provides opportunity to improve cycling and pedestrian facilities through the village.

15.14.8 The only public transport that currently operates in the vicinity of the Scheme is a bus service. The bus stops will be located on the section of bypassed existing road that will be detrunked. The bus services will

need to leave the proposed A40 and travel through the village using the proposed junctions. It is envisaged that the bus services will continue to function as they do presently and therefore there will be no effects arising from the operation of the proposed new section of trunk road.

Table 15.11 Summary of Likely Environmental Effects on All Travellers

Activity/Receptor	Sensitivity of receptor	Description of impact	Short/ medium/ long term	Magnitude of impact (without mitigation)	Significance of effect (without mitigation)	Magnitude of impact (with mitigation)	Significance of effect (with mitigation)	Significant/ not significant
Land Take								
PRoWs	Low	Permanent stopping up or diversion of section of routes and provision of new routes.	Permanent	Minor Beneficial	Slight Beneficial	Minor Beneficial	Slight Beneficial	Not Significant
Cycle Routes		No cycle routes impacted by the Scheme	n/a	No Impact	N/A	N/A	N/A	N/A
Other Routes Used by WCHRs	Low	Stopping up of existing access to Ffynnon, which forms is classified as part of the A40 (Layby)	Permanent	Minor adverse	Slight adverse	Minor adverse	Slight Adverse	Not significant
Public Highways	High (A40 strategic route) Low (Local route)	Diversion of some existing routes. Provision of new section of trunk roads and junctions.	Permanent	Minor adverse	Slight adverse	Minor adverse	Slight Adverse	Not significant
Users of overbridge and underbridge crossings	N/A	No Impact- no existing overbridges or underpasses affected.	Permanent	No Impact	N/A	N/A	N/A	N/A

Activity/Receptor	Sensitivity of receptor	Description of impact	Short/ medium/ long term	Magnitude of impact (without mitigation)	Significance of effect (without mitigation)	Magnitude of impact (with mitigation)	Significance of effect (with mitigation)	Significant/ not significant
Public Transport and Bus Stops	N/A	No Impact	Permanent	No Impact	N/A	N/A	N/A	N/A
Detrunking	Low	No additional land take required	Permanent	No Impact	N/A	N/A	N/A	N/A
Construction								
PRoWs	Low	Temporary stopping up of local routes, including temporary local diversions	Medium term	Moderate Adverse	Slight adverse	Negligible	Neutral	Not significant
Cycle Routes	N/A	No cycle routes impacted by the Scheme	n/a	No Impact	N/A	N/A	N/A	N/A
Other Routes Used by WCHRs	Low	No Temporary Affect (A40 Layby access stopped up early during construction)	Medium term	Slight	Slight	Slight	Slight	Not significant
Public Highways	High	Temporary stopping up and diversion of the Llanfallteg Road. Traffic Management required on the A40.	Medium term	Minor to Moderate adverse	Slight to Moderate adverse	Minor to Moderate adverse	Slight to Moderate adverse	Not significant
Users of overbridge and underbridge crossings	Low	Temporary impact during the construction of new structures for the crossing of WCHRs.	Medium term	Slight	Slight	Slight	Slight	Not significant

Activity/Receptor	Sensitivity of receptor	Description of impact	Short/ medium/ long term	Magnitude of impact (without mitigation)	Significance of effect (without mitigation)	Magnitude of impact (with mitigation)	Significance of effect (with mitigation)	Significant/ not significant
Public Transport and Bus Stops	N/A	No Impact	Medium term	No Impact	Not significant	Not significant	Not significant	Not significant
Detrunking	Low	No temporary impact during construction.	Medium term	No Impact	N/A	N/A	N/A	N/A
Operation								
PRoWs	Low	Maintaining connectivity of network and provision of new routes	Permanent	Minor Beneficial	Slight Beneficial	Minor Beneficial	Slight Beneficial	Not significant
Cycle Routes	N/A	No cycle routes impacted by the Scheme	n/a	No Impact	N/A	N/A	N/A	N/A
Other Routes Used by WCHRs	Low	Route permanently stopped up (A40 Layby access stopped up early during construction)	Permanent	Slight	Slight	Slight	Slight	Not significant
Public Highways	High	Creation of new section of trunk road and new junctions. New local road diversions to provide local highway connectivity	Permanent	Moderate Beneficial	Moderate Beneficial	Moderate Beneficial	Moderate Beneficial	Significant

Activity/Receptor	Sensitivity of receptor	Description of impact	Short/ medium/ long term	Magnitude of impact (without mitigation)	Significance of effect (without mitigation)	Magnitude of impact (with mitigation)	Significance of effect (with mitigation)	Significant/ not significant
Users of overbridge and underbridge crossings	Low	Temporary impact during the construction of new structures for the crossing of WCHRs.	Permanent	Negligible	Neutral	Negligible	Neutral	Not Significant
Public Transport and Bus Stops	N/A	No Impact	Permanent	No Impact	Not significant	Not significant	Not significant	Not significant
Detrunking	N/A	Improved facilities and more attractive to WCHR users	Permanent	Slight Beneficial	Slight Beneficial	Moderate Beneficial	Moderate Beneficial	Significant

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 16: Materials

A40LVP-ARP-EGN-SWI-RP-LE-0001

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21/01/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Figures (unless otherwise stated these are provided in Volume 2)

16.1 Waste Management Facilities

16 Materials

16.1 Introduction

16.1.1 This chapter provides an assessment of the likely significance of environmental effects from the use of material resources and the generation and management of waste resulting from the Scheme.

16.1.2 It should be noted that the impacts on geology and soils, and the potential for land contamination, has been addressed in Chapter 6 Geology and Soils, of this Environmental Statement (ES).

16.1.3 The use of material resources and generation of waste has been estimated based on the requirements of the Key Stage 3 Scheme design as described in Chapter 2 The Project, of this ES.

16.1.4 For the purposes of this assessment, 'Materials' are defined as comprising:

a) use of material resources; and

b) generation and management of waste.

16.1.5 The assessment focuses mainly on the construction phase of the proposed Scheme as this is primarily where potentially significant effects in relation to material resources and waste arisings would arise.

16.1.6 Operational impacts, in terms of resource use and waste generation, have been considered, however the impacts are dependent on the maintenance regime and the need to replace materials throughout the lifetime of the structure.

16.1.7 The assessment has been conducted in accordance with the guidance set out in the Design Manual for Roads and Bridges (DMRB) Interim Advice Note (IAN) 153/11 "Guidance of the Environmental Assessment of Material Resources"[1]. The above IAN has not yet been adopted in Wales. However, it is considered that the IAN reflects current best practice guidance and as there is no suitable Welsh equivalent guidance, it has been used to inform the proposed method of assessment. It is acknowledged that references to the National Planning

[1] DMRB Interim Advice Note (IAN) 153/11 "Guidance of the Environmental Assessment of Material Resources", 2011.

Policy Framework (NPPF) set out in the above IAN is not relevant in the Welsh context.

16.1.8 The estimated cost for the proposed Scheme is greater than the £300,000 threshold included in the guidance. Therefore, it is assumed that potential exists for environmental impacts and effects from the use of materials and generation of waste. As a minimum, a Simple Assessment is therefore required in accordance with IAN 153/11.

16.1.9 The Scoping Report recommended that a Simple Assessment would be appropriate, and dependent on the outcome of this assessment, a Detailed Assessment may also be required in accordance with IAN 153/11. A Simple Assessment has been completed and supplemented by a Detailed Assessment.

16.1.10 The assessment of environmental effects associated with the use of material resources and the generation and management of waste resulting from the construction and operation of the Scheme has taken into account the following:

a) types and quantities of material resources associated with the construction and operational phases of the Scheme;
b) types and quantities of waste arisings associated with the construction and operational phases of the Scheme; and
c) movement of materials during construction (both to and from the site).

16.1.11 It is outside the scope of the guidance to assess the environmental impacts associated with the extraction of raw materials and the manufacture of products which occur off-site. The guidance recognises that these stages of a material's life cycle are likely to have already been subjected to an environmental assessment. These impacts are therefore not addressed in this ES chapter.

Material Resources

16.1.12 Material resources include both primary raw materials, such as aggregates and minerals, and secondary manufactured products. Many material resources would originate off-site and some, such as excavated soils, would arise on-site.

16.1.13 Road schemes require significant quantities of both primary raw materials and secondary manufactured products. The production,

sourcing, transport, handling, storage and use of these materials, as well as the disposal of any surplus, have the potential to affect the environment adversely. The key impacts associated with the use and consumption of material resources in relation to the proposed Scheme are addressed in Sections 16.11 and 16.12. The consumption of significant quantities of material resources is likely to result in indirect and direct impacts on the environment which includes embodied carbon emissions associated with a number of stages in the material resource's life cycle.

Generation and Management of Waste

16.1.14 In considering material resource use and waste management, it is important to define when – under current legislation and understanding – a material is considered to be a waste. The definition of waste is important because the classification of substances as waste is the basis for the formulation of waste management and the application of controls to protect the environment and human health.

16.1.15 Material excavated and reused within the Scheme area / planning boundary is not classed as waste, subject to it being suitable for its intended use.

16.1.16 The EU Waste Framework Directive (Directive 2008/98/EC) includes a common definition of 'waste', which is 'any substance or object which the holder discards or intends or is required to discard', with the term 'discard' including the disposal, recovery or recycling of a substance.

16.1.17 Waste for disposal is classed as hazardous, non-hazardous or inert, depending on the level of harm to human health and/or the environment.

16.1.18 Once a material has become waste, it remains waste until it has been fully recovered and no longer poses a potential threat to the environment or to human health, at which point it is no longer subject to the controls and other measures required by the Directive.

16.1.19 The generation of large quantities of waste in road schemes has the potential to impact on available waste management infrastructure through occupying landfill space, limiting short-term use of available waste storage. The effects of the Scheme may also impact on relevant waste policies and plans.

16.2 Legislation and Policy Context

16.2.1 This section identifies the legislation and policies that are relevant to material resources and waste arisings.

EU Waste Framework Directive 2008/98/EC

16.2.2 The overarching policy in relation to the handling of material resources along the Scheme is the EU Waste Framework Directive 2008/98/EC. This provides the framework legislation for the collection, transport, recovery and disposal of waste. It includes a common definition of 'waste', which is 'any substance or object which the holder discards or intends or is required to discard', with the term 'discard' including the disposal, recovery or recycling of a substance.

16.2.3 The overall purpose of the Waste Framework Directive is to set out measures to protect the environment and human health by preventing or reducing the adverse effects of waste generation and its management, and by improving the efficiency of resource use. Member States are required by the Directive to take all the necessary measures to ensure that waste is recovered or disposed of without endangering human health or causing harm to the environment.

16.2.4 The Directive sets a number of high-level objectives, which have influenced national waste management policy and legislation. In particular, Article 11 of the Waste Framework Directive (amended in 2008) requires that Member States take the necessary measures to achieve 70% recycling of non-hazardous construction and demolition waste by 2020.

The Waste (England and Wales) Regulations 2011 (as amended)

16.2.5 Directive 2008/98/EC has now been transposed in Wales by the Waste (England and Wales) Regulations 2011 (S.I. 2011 No. 988) (as amended). In Wales, the Regulations are supplemented by the Waste (Miscellaneous Provisions) (Wales) Regulations 2011 (S.I. 2011 No. 971 (W.141)). The latter Regulations make a number of consequential amendments to several Welsh Statutory Instruments and revoke one Wales-only instrument (i.e. the Environmental Protection (Duty of Care) (Amendment) (Wales) Regulations 2003).

16.2.6 In addition to the above, reference has been made to the following legislation relating to material resources and waste management:

a) The Controlled Waste (England and Wales) Regulations 2012.
b) The Hazardous Waste (England and Wales) Regulations 2005.

The Well-being of Future Generations (Wales) Act 2015

16.2.7 The act strengthens existing governance arrangements for improving the well-being of Wales to ensure that present needs are met without compromising the ability of future generations to meet their own needs. The act requires all public bodies to embed climate change into their decision making. Chapter 16 Materials particularly relates to objective 12: Manage, use and enhance Wales' natural resources to support long term well-being.

Environment (Wales) Act Part 1: "Sustainable management of natural resources" 2016

16.2.8 The Environment (Wales) Act includes features that would ensure that managing natural resources sustainably would be a core consideration in decision making. Part 1: "Sustainable management of natural resources" provides a modern legislation for managing Wales's natural resources, which helps to tackle the challenges faced and is focused on the opportunities resources provide.

The Environmental Permitting (England and Wales) Regulations 2016

16.2.9 The recovery and disposal of waste requires a permit under EU legislation with the principle objective of preventing harm to human health and the environment.

National Policy: Planning Policy Wales (Edition 10), December 2018

16.2.10 Planning Policy Wales (PPW) presents Welsh Government's land use policy, which should be taken into account when preparing development plans. The policy sets out Welsh Government's objectives in terms of waste management. The main focus of the policy is the provision of future waste management facilities by local planning authorities. However, it promotes design choices to prevent waste and opportunities to reduce or recycle waste as part of design and construction.

16.2.11 Further to this, PPW encourages materials balance on site and the use of renewable resources, including sustainable materials (recycled and

renewable materials and those with a lower embodied energy). Where it is judged necessary to use non-renewable resources they should be used as efficiently as possible. The use of renewable resources and of sustainably produced materials from local sources should be encouraged, with recycling and reuse levels arising from demolition and construction maximised, and waste minimised.

16.2.12 PPW also encourages the efficient use of minerals by promoting the appropriate use of high quality materials, and by minimising the production of waste through maximising the potential for reuse and recycling waste, where environmentally acceptable.

National Policy: Towards Zero Waste, One Wales: One Planet 2010 (Welsh Assembly Government, 2010)

16.2.13 Towards Zero Waste (TZW) was published in 2010 and is the overarching waste strategy document for Wales. TZW sets out a high-level strategy for how Welsh Government will manage waste in Wales to produce benefits not only for the environment, but also for the economy and social well-being. The strategy and its associated sector plans outline the actions Wales must take to reach the ambition of becoming a high recycling nation by 2025 and a zero-waste nation by 2050. Achieving the aims in TWZ relies on a suite of waste sector plans. These provide details on how the outcomes, targets and policies in Towards Zero Waste are to be implemented.

National Policy: Welsh Government (2012) Construction and Demolition Sector Plan

16.2.14 This plan details outcomes, policies and actions on waste for organisations, companies and individuals in Construction and Demolition (C & D) in Wales.

Technical Advice Note 21: Waste, 2014

16.2.15 Technical Advice Note 21: Waste provides advice on how the land use planning system should contribute towards sustainable waste management and resource efficiency.

Minerals Technical Advice Note (Wales) 1: Aggregates

16.2.16 Minerals Technical Advice Note (Wales) 1: Aggregates sets out detailed advice on the mechanisms for delivering the policy for aggregates extraction by mineral planning authorities and the

aggregates industry. Its aim is to ensure mineral resources are used sustainably whilst meeting society's needs. It should be read in conjunction with Minerals Planning Policy Wales which sets out the general policies for all mineral development.

WRAP Cymru Delivery Plan: 2011-15 For a World Without Waste

16.2.17 This plan focuses on the most important issues: minimising resource use and diverting priority materials from landfill. The Plan is divided into two themes: waste prevention and resource minimisation (including reuse), recycling and recovery (including preparation for reuse).

Climate Change Strategy for Wales 2010

16.2.18 Chapter 12 within this strategy, "Resource efficiency and waste sector emission reduction", sets out actions to reduce emissions in the waste sector including:

a) Reducing greenhouse gas emissions from landfill sites.
b) Reducing indirect emissions associated with resource consumption by increasing reuse, recycling and composting.

Pembrokeshire County Council Local Development Plan (LDP)

16.2.19 Pembrokeshire County Council LDP[2], Adopted Plan (February 2013) provides policies on sustainable development (Strategic Policy 1), safeguarding mineral resources (Strategic Policy 6) and waste (Strategic Policy 11). A number of General Policies (GN) relate to materials and waste, including:

a) GN.4 Resource Efficiency.
b) GN.22 Prior Extraction of the Mineral Resource[3] provides supplementary good practice guidance.
c) GN.23 Mineral Working.
d) GN.24 Recycled Waste Materials and Secondary Aggregates.
e) GN.40 New Waste Management Facilities.
f) GN 24 Recycled Waste Materials and Secondary Aggregates.
g) GN.41 Waste Minimisation, Reuse, Recovery, Composting and Treatment.

[2] https://www.pembrokeshire.gov.uk/content.asp?nav=1626,109,2045
[3] Good Practice Guidance Note – LDP policy GN.22 – prior extraction of the mineral resource.

h) GN.42 Disposal of Waste on Land.

16.3 Relevant Guidance

16.3.1 The following relevant published standards, guidance and best practice would be followed.

a) Interim Advice Note (IAN) 125/15 Supplementary Guidance for Users of DMRB Volume 11 'Environmental Assessment Update'.

b) Design Manual for Road and Bridges (DMRB) Volume 11, Section 3 Part 3, Disruption Due to Construction. This covers the effect on people and on the natural environment which can occur, mainly during construction works.

c) DEFRA Environmental Permitting Guidance 'The Waste Framework Directive' for the Environmental Permitting (England and Wales) Regulations 2010.

d) Definition of Waste: Development Industry Code of Practice, Version 2 (Contaminated Land: Applications in Real Environments (CL:AIRE) 2011).

e) Pollution Prevention Guidelines (PPG) 'Working at construction and demolition sites' provides practical advice and guidance for the prevention of pollution during construction and demolition projects. The guidance explains what is required by law and describes good practice measures to reduce the risks of a pollution incident. Although PPG6 was withdrawn on 14 December 2015 and is no longer maintained by the Environment Agency et al., such guidance continues to provide useful pollution prevention guidance for site activities.

16.4 Study Area

16.4.1 The study area for the assessment includes the construction and permanent land take areas associated with the Scheme (see Volume 2 Figures 2.4A and 2.4B) plus the spatial area over which the Scheme would be predicted to have an effect.

16.4.2 Consideration of the potential effects outside of the Scheme area has also been included where appropriate, specifically with regards to the effects associated with the supply and movement (import/export) of material resources and export of waste arisings outside of the Scheme boundary. For material resources and waste arisings, the study area would typically relate to the region, in this case South West Wales.

16.5 Methodology

16.5.1 The assessment of the environmental effects associated with the use of material resources, the generation and management of waste resulting from the construction of the Scheme has been undertaken in accordance with the guidance provided within the IAN 153/11 – Guidance on the Environmental Assessment of Material Resources.

Baseline Methodology

16.5.2 The existing baseline conditions were identified from desk studies and information from ground investigations. This information was used to determine the nature of existing material resources on site that will be used in the earthworks. The potential locations of material resource sources, disposal and management sites were also reviewed.

Ground Conditions

16.5.3 The baseline ground conditions within the study area were established through desk studies and intrusive ground investigations.

16.5.4 The following sources of information were used to assess baseline ground conditions:

a) 1:50,000 Geological Plan, Sheet 228 Haverfordwest (Drift) 1976, British Geological Survey.
b) 1:50,000 Geological Plan, Sheet 228 Haverfordwest (Solid) 1976, British Geological Survey.
c) A40 Llanddewi Velfrey to Penblewin Improvement – Preliminary Sources Study Report, March 2016, Mott MacDonald.
d) A40 Llanddewi Velfrey to Penblewin – Ground Investigation Factual Report, June 2016, WYG Environment Planning Transport Ltd.
e) A40 Llanddewi Velfrey to Penblewin Improvement – Ground Investigation Report, June 2017, Arup.
f) A40 Llanddewi Velfrey to Penblewin – Geotechnical Design Report, August 2017, Arup.

Mineral Resources

16.5.5 The following published maps were reviewed to establish the presence of mineral resources within the Scheme area and wider study area:

a) British Geological Survey 1:100,000 South West Wales Mineral Resource Map.
b) British Geological Survey 1:100,000 South West Wales Aggregate Safeguarding Map.
c) Pembrokeshire County Council (2013) LDP up to 2021.

Waste Management Facilities

16.5.6 Searches were undertaken to establish the location of suitable waste management facilities. The following sources were reviewed:

a) Natural Resources Wales Public Register of Operational Waste Management Facilities was reviewed based on information downloaded from the Lle Geo-Portal[4].
b) Pembrokeshire County Council (2013) LDP up to 2021.

Assessment of Construction Effects

16.5.7 The assessment aims to identify the environmental effects associated with material resource demand and waste arisings through a review of the resources required for the construction phase of the Scheme and the waste that is likely to arise.

16.5.8 A Simple Assessment has been carried out in accordance with IAN 153/11.

16.5.9 The Simple Assessment comprises the assembly of data and information that is readily available to address potential effects identified at the Scoping level, to reach an understanding of the likely environmental effects to inform the final design, or to reach an understanding of the likely environmental effects that may result in the need for Detailed Assessment.

16.5.10 For the purposes of assessing the effects associated with material resource use and waste arisings, the Simple Assessment is a qualitative exercise which aims to identify the following:

a) The material resources required for the project and where information is available, the quantities.
b) The anticipated waste arisings from the project, and where information is available, the quantities and type (e.g., inert, hazardous).

[4] Lle Geo-Portal http://lle.gov.wales/home?lang=en

c) The impacts that will arise from the issues identified in relation to material resources and waste.

d) The results of any consultation.

e) A conclusion about whether this level of assessment is sufficient to understand the effects of the project or whether a Detailed Assessment is necessary.

16.5.11 The assessment identifies the environmental impacts and the measures to mitigate the impacts. The assessment of potential effects due to construction was based on estimated material resource requirements and includes a review of material volumes, sources and movements. Vehicle movements required for delivery and export of materials were considered.

16.5.12 The outcome of the Simple Assessment was that a Detailed Assessment was required. The Detailed Assessment is a quantitative assessment and was completed in accordance with IAN 153/11. It used the data gathered at the Simple Assessment level along with additional information collated to quantify the material resources required for the project and the estimated quantities and types of waste that would be produced.

16.5.13 As noted in IAN 153/11, the guidance is not exhaustive and thus provides a flexible approach which enables the tailoring of the approach to the specific characteristics of each project. For the purposes of assessing the effects associated with material resources and generation and management of waste arisings in this Scheme, the Detailed Assessment is a quantitative exercise.

Assessment of Operational Effects

16.5.14 The environmental effects associated with material resource demand, and the generation and management of waste arisings during operation are generally limited to those associated with periodic maintenance.

16.5.15 For the assessment of potential operational effects, the periodic maintenance requirements presented in Volume 7 of DMRB have been considered. A qualitative assessment has been carried out of the sensitivity of the facilities required to source necessary material resources and facilities required for waste disposal. The impact on these facilities has been based on the scale and nature of the periodic maintenance work.

16.6 Significance Criteria

16.6.1 There is currently no specific defined methodology for assessing the environmental significance of a material resource or for determining the magnitude of the impact on such a resource. Similarly, there is no specific methodology for assessing that of the generation and management of waste arisings. The general guidance given in DMRB Volume 11, Sections 1 and 2 was therefore considered. In particular, the guidance in Volume 11, Section 2, Part 5 (HA 205/08) together with professional judgement was used to assess environmental value, magnitude of impact and the significance of environmental effects.

Sensitivity

16.6.2 The first stage of the assessment is an evaluation of the sensitivity of the material resource or feature, based on an assessment of the quality, scale, rarity and the services provided. The value (sensitivity) of the material resources or waste arisings and management facilities within the study area is determined on the basis of the descriptions described in Table 11.1 of HA 205/08 as reproduced below in Table 16.1.

Table 16.1 Environmental Value (or Sensitivity)

Value/Sensitivity	Typical descriptors
Very High	Very high importance and rarity, international scale and very limited potential for substitution.
High	High importance and rarity, national scale, and limited potential for substitution.
Medium	High or medium importance and rarity, regional scale, limited potential for substitution.
Low	Low or medium importance and rarity, local scale.
Negligible	Very low importance and rarity, local scale.

Magnitude of Impact

16.6.3 The second stage is an evaluation of the magnitude of impact that the proposed works are likely to have on the resource or feature. The magnitude of the impact has been determined on the basis of the descriptions derived from Table 11.2 of the HA 205/08 as reproduced in Table 16.2 below.

Table 16.2 Magnitude of Impact

Magnitude of Impact	Typical descriptors
Major	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse).
	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).
Moderate	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements (Adverse).
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).
Minor	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse).
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse).
	Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).
No Change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

Significance of Effects

16.6.4 The final stage of the assessment combines the value (sensitivity) of the receptor and the magnitude of impacts to arrive at a level of significance. The significance has been derived in accordance with Table 2.4 of HA205/08 as reproduced in Table 16.3 below.

Table 16.3 Significance of Effect

Value/ Sensitivity	Magnitude of Impact				
	No Change	**Negligible**	**Minor**	**Moderate**	**Major**
Very High	Neutral	Slight	Moderate or large	Large or Very large	Very large
High	Neutral	Slight	Slight or moderate	Moderate or Large	Large or Very large
Medium	Neutral	Neutral or slight	Slight	Moderate	Moderate or Large
Low	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or moderate
Negligible	Neutral	Neutral	Neutral or slight	Neutral or slight	Slight

16.7 Limitations and Assumptions

16.7.1 The following limitations and assumptions have been noted.

a) The assessment of material resources and generation and management of waste arisings is still a developing area; detailed guidance is therefore not yet available on some aspects of the assessment process. This limitation has been considered and IAN 153/11 has formed the basis for the assessment.

b) The construction and operation of the Scheme would be carried out in accordance with normal good working practice implemented on such projects. The Preliminary Construction Environmental Management Plan (CEMP) sets out the environmental measures that would be adopted during the construction phase. This is provided in Volume 3 Appendix 2.2 of the ES and would form the basis of the full CEMP prior to construction commencing.

c) The quantities of material resources to be used for the construction of the Scheme, the sources from where they would be obtained and their mode of transport is yet to be finalised; they are estimated based on the Scheme design as described in Chapter 2 The Project. The quantities of the waste likely to arise were estimated on this basis. It is anticipated that the quantities would not be significantly different, and therefore would not produce a greater magnitude of impact.

d) The final quantities of material resources to be used for construction of the Scheme, the sources from where they would be

obtained and their mode of transport would be further reviewed during detailed design to ensure overall best value.

e) Whilst limitations exist, it is considered that the assessment of material resources and waste arisings is sufficiently robust according to the guidelines set out in the IAN 153/11 and for the purposes of this ES.

16.7.2 A Site Waste Management Plan (SWMP) would be prepared for the Scheme as part of the CEMP; refer to Chapter 22 Management of Environmental Effects. This would be implemented by the Contractor during construction. The SWMP would set out how the resulting waste would be managed during the construction of the Scheme. As SWMPs are not a legal requirement in Wales, this would be undertaken to provide supporting information on the basis of best practice. An outline SWMP is provided within the Preliminary CEMP which is contained in Appendix 2.2 of the ES.

16.7.3 Related guidance for the SWMP includes the following by Waste & Resources Action Programme (WRAP):

a) WRAP SWMP template; and

b) WRAP Designing out Waste: a design team guide for Civil Engineering.

16.7.4 A Materials Management Plan (MMP) would be prepared for the Scheme as part of the CEMP. This would also be implemented by the Contractor during construction and would set out how materials would be managed during the construction of the Scheme.

16.8 Consultations

16.8.1 Consultation with Natural Resources Wales (NRW) and Pembrokeshire County Council (PCC) was undertaken through the submission of the draft Scoping Report, in discussions at the ELG meetings and by direct correspondence.

16.8.2 NRW were asked for baseline information relating to historical and licenced landfills, and licenced waste management facilities (including soil treatment hubs / recycling centres) in Pembrokeshire and Carmarthenshire. Web links to the relevant pages of the Lle database were provided.

16.8.3 PCC were asked for baseline information relating to details of aggregate resources within the county (land bank figures) and local waste management infrastructure within the county. The council responded with references to specific appendices of the LDP.

16.9 Baseline Environment

Ground Conditions

16.9.1 Details relating to the geology and soils within the study area are presented in Chapter 6 Geology and Soils. A brief summary of key aspects is provided below. The Arup Ground Investigation Report (GIR)[5] (enclosed in Volume 3 Appendix 6.3) provides more details regarding detailed descriptions of the below-mentioned formations.

Superficial Deposits

16.9.2 Published geological maps show no superficial deposits across the majority of the proposed Scheme area. Localised areas of glaciofluvial deposits, boulder clay and alluvium are shown to be present.

16.9.3 Topsoil was encountered in the majority exploratory hole locations directly overlying the bedrock. Made-ground materials were also encountered locally within the scheme area.

16.9.4 Although shown locally on the geological maps, glaciofluvial deposits, boulder clay and alluvium were not encountered by the ground investigations.

Bedrock

16.9.5 The bedrock beneath the Scheme comprises three formations: primarily the Slade and Redhill Formation in the east and the Haverford Mudstone Formation with some discrete areas of the Portfield and Haverford Formation in the west.

16.9.6 As described in the Geotechnical Design Report[6], the materials excavated from the cuttings are expected to be predominantly granular in nature, which are likely to break down easily under processing and compaction to a Class 1 material in grading. However, a mantle of

[5] Welsh Government, A40 Llanddewi Velfrey to Penblewin Improvements, Ground Investigation Report, ref. A40LVP-ARP-VGT-SWI-RP-C-0001, Arup, July 2017
[6] A40 Llanddewi Velfrey to Penblewin – Geotechnical Design Report, August 2017, Arup.

mudstone rock along some lengths of proposed cutting are likely to have weathered down to a clay and would comprise a Class 2 material in grading.

Material Resources

16.9.7 The scheme would require both mineral resources, such as stone and soil, and manufactured construction material resources such as concrete, bricks, wood, bituminous macadam and steel. Access to mineral resources within the Scheme areas is discussed in Chapter 6 Geology and Soils. This chapter discusses the mineral resources available in the region surrounding the Scheme.

16.9.8 The imported manufactured material resources would be sourced from established suppliers who regularly provide materials for similar sized projects. The suppliers have not yet been determined, but the Contractor would ensure that they are suppliers with adequate resources to meet the quantitative needs of the scheme, without having a negative influence on their resources. Where possible, material resources would be provided from local sources. The sensitivity of the imported manufactured material resources is thus considered to be low.

16.9.9 The Mineral Landbank Calculations Summary Statement for PCC, LDP, Adoption – 2021, Revision (position at July 2012) 7 describes the Welsh Government landbank requirements of a minimum of 10 years for hard rock and a minimum of seven years for sand and gravel, for the entire period of the Council's LDP period.

16.9.10 It is stated that Pembrokeshire's current (2012) hard rock landbank is 38.32 years (excluding the National Park) – sufficient for 28.82 years at the end of 2021.

16.9.11 The Mineral Landbank Calculations show that there is currently no landbank of sand and gravel and thus the Welsh Government requirements are not met. However, an in-principle agreement was made between PCC and the Pembrokeshire Coast National Park Authority which allows the County to take account of permitted reserves within the National Park so that a Pembrokeshire wide landbank calculation can be used for the PCC LDP. This being the case, the combined landbank for hard rock would decrease slightly to 36.47

[7]The Mineral Landbank Calculations Summary Statement for Pembrokeshire County Council, Local Development Plan (LDP), Adoption – 2021, Revision (position at July 2012).

years (sufficient for 26.97 years at the end of 2021) but the current combined landbank for Sand and Gravel would increase to 17.86 – sufficient for 8.36 years at the end of 2021.

16.9.12 The current mineral workings within the Pembrokeshire LDP area are summarised in Table 16.4 below.

Table 16.4 Current mineral working

Name	Mineral	Status
Blaencilgoed / Gellihalog	Limestone	Active
Bolton Hill	Igneous	Active
Slade Hall Farm	Mudstone	Active
Glogue	Slate	Active
Cotts Lane	Slate	Active
Penlan	Slate	Active
Cefn	Slate	Active
Plascwrt	Sandstone	Active
Pope Hill	Shale	Active
Tangiers Farm	Shale	Active
Cronllwyn	Slate waste	Planning permission granted and working recently commenced
Treffgarne	Igneous	Dormant
Gilfach for owners' personal use	Slate	Small-scale working
Yetwen	Sandstone	Dormant
Trefigin133 (the part of the site outside the National Park)	Sand and gravel	Planning permission M15 granted, but working not commenced

16.9.13 There is also a wharf for landing of marine-won sand and gravel at Pembroke Dock.

16.9.14 It is considered that the hard rock landbank in Pembrokeshire is sufficient to support demand and is therefore considered to have a low sensitivity.

Waste Management Facilities

16.9.15 The waste management facilities[8] located within approximately 30km of the Scheme are deemed suitable for disposal of waste (based on their waste activity type) are shown on Volume 2 Figure 16.1.

16.9.16 The South West Wales Regional Waste Plan 1st Review (August 2008)[9] looks at waste across South West Wales (including Pembrokeshire CC, Pembrokeshire NPA, Bridgend CBC, Brecon Beacons NPA, Carmarthenshire CC, Ceredigion CC, Neath Port Talbot CBC and City & County of Swansea). The review states that in 2003, estimated regional arisings of C&D waste were 1,754,920 tonnes and by 2012/2013 they would stabilise at 2,076,883 tonnes.

16.9.17 There is likely to be availability in waste management facilities in the region. This will be confirmed during Detailed Design. The sensitivity is thus considered to be low to medium.

16.10 Potential Construction Effects

16.10.1 This section assesses the potential impacts of the material resources used and waste generated during the construction phase.

16.10.2 The Scheme has the potential to generate local effects during the construction and operational phase. This is due to:

a) The requirement for the import of construction materials (including primary aggregates).
b) The generation of excess materials requiring removal from site to alternative sites or landfill.
c) Depletion of construction material and waste management facility resource.

Types and quantities of materials

16.10.3 A variety of different material resources would be required for the construction phase of the Scheme. The Scheme would be designed, as close as possible achieve a cut fill balance, and to prevent, where possible, the generation of waste arisings and the import of construction

[8] Lle Geo-Portal http://lle.gov.wales/home?lang=en
[9] South West Wales Regional Waste Group, South West Wales Regional Waste Plan 1st Review (August 2008)

materials by reusing or recycling the available existing material resources along the Scheme.

16.10.4 Where possible, site won material would be reused for the earthworks, however, some materials would be unsuitable for reuse. Other materials cannot be sourced on site and would need to be imported. As is the case with other highway schemes, at this stage it is not possible to confirm the specific sources for imported materials or disposal sites. This will be confirmed during Detailed Design.

16.10.5 A summary of the predicted material resource use is presented in Table 16.5 and a summary of the predicted waste arisings is presented in Table 16.6.

Table 16.5 Summary of materials resource use

Project Activity	**Material resources required for the project**	**Quantities of material resources required**	**Additional information on material resources**
Earthworks	Topsoil	Some 38,500m^3* of topsoil would be reused*	Sourced from site
	General fill for embankments – primary or secondary / recycled materials	Some 313,500m^3* of material would be reused in earthworks	Sourced from site
	Capping	Some 8,000m^2* of granular selected fill would be used as Capping	Sourced from local suppliers
Installation of pavement	Type 1 subbase	25,500m^3*	Sourced from local suppliers
	Base, binder, and surface course. Primary or Secondary / Recycled materials	15,500 m^3*	Sourced from local suppliers
Structures	Concrete	TBC	Local batching plants
Installation of manufactured products	Drainage, kerbs, trees, traffic signs, lighting etc.	Various quantities relative to road length and necessary safety measures	To be established local/national suppliers
Operation of the road	No significant material resources required	No significant material resources required	

* Please note that these figures are based on estimates made at the current preliminary design stage.

Table 16.6 Summary of waste arisings

Project Activity	Waste arisings from the project	Quantities of waste arisings	Additional information on waste arisings
Site clearance	Vegetation surface strip, kerbs, trees, traffic signs, lighting etc.	Quantities not available at this stage.	Likely to be a combination of locally recycled, disposal at an inert or non-hazardous landfill site.
Earthworks	Excess Topsoil	20,000m^3	To be used in landscaping where possible. If necessary, likely to be local recycling facilities.
	Surplus excavated material (acceptable and unacceptable materials)	Nil	It is anticipated that the earthworks part of the balance would be neutral. This is considered to be achievable provided that the excavated materials are suitably excavated and stockpiled for reuse.
Installation of pavement	Surface planings	Tie-ins at both ends of the Scheme.	Potential to be reused for access tracks to attenuation ponds and private means of access tracks.
Installation of manufactured products	No significant waste arisings.	No significant waste arisings.	
Operation of the road	No significant waste arisings.	No significant waste arisings.	

*Please note that these figures are based on the estimates made at the current preliminary design stage.

Materials resource use

16.10.6 As presented in Table 16.5, sufficient quantities of material resources can be won from site for use as general fill for embankments and topsoil. Selected granular fill materials for use as capping, subbase and bound pavement materials are highly unlikely to be able to be sourced on site and would need to be imported. Manufactured goods including drainage, kerbs, trees, traffic signs, lighting etc. would also require importing.

16.10.7 The import of capping and subbase construction material resources may have an impact on material sources. However, the likely sources of construction material resources are established local suppliers and as

discussed in the Section 16.10, the hard rock landbank in Pembrokeshire is sufficient to support demand and is therefore considered to have a low sensitivity. The quantities of the material resources required for construction are considered to have a minor magnitude of impact on the resources available to established suppliers. The significance of effect from construction is therefore neutral or slight.

16.10.8 Bound pavement materials and manufactured goods are likely to be sourced from established suppliers and are therefore considered to have a low sensitivity. The quantities of the common construction material resources required for construction are relatively small in the context of the material suppliers and therefore the magnitude of impact is assessed to be minor. The significance of effect from construction is therefore neutral or slight.

Waste

16.10.9 It is proposed that all materials arising from construction would be managed in accordance with the waste hierarchy defined within the Waste Framework Directive.

16.10.10 Site clearance would include clearing existing trees, safety barriers, concrete kerbs, lighting columns, and traffic signs. It is likely that the materials would be segregated and appropriately recycled on site or disposed of at an appropriate waste handling facility.

16.10.11 Earthworks estimates predict a balance of the majority of earthworks materials but a surplus of some 20,000m^3 of topsoil. If removal of materials from site is required, the location for the disposal of these materials may include a combination of local recycling facilities and potentially disposal at an inert or non-hazardous landfill site. It is anticipated that a local recycling facility would be favoured.

16.10.12 It is proposed that all materials/waste arisings from construction would be reused on site in accordance with the waste management hierarchy defined within the waste framework directive. There may be some waste arisings associated with the works which cannot be reused on site. This may include waste arisings generated from the demolition of Trefangor Cottage, and any existing drainage infrastructure which would be replaced. The export of excess construction materials may have an impact on sites receiving the waste arisings. The facilities to

which waste arisings would be taken are likely to be established recycling facilities or landfill sites which have a low to medium sensitivity. The quantities of excess waste arisings requiring disposal are relatively small and would be a very small proportion of the overall construction and demolition waste disposal in the region, therefore the magnitude of impact is assessed to be minor. The significance of effect from construction is therefore slight.

16.10.13 Construction would include milling the surface of the existing pavement at the tie-ins with the existing highway. The surface planings could be reused in access tracks to attenuation ponds and private means of access tracks, which would result in no impact on material resources.

Local Road Network

16.10.14 The impact of vehicle movements associated with construction has been considered. The Scheme is in a heavily trafficked area, with over 11,000 vehicles using the existing road per day, and the import and export of construction material resources would result in additional traffic. Due to the current volume and type of traffic use, the sensitivity of the local road network is considered to be medium. As presented in Table 2.6 of Chapter 2 The Project, it is estimated that the import of bulk material would result in an average of 28 truck movements per day throughout the duration of the programme. This would include the import of drainage stone, concrete, subbase and pavement materials.

16.10.15 In addition to the bulk materials, there would be miscellaneous deliveries for items such as ducting, street lighting etc. There would also be export of waste arisings from site, although the quantities would be relatively small. Given the number of vehicles required for the import and export of material resources in comparison to the total number of vehicles using the existing road daily (amounting to 0.25%), it is considered that the magnitude of effect would be minor. The significance of effect from construction is therefore slight.

16.11 Potential Operation Effects

16.11.1 The Scheme has limited potential to generate an effect during the operational phase, as there are no requirements to import or export material resources or to generate waste on a day-to-day basis.

16.11.2 Roads are subject to a periodic maintenance regime. Volume 7 of DMRB requests that all new roads are built to a 40-year design life, which can only be achieved if the highway is maintained. Maintenance is needed using a 10-year cycle of interventions, which are likely to be:

a) Year 10, minor intervention. Remove and replace the surface course.

b) Year 20, major intervention. Remove and replace surface course, replace kerbs, upgrade drainage system. Replace road signs. Patch the binder and road base selectively.

c) Year 30, minor intervention as year 10.

d) Year 40, major intervention as year 20.

16.11.3 The maintenance works would involve export of surface course planings and damaged kerbs etc. At this stage, the location for the disposal of these waste arisings is not known, however, it is likely that road planings would be recycled and other materials processed off-site for reuse. Import of materials would be required to replace the surface course and damaged kerbs etc. At this stage the source of these material resources is not known, however, it is likely to be from local suppliers.

16.11.4 The import and export of construction material resources during maintenance works would involve quantities of materials that are extremely small compared to those for construction and would therefore have a lower impact on source sites and sites receiving the material. The facilities are likely to be established facilities and are therefore considered to have a low to medium sensitivity. The quantities of material resources would be relatively small and therefore the magnitude of impact is assessed to be minor. The significance of effect from operation is therefore slight.

16.12 Assessment of Effects Summary

16.12.1 Table 16.7 provides an overview of the potential impacts associated with each stage of the Scheme. This is in accordance with IAN 153/11 which requires, as a minimum, an overview of whether the impacts are positive/negative, permanent/temporary and direct/indirect.

Table 16.7 Detailed Assessment Reporting Matrix

Project Activity	Potential impacts associated with material resources / waste arisings	Description of the impacts
Site preparation and construction	Import of subbase and capping.	Permanent, neutral or slight Adverse to off-site sources.
	Import of pavement material and manufactured products.	Temporary, neutral or slight Adverse to established suppliers.
	Generation of waste and associated impacts on off-site waste management infrastructure.	Permanent, slight Adverse to recycling/disposal sites.
	Transportation of material resources and waste.	Temporary, slight Adverse to traffic
Operation and maintenance of asset	No significant impacts anticipated	No significant impacts anticipated

16.13 Mitigation and Monitoring

16.13.1 The assessment of effects during construction and operation predicts a slight impact on material resources and generation and management of waste. Procedures would be adopted by the Contractor prior to construction to control the use of material resources and further reduce the impacts. The relevant procedures shall be documented in the Contractor's SWMP and MMP for the works.

16.13.2 Wherever possible, site won material resources should be reused in construction. Site won material resources would only be reused on site if assessed as being suitable for reuse without causing unacceptable impacts on the end users and the environment. A specification for acceptable material to be used in construction would be developed, in accordance with the Specification for Highway Works (SHW)[10]. A specification would set material testing requirements for construction to confirm whether the proposed materials meet the requirements which have been developed in line with the CL:AIRE Code of Practice.

16.13.3 It would be necessary to remove some unacceptable and excess materials from site. A SWMP would be produced to detail the estimated quantities of waste arisings and the opportunities for reuse, recycling,

[10] Manual of Contract Documents for Highways Works (MCHW), Volume 1 Specification for Highway Works (SHW).

recovery or disposal. An outline SWMP is provided within the Pre-CEMP contained in Appendix 2.2.

16.13.4 Materials would be sorted and/or processed, and where necessary treated, before reuse or disposal. This would limit the overall quantities disposed to landfill and maximise disposal to the most appropriate waste stream. The pre-treatment of waste material prior to disposal to landfill is a requirement of the waste regulations. By minimising the quantity of materials/waste arisings to be disposed offsite the associated vehicle movements would be minimised.

16.13.5 Due to the relatively simple nature of the construction processes involved, the small number of different types of potential surplus materials, and relatively small quantities of these, preparation and use of a SWMP is likely to be an effective approach to the mitigation of potential effects.

16.13.6 Table 16.8 summarises the mitigation measures that would be implemented.

Table 16.8 Summary of mitigation measures

Project Activity	Potential impacts associated with material resource use/ waste management	Description of mitigation measures	How the measures would be implemented, measured and monitored
Site clearance.	Waste disposal.	Identify opportunities for reuse, recycling, recovery.	Materials to be sorted, and where practical disposed to recycling facilities. Site SWMP to implement, measure and monitor.
Earthworks.	Use of primary resources. Waste disposal.	Reuse of materials in earthworks. Limit disposal and movements.	Design to maximise the earthworks balance. SWMP to implement, measure and monitor.
Pavement planings.	Waste disposal.	Possible reuse in access tracks.	Design to maximise the materials balance. SWMP to implement, measure and monitor.

Monitoring

16.13.7 Procedures would be established by the Contractor prior to construction to control the use of materials and further reduce the impact. These

would be documented in the SWMP for the Scheme which would form part of the CEMP. The SWMP would detail the estimated quantities of waste arisings and the opportunities for reuse, recycling, recovery or disposal.

16.13.8 Material would be responsibly sourced (i.e. must have a certified provenance, traceability and sustainability) where possible, to reduce the impact on material resources. Responsible sourcing is defined in BS8902 Responsible sourcing sector certification schemes for construction projects – Specification as:

> *"the management of sustainable development in the provision or procurement of a product"*

16.13.9 Where sustainable development is further defined as:

> *"an enduring, balanced approach to economic activity, environmental responsibility and social progress".*

16.13.10 In order to comply with responsible sourcing principles, the Contractor would refer to a relevant standard, such as BRE standard BES 6001 The Responsible Sourcing of Construction Products.

16.13.11 Construction would be undertaken in accordance with a detailed specification prepared in line with SHW. The Specification would define the requirements for materials used on site and would define testing and verification required to confirm acceptability for use.

16.14 Residual Effects

16.14.1 A slight significance of effect remains in relation to material resources and the generation and management of waste following mitigation and monitoring. This is due to the effects being largely governed by the relatively fixed volume of imported material resources required for the Scheme, and the limited scope for reuse of the relatively small proportion of waste material that the Scheme will generate.

16.14.2 The good practice measures outlined above do however provide a potential for reductions in the effects, whilst controlling and limiting the significance to no greater than the levels that have been assessed.

16.15 Summary

16.15.1 The assessment of material resources and waste arisings has been undertaken in line with DMRB IAN 153/11.

16.15.2 The assessment of impacts during construction and operation predicts a slight significance of effect on material resources and generation and management of waste. Procedures would be adopted by the Contractor prior to construction to control the use of materials and further reduce the impact, which shall be documented in their SWMP for the works. The Contractor's CEMP would detail measures to be implemented to manage risks associated with excavation, export and import of materials in terms of health and safety, and the environment.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 17: Population and Human Health

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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17.1 Population and Health Baseline

17 Population and Human Health

17.1 Introduction

17.1.1 This assessment documents the findings of an assessment of how the Scheme may influence public health and well-being in the areas surrounding the Scheme, through environmental and socioeconomic pathways. The assessment also considers, where possible, the distribution of impacts within different social groups, and the potential equalities impacts of the Scheme. The Scheme has been assessed both during construction and operation.

17.1.2 Health assessments are multidisciplinary and cut across the traditional boundaries of health, public health, social sciences and environmental sciences. The most commonly used definition of a health assessment is taken from the World Health Organisation (WHO) Gothenburg Consensus Paper:

> *'……a combination of procedures, methods and tools by which a policy, programme or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population'.1*

17.1.3 The broader understanding of health is captured by the WHO definition:

> *'Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'2.*

17.1.4 With this in mind, the objectives of this assessment are to:

a) identify any negative or positive population and health impacts of the Scheme during construction and operation;

b) develop mitigation and enhancement measures that can be applied to the Scheme (to be applied following planning consent) in order to minimise the negative and enhance the positive health and wellbeing impacts; and

c) identify possible indicators for monitoring and evaluating the actual health impacts during construction and operation.

17.1.5 The following sections set out how the assessment has been carried out,

1 WHO European Centre for Health Policy (1999). Health impact assessment: main concepts and suggested approach. Gothenburg consensus paper. WHO Regional Office for Europe.
2 World Health Organisation (WHO) (2007). Constitution of the World Health Organisation, Geneva, 1946.

the results of the assessment and recommendations for improving the health and wellbeing effects of the Scheme.

17.2 Legislative context

17.2.1 The requirement for health and equalities to be assessed are covered by the following legalisation:

a) **The Environmental Impact Assessment (Miscellaneous Amendments relating to Harbours, Highways and Transport) Regulations 2017** requires the consideration of effects of a project on human health.

b) **The Equality Act 2010**, states in Section 149 of the Act, that public bodies are subject to the Public Sector Equality Duty ('the Duty'), which requires that, in the exercise of their functions, they have due regard to the need to:

   i. Eliminate discrimination, harassment, victimisation, and any other conduct that is prohibited by or under this Act;

   ii. Advance equality of opportunity between persons who share a protected characteristic and persons who do not share it; and

   iii. Foster good relations between persons who share a relevant protected characteristic and persons who do not share it.

   There are eight protected characteristics covered by the Public Sector Equality Duty including age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex and sexual orientation.

c) **The Well-being of Future Generations (Wales) Act 2015** which places a duty on public bodies in Wales and those listed in the Act to work to improve the economic, social, environmental and cultural well-being of Wales. It puts in place seven well-being goals, as shown in Figure 17.1.

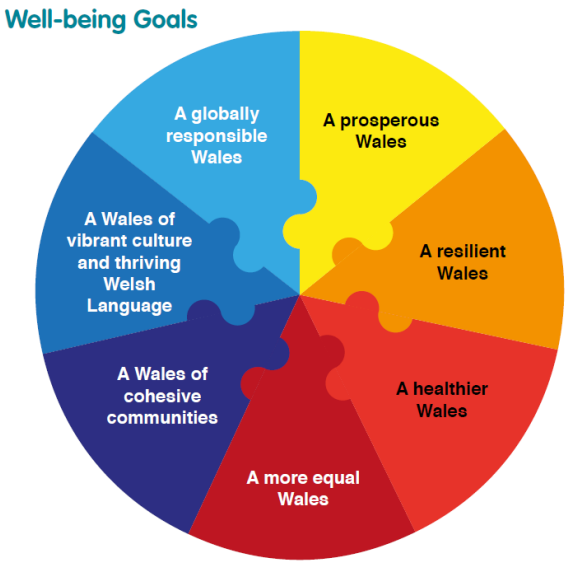

Figure 17.1 Well-being goals

d) **The Public Health (Wales) Act 2017** requires Welsh Ministers to make regulations to require public bodies to carry out health impact assessments (HIA)3 in certain circumstances. These circumstances are yet to be defined, and the Act is specific to public bodies; however, the Act is currently serving as a driver for HIA to be undertaken, aligning with the EIA Regulations.

17.2.2 As a result of the need to meet the legislative requirement for an assessment of both health and equalities, this population and health assessment considers both.

17.3 Relevant guidance

17.3.1 The approach and methodology for the assessment is primarily driven through the specific requirements within the Welsh Transport Planning and Appraisal Guidance (WelTAG) (Welsh Government, 2017)[4] and the assessment approach outlined in Section 2 Methodology.

17.3.2 Guidance provided through the Wales HIA Support Unit (WHIASU) has also been used to identify vulnerable groups within the local population. This was augmented by consideration of people within the communities who have protected characteristics and which therefore need to be considered under the Equality Act, 2010.

[3] HIA reports can, in some circumstances be prepared and submitted as separate assessment reports. They are fundamentally the same as an assessment of population and health.
[4] https://consultations.gov.wales/sites/default/files/consultation_doc_files/161208-weltag-consultation-en.pdf

17.4 Assessment Methodology

17.4.1 The assessment of population and health is a multidisciplinary process designed to identify and assess the potential health outcomes (both adverse and beneficial) of a proposed project, plan or programme and to deliver evidence-based recommendations that optimise health gains and reduce or remove potential negative impacts or inequalities on people with protected characteristics.

17.4.2 This section sets out the scope of this assessment and the specific methodology that was followed including the study area, the study population, information and data sources that were consulted, assessment criteria and assessment outcomes.

17.4.3 The assessment approach was qualitative except where informed by quantitative findings from the EIA. The population and health assessment has been informed by and builds on the analysis of the EIA (air quality, noise, etc).

Geographical scope

17.4.4 The study area includes the wards of Lampeter Velfrey, Narberth Rural, Narberth and Whitland that sit within the wider area of the County of Pembrokeshire. Where possible, data is provided at the level of the study area (i.e. the three wards listed above), however the majority of data is only available at the County level (i.e. for Pembrokeshire).

Baseline data gathering - Community Profile

17.4.5 Baseline data has been collated from a range of sources to provide an overview of the existing population, existing health profile, socioeconomic conditions in the local community and the physical environment in the locale.

17.4.6 This gathering of baseline data has been coordinated with other workstreams within the EIA such as socioeconomic assessment and the air and noise assessments.

17.4.7 The data reviewed has included, but has not been limited to:

a) Public Health Wales publications such as Welsh Health Survey lifestyle trends (2015);

b) Health Board Maps, Demography (2016); and

c) Office for National Statistics, Census 2011 data

Determinants of health

17.4.8 Environmental, social, economic and fixed factors, which are collectively known as 'health determinants' influence health and well-being. The key determinants of health can be characterised as:

a) Pre-determined factors such as age, genetic make-up and gender are fixed and strongly influence a person's health status;

b) Social and economic circumstances such as poverty, unemployment and other forms of social exclusion strongly influence health, and improving them can significantly improve health;

c) How the environment in which people live, work and play is managed - its air quality, built environment, water quality – can damage health, or provide opportunities for health improvement;

d) Lifestyle factors such as physical activity, smoking, diet, alcohol consumption and sexual behaviour, can have significant impacts on health;

e) Accessibility of services such as the National Health Service (NHS), education, social services, transport (especially public transport) and leisure facilities influence the health of the population.

17.4.9 Of these, only the pre-determined factors are unlikely to be influenced by a development proposal. This population and health assessment therefore considers all relevant health determinants other than the pre-determined factors.

17.4.10 Guidance from WHIASU has been adapted to identify a list of potential health determinants that may be relevant to a given project. This in turn allows for the identification of any likely significant effects that would need to be assessed further within the EIA.

17.4.11 Health determinants which have been identified as being relevant to the Scheme include:

a) Access to open space and nature;

b) Noise;

c) Air quality;

d) Flood risk;

e) Access to work and training;

f) Accessibility and active travel;

g) Access to services and social infrastructure (including education)

17.4.12 Each of these health determinants is discussed further in the assessment section (Section 17.6).

Local community

17.4.13 The health assessment has considered health and well-being status and current health problems of all people within the local community. However, vulnerable and/or disadvantaged groups can often experience health impacts more acutely than other groups within communities resulting in health inequalities.

17.4.14 Vulnerable and/or disadvantaged groups within the local community have been identified using the Wales Health Impact Assessment Support Unit (WHIASU) Practical Guide to HIA vulnerable group checklist. Groups with protected characteristics (as defined by the Equality Act 2010) are also included for consideration in the assessment.

17.4.15 Table 17.2 identifies which groups are considered to have high relevance to the Scheme and which are therefore considered in more detail in the assessment. The selection has been based on the local community profile.

17.4.16 The WHIASU vulnerable group checklist systematically considers inequalities and the impacts on a range of vulnerable groups (including those with protected characteristics) within the population and assesses the extent and distribution of them. These groups can, for example, include older people, children and young people, those who suffer from chronic conditions, or those who are geographically isolated.

Table 17.1 Vulnerable and disadvantaged groups and their relevance to the assessment

Vulnerable and disadvantaged groups	**Protected characteristic represented**	**Relevance to assessment (high/medium/low)**
Age related groups:		
Children and young people	Age	High
Older people	Age	High
Income related groups:		
People on low income	Potentially all	Medium
Economically inactive	Potentially all	Medium
Unemployed/workless	Potentially all	Medium
People who are unable to work due to ill health.	Disability	Low
Groups who suffer discrimination or other social disadvantage:		
People with physical or learning disabilities /difficulties	Disability	Low
Refugee groups	Potentially all	Low
People seeking asylum	Potentially all	Low
Travellers	Race	Low
Single parent families	Potentially all	Low
Lesbian and gay and transgender people	Sex	Low
Black and minority ethnic groups	Race	Low
Religious groups.	Religion	Low
Geographical groups:		
People living in areas known to exhibit poor economic and/or health indicators	Potentially all	High
People living in isolated areas	Potentially all	High

Equalities

17.4.17 When considering whether a proposed project has equalities impacts it is necessary to determine whether impacts identified are likely to have a differential or disproportionate effect on people with protected characteristics:

a) Differential effects arise where people with protected characteristics could be affected differently from the rest of the population, due to a particular need or sensitivity;

b) Disproportionate effects arise when an impact has a proportionately greater effect on people with protected characteristics than the rest of the population.

17.4.18 The assessment considers all protected characteristics and whether there is likely to be a differential or disproportionate impact on any of these groups.

Literature review – Linking health determinants to health impacts

17.4.19 Several types of literature have been used to inform the health assessment including research reports from organisations such as the World Health Organization, as well as literature reviews, and primary research studies. Using available literature, including previous health studies and recent research, an evidence base has been collated to identify links between the selected determinants and health impacts. Key reference material has included:

a) Government health policies, programmes and strategies;

b) Previous health assessments for masterplans;

c) Public health reports and research papers from a range of sources, including:

   i. Public Health Wales;

   ii. WHO;

   iii. National Institute for Health and Care Excellence (NICE);

   iv. Health Development Agency (HDA).

17.4.20 All reference material is acknowledged and referenced within the assessment text in Section 17.6.

Assessing population and health effects

17.4.21 There is no established or widely accepted framework for assessing the 'significant' health effects of a development proposal. The health significance of an environmental impact is typically a function of the 'magnitude' and 'duration' of the change to health determinants and the extent of the population exposed to this change. When considering the extent of the population, consideration also need be given to whether

there are populations within the study area that are particularly vulnerable to health effects.

17.4.22 The criteria that have been used to define significance of effects are set out in Table 17.2 which also considers whether the effect is direct or indirect, positive or negative and permanent or temporary.

Table 17.2 Impact Significance Matrix

Significance level	Criteria
Major +++/--- (positive or negative)	Health effects are categorised as a major positive if they prevent deaths/prolong lives, reduce/prevent the occurrence of acute or chronic diseases or significantly enhance mental wellbeing would be a major positive. Health effects are categorised as a major negative if they could lead directly to deaths, acute or chronic diseases or mental ill health. The exposures tend to be of high intensity and/or long duration and/or over a wide geographical area and/or likely to affect a large number of people (e.g. over 500) and/or sensitive groups e.g. children/older people. They can affect either or both physical and mental health and either directly or through the wider determinants of health and wellbeing. They can be temporary or permanent in nature. These effects can be important local, district, regional and national considerations. Mitigation measures and detailed design work can reduce the level of negative effect though residual effects are likely to remain.
Moderate ++/-- (positive or negative)	Health effects are categorised as a moderate positive if they enhance mental wellbeing significantly and/or reduce exacerbations to existing illness and reduce the occurrence of acute or chronic diseases. Health effects are categorised as a moderate negative if the effects are long-term nuisance impacts, such smell and noise, or may lead to exacerbations of existing illness. The negative impacts may be nuisance/quality of life impacts which may affect physical and mental health either directly or through the wider determinants of health. The exposures tend to be of moderate intensity and/or over a relatively localised area and/or of intermittent duration and/or likely to affect a moderate-large number of people e.g. between 100-500 or so and/or sensitive groups. The cumulative effect of a set of moderate effects can lead to a major effect. These effects can be important local, district and regional considerations. Mitigation measures and detailed design work can reduce and in some/many cases remove the negative and enhance the positive effects though residual effects are likely to remain.
Minor +/- (positive or negative)	Health effects are categorised as minor either, positive or negative, if they are generally lower level quality of life or wellbeing impacts. Increases or reductions in noise, odour, visual amenity, etc. are examples of such effects. The exposures tend to be of low intensity and/or short/intermittent duration and/or over a small area and/or affect a small number of people e.g. less than 100 or so. They can be permanent or temporary in nature. These effects can be important local considerations. Mitigation measures and detailed design work can reduce the negative and enhance the positive effects such that there are only some residual effects remaining.

Significance level	Criteria
Neutral/No Effect ~	No health effect or effects within the bounds of normal/accepted variation.

Limitations and assumptions

17.4.23 Literature and baseline data used in the study has been limited to readily available public and published sources. The information contained within the ES and other project documents has been used to characterise the study area and identify impacts on health determinants.

17.4.24 The approach to the assessment of health impacts is generally qualitative, identifying likely positive and negative impacts based on the relationships between determinants and health outcomes identified within the literature reviewed.

17.5 Community health and well-being profile

17.5.1 This section sets out the summary of the community and health profiles within the study area likely to be directly or indirectly affected during the construction and operation of the Scheme. A focus has been made on demographic factors which are of particular relevance to health determinants of the health assessment. The full baseline data is included within Appendix 17.1 which includes all references for the quoted data.

Community profile

17.5.2 The Scheme is located in a rural area with low population density, and lower than average rates of ethnic and religious diversity. Pembrokeshire has an older population than the Welsh average, with higher proportions of residents in groups aged 50 and over, and smaller proportions of residents in younger age groups. This is reflected in a higher than average proportion of residents who are retired.

17.5.3 Unemployment is low, and the workforce is relatively highly skilled, particularly in the local study area where the proportion of working-age residents with a degree-level qualification is above the national average. The largest sector for employment is public administration, education and health, and the agriculture and tourism sectors provide a higher proportion of employment than the Welsh average. Deprivation in the local study area is low. Across Pembrokeshire, there are pockets of higher deprivation in urban areas including Pembroke, Pembroke Dock,

Milford Haven and Haverfordwest.

Health profile

17.5.4 Health deprivation is also low across the study area, with some pockets of higher deprivation. Life expectancy is above the average for Wales, and mortality rates – including from cancer, respiratory and cardiovascular diseases – are lower than average. There are higher than average levels of alcohol consumption and smoking, but lower than average mortality rates attributable to alcohol and tobacco. The proportion of adults who are overweight or obese is slightly higher than average, although a higher than average proportion of adults meet the recommended level of physical activity. Crime is generally low, with the exception of antisocial behaviour and drugs offences where there are higher rates than the figures for England and Wales.

17.6 Assessment of health effects

17.6.1 The assessment of effects considers each of the determinants of health, identified in paragraph 17.4.11. Findings from the literature review are firstly set out, followed by an assessment of how, as a result of the Scheme, the determinants of health are likely to affect any of the identified vulnerable and disadvantaged groups of people within the population (see Table 17.2) in addition to the population in general.

17.6.2 The assessment matrixes below (Table 17.3 and Table 17.4 respectively) are an overall summary of this assessment which is elaborated on more within each health determinant assessment section. Consideration has been given to both the construction and operational phases.

Table 17.3 Summary of construction stage health effects

People/Groups considered	**Determinant of health**	Access to open space and nature	Noise	Air quality	Flood risk	Access to work and training	Accessibility and active travel	Access to services and other social infrastructure (including education)	Community safety	Use of natural resources
Children and young people		-	-	-	~	+	-	~	-	~
Older people		-	-	-	~	~	-	~	-	~
People on low incomes		-	-	~	~	~	-	~	~	~
Economically inactive		-	-	~	~	~	~	~	~	~
Unemployed/workless		-	- -	~	~	+	-	~	~	~
Long term sick		-	- -	-	~	~	-	~	~	~
People with physical/learning difficulties		-	- -	~	~	~	-	~	-	~
People with [other] protected characteristics[5]										
People in areas of poor economic/health status		-	-	~	~	+	~	~	~	~
People living in isolated areas		-	-	~	~	~	~	~	-	~

Key: + or - = minor effect | ++ or -- = moderate effect | +++ or --- = major effect | ~ = neutral effect

Red = adverse effect | Amber = mixed effect | Green = positive effect

[5] This includes gender, pregnancy and maternity, race, religion, sex & sexual orientation, marriage & civil partnership. Age and disability are covered separately.

Table 17.4 Summary of operational health effects

People/Groups considered	**Determinant of health**	Access to open space and nature	Noise	Air quality	Flood risk	Access to work and training	Accessibility and active travel	Access to services and other social infrastructure (including education)	Community safety	Use of natural resources
Children and young people		+	++/--	~	~	+	+	~	~	~
Older people		+	++/--	~	~	~	+	~	~	~
People on low incomes		+	++/--	~	~	+	+	~	~	~
Economically inactive		+	++/--	~	~	+	+	~	~	~
Unemployed/workless		+	++/--	~	~	+	+	~	~	~
Long term sick		+	++/--	~	~	~	+	~	~	~
People with physical/learning difficulties		+	++/--	~	~	~	+	~	~	~
People with [other] protected characteristics[6]		+	++/--	~	~	~	~	~	~	~
People in areas of poor economic/health status		+	++/--	~	~	~	+	~	~	~
People living in isolated areas		+	++/--	~	~	+	+	~	~	~

Key: + or - = minor effect | ++ or -- = moderate effect | +++ or --- = major effect | ~ = neutral effect

Red = adverse effect | Amber = mixed effect | Green = positive effect

[6] This includes gender, pregnancy and maternity, race, religion, sex & sexual orientation, marriage & civil partnership. Age and disability are covered separately.

Access to open space and nature

Literature review

17.6.3 Access to open space, green space and nature has health benefits, in relation to increasing physical activity[7,] as well as for mental wellbeing[8, 9.]

17.6.4 A Forestry Commission[10] review identified the key health benefits of green space as:

a) Long and short term physical benefits associated with obesity, life expectancy, heart rate and blood pressure;
b) Attention and cognitive benefits associated with restoration, mood and self-esteem;
c) Physical activity benefits associated with the use of greenspace;
d) Self-reported benefits in terms of health and life satisfaction; and
e) Community cohesion benefits through social contact fostered by greenspace'.

17.6.5 Studies have found that the amount of green space and the walkability, connectivity and accessibility of the neighbourhood influence adult and children's mental health and physical health[11], [12]. The attractiveness or quality of green space is also an important determinant of use of green space[13.]

17.6.6 Contact with nature has positive health benefits through its positive effects on blood pressure, cholesterol and stress reduction, with particular relevance to mental health and cardiovascular disease[14]. Green space can also provide spaces to promote social interaction and cohesion[15], and reduce social annoyances and crime, all of which can

[7] Scrivens, K. S. (2013). *Four interpretations of social capital: an agenda for measurement. Working Paper no. 55.* OCDC.
[8] Gong Y, P. S. (1996). A systematic review of the relationship between objective measurements of the urban environment and psychological distress. *Environment International* , 48-57.
[9] Lee, A. (2010). The health benefits of urban green space: a review of the evidence. *Journal of Public Health , 33* (2), 212-222.
[10] O'Brien, L., Williams, K., Stewart, A.,(2010), Urban health and health inequalities and the role of urban forestry in Britain: A review, The Research Agency of the Forest Commission.
[11] Lee, A. (2010). The health benefits of urban green space: a review of the evidence. *Journal of Public Health , 33* (2), 212-222.
[12] Ward, J. S. (2016). Ward et al, 2016. The impact of children's exposure to greenspace on physical activity, cognitive development, emotional wellbeing, and ability to appraise risk. *Health and Place , 40*, 44-50.
[13] Croucher, K. M. (2007). *The links between greenspace and health: a critical lilterature review.* Greenspace Scotland.
[14] Maller, C. T. (2005). Healthy Nature Healthy People. *Health Promotion International , 21* (10).

[15] Lee, A. (2010). The health benefits of urban green space: a review of the evidence. *Journal of Public Health , 33* (2), 212-222.

contribute to the mental health of individuals[16].

17.6.7 Often the poorest or most vulnerable people experience poorer quality outdoor environments and suffer disproportionately from a lack of equitable access to ecology and green spaces. Recent research has suggested that there is a positive association between the percentage of green space in a person's residential area and their perceived general health and that this relationship is strongest for lower socio-economic groups[17].

17.6.8 Evidence demonstrates that 'an inactive lifestyle has a substantial, negative impact on both individual and public health – specifically, physical inactivity is a primary contributor to a broad range of chronic diseases such as coronary heart disease, stroke, diabetes and some cancers'[18]. Even relatively small increases in physical activity are associated with some protection against chronic diseases and an improved quality of life.

Construction phase effects

17.6.9 During construction, there are a number of footpaths which would be temporarily closed or diverted. These include: as shown on Volume 2 Figure 15.1: SP19/31/3; SP19/37/1; SP19/30/1; SP19/38/1; SP19/38/2; SP19/1/1; SP19/2/2; SP19/3/2; SP19/4/5; SP19/4/7; and SP19/17/1. There are no bridleways that would be directly affected although there are two within close proximity to the Scheme (Bridleway SP19/34/4 and Bridleway SP19/29/3). See ES Chapter 15 All Travellers for further details on which routes would be affected.

17.6.10 The closure and/or diversions of the footpaths and the general disturbance that would occur during construction would potentially affect use of these areas for recreation as people are generally disinclined to use such resources where there are chances of disruption and noise. This would subsequently potentially impact on physical fitness, particularly for people within the local residential areas who would become 'cut off' from footpaths either south or north of the A40 during the construction period.

17.6.11 For example, residents in Llanddewi Velfrey would have access on

[16] Maas, J. (2006). Green space, urbanity and health: how strong is the relation? *Journal of Epidemiology and Community Health , 60* (7), 587-592.
17 Maas, J. (2006). Green space, urbanity and health: how strong is the relation? *Journal of Epidemiology and Community Health*, 60 (7), 587-592.
[18]http://www.dchs.nhs.uk/your_health_useful_info/cyph/cyph_resources_and_support_materials/active_lifestyles

footpath SP19/1/1 disrupted which would reduce access by foot to areas of open space north of the new alignment. However, the results of the PRoW survey, which was carried out in May 201719, revealed that none of the routes around the Scheme were well used. This suggests that they are not important assets in relation to health and wellbeing of the local communities. Notwithstanding this usage evidence, the disruption to these rights of way during construction will reduce accessibility options to open space for the local communities and psychologically may lead to residents feeling restricted. Overall, it is considered that the effect on health would be short term, and minor.

Operation phase effects

17.6.12 There will be one new public bridleway and two new public footpaths created as part of the Scheme. One of the bridleways will be created to run from the public highway leading to Trefangor Burial Ground, east along the highway boundary to Ffynnon Chapel, where it intersects with footpath 19/30/1. At this location, the new northern bridleway will pass beneath the Scheme in a new underpass.

17.6.13 In addition, a new combined equestrian, cycling and pedestrian link will be provided along the southern highway boundary of the A40, running east from just south of Henllan Lodge to meet the detrunked A40 at Llanddewi Velfrey Western Junction. This route will link to the proposed bridleway described in the previous paragraph.

17.6.14 Whilst access to and use of some existing pathways will continue during the operation of the A40, the Scheme does present an opportunity to support physical activity and social connectivity improvements at the local level. Proposals also exist to address existing environmental and behavioural barriers limiting levels of physical activity, including:

a) improving the quality of green transport networks (influencing the desire to walk/cycle over alternative options);
b) improving pedestrian safety and addressing perceptions of poor safety e.g. through the improvement of junctions, signage and lighting (enabling people of all ages and levels of mobility to safely utilise routes); and
c) raising awareness regarding the convenience, economic and social, mental and physical health benefits of active lifestyles.

17.6.15 From a health perspective these changes and improvements to access

[19] WCHR Assessment Report at Volume 3 Appendix 15.1.

are likely to result in a long term, **positive**, **minor effect,** especially for members of the community who currently may be more restricted in access options.

Noise

Literature review

17.6.16 Evidence for health impacts from environmental noise has also been established, including sleep disturbance, cognitive impairment in children, hypertension and stroke, and cardiovascular disease, particularly ischaemic heart disease[20]. Sleep disturbance in turn is associated with obesity, diabetes, cardiovascular disease and all-cause mortality, and is "usually considered the most severe non-auditory effect of environmental noise exposure"[21][22][23], a view re-emphasised in almost the same terms in a recent 2014 summary of noise effects on health (Basner, et al., 2014).

17.6.17 Sufficient evidence of heart disease risk is available to allow quantification of heart disease risk from road noise exposure[24,25]. Other potential health outcomes in susceptible groups (children and older people), such as birth weight, cognitive performance, diabetes and cancer, are the subject of the 'QUIET' research programme in Europe, using data from the population of Denmark. The QUIET programme which ended in 2017 found that certain diseases, including diabetes, were higher when traffic noise exposure was increased (Sørensen, et al., 2017)[26].

17.6.18 Separating the effects of noise and air pollution exposure is difficult, as both tend to be linked to road traffic in urban areas, but recent research on populations in two Danish cities (as part of the QUIET project) suggests that stroke risk is increased by combined exposure to noise and air pollutants from road traffic, possibly with the stress effect of noise exposure creating stroke risk at a relatively low level of air pollution exposure (Sørensen, et al., 2017)[35]. A recent study of mortality and hospital disease outcomes in London found increased risks associated

[20] Fritschi, L. et al., 2011. Burden of disease from environmental noise, Copenhagen: WHO Regional Office for Europe.
[21] Fritschi, L. et al., 2011. Burden of disease from environmental noise, Copenhagen: WHO Regional Office for Europe.
[22] Muzet, A., 2007. Environmental noise, sleep and health. Sleep Medicine Review, Volume 11, pp. 135-142.
[23] Hume, K., Brink, M. & Basner, M., 2012. Effects of environmental noise on sleep. Noise and Health, 14(61), pp. 297-302.
[24] Fritschi, L. et al., 2011. Burden of disease from environmental noise, Copenhagen: WHO Regional Office for Europe.
[25] Babisch, W., 2008. Road traffic noise and cardiovascular risk. Noise Health, Volume 10, pp. 27-33.
[26] Sorensen, et al, 2017. Health consequences of noise exposure from road traffic. European Research Council. [Accessed January 2019] https://cordis.europa.eu/project/rcn/102535/reporting/en

with noise exposure after adjustment for $PM_{2.5}$ exposure among other potential confounding factors.[27]

17.6.19 Noise as discussed here is environmental noise (i.e. unwanted or harmful outdoor sound, as defined in the Environmental Noise Directive (Directive 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise., 2002), as opposed to workplace noise, and likewise the health impacts discussed are those other than direct auditory damage (as environmental noise is below the threshold for such damage).

17.6.20 The non-auditory effects of noise, as summarised above, can include annoyance or sleep disturbance, in turn with potential to cause stress and health risk factors such as increased blood pressure, resulting in health outcomes such as cardiovascular disease. Figure 17.2 "Summary of Noise Health Effects" and Figure 17.3 "Noise Health Pathways" illustrate these pathways, albeit noting that the 'direct' pathway (hearing loss) is not relevant in this case. This also illustrates the fact that adverse health outcomes (disease or mortality) would affect only a small proportion of those experiencing noise.

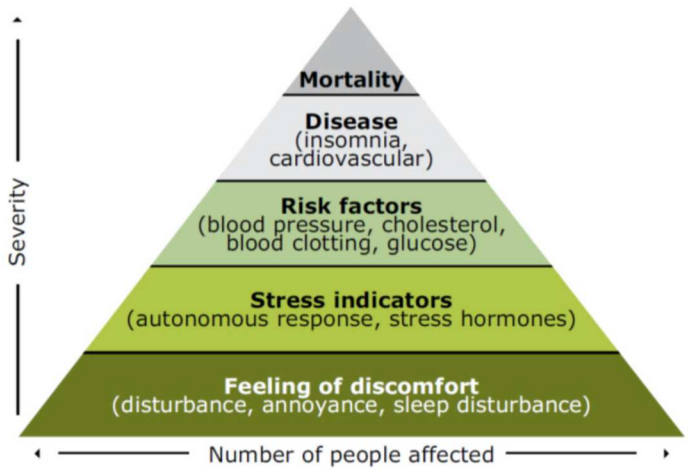

Figure 17.2 Summary of Noise Health Effects

[27] Halonen, J. et al., 2015. Road traffic noise is associated with increased cardiovascular morbidity and mortality and all-cause mortality in London. European Heart Journal, Volume 36, pp. 2653-2661.

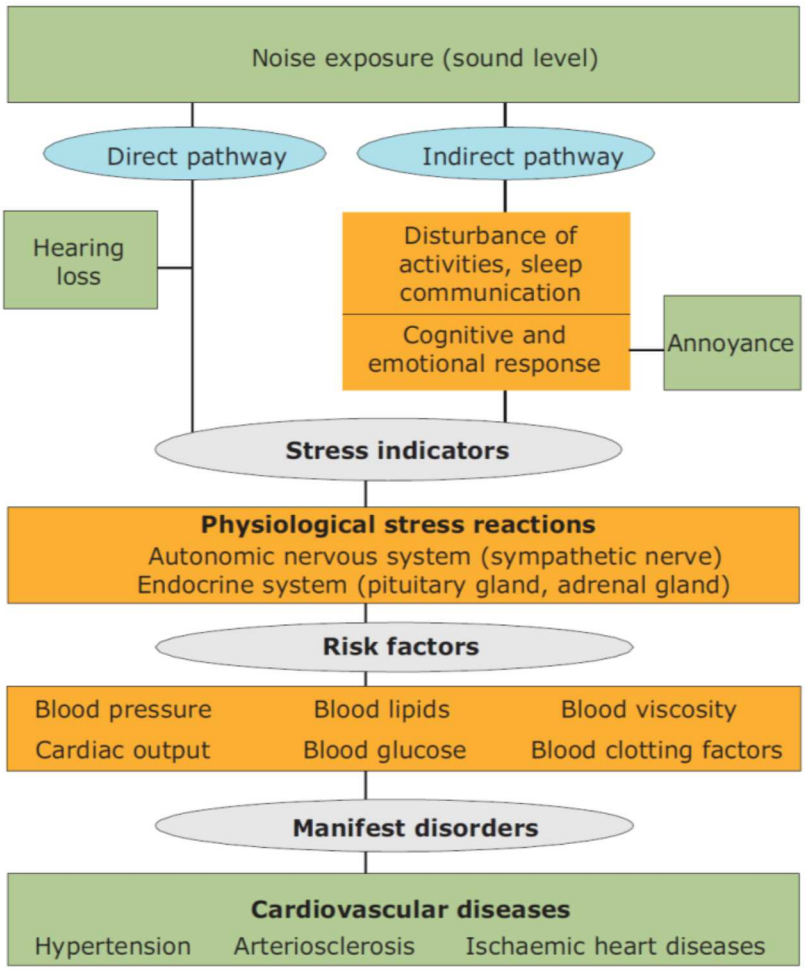

Figure 17.3 Noise Health Pathways Source: (Expert Panel on Noise 2010)[28]

17.6.21 The WHO suggests that some people may be less able to cope with the impacts of noise exposure and be at greater risk for harmful effects, including older people, the physically ill, those with existing mental illness, people with hearing impairment, and young children. Families with lower income tend to have lower mobility but greater exposure to adverse environmental conditions related to noise pollution[29].

Construction phase effects

17.6.22 A noise survey was undertaken to establish baseline noise levels in the vicinity of the Scheme, as recommended as part of the HD 213/11 detailed assessment procedure. The survey locations were selected to represent the nearest residential receptors. Noise loggers were used in selected locations to capture baseline noise over a period of more than

[28] Babisch, W., 2002. The noise/stress concept, risk assessment and research needs. Noise Health, 4(16), pp. 1-11
[29] World Health Organization. (2011). Burden of Disease from Environmental Noise. Geneva, Switzerland: World Health Organization Europe.

24 hours.

17.6.23 Detailed results and the survey method are reported in Volume 3 Appendix 14.2 of ES Chapter 14 Noise and Vibration, along with a plan of the survey locations. However, as would be expected, the dominant noise source at the attended measurements was road traffic on the A40. Other notable noise sources were distant farm vehicles and aircraft.

17.6.24 Chapter 14 Noise and Vibration concludes that the construction of the Scheme has the potential to give rise to temporary short-term increases in noise and vibration at sensitive receptors which include residential properties, community facilities, educational facilities and commercial premises which are sensitive to noise and vibration.

17.6.25 Noise threshold levels (BS 5228-1 ABC thresholds) are predicted to be exceeded at receptors R1 Penblewin Farm, R3 Henllan Lodge, R4 Penrhiw Cottage, R5 Maes-y-ffynnon and R8 Bethel Cottage. However, the noise assessment concludes that if natural screening from landform and vegetation is taken into consideration, along with purpose-built noise barriers, level of noise can be effectively mitigated by approximately 5-10dB. It is however, predicted that some properties will still experience significant increases in noise during construction which can be mitigated by providing individual sound insulation at these affected properties (i.e. insulated glazing). Due to these mitigation measures, the assessment in Chapter 14 concludes that there will be no significant effects as a result of noise and vibration during construction.

17.6.26 From a population health perspective, the increases in noise is potentially likely to result in annoyance and, for the residents whose property is affected, increased stress and a reduced capacity to enjoy outside space or have open windows during the construction period. However, due to the low number of people affected, noise during construction is predicted to have a **short term, minor, adverse health effect**.

Operational phase effects

17.6.27 Chapter 14 Noise and Vibration sets out the full assessment for noise and vibration in relation to the Scheme. Significant permanent direct beneficial effects have been identified for the community of Llanddewi Velfrey as a result of the Scheme in the short and long term. Receptors to the south of the existing A40 in and around the village of Llanddewi

Velfrey are predicted to experience major beneficial noise impacts reducing to moderate and minor beneficial impacts with distance from the existing A40 in the baseline year with the Scheme in operation.

17.6.28 Short term significant increases in noise levels across the scheme area of more than 3dB$L_{A10, 18h}$ dB will be experienced by 7 dwellings, whilst an equivalent significant decrease in noise will be experienced by 63 dwellings.

17.6.29 Long term significant increases in noise levels across the scheme area of more than 3dB$L_{A10,18h}$ dB will be experienced by 8 dwellings (with one experiencing an increase of 10+dB$L_{A10,18h}$), whilst an equivalent significant decrease in noise will be experienced by 54 dwellings.

17.6.30 There are three properties along the bypass section of the Scheme which would experience major noise increases. These include properties to the north of the new A40 bypass around Llanddewi Velfrey at Valley View and Castell; properties at the northern extent of Glan Preseli (Brynwylfa and Llanddewi Village Hall) and Maes-y-ffynnon situated to the east of the new junction, equidistant at around 50m from the new bypass and the existing A40 through Llanddewi Velfrey.

17.6.31 For those properties which would experience noise reductions, it is considered that the health effects would be moderately beneficial. For properties that would experience significant increases in noise, health effects are likely to be moderately adverse. It is not known who lives in these properties and therefore no assessment can be made on whether the residents would be particularly vulnerable to changes in noise levels. Whilst at the individual level, these reductions and increases in noise could lead to positive and adverse health impacts respectively, at a population level, the changes in noise are considered likely to result in an overall health effect that is **neutral**.

Air Quality

Literature review

17.6.32 Ambient outdoor air pollution to which populations are exposed on a day-to-day basis is associated both with long-term burdens of disease across the whole population, and with short-term changes in mortality due to acute exposure in vulnerable populations such as elderly people or those already suffering from cardiovascular or respiratory disease.

This is an area of active scientific research (see, for example, recent reviews of cardiovascular disease and air pollutant exposure evidence,[30,31]) but given the strong link to public policy, is also characterised by frequent reviews of the evidence base, including summaries published by health protection bodies that are designed to bring the evidence base together for use by those applying research to policy formulation or decisions, as in the case of this study.

17.6.33 Evidence on the links between road traffic emissions and respiratory health is well established, based on numerous research studies. Epidemiological studies have shown that long-term exposure to air pollution (over years or a lifetime) reduces life expectancy, due to cardiovascular and respiratory diseases and lung cancer. Short-term exposure (over hours or days) to increased levels of air pollution can also have a range of health effects, including effects on lung function, asthma, as well as increases in respiratory and cardiovascular hospital admissions, and mortality.[32]

17.6.34 Populations thought particularly vulnerable to the effects of PM10 are those with pre-existing lung or heart disease, the elderly and children[33], [34].

Construction phase effects

17.6.35 The Scheme has the potential to generate dust during the construction phase. Dust-generating activities would occur along the length of the Scheme and include: demolition of Trefangor Cottage, earthworks to create attenuation ponds, embankments and cuttings and construction of the proposed new section of road, proposed roundabouts at either end of the Scheme and Llanfallteg Road bridge.

17.6.36 Chapter 13 Air quality identifies five residential properties within 20m of the site boundary, and which have a medium sensitivity for dust soiling as a result of earthworks and construction.

17.6.37 The dust emitting activities can be greatly reduced or eliminated by

[30] Shah, A. et al., 2013. Global association of air pollution and heart failure: a systematic review and meta-analysis. Lancet, Volume 382, pp. 1039-48.
[31] Lee, B.-J., Kim, B. & Lee, K., 2014. Air Pollution Exposure and Cardiovascular Disease. Toxicological Research, 30(2), pp. 71-75.
[32] Public Health England 2018. Guidance: Health Matters: Air pollution https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution
33 World Health Organization . (2013). Health effects of particulate matter. Denmark: World Health Organization Europe.
34 Defra, Netcen, Department for Communities and Local Government, National Statistics. (2006). *Air Quality and Social Deprivation in the UK: an environmental inequalities analysis (AEAT/ENV/R.2170).* London: Defra.

applying the site-specific mitigation measures for medium risk sites according to the guidance published by the Institute of Air Quality Management (IAQM)[35] and reported in the Scheme specific pre-construction CEMP (ES Appendix 2.2).

17.6.38 Overall, the construction effects were assessed using the qualitative approach described in the latest IAQM guidance and it was concluded in the Air quality ES chapter (Chapter 13) that with mitigation measures appropriate for a medium risk site in place, there is likely to be no significant effect from the dust-generating activities on site. **No health effects** in relation to air quality during construction are therefore predicted for the majority of the population. However, it is likely that children, older people and those who have long term health effects may be more susceptible to even small changes in air quality and therefore a **short term, minor adverse** effect is predicted for these groups.

Operational phase effects

17.6.39 No exceedances of the air quality objectives were predicted with or without the Scheme in place in any of the scenarios assessed.

17.6.40 The key criteria for evaluating significance are set out and results for each summarised in Table 17.5. The answers to these questions show that the Scheme is not predicted to have a significant effect on local air quality. The use of the IAN 174/13 methodology for assessing significance does not allow a significant beneficial effect to be determined unless there is removal of an exceedance of a relevant air quality objective. Whilst the Scheme does not result in a significant beneficial effect overall, the Scheme would deliver improvements in air quality at the majority of receptors in the study area.

[35] IAQM (2014), Guidance on the assessment of dust from demolition and construction, Version 1.1.

Table 17.5 Evaluation of Significance

Key Criteria Questions	Yes/No	Reasoning
Is there a risk that environmental standards will be breached?	No	No exceedances of air quality objectives are predicted as a result of the Scheme
Will there be a large change in environmental conditions?	Yes	The Scheme does result in a large beneficial change (>4µg/m3) in annual mean NO_2 concentrations at some receptor locations on the existing A40 corridor.
Will the effect continue for a long time?	Yes	The effect of the Scheme would be permanent, however the effect of the Scheme on local air quality whilst beneficial is not considered to be significant.
Will many people be affected?	No	There are few receptors given the rural location of the Scheme. At the majority of receptors, the Scheme would have a beneficial impact.
Is there a risk that designated sites, areas, or features will be affected?	No	There are no designated sites present within the study area.
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	No	No adverse effects have been identified which would require mitigation.
On balance is the overall effect significant?	No	

17.6.41 Potential impacts during the operational phase of the Scheme have been assessed to be not significant as modelled pollutant concentrations are already well below the air quality objectives. However, many receptors would experience a beneficial impact as a result of the Scheme.

17.6.42 **No health effects** are predicted as a result of local air quality during operation of the Scheme. Vulnerable groups within the local population such as children, older people and those with long term health issues may experience health benefits from the minor improvements in air quality predicted as they are more sensitive to any changes.

Flood Risk

Literature review

17.6.43 The damaging consequences of flooding are not only limited to property and possessions but can also have lasting impacts on health

and well-being. Physical and mental health may be affected during and after flooding and studies have shown that stress may continue for a long time after the water has receded. It is important to be aware that the impact on health is often not immediately obvious.

17.6.44 Injuries and illness, the anxiety caused through being involved in a flood, disruption to healthcare services and the effect of being displaced placed from homes and local area can all take their toll on people's well-being and can affect anyone.

17.6.45 Flooding can affect people of all ages and while most go on to recover with the support of their families, friends and local community, for others the longer-term, indirect effects on their health, relationships and welfare can be far reaching. Symptoms can include insomnia, anxiety disorders, phobias, depression and post-traumatic stress disorder[36].

Construction phase effects

17.6.46 All areas of the Scheme route are designated as Zone A on Welsh Government's TAN15 mapping. Areas designated as Zone A are considered to be at little or no risk of fluvial or coastal/tidal flooding.

17.6.47 Where works take place in the vicinity of watercourses, material and plant would be stored beyond the areas potentially susceptible to flooding in order to mitigate any adverse effects. The health effect during construction associated with flooding is **neutral**.

Operational phase effects

17.6.48 In addition to the Scheme continuing to be within Zone A, i.e. at little or no risk of fluvial or coastal/tidal flooding during operation, the Scheme is also not expected to cause any detriment to fluvial, surface or groundwater flood risk.

17.6.49 The health effect is therefore considered to **neutral**.

Access to work and training

Literature review

17.6.50 Employment and income are among the most significant determinants of long-term health, influencing a range of factors including the quality

[36] http://www.floodlinescotland.org.uk/media/1881/health-effects-of-flooding_swish_bottom.pdf

of housing, education, diet, lifestyle, coping skills, access to services and social networks. Consequently, poor economic circumstances can influence health throughout life, where communities subject to socio-economic deprivation are more likely to suffer from morbidity, injury, mental anxiety, and depression, and tend to suffer from higher rates of premature death than those less deprived[37].

17.6.51 The Marmot Review (2010)38 looked at the differences in health and well-being between social groups. The Review identified the importance of work for health: 'being in good employment is protective of health. Conversely, unemployment contributes to poor health.' The documented linkages between access to work and health are often related to the negative impacts of unemployment, rather than the positive impacts of employment. However, it follows that employment is generally expected to be positive in health terms.

17.6.52 Employment is also related to social and psychological well-being; a study commissioned by the Department of Work and Pensions[39] found that *'work meets important psychosocial needs in societies where employment is the norm'* and that *'work is central to individual identity, social roles and social status'*.

17.6.53 The evidence suggests, therefore, that projects that have the potential to support regeneration, reduce unemployment and improve socio-economic circumstance, would contribute to improving the health and well-being of socio-economically deprived communities. It is important to note, however, that increasing employment and income opportunities alone would not maximise health benefits. Increased support, training and community involvement is required in order to link and develop skills to employment and reduce the risk of inequality.

Construction phase effects

17.6.54 The creation of new job opportunities during the construction phase of the proposed development would have a positive effect on health and wellbeing for those that secure jobs. This assessment is based on the known links between employment and mental health, and the positive health effects of increased wealth on access to services, food and other

[37] Beland, F., Birch, S. and Stoddart, G. (2002), Unemployment and health: contextual level influences on the production of health in populations. *Social Science and Medicine*, Volume 55, pp. 2033-2052; Stafford, M., Marjkainen, P., Lahelma, E., and Marmot, M. (2005) Neighbourhoods and self-rated health: a comparison of public sector employees in London and Helsinki. *Journal of Epidemiology and Community Health*, Volume 58, pp. 772-778.
[38] Marmot M. (2010) Fair Society, Healthy Lives: A Strategic Review of Inequalities in England. London: University College London
[39] Waddell, G and Burton, A.K. (2006) Is work good for health and wellbeing?, Department for Work and Pensions

health determinants.

17.6.55 The community profile (Appendix 17.1) shows that the Scheme is located in an area of relatively low multiple socio-economic deprivation, with lower than average rates of unemployment and a relatively highly skilled workforce. It is expected that the construction of the Scheme will create new employment opportunities, and there may be the potential for local people, and young people in particular, to benefit from these jobs and from any training opportunities that may be provided. Any investment in skills and training would have the potential for long-term positive impacts on employment and skills in the local economy (and consequently benefits to health and well being), although due to the low unemployment levels, benefits are likely to be diluted over a wider area.

17.6.56 People within the community who are most likely to benefit from securing jobs would be those that are currently unemployed or economically inactive and wish to find work. Those that already have employment would benefit if it led to better paid, or more skilled work (either through training opportunities or organic promotion). Overall, it is considered that the health effects from this would be **long-term, minor beneficial**.

Operational phase effects

17.6.57 The Economic Appraisal Report (EAR) provides an assessment of the direct and wider economic costs and benefits accrued over a 60-year period for the Scheme. Benefits relating to the 'economic efficiency' of transport schemes are derived from journey time savings, vehicle operating cost savings, user charges (tolls) and additional costs to travellers due to construction/maintenance works. Costs to implement the Scheme are measured in terms of 'public accounts' and include revenue, operating costs, investment costs, developer and other contributions (not applicable), grant/subsidy payments (not applicable), and indirect tax revenues to Central Government through, for example, fuel duty[40].

17.6.58 The EAR concludes that the Scheme would have a Benefit-Cost Ratio (BCR) of 0.13 under the central case, which indicates that the costs of the Scheme outweigh the quantifiable benefits. However, the economic appraisal is only a partial assessment of value for money which does

[40] Welsh Government (2017), A40 Llandewi Velfrey to Penblewin Improvements: Economic Assessment Report.

not capture all of the expected benefits of the Scheme. There are a range of other impacts and considerations that the Welsh Government will take into account in its decision-making process, such as the Scheme objectives. These set out the Welsh Government's intention to deliver benefits in relation to enhanced network resilience, improved prosperity and reduced community severance. These are only partially reflected in the quantified economic analysis set out in the EAR.

17.6.59 In terms of wider economic benefits, an 'Economic Activity and Location Impact' study undertaken by Peter Brett Associates on behalf of the Welsh Government in 2015 identified a number of mechanisms through which improvements to the A40 could deliver economic benefits[41]. This included widening the labour market, inward investment, improved business performance, enhanced prospects for the Enterprise Zone, increased residential development, increased trade and improved strategic rail access.

17.6.60 Each of these economic benefits suggests that there is a likelihood of increasing job and training opportunities long term through indirect benefits of the Scheme, which would result in a **long term, minor beneficial** health effect for the local population.

Accessibility and active travel

Literature review

Accessibility

17.6.61 Research indicates that public transit improvements and more transit-oriented development can provide large but often overlooked health benefits. People who live or work in communities with high quality public transportation tend to drive significantly less and rely more on alternative modes (walking, cycling and public transit) than they would in more automobile-oriented areas. This reduces traffic crashes and pollution emissions and increases physical fitness and mental health. These impacts are significant in magnitude compared with other planning objectives but are often overlooked or undervalued in conventional transport planning[42].

[41] Peter Brett Associates (2015), A40 St Clears to Haverfordwest Economic Activity & Location Impacts (EALI) Study.
[42] Litman, T (2010), Evaluating public transportation health benefits. Victoria Transport Policy Institute.

Active travel

17.6.62 Active travel applies to modes of transport that require physical activity (i.e. cycling and walking), in contrast to modes that require little physical effort such as motor vehicles. It is therefore the physical activity associated with active travel that brings about health effects.

17.6.63 Active travel in areas with low pollution levels has been associated with increased physical activity among older adults. Where there is a perception that there is air pollution this appears to constitute a barrier to participating in outdoor physical activity and active transport[43].

17.6.64 The positive effects of physical activity on physical health was summarised in the Department of Health's 2011 report[44] which suggests that:

17.6.65 'Regular physical activity can reduce the risk of many chronic conditions including coronary heart disease, stroke, type 2 diabetes, cancer, obesity, mental health problems and musculoskeletal conditions. Even relatively small increases in physical activity are associated with some protection against chronic diseases and an improved quality of life.'

17.6.66 An ever-growing body of research also provides consistent evidence of a relationship between physical activity and mental capacity, especially in older and elderly people. Longitudinal studies show not only that physical activity is associated with a reduced risk of age-related cognitive decline, but also that regular physical activity is linked to a lower risk of Alzheimer's disease (AD) and other forms of dementia[45]. Age UK's guidelines also outlines examples of practical ways to promote older people to become more active, including Nordic walking, Tai-Chi sessions aimed at older people, walking groups, and an 'easy rider' scheme (using a fixed-wheel bike, tricycles and tandems to aid balance)[46].

[43] Annear, M., Keeling, S., Wilkinson, T., Cushman, G., Gidlow, B., & Hopkins, H. (2014). Environmental influences on healthy and active ageing: A systematic review. Ageing & Society, 34 (4), 590-622
[44] CMO (2011) Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers, Department of Health, Physical Activity, Health Improvement and Protection.
[45] Government Office for Science. (2008). Mental Capital and Wellbeing: Making the most of ourselves in the 21st century. State-of-Science Review: SR-E24, p.2.
[46] Age UK. (2010). Promoting Mental Health and Well-being in Later Life: A Guide for Commissioners of Older People's Services

Construction phase effects

17.6.67 No changes to the existing bus service provision are anticipated during the construction phase.

17.6.68 There are a variety of links available for Walking, Cycling and Horse Riders (WCHR) within the study area. The density of routes is greatest to the north and south of the existing A40. Overall there are very few bridleways and restricted byways, which limits opportunities for equestrian and cycle users. Although National Cycle Routes 4 and 47 do not directly interface with the proposed A40 Scheme, many WCHR may cross the A40 study area to access these routes. No WCHR routes are explicitly identified for east-west movement along the Scheme and the existing A40 is the only attractive route currently.

17.6.69 Along the length of the existing A40 through Llanddewi Velfrey, there is a substandard footpath adjacent to the westbound lane. There is no adjacent provision for the eastbound lane. Therefore, there are no crossing points along the route. These will not be affected during construction.

17.6.70 There is no WCHR facility west of Llanddewi Velfrey along the existing A40.

17.6.71 On both sides of the existing A40, the density of Public Rights of Way (PRoWs) for the exclusive use of WCHR is relatively sparse and spread out over the landscape. This probably reflects that most routes have followed the land boundaries for landowners in the area. The connections provided tend to connect places of residence with places of work. As discussed in the assessment on effects to access to open space (Section 17.6.9) there are several PRoW that will be affected during construction through temporary closure or diversion.

17.6.72 These PRoWs include: as shown on Volume 2 Figure 15.1: SP19/31/3; SP19/37/1; SP19/30/1; SP19/38/1; SP19/38/2; SP19/1/1; SP19/2/2; SP19/3/2; SP19/4/5; SP19/4/7; and SP19/17/1. There are no bridleways that would be directly affected although there are two within close proximity to the Scheme (Bridleway SP19/34/4 and Bridleway SP19/29/3). See ES Chapter 15 All Travellers for further details on which routes would be affected.

17.6.73 During construction, the existing A40, together with most local roads

crossing the Scheme or linking to it, would remain open under traffic management, where required, except for some overnight weekend road and lane closures during works such as utility diversions and tie-in works.

17.6.74 Llanfallteg Road would be temporarily stopped up during construction with a temporary diversion put in place to allow for the construction of a new overbridge. This, together with the temporary impacts on PRoWs used by pedestrians, would result in a construction effect on community severance and accessibility i.e. some residents may be dissuaded from making trips and some trips would be made longer or less attractive, particularly for children and older people or people who may have restricted mobility. It is also likely that active travel would be less attractive for local communities during construction who are therefore less likely to participate in this form of travel.

17.6.75 Health effects during construction as a results of impacts on accessibility and active travel options is considered to be **short term, minor adverse**.

Operational phase effects

17.6.76 The only public transport that currently operates in the vicinity of the Scheme is a bus service. The bus stops are currently located on the existing road that would be detrunked as part of the Scheme. During operation of the Scheme the bus services would need to leave the proposed A40 and travel through the village using the proposed junctions. It is envisaged that the bus services will continue to function as they do presently and therefore there would be no potential for equality effects arising from the operation of the proposed new section of trunk road.

17.6.77 Following the completion of the construction works, the connectivity of the PRoW network would be maintained. Those routes that were partly or fully stopped up on a permanent basis (see section 17.6.1 for details of which ones) will have been diverted, with the exception of one public footpath (SP19/4/5). However, the proposed network provides alternative, equally advantageous routes that do not result in longer routes. Those that were partly or fully stopped up temporarily during the construction phase will have been reinstated along their original alignment or their permanent diversion alignment.

17.6.78 In addition, one new public bridleway and two new public footpaths created as part of the Scheme would be operational. These include:

a) A new public footpath would be created along the fence line of the proposed new section of trunk road, running from the unnamed road that leads to Trefangor Burial Ground, eastwards to meet footpath SP19/37/1;

b) A new bridleway would be created, linking the unnamed road that leads to Trefangor Burial Ground to the north of the proposed A40 with the unnamed road that leads to Henllan Farm to the south of the proposed A40. The bridleway would pass under the proposed A40 in an underpass in the area of Fynnon; and

c) A new public footpath would be created at the east Llanddewi Velfrey Junction. The footpath would cross the proposed A40 carriageway at the proposed roundabout, at an at-grade crossing. This provides connectivity between the village of Llanddewi Velfrey and Bethel Chapel and the properties to the north of the A40.

17.6.79 There are several new crossing points that will be delivered as part of the proposed new trunk road to maintain connectivity of the local highway and PRoW networks:

a) A new underpass, which a new bridleway will pass through, providing north/south connectivity between SP19/30/1 and SP19/37/1.

b) A new pedestrian underpass will be provided for diverted footpath SP19/38/1. This underpass will also provide farm access to severed land.

c) A new overbridge to carry the public road that leads from Llanddewi Velfrey to Llanfallteg.

d) A new pedestrian underpass to carry a new footpath that is the diversion for several stopped-up footpaths (SP19/1/1, SP19/2/2 & SP19/3/2).

17.6.80 These improvements to PRoW are likely to encourage more use of the currently underused network which will lead to improvements in both active travel and accessibility to the network. It is possible that the improvements will increase active travel participation by people who may otherwise be unwilling to use the network due to perceived or real shortcomings, e.g. older people, families with young children or people with mobility challenges.

17.6.81 The provision of an improved A40 will result in improved accessibility due to reduced congestion and improved travel conditions. This would

lead to less stress related to travel which would bring minor beneficial health effects.

17.6.82 Overall it is considered that there would be a **long term, minor beneficial health effect** on accessibility and active travel during operation.

Access to services and social infrastructure

Literature review

17.6.83 Services and social infrastructure such as healthcare, education, social networks and social interaction can impact on people's physical and mental health[47]. 5% of adults in Great Britain have reported feeling a sense of isolation due to difficulties accessing local shops and services[48]. Furthermore, over a fifth of adults reported knowing someone who felt a sense of isolation due to these difficulties.

17.6.84 Access to healthcare is important for communities as healthcare offers information, screening, prevention and treatments. Restricted access to healthcare prevents patients gaining necessary treatments and information. Access to healthcare services is affected by transport modes, availability of financial support for those on low incomes and the location of healthcare services. Groups impacted by disability and older people are more dependent on health and social care services[49] therefore these groups are more vulnerable if access to health and social care services becomes restricted.

17.6.85 Access to social infrastructure including leisure and cultural facilities is a determinant of health and well-being. According to research, 'leisure activities can have a positive effect on people's physical, social, emotional and cognitive health through prevention, coping (adjustment, remediation, diversion), and transcendence'[50]. People participate in cultural activities for a number of reasons including personal growth and development, to learn new skills, enjoyment and entertainment and as a 'means of creative expression', or 'to meet new people' and to 'pass

[47] Global Research Network on Urban Health Equity (2010) Improving urban health equity through action on the social and environmental determinants of health
48 Randall, C., 2012, Measuring National Well-being - Where we Live – 2012, Office for National Statistics
[49] Hamer, L., 2004, Improving patient access to health services: a national review and case studies of current approaches, Health Development Agency
[50] Caldwell, L.L. (2005) Leisure and health: Why is leisure therapeutic?

on cultural traditions'[51].

Construction phase effects

17.6.86 During the construction phase, access to existing social infrastructure will not change from the existing baseline because there are no significant journey time increases to services or direct loss of services. Therefore, **no effect** is expected.

Operational phase effects

17.6.87 During operation the improved road and the access it provides to services will continue long term. However, it is considered that the health effects associated with this would be neutral and therefore **no effect** expected.

Road safety

Literature review

17.6.88 According to Department of Transport (2016)[52], in the UK, road traffic accidents in 2015 included a total of 186,209 casualties of all severities. The number of people seriously injured decreased by 3% to 22,137 compared with 2014, although traffic volumes rose by 1.6% compared with 2014. There is no single underlying factor that drives road casualties; instead there are a number of influences which include:

a) The distance people travel;
b) The mix of transport modes used;
c) Behaviour of drivers, riders and pedestrians;
d) Mix of groups of people using the road e.g. changes in the number of newly qualified or older drivers; and
e) External effects such as the weather which can influence behaviour for instance, encouraging/discouraging travel, or closing roads or change the risk on roads e.g. by making the road surface more slippery.

17.6.89 Children are subject to higher risk from road traffic accident and injury than adults, and other groups including women and older people may

[51] New Zealand Government, 2007, Social Report: Leisure and Recreation, Ministry of Social Development, New Zealand Government
[52] Department for Transport (2016), Reported road casualties in Great Britain, main results: 2015

be more likely to report feeling nervous about driving[53].

Construction phase effects

17.6.90 During the construction phase, there would be temporary increased HGV movements and a change in road layout. The temporary increased HGV movements and change in road layout could increase risk of accidents. However, when work is required online, a series of traffic management measures and speed restrictions would be implemented in work areas for the safety of road users and the construction workforce. These restrictions would only be introduced when the works commence and would remain until a specific section was complete.

17.6.91 It is considered that there would be no changes to any crime rates during construction.

17.6.92 Health effects related to community safety during construction are considered to be **short term, minor, adverse**. This is based on consideration of how vulnerable groups such as young people, older people and those with reduced mobility may perceive their safety during construction.

Operational phase effects

17.6.93 The Scheme will aim to improve transport safety and reduce the number and severity of collisions. There may be the potential for this to result in a positive effect for people sharing certain protected characteristics, including women and older people, who may be more likely to report feeling nervous about driving[54]. In addition, one of the environmental design principles of the Scheme involves *'using design of the carriageway, structures, earthworks and landscape to incorporate the connectivity requirements of indigenous native species. Where necessary to provide barriers to movement, or to reinstate safe routes across the new road so that natural patterns of movement are not unduly interrupted and casualties from collisions with vehicles are minimised'*. See ES Chapter 2 The Project for further information.

17.6.94 The Walking Cycling Horse Riding Assessment (WCHRA) Report indicates that all facilities directly provided by the Scheme would, within reason be: accessible, attractive for use, coherent, comfortable,

[53] DfT (2011) Road Safety Research Report No.122: Attitudes to Road Safety: analysis of Driver Behaviour Module, 2010 NatCen Omnibus Survey.
[54] Ibid.

convenient, direct, and safe for users to use. If the WCHR Objectives set out in the WCHRA Report are met - which should be secured through the further stages of WCHR Reviews that would be undertaken during detailed design - it is anticipated that there would be no health impacts due to road safety risk for WCHR. Conversely, conditions for WCHR predicted to improve.

17.6.95 Overall it is considered that there would be a **long term, minor beneficial** health effect in relation to community safety.

17.7 Mitigation Measures

17.7.1 Adverse health impacts have only been identified to arise during the construction phase. These are only likely to persist for the duration of construction and are therefore only temporary. To mitigate these adverse effects, measures outlined in the CEMP will be followed and it is recommended that effective community liaison is established early. This should take into account the needs of the local communities such as older people and those with Welsh language skills.

17.7.2 Where health benefits have been identified during operation, these predominantly relate to improved access to open space, improved accessibility and opportunities for active travel. During the design of these improved features, such as new PRoWs and overbridges, consideration should be given to the needs of the local communities such as clear wayfinding (including distances to next location on signs).

17.8 Monitoring

17.8.1 There are no specific monitoring requirements for population and health.

17.9 Summary

17.9.1 Temporary adverse health effects have predominantly been identified for the construction phase including the following:

a) Minor adverse health effects as a result of changes to access to open space and nature. This may occur due to changes in PRoWs during the construction period. This would affect all of the community with vulnerable groups unlikely to be affected disproportionately or differentially.

b) Minor adverse health effects as a result of construction noise. People who are likely to spend more time in one place, and therefore have a longer exposure to construction noise, including older people, unemployed and long-term sick are likely to experience noise increases as a moderate adverse health effect.

c) Minor adverse health effects in relation to air quality for vulnerable groups such as children, older people and long-term sick who may be more sensitive to small adverse changes in air quality.

d) Minor adverse health effects as a result of changes to provisions for active travel during the construction stage, which may discourage more vulnerable groups such as children, older people and people with physical disabilities from using active travel options during construction. Accessibility is not considered to be affected.

e) Minor adverse health effects as a result of vulnerable groups such as young people, older people and those with reduced mobility having the perception of reduced safety during construction.

17.9.2 During operation the only adverse health effect identified relates to an increase in noise for some properties. More properties would experience a health benefit due to reduced traffic noise as the Scheme takes traffic further away from their properties.

17.9.3 Beneficial health effects associated with operation include:

a) Minor beneficial health effects from improved access to open space and nature. This is likely as a result of improved PRoW provision;

b) Minor beneficial health effects from improved access to work and training as a result of an improved road network and the corresponding reduced congestion.

c) Minor beneficial health effects from improved participation in active travel. As with improved access to open space and nature, this is also related to improved PRoW provision that would provide more opportunities and easier access.

17.9.4 An equalities assessment considers whether the scheme would have any disproportionate or differential effects on people with protected characteristics. Table 17.6 below summarises potential effects for each protected characteristic group.

Table 17.6 Summary of equality effects

Protected characteristic	Likely disproportionate or differential effect	
	Construction	**Operation**
Age	Children and older people who engage in active travel may be more likely to be discouraged from doing so during construction and would therefore be disproportionately adversely affected. It is not considered that this would be significant.	Children and older people may become more engaged with active travel as provision is improved and safety is improved. They would therefore be disproportionately beneficially affected. It is not considered that this would be significant.
Disability	As above	As above
Gender	None	None
Pregnancy and maternity	None	None
Race	None	None
Religion or belief	None	None
Sex or sexual orientation	None	None
Marriage & civil partnership	None	None

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 18: Climate Change

A40LVP-ARP-EGN-SWI-RP-LE-0013

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01/04/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Appendices (unless otherwise stated these are provided in Volume 3)

18.1 Climate Change- Additional Information

18 Climate Change

18.1 Introduction

18.1.1 This chapter of the Environmental Statement provides the context, baseline data, methodology and approach, assessment results and mitigation measures for the three assessments under the climate change topics:

a) Greenhouse gas (GHG) emissions assessment;

b) Climate change resilience (CCR) assessment, and

c) In-combination climate change impact (ICCI) assessment.

18.1.2 The **GHG emissions assessment** quantifies the potential GHG emissions associated with the construction and operation of the proposed development and identifies mitigation measures to reduce these emissions.

18.1.3 The **CCR assessment** evaluates the effectiveness and feasibility of adaptation measures integrated into the proposed development to avoid or reduce hazards and/or increase resilience of the proposed development to climate change impacts.

18.1.4 The **ICCI assessment** evaluates the combined effect of the proposed development and potential climate change impacts on the receiving environment during construction and operation.

18.1.5 Consideration of the three related but separate climate change assessments within this chapter provides a holistic assessment of climate change aspects related to the proposed development.

18.2 Legislation, policy context and guidance

18.2.1 The climate change assessment has been undertaken in line with the relevant legislation, policies and guidance documents, as outlined below.

Paris Agreement

18.2.2 Adopted in 2015 and entered into force in November 2016, the Paris Agreement is an international climate agreement aiming to limit global temperature increase this century to less than 2 degrees Celsius above pre-industrial levels. It additionally establishes a goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing

vulnerability to climate change. During the 24th Conference of the Parties to the United Nations Convention on Climate Change, held in Katowice in December 2018, nearly 200 countries signed up to a 156-page rulebook. This rulebook acts as a set of guidelines for implementing the Paris Climate Change Agreement.

EIA Directive 2014/52/EU

18.2.3 The Directive 2014/52/EU states that EIAs shall identify, describe and assess the direct and indirect significant effects of climate change relevant to the project. The regulations implementing this directive were transposed into UK legislation in May 2017.

Climate Change Act 2008

18.2.4 The Climate Change Act 2008 committed the UK to its first statutory carbon reduction target to reduce carbon emissions by at least 80% from 1990 levels by 2050. It also requires that five-yearly carbon budgets are set and not exceeded. It also established a requirement to undertake a climate change risk assessment every five years and develop a programme for adaptation action in response to the risks identified.

Well-being of Future Generations (Wales) Act 2015

18.2.5 The Well-being of Future Generations (Wales) Act 2015 requires public bodies to carry out sustainable development, which is the process of improving the economic, social, environmental and cultural well-being of Wales by taking action aimed at achieving the well-being goals. The Act establishes seven well-being goals, which specifically reference acting on climate change. As such, the Act requires all public bodies to embed climate change into their decision-making.

Environment (Wales) Act 2016

18.2.6 The Environment (Wales) Act 2015 requires Welsh Ministers to meet greenhouse gas reduction targets for Wales and establishes a 2050 emission target of 80% reduction in net emissions from the baseline year (1990 or 1995 depending in the specific greenhouse gas). Progress to this target is supported by interim emissions targets set for every ten years until 2050 and carbon budgets established for five-yearly periods.

Planning (Wales) Act 2015

18.2.7 The Planning (Wales) Act 2015 emphasises that national, strategic and

local planning must be carried out in accordance with the sustainable development definition and principle as per the Well-being of Future Generations (Wales) Act 2015.

Clean Growth Strategy (UK)

18.2.8 Published in October 2017, the Clean Growth Strategy outlines the UK government's proposals to decarbonising all sectors of the UK economy though the 2020s.

Climate Change Strategy for Wales

18.2.9 Published in October 2010, the Climate Change Strategy for Wales establishes a target to reduce greenhouse gas emissions by 3% per year from 2011 in areas of devolved competence, against a baseline of average emissions between 2006 and 2010. It is supported by the actions set out in the Delivery Plans for emission reduction and adaptation.

UK Climate Change Risk Assessment

18.2.10 The second UK climate change risk assessment was published in 2017, as required under the Climate Change Act 2008. It establishes the six priority risk areas for action over the following five years. It is based on the independent evidence report published by the Committee on Climate Change.

Pembrokeshire County Council Local Development Plan (2013-2021)

18.2.11 Strategic Objective A in the LDP is mitigating and responding to the challenge of climate change. It is supported by Strategic Policy 1 – Sustainable Development and General Policy GN.2 Sustainable Design, on the basis that climate change is a key long term environmental challenge and the need to reduce emissions and use resources more efficiently is essential.

Carmarthenshire County Council Local Development Plan

18.2.12 The LDP includes several policies and objectives relating to sustainable development. Of particular relevance is Strategic Objective 5 – to make a significant contribution towards tackling the cause and effect of climate change by promoting the efficient use and safeguarding of

resources.

Carmarthenshire County Council Local Flood Risk Management Strategy

18.2.13 Carmarthenshire County Council (CCC) are a designated Lead Local Flood Authority (LLFA) under the Flood and Water Management Act (the Act) 2010 and are required to produce a Local Flood Risk Management Strategy.

Pembrokeshire Local Flood Risk Management Strategy 2012

18.2.14 Pembrokeshire County Council has responsibility for 'local flood risks', which includes the risk of flooding from ordinary watercourses, surface runoff and groundwater. The Council have published a draft Flood Risk Management Strategy that details responsibilities, measures, objectives and assessments of flood risk.

Guidance

Institute of Environmental Management and Assessment (IEMA) (2015) Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation

18.2.15 This guidance provides a framework for the consideration of climate change resilience and adaptation in the EIA process, in line with Directive 2014/52/EU.

IEMA (2017) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance

18.2.16 This guidance aims to assist EIA practitioners with addressing greenhouse gas emissions assessment and mitigation. It outlines the process for undertaking the carbon assessment as it relates to the EIA stages.

PAS 2080:2016 Carbon management in infrastructure

18.2.17 PAS 2080 provides a framework on how to manage whole life carbon[1] when delivering infrastructure assets and programmes of work. This assessment broadly follows the principles set out in PAS 2080 for the quantification of greenhouse gas emissions.

[1] Carbon is used throughout this report as shorthand for emissions of all greenhouse gases, measured in units of carbon dioxide equivalent (CO_2e).

18.3 Scoping and consultation

18.3.1 The purpose of the EIA screening and scoping exercise is to determine the topics to be included in the EIA. As a consequence of the delays to the project in early 2018, the decision was made to update the Screening Report, Scoping Report and the full Environmental Statement (ES) to take account of the most recent 2014 Directive (as amended) 2014/52/EU. Following the introduction of the regulations implementing EIA Directive 2014/52/EU in May 2017, the climate change chapter has been introduced into the EIA as a standalone topic chapter.

18.3.2 No consultation has been undertaken in the preparation of this chapter.

18.4 Assessment Methodology

GHG emissions assessment

Capital carbon

18.4.1 The scope of the capital carbon assessment covers the following:

a) **Materials** – The total amount of carbon produced during resource extraction, transportation, manufacturing and fabrication, to bring a product to its existing state;

b) **Plant** – The carbon produced from the combustion of fuel or consumption of energy by machinery, plant and vehicles used on site, including vehicles used for moving fill within the alignment, and

c) **Transport** – The carbon produced from the combustion of fuel or consumption of energy by the transportation of materials, plant and people to and from site.

18.4.2 The method applied used the Scheme material quantities, derived from the highways design model and drawings, which were then converted into CO_2e through the application of documented emission conversion factors.

18.4.3 The emission conversion factors used in the assessment are from the following sources:

a) 'Inventory of Carbon and Energy (ICE) Version 2.0' developed in 2008 and updated in 2011 by the University of Bath: Sustainable Energy Research Team;

b) 'Greenhouse gas reporting: conversion factors 2017', published in August 2017 by the UK Department of Business, Energy and Industrial Strategy (BEIS);

c) 'Environmental Product Declarations (EPDs)' – specifically for methacrylate resin products[2], and

d) 'Updated Energy and Emissions Projections: 2017', published in 2018 by the Department for Business, Energy and Industrial Strategy[3].

18.4.4 Volume 3 Appendix 18.1 summarises the emissions factors used in the carbon assessment.

Operational carbon

18.4.5 The scope of the operational carbon covers the emissions resulting from consumption of energy in all network assets. In this assessment, it includes:

a) **Maintenance** – This includes carbon emissions that result from activities such as the wearing course, road markings, railings and fences, grass cutting or gritting for example. As outlined in the assumptions below, the quantification of maintenance emissions in this assessment is limited to the embodied material emissions associated with resurfacing the road.

b) **Street lighting** – Emissions from electricity consumed by street lighting along the road alignment.

18.4.6 As outlined in PAS 2080, other sources of operational carbon can include energy for control and automation systems, signage, signalling and other energy related emissions and operational processes necessary for the operation and management of transport assets. The Scheme does not have any energy-consuming control and automation systems, signage or signalling, so these were excluded from the assessment.

User carbon

18.4.7 Changes in user carbon as a result of the Scheme were assessed. The assessment was undertaken following the principles set out in WebTAG guidance[4] for the assessment of greenhouse gases, which is predominantly used for option appraisal and monetisation of impacts to feed into the economic appraisal of a scheme.

18.4.8 The study area of the assessment was taken to be the entirety of the traffic model network area, to ensure all potential impacts resulting from changes to traffic were captured. The study area is shown in Figure 18.1.

[2] Bauder, EPD for MMA resin products, https://www.bauder.co.uk/assets/e/n/environmental-product-declaration-mma-resin-products-liquitec.pdf [Accessed November 2017]
[3] BEIS, Updated Energy and Emissions Projections: 2017, 2018, https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2017 [Accessed March 2019].
[4] Department for Transport, TAG Unit A3, Environmental Impact Appraisal, December 2015

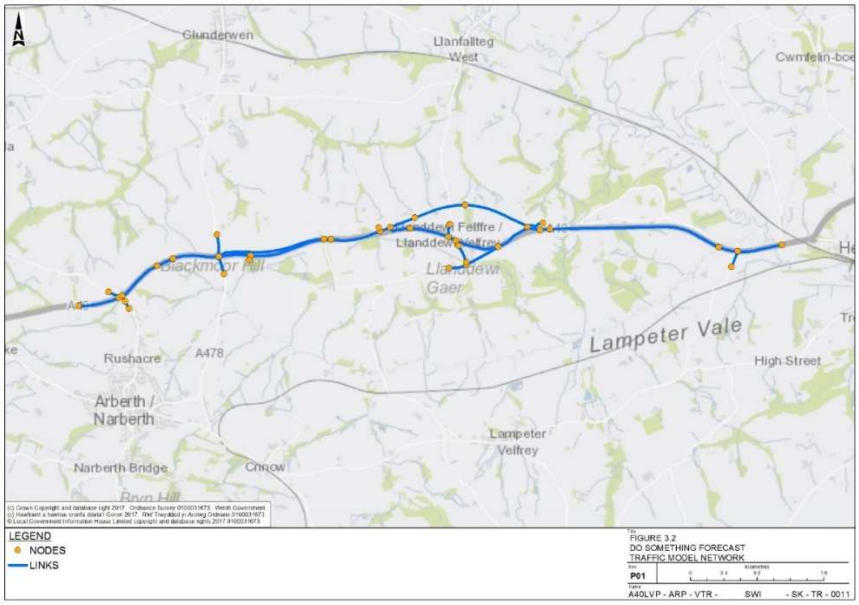

Figure 18.1 Assessment study area for user vehicle emissions

18.4.9 Total carbon emissions for all road links in the study area were calculated for the Do Minimum (without Scheme) and Do Something (with Scheme) scenarios for an opening (2021), forecast (2036) and future (2051) year. Emissions were calculated using the Defra Emission Factor Toolkit[5] (EFT v8.0.1). The EFT makes an estimate of future vehicle fleet mix in the UK and provides predicted emission rates for all years up to 2030. Therefore, for the forecast and future year scenarios, emission rates and predicted fleet mix were held constant at 2030 levels.

18.4.10 The change in carbon emissions as a result of the Scheme were calculated for every year over the 60-year appraisal period. A linear interpolation was applied to the change between the opening and forecast year and forecast and future year to provide the yearly change in emissions in both Do Minimum and Do Something scenarios. It should be noted that carbon emissions were held constant for 2051 onwards due to uncertainties regarding future traffic growth beyond this point.

Assumptions

18.4.11 The carbon assessment was undertaken based on the information available at the time of the assessment.

18.4.12 Specifically, the assessment of embodied carbon in materials was undertaken based on high-level material quantities, which were

[5] DEFRA, Emission Factor Toolkit (v8.0.1), https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html [Accessed November 2018]

calculated prior to construction. It provides bulk estimates of materials and fuel quantities, however does not provide specific information relating to their use in individual structures. The reported emissions by activity type are based on estimates of the proportion of materials and fuel used.

18.4.13 This assessment is based on the assumptions outlined in Table 18.1

Table 18.1 Carbon assessment assumptions

Carbon component	Assumption
Capital	
Materials Plant	The quantities of materials and fuel for plant were based on initial Scheme material quantity calculations. Subsequent design changes were generally not reflected in the carbon assessment; however, these were expected to be small.
	Emissions factors for materials and fuel for plant were based on the closest emissions factor available for the material type. UK typical values were used where more specific information is not available.
Transport	Worker transport is calculated based on number of days worked derived from overall labour costs, assuming an 8-hour work day.
	All worker transport to site would be by single occupancy car (assuming average car).
	Daily travel distance by workers is estimated to be in the following proportions: 10km - 20% 20km - 25% 50km - 10% 100km - 20% 200km - 10%
	Transport distances for materials are based on distances to likely sources (suppliers or manufacturers) of each material type. Distances are provided in Table 18.4.
	Land transport is assumed to be in a rigid truck, while sea transport is assumed to be by container ship.
	Emissions from transport of waste are not included in the assessment. Transport of waste from the site will be minimal as a cut-fill balance is achieved by the design. It is assumed that topsoil excess will be reused around the Scheme or in the local area, negligible transport required.
Maintenance	Maintenance emissions are based on the embodied emissions in the pavement materials used to replace 30mm of pavement surface every 10 years over the life of the Scheme. For the detrunked section of the existing A40, surface replacement is assumed to occur every 20 years.

Carbon component	Assumption
	Maintenance, operation and user emissions are calculated over a 60-year appraisal period. This appraisal period has been selected for consistency with the WebTAG assessment.
Other	The impact of vegetation removal as a lost carbon sink has not been quantified in the carbon assessment as all vegetation removed in the construction phase of the Scheme will be replaced.
Operation	
Street lighting	Street lighting operation hours are estimated to be 15 hours/day for winter use (half year), and 7 hours/day for summer use (half year).
	Emissions from the UK electricity grid are reduced in line with the 2017 BEIS Energy and Emissions Projections.
	The majority of street lighting that already exists along the alignment (road to be detrunked) is expected to be retained when the proposed Scheme is operational.
User	
Vehicle emissions	Future vehicle use of the road has been predicted using the traffic model produced for the Scheme.
	Vehicle fleet mix and emission rates for future scenarios are based on predictions included in the Defra Emission Factor Toolkit.
	The emissions are calculated based on average speeds and daily use along modelled sections of the road, which do not account for the following factors which may influence emissions: Road gradient and curvature; Changes in user numbers along the road due to induced demand, and Changes in speed within modelled sections of road, for example acceleration and deceleration due to intersections and/or congestion.
	A linear interpolation has been assumed between the opening and forecast year and the forecast and future year.
	The assessment has assumed no further traffic growth post 2051.

Significance criteria

18.4.14 The IEMA guide to assessing greenhouse gas (GHG) emissions and evaluating their significance[6] publishes the over-arching principle:

[6] IEMA, 2017, Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance

"The GHG emissions from all projects will contribute to climate change; the largest inter-related cumulative environmental effects…as such any GHG emissions or reductions from a project might be considered to be significant…"

18.4.15 In accordance with this guidance, any carbon emissions associated with the Scheme can be deemed significant. Accordingly, initiatives to mitigate emissions were integrated into the design where possible, as outlined in Section 18.7.

18.4.16 To provide an indication of the relative scale of the emissions from the Scheme they can be compared to the carbon emissions from road transport on all purpose roads (commonly referred to as A roads) in Pembrokeshire, which were 124 ktCO_2e in 2012[7].

CCR assessment

18.4.17 The approach and methodology for the climate change resilience assessment is based on UKCP09[8] and is as follows:

a) analysis of relevant climate change and weather data, emissions scenarios and probability levels;
b) assessment of climate hazards;
c) identification of potential risks from these climate hazards to the assets and occupants of the proposed A40 Scheme;
d) consideration of the resilience of the proposed Scheme within the context of any incorporated mitigation measures, including resilience measures which are embedded within the design due to regulations and design guidelines, and
e) identification of need for any further resilience measures to protect the proposed Scheme against the effects of climate change.

18.4.18 For the CCR and ICCI assessments, the timeframes for the risk assessment were selected to align with the start and end of the appraisal period.

18.4.19 Due to the short temporal phase of construction, it is unlikely that climate change would affect the before-use stage. This phase is therefore not considered in the CCR and ICCI assessments.

18.4.20 In the case of flood risk, detailed planning requirements and design

[7] UK Government, Local Authority Emissions Estimates, https://www.gov.uk/government/statistics/local-authority-emissions-estimates [Accessed November 2017]
[8] At the time of assessment in October 2018, UKCP18 had not yet been released. The trends in climate variables in the UKCP18 projections are broadly consistent with the UKCP09 projections and would not materially affect the CCR and ICCI assessment results reported in this chapter. Further detail on the UKCP18 projections is available at Met Office, 2018, UKCP18 Headline Findings, https://www.metoffice.gov.uk/binaries/content/assets/mohippo/pdf/ukcp18/ukcp18-headline-findings.pdf, [Accessed March 2019]

guidance relating to climate change exist. Therefore, an assessment of climate change impacts on flood risk is carried out within ES Chapter 7 Road Drainage and the Water Environment, taking into account current Environment Agency climate change allowances for increases in peak river flow and rainfall intensity.

Significance criteria

18.4.21 The significance of the risks identified in the CCR assessment is based on the likelihood of a hazard having an impact on the proposed development, and the consequence of the impact. The potential likelihood and consequence of impacts to the proposed development were assessed using a qualitative five-point scale as defined in Appendix 18.2.

ICCI assessment

18.4.22 The approach and methodology for the ICCI assessment is as follows:

a) analysis of relevant climate change and weather data, emissions scenarios and probability levels;

b) consideration of potential climate change impacts for all environmental topics;

c) assessment of each environmental topic's respective significant effects and the corresponding mitigation measures identified by each topic;

d) assessment of any potential in-combination climate change impacts and effects given existing mitigation measures (i.e. mitigation measures identified by each environmental topic);

e) assessment of whether there are any significant in-combination climate change effects, based upon whether potential in-combination climate change impacts are assessed to be 'likely' or 'high' consequence;

f) consideration of additional mitigation measures to address significant in-combination climate change effects, beyond those existing mitigation measures identified by other environmental topics, and

g) inclusion of allowances for future mitigation measures and monitoring, to ensure continued resilience of receiving environment.

Significance criteria

18.4.23 The outcomes of the ICCI assessment will be the categorisation of each environmental topic based on the following significance criteria:

1. many potential in-combination climate change impacts with high consequences;
2. some potential in-combination climate change impacts with high consequences;
3. some potential in-combination climate change impacts with low consequences, and
4. no potential in-combination climate change impacts.

18.5 Baseline Conditions

GHG emissions assessment

18.5.1 User GHG emissions from vehicles using the existing road have been quantified. Total carbon emissions for all road links in the study area were determined for the Do Minimum (without Scheme) scenario for every year over the 60-year appraisal period.

18.5.2 In the opening year of the Scheme (2021) user emissions are modelled to contribute 6.3 ktCO_2e, increasing to 7.8 ktCO_2e per year by 2051. This is based on the traffic models of the Scheme, as per Section 0. The cumulative emissions from road users are 446 ktCO_2e over the 60-year appraisal period.

CCR and ICCI assessments

18.5.3 The baseline environment for the CCR and ICCI assessments include consideration of:

a) Current climate conditions; and
b) Projected future climate conditions.

18.5.4 The **current climate conditions** were established for a range of climate variables based on the long-term average of historical weather data for 1961 – 1990. This data was taken from the UK Climate Projections (UKCP09) gridded observations. The projections used for the Scheme are based on the 25km^2 grid area where the proposed Scheme is located. These values are presented in Figure 18.3 as a baseline for comparison with the projected future climate conditions.

18.5.5 The future climate conditions are also presented in Figure 18.3, based on projections of different probability levels and emissions scenarios. These are presented over two timescales; 'the 2020s' (which is defined by the Met Office as the period 2010-2039) and 'the 2070s' (which is defined as the period 2060-2089). These periods were selected as they align with the construction and operational phases of the proposed

development, based on the 60-year design life.

18.5.6 In Figure 18.3 the future climate conditions are given for both a medium emissions and high emissions scenario at the 50% probability level. A reference range is also provided in each case, using the 10% probability level medium scenario as a lower limit and the 90% probability level high scenario as an upper limit.

18.5.7 An indication of the directional trend for each of the climate variables is also included in Figure 18.3. Overall, the trends in climate variables are summarised as:

a) **High temperatures** – Increase in mean daily temperatures in the summer and winter, increase in the number of hot days (days when daily mean temperature is >25°C) and increased insolation;

b) **Low temperatures** – Decrease in the number of frost days (days when daily minimum temperature <0°C);

c) **High precipitation** – Increase in mean daily rainfall in the winter, increase in the number of days with heavy rain;

d) **Low precipitation** – Decrease in mean daily rainfall in the summer, increase in the annual number of dry spells;

e) **Extreme wind** – Increase in extreme wind events[9], and

f) **Lightning** – Increase in the number of lighting days, particularly in Autumn[10].

[9] IPCC (2014) Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, https://ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap23_FINAL.pdf [Accessed December 2017] page 1279

[10] Future changes in lightning from the UKCP09 ensemble of regional climate model projections, http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87950&filetype=pdf [Accessed December 2017]

Table 18.2 UKCP09 historical climate data (1961-1990) and climate change projections for the Scheme

Parameter		**Long-term average (1961-1990)**	**2020s (2010 – 2039)**			**2070s (2060 – 2089)**			**Trend**
			Medium emissions scenario	*High emissions scenario*	*Range*[11]	*Medium emissions scenario*	*High emissions scenario*	*Range*	
Temperature	Mean summer daily temperature [°C]	14.9	16.4	16.3	15.4 - 17.3	18.2	18.9	16.6 - 21.4	↑
	Mean winter daily temperature [°C]	4.5	5.7	5.7	5.1 - 6.5	7.1	7.4	5.98 - 9	↑
	Mean daily summer maximum temperature [°C]	18.9	20.8	20.7	19.4 - 22.1	23.1	24.1	20.6 - 27.9	↑
	Mean daily summer minimum temperature [°C]	10.9	12.3	12.3	11.4 - 13.3	14.1	14.9	12.4 - 17.7	↑
	Mean daily winter maximum temperature [°C]	7.2	8.4	8.4	7.7 - 9.3	9.7	10.0	8.2 - 12.1	↑
	Mean daily winter minimum temperature [°C]	1.7	3.2	3.2	2.3 - 4.1	4.7	5.2	3 - 7.5	↑
Precipitation	Annual mean daily precipitation [mm/day]	3.9	4.0	3.9	3.7 - 4.2	3.9	4.0	3.6 - 4.4	↕
	Winter mean daily precipitation [mm/day]	4.7	5.1	5.1	4.6 - 5.7	5.9	6.2	5 - 8.2	↑

[11] Range is from 10% probability level at the medium emissions scenario to 90% probability level at the high emissions scenario, for both timescales

Parameter		**Long-term average (1961-1990)**	**2020s (2010 – 2039)**			**2070s (2060 – 2089)**			**Trend**
			Medium emissions scenario	*High emissions scenario*	*Range*[11]	*Medium emissions scenario*	*High emissions scenario*	*Range*	
	Summer mean daily precipitation [mm/day]	3.1	2.9	3.0	2.4 - 3.6	2.5	2.4	1.8 - 3.4	↓
Cloud	Annual cloud cover [%]	70.9% (1423.5 sunshine hours per year)	69.7%	69.7%	67.9% - 71.4%	68.3%	67.9%	65.6% - 70.8%	↓
Extreme weather events	Annual number of hot days (daily mean temperature is >25°C)	0	0.2	0.2	0 - 0.48	2.4	4.8	0 - 14.08	↑
	Annual number of frost days (daily minimum temperature <0°C)	44.0	19.2	20.6	12.8 - 27.3	9.6	9.0	2.0 - 16.7	↓
	Annual number of days per year when precipitation is greater than 25mm per day (Met Office definition of 'heavy rain')	4.0	4.8	4.7	3.6 - 5.8	6.2	7.0	4.5 - 9.4	↑
	Annual number of dry spells (10+ day with no precipitation)	2.7	3.2	3.1	2.4 - 4.0	3.7	4.1	2.6 - 5.3	↑

18.6 Assessment of Environmental Effects

GHG emissions assessment

18.6.1 This section outlines the results of the carbon assessment. Overall, the current design of the Scheme has a carbon footprint of 486 ktCO_2e over the 60-year appraisal period. Table 18.3 summarises the results for each component of the assessment scope.

Table 18.3 Carbon assessment results[12]

Carbon component	Do nothing scenario (tCO_2e)	Scheme emissions (tCO_2e)
Capital		10,000
Materials		*4,600*
Plant		*4,600*
Transport		*830*
Operation	2,400	3,200
Maintenance	*2,100*	*2,900*
Street lighting	*200*	*300*
User	446,000	472,000
Total	**448,000**	**486,000**

Capital carbon

18.6.2 The capital carbon emissions account for 2.1% of the emissions over the 60-year appraisal period. The two largest sources of emissions during the construction phase are the embodied carbon in construction materials, and direct emissions on site from fuel consumption in site plant, equipment and vehicles (referred to as 'plant').

18.6.3 Emissions associated with the transport of waste around the site are included in the plant carbon component as earthworks movements. It is assumed that topsoil will be reused around the Scheme or in the local area, negligible transport required.

18.6.4 The assumed distances travelled by different materials to the sites are summarised in Table 18.4.

[12] Note that values reported in the table do not add to the total due to rounding.

Table 18.4 Assumed material transport distances

Material	Source	Transport distance (km)
Aggregates	Local quarries	15
Concrete	In-situ concrete - local batching plants	20
Concrete	PC concrete - Swansea	70
Concrete	PC concrete - Ireland	400
Fuel	Swansea	70
Steel	Newport	150
Steel	Kent + Midlands	350
Bitumen	Swansea	70
Timber	Swansea	70
Timber	Hereford	180
Bricks	Swansea	70
Mortar	Swansea	70
Iron	Swansea	70
Iron	Midlands	300
Aluminium	Midlands	300
Plastic	Swansea	70

18.6.5 Figure 18.2 shows the emissions from these two largest sources by activity type. The emissions from plant are calculated based on the estimated fuel quantities during construction and are estimated for each activity based on the proportion of fuel consumed by that activity.

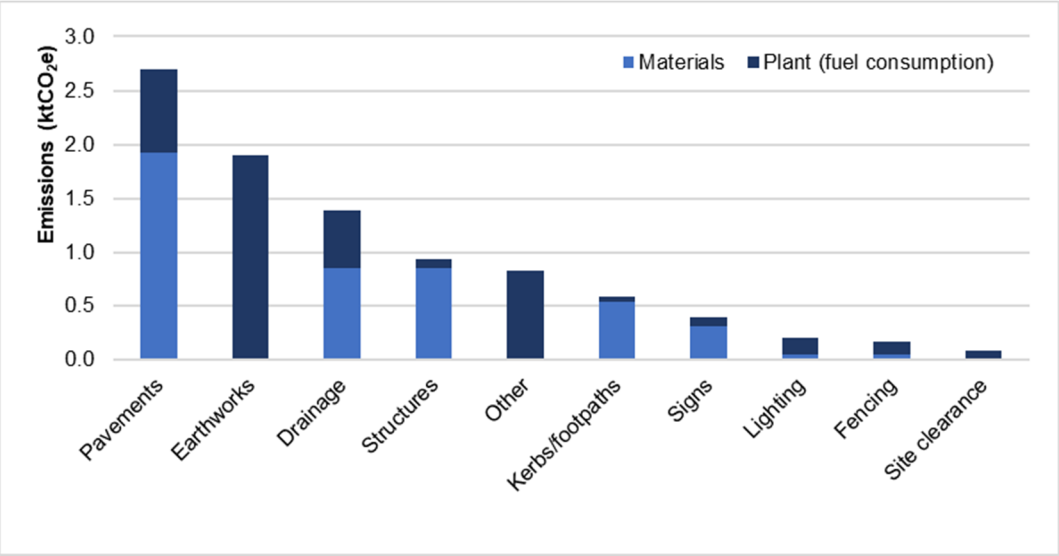

Figure 18.2 Emissions from materials and plant sources ($ktCO_2e$), by activity type

Operational carbon

18.6.6 During the operational phase, street lighting is estimated to consume 95MWh per year. Over the 60-year appraisal period this results in operational emissions of 0.3$ktCO_2e$, making up far less than 1% of the overall Scheme emissions.

18.6.7 The embodied carbon impacts associated with replacing the road surface during maintenance resulted in emissions of 2.9 $ktCO_2e$ over the project life.

User carbon

18.6.8 Emissions from vehicles using the road account for the vast majority of emissions over the project life (97.3%). In the opening year of the Scheme (2021) user emissions are modelled to contribute 6.7 $ktCO_2e$, increasing to 8.2 $ktCO_2e$ per year by 2051. This is based on the traffic models of the Scheme, as per Section 0.

18.6.9 Annual user emissions in the Do Something scenario are greater than in the Do Minimum scenario for all years assessed, by between 5% to 6%. Over the appraisal period, the impact of the additional road use will increase emissions by 27 $ktCO_2e$ compared to the Do Minimum scenario. The cumulative emissions from road users are shown for the Do Minimum and Do Something scenarios in Figure 18.3.

18.6.10 The increase in emissions is due to an increase in average speeds, based on the traffic forecast models, and also a very slight increase in vehicle kilometres travelled due to the alignment of the proposed road.

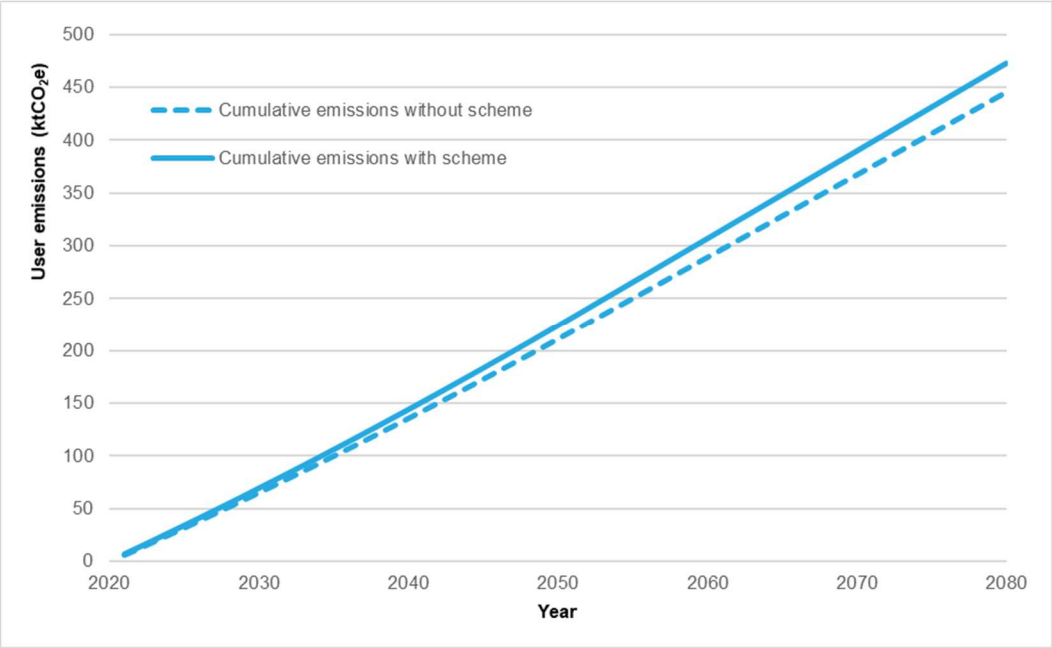

Figure 18.3 Cumulative user carbon emissions ($ktCO_2e$), Do Minimum (without Scheme) and Do Something (with Scheme) scenarios

18.6.11 The Scheme includes an additional roundabout (compared to the Do Minimum scenario), which is likely to increase emissions as vehicles must decelerate to pass through the roundabout and accelerate again. This impact has not been quantified in the traffic model used to calculate the user emissions, as it is based on average daily trip data; however the impact will be minimal compared to the factors outlined in 18.6.10 above.

18.6.12 The user emissions in both scenarios are based on conservative projections of improvements in vehicle fuel efficiency, and do not allow for the emissions reductions that could be achieved with increased penetration of electric vehicles in the fleet[13]. However, any improvements in fuel efficiency will impact both scenarios and user emissions will remain greater in the Do Something scenario.

18.6.13 User emissions from the Scheme account for the vast majority of impacts from the Scheme and can be used as a comparator on an annualised basis. In the opening year of the Scheme (2021) user emissions are modelled to contribute 6.7 $ktCO_2e$. This is equivalent to 5.4% of overall annual emissions from road transport on A roads in Pembrokeshire. At approximately 10 km, the length of the modelled length of the A40 is about 3.6% of the length of all A roads in

[13] The predicted fleet mix used in the emission Factor Toolkit is taken from the National Atmospheric Emission Inventory (NAEI) Vehicle Fleet Composition Projections, http://naei.beis.gov.uk/data/ef-transport, [Accessed November 2017]

Pembrokeshire (280 km)[14].

18.6.14 This comparison shows that the emissions from this section of road in the Do Something scenario are disproportionately high compared to its length (which is also the case in the Do Minimum scenario, with user emissions of 6.3 ktCO_2e in 2021). Overall, this indicates that this length of road is already well used compared to other 'A roads' in Pembrokeshire, and as a result is a comparatively significant source of user carbon emissions.

18.6.15 Another reference for comparison is the emissions from the transport sector in Wales. According to the most recently published greenhouse gas emissions inventory, the transport sector in Wales accounted for 6.0 MtCO_2e in 2015, or 13% of the total national emissions[15]. In the first year of Scheme operation, user emissions would be equivalent to approximately 0.1% of the current annual emissions from the transport sector in Wales.

CCR assessment

Assessment of effects in construction

18.6.16 The construction works are to be completed by 2021, thus the associated changes in climate are expected to be relatively small compared to the current baseline. Therefore, it has been assumed that sufficient mitigation measures are already in place during the construction programme to ensure resilience under current climate conditions.

Assessment of effects in operation

18.6.17 Over the near term (the 2020s), the risks identified in the CCR assessment have a 'Low' or 'Very low' risk rating due to the mitigation measures embedded in design.

18.6.18 Over the long term (the 2070s), while most risk are low or very low, one risk identified has a 'Medium' risk rating. This is risks associated with flooding as a result of extreme rainfall events. No risks identified in the CCR assessment were classified as significant. The results of the CCR assessment are included in Volume 3 Appendix 18.2.

[14] StatsWales, 2017, Road length (Km), by type of road and local authority, Wales https://statswales.gov.wales/Catalogue/Transport/Roads/Lengths-and-Conditions/roadlength-by-typeofroad-localauthority-year [Accessed November 2017]
[15] National Atmospheric Emissions Inventory, 2017, http://naei.beis.gov.uk/reports/reports?report_id=932 [Accessed November 2017]

ICCI assessment

Assessment of effects in construction

18.6.19 The construction works are to be completed by 2021, thus the associated changes in climate are expected to be relatively small compared to the current baseline. Therefore, it has been assumed that sufficient mitigation measures are already in place during the construction programme to ensure resilience under current climate conditions.

Assessment of effects in operation

18.6.20 No risks identified in the ICCI assessment were classified as significant. The results of the ICCI assessment are included in Volume 3 Appendix 18.3.

18.7 Mitigation Measures

GHG emissions assessment

18.7.1 The GHG emissions assessment provides an indication of the emissions associated with the construction and operation phases of the proposed development. As all emissions from the development are considered significant under the definition in the methodology, mitigation actions should be implemented to reduce GHG emissions from the development.

18.7.2 PAS 2080 provides a framework for the management of carbon in projects in the built environment. The use of PAS 2080 to guide the approach to reducing GHG emissions associated with the proposed Scheme is recommended.

Scheme Design considerations

18.7.3 This section considers the elements of the design development that have resulted in capital and operational carbon reduction on the Scheme relative to 'business-as-usual' design. The reductions are already included in the carbon footprint presented in the assessment results.

18.7.4 The **lighting** strategy is to minimise the extents of lighting in order to reduce operation and maintenance costs, ecological and landscape impacts and reduce carbon. Only the two roundabouts proposed at either end of the Scheme are proposed to be lit. The extents of the lighting of the approaches to the roundabouts were reviewed and minimised, requiring a Departure from Standard.

18.7.5 The highway alignment has been developed to provide an **earthworks balance**. This means that the excavated material that is exported as waste to landfill has been minimised and the majority will be reused in the construction of embankments, landscaping and in the road build-up, therefore reducing the carbon impact.

18.7.6 The **pavement design** has considered the traffic forecast data, with a view to minimise the thickness of material required. Pavement materials are carbon intensive, so the pavement thicknesses were minimised as far as practicable without impacting durability.

18.7.7 Alternative junction arrangements to the additional roundabout were considered in order to reduce the carbon impact of stop-start conditions. These were not adopted in the current design due to a range of considerations, including improved safety by reducing the likelihood of a high-speed collision.

Future mitigation opportunities

18.7.8 In recognition of the significance of any carbon emissions associated with the Scheme, further mitigation opportunities will be identified, assessed and integrated as the project progresses. In line with the carbon emissions reduction hierarchy outlined in PAS 2080, in the context of the current design stage, these opportunities will broadly include:

a) *Build clever – considering the use of low carbon solutions (including technologies, materials and products) to minimise resource consumption during all project phases*

b) *Build efficiently – using techniques (e.g. construction, operational) that reduce resource consumption during the construction and operation phases.*

18.7.9 Where practicable, local suppliers of resource and material will be used. This will minimise the journey distances to the project site, therefore reducing the carbon impact required to transport materials to site. These will be identified at a later stage of design and construction of this project.

18.7.10 There is also an opportunity to explore strategies to reduce emissions within the local community as part of the project, for example through

provision of decarbonised energy infrastructure. This type of initiative would offset the carbon impact of the project, by reducing carbon emissions elsewhere in the community.

CCR assessment

Mitigation of effects from operation

18.7.11 Mitigation measures currently included within the design are:

a) The drainage design includes allowance for climate change as design for ponds and culverts includes an allowance for a 1 in 100-year flood occurrence with an added 30% allowance.

b) Overland flow analysis has been in included for a 1 in 100-year flood occurrence plus a 30% allowance to see how water moved in the event of a flood however no impact on third party land was shown.

c) The structures have been designed to Eurocode standards to allow for expansion and contraction, to provide resilience to extreme temperatures.

18.7.12 Further measures are not currently recommended to address the risks identified in the CCR assessment as they are not classified as significant.

18.7.13 Due to the uncertainties involved in adapting to future climate change, a pathways approach is recommended for monitoring and managing climate risks into the future. Further measures to reduce climate risks over the long term are not currently recommended for implementation as they may result in maladaptive outcomes that limit future adaptation options.

ICCI assessment

Mitigation of effects from operation

18.7.14 Further measures are not currently recommended to address the risks identified in the ICCI assessment as they are not classified as significant.

18.8 Summary

18.8.1 The climate change assessment addresses the potential effects of the Scheme on greenhouse gas (GHG) emissions; the resilience to the consequences of climate change (CCR); and the in-combination climate change impact (ICCI), which evaluates the combined effect of the

proposed development and potential climate change impacts on the receiving environment during construction and operation.

18.8.2 The GHG assessment identified that over the whole life of the Scheme there will be an increase in emissions associated with the Scheme, with the majority (97.3%) due to vehicles using the road during operation. The increase in user emissions is due to an increase in average speeds and a slight increase in distance travelled due to the alignment of the roads. There are also emissions associated with the construction and operation of the Scheme. Over the 60-year appraisal period, the total emissions from the construction, operation and use of the road are expected to increase by 8.4% compared to the Do Minimum scenario.

18.8.3 The CCR and ICCI assessments did not identify any significant risks associated with climate change. Potential risks associated with flooding are addressed by mitigation measures in design.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapters 19, 20 and 21: Cumulative Effects

A40LVP-RML-EGN-SWI-RP-LE-0006

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15/01/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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19.1 Other Planning Applications and Allocated Sites in the vicinity of the scheme

Appendices (unless otherwise stated these are provided in Volume 3)

19.1 Development matrix: allocated sites and Planning applications

19.2 Development matrix

19 Assessment of Cumulative Effects

19.1 Subject Introduction

19.1.1 Cumulative effects result from multiple actions on receptors or resources occurring in combination over time. This chapter explains the two types of cumulative impact and refers the reader to the two chapters 20 and 21 which assess these two types separately:

Type (i) Cumulative Effects from a Single Scheme (Interrelationships): is the assessment of effects on receptors or receptor groups, such as local residents, users of local rights of way or services, which may be affected by different environmental effects generated by the Scheme simultaneously or concurrently. This is sometimes referred to as the 'interrelationships' between different environmental effects. This assessment includes consideration of particular locations where several effects, for example noise, air quality and visual change, may all occur. **Refer to Chapter 20.**

Type (ii) Cumulative Effects from Different Schemes: is the assessment of effects of the Scheme together with other proposed (but not yet built) developments, where there is the potential for impacts to overlap spatially or temporally. **Refer to Chapter 21.**

19.2 Legislation and Policy Context

19.2.1 The EIA Directive requires consideration of cumulative effects and interrelationships. Cumulative impacts can also be considered as: *'…impacts resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project.'* (European Commission 1999).

Planning Policy Context

19.2.2 The adopted Local Development Plan (LDP) for Pembrokeshire County Council (2013) makes reference to the importance of cumulative effects. Other references to cumulative effects relate to a requirement for development near existing residential areas to not adversely affect 'local residential amenity, either in its own right or cumulatively with other uses'.

19.2.3 The adopted Pembrokeshire and Carmarthenshire LDPs highlight the importance of ensuring that the cumulative effects of development in Pembrokeshire and adjoining areas do not result in harm to internationally designated nature conservation sites. The LDPs also state that development in neighbourhood centres, new retail and renewable energy schemes will be permitted provided that the development, either individually or cumulatively with other recently proposed development, does not undermine vitality, attractiveness or viability. The adopted LDPs are currently progressing with a statutory review process.

19.2.4 There are no specific local planning policies relating to cumulative effects in relation to new highway development.

19.3 Relevant Guidance for the assessment

19.3.1 There is no single, agreed industry standard method at the time of preparing this ES on Cumulative Effects Assessment (CEA). Relevant guidance for the ES is the following:

a) **HA205/08** Principles of Environmental Assessment – Assessment and Management of Environmental Effects (Highways Agency et al., 2008). The Design Manual for Roads and Bridges (DMRB) guidance set out in HA 205/08 (Highways Agency et al., 2008) stated that there were two types of cumulative effects to be considered in environmental assessment: (i) cumulative effects from a single scheme (referred to as 'interrelationships') and (ii) cumulative effects from different schemes.

b) **Advice Note 17:** Cumulative effects assessment relevant to nationally significant infrastructure projects (Planning Inspectorate, 2015).

c) **Advice Note 9**: Rochdale Envelope (Planning Inspectorate, 2012). Although not specifically designed for highway schemes, the Planning Inspectorate guidance note provides more recent guidance on good practice for the assessment of cumulative effects for major infrastructure schemes.

d) **The Planning Inspectorate** provide guidance on the approach to Type (ii) cumulative assessment and this guidance is referenced in Chapter 21.

19.4 Study Area

19.4.1 The study area for the cumulative and in-combination effects assessment is based on the Zones of Influence[1] (ZoI) of the environmental effects of the Scheme. These are presented in Tables 19.1, 19.2 and shown in Volume 2, Figure 19.1 which includes part of the neighbouring planning authority of Carmarthenshire. The information within this chapter was based on the baseline data and assessments provided in Chapters 7 to 16 of this ES.

19.5 Consultation

19.5.1 The Environmental Liaison Group (ELG) was invited to comments on the ES Scoping Report, but none chose to comment specifically on cumulative effects. Subsequently consultation took place with the Pembrokeshire and Carmarthenshire County Councils to identify a list of proposed other developments for inclusion in the Type (ii) cumulative effects assessment. These potential impacts are assessed in Chapter 21.

19.6 Assessment Criteria and Assignment of Significance

19.6.1 The assessment does not aim to assign significance levels; instead it is used to identify the potential for cumulative effects. A statement is made as to whether the cumulative effect would be more significant than the effects of the Scheme alone and whether this would be adverse or beneficial.

19.7 Limitations of the Assessment

19.7.1 The assessment of cumulative effects depends, to a large degree, on the amount of detail that is available about other proposed developments, and the need to rely on environmental assessments carried out by others. Proposals at an early stage of development, or planning applications for which no EIA has not been undertaken, assessing potential cumulative effects must rely on professional judgements based on and knowledge of the study area.

[1] Zone of Influence is the term used to describe the extent to which a specific potential impact is considered likely to cause an effect.

Table 19.1 Zones of Influence during Construction

Topic	Potential impact	Receptor resource	Zone of Influence (ZoI)
Air Quality	Dust	Humans and designated ecological sites	350m
Cultural Heritage	Indirect non-physical (visual and aural change	Heritage assets and visitors to assets	200m
	Change in the setting of assets	Settings of designated and other heritage sites (HER)	Based on the Zone of Theoretical Visibility
Landscape and visual	Visual change	Humans	5km from the centreline.
	Change to character of landscape	Designated and non-designated landscapes & humans	Based on the Zone of Theoretical Visibility
Ecology and nature conservation	Disturbance, severance, fragmentation, wildlife casualties, barrier effects, lighting, air pollution	Protected species, habitats, ecologically designated sites	Up to 500m for disturbance from noise, visual, lighting. Receptor specific for severance, fragmentation and barrier impacts.
Geology and soils	Creation of pathways for contamination migration	Aquifers and surface waters	Land take. Maintaining stability is an inherent part of highway design. Implementation of the design as approved would mitigate potential effects.
Geology and soils	Exposure to contamination through dermal contact, ingestion and inhalation of contaminated soil/soil derived dust. Exposure to waste/Made Ground with potentially elevated levels of soil contamination and asbestos. Inhalation of ground gases with elevated concentrations	Construction workers and adjacent land users	Land take. Human health would be managed by implementation of appropriate working methods and protocols. Work would be undertaken as described in the Construction Environmental Management Plan (CEMP).

Topic	Potential impact	Receptor resource	Zone of Influence (ZoI)
Materials	Generation of waste from construction	Waste disposal facilities	Land take. Offsite disposal of contaminated (if any) and uncontaminated soils to landfill would be limited through the implementation of the Materials Management Plan and the Site Waste Management Plan. Where practical, all site won materials would be reused or treated and reused in order to minimise disposal.
Noise and vibration	Noise from machinery	Humans	300m
	Vibration from construction activities	Humans and structures	30m
All travellers	Diversions, stopping up, provision of new routes, temporary loss of use, change to operation of public transport services, change in attractiveness or length of journey, change in amenity, community severance.	Users of public highways, public transport, existing and proposed PROW connecting settlements.	Existing and proposed PRoW connecting settlements see Volume 2 Figure 15.1 and 15.2.
Community and Private Assets	Construction traffic/noise affecting amenity, temporary loss of land.	Local communities - Volume 2 Figure 15.1.	As for the noise/traffic/visual/air with account taken of the nearest available community facility where these are not available within these settlements
	Change in the amenity of property along construction corridors/access routes due to construction traffic/noise, temporary loss of land.	Private Assets	All properties and land, including agricultural land, which have the potential to be affected by demolition of property or loss of land (land take) or to experience changes to the amenity of properties or land because of the Scheme.

Topic	Potential impact	Receptor resource	Zone of Influence (ZoI)
Road Drainage and the Water Environment	Generation of silt laden runoff during construction, abstraction and discharge of low-quality groundwater into surface water during dewatering, generation of contaminated leachate during fill, contaminated waters from known areas of contamination, sediment generated during culverting, creation of pathways for contamination, accidental spillage surcharge periods / through infiltration through embankment	Surface water	The principal premise is that surface water and groundwater pollution is managed for this Scheme to prevent deterioration of water status under the Water Framework Directive. This is achieved through risk assessment, use of remedial criteria and via baseline and aftercare monitoring. The baseline water quality will be established prior to construction and take account of non-construction related variation in water quality measured at distant monitoring locations. As such the potential for a cumulative impact on surface water quality was screened out.

Table 19.2 Zones of Influence during Operation

Topic	Potential impact	Receptor resource	Zone of Influence (ZoI)
Air Quality	Change in the level of vehicle emissions	Humans	Up to 200m from traffic
Air Quality and Ecology	Change in the level of vehicle emissions	Ecologically designated sites sensitive to vehicle emissions	Up to 200m from traffic
Cultural Heritage	Indirect non-physical (visual and aural) change, change to the setting of heritage assets.	Heritage assets, visitors to heritage assets	Based on Zone of Theoretical Visibility

Topic	Potential impact	Receptor resource	Zone of Influence (ZoI)
Landscape and Visual	Visual change	Humans	Based on Zone of Theoretical Visibility
Ecology and Nature Conservation	Disturbance, severance, fragmentation, wildlife casualties, disruption to hydrology, polluted run-off into watercourses, barrier effects, lighting, air pollution, traffic spray (de-icing salt).	Protected species, habitats, ecologically designated sites	Wildlife casualties within the highway, up to 500m for traffic spray, disturbance from noise, visual, lighting. Receptor specific for severance, fragmentation and barrier impacts
Geology and Soils	Pollution of soils due to traffic spray/airborne pollutants.	Topsoil and subsoil	New section of trunk road footprint. Committed mitigation would avoid topsoil and subsoil being affected beyond the footprint. The mitigation measures would be implemented via the approved drainage design and landscape planting.
Geology and Soils	Exposure through dermal contact, ingestion and inhalation of Exposure through dermal contact, ingestion and inhalation of contaminated soil derived dusts on end users/maintenance workers. Ground gas migration and inhalation of gases by end users/maintenance workers.	End users / maintenance workers	Land take. Routine maintenance is expected during operation. Working procedures and safe systems of work would be implemented in accordance with existing requirements for highway management to mitigate exposure
Noise and Vibration	Traffic Noise change	End user /maintenance workers	1km either side of the road or extent of the contour plots in the figures for Chapter 13 Air Quality
Noise and Vibration	Traffic Noise change	Residents	1km either side of the road or extent of the contour plots in the figures for Chapter 13 Air Quality.
Noise and Vibration	Vibration	Non-residential noise sensitive receptors (schools, places of worship, care homes)	1km either side of the trunk road edge.

Topic	Potential impact	Receptor resource	Zone of Influence (ZoI)
All travellers	Diversions, provision of new routes; loss of use; change to operation of public transport services; change in attractiveness or length of journey; change in amenity, community severance.	Users of public highways, public transport, existing and proposed PRoW connecting settlements.	Local public highways, local public transport. Existing and proposed Public Rights of Way (PRoWs)
Community and Private Assets	Change in traffic flows on routes which serve the local community; change in amenity of land used by the community due to predicted changes in operational traffic flows.	Communities	The settlements in the surround district with account taken of the nearest available community facility where these are not available within these settlements.
Community and Private Assets	Change in the amenity of properties along the alignment of the new section of road	Private assets	All properties and land, including agricultural land, which have the potential to be affected by demolition of property or loss of land (land take) or to experience changes to the amenity of properties or land as a result of the Scheme.
Road Drainage and Water Environment	Run-off polluting surface water bodies, and groundwater followed by lateral movement to surface waters.	Surface water	The main impact is from traffic use. The assessment has used predicted traffic flows from the traffic forecasting report which included all likely future development to account for cumulative traffic generation
Road Drainage and Water Environment	Generation of contaminated leachate through infiltration through embankment; generation of contaminated groundwater; change to supply, quality, reliability of groundwater dependant features.	Groundwater.	The main impact is from traffic use. The assessment has used predicted traffic flows from the traffic forecasting report which included all likely future development to account for cumulative traffic generation.

Topic	Potential impact	Receptor resource	Zone of Influence (ZoI)
Road Drainage and Water Environment	Changes to flood risk	All resources/receptors sensitive to flooding within the flood risk area of the Scheme	Flood risk assessment and management of all development is undertaken with the philosophy of not increasing flood risk parameters of the land take and third-party land. This also implies cumulative risks from flooding are not possible insofar as all development cannot be permitted if it renders other projects responsible for mitigating any associated adverse effects (detriment) of flooding.

20 Type (i) Cumulative Effects from a Single Scheme

20.1 DMRB guidance for Type (i) cumulative effects

20.1.1 The DMRB states that Type (i) Cumulative Effects from a Single Scheme (Interrelationships) are those that arise from the combined action of several different environmental impacts from a single scheme upon a single receptor/resource. The guidance states that, when considered in isolation, the environmental effects upon any single receptor/resources may not be significant. However, when all effects from a single scheme are considered together, the resulting cumulative effect may be significant.

20.1.2 The guidance sets out factors to be considered in the assessment of:

a) Which receptor/resources are affected?

b) How will the activity or activities affect the condition of the receptor/resource?

c) What are the probabilities of such effects occurring?

d) What ability does the receptor/resource have to absorb further effects before changes become irreversible?

20.2 The Planning Inspectorate Guidance

20.2.1 The Planning Inspectorate's Advice Note Nine (2012) states that for the Type (i) Cumulative Effects from a Single Scheme, '*The interrelationship between aspects of the proposed development should be assessed and careful consideration should be given by the developer to explain how interrelationships have been assessed in order to address the environmental impacts of the proposal. It need not necessarily follow that the maximum adverse impact in terms of any one topic impact would automatically result in the maximum potential impact when several topic impacts are considered collectively. In addition, individual impacts may not be significant but could become significant when their inter-relationship is assessed. It will be for the developer to demonstrate that the likely significant impacts of the project have been properly assessed.*'

20.3 Method of assessment of cumulative effects from a single scheme

20.3.1 This assessment considers receptors or receptor groups, such as residents, users of local rights of way or services that may be affected by different environmental effects generated from the Scheme simultaneously or concurrently. This may include, for example, locations where noise, air quality and visual change may all occur at the same time. The approach to assessing Type 1 effects or interrelationships has followed a four-staged process, as summarised in Table 20.1.

Table 20.1 Approach to Assessment of Interrelated Effects

Stage	Description
1. Which receptors/resources are affected?	Exercise to identify receptor/resource types are not affected by in-combination effects or where these receptor/resource types are assessed wholly in a single EIA topic area.
2. Identify impacts of receptor/resources?	Review of the likely receptor(s)/resource affected by more than one impact through analysis of the assessment of effects sections undertaken for individual EIA topic areas.
3. In-combination effects	Identification of potential in-combination effects on these receptor groups through review of the topic specific assessments in the EIA chapters.
4. What ability does the receptor/resource have to absorb further effects before changes become irreversible?	Assessment undertaken on how individual effects may combine to create interrelated effects on each receptor for: 'Project lifetime effects', i.e., during construction, operational and decommissioning phases; and 'Receptor-led effects', i.e., multiple simultaneous effects on a single receptor/resource.

20.4 Identification of Receptors/ Resources

20.4.1 The EIA topic chapters report on the effects of the Scheme on receptors or receptor groups. Many of the interrelated impacts on those receptors are also considered within the topic chapters. For instance, effects on ecological receptors arising from any combination of land take, noise/visual disturbance, air quality impacts, water quality impacts and potential traffic collision (see Chapter 8 Ecology and Nature Conservation).

20.4.2 This chapter presents those cumulative effects which are not explicitly addressed elsewhere in the ES. The topics where this applies are shown in Table 20.2 below.

Table 20.2 ES Topics excluded from further interrelated effects assessment

Topic receptor/ resource	Rationale for exclusion from further in combination effects
Cultural Heritage	The assessment of effects on historic assets is provided in Chapter 10 Archaeology and Cultural Heritage. This assessment considers all potential impacts on the relevant receptors, namely buried archaeology and historic assets. This topic relies heavily on coordination with other topics to understand the variety of impacts on receptors i.e. interrelationships.
Landscape Resources	The landscape assessment presented in Chapter 9 Landscape and Visual Effects, includes the consideration of all potential impacts on landscape character and landscape quality. Therefore, no additional interrelated effects are considered likely to occur beyond those identified in the specific assessment in Chapter 9 Landscape and Visual Effects
Ecology	The assessment of in combination effects (many impacts on one receptor/resource e.g. disturbance from noise, emissions, land take) is central to the assessment of potential impacts on ecological receptors and the integrity of designated sites and, as such, has already been assessed within 8 Ecology and Nature Conservation. No additional effects are therefore, considered likely to occur beyond those identified in the assessment in Chapter 8. This topic relies heavily on coordination with other topics to understand the variety of impacts on ecological receptors i.e. interrelationships
Geology and soils	All the potential impacts on geological receptors and soils were assessed and reported within Chapter 6 Geology and Soils
Materials	All the potential impacts on materials and waste were assessed and reported in Chapter 16 Materials
Private assets	All the potential impacts on private assets (farm holdings) were assessed and reported within Chapter 12 Community and Private Assets: Agriculture
Road drainage and water	All the potential impacts on road drainage and water were assessed and reported in Chapter 7 Road Drainage and the Water Environment.

20.4.3 Potential interrelated effects of the Scheme with other developments can only occur in the Zones of Influence (ZoI) presented in Tables 19.1 and 19.2. The receptors identified as likely to experience interrelated effects are people living in or using the area near the Scheme who could be affected by combinations of air quality, noise and visual impacts. Based on the ZoI, a core study area for the assessment of these effects of 350m from construction activities has been adopted. The in-combination

effects would only occur where there is the influence of more than one effect. For example, while a visual impact such as a view of the road, or a traffic noise impact, could be experienced at a far greater or far lesser distance than 350m, an air quality effect would only influence receptors up to 200m from the source. Determining where the in-combination effects would occur would vary through the study area depending upon where multiple effects combine.

20.4.4 There are broadly two receptor groups:

Closest long-term receptors: people living at dwellings within 350m of construction activities and within 1km of the Scheme / or the limits of the noise effects shown on the noise contour plots.

Closest intermittent receptors: people using PRoWs (and other linear routes) within 350m of construction activities and within 1km of the Scheme / or the limits of the noise effects shown on noise contour plots.

20.5 Identification of Potential Effects

20.5.1 For each receptor group, Table 20.3 lists the potential effects.

Table 20.3 Potential effects for each receptor group

Receptor Group	Potential Impacts
Closest long-term receptors - people living at dwellings within 350m of construction activities and within 1km of the Scheme / or the limits of the noise effects shown on the noise contour plots.	a) Potential impacts from dust soiling surfaces, particularly window sills, cars and laundry b) change to the level of traffic emissions (adverse or beneficial); changes to the noise environment and vibration (adverse or beneficial); and c) changes to views
Closest intermittent receptors - people using PRoWs (and other linear routes) within 350m of construction activities and within 1km of the Scheme / or the limits of the noise effects shown on the noise contour plots.	a) Changes to the PRoW network and other linear routes; b) change to the level of traffic emissions (adverse or beneficial); c) changes to the noise environment (adverse or beneficial); and d) changes to views.

20.5.2 Tables 20.4 and 20.5 list the interrelated effects that are predicted to arise during construction and operation of the Scheme. The tables present the Scheme lifetime interrelated effects and the text beneath each table describes the simultaneous interrelated effects. The effects are adverse and beneficial.

Table 20.4 Potential Type (i) Cumulative (Interrelated) Effects for People Living Near the Scheme

Receptor:	**Closest long-term receptors – people living within 350m of construction activities and within 1km of the Scheme alignment**				
Phase:	**Construction phase**		**Operational and maintenance phase**		**Project lifetime Cumulative Effects**
Impact type	**Source of impact**	**Significance of individual effect with mitigation**	**Source of impact**	**Significance of individual effect with mitigation**	
Dust soiling surfaces, particularly window sills, cars and laundry.	Dust generating construction activities such as excavating and moving earth.	A temporary, short/medium term effect which would be a negligible effect and not significant	Not applicable	Not applicable	Through the project lifetime, the receptors living closest to the existing A40 would experience limited construction related effects (construction noise, dust) followed by a reduction in traffic noise and traffic related emissions once traffic starts using the new road and limited change in views. Through the project lifetime, the people living closest to the new section of road may experience noise and dust during construction alongside changes in views (both day and night). This would be followed by increased traffic noise and traffic-related emissions once traffic starts using the new road as well as changes in views (both day and night). This assumes that the same people (receptors) would remain in the same properties from the start of Scheme construction through to operation.
Air Quality	Exhaust emission impacts from construction traffic on human health.	A temporary, short/medium term effect which would not be significant. Traffic emission impacts on human health.	Traffic emission impacts on human health.	Major beneficial effects (improvements in human health) for the receptors along the existing A40 that will benefit from reduced traffic. The modelling results indicate that there is not a risk of environmental standards for NO2 or PM10 being breached in the Scheme opening year (2021) or future year (2050). There are no large increases in pollutant concentrations as a result of the Scheme. The maximum increase in annual mean NO2 concentrations is classified as a minor adverse impact according to the criteria and not significant. Refer to Chapter 13 Air Quality for the Air Quality Assessment.	
Noise change	Noise generating construction activities such as excavation activities, piling, working machinery, construction traffic, etc.	A temporary, short/medium term effect, which would be: a significant 'moderate' or 'major' beneficial effect for 66 residential noise sensitive receptors, with 70 that would be minor or negligible. a significant moderate or major adverse effect for 7 residential noise sensitive receptors, with 35 that would be minor.	Noise from traffic on the new road	In the medium to long term (2022-2037) there would be a significant moderate or major adverse effect for five residential noise receptors; while there would be a significant moderate or major beneficial effect for 43 residential noise receptors. Refer to Chapter 14 Noise and Vibration for the Noise and Vibration Impact Assessment.	
Vibration	Vibration generating construction activities such as blasting or piling.	A temporary, short/medium term adverse effect which would be neutral or slight and would not be significant.	Vibration generated from traffic moving on the new road	A neutral effect (not significant) and scoped out of the noise and vibration assessment as a result.	
Changes to views	Visibility of the construction activities.	A temporary, short/medium term neutral to very large adverse effect, which would be significant	Visibility of the new road	Slight beneficial to very large adverse (significant) effect at year one and neutral to very large adverse (significant) effect at Year 15 after opening.	

Table 20.5 Potential Type (i) Cumulative (Interrelated) Effects for People using the PRoW network.

Receptor:	**Closest long-term receptors – people living within 350m of construction activities and within 1km of the Scheme alignment**				
Phase:	**Construction phase**		**Operational and maintenance phase**		**Project lifetime Cumulative Effects**
Impact type:	**Source of impact**	**Significance of individual effect with mitigation**	**Source of impact**	**Significance of individual effect with mitigation**	
Changes to PRoWs Network	Temporary stopping up and diversions: temporary stopping up affecting routes. Temporary effects on ability to access local routes: resulting in effects on route integrity.	The predicted effects arising from the temporary stopping up of PRoWs during construction were assessed to be temporary and medium term and of slight adverse significance in relation to local routes.	The introduction of new section of road close to existing routes. Permanent diversions and new cycle routes created.	The predicted environmental land take effects arising from the permanent stopping up and diversion of local PRoWs, and the provision of new routes are assessed as permanent and of slight beneficial significance.	Project lifetime cumulative effects could only be experienced by regular users of the routes affected by the Scheme and the combination of types of impacts and levels of effects would be highly variable depending on the route itself.
Changes to the Public Highways, public transport, Driver stress.	Stopping up and diversion, resulting in temporary change in length of route. Temporary loss of access across existing structures impacting local journeys.	The effect arising during the construction of the new trunk road were assessed to be permanent and of neutral to slight significance.	Creation of new section of road and change in amenity of existing routes. Change in traffic flows and journey experience. No effect on public transport during operation	The two bus stops within the village of Llanddewi Velfrey (one westbound, one eastbound) would be bypassed as part of the Scheme. As the bus stops would need to divert from A40 trunk road and negotiate the junctions when entering and exiting the village, some journey time would be added to the bus route, but this was deemed to be negligible.	
Noise change	Noise generating construction activities such as excavation activities, piling, working machinery, construction traffic, etc.	A temporary, short term effect is expected for users of PRoWs in the vicinity of construction activities.	Noise from traffic on the new section of road	There would be marked changes to the amenity of the existing footpaths/ and the bridleway, and other routes that currently run through areas immediately to the north of the existing A40. During the operation of the new road, local routes for NMUs will operate. Whilst these will be close to the road, they will be separated from the carriageway. Other non-motorised users would also have a different experience to that presently enjoyed.	
Changes to views	Visibility of construction activities	Short / medium term slight to very large significant adverse effects.	Visibility of the new section of road	Slight adverse effects at Year 1 (2021) and slight beneficial to very large adverse significant adverse effects at Year 15 (2036)	

20.6 Summary of Type (i) Cumulative Effects from the Scheme on People Living Locally

20.6.1 The Scheme would cause a range of cumulative effects for properties in the surrounding area. The Scheme would carry traffic to the north of the more densely populated residential area of Llanddewi Velfrey thus moving traffic-related effects to this less populous area with the general result that. From Ffynnon to Penblewin roundabout the Scheme would carry traffic slightly further north and away from properties along the existing road. Despite the lower density of dwellings near the Scheme, there would be new receptors affected and there would be changes to effects on existing receptors:

a) Some people living near the existing A40 trunk road would see beneficial changes of varying significance with reduced traffic noise, better views and improved air quality;

b) People across the study area would experience a combination of beneficial and adverse effects of varying significance.

c) People living close to the Scheme and its traffic could experience the adverse effects of increased visual intrusion, traffic noise and a reduction in air quality.

20.6.2 Taking the three main interrelated effects set out in Table 20.4 for the operational phase of the proposed road (noise (Chapter 14), changes to views (Chapter 9), air quality (Chapter 13)) it can be seen that some residential properties could experience a cumulative impact of two or more beneficial or adverse effects, which could potentially be more significant than the individual effects of the Scheme. Table 20.6 has been compiled to illustrate this potential for some of the closest properties to the existing and proposed trunk road in the Design Year (2035). The table does not attempt to quantify or qualify the impacts, but states whether the effects are predicted in the separate topic assessments to be generally Beneficial (B), Adverse (A) or Neutral (O). Reference to the relevant topic chapter will provide more detail on the predicted effects.

Table 20.6 Examples illustrating how the beneficial and adverse cumulative impacts set out in Table 20.4 can combine for receptors

Location	**Nº of properties affected**	**Air Quality**	**Traffic Noise**	**Views**
Preseli Terrace / Glan Preseli properties	**Over 20**	**B**	**B**	O
Llandaff Row and Maes Y Dderwen	**Over 30**	**B**	**B**	**B**
Properties around Bethel Chapel	**3**	O	**B**	O
Tir-bach	**1**	O	**B**	**A**
Castell	**1**	O	**A**	**A**
Properties on the A40 between Londis and Awelfa	**Approx. 15**	**B**	**B**	**B**
Blaen-pen-troydin	**1**	O	O	O
Pen-troydin-fawr	**1**	**A**	**A**	**A**
Pen-troydin-fach	**1**	**A**	**A**	**A**
Properties beside old A40 west of Llanfallteg Road	**15**	**B**	**B**	**B**
Maes-y-Ffynnon, Maes-y-Rhos	**2**	**A**	**B**	**A**
Parc y Delyn	**1**	O	O	O
Ffynnon (several properties)	**5**	**B**	**B**	O
Brominau	**1**	O	**B**	**A**
Henllan Lodge	**1**	O	O	**A**
Trefangor Farm	**1**	**B**	**B**	**A**
Ca'rmaenau-fach	**1**	**B**	**B**	**A**
Grosvenor Court and Bounty Farm	**2**	O	**B**	O

Location	Nº of properties affected	Air Quality	Traffic Noise	Views
Ca'rmaenau-fawr	**1**	O	**B**	O
Pen-blewin	**1**	**B**	**B**	**A**
Blackmoor Hill	**1**	O	**B**	O

20.7 Summary of Type (i) Cumulative (Interrelated) Effects from the Scheme on People Using Public Rights of Way

20.7.1 Users of PRoWs and other routes near the Scheme during construction may be simultaneously affected by the dust and noise generated during construction activities as well as the visual effects (change in views). Users could also experience a temporary diversion or closure of a route (shown on Volume 2 Figures 15.1 to 15.4). Such effects would only combine where users of PRoWs are in close proximity to the Scheme's construction activities. The receptors are transient through the landscape along the paths or routes and would not experience a long-term effect unless out of choice. Nevertheless, the cumulative adverse effects have the potential to be more significant than the individual effects of the Scheme.

20.7.2 During operation, users of PRoWs and other routes may be simultaneously affected by changes in the amount of traffic noise and air quality from the new section of road as well as the visual effects (change in views). Users could also experience a permanent diversion or closure of a route (shown on Volume 2 Figures 15.1 to 15.4). Such effects would only combine where users of PRoWs are near the Scheme. The receptors are transient through the landscape along the paths or routes and would not experience a long-term effect unless out of choice. Effects are more likely to be felt intermittently. Nevertheless, the cumulative adverse effects have the potential to be more significant than the individual effects of the Scheme.

20.7.3 Taking the three main interrelated effects set out in Table 20.5 for the operational phase of the proposed road (noise (Chapter 14), changes to views (Chapter 9), air quality (Chapter 13)) it can be seen that some PRoWs could experience a cumulative impact of two or more beneficial or adverse effects, which could potentially be more significant than the

individual effects of the Scheme. Table 20.6 has been compiled to illustrate this potential for some of the closest routes to the existing and proposed trunk road in the Design Year (2035). The table states whether there are changes proposed to the route but does not attempt to quantify or qualify the impacts pf the Scheme, but states whether the effects, are predicted in the separate topic assessments to be generally Beneficial (B), Adverse (A) or Neutral (O). Reference to the relevant topic chapter will provide more detail on the predicted effects.

Table 20.7 Examples illustrating how the beneficial and adverse cumulative impacts set out in Table 20.4 can combine for receptors

PRoW close to the Scheme	Changes to route?	Air Quality	Traffic Noise	Views
SP27/1/1 (west of Penblewin)	None	O	**A**	O
SP19/32/1 & 2 (near Bounty Farm)	None	O	**A**	O
SP19/31/3 (near Bounty Farm)	Diverted	O	**A**	**A**
SP19/34/2, 3 & 4. Bridleway near Trefangor Burial Ground	New link & new underpass on Scheme	O	**B**	O
SP19/36/1 &2 & 3 with SP19/37/1 & 2. (around Pen-ca'rmaenau and Ffynnon)	New links & underpass at Ffynnon	O	**B**	**A**
SP19/38/1 & 2 (Pen-troydin)	Diverted and underpass provided	**A**	**A**	**A**
SP19/1 & SP19/2 & SP 19/3 & SP19/4 (Llanddewi Velfrey, Blaen-pen-troydin and Castell)	Diversions and underpass provided	O	**A**	**A**
SP19/4 & SP19/5 (Bethel and Gwyndy Fach)	Diverted	O	**B**	**A**
SP19/6 (Castell Gwyndy and Pencwmmau)	None	O	**B**	O

PRoW close to the Scheme	Changes to route?	Air Quality	Traffic Noise	Views
SP19/29/1 & 2 & 3 (Bridleway from Stoneyford Farm to Henllan	None	O	**B**	O
SP 19/28/1 & SP19/27/1 (Henllan)	None	O	**B**	O
SP 19/30/1 Ffynnon to Stepin	Underpass provided and new link	O	**B**	**A**
SP19/39/1 (Bridleway south from Stepin)	None	O	**B**	O
SP19/21/1, 21/2, /22/2, & 23/1 (Llanddewi Gaer)	None	O	**B**	O
SP19/20/7 (Llanddewi Church to Llanddewi Velfrey)	None	O	**B**	O
SP19/19 & SP19/18 (Llanddewi Velfrey and Pant Teg)	None	O	**B**	**A**
SP19/17 (south from Bethel)	North link diverted	O	**B**	**B**
SP19/16 (South from Bryncoed)	None	O	**B**	O

20.8 Mitigation and Monitoring

20.8.1 Mitigation is proposed for each environmental topic to reduce or remove the adverse effects of the Scheme. Each environmental topic chapter sets out any mitigation that is proposed. Those topics discussed in this chapter are listed in Table 20.8 with the approach to mitigation described.

Table 20.8 Mitigation approach for environmental topics with cumulative effects

Relevant environmental topic chapter	Approach to mitigation
Chapter 9 Landscape and Visual Effects	*Changes to views* would be addressed by the introduction of measures to integrate the new earthworks and carriageway Scheme with the landscape and to provide a visual screen to adverse views of the carriageway and vehicles. Views are often screened by the landform if the Scheme is in cutting. Planting of trees and shrubs and hedges will provide visual screening where landform does not. Chapter 9 describes mitigation and indicates how effective it will be when the Scheme is first completed and in the Design Year 15 years after completion, when planted screens have grown sufficiently.
Chapter 13 Air Quality	*Dust associated with construction*; is produced by excavation, haulage, processing and storage of soils. Mitigation includes best practice construction measures to avoid producing dust and limiting the opportunity for dust to be raised into the air. Chapter 13 describes these and Chapter 22 describes how mitigation during construction is managed. *Air Quality:* there is no mitigation provided for air quality, although selection of the Preferred Route took account of the implications for air quality with the objective of reducing traffic pollution by moving the A40 away from the main centre of population.
Chapter 14 Noise and Vibration	*Noise* was considered in the selection of the Preferred Route. Increasing the distance between source and receptor is an effective way to reduce the impact of traffic noise. Planners took account of this objective by moving the A40 away from the main centre of population. The assessment demonstrated that the Preferred Route does not increase traffic noise at effected receptors sufficiently to require mitigation.
Chapter 15 All Travellers	*Changes to the PRoWs network* occur where the Scheme crosses an existing route. Mitigation has included closures and diversions to discourage users from crossing the road but guiding them towards one or other of the three proposed underpasses which allow them to cross in greater safety.

Relevant environmental topic chapter	Approach to mitigation
	Some additional routes have been provided to create a series of looped routes for cyclists and pedestrians. *Public transport* will be beneficially affected by the Scheme, and so no mitigation is required. *Driver stress* will be reduced by the Scheme by reducing congestion, delays and local traffic from the A40. No further mitigation is required.

20.8.2 The location and extent of permanent mitigation measures are set out in the Environmental Masterplan (see Appendix 2.5) and are recorded in the Register of Environmental Actions and commitments (REAC) in Appendix 2.3.

20.8.3 Environmental effects from the construction of the Scheme would be mitigated and monitored through the Construction Environmental Management Plan (CEMP). A Pre-CEMP is provided at Volume 3 Appendix 2.2 of this ES.

Monitoring

20.8.4 Operational environmental effects from the Scheme would be mitigated and monitored as set out in this ES, including the Register of Environmental Actions and Commitments (REAC) included in Volume 3 Appendix 2.3. Specific measures for monitoring the Scheme and mitigation is set out in the relevant environmental topic chapter as set out in Table 20.9.

Table 20.9 Chapters where monitoring relevant to cumulative effects is proposed

Topic	**Monitoring requirements**
Chapter 9 Landscape and Visual Effects	Chapter 9 Section 9.9 Sets out how the development of the proposed landscape measures will be monitored to ensure that the objectives of mitigation are achieved in the required timescale.

Topic	Monitoring requirements
Chapter 13 Air Quality	Chapter 13 Section 13.11 Sets out a range of measures to monitor the effectiveness of the contractor's air quality/dust control during construction.
Chapter 14 Noise and Vibration	Chapter 14 Section 14.7 Sets out Welsh Government duty to assess noise levels following the opening up of the scheme to traffic.
Chapter 15 All Travellers	There is no proposal for monitoring of measures proposed for in this topic chapter beyond the routines on highway maintenance.
Chapter 22 Management of Environmental Effects	The chapter is included to set out how the construction works will be controlled and managed to minimise or avoid adverse effects. Roles and responsibilities are set out, the control mechanisms described and the REAC and Environmental Masterplan cross referenced. This chapter includes Section 22.8 which sets out the scope of aftercare and associated monitoring

21 Type (ii) Cumulative Effects of Different Schemes

21.1 DMRB guidance for Type (ii) cumulative effects

21.1.1 Type (ii) effects arise from two or more proposed or reasonably foreseeable developments upon the same receptor/resource.

21.1.2 The DMRB guidance defines 'reasonably foreseeable' to mean other proposed developments that are committed. It states that these should include (but not necessarily be limited to) trunk road and road schemes which have been confirmed (gone through the statutory process) and development projects with valid planning permissions, as granted by the local planning authority, and for which formal EIA is a requirement or for which a non-statutory environmental impact assessment was undertaken.

21.2 Planning Inspectorate Guidance

21.2.1 Planning Inspectorate Advice Note 17 (Planning Inspectorate, 2015) provides a clear and systematic approach to type (ii) cumulative effects assessment. This guidance identifies a wider range of other proposed developments to be considered:

a) Under construction.

e) Permitted applications not yet implemented.

f) Submitted applications not yet determined.

g) Planning applications where a scoping report was submitted.

h) Projects on the planning register where a scoping report was submitted.

i) Sites identified in the relevant LDPs (and emerging LDPs – with appropriate weight being given as they move closer to adoption).

j) Other plans and programmes (as appropriate) which set the framework for future development consent/approval, where such development is reasonably likely to come forward.

21.3 Assessment Method Adopted Approach to Type (ii) Cumulative Effects from Different Schemes

21.3.1 The approach taken for the assessment of type (ii) effects follows the guidance published by the Planning Inspectorate (2015) and centres on screening other proposed developments within the Zone of Influence (ZoI) of the Scheme using a using matrices to clearly present the four-stage approach and findings:

Stage One: Establish the Zone of Influence and Identify Long List of 'Other Developments'

a) Establish the ZoI of the Scheme.

b) Identify a long list of 'other development' and show in a matrix with key information (Table 21.1).

c) Assign to tiers 1, 2 or 3 for the level of certainty in Table 21.1.

d) Consult planning authorities and statutory consultees regarding 'Other Development'.

Table 21.1 Tiers for 'Other Development' for inclusion in CEA

Tier	Description	
1	Under construction but not considered as part of the baseline.	Decreased level of detail likely to be available
	Permitted Applications not yet implemented.	
	Submitted applications but not yet determined.	
2	Planning applications where only a scoping report has not been submitted.	
3	Projects on the planning register where a scoping report has not been submitted.	
	Sites identified in the relevant LDPs with appropriate weight being given to emerging plans.	
	Other plans and programmes which set the framework for future development where development is reasonably likely to come forward.	

21.3.2 Pembrokeshire County Council and Carmarthenshire County Council were requested to provide planning application details including minerals applications for the time period of 2010-2018. The review included a total of 675 planning applications within the 5km ZoL. From

these a long list of 23 developments were identified as relevant to the Scheme.

Stage Two: Identify Shortlist of 'Other Development' for Cumulative Effects Assessment (CEA)

a) Shortlist 'Other Development' by applying inclusion/exclusion criteria to the Stage One list.

k) Consider inclusion/exclusion threshold criteria based on the potential for significant cumulative effects by virtue of overlaps in temporal scope, the scale and nature of the 'other development' or other factors.

Stage Three: Information Gathering

a) Gather information regarding the shortlisted 'other development' to inform the CEA and document in a second matrix.

Stage Four: Assessment

a) Review shortlisted 'other development' to assess whether cumulative effects may arise (see Table 21.1).

b) Identify mitigation in relation to adverse cumulative effects and document the means of delivering the mitigation.

c) Consider the apportionment of effect between the Scheme and the 'other development' e.g. the contribution to the effect demonstrably related to one development or is there an equal contribution from either development. However, the Scheme is a larger scale than all the other developments and therefore, the focus for this chapter was to describe the mitigation that would be put in place for the Scheme itself.

21.4 Assessment of Type (ii) Cumulative Effects from the Scheme and Other Proposed Development

21.4.1 'Other Developments' were identified and are shown on Volume 2 Figure 19.1. These are listed in Tables 20.4 and 20.5.

21.4.2 For the Cumulative Effects Assessment (CEA) of this Scheme, the Temporal Limit[2] is defined by the potential timeframe during which the scheme could affect Other Developments, either from the construction stage or following completion.

[2] Temporal Limit the term used in guidance on CEA to explain the duration of potential influence of a scheme.

21.4.3 The Spatial Limit[3] CEA was based on the same study areas as the individual topic assessments reported in Chapters 6 onwards in this EIA. Volume 2 Figure 19.1, the CEA map shows the overall cumulative effects, using the respective topic assessments overlaid on one map, the CEA. The full extent of this map includes a 5km zone along the length of the proposed Scheme.

21.4.4 Whist the map in Volume 2 Figure 19.1 provided a focus for the CEA, the effects of a limited number of developments were identified on the periphery of the Spatial Limit. This measure was necessary so that additional or new receptors for visual and transport effects for large scale or major developments could be considered at the onset.

21.5 Zones of Influence (ZoI)[4] for land take

21.5.1 The land and buildings will be taken permanently to construct the scheme at the commencement of construction. The consequences of land take are not expected to have any effects that extends beyond the ZoI, as shown in Table 21.2 below. Land take impacts cause a cumulative effect in combination with 'Other Developments' affected by the footprint of the Scheme.

Table 21.2 Zones of Influence (ZoI) for land take effects

Topic	Potential impact	Receptor / resource	Zone of Influence (see Volume 2 Figure 16.2 & 16.2)
Cultural Heritage	Loss and direct physical change	Buried archaeology, designated heritage assets	Land take
Ecology and Nature Conservation	Loss of habitats, loss of ecologically designated land.	Habitats, ecologically designated sites	Land take
Geology and Soils	Geological exposure, loss of seedbank	Solid geology, superficial geology, geological designations and the seedbank	Land take
Materials	Sterilisation of mineral resources	Mineral resource	Land take
Community and Private Assets	Loss of land and properties	Users of land, users of community facilities, landowners	Land take

[3] Spatial Limit is the term used in guidance on CEA to explain the geographical potential influence of a scheme on an area.
[4] Zone of Influence is the term used to describe the extent to which a specific potential impact is considered likely to cause an effect.

21.5.2 The ZoI for construction effects are relevant to the Scheme and to any other developments undergoing construction at the same time. This could lead to cumulative effects arising as a result of construction activities (see Table 19.2). For this reason, the ZoI for 'other developments' remains flexible. As construction takes place over a limited period, the potential impacts from 'other developments' should not be disregarded so that mitigation can be considered.

Relevant town planning projects

21.5.3 Early identification of relevant town planning LDPs and permissions included a review of the LDP maps and indexes; various planning permissions and Local Planning Authority annual monitoring records. Where relevant and information was available, developments which could potentially reach completion stage before the commencement of the Scheme are noted.

21.5.4 Through consultation with the Planning Services of Carmarthenshire and Pembrokeshire County Councils, the initial long list of planning applications focused on those submitted and determined within a five-year period up to the end of December 2017. For the land situated within the boundaries of Pembrokeshire County, a total of just under 660 planning applications required an initial brief review for further refinement as either 'major' developments; EIA developments and/or those with sensitive receptors or unique matters relevant to the Scheme. Those that were limited to the Carmarthenshire County were significantly less in overall total numbers. The review of these first list of planning applications, together with LDP allocations, provided a 'long list' of 23 town planning 'developments' included in Volume 3 Appendix 19.1.

21.5.5 Applying the Planning Inspectorate Advice Note 17 (2015), a further scoping process refined this 'long list' into a 'short list' of 11 sites, the majority of which lie within the administrative boundaries of Pembrokeshire Council. Those projects included on the 'short list' are included in the matrix in Volume 3 Appendix 19.2.

21.5.6 The 2015 Advice Note 17 identifies three tiers as part of the CEA process, from 'Tier 1' the most certain of projects, to the least certain level, Tier 3.

21.5.7 Twelve 'long list' sites were 'scoped out' from the Second Stage, in the given variables:

a) level 3 details only;

l) limited scale of development;

m) works completed, sufficient distance away from the Scheme.

21.5.8 Of the remaining eleven 'short list' projects, five are 'greenfield' sites with 'major' housing levels/numbers approved.

21.5.9 The Development Matrix in Volume 3 Appendices 19.1 shows the 'long list' identified in the area that require assessment.

21.6 Summary of Cumulative Effects from the Scheme and other proposed developments

21.6.1 There are several types of cumulative effects likely to occur during the lifetime of the Scheme, including loss of land to farm businesses; loss of terrestrial habitat for dormice, bats and other protected species. Most potential cumulative impacts would arise as a result of proposed housing developments in the vicinity of the Scheme.

21.6.2 The proposed development would add to urbanisation in some certain Landscape Character Areas but would not result in a significant cumulative effect on landscape. Similarly, for views, the introduction of more development in some areas would not present a noticeable cumulative visual effect, while in other locations, where development represents a more noticeable change, there may be an increase in adverse visual effect on residential receptors, users of PRoWs and roads.

21.6.3 Of the remaining eleven 'short list' projects, five are 'greenfield' sites with housing approved. Undeniably, the CEA identifies changes in the future for both the current environmental baseline and provides additional receptors for the effects of the Scheme. Although unlikely to incur a significant negative impact, it is possible that noise and dust mitigation, discouraging light pollution and diversion routes on local roads are identified as suitable mitigation and included in the Register of Environmental Actions and Commitments (REAC).

21.6.4 Overall, the combined effect of either a limited number or all these future projects concurrently (at construction or completed stage) could

have a limited effect on the Scheme, at construction and post-construction stage.

21.7 Mitigation and Monitoring

21.7.1 Mitigation measures are proposed as part of the Scheme. Construction environmental effects would be mitigated and monitored through the Construction Environmental Management Plan (CEMP). A Pre-CEMP is provided at Volume 3 Appendix 2.2 of this ES.

21.7.2 Operational environmental effects from the Scheme would be mitigated and monitored as set out in this ES, including the REAC set out at Volume 3 Appendix 2.3.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 22: Management of Environmental Effects

A40LVP-RML-EAC-SWI-RP-LE-0005

P04 | S4

12/03/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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22 Management of Environmental Effects

22.1 Introduction

22.1.1 The Environmental Impact Assessment (EIA) carried out for this project, reported in the topic chapters of this Environmental Statement (ES), identified the following matters that need to be addressed in detailed design, construction and aftercare:

a) Potentially significant effects associated with the Scheme;

b) Strategies to avoid, reduce or remedy (mitigate) these adverse environmental effects.

22.1.2 Ensuring that commitments to comply with the law and to provide mitigation are fulfilled during design, construction and operation of this project, is a binding requirement on Welsh Government. A contractor will be appointed who will be responsible for design and construction of the Scheme. Welsh Government will require the contractor to:

c) Conform with relevant legislation;

d) Satisfy national policy and standards;

e) Fulfil project-specific commitments;

f) Provide mitigation as it is set out in the ES and associated documents and appendices;

g) Implement a programme of monitoring to demonstrate that mitigation measures are effective.

Environmental Management

22.1.3 Ensuring compliance with environmental commitments is a process known as Environmental Management which is delivered through the operation of an Environmental Management System (EMS). The EMS is a procedure run by an organisation to ensure that its activities are carried out in a manner that is complaint with legislation and its own environmental policy and commitments.

22.1.4 The requirements of the EMS are applied to a specific construction project through a Construction Environmental Management Plan (CEMP). Of key importance in a CEMP is that there would be specific project objectives and many commitments that apply to that project.

22.1.5 The contractor will be expected to ensure that the project is effectively managed, environmental impacts are minimised. Contractors will have an environmental policy and will be required to maintain an Environmental Management System (EMS) in compliance with ISO 14001 and ISO 14004 is recognised.

22.1.6 The EMS sets out:

a) Commitments to continuous improvement, sustainable construction objectives, prevention of pollution and waste, compliance with legislation and requirements of Statutory Environmental Bodies;
b) The framework for setting and reviewing objectives and targets;
c) A monitoring and review process that audits and reports on compliance;
d) The basis for the future operation and maintenance of the completed Scheme.

22.1.7 For a construction project these matters are set out in a Construction Environmental Management Plan (CEMP).

22.2 The Construction Environmental Management Plan (CEMP)

22.2.1 The Contractor will prepare the CEMP to set out a plan of work which is often brought together into an overall plan for the project that also deals with contractual matters, quality and health and safety. Table 22.1 sets out the stages of development of CEMP. The CEMP would not only address the environmental commitments and mitigation requirements, but also set out plans for procurement, energy use and waste management activities are subject to continual improvement.

22.2.2 Understanding the approach to construction of the Scheme is important when preparing the CEMP. The plans for construction would include a construction programme which describes the sequence of activities required to complete the construction contract. Construction activities have been considered in each of the environmental topic chapters of this ES. For this Scheme the approach to construction is set out in Chapter 2, Section 2.3 of this ES.

22.2.3 The following would be set out in the CEMP:

a) targets and commitments to continual improvement, sustainable construction objectives, prevention of pollution and waste,

compliance with legislation and the requirements of Statutory Environmental Bodies;

b) framework for setting and reviewing objectives and targets;

c) monitoring and review process that audits and reports on compliance;

d) guidance for the future operation and maintenance of the Scheme.

22.2.4 A highly important function of the CEMP is alert the Contractor's site personnel, and those of his sub-Contractors and suppliers, to the following:

a) good practice and statutory guidance;

b) the need to comply with the EMS;

c) the significance of actual or potential environmental impacts;

d) list the mitigation outlined in the ES that the contractor and the maintaining agent are required to implement;

e) the consequences of construction activity;

f) the performance benefits of raised environmental awareness of personnel;

g) personnel roles and responsibilities in meeting the requirements of the EMS including remedial and emergency procedures;

h) the potential consequences of departure from operating procedures;

i) environmental hold points at which construction work shall cease until the ECO agrees that work can proceed.

22.2.5 The following list describes how the components of this written document are used by the Contractor's construction team to be as informative and useful as possible:

a) The main reference document for environmental matters so that continuity of knowledge is maintained between each stage of the project: route selection, preferred route design, detailed design, construction, the maintenance and operation;

b) Identify the key staff structures and responsibilities associated with the delivery of the project and environmental control and communication and training requirements as necessary;

c) Record environmental risks and identify how they will be managed during the construction period;

d) Record how the requirements of environmental legislation, policy, good practice, regulatory authorities, third parties and project objectives are to be met;

e) Record how commitments, mitigation measures and the environmental design are to be implemented and to gather evidence of completion and the date of achievement;

f) Provide a review, monitoring and audit mechanism to determine effectiveness of, and compliance with, environmental control measures and how any necessary corrective action will take place.

Sequence of CEMP development

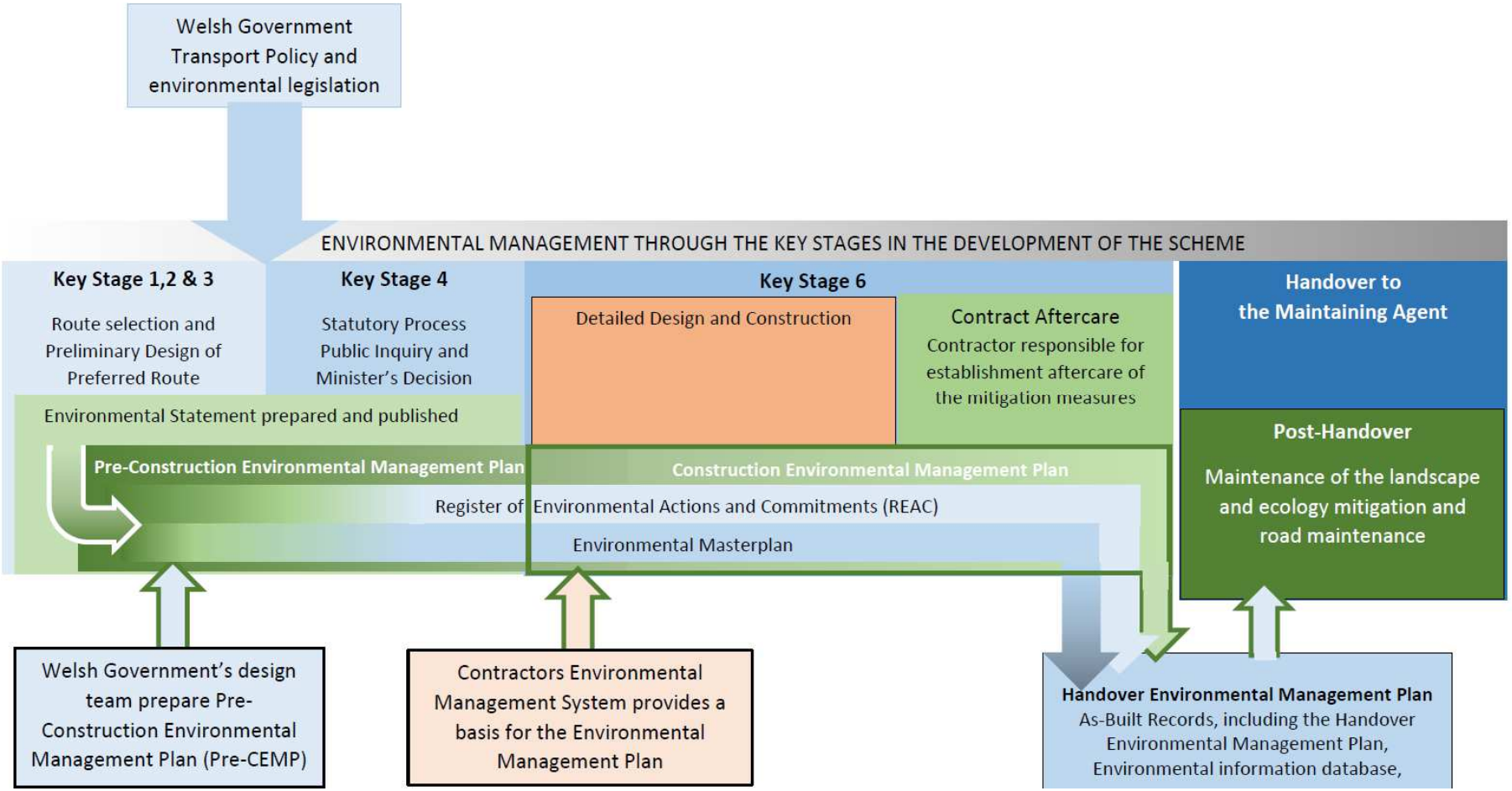
22.2.6 As knowledge about the Scheme continues to grow the CEMP goes through a development sequence which is set out in Table 22.1 and shown diagrammatically in Table 22.2.

Table 22.1 Sequential development of the CEMP

Key Stage of project	Description	Status	Responsibility
Key Stage 0	Shaping of strategy	None	Welsh Government
Key Stage 1	Identification and selection of options		
Key Stage 2			
Key Stage 3	Preliminary design	(Pre-CEMP) Pre-construction environmental management plan (refer to Section 22.3 below)	Designer
Key Stage 4	Statutory procedures and powers		
Key Stage 5	Preparation for construction	(CEMP) Construction environmental management plan and aftercare management plan	Contractor (to be appointed)
Key Stage 5/6	Construction and aftercare		
Key Stage 6	Handover	(AMP) Aftercare Management Plan	
Key Stage 7	Operation and maintenance		Maintaining Agent

22.2.7 A pre-contract working draft of the CEMP (Pre-CEMP) has been compiled for handover to the Contractor. A copy is provided in Volume 3 Appendix 2.2. The Contractor will adopt, refine and expand the Pre-CEMP into a 'live' construction version so that it will contain all current environmental management plans, method statements, permits, relevant licences, certificates, health & safety plans, the register of environmental commitments, quality assurance procedures, and any other relevant documentation the site environmental team require in order to manage the site effectively.

Table 22.2 Showing how the various stages in the development of the CEMP provide continuity of knowledge through the project from the publication of the Environmental Statement through to the post-completion handover of the completed Scheme for operational maintenance.



22.3 Pre-construction CEMP (Pre-CEMP)

22.3.1 A Pre-CEMP has already been prepared as part of this ES to form the framework that the contractor would adopt throughout the construction and aftercare stage. Subsequently the maintenance organisation will make use of the information in operational maintenance of the Scheme.

22.3.2 The Pre-CEMP ensures that the environmental constraints, challenges and risks of construction are identified, assessed, understood, planned for and satisfactorily addressed. A list of the Management Plans which will be provided by the appointed Contractor are listed in Table 22.3. It is anticipated that there will be further management plans and method statements required as the design of the Scheme progresses.

Table 22.3 Annexes within ES Volume 3 Appendix 2.2 Pre-CEMP

Proposed title	Description
A Regulatory Framework	A list of the legal statutory requirements for construction staff working on this Scheme.
B Preliminary List of Permits/Consents	A list of the statutory consents and permits required before construction can proceed. Some items will be subject to seasonal requirements.
C Invasive Species Management Plan	Identifies which invasive species have been identified on site and the procedure for construction works on how to deal with invasive species.
D Outline Pollution Control and Prevention Plan	Identifies the main risks of pollution during construction and the prevention measures which should be implemented to prevent or reduce the effects.
E Outline Site Waste Management	Plan Site Waste Management Plan ("SWMP"), used to plan, implement, monitor and review waste minimisation and management on construction sites. The plan can be based on the Waste and Resources Action Programme's ("WRAP") SWMP template;
F Outline Ground and Surface Water Management Plan	Developed in consultation with Natural Resources Wales (NRW). It describes the design of each element of surface water management system required to manage surface water runoff during construction and potential risks to surface waters. It would include, consideration of temporary storage and settlement requirements to manage waterborne sediment,

Proposed title	Description
	water quality criteria to ensure any discharge to receiving watercourses meets regulatory requirements.
G Outline Materials Management Plan (MMP)	The Scheme's Materials Management Plan ("MMP") would detail how all construction phase materials (material resources and waste) would be managed, developed and implemented by the appointed Contractor and provides a framework which will be used as a basis from which to develop the Scheme's MMP.
H Outline Cultural Heritage Management Plan (CHMP)	Informed by the outcome of the EIA, the CHMP should contains detailed method statements for the Scheme construction (from survey, machine excavation, hand-excavation, environmental sampling etc. to office-based activities such as finds processing, database use, reporting etc.).
I Outline Ecological Management Plan	This outline plan sets out the measures and procedures for reducing impacts on ecological receptors. It outlines the procedures for preconstruction surveys, vegetation clearance, draining of ponds, translocating of hedges or trees, temporary or permanent measures for protected species.

22.3.3 In addition to the management plans listed in Table 22.3, there would be several key documents. These are described in the following sections.

22.4 Register of Environmental Actions and Commitments (REAC)

22.4.1 A draft Register of Environmental Actions and Commitments (REAC) was created and provided in ES Volume 3, Appendix 2.3. This is a record of the specific environmental actions and commitments to be implemented and managed through all stages of the Scheme. The draft REAC lists commitments made within the ES (principally taken from the mitigation sections of each chapter).

22.4.2 The draft REAC is critical to the success of an EMP and subsequently the environmental performance of a Scheme. The REAC would be implemented through the CEMP and the Environmental, Landscape and Ecology, Monitoring, Aftercare and Management Plan.

22.4.3 The draft REAC is provided in table format with each column of the

table containing an element of the information required as detailed below:

Column A & B: Identification and referencing of the environmental aspect in question (*a reference letter and number*);

Column C & D: The primary and secondary environmental topic that is concerned (*e.g. Landscape and Visual & Nature Conservation*);

Column E: Brief description of the environmental action or commitment (*e.g. to plant a screen belt of trees*);

Column F: The objective or desired outcome of the mitigation/action (*e.g. to screen a view of the road*);

Column G to M: The main and secondary source of the commitment and a document reference (*e.g. Environmental Statement/ Chapter X, Section or Table Y, chainage 0.0034*);

Column N & O: Which organisation is responsibility for completion and at what stage of the project (*e.g. Contractor, during construction*);

Column P: Is the commitment to avoid, mitigate, enhance or a combination of these;

Column Q: How is the outcome to be achieved (*the physical work required*);

Column R: Sets out the current state of taking the action or fulfilling the commitment, to indicate the status of the necessary actions. This will be updated as the project progresses

Column S: Is the location for notes on completion to be added and updated until fulfilment;

Column T: A location to provide a cross reference to where evidence is provided of completion of a commitment or action. The evidence could be in meeting minutes, reports, photographs, drawings or site notes.

22.4.4 The details of monitoring, success criteria, reporting requirements and trigger level for remedial works would be clearly defined. where it is deemed necessary that mitigation/action must be monitored to determine success.

22.5 Environment Masterplan

22.5.1 The environmental mitigation measures incorporated within the design of the Scheme are illustrated on the Environmental Masterplan (see drawings in Appendix 2.5 A to F, Volume 3). The masterplan drawings

have been prepared in accordance with DMRB Volume 10. The landscape and environmental design proposals for the proposed new section of highway are described in Chapter 9 Landscape and Visual Effects.

22.5.2 Symbols are used on these plans to represent existing or proposed landscape and environmental features. Each feature is ascribed both an Element and a 'Function' to indicate the physical attributes and the purpose. Sometimes, when appropriate, highway and structural elements are given an environmental function that will guide design and maintenance. Elements and Function are described in Tables 22.4 and 22.5.

Table 22.4 Masterplan Elements

Term used	Definition
Landscape Element	Landscape features found within the highway estate, which can encompass both hard landscape features (i.e. retaining walls, hard surfacing) and elements of the soft estate (i.e. grasslands and woodlands);
Environmental Element	Non-landscape features of the highway estate that have environmental functions, i.e. noise attenuation measures, water quality controls, protected species, and legislated elements such as injurious weeds and pests
Planning Policy Feature	Features pertaining to, or situated in close proximity to, the highway estate that have a specific designation or land use, i.e. Special Area of Conservation (SAC), Scheduled Ancient Monuments (SAM), Snowdonia National Park (SNP) or Listed Building.

22.5.3 In addition to a range of proposed features, the masterplan shows existing features, for example retained vegetation, watercourses and culverts.

Table 22.5 Masterplan Functions

Definition: The intended environmental purpose of features within the highway estate			
Visual Screening	EFA	Heritage	EFF
Landscape Integration	EFB	Auditory amenity	EFG
Enhancing Built Environment	EFC	Water quality	EFH
Nature conservation & biodiversity	EFD	Highway/land boundary	EFJ
Visual amenity	EFE	Access	EFK

22.6 Roles and responsibilities of those implementing the CEMP

22.6.1 For the environmental team to be effective in the implementation of a Welsh Trunk Road project, some key roles require experienced staff who will need to work across organisational boundaries to ensure continuity of knowledge and a cooperative and productive approach.

Contractor's Project Manager and Environmental Manager

22.6.2 The Contractor's Project Manager will be responsible for developing the Construction Environmental Management Plan (CEMP) for the project. The Contractor's Environmental Manager will oversee and audit the internal systems and plans to ensure compliance with the environmental management system.

Environmental Coordinator (ECO)

22.6.3 The ECO will work alongside the Project Manager to ensure that environmental commitments set out in that document are fulfilled. The Environmental Clerk of Works (ECoW), will support the ECO during pre-construction and construction.

22.6.4 The ECO will be an experienced Chartered Member of an appropriate environmental profession. Their role is to ensure that the key environmental documents are properly consideration during the development of the detailed design and during construction. The ECO will oversee the Environmental Compliance Process.

22.6.5 The ECO will identify works that are likely to have a significant environmental impact and advise the Contractor how to avoid the impacts. If necessary, the ECO will identify activities that should only proceed once he/she has agreed that adequate measures are in place for environmental protection. As works progress the ECO will review the Contractor's environmental performance against the commitments, objectives and targets/key performance indicators in the CEMP.

22.6.6 To assist in, this the CEMP will be developed to contain procedures for checking, auditing and corrective action. These procedures will continue through the construction and aftercare period.

Environmental Clerk of Works (ECoW)

22.6.7 The ECoW is also an experienced professional with a competency in environmental management, construction and environmental surveys. The ECoW will assist the ECO by overseeing the implementation of environmental mitigation and compliance with environmental management systems and plans.

22.6.8 Both the ECO and ECoW will work with the Contractor's Environmental Manager to apply the CEMP through the company's Environmental Management System.

22.7 The next stage in the development of the Pre-CEMP

22.7.1 Following the publication of this ES, the public with have the opportunity to scrutinise the Scheme. If required, an independent Inspector will hold a Public Inquiry to allow a detailed examination. It is possible that during this stage (Key Stage 4 shown in Table 22.1) further requirements, or mitigation will be introduced. These will be added to the Pre-CEMP in preparation for the construction contract to commence.

22.7.2 The next stage in the development of the Pre-CEMP would be in early Key Stage 6, when updates from pre-construction surveys and any modifications to the Scheme will be added. The Pre-CEMP would then be made available for the key stakeholders to comment and would be in place before construction on site commences.

22.7.3 During construction, the CEMP would be modified as necessary to take account of changes arising during construction works. These modifications could include changes to the design to reflect site conditions, but also because of:

a) New legislation or standards;
b) Unforeseen site conditions, for example the discovery of ground contamination, a previously unknown protected species, or archaeological discoveries;
c) Failings in the environmental performance of the Contractor that require improved procedures, or changes in the design;

22.7.4 Towards the end of the construction phase, the CEMP would be refined

to provide the essential environmental information needed by the body responsible for the five years of contract aftercare and the future maintenance and operation of the road and the associated land.

22.8 Aftercare, monitoring and management

22.8.1 Proposed mitigation is provided for a purpose and is a commitment made in the ES on behalf of Welsh Government to address a particular environmental impact. For example, tree planting might be proposed to reduce the visual impact of a view of traffic. When they are planted, trees will not be an effective screen and will need to grow over several years to perform their function properly. There are three tasks that the Contractor who builds the Scheme will have to carry out to ensure the proposed mitigation performs the required task:

22.8.2 **Aftercare:** will be carried out by the Contractor for a period of 5 years, as required under the contract. This is known as the aftercare period. During that time, the Contractor will carry out tasks such as grass cutting, weed control, replacement of dead plants, watering, repair of fences, cleaning out ditches, and repair or replacement of bat boxes or other environmental measures. These tasks will be performed to ensure that the seeding and planting survive and successfully establish as new vegetation. At the end of the aftercare period the Contractor will hand over the now established and healthily growing landscape and environmental mitigation to the Welsh Government's maintenance organisation called South Wales Trunk Road Agent (SWTRA).

22.8.3 **Monitoring:** Throughout the aftercare period, and for as long as is necessary to fulfil commitments, the Contractor and then SWTRA will monitor the mitigation measures to:

a) Ensure that it continues to develop properly to meet commitments and functions (e.g. trees should grow as planned);

b) Review if it will achieve the commitment and function in the required time period (e.g. will an area of planting and seeding develop fast enough to satisfy a requirement of a Protected Species Licence);

c) Check for adverse or changing conditions that might compromise the effectiveness of mitigation (e.g. has a drain blocked, or has a utility company or neighbouring landowner damaged a fence or trees);

d) Advise on maintenance interventions that might be required if a failure to meet commitments is identified in a) to c) above.

e) Once the mitigation achieves full effectiveness, monitoring will continue to ensure that it continues to perform its proposed function (see Table 22.5)

f) Monitoring of various kinds ranging from day-to-day observation to sophisticated sampling and analysis is essential to provide information that managers use to make management decisions.

22.8.4 **Management:** once established, the scheme of mitigation will continue to perform its function and satisfy commitments made in the ES until circumstances change. Changing conditions can be predictable or unexpected and they can occur slowly or catastrophically. For example, a hedge will continue to grow but will need trimming regularly to ensure it remains stock proof. In the case of a plantation, it will grow for 15 to 20 years before it will need to be thinned, coppiced or underplanted to ensure it remains an effective visual screen. A fire could destroy a coniferous plantation within hours, while a plant disease could kill only one species in a plantation. Completing both routine annual maintenance guiding long term change and dealing with occasional unexpected incidents is the process of management.

Aftercare monitoring and handover

22.8.5 During the Contractor's aftercare period, regular monitoring visits will be undertaken to monitor the performance of the mitigation. Reports will be prepared for the Project Manager to provide:

a) the results of each visit;

b) the requirements for additional maintenance work; and

c) indications of how the scheme of mitigation is performing against agreed indicators.

22.8.6 An annual report will bring these together at the end of each year of aftercare. At the end of the aftercare period, a Handover Environmental Design Performance Report (HEDPR) will be prepared. The HEDPR will accompany the Handover Environmental Management Plan to assist SWTRA in taking on the long-term maintenance.

22.9 Summary

22.9.1 Environmental Management of the Scheme is a continuous process during design, construction, operation and maintenance which is in line with the requirements of the DMRB and IS0 14001. The Contractor will implement a scheme specific EMS and a CEMP.

22.9.2 As identified within this chapter, there are a number of management plans within the CEMP which will be treated as 'live' documents. These documents will ensure that design and mitigation measures from the EIA will be implemented on-site by the Contractor. The CEMP will identify those responsible for implementing the various management plans. These management plans will compliment and inform one another as well as require regular updates and revisions. Outline versions of these management plans have been prepared at Key Stage 3 and are provided as Annexes to the Pre-CEMP in ES Volume 3 Appendix 2.2.

22.9.3 The objective of the EMS and the CEMP is to mitigate environmental impacts and have a comprehensive management plan in place to reduce any unforeseen environmental impacts.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement Chapter 23: Conclusions

A40LVP-RML-EAC-SWI-RP-LE-0004

P05 | S3

08/07/19

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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23 Conclusions

23.1 Introduction

23.1.1 This Environmental Statement (ES) reports the findings on the Environmental Impact Assessment (EIA) undertaken for the A40 Llanddewi Velfrey to Penblewin Improvements Scheme and was carried out in accordance with current legislation and guidance. It highlighted adverse and beneficial impacts and residual effects associated with the Scheme under several environmental topic headings and described how any adverse effects would be mitigated.

23.1.2 A Non-Technical Summary (NTS) of the Environmental Statement (ES) has been produced and the contents are very similar to these conclusions. This is not regarded as duplication because the NTS is a separately bound document which will be read is isolation from the full ES. However, this Conclusion is intended to draw together the conclusions of the various assessments.

23.1.3 In accordance with the requirements of the Well-Being of Future Generations (Wales) Act 2015, the proposed Scheme includes incorporated elements that contribute further to 'improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals. The Environment Act 2016 requires public authorities to maintain and enhance biodiversity to promote the resilience of biodiversity. These improvements go further than mitigation in addressing these two Acts.

23.1.4 A list of the proposed enhancements is set out in the summary section of this chapter.

23.2 Alternatives considered

23.2.1 Alternatives were considered in previous studies for improvements to the A40 between St Clears and Haverfordwest. This ES covers the proposals to address several recognised problems between Llanddewi Velfrey and Penblewin. These problems include limited overtaking opportunities, poor forward visibility, numerous minor accesses, slow-moving agricultural and heavy good vehicles resulting in 'platooning', poor journey time reliability, driver frustration, risky manoeuvres and

collisions. During the summer, traffic volumes can increase by over 30%.

23.2.2 Due to the amount of traffic passing through Llanddewi Velfrey, pedestrians have difficulty in crossing roads and drivers face conflict with pedestrians and cyclists, particularly along sections where footways are substandard. Severance of the village of Llanddewi Velfrey by traffic, traffic noise and air pollution are of concern to the community.

23.2.3 During public consultations, public support was expressed for a northern bypass for Llanddewi Velfrey and improvements between Ffynnon Wood and Penblewin roundabout. A review in 2015 concluded that there is a good case for proceeding with the A40 Llanddewi Velfrey to Penblewin Improvements.

23.2.4 In February 2017, the Welsh Government appointed Carillion, with Arup and RML (the 'Carillion Team') as their technical and environmental advisors, to develop the design of the proposed A40 Llanddewi Velfrey to Penblewin Improvements up to publication of draft Orders.

23.2.5 Carillion entered liquidation in January 2018. The Welsh Government subsequently appointed Arup, supported by RML, to continue the development of the design up to publication of draft Orders and to support the Welsh Government through the Statutory process.

23.3 Scheme description

23.3.1 The Scheme was designed to meet the project objectives by providing overtaking opportunities with a '2+1' carriageway (two lanes in one direction to allow overtaking, and one lane in the opposite direction). Overtaking opportunities will alternate so that both eastbound and westbound traffic can overtake. These will provide more than 1km extra overtaking opportunities in both directions. The Scheme is described from west to east, starting at Penblewin in the west and proceeding towards Bethel Chapel in the east, using local place names.

23.3.2 At Penblewin Cross a new roundabout would be required to accommodate the Scheme, which would extend eastwards on embankment on a roughly parallel alignment with the existing A40. Trefangor Cottage would be demolished. The existing A40 would

provide local access to properties to the south, while a new local road would be constructed on the north side to carry local traffic to farms, residential properties and fields.

23.3.3 At Henllan Lodge, the Scheme would follow the alignment of the existing A40. The junction with a minor county road on the south side and the Private Means of Access (PMA) and bridleway on the north side would be stopped-up, but both would tie-in to the detrunked A40 road and the proposed new single lane side road, respectively. A new bridleway and cycleway would extend east to a new underpass provided under the A40 close to Ffynnon Chapel. The Scheme would follow the existing road embankment through Ffynnon Wood, although the wider carriageway would require some widening of that embankment. The new carriageway would be further from Ffynnon Chapel, allowing space for a new access road to residential properties and fields, which would tie-in to the existing access to Ffynnon.

23.3.4 Towards the eastern edge of Ffynnon Wood, the Scheme would draw to the north of the existing A40. There would be a staggered junction giving access to the settlement of Ffynnon Wood to the north and the existing A40 to Llanddewi Velfrey, to the south. A PMA for Pen-troydin-fach Farm would be required and a farm underpass to provide access to fields to the south of the road.

23.3.5 Continuing east, the Scheme would traverse the increasingly steep north slope of the Llanddewi Velfrey ridge and would pass to the south of Pen-troydin-fach Farm. Continuing onto embankment, the Scheme would curve to the south around the village. Passing into cutting, the Scheme would cross under a new bridge which would be constructed to carry the Llanfallteg Road.

23.3.6 The landform to the east of Llanfallteg Road becomes more rolling with the ridge slope dissected by small valleys. The Scheme crosses these valleys on an embankment. The small watercourses would be culverted under the embankment and an underpass would be required to carry several diverted public footpaths across the Scheme.

23.3.7 From here, going eastwards, the Scheme would pass into a cutting, to emerge and meet the line of the existing A40 at Bethel Chapel. Close to the chapel would be a four-arm roundabout, with a new PMA provided on the north side to the chapel and several private properties. On the south side, a road link to Llanddewi Velfrey would be provided.

The Scheme and the existing A40 would tie-in at the top of Fron Hill.

23.4 Scheme construction

23.4.1 If the Welsh Ministers confirm the Orders, construction could start in Spring 2020 and the Scheme could open in late 2021. The start of construction could be affected by statutory procedures, weather conditions or unforeseen engineering conditions experienced on site. Following the construction phase, there would be 5-years of landscape aftercare.

23.4.2 Construction working hours would normally be 07.00 to 19.00 hours (Monday to Friday), and 07.00 to 17.00 hours on Saturdays. In certain circumstances, specific works may have to be undertaken outside these hours with some night working required. Temporary traffic management would be necessary where the Scheme meets existing roads.

23.5 Environmental design and mitigation

23.5.1 The strategy for landscape and environmental design has the general objective of integrating the road and structures within the setting, by refining the road alignment, earthworks, footpaths and cycleways, planting and boundary treatments, to reflect the character and quality of the historic fabric of the landscape. This includes retaining existing vegetation, avoiding loss or damage to hedges and hedge-banks, individual trees, woodland, water features, public rights of way and field systems.

23.5.2 Translocation of vegetation and new planting and seeding with local provenance plant material, will assist in repairing or replacing indigenous landscape features affected by the Scheme. Culverts and underpasses would be provided to maintain connectivity across the Scheme for watercourses, native animal species, farm animals and users of public footpaths.

23.5.3 The Scheme is an opportunity to maintain and open routes for pedestrians, cyclists and horse riders. Existing links would be maintained or improved by removing all but local traffic from the existing A40, retaining and diverting public rights of way and by creating new routes.

23.5.4 The Scheme has the potential to cause pollution during both the construction and operational phase. Water pollution measures will include balancing ponds and penstocks to reduce the risk of pollution from the road adversely effecting local hydrology. Noise and visual intrusion from the road and traffic would be minimised by using low-noise surfacing, providing screening, using earthworks, planting and boundary treatments in critical locations.

23.5.5 The ecological mitigation will include measures to minimise the loss of foraging habitat for wildlife, new areas of ecological mitigation, measures to avoid habitat fragmentation and to maintain connectivity across the landscape for protected species and other wildlife.

23.6 Environmental effects

23.6.1 The conclusions of the environmental assessments are set out in the following sections.

Geology and soils

23.6.2 The Scheme is located towards the top of the Llanddewi Velfrey ridge and crosses undulating terrain mainly associated with valleys of streams that flow into the Afon Taf or the Afon Marlais. The underlying bedrock of mudstone has some localises superficial deposits of glacial till. Alluvium deposited by watercourses is also present.

23.6.3 Bedrock could contain water-bearing strata that provides some local water abstraction. The superficial deposits may also support local water abstraction and supply water courses. No hazards relating to past mineral exploration or general ground hazards were identified.

23.6.4 Activities associated with the construction of the embankments, cuttings and structures, and the operation of the Scheme, would have a neutral to slight adverse effect on the underlying geology and geomorphology.

23.6.5 The Scheme would affect discrete areas of made ground, possibly associated with the existing road network, agricultural activities or historical infilled quarries or gravel pits, which could be a potential source of contamination. Potential sources of contamination such as sewage works, burial grounds or other infilled quarries are also present in the study area but are remote from the Scheme. Land contamination

would have a neutral to slight adverse effect on construction works in relation to the identified human and environmental receptors. Applying best practice construction management measures would reduce the risks to the environment. Land contamination would have a neutral impact on the operation of the Scheme and therefore no mitigation measures would be considered necessary during the Scheme operation.

Road drainage and water environment

23.6.6 The water environment surrounding the Scheme includes minor streams in the Marlais, Cleddau and Taf catchments, the underlying groundwater and other water dependant features. The road alignment would generally follow a ridgeline, with two areas of cutting below the existing ground level and five stream crossings. No impacts to flood risk are expected and there are no water-related designated areas near to the Scheme.

23.6.7 Potential construction effects, including surface water or sediment runoff and accidental spillages, would be mitigated by the implementation of industry best practices, which are described in the Pre-Construction Environmental Management Plan (Pre-CEMP). A temporary lowering of groundwater levels to construct a section of road cutting would have a slight adverse impact on the flow of a minor stream.

23.6.8 During operation of the Scheme, slight adverse impacts are anticipated to the flows of four minor streams due to localised changes in groundwater drainage due to the road cuttings. Slight adverse impacts are also expected to the Afon Daulan as a result of a new culvert, and the groundwater beneath the Scheme, due to the infiltration of water from the road drainage. The design of culverts and the road drainage treatment system would mitigate these localised impacts as far as practicable.

23.6.9 Overall, it is anticipated that the impacts on the water environment, as a result of the construction and operation of the Scheme, would not result in any significant adverse effect.

Nature conservation

23.6.10 There are five Special Areas of Conservation (SAC) within 10km of the Scheme (Afonydd Cleddau; Yerbeston Tops; Pembrokeshire Bat Sites

and Bosherton Lakes; Pembrokeshire Marine; and Carmarthen Bays and Estuaries) and a Special Protection Area (SPA) within 30km (Carmarthen Bay). As a result of the proximity of these sites, an Assessment of Implications on European Sites (AIES) was undertaken and a Statement to Inform and Appropriate Assessment (SIAA) prepared.

23.6.11 Surveys identified that several species of bats, dormice, badger were present or used habitat in areas likely to be affected by the Scheme. Otter and barn owl have also previously been identified in the study area. During construction, protected species licences would be required for bats, dormice and badger (obtained from Natural Resources Wales) prior to the commencement of works. Construction period mitigation measures which would reduce the impact to levels that are not significant would include:

a) Sensitive timing of works, including vegetation clearance to avoid disturbance to protected species and birds;
b) Protecting wildlife habitat areas and minimising/avoiding damage to existing vegetation close to the works. Translocation of suitable hedges to receptor sites;
c) Pre-construction bat, dormouse, otter and badger surveys;
d) Restrictions on working hours to minimise task lighting at light, in the vicinity of watercourses and key bat flight lines;
e) Construction pollution and sediment control measures; and
f) An Invasive Species Management Plan to ensure that plant species such as Japanese Knotweed are not spread outside of the working areas.

23.6.12 The following mitigation measures would be incorporated in the Scheme design to reduce the scale of effects after road opening:

a) Planting to maintain bat flight lines, mammal fencing and underpasses (including dedicated dormouse underpass) to encourage mammals to cross the road.
b) Extensive woodland and hedgerow planting throughout the Scheme, including replacement habitat for dormice.
c) A replacement badger sett for the main sett directly affected by the Scheme.
d) Control measures to protect watercourses from road-based pollution;
e) Biodiversity enhancements including the seeding of large areas of wildflowers within seeded grassland within the Scheme.

f) Monitoring of the effectiveness of ecological mitigation.

23.6.13 The impacts during construction on all identified ecological receptors are not considered significant. During operation, the impacts would not be significant.

Landscape and views

23.6.14 The landscape of the area is rural and agricultural with hedged fields interspersed with woodland. The bypass of Llanddewi Velfrey passes along the north slopes of the Llanddewi Velfrey ridge, while the central section of the Scheme passes through Ffynnon Wood. The western section is on a gently undulating low-lying pastureland. The bypass of Llanddewi Velfrey passes through more steeply undulating land and requires cutting and embankments.

23.6.15 The landscape design for the Scheme includes plantations and hedges that will integrate the cuttings, embankments, bridge and carriageway into the landscape setting, while also providing screening or filtering of the views of traffic on the Scheme.

23.6.16 The effects of major earthworks on the landscape, which changes landform and removes existing hedges, woodland and trees and reduces the sense of tranquillity in a rural area, but these effects will mainly be perceived only north of and close to the Llanddewi Velfrey ridge. This would be a large adverse effect during construction and the winter of Year 1, but by Summer of Year 15 the adverse effects on the landscape would be lessened to moderate adverse. The effect of reducing traffic on the existing A40 would be a slight beneficial effect on landscape character areas.

23.6.17 Dwellings and footpaths on the north facing slopes of the Llanddewi Ridge are predicted to experience a range of visual effects from minor adverse to very large adverse at construction and winter of Year 1, without mitigation. With mitigation that includes new grassland on slopes and verges, as well as planting of hedges, woodland and scrub the significance of effect will reduce noticeably.

23.6.18 Dwellings and footpaths to the south of the Scheme would generally experience beneficial visual effects due to reduced traffic on the existing A40 which would improve views.

Archaeology and cultural heritage

23.6.19 Within the 500m wide Scheme study area there are 123 cultural heritage sites. This assessment has identified that the implementation of the Scheme would result in an adverse effect on a number of heritage assets. This results from physical damage to some assets and a limited impact on the visual setting of some assets that are not physically affected.

23.6.20 The Scheme would result in physical damage, a major impact, on 23 non-designated heritage features, including three cottages and a possible leat and 19 other sites identified in the geophysical survey. There would be a moderate impact at two burnt mounds, the site of a cottage near Henllan and the line of the former Turnpike road.

23.6.1 Four assets, where the evidence is unclear at present, will receive some form of impact of an uncertain nature. These include a burnt mound and two possible cottage sites. Aa further cottage site may be protected if landscape designs can be refined in detailed design to avoid the asset.

23.6.2 For seven designated assets, there will be negligible impact on setting. These include 2 listed buildings, two Scheduled Ancient Monuments and three non-designated sites. The Llanddewi Velfrey War Memorial, a listed building, will have an improved, minor setting impact.

Community Assets

23.6.3 The Scheme would pass through predominantly rural agricultural land located within the settlements Llanddewi Velfrey, Narberth, Llanfallteg, Whitland and Clynderwen. In the vicinity are places of worship, shops, play areas, village halls, post offices, schools, hospitals and doctor's surgeries. Tourist attractions in the vicinity of the Scheme include Oakwood Theme Park, Bluestone Resort, The Grange, and Folly Farm.

23.6.4 There would be no loss of, or direct effects on, community facilities or tourist attractions during construction. There would be indirect effects on Ffynnon Chapel and Bethel Chapel as they are located close to the Scheme. These effects would be temporary and mitigated through liaison and planning of construction activity.

23.6.5 The effects from operation would be limited to changes in walking routes and traffic flows on routes that serve local communities and

facilities. Non-motorised access to community facilities would generally be improved due to a reduction of traffic using the existing A40, improving access between the North and South of Llanddewi Velfrey.

23.6.6 There would be no loss of community facilities or tourist attractions as a result of the Scheme. Access to doctor's surgeries, hospitals, primary schools, secondary schools, shops, aged people's homes, parks, play areas or visitor attractions would not be directly affected by construction. Access to these local facilities would be via the existing road network, which would be kept open during the construction and operation. The Scheme would improve accessibility to some facilities by improving the flow of traffic along the A40.

Agricultural assessment

23.6.7 The Scheme will involve the permanent loss of approximately 27.4 hectares of agricultural land. None of this is shown to be of the best and most versatile agricultural quality. This is an impact of slight magnitude on a resource of high significance, leading to an overall impact of minor adverse significance.

23.6.8 There are seven farms affected. All will experience significant changes in day-to-day operations, but the viability and continued functioning of the holdings is not threatened. Accordingly, in all cases the effect is of moderate adverse quantum on an interest of medium sensitivity, leading to a minor adverse significance.

Air quality

23.6.9 A baseline assessment of current air quality conditions in the vicinity of the Scheme and an assessment of the likely air quality impacts associated with the construction and operation of the Scheme have shown that existing pollutant concentrations in the study area are low and meet air quality objectives. There are no areas where air quality is poor. With appropriate mitigation during construction there is likely to be no significant effect from the dust-generating activities on site.

23.6.10 Potential impacts during the operational phase of the Scheme were assessed to be not significant as modelled pollutant concentrations are well below the air quality objectives. However, many receptors would experience a beneficial impact as a result of the Scheme.

Noise and vibration

23.6.11 Noise surveys in the study area were undertaken to establish a baseline for the assessment of noise from the Scheme. The predictions of noise effects include the impacts of moving traffic from the existing A40 to the Scheme.

23.6.12 Construction noise levels during the proposed works were assessed as not significant. There are predicted to be significant permanent direct beneficial effects for the community of Llanddewi Velfrey as a result of the Scheme in the short and long term. There would be increases in noise for some properties near the proposed bypass, although these were not assessed to be significant adverse effects.

23.6.13 Construction vibration levels during the proposed works were assessed as not significant. This is providing either the distance at which vibratory rollers operate is limited and/or construction vibration monitoring is undertaken along with a further assessment of the risk of impact.

23.6.14 No ground borne vibration impacts are forecast during operation because, in accordance with highway construction standards, the surface of the proposed upgraded roads would be smooth with no surface irregularities of enough size to generate significant levels of ground-borne vibration.

All travellers

23.6.15 The Scheme would affect several public rights of way (PRoWs), predominantly used for informal recreation by pedestrians. Some of these PRoWs would be stopped-up on a temporary basis during construction, or permanently, with diversions provided to maintain connectivity. Taking account of these mitigation measures, no significant adverse effects on PROWs or other routes are predicted.

23.6.16 During construction, the existing A40, and most local roads crossing the Scheme or linking to it, would remain open except for some overnight or weekend closures. During construction, some trips would take longer or would be less attractive and some travellers might be discouraged. After construction, some PRoWs would be reinstated along their original alignment or their permanently diverted route.

23.6.17 One new public bridleway and two new public footpaths would be created as part of the Scheme.

23.6.18 A bus service is the only public transport that currently operates in the vicinity of the Scheme, with bus stops located on the existing A40 in the village. Buses would leave the Scheme at the proposed junctions and travel through the village using the proposed junctions. Bus services would be able to function as they do presently and there would be no effects arising from the Scheme.

Materials

23.6.19 A total of around 370 thousand cubic metres of topsoil, superficial deposits and rock would be excavated during construction, all of which would be reused within the Scheme boundaries where suitable for reuse without causing unacceptable impacts on the end users and the environment. The reuse of site won excavated material would minimise the amount of raw material that would otherwise be imported to site and minimise the requirement for offsite disposal at a waste facility thus minimising traffic on public roads.

23.6.20 Construction would require the import of around 50 thousand cubic metres of stone and road surfacing materials. Where possible, these would be from local suppliers.

23.6.21 During operation, there would not be a significant requirement for the importation or disposal of materials other than those required for routine maintenance operations, such as resurfacing materials. The effects on materials during operation would not be significant. Overall, it is anticipated that the potential impacts on the material resources as a result of the construction and operation of the Scheme would not result in any significant adverse effect on the material resources.

Population and human health

23.6.22 The Scheme has the potential to influence the health of communities as a result of changes to determinants of health. These are environmental, social and economic factors which influence health and wellbeing. A health impact assessment (HIA) was undertaken to meet the requirements of the EIA Regulations (2017) and also the Well-being of Future Generations Act (2015) and the Equalities Act 2010.

23.6.23 The Scheme is in a rural area with low population density, and lower than average rates of ethnic and religious diversity. Pembrokeshire has an older population than the Welsh average, with higher proportions of residents in groups aged 50 and over, and smaller proportions of residents in younger age groups. This is reflected in a higher than average proportion of residents who are retired. Unemployment is low, and the workforce is relatively highly skilled, particularly in the local study area where the proportion of working-age residents with a degree-level qualification is above the national average. The largest sector for employment is public administration, education and health, and the agriculture and tourism sectors. These provide a higher proportion of employment than the Welsh average. Deprivation in the local study area is low. Across Pembrokeshire, there are pockets of higher deprivation in urban areas including Pembroke, Pembroke Dock, Milford Haven and Haverfordwest.

23.6.24 Health deprivation is also low across the study area, with some pockets of higher deprivation. Life expectancy is above the average for Wales, and mortality rates – including from cancer, respiratory and cardiovascular diseases – are lower than average. There are higher than average levels of alcohol consumption and smoking, but lower than average mortality rates attributable to alcohol and tobacco. The proportion of adults who are overweight or obese is slightly higher than average, although a higher than average proportion of adults meet the recommended level of physical activity. Crime is generally low, except for antisocial behaviour and drugs offences where there are higher rates than the figures for England and Wales.

23.6.25 The HIA did not identify any significant adverse health impacts arising from the Scheme during either the construction or operation phases. However, minor beneficial health outcomes were identified due to a reduction in residential noise and air pollutant exposure. Construction-stage employment, investment and training, and operational-phase improvements to the accessibility of services and reduced journey costs are predicted to have socio-economic health and well-being benefits. The impacts on physical fitness and permeability are on balance likely to be neutral.

23.6.26 No specific disproportionate impact on individuals or groups based on their gender, race, ethnicity, religion, sexual orientation or sexual preference were identified.

Climate Change

23.6.27 The Scheme has the potential to influence the climate and so an assessment of climate change was completed, to consider three aspects, namely, greenhouses gases, climate change resilience and in-combination climate impacts.

23.6.28 A greenhouse gas (GHG) assessment quantifies the potential GHG emissions associated with the construction and operation of the proposed development and identifies mitigation measures to reduce these emissions.

23.6.29 A climate change resilience (CCR) assessment evaluates the effectiveness and feasibility of adaptation measures integrated into the proposed development to avoid or reduce hazards and / or increase resilience of the proposed development to climate change impacts.

23.6.30 An in-combination climate change impact (ICCI) assessment evaluates the combined effect of the proposed development and potential climate change impacts on the receiving environment during construction and operation.

23.6.31 The GHG assessment identified that over the whole life of the scheme there would be an increase in emissions associated with the scheme, with the majority (97.6%) due to vehicles using the road during operation. The increase in user emissions is due to an increase in average speeds and a slight increase in distance travelled due to the alignment of the roads. There are also emissions associated with the construction and operation of the scheme. Over the 60-year appraisal period, the total emissions from the construction, operation and use of the road are expected to increase by 8.4% compared to the Do Minimum scenario.

23.6.32 The CCR and ICCI assessments did not identify any significant risks associated with climate change. Potential risks associated with flooding are addressed by mitigation measures in design.

Cumulative effects

23.6.33 Cumulative effects are those impacting on receptors but arising from multiple sources. These could be from the same Scheme (Type i); for example, noise and visual impact from traffic on the Scheme.

Alternatively, there could be cumulative effects arising from two or separate developments, for example the Scheme and a nearby housing development (Type ii). The assessment has shown that a number of potential beneficial and detrimental cumulative impacts would arise during the construction and lifetime of the Scheme.

23.6.34 The assessment has shown that for Type (i) effects, those people living near the existing A40 trunk road or using public rights of way in the vicinity would see beneficial changes in relation to noise, air quality and visual change, while others living or using PRoWs close to the Scheme, could see adverse changes. Overall, whilst several properties and users of Public-Rights-of-Way close to the new bypass would see a cumulative adverse impact from noise and views of the road and traffic, the overall cumulative impact of this scheme is a significant beneficial effect.

23.6.35 Type (ii) effects, the Scheme with other proposed developments, could potentially result in increased urbanisation of the rural setting. A review of planning applications and permissions for 'other development' has shown that there are only a small number that could cause Type (ii) cumulative impacts. Of these, a small number could result in cumulative traffic, air quality and noise impacts, if construction on more than one coincides. The impacts would be minor with a low risk of coincidence.

23.7 Summary

23.7.1 The Scheme would provide an improved carriageway designed and built to current standards with good overtaking opportunities. Side roads and cycleways will provide local access to residential properties, farms and fields with safer and more attractive routes for cyclists, walkers and horse riders.

23.7.2 The amount of traffic passing through the Llanddewi Velfrey would be substantially reduced making crossing the road and walking around the village safer.

23.7.3 The environmental assessments, reported previously, have determined that there would be some beneficial and adverse impacts on the local environment as a result of the Scheme. Where adverse impacts were identified, these were mitigated where feasible, as part of the design. The mitigation measures were developed in collaboration with the

Statutory Environmental Bodies, landowners and other key stakeholders.

23.7.4 The Scheme was designed following the principles of sustainability and would reuse excavated materials within the Scheme. To minimise pollution risks during construction and after road opening, measures to protect watercourses, including four balancing ponds, were included in the Scheme.

23.7.5 Mitigation measures were designed to reflect the landscape character of the area, to provide some visual screening, ecological mitigation and enhancement. The ES has also considered the effects of the Scheme in combination with other proposed developments in the area and has concluded that there would be no significant cumulative effects.

23.8 Enhancements

23.8.1 Table 23.1 is provided to demonstrate the character of enhancements and to allow them to be differentiated from mitigation. The assumption is that all areas of landscape mitigation are required for screening or integration and so the table includes these areas only as habitat.

Table 23.1 Schedule of proposed enhancements

Proposal	Form	
Enhancement of the routes for non-motorised users	Local access road from Penblewin roundabout to Brominau	1000m
	Detrunking of existing A40 to provide local access road from the Penblewin Service Area to The Lodge	800m
	New route from Brominau to Ffynnon Chapel	270m
	New route from The Lodge to the detrunked A40 link to Llanddewi Velfrey (figure does not include existing footpath).	780m
	Detrunking of A40 through Llanddewi Velfrey to provide safer route.	1,500m
	New pedestrian and equestrian underpass in Ffynnon Wood to provide safer connection with Llanddewi Velfrey.	
	Total length of new or improved route:	4,350m
Biodiversity and habitat enhancements	An additional area of native woodland and scrub habitat*	5.03 hectares
	Additional species rich grassland*	3.75 hectares
	Additional standing water*	200m^2
	Additional watercourses and ditches	3.9km
	Rock and scree habitat*	3.9 hectares
	Boundary features: hedges, and Pembrokeshire hedge-banks*	4km
	*These are referred to in Chapter 8. Items with an asterisk * are Biodiversity Action Plan Habitats in the Trunk Roads Biodiversity Action Plan.*	