PARSONS BRINCKERHOFF

February 2016

FIVE MILE LANE IMPROVEMENTS ENVIRONMENTAL STATEMENT

Vale of Glamorgan Council

3512646D-HHC

Final

Five Mile Lane Improvements Environmental Statement

3512646D-HHC

Prepared for
Vale of Glamorgan Council
Civic Offices
Holton Road
Barry
CF63 4RU

Prepared by
Parsons Brinckerhoff
1 Capital Quarter
Tyndall Street
Cardiff
CF10 4BZ

www.wsp-pb.co.uk

Report Title	**:**	**Five Mile Lane Improvements Environmental Statement**
Report Status	**:**	**Final**
Job No	**:**	**3512646D-HHC**
Date	**:**	**February 2016**

DOCUMENT HISTORY AND STATUS

Document control			
Prepared by	James McDonough & Various Authors	**Checked by** *(technical)*	Marc Thomas
Approved by	James Evans	**Checked by** *(quality assurance)*	Marc Thomas
Revision details			

CONTENTS

VOLUME 1

VOLUME 2

Figures

Appendices

LIST OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekday Traffic
ACEC	Aggressive Chemical Environment Class
ADMS	Atmospheric Dispersion Modelling System
AIES	Assessment of Implications on European Sites
ALC	Agricultural Land Classification
AOD	Above Ordnance Datum
AQMA	Air Quality Management Area
ASNW	Ancient Semi-Natural Woodlands
ASPT	Average Score Per Taxon
AURN	Automatic Urban and Rural Network
AWSU	Ancient Woodland Site of Unknown Category
BAP	Biodiversity Action Plan
BCT	Bat Conservation Trust
BFI	Base Flow Index
BGS	British Geological Survey
BMV	Best and Most Versatile
BMWP	Biological Monitoring Working Party
BPM	Best Practicable Means
CadnaA	Computer Aided Noise Abatement
CEMP	Construction Environmental Management Plan
CLR	Contaminated Land Report
CRoW	Countryside Rights of Way
CRTN	Calculation of Road Traffic Noise
CSM	Conceptual Site Model
DCMS	Department of Culture, Media and Sport
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
DWS	Drinking Water Standard
EA	Environment Agency
EfT	Emissions Factors Toolkit
EHO	Environmental Health Officer
EIA	Environmental Impact Assessment
ES	Environmental Statement

ELD	Environmental Liability Directive
EPA	Environmental Protection Act
EPUK	Environmental Protection UK
EQS	Environmental Quality Standard
ES	Environmental Statement
FCA	Flood Consequence Assessment
GAC	Generic Assessment Criteria
GGAT	Glamorgan-Gwent Archaeological Trust
GIR	Ground Investigation Report
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GQRA	Generic Level Quantitative Risk Assessment
GSV	Gas Screening Values
HAWRAT	Highways Agency Water Risk Assessment Tool
HDV	Heavy Duty Vehicle
HGV	Heavy Goods Vehicle
HRA	Habitats Regulations Assessment
IAN	Interim Advice Note
IAQM	Institute for Air Quality Management
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
IfA	Institute for Archaeologists
IROPI	Imperative Reasons of Overriding Public Interest
IUCN	International Union for Conservation of Nature
LAQM	Local Air Quality Management
LBAP	Local Biodiversity Action Plan
LCA	Landscape Character Area
LDP	Local Development Plan
LFRMS	Local Flood Risk Management Strategy
LI	Landscape Institute
LLFA	Lead Local Flood Authority
LNR	Local Nature Reserve
LOD	Laboratory Limit of Detection
LPA	Local Planning Authority
LTP	Local Transport Plan
MAFF	Ministry for Agriculture, Fisheries and Food

MoRPHE	Management of Research Projects in the Historic Environment
MT	Motorised Travellers
NERC	Natural Environment and Rural Communities
NIR	Noise Insulation Regulations
NMU	Non-Motorised Users
NNR	National Nature Reserves
NRW	Natural Resources Wales
NTP	National Transport Plan
NTS	Non-Technical Summary
NVC	National Vegetation Classification
OS	Ordnance Survey
PAWS	Plantation on Ancient Woodland Sites
PFRA	Preliminary Flood Risk Assessment
PIC	Personal Injury Collisions
PPE	Personal Protective Equipment
PPG	Pollution Prevention Guidelines
PPV	Peak Particle Velocity
PPW	Planning Policy Wales
PRA	Preliminary Risk Assessment
PRoW	Public Right of Way
RAWS	Restored Ancient Woodland Sites
RoWIP	Rights of Way Improvement Plan
RSPB	Royal Society for the Protection of Birds
SAAR	Standard Annual Average Rainfall
SAB	Systems Approving Body
SAC	Special Areas of Conservation
SEA	Strategic Environmental Assessment
SEWBReC	South East Wales Biodiversity Records
SEWTA	South East Wales Transport Alliance
SINC	Sites of Importance for Nature Conservation
SLA	Special Landscape Area
SOA	Strategic Opportunity Area
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest

SWMP	Site Waste Management Plan
TA	Technical Advice
TA	Transport Assessment
TAN	Technical Advice Note
TOC	Total Organic Carbon
TPO	Tree Preservation Order
UDP	Unitary Development Plan
UKBAP	United Kingdom Biodiversity Action Plan
UKCP	UK Climate Projections
UKIC	United Kingdom Institute for Conservation
VoG	Vale of Glamorgan
VoGC	Vale of Glamorgan Council
WAC	Waste Acceptance Criteria
WaFD	Waste Framework Directive
WCA	Wildlife and Countryside Act
WFD	Water Framework Directive
WG	Welsh Government
WIIP	Wales Infrastructure Investment Plan
WPZ	Water Protection Zone
WRAP	Waste and Resources Action Programme
WSP	Wales Spatial Plan
ZVI	Zone of Visual Influence

NON-TECHNICAL SUMMARY

PARSONS BRINCKERHOFF

February 2016

FIVE MILE LANE IMPROVEMENTS: ENVIRONMENTAL STATEMENT NON-TECHNICAL SUMMARY

Vale of Glamorgan Council

1. Introduction

This document is a Non-Technical Summary (NTS) of the information provided in the Environmental Statement (ES) for the proposed Five Mile Lane Improvement Scheme (the Scheme). The full ES is available as a separate report.

The Scheme

The existing A4226 (Five Mile Lane) is a single carriageway road, in a rural location that currently fails to meet appropriate highway standards. In order to improve safety along the road and meet the aim of creating a strategic route to the St Athan and Cardiff Airport Enterprise Zones, there is a need to undertake a number of improvements to upgrade the road so it meets modern highway standards.

The Scheme involves a combination of online improvements to Five Mile Lane and construction of a new road alignment that bypasses the more winding central section of the existing road. The Scheme will make use of the existing and already upgraded highway immediately off the A48 at Sycamore Cross and then go offline at a point about 1.5km south, following a southerly course for about 4km, before re-joining the existing road just north of the River Waycock Bridge, about 1.1km north of the Waycock Cross. Minor intersection upgrade works will also be undertaken at the junction of the A48 and Five Mile Lane at Sycamore Cross.

The Environmental Statement

The ES (including this NTS) is one of the documents accompanying a planning application made by the Vale of Glamorgan Council (referred to as the applicant) under the Town and Country Planning Act 1990.

As part of the planning application for the Scheme, the applicant is required to undertake an Environmental Impact Assessment (EIA). EIA is the process whereby environmental information is collected and the potential significant environmental effects that are likely to arise from a development are identified and assessed. The findings of the EIA for the Scheme are contained in the ES.

The ES describes the environmental effects of the construction and operation of the Scheme and identifies adverse and beneficial impacts, together with measures (termed 'mitigation') that are proposed to avoid, reduce or offset any significant environmental effects.

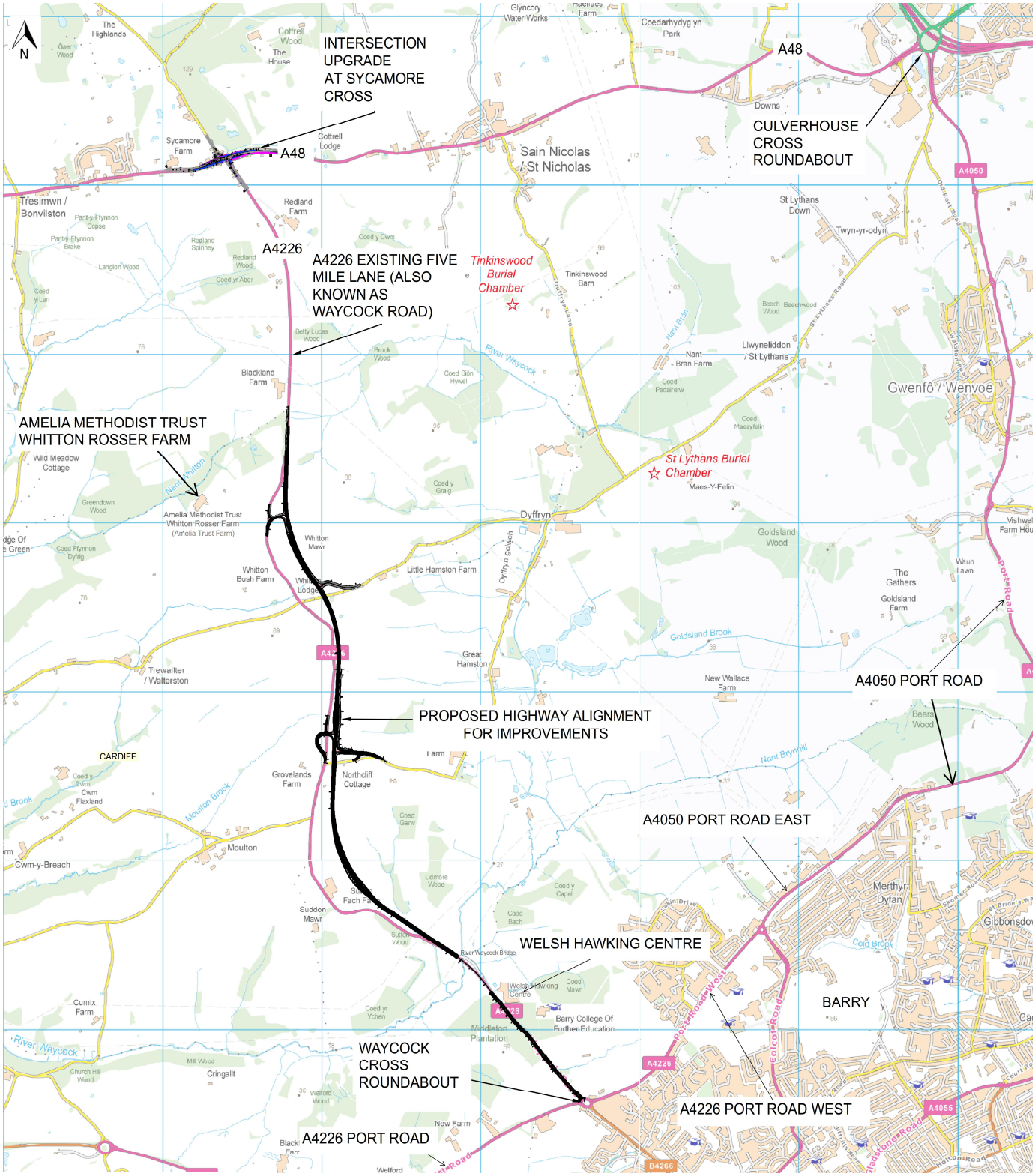
This NTS summarises in non-technical language the main points of the ES and its findings for each of the environmental topics covered. More specifically, this NTS:

- Sets out the need for the Scheme, its principal objectives and benefits;
- Provides an overview of the alternatives that were considered;
- Provides a description of the Scheme and the proposed route;
- Provides an overview of the significant environmental effects that have been identified in the technical sections of the ES; and
- Provides a summary of the proposed mitigation measures to reduce or remedy any significant environmental effects.

2. Project Background and Alternatives

Background

The Local Transport Plan outlines the strategy to support the economic growth and social inclusion



Location of the Scheme

within the county by providing an efficient transport network and improved accessibility to services.

The Scheme aims to improve access and journey time reliability to the St Athan and Cardiff Airport Enterprise Zones and reduce congestion along the A4050 Port Road, A4050 Port Road East and the A4226 Port Road West between Culverhouse Cross and Waycock Cross Roundabout. The proposal also includes provisions to improve access and safety for Non-motorised Users (NMUs) in the form of a combined footway and cycleway comprised of sections of new

path and upgrades to the old road alignment. A more detailed description of these improvement works is provided in Section 3.4 of the ES.

The works will be undertaken by the Vale of Glamorgan Council, with Welsh Government funding. Both organisations are committed to improving access to the St Athan and Cardiff Airport Enterprise Zones in order to encourage economic development and inward investment.

The main benefits of the works can be described as follows:

- Improved strategic access for Heavy Goods Vehicles (HGVs) and development traffic to the St Athan and Cardiff Airport Enterprise Zones;
- Improved safety for cyclists and pedestrians through creation of a safer environment on the new road and a reduction of vehicles travelling on the bypassed road (which will have a lower speed restriction);
- Improved access for regional and local businesses by providing better access to the M4 and distant markets and more reliable journey times for customers and freight;
- Improved reliability and safety for private road users through the straightening and widening of Five Mile Lane;
- Greater resilience on the network by providing a more appropriate alternative route to the Port Road Link;
- Improved safety for highway maintenance activities;
- Improved perceptions of safety of this link for motorised and non-motorised users; and
- Local economic benefits realised through construction of the scheme.

Alternatives

A previous WelTAG Stage One Assessment undertaken in March 2012 identified five similar route alternatives which were considered for the Scheme, termed the Red, Green, Purple, Blue and Orange routes. Each option was reviewed with consideration of its environmental, social and economic impacts and benefits, which has been summarised below:

- Blue Route – Impacts on noise, air quality and social aspects would be beneficial or moderate beneficial. Impacts on heritage would be moderate adverse due to effects around Whitton Lodge. Impacts on the Transport Planning Objectives and vehicle travellers would be moderate beneficial;
- Purple Route – Similar to the Blue Route but with a moderate beneficial effect on air quality only;
- Red Route – Similar to Purple Route but with no moderate beneficial effects;
- Orange Route – Similar to Blue Route but with a significant beneficial effect on noise and vibration and a neutral effect on air quality; and
- Green Route – Similar to Red Route, but with a significant adverse impact on the water environment.

The initial assessment recommended that the 'Orange Route' and 'Purple Route' be progressed further towards detailed design. These two routes were developed further into a single option (supported by traffic data) that made best use of the existing Five Mile Lane and took the route offline along the more constrained sections between Blackland and Grovelands Farms and at Sutton Fach Farm.

The assessment concluded that a combination of the 'Orange Route' and 'Purple Route' was the best option overall, albeit with a few minor amendments incorporated as a result of subsequent consultations with highway authorities.

Preferred Option

The proposed alignment will go offline at a point about 1.5km from the Sycamore Cross signalised junction and follow a southerly course running parallel with the existing Five Mile Lane, before re-joining the existing Five Mile Lane about 1.1km north of Waycock Cross.

3. Project Description

The proposal includes making use of the existing and already upgraded highway immediately off the A48 at Sycamore Cross. The proposal also includes provisions to improve access and safety for non-motorised users in the form of an accommodation overbridge and a combined footway and cycleway comprised of sections of new path along the existing road alignment. These improvements are detailed further in the following subsections.

Highway improvements

The route will run from the north of The Amelia Methodist Trust Farm in the north, to Waycock Cross roundabout in the south. It will be 4,850m in length, but 300m of this, just north of the Hawking Centre, will be existing road that will remain unchanged. The proposed alignment will go offline at a point about 1.5km from the Sycamore Cross junction and follow a southerly course running generally parallel with the existing Five Mile Lane. The proposed alignment will re-join Five Mile Lane just north of the existing River Waycock Bridge. There will also be the need to undertake works to improve the drainage for the existing carriageway south of the point where the new alignment re-joins Five Mile Lane.

The proposed alignment will be constructed on a combination of earthworks and 'in cutting'. The route will be a 7.3m wide single carriageway with 1m hardstrips, making the total carriageway 9.3m wide except for the carriageway section approaching Waycock Cross junction, which will be 7.3m wide due to the absence of hardstrips. A 2.5m wide verge would be located on west side of the on-line road widening for a proposed cycleway / footpath. The route will include three junctions; one staggered junction and two T-junctions located about 2km, 3km and 3.5km northward from Waycock Cross respectively. Vehicles will be able to turn in both directions when leaving the junctions. The southbound approach to Waycock Cross will also be widened to two lanes, being about 60m in length.

The Scheme will allow a 60mph speed limit to be maintained from Sycamore Cross down to the Hawking Centre, upon which it will revert to 40mph for south-bound traffic, and then 30mph on the approach to Waycock Cross.

In order to facilitate access to the farms and properties to the east of the Scheme and to provide a safe crossing for equestrian users, an overbridge will be constructed to the north of Sutton Fach Farm, about 1.9km northward along the alignment from Waycock Cross. Access to plots to the west of the existing Five Mile Lane will be maintained by retaining the existing Five Mile Lane alignment as a side road for access and connective purposes.

The existing road will remain open after the Scheme is completed to provide local access to the various farms along its length and as a safer route option for non-motorised users. The only vehicular access to and from this road will be from the three proposed junctions linking to the new road. All other footpaths and street lighting along the existing Five Mile Lane will remain unchanged.

Minor improvements will also be made to the existing junction between the A48 and Five Mile Lane at Sycamore Cross. These works will be undertaken within the existing highway corridor and will consist of carriageway widening, shifting the existing east-bound bus lane to the north to provide two east-bound lanes through the junction and provision of a dedicated lane for turning left onto Five Mile Lane. The aim of this element of the works is to provide capacity increases for the turning movements at the junction, therefore enabling the benefit of any improvements along Five Mile Lane to be maximised.

Accommodation Works

The Scheme will also include construction of an integral single span steel composite accommodation

bridge carrying a farm access road over the proposed route. It will be located immediately north east of Sutton Fach Farm, spanning the proposed road to provide the farm with access to local fields. The bridge will consist of twin steel girders braced together and made composite with a concrete deck slab. The bridge deck will be comprised of a 3.5m carriageway with a 0.5m verge on either side. The bridge abutments will be covered with a local stone façade to ensure the structure is in keeping with the rural environment.

Improvements for Non-motorised Users

As part of the Scheme, a cycle path will be included alongside the road alignment north of Waycock Cross and north of the proposed tie-in location to the old carriageway. At its northern end, the proposed new road verge on the west side will be surfaced to provide an unsegregated footway/cycleway link between the existing Five Mile Lane and a proposed cycleway route, which will utilise the existing roadside verge between the Sycamore cross junction and the new cycleway. To the south, a new length of unsegregated footway/cycleway will be provided running adjacent to the west side of the on-line road widening, to link the existing Five Mile Lane to the Waycock Cross roundabout. The intention is to utilise the existing road for pedestrian and cycle access as traffic flows will be significantly reduced. A safety review will be undertaken to identify any works considered necessary to enable safe pedestrian and cycle access.. These will likely include appropriate signage to indicate access for both pedestrians and cyclists.

A new bridleway, that can be used by equestrians and pedestrians, will provide a link across the new road linking the existing Five Mile Lane to the new overbridge.

As the old road will be secondary to the new main road, the number of vehicles will significantly reduce with only local traffic (i.e. to the farms) using the road. Therefore, this will provide much safer and more comfortable conditions for cyclists and pedestrians.

Drainage

The Scheme will include drainage improvement works, which will require a series of attenuation ponds on land adjacent to the new alignment. Existing ditches located either side of the length of road subject to an on-line improvement will also require realignment. These will be utilised to drain the improved highway.

Land take

The Scheme will be subject to land acquisition through Compulsory Purchase. The land required is predominantly agricultural in nature. At the northern end of the Scheme, woodland will be required to widen the existing carriageway and provide a new adjacent cycleway / footway. Land is also required from.the Welsh Hawking Centre, Barry College of Further Education and Northcliffe Cottage.

The land is required to accommodate the new highway, together with side road connections and associated drainage. Land will also be required for the new cycleway and bridleway / footway and for replacement woodland planting, environmental mitigation and landscaping, provision of hedgerows, watercourse realignments, private means of access and areas subject to archaeological investigation.

Consultation with the landowners will continue in respect of land acquisition requirements prior to and during construction of the Scheme.

Landscape and Biodiversity Design

A key component of the Scheme will be its landscape and biodiversity design. Landscape mitigation elements will include planting, including broadleaf woodland, native mixed-species hedgerows, individual trees, species-rich and amenity grassland and earthworks.

Where the proposed road will connect with the existing Five Mile Lane, careful consideration of the structures and finishes will ensure that they become integrated into the landscape.

Existing trees, woodland and hedgerows will be retained wherever possible to help mitigate any adverse landscape, visual amenity and ecological impacts. New hedgerows and individual trees will be planted along the edges of the Scheme boundaries to replace any lost to the Scheme and to provide landscape integration, connectivity and visual screening.

Land adjacent to the Scheme will be planted with locally present native woodland species to mitigate for the loss of habitat and provide screening and landscape integration.

Construction

Construction of the Scheme is expected to commence in January 2017 and be completed by January 2018. Phasing of the works will be developed with the Contractor, who will aim to maintain traffic on the existing highway whilst the majority of the works are constructed off-line. However, temporary traffic management measures will be necessary to undertake the works at the tie-ins and during the on-line improvements.

Where possible, works will be undertaken to ensure vegetation clearance is undertaken outside the bird nesting season. Habitat will also be managed to aid in the relocation of reptiles from the site in advance of any main construction works. A scheme of archaeological investigative fieldwork will also be undertaken post-submission / predetermination.

Works will also be managed to minimise the impact on adjacent businesses and co-ordinated to account for any events or highway works planned by Vale of Glamorgan Council.

4. Environmental Assessment Topics

The Environmental Statement (ES) comprises this Non-Technical Summary, Volume 1 (the Main Text of the ES) and Volume 2 (Technical Appendices and Figures). Volume 1 contains details of the proposals and the likely environmental effects. A summary of the main findings of the ES are set out below.

Air Quality

Current air quality in the vicinity of the Scheme is generally good, although some exceedences of the air quality objective for nitrogen dioxide have been observed at the roadside of routes with high volumes of traffic. There are no Air Quality Management Areas in the vicinity of the Scheme. A Site of Special Scientific Interest (SSSI) lies adjacent to the Scheme, which is split into areas geographically. There is also a Local Nature Reserve to the south of the Scheme. Current nitrogen oxide concentrations at the roadside within the SSSI exceed the air quality objective for the protection of vegetation.

A qualitative assessment of the potential for dust emissions from construction activities was undertaken, and the significance of likely impacts was determined for both human and ecological receptors. The area around the Scheme is not heavily populated and, as such, there is limited potential for dust nuisance or risk to human health as a result of construction activities. However, largely due to the proximity of ecological receptors to the Scheme, there is potential for adverse effects to habitats during the construction phase. A number of standard mitigation measures would be implemented to ensure that good construction practices are followed including the preparation of a Dust Management Plan for the site.

Changes in pollutant concentration at human and ecological receptors during operation of the Scheme relate largely to the redirection of traffic to the improved route introduced by the Scheme and the spatial realignment of this route. It was calculated that pollutant concentrations will increase at human receptors and woodland habitat along the A48 and Five Mile Lane and decrease along the A4050 and Port Road, to the east and south of the Scheme No exceedences of air quality objectives at human receptors have been predicted. Overall the impact of

the Scheme is negligible on human health. Further information on the effects of changes in air quality resulting from the Scheme on ecological receptors is set out in the Nature Conservation section.

Cultural Heritage

There are twelve undesignated heritage assets within 250m of the Scheme and five Scheduled Monuments within 1km of the Scheme. The Scheme is also located within a Historic Landscape.

Due to topography and intervening woodland, the five Scheduled Monuments will not be significantly impacted by the Scheme. However, the Scheme is likely to have slight to large adverse impacts upon four known below-ground heritage assets, which include remains associated with the Whitton Lodge Roman villa, a ring ditch and part of an extensive Iron Age/Romano-British settlement. There is high potential for hitherto unknown buried archaeology to be present within areas of new land take, as indicated by significant evidence for prehistoric and Romano-British activity in the immediate vicinity of the Scheme. A programme of fieldwork will be undertaken as part of the Scheme's construction to inform a mitigation strategy for a final stage of more detailed archaeological investigation of significant remains. This mitigation strategy will reduce the adverse effect upon the four below-ground heritage assets to neutral.

It is considered that the Scheme will have a slight to moderate adverse impact upon the setting of three Scheduled Monuments and a moderate adverse impact on the setting of a Historic Landscape during construction. Effects from the new road on the setting of the same assets during the operational phase are expected to be the same but permanent. Mitigation of impacts to cultural heritage will be provided through design and screening.

Landscape

The Scheme is located to the east of Nant Landcarfan Special Landscape Area (SLA) and to the west of the Dyffrin Basin & Ridge Slopes SLA. The Barry Woodlands SSSI is located adjacent to the Scheme. There are also a number of Sites of Importance for Nature Conservation (SINC) in the surrounding area and one National Trust property is located about 1.7km east of the Scheme.

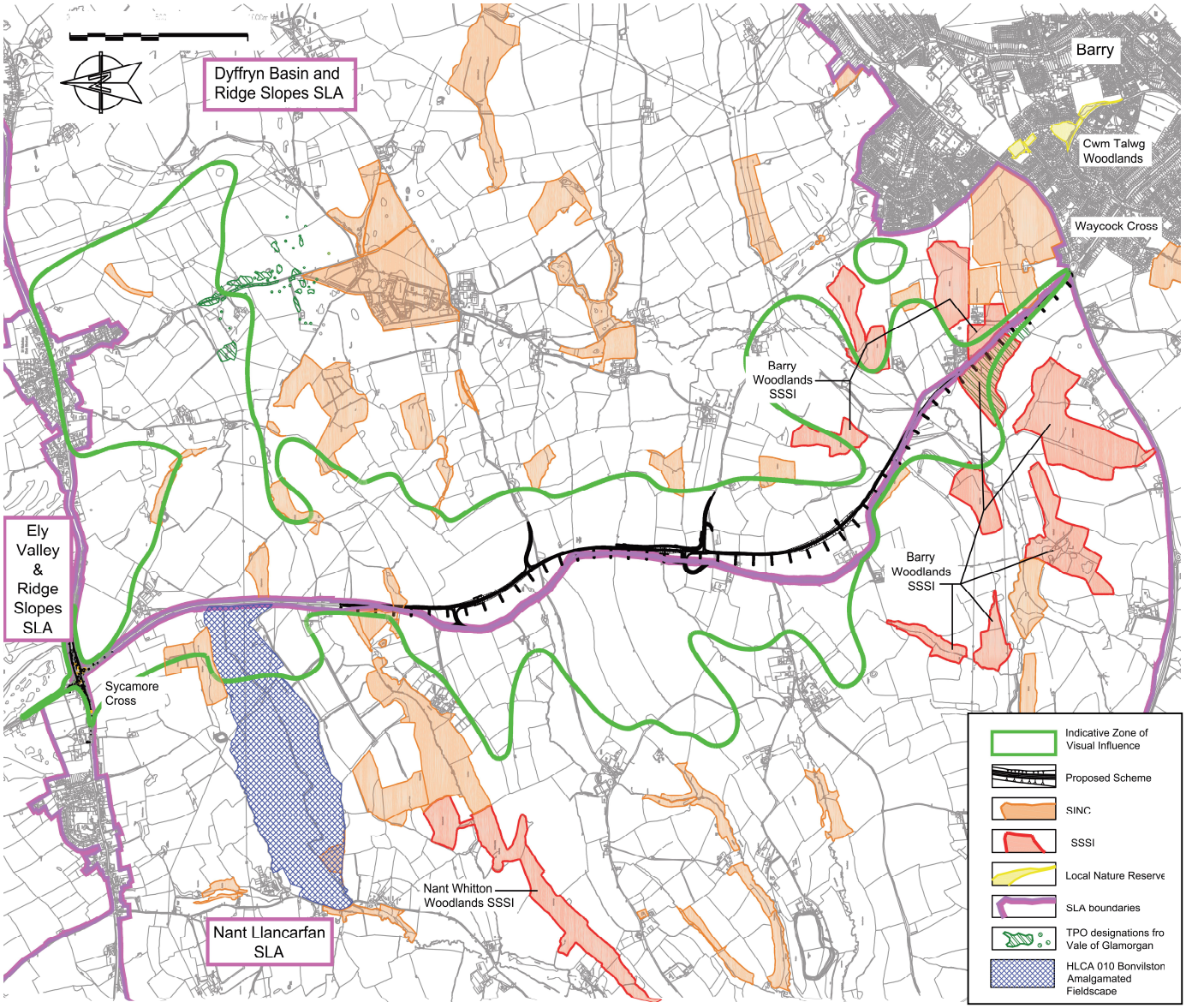
The land surrounding the Scheme is used as a mixture of arable and pastoral land. There is dense development in Barry to the south east and dispersed houses and individual farms along the route of the Scheme. The area is interspersed with semi natural mixed and broadleaved woodland and smaller intermittent blocks of broadleaved plantation.

The Scheme would introduce some minor to moderate adverse effects to the landscape of the area, especially along the proposed highway embankments and at the proposed junctions, although these will generally reduce over time. The scale of these impacts is reduced due to the presence of the existing Five Mile Lane, which provides infrastructure through the landscape setting and forms an important component of the historic context of the landscape. In addition, the landform and existing vegetation limit the visual context of the Scheme, thus reducing the overall impact on the landscape character of the area. The proposed hedgerow and woodland planting will help integrate the Scheme into the local landscape.

The Scheme would result in a range of visual impacts, determined by distance, aspect, elevation and intervening topography and vegetation. However, given the local topography, existing woodland cover and the existing Five Mile Lane, the change in views would be limited to the junctions and embankments. With mitigation planting in place there would be very limited impact on the visual amenity of the area.

Nature Conservation

The assessment has been informed through a suite of desk and field based surveys to inform the baseline conditions of the survey area including:



Designated Sites

- An Extended Phase 1 Habitat Survey;
- An amphibian survey (including great crested newts);
- Aquatic invertebrate surveys;
- Bat activity surveys;
- Bat roost inspections / tree climbing inspections;
- A dormouse nest tube survey; and
- A water vole survey.

Ecological receptors have been identified and assigned a geographic value in consideration of their abundance and location. The potential effects on these receptors during construction and operation of the Scheme and their significance have been identified.

Where significant adverse effects have been identified, appropriate mitigation has been prescribed in accordance with the best available guidance and research, where applicable. This has minimised adverse impacts on valued ecological receptors. A limited number of significant adverse effects are predicted to remain. Several beneficial effects have also been predicted.

The most significant impact of the Scheme will be on two of the 14 woodlands, which together comprise the Barry Woodlands SSSI. The Scheme would result in the permanent loss of a 0.264 hectare (ha) strip of vegetation within the 'Middleton Plantation' woodland and another 0.167ha within the Barry College Wood,

equating to a total loss of 0.431ha. The operation of the Scheme would also result in air quality impacts to areas of these woodlands that are adjacent to the Scheme.

The Scheme would also result in slight adverse effects on a number of Sites of Importance for Nature Conservation (SINCs) and semi-natural woodlands, scrub, grasslands, hedges and watercourses. These impacts include the loss of 0.12ha of scrub within SINC 222 'Land North-east of Whitton Rosser Farm' and the loss of 0.016ha of broad-leaved woodland within 'SINC 220 Land South of Blackland Farm'.

Slight adverse effects are also expected for a range of other species and habitats, most of which are likely to be of low significance, due to the low populations of species present and the little semi-natural habitat present in the predominantly agricultural area.

Some woodlands in the area (Pencoetre and Cwm Talwyg Woods) are expected to experience beneficial effects during operation of the Scheme. This is due to the improvements in air quality that will be achieved from a decrease in congestion along surrounding roads once the Scheme is constructed.

The loss of 0.431ha of the Barry Woodlands SSSI will be partially mitigated by planting 2.8ha of broad-leaved woodland at Waycock Bridge. This planting will be supplemented with other plantings adjacent to Sutton Wood and Sutton Fach Wood, providing a total additional woodland area of 5ha. It is acknowledged that this will not replace the quality of the SSSI woodland lost in the short term, but longer term may prove to be of value.

Generally the Scheme's adverse impacts are expected to be balanced with time by the slight beneficial effects delivered through habitat creation and air quality improvements.

Post-construction monitoring will be required to ensure that mitigation measures are effective.

Geology and Soils

An assessment has been made on the potential impacts on geology, geomorphology and soils arising from the construction and operation of the Scheme. This assessment has included consideration of ground instability and potential land contamination issues.

There are no geological SSSIs or Regionally Important Geological Sites located within the study corridor. The Scheme is not located within a groundwater Source Protection Zone.

Previous ground investigations have not identified any contamination or the presence of Made Ground. The Scheme is in a 'safeguarding minerals area', and agricultural soils are classified as Grade 3 (good to moderate quality) to 4 (poor quality). The Scheme is underlain by aquifers capable of supporting water supplies at a local scale and others of low permeability. There are also two primary watercourses traversing the existing road.

The sensitivity of resources and receptors is considered to range from low to high. However following the implementation of a sufficient design to take into account mitigation measures, there are no significant residual impacts predicted on geology, soils or hydrogeology.

Materials

The construction of the Scheme requires a large amount of raw materials and would generate some waste. The consumption of material resources and the generation of waste would give rise to environmental impacts that would need to be managed and mitigated.

The bulk of the material requirements are for the earthworks. About 81,570m^3 of fill material is needed to build the Scheme with about 50,330m^3 of fill material to be imported from quarry sources and 31,240m^3 to be site won from the excavation of cuttings and re-used within the Scheme.

Other materials such as pre-cast concrete culverts and steel plate girders will be used for the Scheme. Temporary minor impacts are anticipated from the transportation of these materials to site and the associated effects of noise and air pollution on sensitive receptors.

About 62,480m^3 material would be produced by the Scheme from the excavation of cuttings. It is expected that half of this material (31,240m^3) would be unsuitable for reuse by the Scheme and will go for recycling or disposal offsite. Where possible this material will be used for landscaping on the Scheme. The remaining half of this material (31,240m^3) will be used as fill on Scheme as described earlier.

Other waste that will go for recycling or disposal offsite will include putrescible and non-putrescible waste, green waste (that is unable to be reused in onsite landscaping) and residual / unused construction products.

Overall, it is considered that the effects of the Scheme in relation to materials and waste will be no more than minor adverse.

Noise

A noise and vibration assessment has been undertaken to determine the likely impacts arising from the construction and operation of the Scheme.

A baseline noise survey was conducted between 9th and 10th July 2014 to establish the existing noise environment surrounding the Scheme.

The residual noise and vibration effects from construction of the Scheme are not considered to be significant. A Construction Environmental Management Plan (CEMP) will be developed and implemented that will help to ensure that construction effects are minimised.

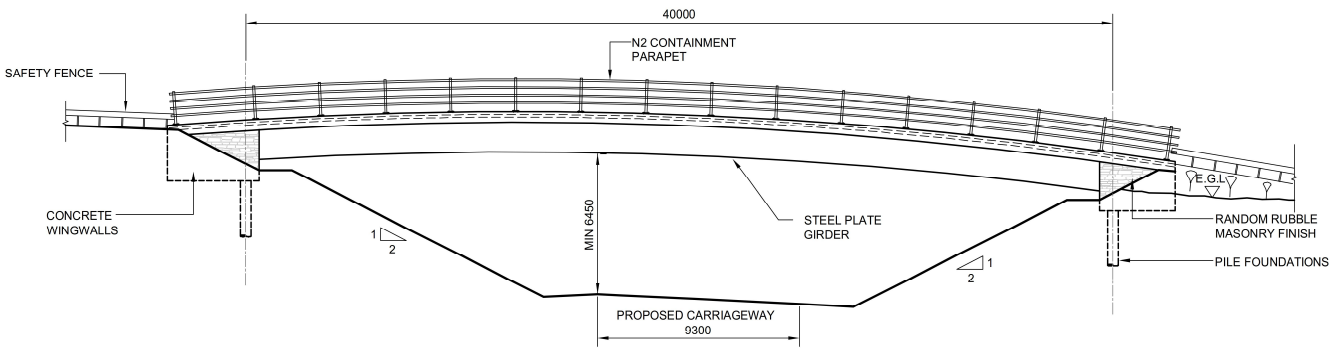
A computer noise model has been prepared to determine the likely noise effects arising from the operation of the Scheme. Eight properties will experience a significant adverse effect during the day-time in the long-term, however the majority of properties assessed will not experience a significant effect.

The scheme design incorporates a low noise road surface on part of the scheme. Further mitigation measures are not required during the operation of the scheme.

Effects on all Travellers

During construction, motorised travellers are expected to experience an increase in Driver Stress from existing delays, which will be exacerbated by construction traffic. Whilst this impact will be mitigated through construction management and the implementation of a Construction Traffic Management Plan, it is expected that there will still be a temporary negative impact.

Once operational, the Scheme will deliver improvements for motorised travellers and



Proposed Accommodation Bridge

pedestrians, cyclists and equestrians. Motorised travellers are expected to benefit from reduced congestion and delays, and improved safety along the route. Pedestrians, cyclists and equestrians are expected to benefit through the provision of safer segregated cycle paths / footpaths and bridleways, and also from access to the existing Five Mile Lane alignment. These improvements are expected to encourage pedestrians, cyclists and equestrians to travel between neighbouring rural communities.

Community and Private Assets

The Scheme will permanently require about 27.3ha of agricultural land, of which about 3.5ha is considered to be Grade 3a (good quality) land. This will result in a slight adverse effect on agricultural land. This land loss is considered unavoidable given the benefits of the Scheme. The Scheme will also require about 0.6ha of land from private properties including a small area of parking belonging to the Welsh Hawking Centre, part of an access track leading to Barry College of Further Education and part of a field belonging to Northcliffe Cottage. This will result in a slight to moderate adverse effect on private property. No changes are expected on community land or development land.

Road Drainage and the Water Environment

An assessment of the potential impacts associated with construction and operation of the Scheme has been undertaken in relation to the water environment. The assessment identified the potential hydrological effects that the Scheme may have on the surrounding area and assessed the potential implications of any such hydrological effects for the Scheme. Mitigation measures have been proposed, where necessary, to minimise the scale of the impacts identified.

Through the provision of a Sustainable Urban Drainage System, the risk of pollution to groundwater and surface water has been assessed to be, for the most part, negligible during operation of the Scheme.

Mitigation measures implemented during the Scheme's construction will ensure that the risk of pollution to surface water and groundwater is largely negligible. However, a residual risk remains, especially where construction occurs directly above watercourses or in excavations near the groundwater table. These risks are temporary however and therefore do not pose a long term risk to water quality.

The impact of the Scheme on flood risk on users of the road and third party people and property is negligible therefore not significant.

Cumulative Effects

The following developments (currently within the planning phase) are those which have been considered for cumulative effects with the Scheme:

- A residential development of 120 dwellings located about 160m to the west of the Scheme;
- A 6MW Photo Voltaic (PV) solar farm located about 120m east of the Scheme;
- A 8MW PV solar farm located about 300m west of the Scheme;
- A 7MW PV solar farm located about 50m east of the Scheme; and
- An APV solar farm of unknown capacity, but covering an area of 14 ha, located 400m south-west of the Scheme.

During construction, the Scheme will have a cumulative substantial adverse effect on residents of a small number of dwellings (<10) near the Scheme and a negligible effect on residents of communities neighbouring the Scheme. The Scheme will also have a cumulative minor adverse effect on the experience of travellers, a moderate adverse effect on the riverine environment and a large adverse effect on woodland habitats during construction of the Scheme.

During operation, the Scheme will have a neutral cumulative effect on riverine environments, a minor adverse to moderate adverse effect on the residents of nearby dwellings, and a large adverse effect on woodland habitats. However, it will also have a minor

beneficial cumulative effect on the residents of communities neighbouring the Scheme and a major beneficial effect on the experience of travellers.

5. What Happens Next?

The Environmental Statement, of which this non-technical summary forms one part, will be considered by Vale of Glamorgan Council in their consideration of the planning application.

If you wish to look at the application, plans and supporting documents they can be viewed, normally within 24 hours of the planning application being registered, by entering the application number on:

http://vogonline.planning-register.co.uk/

Internet access to view the documents is also available at the Council's Customer Service Centre. For location, opening times and accessibility please see below:

Switchboard Telephone Number: 01446 700 111

Email: contactonevale@valeofglamorgan.gov.uk

Address:

Vale of Glamorgan Council
Civic Offices
Holton Road
Barry
CF63 4RU

If you wish to make comments that you would like the Council to take into account before making a decision on the application, you can use one of the following options:

- Via the website (using the online comment form);
- Via e-mail (at the address above) contactonevale@valeofglamorgan.gov.uk; or
- Via post (to the address above).

Hard copies of the ES can be purchase from the above address at a cost of:

- Non-Technical Summary: Free of charge;
- Volume 1: Main Text: £150; and
- Volume 2: Figures & Appendices: £150

Electronic copies of the ES (on CD/DVD) can be purchased from the above address at a cost of £10 or downloaded free of charge via the following website: http://vogonline.planning-register.co.uk/.

Further copies of this Non-Technical Summary may be obtained free of charge from the Vale of Glamorgan Council at the address shown above.

1 INTRODUCTION

1.1 General

1.1.1 This document is the Environmental Statement (ES) for the A4226 Five Mile Lane Improvements scheme, hereafter referred to as 'the Scheme'. Figure 1.1, in Volume 2 of this report, shows the Scheme's location. The improvements proposed under the Scheme are shown in further detail in Figure 1.2 and Figure 1.3 (also in Volume 2). The ES reports the findings of the Environmental Impact Assessment (EIA) of the Scheme and is produced in accordance with the requirements of Town and Country Planning (Environmental Impact Assessment)(England and Wales) Regulations 1999, as amended. This ES therefore contains the information required under the EIA Directives.

1.2 Scheme Background & History

1.2.1 Five Mile Lane has been a hot spot location for road accidents in an even distribution along its length. There have been 65 accidents between the years 1994 to 2007, of which 11 were fatal. In the same period, there have been 16 accidents at the Sycamore Cross junction and 3 slight accidents at Waycock Cross.

1.2.2 Vale of Glamorgan Council has endeavoured to improve safety on the road through the introduction of speed limits, re-surfacing, improved signage, lighting, and solar powered LED cat's eyes. However, the road still contains a number of sharp bends, has substandard forward visibility and is too narrow in places for two large vehicles such as farm traffic, lorries or buses to pass. Along most of its length, the speed limit is 40 miles per hour and overtaking is not permitted.

1.2.3 Pedestrians, cyclists and equestrians are not catered for in the main. Those who do use the route are effectively doing so at considerable risk to themselves and others.

1.2.4 In March 2012, Arup published an Interim Scheme Assessment Report as part of a WelTAG Stage One Assessment (Arup, March 2012) on behalf of the Vale of Glamorgan Council which examined the potential to improve Five Mile Lane in detail. It considered five route options which are described in Section 3 of this report. Subsequently, Parsons Brinckerhoff has tested these options further in order to identify a preferred option for improvements to Five Mile Lane. The preferred option has been identified and taken forward for detailed design, and is considered in this assessment.

1.3 Scheme Objectives

1.3.1 The works will be undertaken by the Vale of Glamorgan Council with Welsh Government funding. Both organisations are committed to improving access to the Cardiff International Airport and the St Athan Enterprise Zone in order to encourage economic development and inward investment.

1.3.2 The objectives of the Scheme are as follows:

- Objective 1: Improve network resilience across the Study Area
- Objective 2: Reduce journey time variability from Culverhouse Cross interchange to Cardiff Airport Enterprise Zone
- Objective 3: Reduce journey time variability from Culverhouse Cross interchange to St Athan Enterprise Zone

- Objective 4: Discourage strategic traffic from utilising inappropriate routes to gain access to Cardiff Airport and St Athan Enterprise Zones
- Objective 5: Maintain access to local amenities and reduce community severance
- Objective 6: Improve access to Cardiff Airport and St Athan Enterprise Zones for Public transport and Non-Motorised Users (NMUs).

1.4 Legal Basis of the ES

1.4.1 In Wales, the EIA regime is governed by European Council Directive No 85/337/EEC, as amended by Directives 2011/92/EU. It is translated into law in Wales by the Town and Country Planning (Environmental Impact Assessment)(England and Wales) Regulations 1999, as amended, hereafter referred to as 'the EIA Regulations'.

1.4.2 Under the EIA Regulations the scheme was considered for EIA under Part 10(f) of Schedule 2 which comprised the construction of roads, which will involve a site area of more than 1 hectare.

1.4.3 In accordance with the EIA Regulations a screening opinion was obtained from the Vale of Glamorgan Council in June 2014 (refer to Appendix 1.1) who advised that an EIA is required for the following reason:

Having regard to the key issues identified in Schedule 3 of the Regulations and WO Circular 11/99, the Local Planning Authority is of the view that the characteristics of the development, characteristics of the impacts and location of the site are such that the potential impacts of the development are likely to be significant upon the environment, for the reason identified in the screening opinion attached. (refer to Appendix 1.1)

1.4.4 A scoping opinion was also obtained from the Vale of Glamorgan Council in August 2014. The scoping opinion included consultation responses from Natural Resources Wales (NRW), Glamorgan-Gwent Archaeological Trust (GGAT), CADW, and from various departments from within the Vale of Glamorgan Council. The scope and content of the ES is discussed in Section 1.6.

1.5 Purpose of the ES

1.5.1 Environmental assessment is a process by which information about the environmental effects of a proposed Scheme is collected, assessed and used to inform decision making. The purpose of the ES is to ensure that the Vale of Glamorgan Council makes their decision in the knowledge of any likely significant impacts on the environment. The main aims of the ES are:

- To provide a description of the Scheme;
- To provide detailed information regarding the likely main environmental impacts of the Scheme, having taken into account measures to avoid, reduce and, if possible, neutralise any predicted significant adverse impacts upon the environment or to enhance the beneficial impacts of the Scheme; and
- To allow the Vale of Glamorgan Council to take into consideration any representations before deciding whether to implement the Scheme with or without modifications; and to outline any alternatives studied and provide reasons why these were not chosen as the preferred option, in line with best practice.

1.5.2 EIA is a systematic process that identifies, predicts and evaluates the impacts of a development on the environment prior to it proceeding. This provides an opportunity for the proponents of a scheme to design out adverse environmental impacts at an early stage, while also providing decision-makers with sufficient environmental information regarding any significant effects that are likely to arise as a result of the development. The outcome of the EIA process is drawn together and presented in a document or series of documents known as an ES.

1.5.3 The methods used in the preparation of this ES follow those set out in official guidance published by the Welsh Government in the Design Manual for Roads and Bridges (DMRB) Volume 11 'Environmental Assessment' as supplemented by Interim Advice Notes (IAN) adopted by the Welsh Government.

1.5.4 The EIA process is described in more detail in Section 4 of this report.

1.6 Scope & Content of the ES

1.6.1 This ES comprises two volumes as follows;

- Volume 1: comprises the main text of the document (of which this introduction chapter is a component part) and includes the background, description and need for the Scheme along with the detailed technical assessments, mitigation and conclusions of the EIA. It also includes the Non-Technical Summary (NTS) at the front of the ES. The NTS is also provided as a separate, stand-alone document. It is a brief report, which summarises the key findings of the ES using non-technical language
- Volume 2: comprises the figures and appendices that accompany the component chapters contained within Volume 1.

Scoping and screening

1.6.2 The technical content of the ES and the topics to be considered in detail were determined through the completion of an environmental Screening and Scoping exercise. The need for a statutory EIA was confirmed from a Screening Opinion received from the Vale of Glamorgan Council on 6th June 2014.

1.6.3 The Screening Opinion cited the Scheme's potential for production of waste and pollution, increased traffic movement, noise and vehicle emissions, concerns on loss of agricultural soils, as well as visual and ecological impacts as reasons why an EIA would be required. It also noted that the Scheme was likely to exceed the 2km length threshold for linear infrastructure schemes outlined in Circular 11/99. The Screening Opinion is appended in Appendix 1.1.

1.6.4 A Scoping Report was provided to the Vale of Glamorgan Council on 7th July 2014 together with a request for a Scoping Opinion. The Vale of Glamorgan Council subsequently consulted with a range of statutory and non-statutory consultees for comment and a Scoping Opinion was provided on 27th August 2014. The EIA Scoping Report and the Scoping Opinion are appended in Appendix 1.2 and 1.3 respectively.

1.6.5 The Scoping Opinion together with the consultation responses has formed the basis of technical content and topics to be considered in the ES. These have been summarised in Table 1.1.

Table 1.1: Summary of Scoping Opinion and Consultation Responses received

Topic	Summary of Response
Noise & Vibration	Vale of Glamorgan Council stated that the ES should include an assessment of noise impacts as a direct consequence of traffic associated with the Scheme. In this respect, they indicated the ES should be informed by the Transport Assessment (TA) and the traffic projections. They requested that the Welsh Hawking Centre and Barry College be included in the noise assessment for the ES.
Air quality	Vale of Glamorgan Council stated that the ES should include an assessment of air quality impacts as a direct consequence of traffic associated with the Scheme. In this respect, they indicated the ES should be informed by the (TA) and the traffic projections.
Cultural Heritage	Glamorgan Gwent Archaeological Trust (GGAT) stated they were satisfied with the methodology for undertaking the cultural heritage assessments as outlined in the Scoping Report and requested that the work be undertaken by suitably qualified professional archaeologists. CADW highlighted that while they do not oppose the methodology outlined in the English Heritage document, it should be noted that in Wales the conservation principles identified by CADW, rather than those of English Heritage, should be used in the assessment. They also questioned why a zone of 1km wide was determined to be sufficient to identify designated monuments where the proposed works could have an impact on their setting. CADW identified 5 sites (in addition to those described in the Scoping Report) within 1km of the Scheme that should be added to the list of high value sites. The following sites were identified as within the 1km zone- Coed y Cwm Ringwork, Moulton Roman Site, Castle Ringwork, Ty'n y Coed and the remains of Highlight church. They indicated that evidence for significant settlement surrounding the Roman Villa site is likely to be found.
Nature conservation	Natural Resources Wales agreed with the approach outlined in the Scoping Report, which focused on ecology and nature conservation, but also stated that if the EIA concludes that the loss of SSSI habitat is unavoidable then it should set out an appropriate and robust mitigation package. They suggested conducting a bird survey given the scale of the Scheme and the presence of at least one breeding section 42 species (yellowhammer). They also requested an assessment be undertaken to establish whether there were likely significant effects from the Scheme on barn owls. They noted the intention to use survey data gathered from 2008 and 2009 and welcomed the scope of further works to review the available desk study information and update the following European Protected Species: • Great Crested Newts; • Dormouse nest tube surveys; • Bat activity surveys; and • Bat roost inspections/tree climbing inspections. They requested that the surveys are undertaken following best practice guidance and survey methodologies and that full detail is provided in the ES. NRW also requested that otters are considered in the ES. Vale of Glamorgan Council stated that the ES should consider the following:

Topic	Summary of Response
	• Statutory Nature Conservation Sites (SAC, SPA, SSSIs etc.); • Non-statutory Nature Conservation Sites (SINC's); • Legally Protected Species; • UK and Local Biodiversity Action Plan Habitats and Species; and • Landscape. They also requested that the ES include a detailed and comprehensive assessment of protected species that may be affected by the Scheme, including any species that occupy adjoining land, but which may use the proposed site. The assessment should include an evaluation of the population and detail any mitigation measures that will be necessary and implemented to ensure that the population is maintained. The Vale of Glamorgan Council's ecology officer agreed with the recommendations made in the Scoping Report and also recommended that surveys for birds, and in particular ground nesting birds are carried out to allow the LPA to fully assess the impact and for appropriate mitigation / compensation to be designed.
Landscape	Vale of Glamorgan Council stated that the ES must include a description of all the existing landscape interests within and in the vicinity of the Scheme. They suggested this could be done using the Countryside Council for Wales' (now Natural Resources Wales) LANDMAP methodology (www.landmap.ccw.gov.uk). They also required the ES to consider protected landscapes in the vicinity of the Scheme and suggested it is vital that the landscape and visual impact assessment utilises appropriate viewpoints to consider the impacts of the proposals on these protected landscapes. This was due to the potential for the Scheme to be visible from a wide area. Natural Resources Wales stated that they expect the ES to demonstrate the use of all five LANDMAP data sets for completion of the landscape and visual assessment.
Road Drainage and the Water Environment	Vale of Glamorgan Council recognised that the majority of the site is outside any flood risk area but that a section of the road is in part located within Flood Zone C1 and B in an area that has known to have flooded in the past and is without significant flood defence infrastructure. Natural Resources Wales noted that if any changes are made to the road at locations that could affect flood storage or conveyance, they should be investigated as part of a Flood Consequences Assessment (FCA). If the EIA concludes that an FCA is to be undertaken, this should include an assessment of water features.
Geology & Soils	Natural Resources Wales had some concerns regarding impacts from the construction and operation of the Scheme on controlled water including groundwater abstraction from licenced and private water supplies. They suggested that a risk assessment be undertaken to investigate the potential for land contamination along the route as there is a historic landfill to the west of the existing route at Blacklands Farm. They also required information on the proposed drainage from the road to be included, particularly with the use of a soak-away. They noted that the area around Sycamore Cross is underlain by a principal aquifer, which is sensitive to controlled water. They also requested that they be notified if the Scheme is likely to impact a groundwater observation borehole that is located on the grass verge of Sycamore Cross.

Topic	Summary of Response
Materials	Vale of Glamorgan Council indicated that the generation of waste from the Scheme and the potential to manage such generation within the site, and reuse and capture recyclable materials should be considered.

1.6.6 The following consultees did not comment on the Scoping Report:

- Wenvoe Community Council (advised that the application was noted, but did not make any specific comments);
- Barry Town Council;
- Peterston-Super-Ely Community Council;
- St. Nicholas and Bonvilston Community Council;
- Vale of Glamorgan Council - Highways and Engineering Section; and
- Dwr Cymru Welsh Water.

1.6.7 Based on the feedback received in the Scoping opinion and with consideration of relevant EIA Guidance (see Chapter 4: Assessment Methodology & Approach), it was determined that the following topics should be considered in further detail within this ES to determine the significance of the Scheme's effects on the environment:

- Air Quality (Chapter 6);
- Cultural Heritage (Chapter 7);
- Landscape (Chapter 8);
- Nature Conservation (Chapter 9);
- Geology & Soils (Chapter 10);
- Materials (Chapter 11);
- Noise & Vibration (Chapter 12);
- Effects on All Travellers (Chapter 13);
- Community & Private Assets (Chapter 14)
- Road Drainage & the Water Environment (Chapter 15); and
- Cumulative Impacts (Chapter 16).

1.7 Publication of the ES

1.7.1 Hard copies of the ES may be inspected free of charge during normal office hours during the objection period as set out in the Public Notice, at the following premises:

The Vale of Glamorgan Council
Civic Offices
Holton Road
Barry
CF63 4RU

1.7.2 Hard copies of the ES can be purchase from the above address at a cost of:

- Non-Technical Summary: Free of charge;

- Volume 1: Main Text: £150; and
- Volume 2: Figures & Appendices: £150

1.7.3 Electronic copies of the ES (on CD/DVD) can be purchased from the above address at a cost of £10 or downloaded free of charge via the following website: http://vogonline.planning-register.co.uk/.

2 EXISTING CONDITIONS

2.1 Scheme Context

2.1.1 The setting of the existing site and surrounding area is shown on Figure 2.1. Five Mile Lane is a north-south oriented single lane carriageway linking the A4226 (Port Road West) at the Waycock Cross junction near Barry in the south, with the A48 at the Sycamore Cross junction near Bonvilston in the north. The route is approximately 7 km in length and is a non-primary local route (i.e. a B road) which is actually managed by the Vale of Glamorgan Council as an A road. This is due to its strategic importance as an alternative route for the local authority highway network. The route is operated at the national speed limit, with 40mph sections at varying locations due to tight bends and residential properties. It is a rural road, which has a number of farm accesses and minor roads connecting to it. The route varies in width between 6.0m and 7.3m with only a small proportion of the route at 7.3m standard and there are no hardstrips throughout. There is minimal positive drainage along the route between the two terminating junctions. This causes issues with flooding and ice during the winter months.

2.1.2 The existing route is lined by mature hedgerows resulting in the side road junctions and direct accesses to farms and properties along its length not having sufficient visibility for safe access / egress. Only two sections along the route has visibility to a reasonable standard. The first section is from the Sycamore Cross junction to the start of the existing 40mph speed limit which is approximately 1.6km south of the junction. The second section is 300m in length section adjacent to the Welsh Hawking Centre towards the Waycock Cross junction. The remainder of the route fails to meet a range of DMRB highway standards.

2.1.3 The improvement works needed for online improvements along the route to meet DMRB highway standards would be extensive. Subsequently, the Scheme will comprise of a combination of online improvements and new offline sections to ensure that the entire route meets DMRB highway standards for an A road.

2.2 Existing Site & Surrounding Area

2.2.1 The Vale of Glamorgan is an attractive and productive lowland landscape on the north coast of the Severn estuary and Bristol Channel. The county is bordered by the large urban centres of Cardiff to the east and Bridgend to the west (see Figure 1.1). The M4 lies to the north and the Severn estuary forms the southern boundary of the county. According to the Vale of Glamorgan Local Development Plan (Written Statement, November 2013) approximately 85% of the Vale of Glamorgan is agricultural land. The Scheme is set within this agricultural landscape, which primarily comprises improved sheep-grazed pasture and arable land separated by well managed native hedgerows and scattered trees. There are areas of ‘best and most versatile’ agricultural land in proximity to the Scheme.

2.2.2 Nearby habitats include blocks of broad-leaved woodland and hedgerows, between the River Waycock and Waycock Cross which fall partly within the Barry Woodlands Site of Special Scientific Interest (see Figure 9.1). The existing alignment bisects one block of the SSSI woodland into two distinct parts. Protected species that are considered likely to be in close proximity include amphibians, otters, reptiles, birds, bats, dormice, water voles, aquatic invertebrates and the riverine habitats of the River Waycock.

2.2.3 A variety of archaeological assets and historic landscapes are located in close proximity (up to 1.2km) to the Scheme including a Roman Villa and several Scheduled Monuments.

2.2.4 There are three broad visual landscape character types within the Vale of Glamorgan; the Rural Vale; the South East Developed Vale; and the Coast. The Rural Vale is further divided into the North Rural Vale and the South Rural Vale, divided by the A48 Roman Road. Five Mile Lane forms a broad boundary between two variations of the South Rural Vale connecting to Barry within the South East Developed Vale. Although the landscape has been classified into broadly homogenous units, or Landscape Character Areas (LCAs), the landscape displays the following common characteristics:

- Land cover and landscape pattern are closely related to elevation and topography;
- The main land use is pastoral agriculture; and
- Landscape trends relate to changing agricultural practices (removal of hedgerows to create larger fields or to replace with fences) and small scale infilling (new dwellings around existing farmsteads).

2.2.5 A small number of rural residences, private business and community facilities are located throughout the study area. Private businesses in the vicinity of the study area include the Welsh Hawking Centre along Five Mile Lane and Cottrell Park Golf Club to the north of the A48 near Bonvilston. The Welsh Hawking Centre is a visitor attraction located along Five Mile Lane and adjacent to the Barry Woodland Site of Special Scientific Interest (SSSI). Cottrell Park Golf Club is a public golf course that lies to the north of the Sycamore Cross junction. Community facilities include the Amelia Methodist Trust Farm (Whitton Rosser Farm), located to the west of Five Mile Lane. The Farm is open to the public with no admission charge. The volunteer charity supports adults with learning difficulties and disadvantaged young people.

2.2.6 There are two public rights of way that connect with Five Mile Lane (see Figure 8.1) and no existing dedicated cycle paths, or cycling facilities along the existing road.

2.2.7 The current traffic noise and vibration levels experienced on the existing road network vary depending on time of day and year, and it is likely the trends found in national traffic data would be relevant and applicable on these sections of roads. The road surface is generally in good condition and the speed limit ranges from 60mph to 40mph. Farm traffic and the road geometry serves to slow traffic below the speed limit at points along Five Mile Lane.

2.2.8 Between the A48 in the north and Barry in the south, Five Mile Lane passes over the River Waycock. It also passes 50m to the west of the source of the Moulton Brook, crosses a continuous channel of water that flows from Ffynnon Whitton Mawr into Ford Brook, and crosses and runs adjacent to a number of other smaller culverted tributaries and drains within the Waycock catchment.

2.2.9 Groundwater vulnerability maps indicate that the overlying soils along Five Mile Lane have low, intermediate and high leaching potential. The soils overlying the Principal aquifer in the north of the study area are classified as having intermediate leaching potential.

2.2.10 There are ten consented discharges within 1,000m and a large number of licensed abstractions at distances ranging from 950m to 1,300m from Five Mile Lane. Most of the abstracted water in the area is used for potable water supply and for industrial

and commercial purposes. The majority of licensed abstractions in the Thaw catchment area are for agricultural purposes.

2.2.11 The Scheme is predominantly underlain by interbedded limestone and mudstone of the Lower Jurassic Porthkerry Member (Blue Lias Formation). Other limestone and mudstone formations have been identified underlying the study area, including the Gully Oolite Formation and the Lavernock Shale Formation. Superficial deposits are present locally, comprising glacial till by Sycamore Cross and fluvial deposits comprising alluvium and alluvial fan deposits surrounding the route of the River Waycock.

2.2.12 The Vale of Glamorgan is of geological interest as it is the only place in Wales where Jurassic strata can be seen on land. However, there are no geological SSSIs, RIGS or quarries within the footprint of the Scheme. There is a history of limestone quarrying within 250m of the existing carriageway, however all operations have now ceased.

2.2.13 There is indicative evidence of one former landfill site near the Scheme at Blacklands Farm. It was licensed from December 1990 to December 1991 and there was no known restriction on the source of the waste. However, the type of waste deposited included 'inert', which means the waste should remain largely unaltered once buried and could include constituents such as glass, concrete, bricks, tiles, soil and stones.

3 SCHEME DESCRIPTION & DEVELOPMENT OF ALTERNATIVES

3.1 Scheme Overview

3.1.1 The Scheme aims to improve access and journey time reliability to the Cardiff Airport and St Athan Enterprise Zones, and reduce congestion along the A4050 Port Road, A4050 Port Road East and the A4226 Port Road West between Culverhouse Cross and Waycock Cross Roundabout (refer to Figure 1.1). WelTAG Stage One, previously produced by Parsons Brinckerhoff, identified highway improvements to A4226 (Five Mile Lane) as the most appropriate option to improve the resilience of the local network and provide a realistic alternative to the A4050 Port Road.

3.1.2 Five Mile Lane is a single carriageway road, in a rural location, varying in width between 6.0 and 7.3m. The route is classified and maintained as an 'A' road by the Vale of Glamorgan; however it currently fails to meet appropriate highway standards for a 60mph road. In order to meet the aim of developing a strategic route to the Cardiff Airport and St Athan Enterprise Zones, there is the need to undertake a number of improvements to upgrade the existing road to modern DMRB highway standards. The proposal includes making use of the existing and already upgraded highway immediately off the A48 at Sycamore Cross. The proposed alignment will go offline at a point approximately 1.5km from the Sycamore Cross signalised junction and follow a southerly course running generally parallel with the existing Five Mile Lane. The proposed alignment will re-join Five Mile Lane just north of the existing River Waycock Bridge. A more detailed description of these highway improvement works is provided in Section 3.2.

3.1.3 The proposal also includes provisions to improve access and safety for Non-Motorised Users (NMUs) in the form of a combined footway and cycleway comprised of sections of new path along the existing road alignment. A more detailed description of these improvement works is provided in Section 3.2.

3.1.4 The works will be undertaken by the Vale of Glamorgan Council with Welsh Government funding. Both organisations are committed to improving access to the Cardiff Airport and St Athan Enterprise Zones in order to encourage economic development and inward investment.

3.1.5 The main benefits of the works can be described as follows:

- Improved strategic access for Heavy Goods Vehicles (HGVs) and development traffic to the Cardiff Airport and St Athan Enterprise Zones;
- Improved safety for cyclists and pedestrians through the potential construction of a safer environment on the new road and a reduction of vehicles travelling on the bypassed road (which may have a lower speed restriction);
- Improved access for regional and local businesses by providing better access to the M4 and distant markets and more reliable journey times for customers and freight;
- Improved reliability and safety for private road users through the straightening and widening of Five Mile Lane;
- Greater resilience on the network by providing a more appropriate alternative route to the A4050 Port Road;
- Improved safety for highway maintenance activities;

- Improved perceptions of safety of this link for motorised and non-motorised users; and
- Local economic benefits realised through construction of the Scheme.

3.2 Highway Improvements

Five Mile Lane

3.2.1 The proposed alignment of the highway improvements along Five Mile Lane is shown in Figure 3.1. The highway improvements will be 4,850m in length from just north of the Amelia Methodist Trust Farm in the north to Waycock Cross roundabout in the south with most of the improvements being offline. A 300m length of this section, located just north of the Welsh Hawking Centre, will be existing road that will remain unchanged.

3.2.2 Minimal improvements are required along the remaining section to the south of the Welsh Hawking Centre to Waycock Cross roundabout. This will entail works to improve the drainage of the existing carriageway and the potential rerouting of some Statutory Undertaker's apparatus, located on the western side of Five Mile Lane, adjacent to Barry Woodlands SSSI.

3.3 The Scheme will result in a new and upgraded single lane carriageway 7.3m wide with a 1m wide hard strip, making the total carriageway 9.3 metres wide, except for the carriageway section approaching Waycock Cross junction, which will be 7.3m wide due to the absence of hardstrips. A 2.5m wide verge would be located on west side of the on-line road widening for a proposed cycleway / footpath. Street lighting is proposed on the approach to Waycock Cross roundabout only.

3.3.1 Three new junctions will be constructed along the route including two T-junctions and one staggered junction. All junctions will have ghost islands that will be DMRB compliant. This will enable through traffic to continue along the route without being hindered by right turn traffic at the junctions. Vehicles will be able to turn in both directions when leaving the junctions. Each junction will have merge and diverge tapers on and off the carriageway that will be DMRB compliant. The southbound approach to Waycock Cross junction will be widened to two lanes, being approximately 60m in length.

3.3.2 The offline section of the scheme will be constructed on mix of embankment and cutting along its length. There is a 40mph speed limit along most of the existing road with overtaking not permitted. The Scheme will allow a 60mph speed limit to be maintained from Sycamore Cross to the Welsh Hawking Centre, upon which it will revert to 40mph for south-bound traffic, and then 30mph on the approach to Waycock Cross.

3.3.3 The existing road will remain open after the Scheme is completed to provide local access to the various farms along its length and as a safer route option for NMUs. The only access to and from this road will be from the three proposed junctions linking to the new road. All other provisions along the existing road will remain unchanged.

Sycamore Cross Junction

3.3.4 Minor improvements will be made to the existing junction between the A48 and Five Mile Lane at Sycamore Cross. The aim of this element of the works is to provide capacity increases for the turning movements at the junction, therefore enabling the

benefit of any improvements along Five Mile Lane to be maximised. The proposed Sycamore Cross Junction improvements are shown on Figure 1.3.

3.3.5 The works will consist of widening of the westbound carriageway of the A48 to provide a dedicated lane for turning left onto Five Mile Lane. In addition, the existing street furniture will be re-arranged, and the road markings amended to enable two lanes of traffic to travel westbound through the existing signalised junction.

3.3.6 For eastbound traffic, there will be two lanes of traffic provided through the junction on the A48 from Bonvilston heading east towards Culverhouse Cross. To enable this to be constructed, the existing bus lane will be re-aligned further towards the north side of the junction to provide sufficient lane width for traffic on the A48.

3.3.7 For traffic travelling north of Five Mile Lane the lane destinations for traffic have been amended. It is proposed to allow both lanes of traffic to be utilised for right turning traffic (to travel eastbound on the A487). In addition to this, the existing left hand lane will also be utilised for left turning traffic.

3.3.8 All the proposed works are to be carried out within the existing Highway Boundary resulting in an area of the grass verge being lost to provide the additional carriageway capacity. The grass verges are currently maintained by the Vale of Glamorgan Council and are therefore disturbed on a regular basis as part of the highway maintenance regime.

3.3.9 The junction was improved by the Vale of Glamorgan Council early in 2013, with the works resulting in a change to the junction type from staggered cross roads to a fully signalised junction. These works resulted in significant disturbance in the area surrounding the junction, partly due to the requirements to significantly widen the highway footprint.

3.4 Accommodation Works

3.4.1 The Scheme will also include construction of an integral single span steel composite accommodation bridge carrying a farm access road over the proposed route (refer to Figure 3.3). It will be located immediately north east of Sutton Fach Farm, spanning the proposed road to provide the farm with access to local fields. The bridge will consist of twin steel girders braced together and made composite with a concrete deck slab. The bridge deck will comprise a 3.5m carriageway with a 0.5m verge on either side. Minimum headroom beneath the structure of 6.45m will be provided. In order to minimise the size of the approaches and abutments, the structure has been curved to facilitate additional headroom beneath. The structure will be open to provide the maximum line of sight for drivers using the proposed route, as well as increasing the aesthetic appeal of the structure. The bridge abutments will be covered with a local stone façade to ensure the structure is in keeping with the rural environment.

3.5 Improvements for NMUs

3.5.1 As outlined in Technical Advice Note (TAN) 18, alterations to existing developments must include appropriate improvements to NMUs. The existing cycle provision in the study area is poor with no cycle route / path along Five Mile Lane, although the local area beyond has a more developed network of cycle routes that link the area to the wider communities, such as Barry and Cardiff.

3.5.2 At the northern end of the Scheme, between Chainage (Ch) 0m to Ch300m, the verge on the west side of the new road will be surfaced to provide an unsegregated footway / cycleway link between the existing Five Mile Lane road and a proposed cycleway route which will utilise the existing roadside verge between the Sycamore Cross junction and the new cycleway (refer to Figure 3.1).

3.5.3 At the southern end of the Scheme, a new length of unsegregated footway / cycleway will be provided running adjacent to the west side of the on-line road widening, between Ch3545m and Ch4800m, to link the existing Five Mile Lane to the Waycock Cross roundabout. The intention is to utilise the existing road for pedestrian and cycle access as traffic flows will be significantly reduced. A safety review will be undertaken to identify any works considered necessary to enable safe pedestrian and cycle access. These will likely include appropriate signage to indicate access for both pedestrians and cyclists.

3.5.4 A new bridleway that can be used by equestrians and pedestrians will provide a link across the new road linking the lane at Ch2180m to the new accommodation overbridge at Ch2920m and to the existing road at Ch3100m.

3.5.5 As the old road will be secondary to the new main road, the number of vehicles will significantly reduce with only local traffic (i.e. to the farms) using the road. Therefore, this will provide much safer and more comfortable conditions for cyclists and pedestrians.

3.5.6 The locations of the improvements for NMUs are shown on Figure 3.1.

3.6 Drainage

3.6.1 The Scheme will include drainage improvement works that will require four treatment and attenuation ponds on land adjacent to the new alignment (see Appendix 15.6).

3.6.2 The first treatment and attenuation pond is located approximately 50m south of the start of the Scheme (Ch50m) and will receive highway drainage from the first 600 metres of the new highway falling in a northerly direction. The pond is located to the east of the new road alignment and will outfall into a watercourse leading to the River Waycock.

3.6.3 Heading south the next treatment and attenuation pond is located at Ch1100m to the west of the new road alignment in the vicinity of the existing Ffynon Whitton-mawr pond. The pond will receive highway drainage from the new highway up to 500m north and 400m south of this location and following treatment and attenuation will outfall into Ford Brook.

3.6.4 Further south another treatment and attenuation pond is located at Ch1900m to the west of the new road alignment. The pond will receive highway drainage from the new highway falling from the north and following treatment and attenuation will discharge via a culvert under the existing Five Mile Lane to the Moulton Brook.

3.6.5 The fourth treatment and attenuation pond is located at Ch3500m to the west of the new road alignment. The pond will receive highway drainage from the new highway falling from the north and following treatment and attenuation will outfall into the River Waycock. An existing watercourse to the east of the new road alignment will require diversion for approximately 300 metres and an existing culvert located beneath the existing road will be extended under the new road.

3.6.6 Am existing drainage ditch located to the east of the existing Five Mile Lane route between Ch3700m and Ch4000m will be enlarged for attenuation storage. Existing drainage ditches on both sides of the existing road between Ch4000m and Ch4900m at Wycock Cross junction will require realignment.

3.7 Land Take

3.7.1 The Scheme will be subject to land acquisition through Compulsory Purchase. The anticipated land acquisition envelope (red line boundary) for both permanent and temporary land is shown on Figure 3.1 and indicates that the land required is predominantly agricultural in nature.

3.7.2 In total the Scheme requires approximately 415,600m^2 (41.6 ha) of land to construct the Scheme. Approximately 311,800m^2 (31.2 ha) of this land would be permanent land take and approximately 103,800m^2 (10.4 ha) required as temporary land take to enable the Scheme to be constructed i.e. areas for Site Compound and Material Storage etc. The type of land required is set out in Table 3.1.

Table 3.1: Permanent and temporary land take required for the Scheme

Land Type	Permanent	Temporary	Total
Agricultural	272,900m^2	100,800m^2	**373,700m^2**
Private (including Commercial)	6,000m^2	200m^2	**6,200m^2**
Other (e.g. Highways etc)	32,900m^2	2,800m^2	**35,700m^2**
Total	**311,800m^2**	**103,800m^2**	**415,600m^2**

3.7.3

3.7.4 To the northern end of the Scheme woodland will be required to widen the existing carriageway and provide a new adjacent cycleway / footway. A strip of existing car park associated with the Welsh Hawking Centre is also required for road widening purposes.

3.7.5 The land is required to provide the new highway together with side road connections and associated highway drainage including cut off drains and attenuation ponds. Land will also be required for the new cycleway and bridleway / footway and for replacement woodland planting, environmental mitigation and landscaping, provision of hedgerows, watercourse realignments and private means of access. The areas have been included within the red line boundary in Figure 3.1.

3.8 Scheme Construction

3.8.1 The Scheme is to be undertaken as a design and build contract with the Principal Contractor. The current programme is as follows:

- March 2016: Submit planning application;
- November 2016: Appoint Principal Contractor;
- January 2017: Commence initial construction. Initial activity will involve advance and investigative works. These works will include site clearance, the improvement of adjacent habitat, utilities diversionary works and Ground Investigations;

- February 2017: Commence main construction; and
- January 2018: Complete Construction.

3.8.2 Phasing of the works is to be developed with the Principal Contractor. The aim will be to maintain traffic on the existing highway whilst the majority of the works are constructed off-line. However, temporary traffic management measures will be necessary to undertake the works at the tie-ins and during the on-line improvements.

3.8.3 Advance site works are anticipated to clear vegetation outside the bird nesting season and manage / manipulate habitat to aid the relocation of reptiles from the site in advance of any main construction works.

3.8.4 A scheme of archaeological investigative fieldwork has been devised with and approved by the Acting Archaeological Planning Manager at GGAT. This has been documented in the Written Scheme of Investigation, provided in Appendix 7.4, and includes a programme of combined evaluation trenching and a 'strip, map and record' exercise will be undertaken post-submission / predetermination.

3.8.5 Works will also be managed to minimise the impact on adjacent businesses and co-ordinated to account for any events or highway works planned by Vale of Glamorgan Council.

3.8.6 The highway will comprise of around 400mm thickness of bituminous road construction overlaying a granular sub-base / capping material. Topsoil and planting will be provided on the embankment and cut slopes. Further details regarding materials that will be used to construct the Scheme are provided in Chapter 11 Materials.

3.9 Scheme Operation & Maintenance

3.9.1 Following the completion of construction works, the Scheme will be adopted by the Vale of Glamorgan Council to manage and maintain as the Local Highway Authority. The existing Five Mile Lane will also continue to be managed and maintained as a Category 2 route by the Vale of Glamorgan Council.

3.9.2 Areas of land not required for the permanent highway works, which have been included in the red line boundary in Figure 3.1, will be returned to the respective ownerships in accordance with the respective land agreements. Easement areas will provide a right of access to maintain / inspect the highway.

3.10 Development of Alternatives

3.10.1 One of the mandatory requirements of the EIA Regulations is to provide:

"An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for his choice, taking into account the environmental effects." Town and Country Planning (Environmental Impact Assessment)(England and Wales) Regulations 1999, as amended, Schedule 4 Part 1(2).

3.10.2 A previous WelTAG Stage One Assessment (Arup, March 2012) identified five route alternatives to be considered for the Scheme. These were termed the Red, Green, Purple, Blue and Orange routes. The conclusions of that assessment, with regard to each of the five route options are summarised as follows:

- Blue route – Impacts on noise, air quality and social aspects would be beneficial or moderate beneficial. Impacts on heritage would be moderate adverse due to effects around Whitton Lodge. Impacts on the Transport Planning Objectives and vehicle travellers would be moderate beneficial;
- Purple route – Similar to the Blue route but with a moderate beneficial effect on air quality only;
- Red route – Similar to Purple route but with no moderate beneficial effects;
- Orange route – Similar to Blue route but with a significant beneficial effect on noise and vibration and a neutral effect on air quality; and
- Green route – Similar to Red route, but with a significant adverse impact on the water environment.

3.10.3 Parsons Brinckerhoff was commissioned by the Vale of Glamorgan Council in 2013 to build on the WelTAG Stage One Assessment work undertaken by Arup. The objective of this study was to make best use of the existing infrastructure within the study area. Two route corridors were given for consideration including the A4050 Port Road and the A48/A4226 Five Mile Lane (also known as Waycock Road).

3.10.4 An appraisal was undertaken to establish which of the two route corridors best matched a series of transport planning objectives and assess each route corridor to WelTAG Stage One under the headings 'Economy', 'Environment' and 'Society'. Overall, the A48/A4226 Five Mile Lane performed better than the A4050 Port Road corridor. The A48/A4226 Five Mile Lane corridor performed comparatively with the Port Road corridor in terms of 'Society', slightly worse in terms of 'Environment', and significantly better in terms of 'Economy'. It also matched more of the transport planning objectives.

3.10.5 It was clear from the engineering analysis of Five Mile Lane that the existing road would not be adequate as it stood. The assessment therefore took into account that the route would need to be upgraded to a suitable standard for a primary Local Authority route. The appraisal was made on the basis that the improvements would be delivered as part of this option, and not addressed at some later stage.

3.10.6 The WelTAG Stage One Assessment undertaken by Arup in 2012 recommended that the 'Orange' route and 'Purple' routes be designed to Wide Single standard. Using the Arup engineering design as a basis, these two routes were developed further into a single carriageway option (supported by traffic data) that made best use of the existing Five Mile Lane and took the route offline along the more constrained sections between Blackland and Grovelands Farms and at Sutton Fach Farm. The assessment concluded that a combination of the 'Orange' and 'Purple' route was the best option overall, albeit with a few minor amendments incorporated as a result of subsequent consultations with highway authorities. The Purple, Orange and Preferred route options are shown on Figure 3.2.

3.11 Preferred Option

3.11.1 The preferred option includes making use of the existing and already upgraded highway immediately off the A48 at Sycamore Cross. The proposed alignment will go offline at a point approximately 1.5km from the Sycamore Cross signalised junction and follow a southerly course running parallel with the existing Five Mile Lane, before re-joining the existing alignment, approximately 1.1km north of Waycock Cross.

3.11.2 The proposed alignment will be constructed on a combination of earthworks and 'in cutting'. It will be a single carriageway with 1m hardstrips, making the total carriageway 9.3 metres wide (with the exception of the carriageway section approaching Waycock Cross junction, which will be 7.3m wide due to the absence of hardstrips). The route will include three junctions; one staggered junction and two T-junctions located approximately 2, 3 and 3.5 km northward from Waycock Cross respectively. In order to facilitate access to the farms and properties to the east of the Scheme and to provide a safe crossing for equestrian users, an overbridge will also be constructed to the north of Sutton Fach Farm, approximately 1.9km northward along the alignment from Waycock Cross. Vehicular access to plots to the west of the existing Five Mile Lane will be maintained by retaining the existing Five Mile Lane alignment as a side road for access and connective purposes.

4 ASSESSMENT METHODOLOGY & APPROACH

4.1 Introduction

4.1.1 This ES sets out the approach to and documents the findings of the assessment of the environmental effects likely to result from the construction and operation of the Scheme. This section sets out the stages of the environmental assessment undertaken for the Scheme and the methods used to assess the various environmental aspects requiring consideration.

4.2 Guidance

4.2.1 The guidance used by the Welsh Government and highways authorities in the UK for the preparation of ES's for trunk roads is the Design Manual for Roads and Bridges (DMRB), Volume 11. Although the proposed Scheme will not be classified as a trunk road, the principles of the DMRB have been followed as they provide established good practice methodologies for the EIA of road projects.

4.2.2 DMRB, Volume 11 was originally published in 1993 but has since been updated with various amendments and Interim Advice Notes (IAN's). Specifically, this ES has been prepared in accordance with the following:

- HA200/08 (DMRB 11.1.1) Aims and Objectives of Environmental Assessment;
- HA201/08 (DMRB 11.2.1), General principles and Guidance of EIA;
- HA202/08 (DMRB 11.2.2), Environmental Impact Assessment;
- HD 47/08 (DMRB 11.2.3) Screening of Projects for EIA;
- HA204/08 (DMRB 11.2.4): Scoping of EIA
- HD 48/08 (DMRB 11.2.6) Reporting of Environmental Impact Assessments; and
- Interim Advice Note 125/09 (W) – Supplementary Guidance for Users of DMRB Volume 11 'Environmental Assessment'.

4.2.3 In addition, specific DMRB Guidance and IAN's have been used for each separate environmental topic. Where other best practice guidance has been used for a particular environmental topic, this has been stated in the relevant chapter.

4.2.4 Other volumes of the DMRB also give guidance on issues such as Environmental Design and Management (DMRB, Volume 10) and specific design topics such as drainage, for example including Vegetative Treatment Systems for Highway Runoff (DMRB, Volume 4). This guidance has also been taken into account where appropriate.

4.3 Regulatory / Policy Framework

4.3.1 The Scheme's relationship with relevant European, National and Local legislation, guidance and planning policy is described in detail in Chapter 5 Planning Policy & Context. Each environmental topic within this ES also refers to the legislation, guidance and planning policy that is applicable to that topic, in accordance with IAN 125/09 (W).

4.4 Study Area

4.4.1 The study area is defined as the geographical area over which changes to the environment are likely to occur as a result of the Scheme. For each assessment topic a study area has been defined and described in the methodology section of each assessment topic chapter.

4.4.2 Where no study area is prescribed by the DMRB, professional judgement has been used to define it, sufficient to allow for the assessment of indirect as well as direct effects. In all cases however, the width of the corridor has been used with a degree of flexibility. Therefore if an important receptor that may experience a likely significant effect is located just beyond the study area boundary it is included in the assessment.

4.5 Duration & Frequency of Effects

4.5.1 Environmental effects 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). The durations of temporary construction effects are listed as follows:

- Short-term: one to three years;
- Medium-term: four to nine years; and
- Long-term: greater than nine years.

4.5.2 Where environmental effects are intermittent, the frequency of the events is predicted.

4.6 Baseline & Assessment Scenarios

4.6.1 A review of existing available information was undertaken using various methods, including literature research, desktop review of previous reports and studies, site investigations and consultations. The majority of the baseline information was established between 2013 and 2014. Sources of information, survey methodologies and survey periods are provided under each of the environmental topics.

4.6.2 The environmental assessment process involves forecasting effects by comparing a scenario with the Scheme against one without the Scheme, over time. The absence and presence of the Scheme are referred to as the Do-Minimum and Do-Something scenarios respectively. The potential significant environmental effects need to be defined for the Do-Minimum and Do-Something scenarios in the baseline year and a future year, or series of future years depending on the assessment topic.

4.6.3 For the Scheme the following baselines and future years are used:

- The existing base line year is 2013-14 and 2015 in some cases (depending on data availability);
- The start of construction is 2017;
- 2018 is the ‘opening year’; and
- A future year of 2033 is the ‘design year’ (generally regarded as the worst impact year in the first 15 years after opening).

4.6.4 The above scenarios are explained further in the environmental topic sections where relevant.

4.6.5 With regard to the effects of construction, the potential temporary effects have been assessed against the existing baseline situation in 2013-14 and 2015 in some cases (depending on the availability of data), but with any significant changes to that baseline that may be brought about by the completion of other developments during the Scheme's construction period (2017 to 2018) having been taken into consideration.

4.6.6 The future years are chosen to reflect any significant effects that may be predicted to arise and will be topic specific (i.e. year 15 for Air Quality and Noise).

4.6.7 Baseline data has been obtained from the collation of existing information or from the results of surveys commissioned specifically for the Scheme, or both. The existing baseline is informed by data that are 'current' and future baselines are informed by a review of the currently available data by reference to, for example, Government policy, planning applications and the expert judgement of the individual topic specialists.

4.6.8 Assessment involving future year baselines and the assessment of cumulative effects (see below) can become confused and it is therefore necessary when undertaking these assessments that the data being used are clearly defined. For example, air quality and noise modelling of a future year scenario are dependent on the results of traffic forecasts which themselves are derived from traffic modelling that includes traffic predicted to be generated by future developments. Therefore traffic generated noise and air quality effects of future developments in the design year would be assessed as part of a future baseline, whereas potential ecological effects of those developments would be assessed as part of the cumulative effects assessment.

4.7 Assessment of Effects

4.7.1 When assessing the effect on the environment or a specific receptor, guidance outlines a three stage approach as follows:

- Assigning environmental value to (or sensitivity of) a resource or receptor
- Assigning a level or magnitude of impact as a result of the Scheme
- Assigning a level of significance

Sensitivity of Receptors

4.7.2 Receptors are defined as the physical resource or user group that would be subject to an impact or are representative of a group of individuals in the area of assessment. The baseline studies have identified potential environmental receptors. Some receptors would be more sensitive to certain environmental impacts than others. The sensitivity of a receptor, for example, may depend on:

- Rarity or relative abundance;
- Its quality;
- Statutory designation and importance in a national, regional or local context;
- Historic or cultural associations;
- Regeneration capacity or fragility;

- Absorption capacity of the natural environment; and
- Irreplaceability.

4.7.3 Table 4.1 describes the typical criteria or descriptors used to determine the environmental value of an environmental resource or receptor (reproduced from DMRB 11.2.5 (HA205/08), Table 2.1.).

Table 4.1: Environmental Value or Sensitivity

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	Low or medium importance and rarity, local scale.
Negligible	Very low importance and rarity, local scale.

Magnitude of impacts

4.7.4 Table 4.2 (reproduced from DMRB 11.2.5 (HA205/08), Table 2.2) provides a generic five point scale for assigning magnitude of impact that will be used wherever possible by individual assessment topics.

Table 4.2: Magnitude of Impact

Magnitude of Impact	Typical Criteria Description
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	No loss or alteration of characteristics, features or elements; no

Magnitude of Impact	Typical Criteria Description
Change	observable impact in either direction.

Significance of Effects

4.7.5 Where sufficient information exists to value a receptor and to understand the magnitude of the impact (as above), the assessment methodology often uses a matrix to determine significance of the effect. In this approach significance of effect is determined by a combination of the value of the receptor being affected and the magnitude of the impact. Table 4.3 (reproduced from DMRB 11.2.5 (HA205/08), Table 2.4) outlines the significance matrix typically used for assigning significance to effects.

Table 4.3: Significance of Effects Matrix

		Magnitude of impact				
		No Change	**Negligible**	**Minor**	**Moderate**	**Major**
Value	**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

4.7.6 In Wales it is a requirement that the assignment of significance before and after the consideration of the effectiveness of the design and committed mitigation measures is undertaken to allow for the case or reason for, and effectiveness of mitigation to be described.

4.7.7 The majority of the assessment topic chapters in this ES have used the above approach although the detailed wording of the criteria descriptors of value/sensitivity and magnitude may vary to make them more pertinent to the individual topic. In cases where the above approach has not been adopted, for example because best practice advocates that the assessment and the significance of effect should be communicated both numerically and descriptively, general levels of significance may still be employed as described in Table 4.4.

Table 4.4: Significance of Effect Categories

Significance Category	Typical Descriptors of Effect
Very large	Only adverse effects are assigned this level of importance as they represent key factors in the decision-making process. These effects are generally, but not exclusively associated with sites and features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. A major change at a regional or district scale site or feature may also enter this category.
Large	These beneficial or adverse effects are likely to be very important considerations at a local or district scale and, if adverse, are potential concerns to the Scheme and may become material in the decision making process.
Moderate	These beneficial or adverse effects while important at a local scale are not likely to be key decision making issues. Nevertheless, the cumulative effect of such issues may influence decision making if they lead to an increase in the overall adverse effects on a particular area or on a particular resource.
Slight	These beneficial or adverse effects may be raised as local factors but are unlikely to be of critical in the decision making process. Nevertheless they are of relevance in enhancing the subsequent design of the Scheme and consideration of mitigation or compensation measures.
Neutral or insignificant	No effect or an effect which is beneath the level of perception, within normal bounds of variation or within the margin of forecasting error. Such effects should not be considered by the decision maker.

Cumulative Impacts

4.7.8 Cumulative impacts can be defined as impacts that "*result from multiple actions on receptors and resources and 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*" (Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interaction, European Commission, May 1999).

4.7.9 This ES will consider:

- Impacts within the Scheme, where there are a number of effects on a single receptor; and
- Impacts arising from other projects which act cumulatively with the Scheme.

4.7.10 The first of these cumulative impact assessment types can be addressed using a matrix style approach, which quantifies the combined impact of a number of differing environmental impacts on a single receptor or resource (e.g. combined effects of noise, air quality and noise impacts on nearby residents).

4.7.11 In the second type, the impact may arise from the combined action of a number of different projects, in combination with the project being assessed, on a single

receptor/ resource. This type is confined to within a single assessment topic but can include multiple effects of the same or similar type from a number of projects upon the same receptor/resource.

4.7.12 Detailed information on the cumulative impacts is provided in Chapter 16: Cumulative effects.

5 PLANNING POLICY & CONTEXT

5.1 Introduction

5.1.1 This section provides an overview of the relevant planning policies and discusses how they relate to the Scheme. It is not the intention of this assessment to address every document that could have some bearing on the Scheme, but rather to identify those matters that are particularly relevant to assessing the compatibility of the Scheme with key elements of the policy or guidance. Specialist assessments within this ES consider the impacts of the Scheme on additional policies and plans relevant to their respective environmental topic (e.g. Air quality, Noise, Traffic, etc.).

Methodology

5.1.2 The assessment has been carried out in accordance with the guidelines in the DMRB Volume 11, Section 3, Part 12 – Impact of Road Schemes on Policies and Plans.

Temporal Context

5.1.3 Policies and plans have largely been considered for the assessment period up to 2026. This period corresponds with the timetable covered by the adopted and emerging (i.e. draft) local development plan (LDP). The weight to be attached to emerging development plans, which are going through the statutory process towards adoption, depends on the stage of preparation – the weight will increase as successive stages are reached and upon the degree of any conflict with the existing plan.

Spatial Context

5.1.4 Spatial planning policy, including transport policy, has been assessed at the national and local geographical levels.

5.2 National Planning Policies

5.2.1 Relevant national planning policies are summarised in the following subsections.

Planning Policy Wales (PPW) (2016)

5.2.2 PPW (edition 8, January 2016) sets out the land use planning policies of the Welsh Government and is supplemented by 21 topic based Technical Advice Notes (TANs). TANs prescribe the government's policies on various planning issues that shape the preparation of development plans. The principles and objectives of TANs prescribe the overarching national guidance for specific individual environmental topics. TANs relevant to the Scheme include:

- TAN 5: Nature Conservation and Planning
- TAN 6: Planning for Sustainable Rural Communities
- TAN 11: Noise
- TAN 12: Design
- TAN 15: Development and Flood Risk
- TAN 18: Transport
- TAN 23: Economic Development

5.2.3 The Scheme is considered to enhance the economic well-being of communities by enhancing access to St Athan and Cardiff Airport Enterprise Zones. The Scheme is considered to enhance the environmental well-being of communities by improving traffic safety, offering an attractive alternative to vehicular traffic away from residential properties along Five Mile Lane and the A4050 through northern Barry. The Scheme offers benefit to non-vehicular users by increasing the facilities for cyclists and pedestrians. The Scheme is therefore considered to help achieve a better quality of life for future generations in terms of living conditions, connectivity and economic sustainability, and is therefore considered to comply with objectives and policies set out in chapter 4 of PPW and TAN 18.

5.2.4 The design of the Scheme is considered to take account of the landscape features and surrounding rural character of the site and surroundings. A number of differing solutions were assessed during the design stage. The chosen design is considered to minimise impact on landscape and biodiversity therefore complying with the objectives set out in Chapters 4 and 5 of PPW.

People, Places, Future: The Wales Spatial Plan (2008)

5.2.5 The Wales Spatial Plan was adopted by the Welsh Government in 2004 and updated in 2008. The purpose of the Wales Spatial Plan is to ensure that what is done in the public, private and third sectors in Wales is integrated and sustainable, and that actions within an area support each other and jointly move towards a shared vision for Wales and for the different parts of Wales. The Plan identifies six Spatial Plan areas within Wales. The Spatial Plan area which the Scheme falls under is South East Wales. The Wales Spatial Plan identifies three Strategic Opportunity Areas (SOAs) within South East Wales that will provide the focus for major employment led development with potential regional benefits. The St Athan Enterprise Zone is identified as one of those SOAs.

5.2.6 The Wales Spatial Plan encompasses the elements required to deliver sustainable development. Whilst it is a statutory plan, it does not form part of the Development Plan framework, but provides the context and informs the preparation of both the Local Development Plan and National and Regional Transport Plan.

Wales Infrastructure Investment Plan (WIIP)

5.2.7 The WIIP for Growth and Jobs “sets out the Welsh Government strategic investment priorities” until 2014/15. The priorities relevant to the proposed development are:

- Economic growth – addressing urban congestion and improving access to key areas;
- Improving inter-modal transport links;

Active Travel Act 2013

5.2.8 The *Active Travel Act 2013* was introduced in November 2013 and applies to all new development within Wales. For the purposes of definition, ‘active’ refers to walking and cycling routes. The *Active Travel Act 2013* 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. These factors have been considered ion the development of the Scheme.

5.3 National Transport Policies

5.3.1 Relevant national transport policies are summarised in the following subsections.

National Transport Plan (NTP) (March 2010) & Prioritised National Transport Plan (December 2011)

5.3.2 The NTP details the Welsh Government's approach to putting transport onto a carbon reduction pathway, whilst at the same time ensuring that it can continue to support sustainable economic development and social inclusion.

5.3.3 Under item 87, the Plan states '*We will introduce a high-quality, express bus service between Cardiff and Cardiff Airport, and, working with the local authority, to take forward safety improvements on the A4226 Five Mile Lane*'.

5.3.4 The prioritisation of the NTP has brought forward investment that will make the transport system in Wales work better to help tackle poverty, increase well-being and assist economic growth.

5.3.5 The NTP has been subject to a Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA) and Equality Impact Assessment, which were all published in 2009. Section 9.2 of the NTP HRA states that '*all projects in the NTP will be subject to a project level HRA / AIES, regardless of the findings of the screening or appropriate assessment stages of this HRA*'.

5.3.6 The studies undertaken in Chapter 9 of this ES has confirmed that no European sites would be affected by the Scheme therefore a project level HRA / AIES is not required for this Scheme.

Draft NTP 2015

5.3.7 The Welsh Government conducted public consultation on the draft NTP between December 2014 and March 2015, with a view to publish the updated version of the NTP in Spring 2015. The final NTP is yet to be published.

5.3.8 Paragraph 3.20.4 of the draft NTP states '*we are enhancing surface connectivity to Cardiff Airport by funding an express bus shuttle service between the airport and the city centre and Cardiff Bay, and funding improvements to the A4226 road (Five Mile Lane)'*.

5.4 Local Planning Policies

5.4.1 Vale of Glamorgan Council is a unitary authority responsible for county-wide planning policies. The development plan for the Scheme comprises:

- The Vale of Glamorgan Adopted Unitary Development Plan 1996-2011 (UDP) (2005); and
- Vale of Glamorgan Draft Local Development Plan (LDP) (2013).

5.4.2 The Scheme's relationship to each of these plans is summarised in the following subsections. In addition to the high level local policy assessment below, a topic specific assessment of local policy is made within the individual discipline chapters.

Vale of Glamorgan Adopted UDP 1996 – 2011 (2005)

5.4.3 The Vale of Glamorgan Adopted UDP provides the strategic and detailed policy framework within which provision will be made for development and conservation needs within the county. The Plan concentrates on the issues that the Vale of Glamorgan Council consider necessary to address in order to protect and enhance the environment of the county whilst providing detailed guidance for future development proposals. Table 5.1 provides a summary of the relevant policies from the Vale of Glamorgan UDP and describes how the Scheme will achieve the objectives of those policies.

Vale of Glamorgan Draft LDP (2013)

Vale of Glamorgan Council is currently in the process of drafting a Local Development Plan for the County. Once adopted, the Local Development Plan will provide a strategic direction to future growth and development within the Vale of Glamorgan. The Draft LDP focuses on the principles of sustainable development, particularly on environmental enhancement and improving economic productivity across the region. A summary of the relevant policies under the Plan and an explanation of how the Scheme will achieve the objectives of those policies are provided in Table 5.2.

Table 5.1: Relevant Vale of Glamorgan UDP Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
1.	**Environment** The Vale of Glamorgan's distinctive rural, urban and coastal character will be protected and enhanced. Particular emphasis will be given to conserving areas of importance for landscape, ecology and wildlife, the best and most versatile agricultural land and important features of the built heritage. Proposals which enhance these areas will be favoured.	The Scheme is located in a rural setting, and is surrounded by agricultural land. Part of the central section of the Scheme travels offline and as a consequence, permanently requires 27.3 ha of agricultural land take of which approximately 3.5 ha is Best and Most Versatile agricultural land. The existing highway will be retained as a cycleway route and to provide access for local users. The proposed Scheme is located between two Special Landscape Areas (Nant Llancarfan and Dyffryn Basin and Ridge Slopes). The proposed Scheme is located in close proximity to a number of designated sites and protected species.
2.	**Environment** Proposals which encourage sustainable practices will be favoured including: • proposals which contribute to energy conservation or efficiency, waste reduction or recycling; pollution control; biodiversity and the conservation of natural resources; • proposals which are located to minimise the need to travel, especially by car and help to reduce vehicle movements or which encourage cycling, walking and the use of public transport; • the reclamation of derelict or degraded land for appropriate beneficial use; and • proposals which improve the quality of the environment through the utilisation of high standards of design.	The Scheme will improve access and safety along Five Mile Lane. Where possible, use of materials for construction will be reduced, through reuse, recycling or reclamation. The Scheme will enhance cycling and pedestrian facilities by constructing dedicated infrastructure into the development and by dedicating part of the existing highway as an advisory cycle route in a safer environment.
3.	**Transportation** Improvements to the transportation network will consist of: • Strategic transport schemes within and adjoining the existing urban areas of the waterfront strip of Penarth, Dinas Powys, Barry and Rhoose; • Local schemes necessary for environmental and safety reasons; and • Schemes to encourage travel by cyclists and pedestrians.	The Scheme is not described as a planned improvement in the UDP, however a primary benefit of the Scheme is to deliver safety improvements. The Scheme will also deliver improved journey times between Barry, Rhoose and the A48. The Scheme will improve provision for cyclists and pedestrians.

Table 5.1: Relevant Vale of Glamorgan UDP Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
12	**Minerals** A sufficient stock of stone, for both aggregate and cement production, will be protected to maintain the Vale of Glamorgan's traditional share of regional supplies. In addition, the recycling of secondary aggregates and industrial wastes will be favoured and encouraged to the maximum practicable extent as substitutes for naturally occurring minerals.	The Scheme is not located within an area that is identified as being protected for minerals in the UDP. However, it should be noted that the area within which the Scheme is located is identified as a Minerals Safeguarding area in the Draft LDP. Where possible, materials used in construction will be reused, or from recycled sources, reducing the requirement for minerals to be provided from external sources, and for minerals extraction.
13	**Waste Management** Development proposals which encourage sustainable principles for waste disposal based on a hierarchical approach of: • waste minimisation / avoidance; • re-use of waste; • waste re-cycling or recovery (including waste conversion to energy); and • waste disposal land fill with minimal environmental impact. Will be favoured.	The approach to waste management will be set out in detail in a Site Waste Management Plan developed by the Principal Contractor during construction. Measures described in this plan will ensure that where possible, materials use will be minimised, through reuse, recycling or recovery.
Env 1	**Development in the Countryside** Within the delineated countryside permission will only be granted for: • Development which is essential for agriculture, horticulture, forestry or other development including mineral extraction, waste management, utilities or infrastructure for which a rural location is essential; • Appropriate recreational use; • The re-use or adaptation of existing buildings particularly to assist the diversification of the rural economy; or • Development which is approved under other policies of the plan.	The Scheme is located in the open countryside, however it is proposed that the Scheme is identified as an allocation in Draft LDP.

Table 5.1: Relevant Vale of Glamorgan UDP Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
Env 2	**Agricultural Land** The Best and Most Versatile agricultural land (Grades 1, 2, and 3a) will be protected from irreversible development, save where overriding need can be demonstrated. Non-agricultural land or land of a lower quality should be used when developments are proposed, unless such land has a statutory landscape, nature conservation, historic or archaeological designation which outweighs agricultural considerations.	The Scheme has been designed to minimise areas of land take over Best and Most Versatile agricultural land. Of the total 27.3ha of agricultural land take permanently required for the Scheme, only 3.5ha is Best and Most Versatile Agricultural Land. This area will be required to develop the offline section of the Scheme. There are no detailed Agricultural Land Classification surveys available for the Scheme however, the provisional Agricultural Land Classification of England and Wales 1985 indicates that the area around the proposed Scheme is a mixture of Grade 3 or 4. DMRB Volume 11.3.6 indicates that when a Scheme would potentially result in the loss of 20 hectares or more of Best and Most Versatile agricultural land the applicant may have to consult Natural Resource Wales. However, as the quantity of land is less than 20ha, there is no need to consult Natural Resource Wales.
Env 4	**Special Landscape Area** New development within or closely related to the following special landscape areas will be permitted where it can be demonstrated that it would not adversely affect the landscape character, landscape features or visual amenities of the Special Landscape Area: • Ely Valley And Ridge Slopes • Lower Thaw Valley • Upper Thaw Valley • Nant Llancarfan • Cwrt Yr Ala Basin • Duffryn Basin and Ridge Slopes • Castle Upon Alun	There are two SLAs relevant to the Scheme and which are bounded by the existing Five Mile Lane: Nant Llancarfan and Duffryn Basin and Ridge Slopes. Moderate Adverse effects are anticipated within the Western Rolling Ridges and Slopes landscape character area (which forms part of the Nant Llancarfan SLA) and Upper Waycock Valley landscape character area (which forms part of the Duffryn Basin and Ridge Slopes SLA) during and within the first year following construction of the Scheme. Slight Adverse effects are anticipated on this landscape character area during operation of the Scheme.

Table 5.1: Relevant Vale of Glamorgan UDP Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
Env 11	**Protection of Landscape Features** Development will be permitted if it does not unacceptably affect features of importance to landscape or nature conservation including: trees, woodland hedgerows, river corridors, ponds, stone walls and species rich grasslands.	The Scheme would introduce some adverse effects where it directly impacts on the landscape, although this will reduce over time. The scale of these impacts is reduced due to the existing Five Mile Lane, which provides infrastructure through the landscape setting and forms an important component of the historic context of the landscape. In addition, the landform and existing vegetation limit the visual context of the Scheme, thus reducing the overall impact on the landscape character of the area. The proposed hedgerow and woodland planting will soften the Scheme and help integrate it into the local landscape.
Env 12	**Woodland Management** The improvement, management and extension of woodland tree cover and hedgerows, particularly of broadleaf native species, will be favoured, especially where it: • Makes a significant improvement of the landscape, such as on derelict land, the urban fringe or in the vicinity of major road/ rail corridors and quarries; or • It helps to diversify and extend wildlife habitats; or • It add to recreational and educational opportunities.	The Scheme will result in the loss of 0.431 ha of ancient semi-natural broad-leaved woodland, 0.016 ha of broad-leaved woodland and 0.12 ha of scrub. These losses will be mitigated through the planting of a 2.8 ha area of new woodland between Middleton Plantation and Sutton Wood, which will include the movement of woodland soil across to the planting site, and another 0.371 ha area of new woodland planted adjacent to the Scheme between Ch400m and Ch500m. Furthermore, 530 m of hedgerow will be lost during Scheme construction. This will be replaced with 6,230 m of new planted hedgerow. Planting of hedgerows will be carried out using the range of tree and shrub species that are found in the existing hedgerow network.
Env 14	**National Sites of Nature Conservation Interest** Development likely to have an adverse effect, either directly or indirectly on the conservation value of a National Nature Reserve or a Site of Special Scientific Interest (SSSI) will not be permitted unless there is no alternative and it can be demonstrated that the benefits arising from the development clearly outweigh the special interest of the site. If development is permitted, appropriate conditions or agreed planning obligations will be used to secure adequate compensation or mitigation measures.	Within 2 km of the Scheme, there are three SSSIs. These are the Barry Woodlands SSSI, the Nant Whitton Woodlands SSSI and the Cliff Wood –Golden Stairs SSSI. The Barry Woodlands SSSI complex is bisected by Five Mile Lane and two blocks of woodland are directly affected. The Scheme will result in the loss of 0.431 ha of this woodland. This impact will be mitigated through the planting of 2.8 ha of new woodland between Middleton Plantation and Sutton Wood. Soil from the area within the SSSI that is lost to the Scheme will also be moved across to the new area to promote the rapid establishment of native ground flora. The two other woodland SSSIs will not be affected.

Table 5.1: Relevant Vale of Glamorgan UDP Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
Env 15	**Local Sites of Nature Conservation Significance** Development and land use change likely to have an unacceptable effect on a local nature reserve, a regionally important geological/ geomorphological site, or a site shown to be of importance for nature conservation will not be permitted unless the reasons for the proposal clearly outweigh the local importance of the site. If development is permitted, appropriate conditions or agreed planning obligations will be used to ensure the impact on nature conservation is minimised.	There are 58 Sites of Importance for Nature Conservation (SINC) within 2km of the Scheme. Of these, three will be directly impacted. Impacts will include the permanent loss of 0.12 ha of scrub from SINC 222 Land North East of Whitton Rosser Farm and 0.016 ha of broad-leaved woodland from SINC 220 Land South of Blacklands Farm. They will also include the temporary loss of 0.03 ha of grassland from the western edge of SINC 336 Walters Farm under a temporary licence for construction. There will also potentially be minor impacts from air pollution, dust and disturbance to these sites during construction of the Scheme. Permanent impacts will be mitigated through the planting of 0.371 ha of woodland at Ch400m to Ch500m along the Scheme alignment. This woodland will be planted with the aim of matching the composition of woodland canopy and shrub species of the original SINC and will replace the area lost. The 0.03 ha of grassland temporarily lost during construction would be restored and replanted upon completion of construction activities.
Env 16	**Protected Species** Permission will only be given for development that would cause harm to or threaten the continued viability of a protected species if it can be clearly demonstrated that: • There are exceptional circumstances that justify the proposals; • There is no satisfactory alternative; • Effective mitigation measures are provided by the developer.	The Scheme is predicted to result in slight adverse effects on fish (including bullhead, European eel and brown trout), skylark, yellowhammer, kingfisher, other breeding birds, commuting and foraging bats, dormice, otters and brown hare during construction. It is also predicted to result in slight adverse effects on other amphibians (i.e. not great crested newts), reptiles, skylark, commuting and foraging bats and dormice during operation of the Scheme. All other impacts on protected species will be either neutral or beneficial. The Scheme will not threaten the continued viability of any protected species.

Table 5.1: Relevant Vale of Glamorgan UDP Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
Env 17	**Protection of built and historic environment** The environmental qualities of the built and historic environment will be protected. Development which has a detrimental effect on the special character appearance or setting of: • A building or group of buildings, structure or site of architectural or historical interest, including listed buildings and conservation area; • Scheduled ancient monuments and sites of archaeological and/ or historic interest; • Designed landscapes, parks or gardens of historic, cultural or aesthetic importance Will not be permitted.	The Scheme will not directly affect listed buildings, conservation areas or historic parks and gardens and there are no scheduled monuments or listed buildings within the disturbance footprint of the Scheme. However, the Scheme is likely to have a Large/Very Large or Moderate/Large adverse effect upon three known below-ground heritage assets which include remains associated with Whitton Lodge Roman villa (00382s), ring ditch (04148s) and part of an extensive Iron Age/Romano-British settlement (03121s). There is high potential for hitherto unknown buried archaeology to be present within areas of new land take, as indicated by significant evidence for prehistoric and Romano-British activity in the immediate vicinity. There is also potential for an extensive burial ground with national significance. A programme of fieldwork will be implemented to inform a mitigation strategy for a final stage of more detailed archaeological investigation of significant remains. It is also considered that the Scheme will have a slight adverse permanent impact upon the setting of two Scheduled Monuments (GM116 and GM117), a slight adverse / neutral impact upon one Scheduled Monument (GM613) and a moderate / large adverse impact upon one Historic Landscape (HLCA010). The effects cannot be reduced through archaeological mitigation; therefore mitigation will be provided through design and screening.
Env 18	**Archaeological field evaluation** Where development is likely to affect a known or suspected site of archaeological significance, an archaeological evaluation should be carried out at the earliest opportunity and may be required before the proposal is determined. Detailed plans would need to reflect the conclusions of the evaluation.	An Archaeological Watching Brief (see Appendix 7.3) and Written Scheme of Investigation (see Appendix 7.4) has been produced in response to a request from the Glamorgan Gwent Archaeological Trust (GGAT).
Env 19	**Preservation of Archaeological remains** Where development is permitted which affects a site of archaeological importance archaeological mitigation measures will be required to ensure preservation on site or adequate recording prior to disturbance.	A suitable scheme of investigation and recording for buried archaeological remains has been devised in conjunction with the Planning Archaeologist at GGAT, in order that mitigation through preservation by record can be achieved.

Table 5.1: Relevant Vale of Glamorgan UDP Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
Env 26	**Contaminated land and unstable land** Proposals for the redevelopment of contaminated land and unstable land will be permitted where the contamination and/ or instability will be removed or reduced to a level where the is no unacceptable risk to the health and safety of those living or working on the site or nearby, to flora and fauna on the site or nearby, and to the quality of the air and water on these sites or nearby.	Ground investigations have not identified any contamination, or the presence of Made Ground, with the exception of the existing Five Mile Lane embankments.
Env 29	**Protection of environmental quality** Development will not be permitted if it would be liable to have an unacceptable effect on either people's health and safety of the environment: • By releasing pollutants into water, soil or air either on or off site; or • From smoke, fumes, gases, dust smell, noise, vibration light or other polluting emissions.	With the implementation of a sufficient design to take into account mitigation measures, there are no predicted significant residual impacts to geology, soils and hydrogeology.

Table 5.2: Draft Vale of Glamorgan Local Development Plan Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
SP1	**Delivering the strategy** The strategy will seek to improve the living and working environment, promote enjoyment of the countryside and coast and manage important environmental assets. This will be achieved by: i. Providing a range and choice of housing to meet the needs of all sectors of the community; ii. Promoting a range of employment sites intended to meet the needs of the Vale of Glamorgan and the wider capital region; iii. Reinforcing the role of Barry, service centre settlements and primary settlements as providers of cultural, commercial and community services; iv. Promoting sustainable transport; v. Delivering key infrastructure linked to the impacts of development; vi. Protecting and enhancing the built, natural and coastal environment; vii. Promoting opportunities for sustainable tourism and recreation; and viii. Favouring development that promotes healthy living.	The Scheme will deliver key infrastructure, and is necessary to support future development in Barry and the Cardiff Airport and St Athan Enterprise Zones. The Scheme will reroute Five Mile Lane across previously undeveloped countryside however, any impacts to ecology, landscape or the built environment will be mitigated or reduced to a level where there are only minor effects. The Scheme will increase opportunities for safer walking and cycling.

Table 5.2: Draft Vale of Glamorgan Local Development Plan Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
SP7	**Transportation** Sustainable transport improvements that serve the economic, social and environmental needs of the Vale of Glamorgan and promote the objectives of the South East Wales Regional Transport Plan will be favoured. Key priorities for the delivery of strategic transportation infrastructure will be: 3. Improvements to the A4226 between Waycock Cross, Barry and Sycamore Cross, A48 (Five Mile Lane); Priority will also be given to schemes that improve highway safety and accessibility, public transport, walking and cycling. All new developments that have a direct impact on the strategic transportation infrastructure will be required to deliver appropriate improvements to the network.	The Scheme is being pursued by the Vale of Glamorgan Council in support of the Welsh Government's Regional Transport Plan, which identified Five Mile Lane as requiring improvements. The Scheme will deliver improvements to journey times and safety for travellers using this route.
SP9	**Minerals** The local and regional need for the provision of a continuous supply of minerals, will be achieved through: 1. Maintaining a minimum of 10 years land bank of hard rock throughout the plan period; 2. Favouring proposals which promote the sustainable use of minerals and encourage the use of secondary and alternative resources; 3. The safeguarding of known resources of limestone, sand and gravel where these occur outside settlements, from permanent development that would prejudice their future extraction; and 4. Safeguarding wharf facilities for the landing of marine dredged sand & gravel.	The Scheme is located within a Minerals Safeguarding Area. The section of the Scheme alignment that is constructed offline will permanently sterilise the minerals resource.

Table 5.2: Draft Vale of Glamorgan Local Development Plan Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
SP10	**Built and Natural Environment** Development proposals must preserve and where appropriate enhance the rich and diverse built and natural environment and heritage of the Vale of Glamorgan including: 1. The architectural and / or historic qualities of individual buildings or conservation areas; 2. Historic landscapes, parks and gardens; 3. Special Landscape Areas; 4. The Glamorgan Heritage Coast; 5. Sites designated for their local, national and European nature conservation importance; and 6. Important archaeological and geological features.	The Scheme will not directly affect listed buildings, conservation areas or historic parks and gardens and there are no scheduled monuments or listed buildings within the Scheme's disturbance footprint. However, the Scheme is likely to have a Large/Very Large or Moderate/Large adverse impact upon three known below-ground heritage assets which include remains associated with Whitton Lodge Roman villa (00382s), ring ditch (04148s) and part of an extensive Iron Age/Romano-British settlement (03121s). There is high potential for hitherto unknown buried archaeology to be present within areas of new land take, as indicated by significant evidence for prehistoric and Romano-British activity in the immediate vicinity. There is also potential for an extensive burial ground with national significance. A programme of fieldwork will be implemented to inform a mitigation strategy for a final stage of more detailed archaeological investigation of significant remains. It is also considered that the Scheme will have a slight adverse permanent impact upon the setting of two Scheduled Monuments (GM116 and GM117), a slight adverse / neutral impact upon one Scheduled Monument (GM613) and a moderate / large adverse impact upon one Historic Landscape (HLCA010). The effects cannot be reduced through archaeological mitigation; therefore mitigation will be provided through design and screening. The proposal is located between two Special Landscape Areas.
MG16 (16 ad 2)	**Transport Proposals** Land for the following transportation schemes is allocated: **Walking and Cycling** 2. A4050 Port Road to Cardiff Airport **Highways** 16. Improvements to the A4226 between Waycock Cross, Barry and Sycamore Cross, A48 **Highway improvement works** In addition, to mitigate the impact of development on the highway network, highway improvement works in the form of corridor or junction improvement schemes will be required.	The entire length of the A4226 (Five Mile Lane) is identified in the plan, as being allocated for 'Improvements to the A4226 between Waycock Cross, Barry and Sycamore Cross, A48'. In the South, the Scheme connects to the A4050, which is also identified in the LDP Key Diagram, and policy MG16 as being subject to improvements.

Table 5.2: Draft Vale of Glamorgan Local Development Plan Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
MG17 (4 & 5)	**Special Landscape Area** The following areas are designated as special landscape areas: 4. Nant Llancarfan; 5. Dyffryn Basin & Ridge Slopes; Within the special landscape areas identified above, development proposals will be permitted where it is demonstrated they would cause no unacceptable harm to the important landscape character of the area.	The Scheme is located on the junction between Nant Llancarfan Special Landscape Area, and Dyffryn Basin & Ridge Slopes Special Landscape Area. Moderate Adverse effects are anticipated within the Western Rolling Ridges and Slopes landscape character area (which forms part of the Nant Llancarfan SLA) and Upper Waycock Valley landscape character area (which forms part of the Duffryn Basin and Ridge Slopes SLA) during and within the first year following construction of the Scheme. Slight Adverse effects are anticipated on this landscape character area during operation of the Scheme.
MG19	**Sites of Importance for Nature Conservation** Development which has an unacceptable impact on Sites of Importance for Nature Conservation (SINCs) will not be permitted	There are 58 SINCs within 2km of the Scheme. Of these, three will be directly impacted. Impacts will include the permanent loss of 0.12 ha of scrub from SINC 222 Land North East of Whitton Rosser Farm and 0.016 ha of broad-leaved woodland from SINC 220 Land South of Blacklands Farm. They will also include the temporary loss of 0.03 ha of grassland from the western edge of SINC 336 Walters Farm under a temporary licence for construction. There will also potentially be minor impacts from air pollution, dust and disturbance to these sites during construction of the Scheme. Permanent impacts will be mitigated through the planting of 0.371 ha of woodland at location Ch400m to Ch500m along the Scheme alignment. This woodland will be planted with the aim of matching the composition of woodland canopy and shrub species of the original SINC and will replace the area lost. The 0.03 ha of grassland temporarily lost during construction would be restored and replanted upon completion of construction activities.

Table 5.2: Draft Vale of Glamorgan Local Development Plan Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
MG20	**Development In Minerals Safeguarding Areas** Known mineral resources of sandstone, sand and gravel and limestone are safeguarded from all forms of permanent built development as shown on the proposals map. New development will only be permitted in an area of known mineral resource where it has first been demonstrated that: 1. Any reserves of minerals can be economically extracted prior to the commencement of the development; or 2. Extraction would have an unacceptable impact on environmental or amenity considerations; or 3. The resource in question is of poor quality / quantity; and 4. The development would have no significant impact on the possible working of the resource by reason of its nature or size.	The Scheme is located entirely within a Limestone Category 2 Safeguarding area. This Safeguarding Area covers much of the Vale of Glamorgan. The Scheme also runs through a Sand and Gravel Category 2 Safeguarding area. The section of the Scheme which travels offline will, in effect, sterilise the mineral resources affected, as it will not be possible to extract them.
MD8	**Environmental Protection** Development proposals will be required to demonstrate they will not result in an unacceptable impact on people, residential amenity, property and/ or the natural environment from either: 1. Pollution of land, surface water, ground water and the air; 2. Contaminated land; 3. Hazardous substances; 4. Noise, vibration, odour nuisance and light pollution; 5. Flood risk and consequences; 6. Coastal erosion or land stability; or 7. Any other identified risk to public health and safety. Where impacts are identified the council will require applicants to demonstrate that appropriate measures can be taken to minimise the impact identified to an acceptable level. Planning conditions may be imposed or legal obligation entered into, to secure any necessary mitigation and monitoring processes.	The impacts associated with the potential environmental effects identified in this policy are addressed in this ES. Where necessary, mitigation is proposed which will ensure any adverse effects are mitigated, and that the Environment is protected. Mitigation measures are described within each of the environmental topic chapters.

Table 5.2: Draft Vale of Glamorgan Local Development Plan Policies

No.	Policy Description and Objectives	Achievement of Policy Objectives
MD9	**Historic Environment** Development proposals must protect the qualities of the built and historic environment of the Vale of Glamorgan, specifically: 1. Within conservation areas, development proposals must preserve or enhance the character or appearance of the area; 2. For listed and locally listed buildings, development proposals must preserve or enhance the building, its setting and any features of significance it possesses; 3. Within designed landscapes, historic parks and gardens, and battlefields, development proposals must respect the special historic character and quality of these areas, their settings or historic views or vistas.	The Scheme will not directly affect listed buildings, conservation areas or historic parks and gardens and there are no scheduled monuments or listed buildings within the Scheme's disturbance footprint. However, the Scheme is likely to have a Large/Very Large or Moderate/Large adverse impact upon three known below-ground heritage assets which include remains associated with Whitton Lodge Roman villa (00382s), ring ditch (04148s) and part of an extensive Iron Age/Romano-British settlement (03121s). There is high potential for hitherto unknown buried archaeology to be present within areas of new land take, as indicated by significant evidence for prehistoric and Romano-British activity in the immediate vicinity. There is also potential for an extensive burial ground with national significance. A programme of fieldwork will be implemented to inform a mitigation strategy for a final stage of more detailed archaeological investigation of significant remains. It is also considered that the Scheme will have a slight adverse permanent impact upon the setting of two Scheduled Monuments (GM116 and GM117), a slight adverse / neutral impact upon one Scheduled Monument (GM613) and a moderate/large adverse impact upon one Historic Landscape (HLCA010). The effects cannot be reduced through archaeological mitigation; therefore mitigation will be provided through design and screening.

5.5 Local Transport Policies

Vale of Glamorgan Draft Local Transport Plan 2015 – 2030 (LTP) (2015)

5.5.1 Five Mile Lane is identified as a Strategic Transport Corridor in the Key Diagram within the adopted LTP. The Scheme is identified as a priority in the LTP and is listed as an improvement for delivery within the next 5 years. The Scheme is described by the LTP as being required to '*provide off line improvements to this very busy corridor to assist with access to the strategic highway network and to the airport Enterprise Zone*.'

5.6 Summary

5.6.1 Although no specific measures would be used to mitigate the impacts of the Scheme on policies themselves, legislation which serves to regulate the material environmental impacts of development will dictate the thresholds and standards required of the Scheme. Consequently, it is assumed that any conflict between policies and the Scheme can be effectively resolved through appropriate mitigation.

5.6.2 The Scheme will improve capacity, safety and amenity on the highway network as is necessary to successfully facilitate effective local and interregional movement which would aid economic growth.

5.6.3 It is evident from this assessment that the Scheme would, in principle, facilitate the underlying purpose of adopted and emerging planning policy and would not conflict or prejudice the implementation of the emerging local development plan.

6 AIR QUALITY

6.1 Introduction

6.1.1 This chapter presents the local air quality assessment for the Scheme. The assessment includes a summary of the local conditions and, where appropriate, identifies mitigation measures for any significant effects that may arise as part of the Scheme.

6.1.2 The Scheme has the potential to affect air quality as a result of emissions to air during construction and operation including:

- During Construction
  - Particulate matter / dust from enabling works including site preparation;
  - Particulate matter / dust from materials handling and transportation;
  - Exhaust emissions and dust from on and offsite construction vehicle movements; and
- During Operation
  - Exhaust emissions from traffic on the local road network.

6.2 Legislative & Policy Context

European and National Legislation

6.2.1 Under the requirements of the *Environment Act 1995*, the UK government published an Air Quality Strategy[1] (1997, revised in 2000 and 2007). The Strategy sets out the UK's national standards and objectives for ambient air quality, and measures to help achieve the objectives. The overall aim of the Strategy is to achieve steady improvement in air quality in the long term. The objectives are transcribed into regulations in the Air Quality (Wales) Regulations 2000 and Air Quality (Amendment) (Wales) Regulations 2002.

6.2.2 The *Environment Act 1995* also sets out the principles for Local Air Quality Management (LAQM) under which Local Authorities are required to review current and future air quality within their area against the air quality objectives. Where it is anticipated that an air quality objective will not be met, the Local Authority is required to declare an AQMA and to produce an Action Plan in pursuit of the achievement of the air quality objectives.

6.2.3 The air quality standards set out in the Strategy are purely health-based and reflect the levels of pollution thought to ensure the avoidance or minimisation of risks to health. The associated air quality objectives are policy targets, expressed as maximum permissible ambient (outdoor) concentrations[2] which take into account economic efficiency, practicability, technical feasibility and timescales.

[1] Air Quality Strategy for England, Wales, Scotland and Northern Ireland, 2007, Department for Environment, Food and Rural Affairs

[2] Maximum concentrations not to be exceeded either without exception or with a permitted number of exceedences within a specific timescale.

6.2.4 The European Union Ambient Air Quality Directive[3] sets similar limit values for the concentration of pollutants in air for the protection of health and ecosystems. The EU Directive is transposed into Welsh legislation in the Air Quality Standards (Wales) Regulations 2010.

6.2.5 For the pollutants of interest in the assessment of the Scheme, the EU limit values are numerically identical to the UK's air quality objectives. They are, however, statutory limits rather than policy targets. Compliance with the limit values is the duty of central and devolved government rather than Local Authorities.

6.2.6 Table 6.1 provides details of the air quality objectives relevant to the assessment of the Scheme.

Table 6.1: Ambient Air Quality Objectives Relevant to the Assessment of Air Quality Impacts for the Scheme

Pollutant	AQS Objective/Limit Value	Measured as
Set for the protection of human health		
NO_2	200 µg/m^3	1hr mean; not to be exceeded more than 18 times per year
	40 µg/m^3	Annual mean
PM_{10}	50 µg/m^3	24hr mean not to be exceeded more than 35 times per year
	40 µg/m^3	Annual mean
Set for the protection of vegetation		
NO_X	30 µg/m^3	Annual mean
	75 µg/m^3	24hr mean

6.2.7 The Air Quality (Wales) Regulations make clear that likely exceedences of the objectives should be assessed in relation to "the quality of the air at locations which are situated outside of buildings or other natural or man-made structures above or below the ground, and where members of the public are regularly present". Air quality assessments should, therefore, focus on those locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. The assessment should not consider exceedences of the objectives at any location where relevant public exposure would not be realistic.

National Policy

Planning Policy Wales (PPW) (2014)

6.2.8 Current land use planning policies in Wales are set out in PPW (Edition 7, 2014). In relation to air quality, PPW states (paragraph 8.1.8) that:

[3] European Union Directive on ambient air and cleaner air for Europe, 2008/50/EC

"Development plan policies and decisions on planning applications should take into account statutory air quality objectives, together with the results air quality reviews and assessments and any Air Quality Management Plans or Area Action Plans."

6.2.9 Furthermore, PPW (paragraph 13.12.1) states:

"The potential for pollution affecting the use of land will be a material consideration in deciding whether to grant planning permission. Material considerations in determining applications for potential polluting development are likely to include:

- *Location, taking into account such considerations as the reasons for selecting the chosen site itself;*
- *Impact on health and amenity;*
- *The risk and impact of potential pollution from the development insofar as this might have an effect on the use of other land and the surrounding environment (the environmental regulatory regime may well have an interest in these issues, particularly if the development would impact on an Air Quality Management Area or a Special Area of Conservation);*
- *Prevention of nuisance;*
- *Impact on the road and other transport networks, and in particular on traffic generation; and*
- *The need, where relevant, and feasibility of restoring the land (and water resources) to standards sufficient for an appropriate use."*

Technical Advice Note (TAN): 18 Transport (2007)

6.2.10 TAN 18: Transport recognises the negative impact that transport, in particular road traffic can have on human health and that traffic growth is a cause of increased local air pollution. It advises that:

"When preparing development plans and considering planning applications, planning authorities should take into account statutory air quality objectives, together with the outcomes of the review and assessment process and any Air Quality Management Area Action Plans that may have been prepared."

6.2.11 In this context, pollution is taken to include local air pollutants covered by the UK's air quality strategy and EU directives (e.g. particulate matter, nitrogen dioxide) and dust.

Local Policy

Vale of Glamorgan Draft Local Development Plan (LDP) 2011 – 2026 (2013)

6.2.12 The Vale of Glamorgan Council Draft LDP states that managing air quality and minimising air pollution from industrial, domestic and road transportation is an essential consideration in development proposals. The Plan states:

"Development proposals will be required to demonstrate they will not result in an unacceptable impact on people, residential amenity, property and / or the natural environment from […] pollution of land, surface water, ground water and the air."

6.3 Assessment Methodology

Introduction

6.3.1 Overall, the methodology used for the air quality assessment follows a risk based approach. Activities with a low potential to impact significantly on receptors have been assessed qualitatively i.e. with reference to the general characteristics of the impact and subjective assessment of the magnitude of the impact. Those activities with a high potential impact have been assessed in detail, using numerical methods.

6.3.2 For the construction phase, the Scheme's air quality assessment has involved the qualitative assessment of the potential impacts of dust and particulate matter emissions from on-site construction related activities. A qualitative assessment of impacts on the local road network from construction related traffic and traffic management measures was undertaken in relation to the objectives set out in the UK's Air Quality Strategy.

6.3.3 The assessment of operational traffic related air quality impacts has been undertaken quantitatively since changes in vehicle emissions, as a result of changes to traffic flows, speeds and alignments, are the most significant potential impact of the Scheme. The assessment of traffic impacts is limited to nitrogen dioxide and particulate matter (as PM_{10}) since these are the pollutants most affected by changes in emissions from traffic and at greatest risk of exceeding the UK's air quality objectives.

6.3.4 There are numerous residential settlements and sites designated for nature conservation in the study area and, therefore, the assessment relates to potential impacts on human health, amenity and ecological sites.

Guidance

6.3.5 The following guidance documents were used in this assessment:

- Depart for Environment, Food and Rural Affairs (Defra), Part IV of the Environment Act 1995, Local Air Quality Management (LAQM), Technical Guidance LAQM TG(09) (2009)
- DMRB, Volume 11, Section 3, Air Quality (May, 2007)
- Highways Agency (HA), Interim Advice Note (IAN)170/12 v3, Updated air quality advice on the assessment of future NO_x and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 Air Quality (November, 2013)
- HA, IAN 174/13, Updated advice on evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality (June, 2013)
- Institute for Air Quality Management (IAQM), Guidance on the assessment of dust from demolition and construction (January, 2014)
- Environmental Protection UK (EPUK, formerly NSCA) Development Control: Planning for Air Quality (2010 Update)

Study Area

6.3.6 The study area for the assessment of construction activities has been determined with reference to the following criteria:

- Areas within 350m of the boundary of the site for human receptors and 50m for ecological receptors (IAQM dust guidance, 2014). This includes dust generating activities within the red line boundary of the Scheme, including any compound locations
- Areas within 50m of construction traffic routes and within 500m of the boundary of any construction compounds (IAQM Dust guidance, 2014)
- Areas within 200m of routes on the local road network where a significant change in traffic (either in terms of flow, speed or composition) is expected as a result of the construction of the Scheme (DMRB, 2007) i.e. affected roads

6.3.7 These criteria are derived from industry guidance on the assessment of construction activities and road traffic as set out in Section 6.2.

6.3.8 The Design Manual for Roads and Bridges (DMRB) (HA207/07), in relation to road schemes with the potential to change vehicle flows, defines an affected route as those with a change of 1,000 vehicles per day or 200 heavy duty vehicles movements per day, both as an annual average. In the case of the Scheme the study area comprises all major routes shown in Figure 6.1b and extends:

- To the north to Sycamore Cross and Culverhouse Cross;
- To the east to the junction of the A4050 with the A4231;
- To the south along the B4266 to the junction with the A4050; and
- To the west along Port Road to Cardiff Airport.

6.3.9 The impacts of changes in traffic will decrease with distance from the Scheme as traffic disperses into unaltered sections of the road network, and becomes negligible beyond the study area. A summary of the traffic data used in the assessment is provided in Appendix 6.1.

6.3.10 The study area for construction impacts is shown in Figure 6.1a and the study area for operational impacts is shown in Figure 6.1b. Sensitive receptors used in the dispersion model are also shown in Figure 6.1b.

Temporal Scope

6.3.11 The assessment has considered the potential impacts and associated significance of effect at the following stages:

- Baseline year (2013)
- Operational Phase (2017)
- Future operation year (2032)

6.3.12 A baseline year of 2013 was used for the assessment in order to align with the traffic data for the scheme. A comparison of Department for Transport traffic counts in the area shows an average change in traffic volumes between 2013 and 2014 of <1%. As such, as baseline year of 2013 is appropriate for this assessment.

Receptors

6.3.13 There are a number of human receptors likely to be impacted by changes to traffic as a result of the Scheme. Table 6.2 and Figure 6.1b detail the local air quality receptors used in the model, which were selected to represent worst case and typical impacts of the Scheme.

Table 6.2: Human Air Quality Receptors Used for Dispersion Modelling

Receptor ID	Easting (m)	Northing (m)	Description of Receptor Location	
01_A48	310435	174548	Grant's Field	A48 Culverhouse Cross to Sycamore Cross
02_A48	309853	174708	The Caia	
03_A48	309236	174344	St Nicholas (along A48, east of Dyffryn Lane)	
04_STN	309069	174298	St Nicholas (along A48, opp Mawsons Mead)	
05_A48	308967	174264	St Nicholas (along A48, west of Mawsons Mead)	
06_STN	308897	174278	Primary School, St Nicholas	
07_STN	308651	174220	St Nicholas (along A48, junction with Chapel Lane)	
08_A48	308360	174184	St Nicholas (along A48, Treehill Cottages)	
09_A48	307708	174206	The Breach (along A48, east of Sycamore Cross)	
10_A48	307299	174141	Sycamore Farm (along A48, west of Sycamore Cross)	
11_A48	307226	174101	Hill Cottage (along A48, west of Sycamore Cross)	
12_WAY	307609	173757	Redland Farm	A4226 Five Mile Lane and associated lanes
13_WAY	307728	173756	Residence (Opp Redland Farm, west of A4226)	
14_DYF	311674	173680	Hill Terrace (Dyffryn)	
15_WAY	307753	172782	Blackland Farm	
16_WAY	307882	171529	Whitton Lodge	
16_DYF	308474	171721	Little Hamston Farm	
17_WAY	308134	170570	Northcliff Cottage	
18_WAY	307927	170493	Grovelands	

Table 6.2: Human Air Quality Receptors Used for Dispersion Modelling

Receptor ID	Easting (m)	Northing (m)	Description of Receptor Location	
19_WAY	308062	169779	Sutton Fach Farm	
20_WAY	309128	169235	Sutton Mawr	
21_WAY	309348	169094	Barry College	
20_RHO	306897	166602	Porthkerry Road, Rhoose	Nr Airport (not shown on Figure 6.1b)
21_PPR	309752	168506	Pontypridd Road, Barry	B4266
22_PPR	309924	168336	Pontypridd Road, Barry	
23_PPR	310318	167995	Pontypridd Road, Barry	
24_PRW	308437	168071	Welford, Port Road West (west of Waycock Cross)	A4226 Port Road West, Waycock Cross to Airport
25_PRW	309091	168372	New Farm, Port Road West (west of Waycock Cross)	
26_PRW	309420	168482	Green Farm, Port Road West (west of Waycock Cross)	
27_WCC	309646	168532	Waycock Cross (south of roundabout)	
28_PRW	309686	168594	Waycock Cross (north of roundabout)	
29_PRW	309793	168579	Waycock Cross (east of roundabout)	
30_PRW	309979	168658	Heol Sirhiwi (on Port Road West)	A4226 Port Road West, East of Waycock Cross
31_PRW	310164	168805	Clos Cefni (on Port Road West)	
32_PRW	310256	168959	Brenig Close (on Port Road West)	
33_PRW	310284	169056	Purdey Close (on Port Road West)	
34_PRW	310507	169275	Barry Comprehensive School (on Port Road West)	
35_PRW	310530	169367	Highlight Lane (on Port Road West)	
36_PRW	310625	169490	Brynhill Close on Port Road West)	
37_PRW	310680	169144	The Barry Hospital	
38_PRE	310802	169580	Colcot Road (junction with Port Road West/East)	A4050 Port Road East, West of Junction with A4231 (Barry
39_PRE	310923	169817	Vale View (on Port Road East)	
40_PRE	311172	169994	Pleasant View (on Port Road East)	

Table 6.2: Human Air Quality Receptors Used for Dispersion Modelling

Receptor ID	Easting (m)	Northing (m)	Description of Receptor Location	
41_PRE	311391	170150	Melville Close (on Port Road East)	Docks Link Road)
42_PRE	311398	170033	Colcot Primary School	
43_PRE	311662	170392	Port Road East (opp Merthyr Dyfan Road)	
44_PRE	311692	170334	Elizabeth Avenue (junction with Merthyr Dyfan Road)	
45_PRE	311798	170426	Port Mews (on Port Road East)	
46_PRE	312038	170322	Bryn Hafren Comprehensive School	
47_PRE	312352	170547	Golwyg y Coed (on Port Road East)	
48_PRN	312581	171026	Port Road East (residence at entrance to Sunny Glen)	A4050 Port Road East, North of Junction with A4231 through Wenvoe to Culverhouse Cross
49_PRN	312246	171511	Port Road East (residence backing onto Wenvoe GC)	
50_PRN	312157	172001	Copper Beech (on Port Road East)	
51_PRN	312304	172085	St Andrews Road (junction with Port Road East)	
52_PRN	312292	172466	Port Road East (residence at entrance to Rectory)	
53_PRN	312329	172802	Venwood Close (nr Port Road East)	
54_PRN	312312	172931	Station Road (nr Port Road East)	
55_PRN	312217	173298	Grange Close (nr Port Road East)	
56_PRN	312293	173337	Brookside (nr Port Road East)	
57_PRN	312198	173378	Nant Isaf (nr Port Road East)	
58_PRN	312086	173731	Old Port Road (nr Port Road East)	
59_PRN	311886	174517	Brooklands Terrace	
60_RAA	311717	175079	Patreane Way (Culverhouse Cross slip road)	Culverhouse Cross

6.3.14 In accordance with DMRB guidance, the air quality assessment also considers the impact of the Scheme on sites designated for nature conservation. In the air quality study area, the only site designated at national or international level, is the Barry Woodlands Site of Special Scientific Interest (SSSI). Five distinct areas of the SSSI lie within the study area as follows:

- Middleton Plantation, east of Five Mile Lane

- Middleton Plantation, west of Five Mile Lane
- Lidmore Wood, east of Five Mile Lane
- Pencoetre Wood, south of A4050 Port Road
- Pencoetre Wood, east of A4231

6.3.15 The Cwm Talwg Local Nature Reserve also lies within the study area, to the south of the A4050 Port Road.

6.3.16 All ecological receptors are indicated with shading in Figures 6.1a and 6.1b and further details are presented in Chapter 9 Nature Conservation.

6.3.17 The ecological sites are represented in the model as a series of discrete receptors aligned as transects extending from the nearest road into the ecological sites in order to determine the spatial extent of potential impacts on the ecological receptor. These are shown in Figure 6.1b.

Construction Dust

6.3.18 The IAQM guidance (IAQM, 2014) provides distance based criteria for qualitatively assessing dust/particulate matter impacts from construction activities and their significance. The assessment criteria consider the scale and nature of the works, classified as small, medium or large, as well as the proximity of the receptors. For the purposes of assessment, activities on construction sites are divided into the following four types:

- Demolition
- Earthworks
- Construction
- Trackout (the movement of dust/mud offsite on haulage vehicle wheels and bodies onto the public road network where it may be suspended by other vehicles)

6.3.19 The three potential effects of dust arising from construction activities are defined in the guidance as:

- Annoyance / loss of amenity due to dust soiling
- The risk to health due to an increase in PM_{10} exposure
- Impacts to ecological receptors

6.3.20 The assessment has five stages:

1. Definition of the potential dust emission magnitude for the works (termed dust emission class)
2. Definition of the sensitivity of the area including identification of specific sensitivities, the proximity and number of receptors (human and ecological), background PM_{10} concentrations and any site specific factors
3. Assessment of the potential risk of impacts in the absence of mitigation
4. Definition of site specific mitigation measures
5. Assessment of whether significant effects are likely following mitigation

6.3.21 The criteria used to assess the dust emission magnitude and risk of impacts prior to mitigation for the various phases of the works is provided in Appendix 6.2.

Traffic Effects

6.3.22 The air quality impacts from operational traffic have been assessed quantitatively using the methodologies set out by Highways England (formerly Highways Agency) (DMRB, 2007) (IAN 170/12v3, 2013 and IAN 174/13, 2013) and Defra (LAQM TG (09) guidance on the conversion of nitrogen oxide to nitrogen dioxide, note on projection of NO_2 concentrations) and with reference to EPUK guidance on air quality.

6.3.23 The method seeks to compare air quality concentrations with and without the traffic changes associated with the operation of the Scheme.

6.3.24 Detailed dispersion modelling, using ADMS Road V3.2 software, was used to assess concentrations of nitrogen dioxide and particulate matter at the receptors identified in Table 6.2 and nitrogen oxides and nitrogen deposition at the ecological sites. All receptors were selected to assess worst case and typical impacts at existing receptors, residential and commercial properties. The air quality assessment requires the comparison of calculated future pollutant concentrations with the UK's air quality objectives.

6.3.25 The model requires receptor coordinates, coordinates of vertices on road links as well as traffic data for each link as light duty vehicle flows, heavy duty vehicle flows and traffic speeds. Traffic data was provided for morning and afternoon peak periods, the inter-peak period and as an annual average for each of the parameters required by the model. Total off-peak traffic flows were calculated by subtracting the peak flows (assumed representative of 3 hours in the morning and afternoon) and inter-peak flows (assumed representative of 6 hours between morning and afternoon) from the daily average flows. In this way, traffic data was specified for each hour of the day and emissions were subsequently calculated using Defra's Emissions factors Toolkit (EfT) v 6.01.

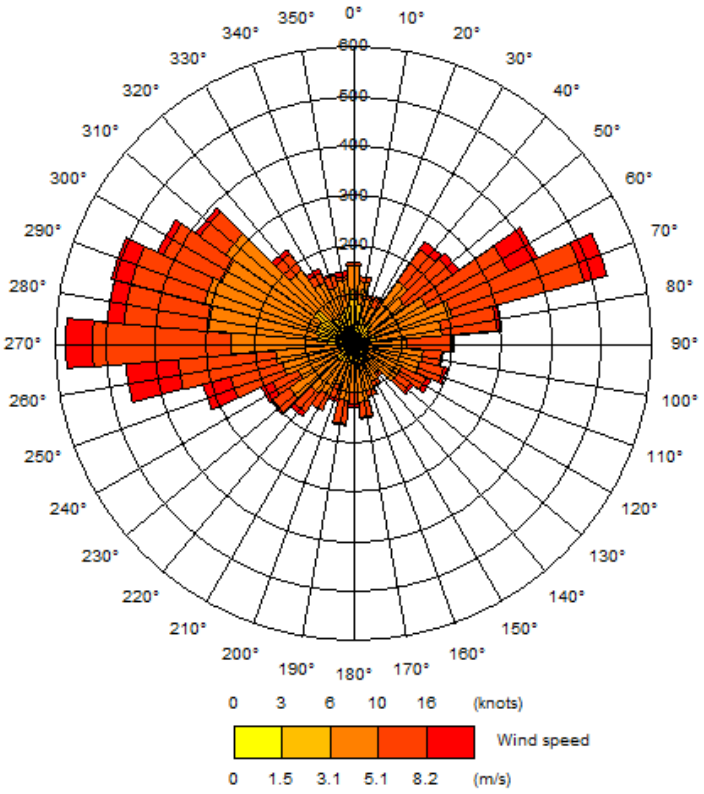
6.3.26 Pollutant concentrations were modelled using one year (2013) of hourly sequential meteorological data from Cardiff Airport. This is nearest meteorological monitoring station to the scheme which measures all necessary parameters for air quality modelling. A comparison with previous years shows little variation in the meteorological data. A wind rose for the station is shown in Insert 6.1.

6.3.27 For assessment of ecological impacts, nitrogen deposition was calculated as per Environment Agency guidance, with a deposition velocity of 3mm/s used for NO_2 over woodland habitats. This is a more conservative approach than the recommended deposition velocity in the DMRB (1.0 mm/s).

6.3.28 Any exercise in predictive modelling has, by nature, some degree of associated uncertainty. In the particular case of modelling traffic emissions, significant uncertainties lie in the specification of traffic data and dispersion specific parameters as described above.

6.3.29 In the baseline year, systematic uncertainties in the model inputs are accounted for by verifying the modelled roadside concentrations against observed roadside pollution levels. This process produces a verification factor which can then be applied to future scenario model results to account for the continued presence of systematic uncertainties.

6.3.30 All modelled pollution concentrations provided in this report are given as corrected values following the verification of the model. A site specific monitoring survey consisting of 30 nitrogen dioxide and 3 nitrogen oxide diffusion tubes was undertaken by Parsons Brinckerhoff, as detailed in Section 6.4, and it was this data that was used to determine an appropriate verification factor for the dispersion model results (Appendix 6.3). In the absence of PM_{10} monitoring in the area, model results relating to particulate matter have been verified using the factor derived for nitrogen dioxide as recommended by Defra.



Insert 6.1: Wind Rose for Cardiff-Wales Airport, 2013

6.3.31 Chief among the remaining uncertainties in this assessment is in the generation of vehicle emissions from published emissions factors with acknowledged shortcomings. Recent research (Carslaw et al., 2011[4]) demonstrated that emissions of nitrogen oxides and nitrogen dioxide from road vehicles have not decreased at the rate projected by the national forecasts. It is, however, anticipated that emissions will reduce with the introduction of very low and zero emissions vehicles into the national fleet. In addition, Defra issued revised vehicle emission factors in July 2014 which incorporate an updated forecast of changes to fleet composition[5].

6.3.32 Nevertheless, sensitivity testing of this assessment was undertaken in order to consider the impact of vehicle emission rates decreasing more slowly that projected

[4] Carslaw, D.C., Beevers, S.D. Westmoreland, E. Williams, M.L. Tate, J.E., Murrells, T. Stedman, J. Li, Y., Grice, S., Kent, A. and I. Tsagatakis (2011). Trends in NOx and NO_2 emissions and ambient measurements in the UK. Version: July 2011.
[5] Defra, Emissions Factors Toolkit User Guide, July 2014.

by national datasets. In these tests, emission factors and background pollutant values were held at values provided for previous years as follows:

- 2017 scenarios were tested using 2013 emission rates and background concentrations
- 2032 scenarios were tested using 2017 emission rates and background concentrations

6.3.33 This process provides a conservative assessment of the potential traffic related impacts of the Scheme since it combines the effects of future year traffic growth with an assumption of limited improvement in vehicle emissions over time.

Impacts at Short Timescales

6.3.34 It is not possible to assess, robustly, hourly mean concentrations using dispersion modelling. By their nature, both local and background hourly mean concentrations are highly variable and therefore verification of the modelling of peak concentrations is challenging. Indeed, for the Scheme, hourly mean nitrogen dioxide background concentrations are not available. As a consequence, hourly mean impacts cannot be modelled directly and they are assessed by reference to annual mean concentrations, as per Defra advice suggesting that where the annual mean concentrations are below 60µg/m^3, the risk of exceedences of the 1-hour mean nitrogen dioxide objective is extremely unlikely.

6.3.35 Similarly, directly predicting the number of exceedences of the daily PM_{10} objective using dispersion modelling is less robust than predicting the annual mean. Therefore the empirical relationship, detailed in Defra's TG(09) guidance, between annual mean PM_{10} and the number of daily exceedences of the 50µg/m^3 objective was used:

No. 24-hour mean exceedences = -18.5 + 0.00145 x annual mean^3 + (206/annual mean) Background Pollutant Concentrations.

6.3.36 The pollutant concentration at any location has two components, namely a contribution from the local (modelled) sources and a contribution from more distant sources. Background pollutant concentrations for the modelling i.e. those resulting from distant sources and pollutant transport, have, for nitrogen dioxide and nitrogen oxides, been taken from the project specific monitoring for the Scheme (from the monitoring location on Dyffryn Road – STA32, as detailed in Section 6.4). For particulate matter, the mapped data provided by Defra were used, with data interpolated to each modelled receptor. Defra provided data as predictions for all years from 2010 to 2030. The project specific monitoring data were projected to future years using the methodology set out in LAQM TG(09), in which the ratio of mapped pollutant concentrations (in this case NO_2 and NO_X) between years is assumed to apply to the monitored baseline concentrations. The background data used in the modelled are provided in Table 6.3.

Table 6.3: Background Pollutant Concentrations Used for Modelling

Year	Pollutant		
	Nitrogen Dioxide	Nitrogen Oxides	PM_{10}
2013 (Base)	9.69	19.99	13 – 15.1
2017	8.44	17.24	12.5 – 14.6
2032 (from data	6.38	12.7	12.0 – 14.1

for 2030)			

**(NO_2 and NO_X taken from Project-specific monitoring at Dyffryn Road; PM_{10} interpolated to study area from mapped data)*

Assessment Criteria

6.3.37 In order to evaluate the impacts on local air quality from the Scheme operations, the approaches set out in IAN 174/13, HA207/07 and EPUK guidance were followed.

6.3.38 The criteria in Table 6.4 set out the classification of the magnitude of change of annual NO_2 NOx and PM_{10}. These criteria are applied to both human and ecological receptors.

Table 6.4: Classification of the Magnitude of Change of Pollutant Concentration

Classification of Magnitude	Change in Concentration (as a %age of the relevant objective)
Large	>10%
Medium	5-10%
Small	1-5%
Imperceptible	<1%

6.3.39 Highways England (formerly Highways Agency) guidance (IAN 174/13) suggests that at receptor locations where concentrations do not exceed the relevant objective, or where the change in concentration is imperceptible as defined in Table 6.4, those locations can be scoped out of any further assessment of the significance of effects.

6.3.40 As will be shown in Section 6.5, in the assessment of the Scheme, no exceedences of air quality objectives in the study area were modelled at any human receptor under any scenario and, therefore, to ensure a comprehensive assessment was undertaken, the significance criteria proposed in EPUK guidance have been adopted for the analysis of impacts of modelled changes in concentration. Under these criteria, the magnitude of the change in concentration is defined as in Table 6.4 and the significance of any resulting effects on air quality is evaluated based on the definitions presented in Table 6.5.

Table 6.5: Criteria for Assessing the Significance of Impacts

Absolute concentration in relation of objective/limit value	Change in concentration (as a %age of objective)			
	Imperceptible (<1%)	Small (1-5%)	Medium (5-10%)	Large (>10%)
Above objective with Scheme	Negligible	Slight Adverse	Moderate Adverse	Large Adverse
Just below objective with Scheme (90%-100% of objective)	Negligible	Slight Adverse	Moderate Adverse	Moderate Adverse

Below objective with Scheme (75%-90% of objective)	Negligible	Negligible	Slight Adverse	Slight Adverse
Well below objective with Scheme (<75% of objective)	Negligible	Negligible	Negligible	Slight Adverse

6.3.41 For the assessment of nitrogen deposition on ecological receptors, the change in deposition due to the Scheme was assessed using the criteria in Table 6.4 and Table 6.5, in relation to the critical loads relevant to the features of interest in the site, the background deposition and the extent of any exceedence. A critical load is defined as:

"a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge."[6]

6.4 Baseline Conditions

Monitored Data

6.4.1 Parsons Brinckerhoff completed a 6 month monitoring survey comprised of 32 nitrogen dioxide diffusion tubes and, at 3 sites, NO_x diffusion tubes. The locations of these diffusion tubes are presented in Table 6.6 and shown in Figure 6.2.

Table 6.6: Locations of diffusion tubes during monitoring

Location	Description	Site Type	Distance from Kerb	X	Y
NO_2 sites					
STA01	Entrance to Grants Field	Background	-	310388	174549
STA02	Old Post Office, St Nicholas	Roadside	2m	309056	174297
STA03	St Nicholas	Roadside	2m	308943	174297
STA04	St Nicholas	Roadside	4m	308871	174238
STA05	St Nicholas	Roadside	3m	309288	174359
STA06	Bonvilston	Roadside	1m	306558	174039
STA07	Bonvilston	Roadside	2m	306445	173987
STA08	Bonvilston	Roadside	1m	306752	174054

[6] http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.htm

Location	Description	Site Type	Distance from Kerb	X	Y
STA09	Bonvilston	Roadside	4m	306804	174084
STA10	Junction A48 / Five Mile Lane	Roadside	2m	307342	174177
STA11	Junction A48 / Five Mile Lane	Roadside	3m	307354	174129
STA12	Junction A48 / Five Mile Lane	Roadside	2m	307465	174162
STA13	Junction A48 / Five Mile Lane	Roadside	1m	307415	174177
STA14	Five Mile Lane (Woods)	Roadside	3m	307807	172890
STA15	Five Mile Lane (Amelie)	Roadside	2m	307677	172132
STA16	Five Mile Lane (Dyffryn Road)	Background	30m	307907	171552
STA17	Five Mile Lane (Hawking Centre)	Background	25m	308956	169403
STA18	Roundabout Five Mile Lane/Port Road	Roadside	2m	309667	168510
STA19	Roundabout Five Mile Lane/Port Road	Roadside	2m	309667	168510
STA20	Roundabout Five Mile Lane/Port Road	Roadside	2m	309667	168510
STA21	Roundabout Five Mile Lane/Port Road	Roadside	2m	309688	168586
STA22	Port Road (Stirling Road)	Roadside	1m	310242	168955
STA23	Port Road (School)	Roadside	5m	310332	169134
STA24	Port Road (East Bound)	Roadside	5m	311162	169982
STA25	Port Road (West Bound)	Roadside	5m	311194	169966
STA26	Crematorium	Roadside	5m	312427	170715
STA27	Wenvoe	Roadside	1m	312279	171539

Location	Description	Site Type	Distance from Kerb	X	Y
STA28	Wenvoe	Roadside	10m	312306	172984
STA29	Wenvoe	Roadside	2m	312199	173449
NO_X and NO_2 sites					
STA31	Grants Fields	Background	-	310691	174478
STA32	Dyffryn Road	Background	-	308283	171660
STA33	Layby on Five Mile Lane/Waycock Road	Roadside	2m	308890	169413

6.4.2 Monitored concentrations from two continuous analysers (located in Cardiff and Newport), operated by Defra as part of the Automatic Urban and Rural Network (AURN), and were used to derive an annualisation factor appropriate to convert the data collected in the diffusion tube survey into annual mean concentrations for 2013. In addition, a bias adjustment factor of 0.95, taken from the National Diffusion Tube Bias Adjustment Factor Spreadsheet (Version 06/14, Defra), and applied to monitored nitrogen dioxide concentrations. The resulting annual mean nitrogen dioxide concentrations are presented in Table 6.7.

Table 6.7: Annualised and Bias-adjusted Nitrogen Dioxide and Nitrogen Oxides Diffusion Tube Results

Location	Description	Annual Mean Nitrogen Dioxide/Oxides ($\mu g/m^3$)
NO_2		
STA01	Entrance to Grants Field	17.2
STA02	Old Post Office, St Nicholas	32.5
STA03	St Nicholas	38.2
STA04	St Nicholas	18.0
STA05	St Nicholas	25.6
STA06	Bonvilston	52.5
STA07	Bonvilston	36.5
STA08	Bonvilston	27.6

Location	Description	Annual Mean Nitrogen Dioxide/Oxides (µg/m^3)
STA09	Bonvilston	18.2
STA10	Junction A48 / Five Mile Lane	17.8
STA11	Junction A48 / Five Mile Lane	27.0
STA12	Junction A48 / Five Mile Lane	27.6
STA13	Junction A48 / Five Mile Lane	23.6
STA14	Five Mile Lane (Woods)	13.9
STA15	Five Mile Lane (Amelie)	14.9
STA16	Five Mile Lane (Dyffryn Road)	14.6
STA17	Five Mile Lane (Hawking Centre)	10.1
STA18	Roundabout Five Mile Lane/Port Road/Waycock Cross	37.5
STA19	Roundabout Five Mile Lane/Port Road/Waycock Cross	35.7
STA20	Roundabout Five Mile Lane/Port Road/Waycock Cross	42.4
STA21	Roundabout Five Mile Lane/Port Road/Waycock Cross	45.6
STA22	Port Road (Stirling Road)	32.1
STA23	Port Road (School)	34.3
STA24	Port Road (East Bound)	22.8
STA25	Port Road (West Bound)	21.1
STA26	Crematorium	20.4
STA27	Wenvoe	20.5
STA28	Wenvoe	17.3
STA29	Wenvoe	62.4
STA31	Grants Fields	10.8

Location	Description	Annual Mean Nitrogen Dioxide/Oxides (µg/m^3)
STA32	Dyffryn Road	9.7
STA33	Layby on Five Mile Lane/Waycock Road	14.7
NO_x		
STA31	Grants Fields	21.5
STA32	Dyffryn Road	20.0
STA33	Layby on Five Mile Lane/Waycock Road	28.9

6.4.3 Though concentrations were generally within the UK objective, potential exceedences were monitored at four locations (STA06, STA20, STA21 and STA29). Each of these locations is in proximity to a major road and none directly represent locations of relevant human exposure i.e. the monitoring site lies closer to the nearest roadside than the nearest human receptor. STA20 and STA21 are located at the Waycock cross junction, where high traffic volumes and the acceleration of slow moving vehicles combine to elevate pollutant concentrations. A similar effect is apparent at STA29, located just down flow of a busy roundabout to the north of Wenvoe.

6.4.4 Background concentrations for the modelling were taken from the background monitoring site on Dyffryn Road (STA32) where the lowest concentrations were monitored.

Baseline Nitrogen Deposition

6.4.5 Baseline levels of nitrogen deposition and critical load values for the types of habitats present were taken from the Air Pollution Information System[7]. These are presented in Table 6.8 where it can be seen that the baseline deposition for each type of habitat is already in exceedence of each critical load value.

6.4.6 In the assessment of impacts at the Cwm Talwg Local Nature Reserve, the background deposition and critical load values used were identical to those used for the Lowland Beech and Yew Woodland habitats.

7 www.apis.ac.uk – developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology.

Table 6.8: Critical Load and Background Deposition for Designated Ecological Sites in the Study Area

Designated Site	Classification	Most Sensitive Habitat	Critical Load (kgN/ha/yr)		Background Deposition (kgN/ha/yr)	
			Min	Max	Min	Max
Barry Woodland SSSI	Marshy Grassland	Neutral Grassland	10	10	12.46	15.40
	Mixed Plantation	Lowland Beech and Yew woodland	5	20	22.12	27.16
	Semi-Natural Woodland	Lowland Beech and Yew Woodland	5	20	22.12	27.16

6.5 Predicted Effects (Without Mitigation)

Construction

6.5.1 Construction activities can give rise to emissions of dust/particulate matter. For larger particles (>75µm), these emissions can give rise to nuisance dust soiling effects on property and effects on ecological receptors. The smaller particles (<10µm) can give rise to effects on human health when inhaled.

6.5.2 In assessing the impacts of construction dust using the IAQM methodology, the study area is normally sub-divided on the basis of a review of the receptors potentially affected by works from different areas of the site. As can be seen in Figure 6.1b, the area is sparsely populated with fewer than 20 residential properties within 100m of the Scheme. Fewer than 150 properties lie within 350m of the Scheme and are largely located to the south and east of the Waycock Cross junction, with a few residences along Five Mile Lane and near the Sycamore Cross junction to the north.

6.5.3 A summary of the dust emissions magnitude assessment is presented in Table 6.9. The large magnitude from earthworks is due to the large total site area (>10,000m^2) which increases the potential for dust emissions. Similarly, the large site area (approximately 42,500m^2) is the primary contributor to the medium magnitude dust emissions potential from construction activities. There is limited potential for dust emissions from track-out due to the relatively low likely numbers of potential HDV movements and the presence of paved roads in the vicinity of the site which places a limit on the likely length of unpaved roads. Further details of the assessment are provided in Appendix 6.2.

Table 6.9: Outcome of the Assessment of Potential Dust Emissions Magnitude from Construction-related Activities

Activity	Dust Emissions Magnitude
Demolition	Negligible
Earthworks	Large
Construction	Medium
Trackout	Small

6.5.4 It should be noted that dust risk levels do not remain constant at all times. Actual risks on any given day will depend on the activities being undertaken, the meteorological

conditions and the proximity of receptors to activities with high dust generating potential. This variability is particularly relevant to the Scheme which will not have construction activities across the whole site for the whole construction period. The assessment is therefore conservative and indicative of the maximum potential impact of construction related dust at any given time.

6.5.5 The sensitivity of the area was defined in relation to the construction activities described in section 6.3.19 and is presented in Table 6.10. Sensitivity to human health and to dust soiling and nuisance is low in the study area as a result of the sparseness of the population and the distance from site to receptors. Furthermore, low background PM_{10} concentrations (~13µg/m^3, as taken from mapped data published by Defra) also diminish the sensitivity of the area to human health impacts.

6.5.6 Two areas of the Barry Woodland SSSI lie in immediate proximity to the site, approximately 400m north of Waycock Cross junction at the south of the Scheme. Direct physical effects, such as the smothering of vegetation, and indirect effects such as chemical alterations to soils or watercourses could occur at ecological receptors in such proximity to potential dust generating activities. A further three areas lie within 350m of the Scheme and also have the potential, although much reduced, to experience adverse impacts as a result of dust emission from construction related activities.

Table 6.10: Sensitivity of the Area to Construction Dust Impacts

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Negligible	Low	Low	Low
Human Health	Negligible	Low	Low	Low
Ecological	Negligible	High	High	High

6.5.7 The dust emission magnitude was then combined with the sensitivity of the area to determine the risk of impacts with no mitigation applied, as summarised in Table 6.11. The proximity to the site, and thereby high sensitivity, of ecological receptors in the area combined with the large magnitude of potential emission predicates a high risk of impacts from earthworks on the ecological receptors shown on Figure 6.1b. However, the magnitude of these emissions is based largely on the size of the Scheme, not on the nature of the works. When considered in the context of the extent of works undertaken at any given time, as indicated in section 6.5.4, the magnitude of emissions at the location of ecological receptors may be lower than the overall assessment for the entire Scheme suggests.

6.5.8 It has also been proposed as part of the Scheme that some clearance of Waycock Woodland, the nearest ecological receptor to the Scheme, will be undertaken, and new woodland planting be provided to the north west of Waycock Wood. This will serve to reduce the proximity of ecological receptors to site works during construction works (although not earthworks/clearance) and limit the sensitivity of the area during later stages of the works

Table 6.11: Risk of Dust Impacts in the Absence of Mitigation

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Negligible	Low Risk	Low Risk	Negligible
Human Health	Negligible	Low Risk	Low Risk	Negligible
Ecological	Negligible	High Risk	Medium Risk	Low Risk

Construction Traffic

6.5.9 Construction traffic related to the Scheme has the potential to impact local air quality due to vehicle exhaust emissions. Impacts from construction traffic will be short term and localised in nature. However, it is anticipated that with good construction practices and a construction traffic management plan any potential impacts can be mitigated.

Operation

Human Receptors

6.5.10 Overall, the predicted air quality effects of the Scheme on human health are negligible in significance.

6.5.11 At all receptors, predicted concentrations of annual mean nitrogen dioxide with the Scheme in operation are below the annual mean objective of 40µg/m^3 (with a negligible risk of exceedence of the hourly mean air quality objective). Similarly, predicted concentrations of annual mean PM_{10} and the number of days exceeding the daily mean standard are well below the UK's objectives (40µg/m^3 as an annual mean; fewer than 35 days with daily mean above 50µg/m^3). The full model results are provided in Appendix 6.3. The following discussion focuses on nitrogen dioxide, since this illustrates the spatial trends in concentrations of nitrogen dioxide and PM_{10}.

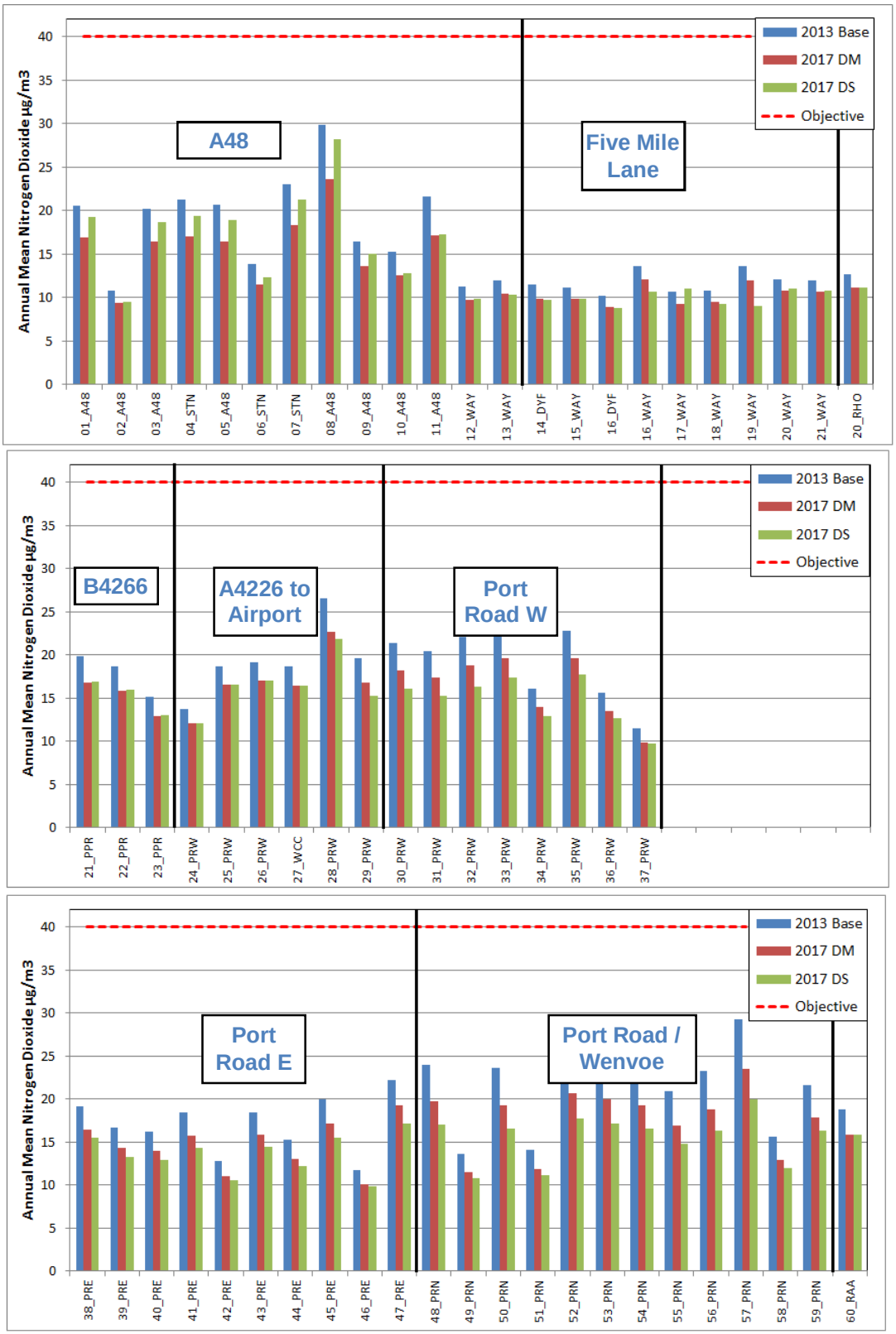
6.5.12 The most significant changes in pollutant concentration result from changes in traffic flows on the major routes near the Scheme. The A48 and Five Mile Lane both experience increases in traffic flow (over 5,500 and 7,100 respectively as two way AADT in 2017) and the A4050 and Port Road both experience decreases in traffic flow (of over 7,100 and 5,400 respectively as two way AADT in 2017). As a result, receptors near the A48 and Five Mile Lane experience an increase in pollutant concentrations and receptors along Port Road experience a decrease in pollutant concentrations. Due to the low pollutant concentrations predicted with the scheme in operation and the minimal change in concentration across the area, no effects at human receptors are significant.

6.5.13 Another influence on the changes in concentration associated with the Scheme is the change in alignment of Five Mile Lane, which alters the distance between the traffic route and sensitive receptors.

6.5.14 The impact of the Scheme on annual mean ambient nitrogen dioxide concentrations at human receptors is shown in Insert 6.2 and summarised in Table 6.12. Results are only presented for 2017 as the forecast reduction in emissions in 2032 simply serves to reduce concentrations across the study area, while the trend of changes remains identical to that in 2017.

6.5.15 The only receptor experiencing potentially non-negligible effects is 08_A48 (Treehill Cottage). Pollutant concentrations at this receptor see a large increase with the Scheme in operation, but total pollutant concentrations remain well below the objective and, as such, no health effects are likely. This effect is, therefore, not significant.

6.5.16 The results of the vehicle emissions improvement rate sensitivity testing are summarised in Table 6.13. Despite the conservative assumptions inherent in the sensitivity tests, no exceedences of objectives were modelled at any receptor. The distribution and nature of impacts is the same as in the year specific model results described above and the magnitude, though inflated somewhat by the higher emission rates, remains similar. That is to say, even if no improvement in emissions per vehicle is assumed between the baseline and the opening year of the Scheme, modelled pollutant concentrations remain within the air quality objectives at all receptors.



Insert 6.2 Annual mean nitrogen dioxide concentrations at human receptors

Table 6.12: Summary of Annual Mean Ambient Nitrogen Dioxide Concentrations at Human Receptors (% change expressed as a proportion of the objective)

Receptors		Impact at Most Affected Receptor							Overall Comment
		Baseline 2013 ($\mu g/m^3$)	2017 DM ($\mu g/m^3$)	2017 DS ($\mu g/m^3$)	Change in Concentration ($\mu g/m^3$)	% Change in Concentration	Magnitude of Change	Significance	
1 to 11	A48, Culverhouse Cross to Sycamore Cross	29.8	23.6	28.2	4.6	11.5%	Large Adverse	Slight Adverse	All receptors show an increase in pollutant concentrations but no exceedence of the objective. Maximum impact at receptor 08_A48, Trehill is slight adverse. All other receptors have impacts of negligible significance
12 to 19	Five Mile Lane and associated minor lanes	10.6	9.3	11.1	1.8	4.5%	Small Adverse	Negligible	Receptors show an increase in pollution levels where the new road alignment moves traffic closer to the receptor (e.g. 17_WAY, Northcliffe Cottage) and a decrease in pollution levels where traffic is mover further from receptor (e.g. 19_WAY Sutton Fach Farm). All receptors have impacts of negligible significance and pollution levels well below the objective
		13.6	12.0	9.1	-2.9	-7.2%	Medium Adverse	Negligible	
20	Rhoose village	12.7	11.2	11.2	0.0	0.0%	Imperceptible	Negligible	Negligible change in traffic flows and negligible impacts on pollution levels
21 to 23	B4266 Pontypridd Road (south of Waycock Cross)	18.7	15.8	16.0	0.2	0.5%	Imperceptible	Negligible	Receptors see an increase in pollution levels, but change is imperceptible everywhere and impacts are of negligible significance

Table 6.12: Summary of Annual Mean Ambient Nitrogen Dioxide Concentrations at Human Receptors (% change expressed as a proportion of the objective)

Receptors		Impact at Most Affected Receptor							Overall Comment
		Baseline 2013 ($\mu g/m^3$)	2017 DM ($\mu g/m^3$)	2017 DS ($\mu g/m^3$)	Change in Concentration ($\mu g/m^3$)	% Change in Concentration	Magnitude of Change	Significance	
24 to 29	Waycock Cross to airport, Port Road West	19.2	17.0	17.1	0.1	0.2%	Imperceptible	Negligible	Receptors on road to airport see an increase in pollution levels, but change is imperceptible (e.g. 26_PRW, Green Farm); Receptors on the eastern arm of Waycock cross (towards Colcot, 29_PRW) see a decrease in pollution levels. But all impacts are of negligible significance and no exceedences of objectives are seen
		19.6	16.8	15.3	-1.5	-3.8%	Small	Negligible	
30 to 37	Port Road West, Waycock Cross to Colcot Road	22.1	18.8	16.4	-2.5	-6.1%	Medium	Negligible	All receptors show a decrease in pollutant concentrations. Maximum beneficial impacts at receptor 32_PRW, Brenig Close but significance is negligible at all receptors and no exceedences of objectives are seen
38 to 47	Port Road East, Colcot Road to junction with A4231 (Barry Docks Link Road)	22.2	19.3	17.2	-2.1	-5.2%	Medium	Negligible	All receptors show an decrease in pollutant concentrations. Maximum beneficial impacts at receptor 47_PRE, Golwg y Coed but significance is negligible at all receptors and no exceedences of objectives are seen

Table 6.12: Summary of Annual Mean Ambient Nitrogen Dioxide Concentrations at Human Receptors (% change expressed as a proportion of the objective)

Receptors		Impact at Most Affected Receptor							Overall Comment
		Baseline 2013 ($\mu g/m^3$)	2017 DM ($\mu g/m^3$)	2017 DS ($\mu g/m^3$)	Change in Concentration ($\mu g/m^3$)	% Change in Concentration	Magnitude of Change	Significance	
48 to 59	Port Road East, A4231 to Culverhouse Cross	29.3	23.5	20.0	-3.5	-8.7%	Medium	Negligible	All receptors show an decrease in pollutant concentrations. Maximum beneficial impacts at receptor 57_PRN, Nant Isaf but significance is negligible at all receptors and no exceedences of objectives are seen
60	Culverhouse Cross	18.9	15.8	15.8	0.0	0.0%	Imperceptible	Negligible	Negligible change in traffic flows and negligible impacts on pollution levels

Table 6.13: Summary of Sensitivity Testing on Ambient Annual Mean Nitrogen Dioxide at Human Receptors (emission rates and background concentrations held at 2013 levels for 2017 scenarios and 2017 levels for 2032 scenarios)

Receptors		Sensitivity Test Comments
1 to 11	A48, Culverhouse Cross to Sycamore Cross	All receptors show an increase in pollutant concentrations but no exceedences of the objective. Maximum predicted concentrations with the Scheme are 34.5ug/m3 in 2017 sensitivity test and 33.0ug/m3 in 2032 sensitivity test, both of which are within the air quality objective (Receptor 08_A48). Impacts at this receptor remain of slight adverse significance as in the year specific tests. All other receptors have impacts of negligible significance except 07_A48 which has a slight adverse impact in the 2032 test (but concentration well below the objective at 24.4ug/m3)
12 to 19	Five Mile Lane and associated minor lanes	Impacts remain negligible at all receptors in sensitivity tests, with both increases and decreases in pollution levels dependent on the location of the receptor in relation to the new route alignment. Maximum beneficial impact, at receptor 19_WAY is a decrease of 3.7ug/m3 in 2017 and 3.8ug/m3 in 2032. This is medium in magnitude but negligible in significance since concentrations are well below the objective with or without the Scheme in operation. Maximum adverse impacts, at 17_WAY, are also medium in magnitude but negligible in significance.
20	Rhoose village	Impacts are imperceptible in sensitivity test
21 to 23	B4266 Pontypridd Road (south of Waycock Cross)	Receptors see an increase in pollution levels, but change is imperceptible everywhere in the sensitivity tests and impacts are of negligible significance
24 to 29	Waycock Cross to airport, Port Road West	Impacts on A4050 to airport remain imperceptible in the sensitivity tests; Impacts on Port Road West (towards Colcot) are beneficial and medium at the most affected receptor (29_PRW) in magnitude but remain of negligible significance as in the year specific model runs.
30 to 37	Port Road West, Waycock Cross to Colcot Road	All receptors show a beneficial impact but, as in year specific runs, whilst the maximum of the impact is small to medium, the significance of the impact is negligible.
38 to 47	Port Road East, Colcot Road to junction with A4231 (Barry Docks Link Road)	All receptors show a beneficial impact but, as in year specific runs, whilst the maximum of the impact is small to medium, the significance of the impact is negligible.
48 to 59	Port Road East, A4231 to Culverhouse Cross	All receptors show a beneficial impact with a decrease in pollution levels. At the most affected receptor (57_PRN), the magnitude of the decrease in pollution levels is large (2017 test only) and, as a result, the impact is classed as being of slight beneficial significance. All other receptors experience impacts of negligible significance
60	Culverhouse Cross	Impacts are imperceptible in sensitivity test

Ecological Receptors

6.5.17 Table 6.14 and Table 6.15 show the impact of the Scheme on ambient NO_X concentrations at ecological receptors for 2017 and 2032 respectively. Table 6.16 shows the impacts on nitrogen deposition.

6.5.18 Exceedences of the objective for annual mean NO_X concentrations are predicted at roadside ecological receptor locations in the baseline and in 2017 at some receptors. This is primarily due to the proximity of the sites to the roadside. The impact of the Scheme is to increase concentrations at receptors along Five Mile Lane (Middleton Plantation and Lidmore Wood) but to decrease concentrations at receptors along Port Road West/East and A4231 (Pencoetre Woods and Cwm Talwyg). At roadside receptors, the change in concentration is large and, with modelled exceedences of the objective with the Scheme in operation, the impact of the Scheme is Large Adverse for Middleton Plantation to the east and west of Five Mile Lane, and Large Beneficial for Pencoetre Wood.

6.5.19 At receptor locations more distant from the road, the impact of the Scheme decreases. Comments within Table 6.14 describe the distance from the roadside at which impacts reduce to negligible significance.

6.5.20 The overall impact of the Scheme decreases in 2032 to the extent that there are no modelled exceedences of the air quality objective for NO_X that are worsened with the Scheme. Indeed, concentrations on Five Mile Lane are predicted to have decreased to within the objective but to experience a large increase with the Scheme (a Moderate Adverse impact). However, whilst exceedences of the objective are modelled without the Scheme at the roadside in Pencoetre Woods, the impact of the Scheme is to reduce concentrations (a large beneficial impact).

6.5.21 The sensitivity test on ecological receptors had the effect of increasing the distance over which large adverse or beneficial impacts were modelled, depending on location, but also increasing the distance over which exceedences of the objective occur.

6.5.22 In terms of nitrogen deposition, baseline deposition exceeded the relevant critical loads for the habitats by a considerable margin. The spatial distribution of impacts with the Scheme follows that for nitrogen oxides, with a significant increase in deposition along Five Mile Lane resulting in large adverse impacts in Middleton Plantation at the roadside, decreasing to slight adverse at distance from the road (but never falling to negligible levels). Conversely, on Port Road, the impact at Pencoetre Wood is Large Beneficial at the roadside, decreasing to Slight Beneficial to Negligible at greater distance from the road.

6.5.23 These conclusions hold for both 2017 and 2032 since no decrease in background wet deposition levels is assumed over time. This is a conservative assumption but, with the minimum critical load being 5kgN/ha/yr for the woodland habitats and existing deposition levels of the order of 22 - 27kgN/ha/yr, it is a near certainty that exceedence of the critical load will continue to 2030 and beyond, whether or not the Scheme proceeds.

Table 6.14: Summary of Ambient NOx Concentrations at Ecological Receptors for 2017

Ecological Receptor	Impact At Nearest Point to Road							Comment
	Baseline 2013 ($\mu g/m^3$)	2017 DM ($\mu g/m^3$)	2017 DS ($\mu g/m^3$)	Change in Concentration ($\mu g/m^3$)	% Change in Concentration	Magnitude of Change	Significance	
Barry Woodlands SSSI (Middleton Plantation, East of A4226)	39.65	34.9	46.9	12.0	40.1%	Large	Large Adverse	Large adverse impacts, with exceedence of objective to 12m from roadside with Scheme and 4m without Scheme; Impacts fall to negligible significance at 45m and greater from roadside
Barry Woodlands SSSI (Middleton Plantation, West of A4226)	30.4	26.7	37.6	10.9	36.4%	Large	Large Adverse	Large adverse impacts, with exceedence of objective to 8m from roadside with Scheme; Impacts fall to negligible significance at 35m and greater from roadside
Barry Woodlands SSSI (Lidmore Wood)	21.2	18.3	19.1	0.8	2.6%	Small	Negligible	Impacts are small in magnitude but adverse across the entire site, no exceedence of objective; negligible significance everywhere
Barry Woodlands SSSI (Pencoetre Wood, South of A4050)	72.1	61.8	52.8	-9.0	-30.0%	Large	Large Beneficial	Large beneficial impacts with reduction in distance from road with exceedence of objective from 30m to 25m; Impacts fall to negligible significance at 50m from A4050 and 30m from A4231

Table 6.14: Summary of Ambient NOx Concentrations at Ecological Receptors for 2017

Ecological Receptor	Impact At Nearest Point to Road							Comment
Barry Woodlands SSSI (Pencoetre Wood, East of A4231)	55.0	42.0	41.7	-0.4	-1.2%	Small	Slight Beneficial	Slight beneficial impacts with reduction in distance from road with exceedence of objective from 30m to 25m; Impacts are of negligible significance within 40m of A4231
Cwm Talwg LNR (South of A4050)	26.2	22.3	21.3	-1.0	-3.2%	Small	Negligible	Impacts are small and beneficial across the entire site, but no exceedence of objective; Impacts are of negligible significance everywhere

Table 6.15: Summary of ambient NOx concentrations at ecological receptors for 2032

Ecological Receptor	Impact At Nearest Point to Road							Comment
	Baseline 2013 ($\mu g/m^3$)	2032 DM ($\mu g/m^3$)	2032 DS ($\mu g/m^3$)	Change in concentration ($\mu g/m^3$)	% Change in concentration	Magnitude of Change	Significance	
Barry Woodlands SSSI (Middleton Plantation, East of A4226)	39.65	23.4	29.4	6.0	20.0%	Large	Moderate Adverse	Moderate adverse impacts at worst but no exceedence of objective; Impacts fall to negligible significance at 10m and greater from roadside

Table 6.15: Summary of ambient NOx concentrations at ecological receptors for 2032

Ecological Receptor	Impact At Nearest Point to Road							Comment
	Baseline 2013 (µg/m^3)	2032 DM (µg/m^3)	2032 DS (µg/m^3)	Change in concentration (µg/m^3)	% Change in concentration	Magnitude of Change	Significance	
Barry Woodlands SSSI (Middleton Plantation, West of A4226)	30.4	18.5	24.2	5.8	19.3%	Large	Slight Adverse	Slight adverse impacts at worst but no exceedence of objective; Impacts fall to negligible significance at 10m and greater from roadside
Barry Woodlands SSSI (Lidmore Wood)	21.2	13.4	13.8	0.4	1.4%	Small	Negligible	Impacts are of small magnitude at worst but negligible significance everywhere
Barry Woodlands SSSI (Pencoetre Wood, South of A4050)	72.1	40.1	34.7	-5.3	-17.8%	Large	Large Beneficial	Large beneficial with reduction in distance from road with exceedence of objective from 6m to 2m; Impacts fall to negligible at 15m from A4050
Barry Woodlands SSSI (Pencoetre Wood, East of A4231)	55.0	26.1	25.8	-0.4	-1.2%	Small	Negligible	Impacts are of negligible significance across site, with no exceedence of objective whether or not Scheme is operating
Cwm Talwg LNR (South of A4050)	26.2	16.0	15.3	-0.7	-2.3%	Small	Negligible	Impacts are small in magnitude and beneficial across the entire site, but no exceedence of objective; Impacts are of negligible significance everywhere

Table 6.16: Summary of Nitrogen Deposition at Ecological Receptors (minimum critical load = 5kgN/ha/yr for all sites)

Ecological Receptor	Impact At Nearest Point to Road							Comment
	Baseline 2013 kgN/ha/yr	2017 DM kgN/ha/yr	2017 DS kgN/ha/yr	Change in deposition kgN/ha/yr	% Change in Deposition	Magnitude of Change	Significance	
2017								
Barry Woodlands SSSI (Middleton Plantation, East of A4226)	30.18	29.90	31.64	1.74	34.7%	Large	Large Adverse	Slight adverse impacts at >55m from roadside
Barry Woodlands SSSI (Middleton Plantation, West of A4226)	28.80	28.66	30.31	1.65	33.1%	Large	Large Adverse	Slight adverse impacts at >45m from roadside
Barry Woodlands SSSI (Lidmore Wood)	27.35	27.32	27.45	0.13	2.6%	Small	Slight Adverse	Slight adverse impacts falling to imperceptible at distances > 230m from road
Barry Woodlands SSSI (Pencoetre Wood, South of A4050)	34.52	33.64	32.45	-1.19	-23.8%	Large	Large Beneficial	Slight beneficial impacts at >45m from roadside
Barry Woodlands SSSI (Pencoetre Wood, East of A4231)	32.32	30.95	30.90	-0.05	-1.0%	Small	Slight Beneficial	Negligible significance at distances >50m from roadside
Cwm Talwg LNR (South of A4050)	28.14	27.97	27.81	-0.16	-3.1%	Small	Slight Beneficial	Slight beneficial everywhere
2032								
Barry Woodlands SSSI (Middleton Plantation, East of A4226)	30.18	28.77	29.64	0.87	17.3%	Large	Large Adverse	Slight adverse impacts at >25m from roadside
Barry Woodlands SSSI (Middleton Plantation, West of A4226)	28.80	28.03	28.89	0.86	17.2%	Large	Large Adverse	Slight adverse impacts at >20m from roadside
Barry Woodlands SSSI (Lidmore Wood)	27.35	27.26	27.32	0.06	1.3%	Small	Slight Adverse	Slight adverse impacts falling to imperceptible at distances > 230m from road
Barry Woodlands SSSI (Pencoetre Wood, South of A4050)	34.52	31.09	30.37	-0.72	-14.3%	Large	Large Beneficial	Slight beneficial impacts at >20m from roadside

Table 6.16: Summary of Nitrogen Deposition at Ecological Receptors (minimum critical load = 5kgN/ha/yr for all sites)

Ecological Receptor	Impact At Nearest Point to Road							Comment
	Baseline 2013 kgN/ha/yr	2017 DM kgN/ha/yr	2017 DS kgN/ha/yr	Change in deposition kgN/ha/yr	% Change in Deposition	Magnitude of Change	Significance	
Barry Woodlands SSSI (Pencoetre Wood, East of A4231)	32.32	29.16	29.11	-0.05	-1.0%	Small	Slight Beneficial	Negligible significance at distances >40m from roadside
Cwm Talwg LNR (South of A4050)	28.14	27.65	27.55	-0.10	-2.0%	Small	Slight Beneficial	Impact becomes negligible at 130m from roadside

6.6 Mitigation

Construction

6.6.1 With the exception of ecological receptors in the area, the risk of impacts from construction dust is low or negligible. The most sensitive ecological receptors have been considered in the implementation of the Scheme and some mitigation of impacts (i.e. establishing new sections of woodland) has been proposed. Further to this, a number of standard mitigation measures would be implemented to ensure that good construction practices are followed including the preparation of a Dust Management Plan (DMP) for the site which should be agreed with the Environmental Health Department at Vale of Glamorgan Council before start of construction. Suggested measures include:

Site management

- Records of dust and air quality complaints to be kept, including likely causes and mitigation measures to reduce impacts if appropriate
- Keep site perimeter, fences etc. clean

Site planning

- Consideration of weather conditions
- Consideration of dust generating potential of material to be excavated prior to commencement of works
- Plan site layout to maximise distance from plant/stockpiles etc. to sensitive receptors
- Dusty materials should be removed from site as soon as possible

Construction traffic and track out

- Loads entering and leaving the site with dust generating potential should be covered and wheel washing facilities made available
- No idling of vehicles
- Vehicles to comply with site speed limits (15mph on hard surfaces, 10mph of unconsolidated surfaces)
- Water assisted sweeping of local roads to be undertaken if material tracked out of site
- Install hard surfacing as soon as practicable on site and ensure that they are maintained in good condition

Site activities, construction activities and earthworks

- Exposed soils should be revegetated as soon as practicable. Near residential properties or sensitive ecosystems (<50m), use hessian/mulches etc. where not possible to revegetate or cover with topsoil
- Minimise dust generating activities, particularly near residential receptors / sensitive ecosystems during prolonged dry, dusty weather unless damping / other suppressants are used

- Ensure an adequate water supply to site and use water as dust suppressant where applicable
- Ensure any site machinery is well maintained and in full working order
- Ensure equipment available for cleaning spills etc. Available at all times
- Sand and aggregates should be stored away from sensitive receptors and screened shielded. Similarly concrete batching should take place away from receptors.

Operation

6.6.2 No air quality specific mitigation measures are required for the operational phase of the Scheme in relation to human health.

6.6.3 The planting of woodland at the northern end of the Barry Woodland SSSI in the improved pasture adjacent to Middleton Plantation (opposite the Welsh Hawking Centre), will aid in the mitigation of impacts to ecological receptors. The woodland will be planted to be continuous with Middleton Plantation, and with other planting will extend to Sutton Wood and Sutton Fach Wood, providing a total additional area of 4.7 ha. This mitigation is described in further detail in Chapter 9 Nature Conservation.

6.7 Residual Effects (With Mitigation)

Construction

6.7.1 There will be no permanent residual risks associated with the construction of the Scheme. The impacts outlined above relating to construction activities and traffic are all temporary.

Operation

6.7.2 There are no significant adverse residual effects to human health anticipated as a result of the operation of the Scheme.

6.7.3 The adverse effects on ecological receptors (as shown in Table 6.16 above) are discussed in further detail in Chapter 9 Nature Conservation.

6.8 Cumulative Effects

Construction

6.8.1 There are no cumulative construction dust effects anticipated in relation to the Scheme since no other development within a few hundred metres of the Scheme is likely to overlap in timing with the road construction.

Operation

6.8.2 Cumulative growth was taken into account in the traffic data used in this assessment, the details of which can be found in the Transport Assessment for the Scheme (Appendix 13.1).

6.9 Summary & Conclusions

6.9.1 Current air quality in the vicinity of the Scheme is generally good, though some exceedences of the air quality objective for nitrogen dioxide were monitored at the roadside of routes with high volumes of traffic. There are no AQMAs in the study area. A Site of Special Scientific Interest (SSSI) lies within the study area and is split into sections geographically and there is also a Local Nature Reserve to the south of the Scheme. Nitrogen oxides concentrations at the roadside within the SSSI exceed the air quality objective for the protection of vegetation.

6.9.2 A qualitative assessment of the potential for dust emission from construction activities was undertaken, and the significance of likely impacts was determined for both human and ecological receptors. The area around the Scheme is not heavily populated and, as such, there is limited potential for dust nuisance or risk to human health as a result of construction activities. However, largely due to the proximity of ecological receptors to the Scheme, there is potential for adverse effects to habitats during the construction phase. A number of standard mitigation measures would be implemented to ensure that good construction practices are followed including the preparation of a Dust Management Plan (DMP) for the site which should be agreed with the Environmental Health Department at Vale of Glamorgan Council before start of construction.

6.9.3 The assessment of changes to traffic flows as a result of the Scheme was undertaken using detailed dispersion modelling and analysed against criteria set out in HA and EPUK guidance. Changes in pollutant concentration at human and ecological receptors relate in large part to the redirection of traffic to the improved route introduced by the Scheme and the spatial realignment of this route. It was calculated that pollutant concentrations will increase at human receptors along the A48 and along Five Mile Lane itself and decrease along the A4050 and Port Road to the east and south of the Scheme. There were no modelled exceedences of air quality objectives at human receptors with or without the Scheme, which was generally evaluated as having Negligible impact. One instance of Slight Adverse impacts was calculated along the A48, but overall the impact of the Scheme is Negligible on human health.

6.9.4 Adverse impacts were predicted at ecological receptors immediately adjacent to the Scheme. Nitrogen deposition without the Scheme in place is already in exceedence of the critical load against which concentrations are assessed, and a large increase was calculated on Five Mile Lane as a result of the Scheme. This is primarily due to the proximity of the Middleton Plantation section of the Barry Woodlands SSSI to the Scheme. Similarly, nitrogen oxides concentrations are predicted to exceed the air quality objective at the roadside and, along Five Mile Lane, concentrations increase with the Scheme. In contrast, on Port Road, the Pencoetre Wood section of the Barry Woodlands SSSI is expected to experience beneficial impacts of a corresponding magnitude.

6.9.5 Overall, the air quality effects on human receptors associated with the Scheme are unlikely to:

- Interfere with or prevent the implementation of actions being undertaken by the Vale of Glamorgan Council to improve air quality;
- Lead to an exceedence of a UK air quality objective;
- Cause a new AQMA to be declared;

- Lead to a significant increase in emissions, degradation of air quality or increase in exposure to pollutants; or
- Result in adverse dust effects from construction activities.

6.9.6 In relation to ecological receptors the air quality effects related to the Scheme are likely to:

- Cause a large increase in nitrogen deposition (which is already in exceedence of the critical load without the Scheme in place) and ambient NOx concentration at the Middleton Plantation section of the Barry Woodlands SSSI, and a large decrease in the same at the Pencoetre Wood section of the Barry Woodlands SSSI.

6.9.7 Air quality effects do not represent a constraint, in the planning context, to the Scheme as a result of impact to human receptors. Further information on the effects of changes in air quality resulting from the Scheme on ecological receptors is set out in Chapter 9 Nature Conservation.

7 CULTURAL HERITAGE

7.1 Introduction

7.1.1 This chapter presents an assessment of the effect of the Scheme on cultural heritage. It considers the potential effects of the construction of the Scheme (site preparation, earthworks and building works) on the known and potential archaeological remains, built heritage and the setting of the cultural heritage. It also considers the effects on the archaeology and built heritage during the operation of the Scheme, and any residual effects and cumulative effects.

7.2 Legislative & Policy Context

European Legislation & Policy

7.2.1 There are no World Heritage sites or sites included on the Tentative List of Future Nominations for World Heritage sites issued by the Secretary of State for Culture, Media and Sport situated within the Scheme area (i.e. Red Line Boundary) or its vicinity.

National Legislation & Policy

7.2.2 National planning policies on the conservation of the historic environment are set out by the National Assembly for Wales in 'Chapter 6: Conserving the Historic Environment' of Planning Policy Wales (PPW) (Edition 8, January 2016) and associated Technical Advice Notes (TAN). These are supplemented by 21 topic-based Technical Advice Notes (TANs). TANs prescribe the government's policies on various planning issues that shape the preparation of development plans. The principles and objectives of TANs prescribe the overarching national guidance for specific individual environmental topics. Both PPW and the TANs are material considerations in determining planning applications under the Town and County Planning Association (TCPA) system.

7.2.3 The guidance emphasises the role of the Welsh Government's executive agency, CADW in providing statutory protection for Scheduled Monuments (SMs) under the Ancient Monuments and Archaeological Areas Act 1979; and buildings of special architectural or historic interest (Listed Buildings) as covered under Section I of the Planning (Listed Buildings and Conservation Areas) Act 1990. There are five Scheduled Monuments within or in the immediate vicinity of the study area (see Figure 7.1). These include Coed y Cwm Long Barrow (GM116), Coed y Cwm Ringwork (GM117) Moulton Roman Site (GM253), Castle Ringwork (GM613) and the remains of Highlight Church (GM344).There are no listed buildings within the Scheme Area or immediate vicinity.

7.2.4 CADW has also compiled a series of non-statutory, advisory volumes comprising a Register of Landscapes of Outstanding Historic Interest in Wales, a Register of Landscapes of Special Historic Interest in Wales and a Register of Parks and Gardens of Special Historic Interest in Wales. Although the Scheme does not lie within any such Registered Landscape, Bonvilston Amalgamated Fieldscape (HLCA 010) is located within the outer study area, 200 m north of the Scheme.

Local Policy

7.2.5 The Vale of Glamorgan Unitary Development Plan (UDP) sets out the key policy relating to the historic environment. Of particular reference is consideration of the historic built environment. PPW clearly outlines the role of the UDP in respect of the historic environment. Paragraphs 6.1.1 and 6.1.2 state:

'It is important that the historic environment encompassing archaeology and ancient monuments, listed buildings, conservation areas and historic parks, gardens and landscapes-is protected. The Assembly Government's objectives in this field are to:

- *Preserve and enhance the historic environment, recognising its contribution to economic vitality and culture, civic pride and the quality of life, and its importance as a resource for future generations; and specifically to*
- *Protect archaeological remains, which are finite and non-renewable resource, part of the historical and cultural identity of Wales, and valuable both for their own sake and for their role in education, leisure and the economy, particularly tourism.'*

7.3 Assessment Methodology

7.3.1 This methodology offers an outline of standards and guidance employed in the compilation of this assessment. It also defines the study area, terminology, and sets out the aims and objectives of the report.

7.3.2 The Scoping report (Appendix 1.1) discussed the requirement for a desk-based assessment of the cultural heritage baseline of the Scheme, and this is presented as Appendix 7.1. It served to identify known, previously unknown and potential heritage assets, and additionally to determine their significance and sensitivity. The potential impact of the Scheme on the assets was assessed and a provisional programme of mitigation compiled. The desk-based assessment and this chapter have been compiled with reference to the following professional guidance:

- Chartered Institute for Archaeologists (CIfA), CADW, Historic England and GGAT:
- CIfA 2015, Standard and Guidance for Historic Environment Desk-based Assessment;
- CIfA 2015, Code of Conduct;
- CADW 2011, Conservation Principles;
- Historic England 2006, Management of Research Projects in the Historic Environment (MoRPHE);
- GGAT 2007, Notes for archaeologists undertaking desk-based studies in South East Wales).
- The assessment of setting has been undertaken in accordance with Historic England guidelines; The Setting of Heritage Assets, Historic Environment Good Practice in Planning: 3 (2015).

7.3.3 In the absence of a Welsh equivalent and in agreement with CADW, the assessment of setting has been undertaken in accordance with Historic England guidelines 'The Setting of Heritage Assets, Historic Environment Good Practice in Planning: 3' (2015) with reference made to the Conservation Principles (CADW, 2011).

7.3.4 This chapter (and its associated figures and appendices) is not intended to be read as a standalone assessment and reference should be made to the front end of this ES (Chapters 1 to 5), as well as Chapter 16 Cumulative Effects.

Data Collection

7.3.5 The principal sources of information consulted were historical and modern maps, although published and unpublished secondary sources were also reviewed. The following repositories were consulted during the data-gathering process:

- The Royal Commission on Ancient and Historical Monuments Wales;
- Glamorgan Gwent Archaeological Trust Historic Environment Record;
- Glamorgan Archive Service, and;
- National Resources Wales.

Study Areas

7.3.6 This assessment has focused on the Scheme although historic information for 250m from the Scheme (hereafter known as the inner study area) was considered in order to provide an essential contextual background. A second, outer study area, defined by a Zone of Visual Influence (ZVI), was applied for the setting assessment and extends to the area from which the Scheme could be visible. The Sycamore Cross junction works have not been included within the inner and outer study areas for the Scheme. This is due to the relatively minor extent of the works and the fact that they will be undertaken on land previously disturbed during an intersection upgrade completed at the same location in 2013. The inner and outer study areas (ZVI) are shown on Figure 7.1.

Terminology

7.3.7 The technical terminology applied to the assessment process in this document is based on that contained within the NPPF Planning Practice Guide (DCLG, 2014), Historic England's 'The Setting of Heritage Assets, Historic Environment Good Practice in Planning: 3' (2015).) and the Cultural Heritage Section (Volume 11, Section 3, Part 2) of the Design Manual for Road and Bridges (DMRB) issued by Highways England (formerly the Highways Agency) in 2007. This latter document has been widely adopted throughout the heritage industry as a baseline. However, the terminology has been enhanced as appropriate throughout this report.

7.3.8 Cultural heritage comprises Scheduled Monuments, Listed Buildings, Parks and Gardens, Registered Historic Landscapes, Conservation Areas, earthworks and buried archaeological remains. For the ease of presentation in this document, cultural heritage features are referred to as heritage assets, and additionally for the purposes of clarity a minor distinction is made between standing remains and buried archaeology.

Study Area Visit and Setting Assessment

7.3.9 The inner study area (Figure 7.1) was visited in September 2014 in order to assess its character, identify any visible historic features and assess possible factors which may affect the survival or condition of known or potential assets. Additionally, the outer study area was visited in order to allow an assessment of the potential for impacts on the significance of the setting of the heritage assets (Figure 7.1). The general

topography was noted, as was the presence of any large areas of plantation, and building complexes such as housing estates, industrial plant, and so forth. Each designated heritage asset, or clusters of assets were also visited in order to assess the potential harm to the significance of the setting of the asset.

Assessment of Significance

7.3.10 The Standard and Guidance for Historic Environment Desk-based Assessment (CIfA, 2015) considers that an assessment of the significance of heritage assets should include archaeological, historic, architectural and artistic interests pertaining to the asset. It should identify the potential impact of proposed or predicted changes on the significance of the asset and the opportunities for reducing that impact. Additionally, this significance may derive not only from its physical presence but also from its setting and relies heavily upon Historic England's guidance 'The Setting of Heritage Assets, Historic Environment Good Practice in Planning: 3' (2015).

7.3.11 In accordance with the DMRB, which is widely adopted by heritage professionals as a standard for the quantification of magnitude and impact assessment, the sensitivity, value or importance of the heritage asset is judged in a neighbourhood, local, regional, national and international context. It should be stressed that enhancements were made to the criteria more appropriate to archaeology and cultural heritage. Furthermore, professional judgement was applied throughout the assessment process which results in the cultural sensitivity of the asset being determined along with the appropriate form of investigation.

7.3.12 CADW present a set of heritage values in their guidance document 'Conservation Principles' (2011) aesthetic, communal, historic and evidential, which is the approach adopted for analysing significance in this document. The CADW criteria are discussed in further detail in the Archaeological Desk-Based Assessment (Appendix 7.1) and have been considered for this assessment.

7.3.13 Initially, the sensitivity, value or importance of the heritage asset is judged in a neighbourhood, local, regional, national and international context, which results in the cultural sensitivity of the asset being determined along with the appropriate form of mitigation, as set out in Table 7.1.

Table 7.1: Criteria Used to Determine Importance of Heritage Assets

Cultural Value/Sensitivity	Criteria
Very high (International)	• World Heritage Sites; • Sites of International Importance.
High (National)	• Scheduled Monuments; • All Listed Buildings • Registered Parks and Gardens.
Medium (Regional/County)	• Conservation Areas containing buildings that contributes significantly to its historic character; • Areas of Archaeological Importance; • Locally listed buildings (local authority listing – non designated).
Low (Local/Borough)	• Archaeological sites and remains with a local or borough interest for education, cultural appreciation. • Assets which contribute to local or cultural understanding of the area.

Cultural Value/Sensitivity	Criteria
Negligible (Neighbourhood / Negligible)	• Relatively numerous types of remains, of some local importance; • Isolated find spots with no context; • Areas in which investigative techniques have revealed no, or minimal, evidence of archaeological remains, or where previous large-scale disturbance or removal of deposits can be demonstrated.
Uncertain / Potential	Potential archaeological sites for which there is little information. It may not be possible to determine the importance of the site based on current knowledge. Such sites are likely isolated find spots, place names or crop marks identified on aerial photographs.

7.3.14 Table 7.1 is a general guide to the attributes of cultural heritage assets and it should be noted that not all the qualities listed need be present in every case and professional judgement is used in balancing the different criteria.

Potential impact

7.3.15 Harm to significance is the basis of assessing impact. In order to assess the level of harm or potential impact of any future development on built heritage or buried archaeological remains, consideration has been afforded to:

- Assessing in detail any impact and the significance of the effects arising from any future development of the study area
- Reviewing the evidence for past impacts that may have affected the archaeological sites of interest identified during the desk-based assessment
- Outlining suitable mitigation measures, where possible at this stage, to avoid, reduce, or remedy adverse impacts

7.3.16 Key impacts have been identified as those that would potentially harm the significance of the heritage asset. Each potential impact has been determined as the predicted deviation from the baseline conditions, in accordance with current knowledge of the site and the Scheme. Although the impact is assessed in terms of the sensitivity of the asset to the magnitude of change or potential scale of harm from the Scheme, consideration is afforded to the heritage values of the assets (Section 7.4.15). The magnitude, or scale of an impact is often difficult to define, but will be termed as substantial harm, moderate harm, slight harm, or negligible, as shown in Table 7.2.

Table 7.2: Criteria Used to Determine Scale of Impact

Magnitude of Impact (In accordance with DMRB)	Description
Major	Significant change in environmental factors; Complete destruction of the site or feature; Change to the site or feature resulting in a fundamental change in ability to understand and appreciate the resource and its cultural heritage or archaeological value/historical context and setting.
Moderate	Significant change in environmental factors; Change to the site or feature resulting in an appreciable change in ability to understand and appreciate the resource and its cultural heritage or archaeological value/historical context and setting.

Table 7.2: Criteria Used to Determine Scale of Impact

Magnitude of Impact (In accordance with DMRB)	Description
Minor	Change to the site or feature resulting in a small change in our ability to understand and appreciate the resource and its cultural heritage or archaeological value/historical context and setting.
Negligible	Negligible change or no material changes to the site or feature. No real change in our ability to understand and appreciate the resource and its cultural heritage or archaeological value/historical context and setting.

Source: After ICOMOS, 2010 Guidance on Heritage Impact Assessments for Cultural World Heritage Properties, Paris

7.3.17 The interaction of the potential scale of impact (Table 7.2) and the sensitivity of the heritage asset (Table 7.1) produce the impact significance. This may be calculated by using the matrix shown in Table 7.3, which is included to allow an objective assessment to be presented.

Table 7.3: Impact Significance Matrix

		Magnitude of impact				
Sensitivity		No Change	Negligible	Minor	Moderate	Major
	Very High	Neutral	Slight	Moderate/ Large	Large/ 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/ Slight	Neutral/ Slight	Neutral/ Slight	Slight

7.3.18 It is normal practice to state that impacts of moderate or above significance are regarded as significant impacts.

Assumptions / limitations

7.3.19 This assessment is based on the Scheme proposals as presented at the time of compiling this report. Any subsequent changes to the Scheme have the potential to change the results of the assessment. Comments received from the Planning Archaeologist on the baseline assessment have been incorporated into this Chapter.

7.4 Baseline Conditions

Geology and Topography

7.4.1 The land within the study area is at approximately 78m above Ordnance Datum (AOD) in the north, sloping steeply down towards the south to 22m AOD. The

Scheme is underlain by the Porthkerry Member, St Marys Well Bay Member and the Lavernock Shales of the Blue Lias Formation comprising thinly interbedded limestone and calcareous mudstone or siltstone. Individual limestones are typically 0.10-0.30m thick. In some areas there are intervening mudstone units with relatively few limestone beds.

7.4.2 Overlying the bedrock geology, a narrow alluvial plain following the River Waycock is indicated to be present in the south of the Scheme comprising clays, sands and gravels. With the exception of this, the BGS mapping data suggests superficial deposits along the length of the Scheme are unknown or absent. Made Ground is not indicated on BGS records but is likely to be present along the route of the carriageway and any other current areas of hard standing.

7.4.3 Further details regarding the geology of the study area are provided in Chapter 10 Geology & Soils.

Archaeological Potential of the Scheme

7.4.4 A detailed historical and archaeological background and context for the Scheme is presented in the Archaeological Desk-Based Assessment (Appendix 7.1). Definitions of British Archaeological Periods are provided in Table 7.4. What follows is an outline summary of the known cultural heritage resource and potential archaeological assets.

Table 7.4: Summary of British Archaeological Periods and Date Ranges

Period	Date Range
Prehistoric Period: Palaeolithic Mesolithic Neolithic Bronze Age Iron Age	 500,000 – 10,000 BC 10,000 – 3,500 BC 3,500 – 2,200 BC 2,200 – 700 BC 700 BC – AD 43
Romano-British	AD 43 – AD 410
Early Medieval (Anglo-Saxon and Viking periods)	AD 410 – AD 1066
Late Medieval	AD 1066 – AD 1540
Post-medieval	AD 1540 – *c*1750
Industrial Period	*c*AD1750 – 1901
Modern	Post-1901

7.4.5 A total of 19 heritage assets were identified within the study areas in addition to one historic landscape. Within the inner study area there are 14 undesignated heritage assets and there is one Scheduled Monument within, and four immediately adjacent to, the outer study area (ZVI).

7.4.6 Summaries of the statutory designated heritage assets and historic landscapes are presented in Table 7.5 and Table 7.6. Summaries of non-designated assets, grouped by period, are provided in Tables 7.7 to 7.11.

Table 7.5: Scheduled Monuments within the Inner and Outer Study Areas

Heritage Asset Number	Name/Location	NGR	Approximate Distance from Scheme
GM117	Coed y Cwm Ringwork	ST08277367	920m
GM116	Coed y Cwm Long Barrow	ST0810873779	1km
GM253	Moulton Roman Site	ST07406968	750m
GM344	Remains of Highlight Church	ST09686989	890m
GM613	Castle Ringwork 850m ENE of Ty'n-y-Coed	ST07057334	1km

Table 7.6: Historic Landscapes Within the Inner and Outer Study Areas

Heritage Asset Number	Name/Location	NGR	Approximate Distance from Scheme
HLCA 010	Bonvilston Amalgamated Fieldscape	ST 06923 73015	200m

Prehistoric Period (500,000BC – AD43)

7.4.7 A total of three heritage assets were recorded within the Inner Study Area (Table 7.7).

Table 7.7: Heritage Assets Dating to the Prehistoric period (AD1066 – c1540)

Heritage Asset Number	Type	Description
03121s	Enclosures	An extensive series of rectangular enclosures identified by geophysics near Whitton Lodge
04147s	Ring Ditches	Two ring ditches identified by geophysical survey at Whitton Cross
04148s	Ring Ditch	One ring ditch identified by geophysical survey at Whitton Cross

Romano-British period (AD43 – AD410)

7.4.8 One heritage asset was recorded within the Inner Study Area (Table 7.8).

Table 7.8: Heritage Assets Dating to the Romano-British period (AD1066 – c1540)

Heritage asset number	Type	Description
00382s	Site of Villa	Roman Villa near Whitton Lodge

Early-medieval period (AD 410 – AD 1066)

7.4.9 No heritage assets dating to this period have been identified within the inner study area.

Late-medieval period (A1066 – c1540)

7.4.10 No heritage assets dating to this period have been identified within the inner study area.

Post-medieval period (AD1540 – c1750)

7.4.11 No heritage assets dating to this period have been identified within the inner study area.

Industrial period (AD1750 – c1901)

7.4.12 A total of six heritage assets were recorded within the inner study area (Table 7.9).

Table 7.9: Heritage Assets Dating to the Industrial period (AD1750-c1901)

Heritage asset number	Type	Description
03951s	Lime Kiln	Site of Lime Kiln
03952s	Quarry	Site of Quarry
02626s	Lime Kiln	Site of Lime Kiln
02625s	Lime Kiln	Site of Lime Kiln
02624s	Lime Kiln	Site of Lime Kiln
03051s	Lime Kiln	Site of Lime Kiln

Modern period (AD1901 – present)

7.4.13 No heritage assets dating to this period have been identified within the inner study area.

Undated heritage assets

7.4.14 A total of two heritage assets could not be dated with certainty and are listed in Table 7.10 below.

Table 7.10: Un-dated Heritage Assets

Heritage Asset Number	Type	Description
00381s	Site of Inhumation	Site of Inhumation
00380s	Site of Inhumation	Site of Inhumation

Importance (or sensitivity) of the heritage assets

7.4.15 Table 7.11 presents the importance or sensitivity of the heritage assets in a neighbourhood, local, regional, national and international context.

Table 7.11 Value/importance of the heritage assets

Value/importance	Heritage assets
International	N/A
National	00382s GM117 GM116 GM253 GM344 GM613 HLCA 010 Potentially 00381s and 00380s
Regional/County	Potentially 03121s 04148s 04147s
Local/Borough	03951s 03952s 02626s 02625s 02624s 03051s 01434s
Uncertain	

Archaeological Investigations

Geophysical Survey

7.4.16 Following consultation with the Acting Archaeological Planning Manager at GGAT, a programme of geophysical survey was undertaken within the footprint of the Scheme in order to inform an intrusive archaeological investigation strategy that is due to be carried out post- submission / predetermination. The full report can be found in Appendix 7.2 and is summarised below.

7.4.17 The survey was carried out in February 2015 by GSB Prospection using a magnetometer and a CartEasyN cart system. A complex of anomalies of clear archaeological interest was identified in a field immediately south of Whitton Lodge Romano-British villa (Area 15 in the report) and includes rectilinear enclosures, ring ditches and other features of interest, including two possible kiln-like features (GSB, 2015). While some of the responses are likely to be associated with the villa, others may be of an earlier date. Another enclosure has been recorded in the field to the north of the villa (Area 17 in the report).

7.4.18 Elsewhere, there are clusters of responses which have been classified as having an uncertain origin; in these instances an archaeological interpretation cannot be ruled out but other explanations; natural, agricultural or recent activity, are equally likely (GSB, 2015).

Watching Brief

7.4.19 In November 2014, an archaeological watching brief was carried out by Archaeology Wales during geotechnical ground investigations associated with the Scheme. The full report can be found in Appendix 7.3 and is summarised below.

7.4.20 A number of test pits and boreholes were excavated and drilled along the course of the proposed route which passes through known archaeologically sensitive areas. The field that contains the excavated remains of Whitton Lodge Roman villa (00382s), ring ditch (04148s) and Iron Age/Romano-British settlement (03121s) were not subject to investigation, though some of the test pits were located near to anomalies identified within a 2010 geophysical survey in fields north and south of these assets. No archaeological deposits were identified in any of the test pits or boreholes. The reason for the lack of deposits appears to be the fortuitous positioning of the test pits and the lack of any investigation within the field known to contain the most significant archaeological remains (Archaeology Wales, 2015).

7.5 Predicted Effects (Without Mitigation)

Construction

7.5.1 The magnitude and nature of the impact and the significance of the effects on designated and non-designated heritage assets are shown below in Table 7.12 and Table 7.13 respectively.

Table 7.12: Nature and Significance of Construction Impacts on Designated Heritage Assets

Heritage Asset Number	Magnitude of Impact	Significance of Effect	Duration of Effect
GM117	Minor	Slight/Moderate Adverse	Temporary
GM116	Minor	Slight/Moderate Adverse	Temporary
GM253	Negligible	Neutral/Slight Adverse	Temporary
GM344	No change	Neutral	Temporary
GM613	No change	Neutral	Temporary
HLCA 010	Moderate	Moderate/Large Adverse	Temporary

Table 7.13: Nature and Significance of Construction Impacts on Non-designated Heritage Assets

Heritage Asset Number	Magnitude of Impact	Significance of Effect	Duration of Effect
03951s	No change	Neutral	N/A
03952s	No change	Neutral	N/A
00381s	No change	Neutral	N/A
02626s	Major	Slight/Moderate	Permanent

Heritage Asset Number	Magnitude of Impact	Significance of Effect	Duration of Effect
		Adverse	
00382s	Major	Large / Very Large Adverse	Permanent
00380s	No change	Neutral	N/A
02625s	No change	Neutral	N/A
02624s	No change	Neutral	N/A
03121s	Major	Moderate/Large Adverse	Permanent
03051s	No change	Neutral	N/A
04147s	No change	Neutral	N/A
04148s	Major	Moderate/Large Adverse	Permanent
01434s	No change	Neutral	N/A

Buried Archaeological Remains

7.5.2 Construction works associated with the Scheme are likely to disturb or truncate known and previously unrecorded below-ground archaeological remains. The works include:

- The construction of a new 4.8km long, two lane wide single carriageway road across agricultural land to the east of the existing Five Mile Lane
- The widening of the existing Five Mile Lane from the Welsh Hawking centre to the Waycock Cross roundabout at the southern end of the Scheme. This will require some clearance of the adjacent SSSI Woodland and a re-grading of the adjacent land
- The excavation of a series of attenuation ponds located along the length of the new road
- Minor improvements to the existing junction between the A48 and Five Mile Lane at Sycamore Cross

7.5.3 Due to essential ground disturbance during the construction of the new road, all of the archaeological assets within its footprint will be substantially harmed (major impact) i.e. the complete physical destruction of an individual asset or complex of assets. Known assets that are located within or extend into the footprint of the road include ring ditches (04148s), the potential remains of a lime kiln (02626s) and of most significance elements of an extensive Iron Age/Romano-British settlement (03121s), as positively identified by geophysics, and which could prove to be associated with Whitton Lodge Roman Villa (00382s).

7.5.4 Two inhumations (00380s and 00381s) discovered in the central part of the study area will not be impacted but have the potential to represent an extensive burial site, the remains of which may lie within the footprint of the Scheme and would hold high (national) significance if found to be present. All of the assets are non-designated and are considered to potentially have medium (regional) significance with the exception of (00382s), which is considered by CADW to hold high (national) significance despite

its non-designated status. Archaeological investigation is to be undertaken in advance of the main construction works to determine the extent of archaeological assets underlying the footprint of the Scheme. All impacts will be permanent.

7.5.5 The potential for previously unrecorded buried remains has been assessed as high within all areas of new land take associated with the Scheme, where to date, significant ground disturbance has been minimal. These include areas located within the footprint of the new road and the attenuation ponds, in addition to land either side of the existing Five Mile Lane proposed for re-grading. Any unknown remains are likely to survive with a good degree of preservation and are at risk of impact.

7.5.6 The proposed works for the minor improvements to the existing junction at Sycamore Cross are to be carried out within the existing Highway Boundary. As a result, some grass verges will be lost to provide the additional carriageway capacity. However, these grass verges are currently maintained by the local authority and, as such, are disturbed on a regular basis as part of the highway maintenance regime. Furthermore, the junction was improved by the local authority early in 2013, with the changes resulting in significant disturbance in the area surrounding the junction. It is unlikely that buried archaeological remains are present within this area and the potential for such is low. Therefore the impact will be neutral to slight.

7.5.7 There will be no impact upon the remaining below-ground assets identified within the inner study area.

Up-standing Archaeological Remains (Earthworks)

7.5.8 Construction works associated with the Scheme are likely to necessitate the use of heavy load construction vehicles and plants, a significant increase in noise and increase in the volume of stationary and flowing traffic. The envisaged impacts these elements will have upon setting of the Scheduled Monuments in or near the ZVI have been assessed in Section 6 of the Archaeological Desk-Based assessment (Appendix 7.1). The assessment concludes that there will be a temporary neutral / slight adverse effect upon the setting of Moulton Roman Site (GM253) and a temporary slight / moderate adverse effect upon the settings of Coed y Cwm Long Barrow (GM116) and Coed y Cwm Ringwork (GM117) Scheduled Monuments. The temporary effect upon the Historic Landscape HLCA010 is envisaged to be moderate / large adverse and therefore significant. This asset will be located approximately 200m north of the Scheme and there will be clear views from its eastern boundary, southeast towards the northern part of the new road where it traverses the agricultural land that forms part of its current setting. The effects of construction upon the setting of these Scheduled Monuments are temporary. There will be no change to setting of the remaining designated assets identified within the ZVI.

Operation

Buried Archaeological Remains

7.5.9 There will be no further impacts upon buried archaeological remains once the Scheme is operational.

Up-standing Archaeological Remains (Earthworks)

7.5.10 The magnitude and nature of the impact and the significance of the effect on up-standing remains is shown below in Table 7.14.

Table 7.14: Nature and Significance of Operational Impacts on Designated Heritage Assets

Heritage Asset Number	Magnitude of Impact	Significance of Effect	Duration of Effect
GM117	Slight	Slight/Moderate Adverse	Permanent
GM116	Slight	Slight/Moderate Adverse	Permanent
GM253	Negligible	Neutral/Slight Adverse	Permanent
GM344	No change	Neutral	Permanent
GM613	No change	Neutral	Permanent
HLCA 010	Moderate	Moderate/Large Adverse	Permanent

7.5.11 Once the Scheme is operational, the potential impacts are likely to be the disruption of the setting and appreciation of the cultural heritage assets caused by construction of an additional road across previously undeveloped countryside (excluding the existing Five Mile Lane). The envisaged impacts these elements will have upon setting of the scheduled monuments in the ZVI have been assessed in Section 6 of the Archaeological Desk-Based assessment (Appendix 7.1). The assessment concludes that there will be a Neutral / Slight Adverse impact upon the setting of Moulton Roman Site (GM253) and a Slight / Moderate Adverse effect upon the setting of Coed y Cwm Long Barrow (GM116) and Coed y Cwm Ringwork (GM117) Scheduled Monuments. The effect upon the Historic Landscape HLCA010 is envisaged to be Moderate/Large Adverse and therefore significant. It is likely that the Scheme will be visible from the eastern boundary of the Historic Landscape as it will traverses a number of field systems within the view from this location. The proposed road will create new land divisions and patterns of movement that will serve to diminish the understanding of the relationship between the parish boundary (Five Mile Lane) and the Historic Landscape.

7.6 Mitigation

Construction

7.6.1 The Scheme is likely to have a direct physical impact upon buried archaeological remains that include adverse impacts upon known and unknown below-ground remains. The construction of the new road has the potential to impact upon known buried archaeological remains include those associated with Whitton Lodge Roman villa (00382s), ring ditch (04148s), the remains of a lime kiln (02626s) and remains of an extensive Iron Age/Romano-British settlement (03121s) and those potential assets identified by geophysical survey.

7.6.2 A Scheme of investigative fieldwork has been devised with and approved by the Acting Archaeological Planning Manager at GGAT. This has been documented in the Written Scheme of Investigation, provided in Appendix 7.4, and includes a programme of combined evaluation trenching and a ‘strip, map and record’ exercise will be undertaken post-submission / predetermination.

7.6.3 A programme of geophysical survey has been carried out along the length of proposed new road where it crosses agricultural land. A summary of results is

presented in paragraphs 7.4.16 to 7.4.18 and the full report is presented in Appendix 7.2.

7.6.4 The fieldwork has been informed by the results of the geophysical survey and is intended to determine the extent, depth, function, chronology and relative significance of any archaeological deposits, and if necessary will serve to inform a mitigation strategy for a final stage of more detailed archaeological investigation of significant remains. The investigation will target those known heritage assets impacted upon by the proposed works, those areas that are shown to have positive results for archaeology as identified by the geophysical surveys from 2010 and 2015 and all other previously undisturbed areas that are viable for archaeological investigation, including the footprint of all proposed attenuation ponds.

7.6.5 The Scheme is likely to truncate a number of post-medieval field boundaries within areas of new land take. It is envisaged that a sample section will be recorded through each affected boundary, carried out by a professional archaeologist where the opportunity arises. It is also envisaged a watching brief will be carried out during ground moving activities associated with any geotechnical investigations and during construction activities that require significant ground disturbance.

7.6.6 A proposed site compound and material storage area has been relocated to an area of negative archaeology in order to avoid the remains of the lime kilns (0265) and the ring ditches (01417).

Operation

7.6.7 Although no specific mitigation is offered to reduce the harm to the setting of the Historic Landscape HLC010, the following Historic England (2011) principles should be considered:

- *Mitigation through design*: changes to design, the creation of effective long-term visual or acoustic screening or management measures secured by planning conditions or legal agreements. For some developments affecting setting, the design of a development may not be capable of sufficient adjustment to avoid or significantly reduce the harm, for example where impacts are caused by fundamental issues such as the proximity, location, scale, prominence or noisiness of a development. In other cases, good design may reduce or remove the harm, or provide enhancement, and design quality may be the main consideration in determining the balance of harm and benefit.
- *Screening*: Where attributes of a single development may cause some harm to significance and cannot be adjusted, screening may have a part to play in reducing harm. As screening can only mitigate negative impacts, rather than removing impacts or providing enhancement, it ought never to be regarded as a substitute for well-designed developments within the setting of heritage assets. Screening may have as intrusive an effect on the setting as the development it seeks to mitigate, so where it is necessary, it too merits careful design. This should take account of local landscape character and seasonal and diurnal effects such as changes to foliage and lighting. The permanence or longevity of screening in relation to the effect on the setting also requires consideration. Ephemeral features, such as hoardings, may be removed or changed during the duration of the development, as may woodland or hedgerows, unless they enjoy statutory protection. Management measures secured by legal agreements may be helpful in securing long-term effect of screening.

7.7 Residual Effects (With Mitigation)

7.7.1 The residual effects after mitigation are summarised in Table 7.15.

Construction

7.7.2 The strip, map and recording programme proposed in section 7.6.2 will aim to preserve by record any archaeological remains that are encountered. This mitigation strategy will reduce any adverse effect upon the site of Whitton Lodge Roman Villa (00382), ring ditch (04148s), the remains of a lime kiln (02626s) and remains of an extensive Iron Age/Romano-British settlement (03121s) to neutral. No mitigation measures are considered appropriate to reduce the moderate/large effect of construction upon the setting of the Historic Landscape HLC010.

Operation

7.7.3 If the mitigation measures outlined above are implemented the negative impact upon the setting of the Historic Landscape HLC010 can be reduced but not removed.

7.8 Cumulative Effects

7.8.1 In terms of potential cumulative impacts on cultural heritage arising from the Scheme with other planned developments, the developments listed in Chapter 16 of this ES were considered. It may be noted that future baseline for the Scheme will change if the planned developments described are constructed, resulting in significant change to the local and wider landscape.

Construction

7.8.2 Chapter 16 Cumulative Effects lists six developments within 500m of the Scheme (Figure 16.1) that will necessitate significant ground disturbance in areas that have been subject to little previous ground disturbance. It is anticipated that there will be a cumulative impact together with the Scheme upon the general archaeological resource of the area, rather than upon any one individual heritage assets identified in this report. It must be highlighted that the Solar PV Array (Development 2 on Figure 16.1) is located approximately 300 m north of a single inhumation site (00380s), which following forthcoming archaeological investigations may be found to be part of a more extensive burial site that falls within the footprint of both the Scheme and the solar development. As both developments will require ground disturbance in their construction, any archaeological remains within the footprint are at risk of being disturbed or truncated. If the burial site was found to be present it would hold national significance and therefore the impact of the Scheme upon the burial site would be large/very large adverse. The in-combination of the two developments would not increase this assessment.

Operation

7.8.3 Development 2, a solar PV array will in combination with the Scheme have an adverse cumulative effect on the setting of Bonvilston Amalgamated Fieldscape (HLCA010), the Historic Landscape located 380 m north of the Scheme. The contribution that the setting makes to the significance of asset is described fully in Section 6 of the Archaeological Desk-Based Assessment (Appendix 7.1). It is anticipated that due to the low lying nature of the landscape, the development will be fully visible from the eastern border of the character area. It is anticipated that the experience of the asset and the 'sense of place' will be affected by the two projects in

combination. The significance of effect of the Scheme alone upon the setting of HLCA010 is considered to be Moderate/Large Adverse and the in-combination effect of the two developments will not increase this.

7.9 Summary & Conclusions

7.9.1 There are no Scheduled Monuments or Listed Buildings within the Inner Study Area. Due to topography and intervening woodland, the five Scheduled Monuments in the Outer Study Area will not be significantly affected.

7.9.2 It is considered that the Scheme will have a Slight/Moderate Adverse effects upon the setting of two Scheduled Monuments (GM116 and GM117), a Slight Adverse / Neutral effect upon one Scheduled Monument (GM253) and a Moderate/Large Adverse effect upon one Historic Landscape (HLCA010) during the construction stage resulting from the presence of construction traffic, machinery and the increase in noise levels. The significance of the effect upon the new road upon the setting of the same assets during the operational phase is considered to be the same but permanent. The impact of the construction and operational effects of the Scheme upon GM116, GM117, GM253 and HLCA010 however cannot be reduced through archaeological mitigation; therefore recommendations for mitigation through design and screening are recommended.

7.9.3 The Scheme is likely to have a Slight to Large Adverse effect upon four known below-ground heritage assets before mitigation which include remains associated with Whitton Lodge Roman villa (00382s), ring ditch (04148s), the potential remains of a lime kiln (02626s) and part of an extensive Iron Age/Romano-British settlement (03121s). There is high potential for hitherto unknown buried archaeology to be present within areas of new land take, as indicated by significant evidence for prehistoric and Romano-British activity in the immediate vicinity of the Scheme. The recovery of two inhumations in the inner study area indicates there is also potential for an extensive burial ground with national significance. In advance of the main construction works, a programme of fieldwork to inform a mitigation strategy and a final stage of more detailed archaeological investigation of significant remains will be undertaken. The strip, map and recording programme proposed as mitigation will aim to preserve by record any archaeological remains that are encountered. This mitigation strategy will reduce the adverse effect upon the four below-ground heritage assets to neutral.

Table 7.15: Summary of Cultural Heritage Impacts

Heritage Asset	Nature of Impact	Predicted Effects (without Mitigation)	Mitigation Measures	Residual Impact (with Mitigation)
Construction				
GM116	Direct Permanent	Slight/Moderate Adverse	None Recommended	Slight/Moderate Adverse
GM117	Direct Permanent	Slight/Moderate Adverse	None Recommended	Slight/Moderate Adverse
GM253	Direct Permanent	Neutral/Slight Adverse	None Recommended	Neutral/Slight Adverse
GM344	No Change	N/A	N/A	N/A
GM613	No Change	N/A	N/A	N/A
HLCA 010	Direct Permanent	Moderate / Large Adverse	None Recommended	Moderate / Large Adverse
03951s	No change	N/A	N/A	N/A
03952s	No change	N/A	N/A	N/A
00381s	No change	N/A	N/A	N/A
02626s	Direct Permanent	Slight/Moderate Adverse	A programme of archaeological field work has been devised in consultation with GGAT	Neutral
00382s	Direct Permanent	Large/Very Large Adverse	The strip, map and recording programme proposed in section 7.6.2 will aim to preserve by record any archaeological remains that are encountered. This mitigation strategy will reduce the adverse effect upon the site of Whitton Lodge Roman villa (00382s) to neutral	Neutral
00380s	No change	N/A	N/A	N/A
02625s	No change	N/A	N/A	N/A
02624s	No change	N/A	N/A	N/A

Table 7.15: Summary of Cultural Heritage Impacts

Heritage Asset	Nature of Impact	Predicted Effects (without Mitigation)	Mitigation Measures	Residual Impact (with Mitigation)
03121s	Direct Permanent	Moderate / Large Adverse	The strip, map and recording programme proposed in section 7.6.2 will aim to preserve any identified archaeological remains by record. This mitigation strategy will reduce any adverse effect upon Iron Age/Romano-British settlement (03121s) to neutral	Neutral
03051s	No change	N/A	N/A	N/A
04147s	No change	N/A	N/A	N/A
04148s	Direct Permanent	Moderate/Large Adverse	The strip, map and recording programme proposed in section 7.6.2 will aim to preserve any identified archaeological remains by record. This mitigation strategy will reduce any adverse effect upon ring ditch (04148s)to neutral	Neutral
Operation				
GM116	Direct Permanent	Slight/Moderate Adverse	None Recommended	Slight/Moderate Adverse
GM117	Direct Permanent	Slight/Moderate Adverse	None Recommended	Slight/Moderate Adverse
GM253	Direct Permanent	Neutral/Slight Adverse	None Recommended	Neutral/Slight Adverse
GM344	No Change	N/A	N/A	N/A
GM613	No Change	N/A	N/A	N/A
HLCA 010	Direct Permanent	Moderate / Large Adverse	None Recommended	Moderate / Large Adverse
03952s	No Change	N/A	N/A	N/A
00381s	No Change	N/A	N/A	N/A
02626s	No Change	N/A	N/A	N/A

Table 7.15: Summary of Cultural Heritage Impacts

Heritage Asset	Nature of Impact	Predicted Effects (without Mitigation)	Mitigation Measures	Residual Impact (with Mitigation)
00382s	No Change	N/A	N/A	N/A
00380s	No Change	N/A	N/A	N/A
02625s	No Change	N/A	N/A	N/A
02624s	No Change	N/A	N/A	N/A
03121s	No Change	N/A	N/A	N/A
03051s	No Change	N/A	N/A	N/A
04147s	No Change	N/A	N/A	N/A
041478s	No Change	N/A	N/A	N/A

8 LANDSCAPE

8.1 Introduction

8.1.1 This chapter sets out the assessment of the predicted effects of the Scheme on the landscape character and visual amenity of the study area. The impact assessment considers the nature and scale of predicted impacts arising from the Scheme, potential mitigation measures and significance of residual impacts.

8.2 Legislative & Policy Context

European Legislation & Policy

8.2.1 The following polices and plans are concerned with, or make reference to, the landscape and its protection.

Environment Strategy for Wales

8.2.2 The Environment Strategy for Wales was published in 2006 and outlines the Welsh Government's long-term strategy for the environment of Wales, for the 20 years up to 2026. It provides a framework within which to achieve an environment, which is clean, healthy, biologically diverse and valued by the people of Wales.

Planning Policy Wales, Edition 7, July 2014

8.2.3 Planning Policy Wales is the National Assembly for Wales' principal statement of national land use policy and was first adopted in March 2002. The latest edition (7) was published in July 2014.

Wales Transport Strategy

8.2.4 A series of route objectives have been established within the Wales Transport Strategy. These are listed under the headings Social, Economy and Environment. Under the last of these are the following objectives, with implications for landscape issues:

Outcome 11: The sustainability of the transport infrastructure. Increase the use of more sustainable materials in our country's transport assets and infrastructure

Outcome 15: The local environment. Reduction in the individual and cumulative impact of transport on communities and the built and natural environment

Outcome 16: Our heritage. The choice and design of transport measures to have a neutral impact, or where appropriate, enhance Wales' natural and built heritage

Local Policy

Adopted Unitary Development Plan – Vale of Glamorgan 1996 - 2011

8.2.5 Until the Vale of Glamorgan Local Development Plan is adopted the Unitary Development Plan is the relevant planning document. The policies relating to the landscape assessment are as follows:

Policy 1

8.2.6 The Vale of Glamorgan's distinctive rural, urban and coastal character will be protected and enhanced. Particular emphasis will be given to conserving areas of importance for landscape, ecology and wildlife, the best and most versatile agricultural land and important features of the built heritage. Proposals which enhance these areas will be favoured.

Policy 2

8.2.7 Proposals which encourage sustainable practices will be favoured including:

i Proposals which contribute to energy conservation or efficiency, waste reduction or recycling; pollution control; biodiversity and the conservation of natural resources;

ii Proposals which are located to minimise the need to travel, especially by car and help to reduce vehicle movements or which encourage cycling, walking and the use of public transport;

iii The reclamation of derelict or degraded land for appropriate beneficial use; and

iv Proposals which improve the quality of the environment through the utilisation of high standards of design.

Policy 7

8.2.8 Improvements to the transportation network will consist of local schemes necessary for environmental and safety reasons.

Policy ENV2 – Agricultural Land

8.2.9 The best and most versatile agricultural land (grades 1, 2 and 3a) will be protected from irreversible development, save where overriding need can be demonstrated. Non-agricultural land or land of a lower quality should be used when development is proposed, unless such land has a statutory landscape, nature conservation, historic or archaeological designation which outweighs agricultural considerations.

Policy ENV3 – Green Wedges

Green Wedges have been identified in order to prevent urban coalescence between and within settlements. Within these areas development which prejudices the open nature of the land will not be permitted. The Barry, Rhoose and St Athan Green Wedge is the only one of relevance to the Scheme. It is located directly to the west of Barry, along the southern edge of the ZVI but will not be directly affected by the proposal.

Policy ENV4 – Special Landscape Areas

8.2.10 New development within or closely related to the following special landscape areas will be permitted where it can be demonstrated that it would not adversely affect the landscape character, landscape features or visual amenities of the Special Landscape Areas (SLA). There are two SLAs relevant to the Scheme and which are bounded by the existing Five Mile Lane: Nant Llancarfan, and Duffryn Basin and Ridge Slopes.

Policy ENV10 - Conservation of the Countryside

8.2.11 Measures to maintain and improve the countryside, its features and resources will be favoured, particularly in the Glamorgan Heritage Coast, areas of high quality landscape, and areas subject to development pressure and/or conflict such as the urban fringe.

Policy ENV11 – Protection of Landscape Features

8.2.12 Development will be permitted if it does not unacceptably affect features of importance to landscape or nature conservation including: trees, woodland, hedgerows, river corridors, ponds, stone walls and species rich grasslands.

Policy ENV12 – Woodland Management

8.2.13 The improvement, management and extension of woodland, tree cover and hedgerows, particularly of broadleaf native species, will be favoured, especially where it:

i Makes a significant improvement to the landscape such as on derelict land, the urban fringe, or in the vicinity of major road/rail corridors and quarries; or

ii It helps to diversify and extend wildlife habitats; or

iii It adds to recreational and educational opportunities.

Vale of Glamorgan Local Development Plan (2011-2026)

8.2.14 The Vale of Glamorgan Local Development Plan (LDP) has the following policies relating to the landscape.

Policy SP 1 - Delivering the Strategy

8.2.15 The strategy will seek to improve the living and working environment, promote enjoyment of the countryside and coast and manage important environmental assets.

Policy SP 10 –Built and Natural Environment

8.2.16 Built and natural environment development proposals must preserve and where appropriate enhance the rich and diverse built and natural environment and heritage of the Vale of Glamorgan.

8.2.17 Policy SP 10 emphasises the need to protect the Vale of Glamorgan's natural and built environmental assets and reinforces that sensitive design and choice of location of new development can have a positive effect on the Vale of Glamorgan's built and natural heritage. Similarly, new development will be required to minimise its impact on natural systems, landscapes, species and habitats and, where appropriate, provide opportunities for the creation of new habitats or the sensitive enhancement of existing habitats.

Policy MG 17 – Special Landscape Areas

8.2.18 Special Landscape Areas (SLA) have been designated to protect areas of the Vale of Glamorgan that are considered to be important for their geological, natural, visual, historic or cultural significance.

8.2.19 The designation of SLAs is not intended to prevent development but to ensure that where development is acceptable careful consideration is given to the design elements of the proposal such as the siting, orientation, layout and landscaping, to ensure that the special qualities and characteristics for which the SLAs have been designated are protected.

8.2.20 Development proposals within or closely related to SLAs will be required to fully consider the impact of the proposal on the SLA through the submission of a landscape impact assessment consistent with the guidance set out in the Council's Design in the Landscape SPG23. Where applicable, this should form a key element of a planning application's design and access statement and should demonstrate that the proposal has been designed to remove or reduce any unacceptable impacts on the qualities for which the SLA has been designated.

8.2.21 Within the Nant Llancarfan and Dyffryn Basin and Ridge Slopes Special Landscape Areas, development proposals will be permitted where it is demonstrated they would cause no unacceptable harm to the important landscape character of the area.

Policy MG 18 - Green Wedges

8.2.22 Green wedges have been identified to prevent the coalescence of settlements and to retain the openness of land between Barry and Rhoose. Within these areas development which prejudices the open nature of the land will not be permitted.

8.2.23 Land on the urban fringe particularly around the key, service and primary settlements within the South East Zone is vulnerable to speculative development that can blur the boundaries between settlement edges and the open countryside. Unchecked this development would result in the incremental loss of open land and ultimately lead to the coalescence of settlements with a resultant detrimental impact upon agriculture, the landscape and the amenity value of land.

8.3 Assessment Methodology

Study Approach

8.3.2 The proposed scope of the assessment was outlined in the Scoping Study (see Appendix 1.2). A detailed level landscape assessment was carried out in accordance with the following guidance:

- Interim Advice Note (IAN) 135/10(W) which supercedes the Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment, Section 2 Part 5 Landscape Effects;
- Reference was made where appropriate to the following documents to provide further definition and clarity:
  - Landscape and Visual Effects Assessment and the Guidelines for Landscape and Visual Impact Assessment (GLVIA), Third Edition, 2013 as published by the Landscape Institute (LI) and Institute of Environmental Management and Assessment (IEMA);
  - Design in the Landscape Vale of Glamorgan UDP SPG23;
  - LANDMAP Guidance Notes 1-3;

8.3.3 Together these documents provide a methodology and process to assess the potential landscape effects arising from the Scheme.

8.3.4 The assessment includes both effects on the landscape as a resource in its own right and effects on views and visual amenity as defined in IAN 135/10 (W) with further definitions provided in GLVIA 2013:

- Assessment of landscape effects – assessing effects on the landscape as a resource in its own right;
- Assessment of visual effects – assessing effects on specific views and on the general visual amenity experienced by people.

Assumptions / limitations

8.3.5 The assessments were carried out based on the following assumptions and limitations:

- Lighting will be restricted to the southern end of the Scheme, where Five Mile Lane ties into the existing roundabout at Waycock Cross.
- It is assumed that by the Design Year (Year 15) hedgerows will have reached a height of 2m.
- It is assumed that by the Design Year (Year 15) trees and woodland blocks will have reached a height of 8-10m.
- Where possible existing vegetation will be translocated to provide early screening.
- In accordance with IAN 135/10 (W) landscape incorporates the effects on townscape, however, as noted in the Scoping Report there are no townscape character areas within the area. Refer to Appendix 1.2
- The original assessment was undertaken prior to the development of a solar farm to the east of the scheme in close proximity to New Zoo Bungalows. Where appropriate amendments have been made to the assessment.
- No access was provided to undertake a visual assessment from individual properties therefore the assessments have been carried out from locations as near to the properties as possible and using existing mapping and other available technology to help determine the impacts.
- All key views have been taken from publicly accessible locations.

Zone of Visual Influence

8.3.6 The Landscape study area boundary reflects the limit of visibility of the Scheme and was established through the definition of a Zone of Visual Influence (ZVI). A computer generated model was developed which was then ground truthed and revised through first walking the Scheme centreline and noting the extent of visible area and then to take account of proposed earthworks as well as a 4m traffic height. The observer height was taken as 1.8m above ground level. Where the potential viewing distance would be extensive the ZVI boundary reflects a distance limit of potential significance, taking account of prevailing topography and existing vegetation relative to the Scheme.

8.3.7 Once established the ZVI was used as the study boundary for the assessment of landscape and visual impacts.

Landscape

8.3.8 The Landscape Character assessment has been based on the relevant landscape character areas identified within the Vale of Glamorgan's Designations of Landscape Character Areas (2013 update). These areas were considered appropriate as they have been published as part of the County planning process and remained applicable to the study area due to the nature and scale of the landform, landuse and vegetation. In addition the initial assessment considered the baseline information contained within LANDMAP Information System published by Natural Resources Wales (NRW).

8.3.9 Each landscape character area was described and then assigned two key measures. The first was its Susceptibility to Change, in particular its capacity to accommodate change arising from the type of development proposed without undue consequences for the maintenance of the baseline situation. This was described using a three point scale, as shown Table 8.1.

Table 8.1: Landscape Susceptibility to Change

Susceptibility to Change	Description
High	• Of high quality with distinctive elements and features making a positive contribution to character and sense of place. • Likely to be designated. • Areas of special recognised value through use, perception or historic and cultural associations. • Likely to contain features and elements that are rare and could not be replaced.
Moderate	• Comprised of common place element and features creating generally unremarkable charter but with some sense of place. • Locally designated or their value may be expressed through non statutory local publications. • Containing some features of value through use, perception or historic and cultural associations. • Likely to contain some features and elements that could not be replaced.
Low	• Comprised of some features and elements that are discordant or in decline, resulting in indistinct character with little or no sense of place. Not designated. • Likely to contain few if any features and elements that could not be replaced.

8.3.10 The second measure to be assigned was Value. As there are no formally designated landscapes within the study area, this was determined through the particular elements contributing to landscape character, and with reference to the LANDMAP data. As recommended by DMRB, a five point scale was used, as shown in Table 8.2.

Table 8.2: Landscape Value

Value	Description
Exceptional	• Strong landscape structure; • A harmonious combination of complementing components; • Distinct landscape characteristics, identity or patterns; • Landmark features worthy of retention; Strong positive sense of place; • No detractive elements.

Value	Description
Very Good	• Strong landscape structure; • Composed of generally harmonious components; • Distinct landscape characteristics, identity or patterns; • Identifiable features worthy of retention; Occasional or minor detractive elements.
Good	• Distinguishable landscape structure; Comprised of generally complementing components; • Identifiable landscape characteristics, identity or patterns; • Some detractive elements.
Ordinary	• Weak landscape structure, including some complementing components; • Remnant or weak indication of landscape characteristics, identity or patterns; • No identifiable features worthy of retention; Frequent detracting elements.
Poor	• Degraded or damaged landscape structure; No complementing components; • No identifiable landscape characteristics, identity or patterns; • Extensive detracting elements.

8.3.11 The Susceptibility to Change and Value measures were then considered in combination to provide a measure of Sensitivity for each Landscape Character Area. Refer to Table 8.3 below.

Table 8.3: Landscape Sensitivity

Sensitivity	Typical Descriptors and Examples
High	Landscapes which by nature of their character would be unable to accommodate change of the type proposed. Typically these would be: • Of high quality with distinctive elements and features making a positive contribution to character and sense of place • Likely to be designated but the aspects which underpin such value may be present outside designated areas • Areas of special recognised value through use, perception or historic and cultural associations • Likely to contain features and elements that are rare and could not be replaced
Moderate	Landscapes which by nature of their character would be able to partly accommodate change of the type proposed. Typically these would be: • Comprised of commonplace elements and features creating generally unremarkable character but with some sense of place • Locally designated • Containing some features of value through use, perception or historic or cultural associations • 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: • Comprised of some elements and features that are discordant, derelict or in decline, resulting in indistinct character with little or no sense of

Table 8.3: Landscape Sensitivity

Sensitivity	Typical Descriptors and Examples
	place • Not designated • Containing few, if any, features of value through use, perception or historic or cultural associations • Likely to contain few, if any, features and elements that could not be replaced

8.3.12 The predicted landscape impact was then derived from identifying the Magnitude of Effect affecting each character area. This Magnitude measure for landscape effects took account of scale, extent and reversibility, and used a five point scale, as defined in Table 8.4. Effects were either adverse of beneficial.

Table 8.4: Magnitude of Landscape Effect

Magnitude	Description
Major	Total loss or major adverse or beneficial change to key element of the landscape resource to the extent that there is a fundamental change to landscape character. A permanent or long term impact.
Moderate	Partial loss or change to key elements, features or characteristics of the landscape resource to the extent that there is a partial change to landscape charter. A long term impact that can be partially mitigated to reduce the impact.
Minor	Slight loss or change (adverse or beneficial) to key elements, features or characteristics of the landscape resource to the extent that there may be some slight perception of change to landscape character. Short term effect that in part can be reversed through appropriate mitigation.
Negligible	Very minor loss or change to elements, features or characteristics of the landscape resource and there would be no fundamental change to landscape character. A short term reversible impact.
No Change	No noticeable loss, damage or alteration to character or features or elements.

8.3.13 The Sensitivity measure was then cross-referenced with the Magnitude of Effect for each Landscape Character Area to give an Impact Significance, based on a seven point scale, as shown below in Tables 8.5 and 8.6.

Table 8.5: Landscape Impact Significance

Landscape Sensitivity	Magnitude of Landscape Impact				
	Major	Moderate	Minor	Negligible	No change
High	Very Large/Large	Large/ Moderate	Moderate/Slight	Slight	Neutral
Medium	Large/ Moderate	Moderate	Slight	Neutral/Slight	Neutral

Landscape Sensitivity	Magnitude of Landscape Impact				
	Major	Moderate	Minor	Negligible	No change
Low	Moderate/ Slight	Slight	Neutral/Slight	Neutral/Slight	Neutral

8.3.14 The following table describes typical values of landscape impacts.

Table 8.6: Description of Typical Landscape Impacts

Magnitude	Description
Very Large Adverse	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.
Large Adverse	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.
Moderate Adverse	The Scheme would: • Conflict with the character (including quality and value) of the landscape. • Have an adverse impact on characteristic features and elements. • Diminish a sense of place.
Slight Adverse	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.
No change	The Scheme would: • Maintain the character (including quality and value) of the landscape. • Blend with characteristic features and elements. • Enable a sense of place to be retained.
Slight Beneficial	The Scheme would: • Compliment the character (including quality and value) of the landscape. • Maintain or enhance characteristic features and elements. • Enable some sense of place to be restored.
Moderate Beneficial	The Scheme would: • Improve the character (including quality and value) of the landscape. • Enable the restoration of characteristic features and elements partially lost or diminished as a result of changes from inappropriate management or development. • Enable a sense of place to be restored.
Large Beneficial	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 restored.

8.3.15 This process was carried out for each of the following stages, with the assessed Magnitude of Effect adjusted as appropriate:

- Construction Phase - taking account of likely construction operations and effects
- Year 1 following completion - completed Scheme but with no effective landscape mitigation
- Year 15 (Winter) - established mitigation without leaf cover, this stage has been added to assess the fully mitigated scheme when the planting is not in leaf
- Year 15 (Summer) - established mitigation in leaf

Visual Amenity

8.3.16 The establishment of a visual baseline followed a similar process to the landscape assessment above, but was based on a series of selected views, under the following categories:

- Representative views: illustrating typical views from public locations
- Valued views: views which are noted as valued by the public, such as known viewpoints, visitor attractions and popular leisure destinations
- Linear views: representing views seen from routes including roads, railways, public footpaths and bridleways

8.3.17 Nine views were selected to provide an appropriate coverage and a range of view types and distances from the Scheme. These were agreed in consultation with the Vale of Glamorgan Council. Initial site surveys were undertaken on 20th March 2014. More detailed site surveys and associated photography were undertaken initially for summer views on 21st and 29th May 2014 and 16th September 2014, for winter views on 5th and 20th March 2015 with updates on 29th January and 2nd February 2016.

8.3.18 An assessment of specific residential properties or groups of properties within the ZVI has been undertaken to reflect the impacts on the visual amenity of these properties. Each view is described in its winter and summer forms, and key elements, patterns, character, night-time appearance and degrees of movement are identified. Given the low number of residential receptors they have been included on Figure 8.5 and the assessment is contained in Appendix 8.2.

8.3.19 For visual impact consideration Visual Quality was considered for each view are described below in Table 8.7.

Table 8.7: Visual Quality

Quality	Description
Very Attractive	The view is comprised of harmonious elements, in a balanced composition, with a degree of visual interest or contrast and no significant detracting elements.
Attractive	The view is comprised of harmonious elements, in a balanced composition, with very few detracting elements.
Moderate	The view is mainly comprised of harmonious elements, with some detracting components.
Poor	The view is comprised of unrelated elements with little composition, and a number of detracting factors.
Very Poor	The view is dominated by discordant and detracting elements.

8.3.20 The magnitude of visual impact on the view was then assessed using the criteria described in Table 8.8.

Table 8.8: Magnitude of Visual Impact

Magnitude	Description
Major	The project, or a part of it, would become the dominant feature or focal point of the view.
Moderate	The project, or a part of it, would form a noticeable feature or element of the view which is readily apparent to the receptor.
Minor	The project, 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 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.

8.3.21 Each visual receptor was attributed sensitivity depending on the type of receptor as set out in Table 8.9.

Table 8.9: Sensitivity of Visual Receptors

Sensitivity	Description
High	Viewers with proprietary / high interest in their everyday visual environment and / or with prolonged and regular viewing opportunities. Such receptors would include: • Residential properties • Users of Public Rights of Ways or other recreational trails e.g. National Trails • Users of outdoor recreational facilities whose attention or interest is focused on the landscape i.e. Country Parks, National Trust or other access land.
Medium	Viewers with moderate interest in their environment, and discontinuous and / or irregular viewing periods. Such receptors would include: • Users engaged in outdoor sport or recreation other than appreciation of the landscape (i.e., hunting, shooting, golf, water-based activities) • Outdoor workers • Schools and other institutional buildings, and their outdoor areas
Low	Viewers with a passing interest in their surroundings and momentary viewing periods. Such receptors include • Drivers/travellers and/or passengers of moving vehicles including trains • People at their place of work, including agricultural workers, road users or those already impacted by intrusive features.

8.3.22 The significance of the visual impact was then assessed as set out in Table 8.10.

Table 8.10: Visual Impact Significance

Receptor Sensitivity	Magnitude of Visual Impact			
	Major	Moderate	Minor	Negligible
High	Very Large/Large	Large/ Moderate	Moderate/Slight	Slight
Medium	Large/ Moderate	Moderate	Slight	Neutral/Slight
Low	Moderate/ Slight	Slight	Neutral/Slight	Neutral/Slight

8.3.23 As with landscape, this assessment process was carried out for the Scheme's visual impact at several stages;

- during construction,
- at Year 1 after completion when the mitigation measures have not taken effect as this can be considered the unmitigated effect,
- Year 15 (Winter) – this has been added to assess the impact of the scheme at the design year when the deciduous trees are not in leaf,
- Year 15 (Summer) when the mitigation measures are considered to be fully implemented.

8.4 Baseline Conditions

General Overview

8.4.1 The Vale of Glamorgan is an attractive and productive lowland landscape on the north coast of the Severn estuary and Bristol Channel. The county is bordered by the large urban centres of Cardiff to the east and Bridgend to the west. The M4 lies to the north and coast to the south. Eighty five per cent of the Vale is agricultural land.

8.4.2 The overall character of the study area is rural undulating agricultural lowland dissected by the river valley of the River Waycock. Mature hedges, farmsteads and woodland are important features within the landscape which together with the topography reduce the length of views from low lying areas. Agriculturally maintained hedgerows and rectilinear fields reflect the predominance of agriculture as a land use although solar farms are being erected on agricultural fields within the area which is resulting in a more urbanised feel to the landscape where these are visible. Five Mile Lane, although bounded for the most part by hedges provides a linear feature through the area linking the A48 to the north with the settlement of Barry to the south.

Designations

8.4.3 There are no national parks or areas of outstanding natural beauty within the study area. The Brecon Beacons National Park is approximately 52km from the study area and the Gower Area of Outstanding Natural Beauty (AONB) is approximately 50km from the study area. There is no impact on these protected areas.

8.4.4 Within or immediately bordering the study area there are a number of statutory and non-statutory designated sites. The following designations are located within or adjacent to the study area and are shown on Figure 8.1:

- **Special Landscape Areas.** There are six SLAs, which are classified as a local designation, within the Vale of Glamorgan reflecting the pastoral and historic character of much of the county. The Nant Llancarfan and Dyffryn Basin & Ridge Slopes SLAs abut along Five Mile Lane and Ely Valley and Ridge Slopes SLA lies to the north of the A48 adjacent to Sycamore Cross. These are described below.

  Nant Llancarfan SLA. The existing Five Mile Lane forms the eastern boundary to this SLA.

  The majority of the area is rolling lowland, dissected by the Nant Llancarfan valley. It is a steep sided, narrow lowland valley enclosed by the adjacent plateau landscape. It contains a tranquil and historic landscape of streams, semi-natural broadleaf woodlands, planted coniferous woodland and small farms. It has a strong, small scale, pastoral pattern and traditional settlement form including villages with Conservation Area designation. It is of high scenic quality with a strong sense of place. There is a diverse range of habitats of local and international importance, including the Nant Whitton Woodlands SSSI. Agricultural improvement (grazing, drainage and chemicals) threatens neutral grasslands and rush pastures have suffered substantial and rapid decline. The scattered rural/farm landscape is of outstanding value as being picturesque, for the preservation of historic communities and the richness of historic past. To the north the prominent ridge crest features, along with the A48 and associated linear development. The A48 follows the course of the Cardiff to Neath Roman road on an east-west alignment, dividing the Vale in two. To the south, on the coastal plateau, there are detractive views to Cardiff Airport hangar and Aberthaw Power Station, and road detailing becomes suburban.

  The eastern boundary along the A4226 abuts the SLA 5 boundary. The north, south and west boundaries follow major roads as defensible boundaries.

  There is planted broadleaf woodland and improved grassland, but the majority of this area is managed intensively for agriculture, with hedgerows in decline, and the feel is generally exposed and open. This area is boundary to the steeper valley slopes and wooded edges of Waycock Valley.

  It should be noted that following the broad search area stage of the study to designate the SLA the SE boundary was extended to Five Mile Lane (A4022) as a defensible boundary.

  Dyffryn Basin & Ridge Slopes SLA. The existing Five Mile Lane forms the western boundary to this SLA.

  The majority of the area is an attractive, gentle valley of the Nant Bran and River Waycock. There are broad, attractive views to well-managed countryside which retains a coherent large field pattern and woodlands. It is a relatively unspoiled historic rural landscape. Settlements are well integrated within the landscape and surrounding vegetation. The combination of road, stream/drainage ditch, stone wall/garden or dwelling is typical and representative of the Vale in this area. This combination has kept a high integrity and is well managed.

  Dyffryn Gardens, at the centre of the SLA, is discretely enclosed by woodlands. Development at Wenvoe and the quarry does not respond to local materials. It is

an otherwise pleasant area with hedgerows, topography and tree areas providing shelter and safety but suffers from closeness to Cardiff and Barry.

To the north, the area acts as a prominent sloping edge to the Ely and Wenvoe Valley. Strong steep slopes with wooded covers and small field enclosures have ancient trackways and high hedgerows to roads give a sheltered feel. The area has a distinct sense of place. However, broadleaf cover is old and deteriorating and there are detractive views to Culverhouse Cross and Cardiff.

Defensible boundaries are formed by: the A4022 to the west, the A48 to the north, urban settlement to the south and the A4050 to the east. It should be noted that following the broad search area stage of the study to designate the SLA the SW boundary was extended to Five Mile Lane (A4022) as a defensible boundary.

Ely Valley and Ridge Slopes SLA. The area is predominantly a lowland rolling landscape with the Ely River valley running through it from north to south-east. The majority of the lowland valley floor is flood plain, with a sense of openness that contrasts with the rising valley sides. A rectilinear pattern of drainage ditches, creating much improved pasture, runs into the River Ely. Towards the east, enclosing the Ely floodplain, the landscape has an intact pastoral field pattern and traditional settlement pattern. Hillsides contain headwaters that feed into the River Ely, and the slopes support improved grassland, arable and some neutral grassland. There are areas of severely fragmented woodland. The M4 and A4232 are significant detractors but character is generally consistent with few areas affected by urban fringe and industry. Pylons in Ely Valley North detract from otherwise attractive views in and out of this area. Inappropriate development of farms into dwellings and poor land management are threatening the character integrity. It is a well-maintained landscape with a tranquil feeling. With strong hedgerow and woodland cover, it has high scenic, but low habitat value.

The southern boundary includes a ridge crest, prominent in the landscape and providing views across the Vale. The A48 bisects this ridge and linear settlements dominate. The landscape includes semi-natural broadleaf woodland, improved grassland, arable and amenity grassland. The southwest corner is more intensively farmed, with inappropriate grazing, chemical improvement, drainage, and infrastructure development all creating pressure on habitats.

The boundary has been extended to the west to include Hensol Forest. The forest is largely planted coniferous, with some semi-natural woodland. The A48 forms it's southern boundary.

- **Site of Special Scientific Interest (SSSI)** are a National nature conservation designation and are described in more detail in Chapter 9 Nature Conservation of this ES. The following SSSIs lie within the vicinity of the Scheme:

  Nant Whitton Woodlands SSSI lies to the west of the Scheme and is not impacted.

  Barry Woodlands SSSI is located to the south of Five Mile Lane and the Scheme would pass through it.

- **Sites of Interest for Nature Conservation (SINC)** are a local designation for Nature Conservation and are described in more detail in Chapter 9 of this ES SINCs near to the Scheme include Amelia Trust Woodland Pond, Amelia Trust Dew Pond, Land South of Blackland Farm, Land North of Whitton Rosser Farm,

Land North-east of Whitton Rosser Farm, Land South of Little Hamston, Land to west of Northcliff Farm, Sutton Wood, East of Barry College, Walters Farm

- **Tree Preservation Orders (TPO)** there are a number of TPOs within the vicinity of the Scheme, refer to Figure 8.1A. These include individual trees and groups to the east of Dyffryn Gardens (TPO No 4 1952) which will not be affected by the Scheme and a Woodland TPO within the Barry Woodlands SSSI along the south west boundary of Five Mile Lane.
- **Historic Landscape Character Area** HLCA010: Bonvilston Amalgamated Fieldscape is located approximately 380m north of the Scheme and lies within the ZVI.
- **Scheduled Monuments and Listed Buildings** lie within the vicinity of the Scheme. These lie outside of the ZVI and whilst they would not be directly affected by the Scheme, there would be indirect impacts.

8.4.5 For more details on Nature Conservation designations refer to Chapter 9 Nature Conservation and Figure 9.1.

8.4.6 Geophysical investigations have been undertaken and these, together with detailed assessments of the impact of the Scheme on the historic assets, are addressed in Chapter 7 Cultural Heritage of this ES.

8.4.7 Dyffryn Gardens is a National Trust property which is approximately 1.7km east of the Scheme. It is an exceptional example of a planned landscape by Thomas Mawson and Grade 1 on the Register of Landscapes, Parks and Gardens of Special Historic Interest in Wales. There is no impact on the property.

8.4.8 The Amelia Trust, a registered charity, supports vulnerable and disadvantaged people on a working farm and promotes community engagement through access to facilities within a natural environment. Access to the Trust lies to the west of the existing A4022.

Landscape Structure

Land Use Types

8.4.9 The land within the study area is used as a mixture of arable and pastoral land. There is dense development in Barry to the south east of the Scheme and dispersed houses and individual farms along the alignment. Industrial units are restricted to the south of the Scheme within the urban fringe of Barry. Cardiff Airport and Aberthaw Power Station are to the south west of the Scheme. To the south east is the urban fringe of Barry.

Existing Vegetation

8.4.10 The area is predominantly agricultural with semi-natural mixed and broadleaved woodland with smaller intermittent blocks of broadleaved plantation. The majority of the woodland blocks are located along the valley watercourses. The field boundaries generally comprise mature, native, managed hedgerows with intermittent trees. The wider landscape contains blocks of ancient woodland and individual mature oak trees. Middleton plantation which lies within the Barry Woodlands SSSI contains ancient woodland which would be impacted by the Scheme. Refer to Chapter 9 Nature Conservation of this ES.

Rivers, Watercourses and Water Bodies

8.4.11 The Waycock Valley is crossed by the existing Five Mile Lane. A number of other watercourses are crossed by Five Mile Lane including Moulton Brook, Ford Brook and unnamed tributaries to the River Waycock. Springs are located along the Five Mile Lane with a number of ponds in close proximity to the Scheme. These are described further in Chapter 15 Road Drainage and the Water Environment.

Roads, Footpaths, Rights of Way

8.4.12 Five Mile Lane provides access via minor roads to villages and settlements to include Dyffryn, Walterston and Llancarfan and to numerous farmsteads and buildings. There are no Public Rights of Ways (PRoW) networks directly to the east of Five Mile Lane, although there are two footpaths that link to the existing Five Mile Lane to the west. At the southern end of the Scheme the Millennium Heritage Trail runs through the Brynhill Golf Course. There is no direct impact on the Trail.

Tranquillity

8.4.13 Although the A48 lies to the north and Five Mile Lane itself is a source of noise, the area is generally agricultural and the level of human access is infrequent, therefore the area is generally considered as tranquil (as referenced in the LANDMAP data for visual and sensory aspect areas along the Scheme in Figure 8.2).

LANDMAP

8.4.14 The LANDMAP process uses Geographical Information Systems (GIS) to store and manage data collected on five evaluated aspect topic layers; Geological Landscapes, Landscape Habitats, Cultural Landscapes, Historic Landscapes, and Visual & Sensory. For each of these topic layers, the landscape is evaluated and divided into geographical units known as aspect areas. A data set is developed for each area that describes, classifies and evaluates its quality based upon an all-Wales set of criteria. Each dataset is summarised as follows:

8.4.15 The Geological Landscape aspect layer considers the physical, primarily geological, influences that have shaped the contemporary landscape and identifies those landscape qualities which are linked to the control or influence exerted by bedrock, surface processes, landforms and hydrology

8.4.16 The Landscape Habitats aspect layer reviews the relationship between vegetation cover, landscape management and biodiversity

8.4.17 The Cultural Heritage aspect layer describes culture as any kind of human activity that can be related to landscape

8.4.18 The Historic Landscape aspect layer reviews the activities of the people who used and shaped the land to serve their needs in the past: they reflect the beliefs, attitudes, traditions and values of those people

8.4.19 The Visual & Sensory aspect layer describes the topography, land cover and form of the landscape, along with an assessment of its visual quality and sensory characteristics.

8.4.20 The main LANDMAP aspect areas are shown in Figure 8.2 and details are contained in Appendix 8.1 in relation to each Landscape Character Area. The main aspect areas within the vicinity of Five Mile Lane are as follows:

***Geological Landscape**: VLFGL170: Moulton*

8.4.21 The overall value of this large aspect area which covers lowland plateau, is Moderate. It forms part of the wider Blue Lias' plateau (Lower Jurassic) which covers other aspect areas in the locality. It includes well developed internal scarps where softer Lavernock Shales between limestone-shale have been eroded. Steep sided cwms also typical.

***Geological Landscape**: VLFGL514: Thaw-Waycock*

8.4.22 The overall value of this narrow aspect area is Moderate. Dendritic river-flood plain system in typically steep sided narrow valley, with local small alluvial fans where tributaries enter. Estuary of main Thaw River is distinctly fan shaped but significantly modified by industrial activity, including a power station, associated ash dumps and aggregate extraction.

***Geological Landscape**: VLFGL692: Barry - Rhoose*

8.4.23 The overall value of this aspect area is High. It comprises a section of broad, low, dissected coastal plateau underlain by Lias (Lower Jurassic) with steep sided valleys and short steep cwms cut into cliffs adjacent to the coast. Area includes key inland exposures of Lower Jurassic, Blue Lias Formation with scientific and educational potential.

***Landscape Habitat**: VLFLH840: Rhoose-Moulton*

8.4.24 The overall value of this aspect area is Moderate. It is classified as agriculturally improved land of limited value for wildlife, the focus of interest being field boundaries and occasional semi-improved grassland communities.

***Landscape Habitat**: VLFLH786: Aberthaw River Valleys*

8.4.25 The overall value of this aspect area is High. The aspect area defines a concentration of semi-natural broadleaved woodland and semi-improved neutral grasslands considered of significant biodiversity interest.

***Visual and Sensory**: VLFGLVS146: Central Vale Ridges and Slopes*

8.4.26 The overall evaluation of this aspect area is Moderate – the integrity of the area has been affected by erosion of hedgerows in places. The area has a sense of place defined in part by its visual relationship with the sea although intrinsically the area does not have a strong character. The area contains many elements typical and representative of the Vale.

***Visual and Sensory**: VLFGLVS271:St Nicholas and Bonvilston Ridge Crest*

8.4.27 The overall evaluation of this aspect area is High – the aspect areas offers many long views to other aspect areas, indeed much of the vale can be seen from here. This is unusual within the study area. The aspect area also offers pleasing views within its own boundaries to hedgerows and pastoral farming often set against woodland edges. The area exhibits several qualities and features that are representative of the

study area. Importantly the aspect area is the only one from where most of the Vale landscape can be viewed.

***Visual and Sensory**: VLFGLVS453: Llancarfan and Waycock Valleys*

8.4.28 The overall evaluation of this aspect area is High – the aspect area possesses a high quality scenic landscape with many picturesque views of fields, hedgerows and steeply wooded valley sides in an aesthetic composition. The integrity of the area is intact with consistent character and in no inappropriate developments within the settlements. The aspect area possess a distinctive character defined by the strong enclosing topography, historic settlement pattern and features, woodland cover all creating a strong sense of place.

***Visual and Sensory**: VLFGLVS608: Upper Waycock Valley / Dyffryn Area*

8.4.29 The overall evaluation of this aspect area is High – the aspect area has broad, pleasing views to well managed countryside with a coherent field pattern and woodlands with settlements well integrated with the landscape and surrounding vegetation. The settlements have stone walls and streams also added to the picturesque quality of this area. The area is unspoilt, well managed and is in good and consistent condition throughout.

***Historic Landscape:** VLFGLHL032: Llancarfan*

8.4.30 The overall evaluation of this aspect area is Outstanding. This area, which roughly represents the extent of the medieval parish of Llancarfan, has been characterised as *'one of the best surviving, most typical historic sections of the whole of the Vale of Glamorgan'*. It comprises a well-preserved irregular fieldscape and a pattern of small nucleated villages with diverse evidence of land use dating from the Iron Age, Roman, medieval and post-medieval periods. The focal point of this area is represented by the ancient settlement of Llancarfan, an historically important Early Christian monastic centre associated with the famous 6th century Welsh saint St Cadog. The existing Five Mile Lane forms the eastern boundary to the aspect area.

***Historic Landscape:** VLFGLHL050: Dyffryn*

8.4.31 The overall evaluation of this aspect area is Outstanding. This area may be justifiably characterised as an outstandingly rich multi-period landscape, with evidence of occupation and funerary activity ranging from the Neolithic period through to the present day, with an exceptionally well-preserved group of Neolithic megalithic burial monuments at Tinkinswood, Maes-y-felin and Coed-y-Cwm which may be regarded as being of national significance. The existing Five Mile Lane forms the western boundary to the aspect area.

***Cultural Landscape:** VLFGLCL039: Vale of Glamorgan Rural Landscape*

8.4.32 The overall evaluation of this large aspect area is High. The aspect area helps to demonstrate that the Vale is essentially an evolved agricultural landscape. It contains abundant evidence of man's occupation and exploitation and its economic value (especially in the mediaeval period).

Landscape Character

8.4.33 The Vale of Glamorgan Council has undertaken an assessment of Landscape Character Areas and prepared the Designation of Landscape Character Areas. The

assessment and report was prepared in 2008 and updated by the Vale of Glamorgan Council as part of the Deposit LDP in 2013. The assessment was based on Level 3 LANDMAP information collected and quality assured in partnership with Natural Resources Wales (previously the Countryside Council for Wales). The Landscape Character Areas identified were defined through a holistic approach which seeks to map areas of distinct landscape character.

8.4.34 In general the landscape displays common characteristics across the study area:

- Land cover and landscape pattern are closely related to elevation and topography
- Main land use is pastoral agriculture
- Landscape trends relate to changing agricultural practices (removal of hedgerows to create larger fields or to replace with fences) and small scale infilling (new dwellings around existing farmsteads)

8.4.35 The Landscape Character Areas (LCA) affected by the Scheme are shown in Figure 8.3. Photographs of each LCA are shown in Figure 8.4. Each character area is described below and assigned measures of Susceptibility to Change and Landscape Value in accordance with Tables 8.1 and 8.2.

LCA1: Central Vale Ridges and Slopes

8.4.36 For the most part, Five Mile Lane forms the eastern boundary of this Landscape Character Area. Five Mile Lane also forms the eastern boundary to Nant Llancarfan Special Landscape Area (SLA). To the north, a limestone ridge runs east-west, along which lie linear historic settlements and an historic Roman Road. The land cover is dominated by a medium to large field pattern, mainly pasture bounded by managed hedgerows. There are some woodland blocks, both coniferous and deciduous. Settlements consist of farmsteads scattered throughout the area. The Bonvilston Amalgamated Fieldscape (HLCA010) is located within the historic parish of Bonvilston and lies within the LCA boundary. Five Mile Lane at this point follows the course of the original parish boundary.

8.4.37 From higher points on plateau within the wider landscape there are long views to Exmoor Heritage Coast / Exmoor National Park. The industrial chimneys of the Aberthaw Power Station and the recent solar farm provide detractors to the view.

8.4.38 This Landscape Character Area has a Moderate Susceptibility to Change, a Good Landscape Value resulting in a Medium Landscape Sensitivity.

LCA2: Upper Waycock Valley

8.4.39 For the most part Five Mile Lane forms the western extent of this LCA; it also forms the western boundary of Dyffryn Basin & Ridge Slopes SLA and the eastern boundary to the Central Vale Ridges and Slopes SLA, further reflecting the undulating landform within the area. The fields are generally bounded by managed agricultural hedgerows and there are isolated farmsteads. There is dense vegetation along the water courses which breaks up the arable land cover and form an important screening component within the landscape. To the north of the Scheme there are two Scheduled Monuments. Overhead pylons run from west to east through the LCA detracting forming a visual detractor.

8.4.40 This Landscape Character Area has a Moderate Susceptibility to Change, a Very Good Landscape Value resulting in a Medium Landscape Sensitivity.

LCA3: Lower Waycock Valley

8.4.41 This LCA is defined by the open valley landscape. Trees are located along the banks of the River Waycock which meanders through smaller agricultural fields bound by ditches and hedgerows reducing the scale of this relatively low lying LCA. Generally attractive views tend to be over the more intimate landscape although overhead power lines and recent solar farm development form visual detractors. The Scheme follows the existing alignment through this Character Area.

8.4.42 This LCA has a Moderate Susceptibility to Change, a Very Good Landscape Value resulting in a Medium Landscape Sensitivity.

LCA4: Rhoose Porthkerry

8.4.43 This LCA includes extensive woodland blocks. The Scheme would be widened online through this character area and there is a limited ZVI within this area as the existing Five Mile Lane passes through the woodland which forms part of the Barry Woodlands SSSI, which also contains ancient woodland and Tree Preservation Orders.

8.4.44 This LCA has a Moderate Susceptibility to Change, a Very Good Landscape Value resulting in a Medium Landscape Sensitivity.

8.4.45 Table 8.11 summarises the resulting Landscape Sensitivity assessments, which were taken forward to the Landscape Impact Assessment.

Table 8.11: Landscape Character Area Sensitivity

Landscape Character Area	Landscape Sensitivity		
	High	Medium	Low
LCA1: Central Vale Ridges and Slopes		•	
LCA2: Upper Waycock Valley		•	
LCA3: Lower Waycock Valley		•	
LCA4: Rhoose Porthkerry		•	

8.4.46 The landscape of the study area is of medium sensitivity due to the wider landscape context, presence of existing woodland and hedgerows and the presence of the existing Five Mile Lane and associated infrastructure.

Zone of Visual Influence

8.4.47 The ZVI is largely defined by the topography of the undulating agricultural landscape with longer views being restricted by the local topography and extensive woodland blocks. The ZVI is shown in Figure 8.5.

Visual Baseline Assessment

8.4.48 The study area is characterised by its generally high visual quality, resulting from an attractive undulating rural agricultural landscape. The views change with the changing

landscape character through the study area from the open plateau with individual mature trees and copses on higher land and through the vegetated river valley to the woodland in the south.

8.4.49 The existing Five Mile Lane creates a linear element through the study area reinforced by the hedgerows which form the field boundaries for the most part along both sides of the road.

8.4.50 The field pattern is characterised by hedgerows along field boundaries with scattered mature trees. Woodland blocks are dispersed through the landscape but are mainly located along valley slopes and river valleys.

8.4.51 There are intermittent long views out to the Exmoor Heritage Coast / Exmoor National Park to the south west from the plateau on higher land, however given the location of the Scheme within a contained ZVI there are no long views from Five Mile Lane..

8.4.52 To the south is the settlement of Barry which is lies on the coastal plain and is generally visually separated from the rolling agricultural landscape within the ZVI by the topography and woodland belts.

8.4.53 The existing Five Mile Lane forms the boundary to the Central Vale Ridges and Slopes and Upper Waycock Valley character areas. Whilst the road forms a linear feature within the landscape, it's visual impact is limited due to it's narrow width and close alignment existing topography. In addition the hedgerows and hedgebanks along both sides of the road and adjacent woodland reduce the visibility of traffic and reinforce the existing field boundaries and landscape structure.

8.4.54 There is currently no lighting along Five Mile Lane and therefore lighting is restricted to head lights and properties adjacent to the road. The impact of headlights is limited by the hedgerows and hedgebanks along the road with greater impact to the north of the scheme at Sycamore Cross.

8.4.55 Nine key views have been selected as representative of typical or important views within the study area, as a baseline against which to assess the potential visual impact of the Scheme. These are shown in Figure 8.5 and illustrated in photographs shown in Figures 8.6A to 8.6E.

8.4.56 The key views are described below, together with their landscape value and receptor sensitivity in accordance with Tables 8.7 and 8.9. Refer to Appendix 8.2 for further details.

Key view 1: View from footpath (S11-9-1) looking south

8.4.57 This view is taken from the footpath near Redland Farm. Its elevated position provides long clear views to the south and southwest. The existing Five Mile Lane is visible towards the west and south west but is mostly screened by existing hedgerows so only intermittent views of vehicles are visible. The view is across rolling countryside of agricultural fields and woodland copses, electricity pylons are visible in the distance.

8.4.58 This view has an Attractive Visual Quality and a High Visual Sensitivity. Receptors include residents and walkers.

Key view 2: View from Scheduled Monument (GM116) looking south southwest

8.4.59 The Scheduled Monument is located 1090m northeast of the Scheme. The view is classified as a valued view due to its cultural context. This is an elevated viewpoint with clear views to the south and south west towards the proposed scheme. The existing Five Mile Lane, is intermittently visible from this viewpoint, however the road is screened by dense and mature hedgerows. .

8.4.60 This view has an Attractive Visual Quality and a High Visual Sensitivity. Receptors include walkers.

Key view 3: View from footpath (L5-20-1) Amelia Methodist Trust Farm looking east southeast

8.4.61 This view is taken from the footpath by the entrance to the Amelia Trust Farm looking directly across the existing Five Mile Lane. Long views are visible over the existing hedgerows across the plateau to the east and south east of gently rolling agricultural land broken up by hedgerows and isolated mature trees

8.4.62 This view has a Moderate Visual Quality and a High Visual Sensitivity. Receptors include walkers and visitors to the Amelia Methodist Trust Farm.

Key view 4: View from un-named road directly to the west of the Equestrian centre looking west

8.4.63 This view is taken from an un-named road looking west. The view is of rolling fields and hedges, with a small woodland copse in the centre. The existing Five Mile Lane is visible through hedgerows to the north-west and south-west, it is obscured in the centre of the view by tree planting and the undulating nature of the landform. Aberthaw power station is visible on the distant horizon.

8.4.64 This view has a Moderate Visual Quality and a Medium Visual Sensitivity. Receptors include agricultural workers and equestrians.

Key view 5: View from unnamed road near Northcliff Cottage looking west

8.4.65 This view is taken from an un-named road adjacent to Northcliff cottage looking west. High hedgebanks on either side of the road restrict any views to the wider landscape. The hedge banks tunnel the view to the end of the lane where vehicles travelling along the existing Five Mile Lane are visible. Due to the speed at which the traffic is traveling and the narrow width of the lane views of the traffic is limited.

8.4.66 This view has a Moderate Visual Quality and a Low Visual Sensitivity. Receptors include motorised travellers.

Key view 6: View from Lidmore Mill looking South southwest

8.4.67 This view is taken from the access road to Lidmore Mill and Barns. The view looks out in a South southwest direction towards the existing Five Mile Lane. The view is across the valley floor over fields and hedgerows with Lidmore Wood visible on the slopes to the south and Coed Bach and Coed y Capel covering the slopes to the north. Overhead electricity pylons are a significant feature of the view following the valley floor detracting from the picturesque quality of the wider landscape. Partial views of the existing Five Mile Lane road are visible in the far distance mostly screened by existing hedgerows.

8.4.68 This view has a Moderate Visual Quality and a High Visual Sensitivity. Receptors include residents and walkers.

Key view 7: View from Millennium Heritage trail – W2-2-1 looking south west

8.4.69 This view is taken from the Millennium heritage trail footpath. The view looks out across the agricultural fields and established hedge planting in a south west direction towards the existing Five Mile Lane. Views of the existing road are very limited due to existing mature vegetation and the distance from the scheme. Electricity pylons are a dominant feature in the view crossing from north east to south west.

8.4.70 This view has a Moderate Visual Quality and a High Visual Sensitivity. Receptors include residents and walkers.

Key view 8: View from Brynhill Golf Club looking south west

8.4.71 This view is located at one of the highest points within the southern extent of the ZVI allowing long open views to the west. The land dips down to the valley bellow with significant areas of woodland screening much of the valley floor. Intermittent views of the existing Five Mile Lane are visible in the middle distance. The new development of a solar farm at Waycock cross is also visible in the centre of the view. On the horizon Cardiff international Airport and Aberthaw power station are both visible

8.4.72 This view has an Attractive Visual Quality and a High Visual Sensitivity. Receptors include walkers and users of the Brynhill Golf Club.

Key view 9: View from the Hawking Centre looking north west

8.4.73 This view is taken from the entrance to the Welsh Hawking Centre looking directly out across the existing Five Mile Lane and to longer views beyond of the rolling hills, woodland copses and agricultural landscape.

8.4.74 This view has a Moderate Visual Quality and a Medium Visual Sensitivity. Receptors include drivers and visitors to the Welsh Hawking Centre.

Key View Sensitivity

8.4.75 Table 8.12 summarises the resulting Key View Sensitivity assessments, which were taken forward to the Visual Impact Assessment.

Table 8.12: Key View Visual Sensitivity

Key View	Visual Sensitivity		
	High	Medium	Low
1 From foot path (S11-9-1) looking south	•		
2 Coed y Cwm Long Barrow (GM116)	•		
3 From foot path (L5-20-1) Amelia Methodist Trust Farm looking east	•		
4 From un-named road to the east of the existing Five Mile Lane near Equestrian centre looking west		•	
5 From un-named road to the east of the existing Five Mile Lane looking west			•

Key View	Visual Sensitivity		
	High	Medium	Low
6 Lidmore	•		
7 From millennium heritage trail at Lidmore looking west	•		
8 From Brynhill Golf Course looking south west		•	
9 From Hawking Centre looking south east		•	

Affected individual properties

8.4.76 In addition to the key views outlined above consideration has also been given to individual properties which are located along the Scheme alignment within the ZVI (illustrated on Figure 8.5). Details of individual properties that have been considered, and their existing views and visual quality are shown below in Table 8.15.

8.4.77 Where properties are screened or have no views of the Scheme due to existing topography, elevation or orientation of the buildings these have not been included, however, where appropriate views near to the properties have been included in the key views assessment as illustrative views above. These include the following:

- Amelia Methodist Trust Farm – the buildings are set within the landscape and are not visible from the existing Five Mile Lane. They are well screened by vegetation and landform and there would be no visual impact on the buildings or their surroundings. Key view 3 is taken from the footpath along it's access track near to Five Mile Lane.

- Little Hampton Farm – this two storey property is situated on lower ground and is surrounded by existing vegetation and other buildings and therefore has no views of Five Mile Lane or the Scheme. Key view 4 is taken from the un named road near to the farm which forms part of the equestrian centre and is considered representative of the worst case for the property and the equestrian centre buildings.

- Welsh Hawking Centre – this single storey building is close to Five Mile Lane as it passes through the Barry Woodlands SSSI at the southern end of the Scheme. The property is well screened by existing vegetation which would not be removed during construction. Whilst there may be some minor visibility of construction traffic along Five Mile Lane this is considered minimal from the building and in keeping with existing traffic that currently uses the road. Key view 9 is taken from the entrance to the Welsh Hawking Centre site and near to the entrance driveway to New Zoo Cottages which is considered to be representative of the worst case for both properties.

- Lidmore – this group of properties contain one and two storey houses and mill which has been expanded with new build approximately 920m from the Scheme. There are existing views to the south over woodland and to the Bryn Hill Golf Course and to the north and east over agricultural land. Five Mile Lane is set within woodland and is screened by vegetation and topography. The Scheme would be widened online to the south west of the properties with very loss of vegetation. Key view 6 which is taken from the access road is considered to be representative of the worst case for these properties.

8.4.78 For details of the properties assessed refer to Appendix 8.2. The receptors are all residential properties and are therefore of high visual sensitivity

Table 8.13: Properties Existing Views

Residential Property	Approx. No. of Homes Affected	Distance from Scheme	Existing Views	Existing Visual Quality
(P1) Redland Farm	4	1115m	The two storey is located on higher land of the plateau to the north of the Five Mile Lane with long views over agricultural land. The house is orientated south west and windows have some views of the existing road although the existing hedgerows and woodland blocks provide screening. To the north lies the A48 which is partially screened by existing vegetation and other buildings. Sycamore Cross lies approximately 420m to the north west of the property.	Attractive
(P2) Redland Court Farm	1	1100m	Newly constructed two storey house. Coniferous planting to the east of the property provides screening from Five Mile Lane and a sense of enclosure to the property. There are long views across the agricultural landscape to the south. Sycamore Cross lies approximately 340m to the north west of the property.	Attractive
(P3) Blackland Farm	1	14m	Two storey property with views across the agricultural landscape. Views to the east and south are restricted by the existing hedgerows and woodland planting which also screening Five Mile Lane.	Attractive
(P4) Whitton Bush Farm	1	390m	The house is set back from the existing Five Mile Lane with long views over the agricultural landscape interspersed with woodland blocks to the south and a more active agricultural landscape to the north with farm buildings and solar farm. The house is screened from the existing Five Mile Lane by existing vegetation and hedgerows.	Moderate
(P5) Whitton Lodge	1	133m	Located 10m from the existing Five Mile Lane and on the junction with an un named road, the two storey property faces south west directly onto the existing Five Mile Lane and across to the agricultural landscape beyond which is interspersed with woodlands and copses. Long views to the south are screened by existing vegetation.	Moderate

Table 8.13: Properties Existing Views

Residential Property	Approx. No. of Homes Affected	Distance from Scheme	Existing Views	Existing Visual Quality
(P6) Northcliffe Cottage	1	53m	The two storey property is located at the junction between Five Mile Lane to the west and an un named road to the north. The views are generally contained with some long views to the surrounding undulating agricultural landscape, mainly to the west and south. Existing hedgerows and garden planting provide screening to the roads although their close proximity is also reinforced as linear features in the landscape.	Moderate
(P7) Grovelands House	1	154m	Three storey house with long driveway to create a tranquil setting to the house adjacent to the farm buildings to the north. Long views over undulating agricultural land with woodland blocks and scattered trees to the south and east.	Moderate
(P8) Sutton Fach Farm	1	151m	Two storey farmhouse surrounded by farm buildings adjacent to the existing Five Mile Lane. To the west of Five Mile Lane lies a recent solar farm and new farm buildings. The views to the south are over farmland surrounded by agriculturally trimmed field boundaries with blocks of woodland such as Sutton Wood and the wooded river valley of R Waycock beyond.	Moderate
(P9) Brooklands	3	1343m	This property is representative of a properties along Brook Lane over a km from the Scheme. The two storey property has intermittent long views over the undulating landscape punctuated and framed by existing hedgerows and woodland. There are long views towards Five Mile Lane which is set against a woodland background and visibility in very limited.	Attractive

8.5 Predicted Effects

Landscape Impact

8.5.2 In considering the Scheme proposals, the Magnitude of Landscape Effect has been assessed for each character area applying the criteria in Table 8.4. The Scheme is described in detail in Section 3 of this ES. Figure 1.2 shows the longitudinal section for the Scheme and Figures 8.9A and 8.9B show indicative cross sections along the Scheme.

8.5.3 The assessment considers both direct and indirect effects on the landscape. Indirect landscape effects are those which result from a change to the visual context of a character area not directly affected by the development. This is only relevant where the visual context is a key element of an area's landscape character. Effects can also be adverse or beneficial, detracting from or enhancing the existing character.

8.5.4 The assessment of the opening year (year 1) was considered without the mitigation planting and in the design year (year 15) when the mitigation would be established. The mitigation is described in Section 8.6 below. Refer also to the Landscape Proposals Figures 8.7A to 8.7H, existing vegetation to be removed Figures 8.8A and 8.8B and indicative cross sections Figures 8.9A and 8.9B.

8.5.5 Night-time effects were considered which include an assessment of the impact of Scheme lighting and traffic headlights within the landscape. The provision of Scheme lighting is restricted to the provision of standard lamps along the approach to Waycock Cross only.

8.5.6 The significance of the landscape impact was assessed in accordance with the criteria shown in Table 8.5 for each character area. Outlined below is a brief description of the outcome of the assessment.

LCA1: Central Vale Ridges and Slopes

8.5.7 The Scheme at Sycamore Cross has a direct impact on the LCA . Five Mile Lane then forms the boundary between LCA 1 and 2 until the approximate commencement of the Scheme Ch 0.0. The Scheme then dissects the LCA up to the junction with the un named minor road at Ch.1180. The LCA continues to the west of the Scheme along the boundary of the existing Five Mile Lane until the Scheme goes back online as it descends to cross Waycock Valley at Ch. 3400. The Nant Llancarfan SLA boundary follows the existing Five Mile Lane between Sycamore Cross and Waycock Cross. The Scheme passes through SINC and ancient woodland which are both addressed further in Chapter 9 Nature Conservation in this ES.

8.5.8 Minor improvements would be made to the existing junction between the A48 and Five Mile Lane at Sycamore Cross. All the proposed works would be carried out within the existing Highway Boundary. As a result some grass verges would be lost to provide the additional carriageway capacity. There would be no impact on landscape character from this component of the Scheme.

8.5.9 From Sycamore Cross to the north along the existing Five Mile Lane the Scheme would be widened online from Ch. 0.0 to approximately Ch300m as it gently descends from the A48 to the north. There would be some loss of agricultural hedgerows to the east and woodland edge planting to the west of the existing road. . There would be attenuation ponds constructed to the east of the Scheme, the existing field boundary hedge would be retained to minimise the impact and help ensure the ponds fit within the agricultural context of the Scheme. There would be limited loss of vegetation within this section, the Scheme is at grade and whilst there would be direct irreversible impact during construction the loss of vegetation would be mitigated and there would be a negligible long term impact on the landscape character along this section.

8.5.10 At Ch300m the Scheme goes offline to the east of the existing Five Mile Lane. The existing section of road would be retained for access. There would be some loss of scrub and woodland from SINC 221 and 222 but this would be replaced by woodland planting within a severed agricultural field which would screen the Scheme, reduce

the impact of the two roads in close proximity to each other, replace lost planting and extend and strengthen the quality and overall landscape value of the existing woodland. The Scheme would pass in slight cutting of less than 1m which would help screen the Scheme minimising the night-time impact of headlights especially from the east. At Ch 600m, there would be a junction primarily at grade. This would introduce additional infrastructure into the landscape as it links to the existing road and severs large agricultural fields. There would be some loss of hedgerows around this junction.

8.5.11 Between Ch 650m and Ch 1100m the Scheme would be on embankment of up to approximately 4m reinforcing the presence of the additional linear infrastructure within the agricultural landscape. This impact would reduce over time when the mitigation planting has established and whilst a large agricultural field would be severed the resulting field sizes are in keeping with the surrounding agricultural context.

8.5.12 The junction at Ch 1100m is on slight embankment and would require the realignment of an existing section of the minor road. There would be some associated loss of hedgerows and woodland, together with the severance of the adjacent field. The severed area would be retained for the Scheme and would be planted which would reduce the scale of the Scheme, provide visual interest and screening and enhance the local biodiversity whilst reflecting the character of the wider landscape. Attenuation ponds would be constructed within an agricultural field to the west of the Scheme. Where the Scheme is on embankment car headlights would be obvious within the ZVI until any mitigation planting has established. There would be a change to the local character from open agricultural fields to a more intimate one of hedgerows and intermittent trees along the Scheme with blocks of tree and shrub planting although this fits with the wider landscape character of the area.

8.5.13 During construction there would be partial loss of features of the landscape with a partial change to the landscape character through this section. This would result in a moderate adverse magnitude of impact on this character area. At opening year (year 1) before the planting has established there would be a moderate adverse impact and this would reduce minor adverse by year 15 both winter and summer when the planting has established.

8.5.14 Given the proximity of the character area to the Scheme along its length to approximately Ch3700m as the boundary follows the existing Five Mile Lane, there would be some indirect impact on the visual context, however this would be negligible and minor adverse at worst given the wider context of the landscape, the proposed hedgerows and planting to integrate the Scheme into the landscape and the narrow visual envelope through this section.

8.5.15 There is no direct impact on the Historic Landscape Character Area. Whilst a small section of the western boundary of the Dyffryn Gardens SLA would be severed the wider landscape context is retained and it is noted that Five Mile Lane was used as a defensible boundary and this section is not considered to form a fundamental constituent of the SLA.

8.5.16 The Magnitude of Landscape Effect and Landscape Impact Significance during each phase of the Scheme based on a medium landscape sensitivity are shown in Table 8.14.

Table 8.14: LCA 1: Central Vale Ridges and Slopes – Magnitude of Landscape Effect and Impact Significance

Phase	Magnitude of Landscape Effect	Landscape Impact Significance
Construction	Moderate Adverse	Moderate Adverse
Year 1	Moderate Adverse	Moderate Adverse
Year 15 (Winter)	Minor Adverse	Slight Adverse
Year 15 (Summer)	Minor Adverse	Slight Adverse

LCA2: Upper Waycock Valley

8.5.17 The Scheme passes directly through this LCA from the junction with the unnamed minor road at Ch 1180m until the Scheme goes back online as it descends to cross Waycock Valley at Ch. 3400m. The western boundary of this character area follows the existing Five Mile Lane.

8.5.18 Through this landscape character area the Scheme passes offline therefore severing the western section of the character area between the Scheme and the existing Five Mile Lane. From Ch1200m the Scheme is at grade or on slight embankment rising the cross over the Moulton Brook at Ch1900m. From Ch1375m to Ch2000m the Scheme would run parallel to the existing section of Five Mile Lane reinforcing the presence of infrastructure within the landscape. However the land between the existing road and the Scheme would be planted with intermittent tree and shrubs planting which would reduce the scale of the infrastructure and help integrate the Scheme into the existing wider landscape. At Ch2100m the junction with the un-named minor road would cause severance of fields and additional infrastructure would be introduced into the agricultural landscape. There would be some a loss of field hedgerow boundaries associated with the junction and the PMA which would be required to provide field access to the west of the Scheme. The boundaries to the severed fields would be planted with hedgerows to reinforce the existing field boundaries, redundant sections of the existing Five Mile Lane would be broken out and seeded and the realignment of the access Northcliff Cottage would provide an improved setting to the property once the planting had established.

8.5.19 The Scheme continues offline through the character area until approximately Ch 3500m where it would return to online widening. Between Ch2200m and Ch 3400m the Scheme is at grade or in cutting where it would pass under the equestrian route at Ch 2920m. This would help screen the vehicles using the Scheme and minimise the impact of head lights on the surrounding landscape and properties. Hedgerows would be planted along the severed field boundaries to reflect the existing landscape structure. The Scheme would sever large agricultural fields through this area providing a more intimate fieldscape characteristic of the LCA. The equestrian bridge would be of simple steel girder design 3.5m wider with 500mm verges on either side. The wing walls would be clad in masonry.

8.5.20 Between Ch3100m and Ch3400m the Scheme runs parallel with Five mile Lane, prior to the tie-in. There would be loss of some field boundaries although wherever possible the hedgerows along the existing Five Mile Lane would be retained to reduce the overall impact of the Scheme. There would be severance of fields although the field pattern changes through this section of the character area as it passes across the wooded Waycock Valley. Woodland planting of severed land would link to the existing woodland blocks on either side of the Scheme and would help integrate the

Scheme into the locality and the wooded valley landscape. The attenuation ponds between Ch3400m and Ch3500m would also be enclosed by woodland planting to both extend Sutton Wood to the south and link it with other surrounding woodland further reinforcing the valley landscape.

8.5.21 Whilst there is the introduction of an additional linear element to the landscape of this character area and associated severance of agricultural fields, the character area is a dynamic agricultural one which has changed to accommodate agricultural diversification. The field patterns, woodland blocks and undulating landform help the landscape accommodate change.

8.5.22 During construction there would be partial loss of change to features of the landscape with a partial change to landscape character through this section. This would result in a moderate adverse magnitude of impact on this character area. At opening year prior to the establishment of mitigation vegetation there would be a moderate adverse impact and given that the Scheme severs a section along the very edge of the character area and there are roads within the wider landscape context the impact would reduce to minor adverse by year 15 both winter and summer when the planting has established. As mitigation planting becomes established the leaf-cover would screen much of this change in the area's visual context and reduce the overall impact. The impact of car headlights would be minimised by the Scheme passing in cutting and by the proposed planting.

8.5.23 Whilst there is a severing of a small section of the western boundary of the Dyffryn Gardens SLA the wider landscape context is retained and it is noted that Five Mile Lane was used as a defensible boundary and this section is not considered to form a fundamental constituent of the SLA.

8.5.24 The Magnitude of Landscape Effect and Landscape Impact Significance during each phase of the Scheme based on a medium landscape sensitivity are shown below in Table 8.15.

Table 8.15: LCA 2: Upper Waycock Valley – Magnitude of Landscape Effect and Impact Significance

Phase	Magnitude of Landscape Effect	Landscape Impact Significance
Construction	Moderate Adverse	Moderate Adverse
Year 1	Moderate Adverse	Moderate Adverse
Year 15 (Winter)	Minor Adverse	Slight Adverse
Year 15 (Summer)	Minor Adverse	Slight Adverse

LCA3: Lower Waycock Valley

8.5.25 The Scheme would cross this valley landscape character area from Ch3700m to approximately Ch4500m. This section of the Scheme is online widening with the loss of some boundary hedgerows, loss of woodland adjacent to the existing Five Mile Lane contained within the Barry Woodlands SSSI and some loss of lesser value trees within the woodland TPO. This loss would be minimised, however, and would be replaced where appropriate. Extensive woodland planting is proposed to the west of the Scheme between Ch3600m and 4000m as replacement for woodland lost to the Scheme. It would link existing woodland in Middleton Plantation and add a broadleaved woodland edge habitat to Sutton Wood. This would reinforce the wooded

valley landscape character of the area. Although the ZVI extends from the Scheme along the river valley there is very limited impact on the character area given the retention of existing hedgerows and the works predominantly online through this area.

8.5.26 The existing boundary of the Nant Llancarfan and Dyffryn Basin and Ridge Slopes SLA follows the alignment of the existing Five Mile Lane as a defensible boundary. There would be a negligible impact on these local designations.

8.5.27 The Magnitude of Landscape Effect and Landscape Impact Significance during each phase of the Scheme based on a medium landscape sensitivity are shown below in Table 8.16.

Table 8.16: LCA3: Lower Waycock Valley – Magnitude of Landscape Effect and Impact Significance

Phase	Magnitude of Landscape Effect	Landscape Impact Significance
Construction	Moderate Adverse	Moderate Adverse
Year 1	Minor Adverse	Slight Adverse
Year 15 (Winter)	Negligible	Neutral
Year 15 (Summer)	Negligible	Neutral

LCA4: Rhoose/Porthkerry

8.5.28 The Scheme passes through a small section of this landscape character area between Waycock Valley and the settlement of Barry. The Scheme would be online with widening occurring predominantly along the eastern edge of the existing Five Mile Lane. There would be some loss of woodland contained within the Barry Woodlands SSSI. There would be replacement planting between Ch4100m – 4660m to mitigate the local impact and also additional planting would be undertaken Ch3600m to Ch4000m as outlined in LCA 3 above to mitigate the wider impact and reinforce the woodland character of the river valley landscape. In the longer term with maintenance of the proposed planting there could be some amelioration of the existing woodland where it has become degraded.

8.5.29 Lighting is proposed on approach to the roundabout at Waycock Cross at the southern end of the Scheme. Due to its location at the edge of Barry and through the woodland planting the impact of this lighting would be limited.

8.5.30 The Magnitude of Landscape Effect and Landscape Impact Significance during each phase of the Scheme based on a medium landscape sensitivity are shown below in Table 8.19.

Table 8.19: LCA4: Rhoose/Porthkerry – Magnitude of Landscape Effect and Impact Significance

Phase	Magnitude of Landscape Effect	Landscape Impact Significance
Construction	Moderate Adverse	Moderate Adverse
Year 1	Negligible	Neutral / Slight Adverse
Year 15 (Winter)	Negligible	Neutral / Slight Adverse

Phase	Magnitude of Landscape Effect	Landscape Impact Significance
Year 15 (Summer)	Negligible	Neutral

Summary of Landscape Effects

8.5.31 In summary, the Scheme would introduce some adverse effects where it directly impacts on the landscape character of the areas through which it passes, especially where it is on embankment and at junctions, although this will reduce over time. The scale of these impacts is reduced due to the existing Five Mile Lane, which provides infrastructure through the landscape setting and forms an important component of the historic context of the landscape. In addition, the landform and existing vegetation limit the visual context of the Scheme, thus reducing the overall impact on the landscape character of the area. The proposed hedgerow and woodland planting will soften the Scheme and help integrate it into the local landscape.

Visual Impact Assessment

8.5.32 The approach to visual impact assessment is similar for landscape, through consideration of the selected key views. For each view the Visual Sensitivity has been identified through the baseline. The Magnitude of Visual Effect is assessed in accordance with the criteria contained in Table 8.10. Receptor Sensitivity is then considered to determine the Visual Impact Significance as shown on Table 8.11. Where there are a range of receptors the worst case has been considered here. A summary of the assessment is given below. Refer also to Appendix 8.2.

Key view 1: View from footpath (S11-9-1) looking South

8.5.33 Five Mile Lane provides an obvious component of the existing view and for the most part the visible section of the Scheme would be online widening. During construction there would be some loss of existing vegetation and hedgerows and the construction activities would be visible within the longer visual context of the view. In year 1 the Scheme would be discernible but not alter the overall balance of features and elements that comprise the view. At year 15 no part of the Scheme would be discernible and therefore the long term impact on this view would be no change.

8.5.34 The Magnitude of Visual Effect and Significance of Visual Impact during each phase of the Scheme are shown below in Table 8.18.

Table 8.18: Key view 1: View from footpath (S11-9-1) looking South – Magnitude of Visual Effect and Impact Significance

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Construction	Moderate Adverse	Large / Moderate Adverse
Year 1	Negligible	Slight Adverse
Year 15 (Winter)	No change	Neutral
Year 15 (Summer)	No change	Neutral

Key view 2: View from Scheduled Monument (GM 116) looking South southwest

8.5.35 There would be views of the Scheme during construction over a distance although this would be within a contained corridor similar to the existing Five Mile Lane and the impact would be reduced by existing vegetation. Where the Scheme is on embankment this would be mostly screened by existing vegetation and hardly visible in the longer views once mitigation planting has established the Scheme would not be perceptible thus By year 15 there would be no change on the view from the Scheme.

8.5.36 The Magnitude of Visual Effect and Significance of Visual Impact during each phase of the Scheme are shown below in Table 8.19.

Table 8.19: Key view 2: View from Schedule Monument (GM 116) looking South southwest – Magnitude of Visual Effect and Impact Significance

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Construction	Moderate Adverse	Large / Moderate Adverse
Year 1	Negligible	Slight Adverse
Year 15 (Winter)	No change	Neutral
Year 15 (Summer)	No change	Neutral

Key view 3: View from footpath (L5-20-1) Amelia Methodist Trust Farm looking East southeast

8.5.37 Looking east southeast from this location the Scheme would be further away than the existing Five Mile Lane, although this would be retained for access. To the right of the view the Scheme would be on embankment, although views would be limited both by existing trees and hedgerows along the existing road. The existing landform would minimise long views of the Scheme. A new access road will be built to link the existing road and farm to the new scheme, this will be clearly visible throughout the construction period.

8.5.38 In year 1 the Scheme would be clearly visible in the existing view. By year 15 the hedgerows and mitigation screen planting would minimise any views to the Scheme from this location.

8.5.39 The Magnitude of Visual Effect and Significance of Visual Impact during each phase of the Scheme are shown below in Table 8.20.

Table 8.20: Key view 3: View from footpath (L5-20-1) Amelia Methodist Trust Farm looking East southeast – Magnitude of Visual Effect and Impact Significance

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Construction	Moderate Adverse	Large / Moderate Adverse
Year 1	Moderate Adverse	Large / Moderate Adverse
Year 15 (Winter)	Minor Adverse	Moderate / Slight Adverse
Year 15 (Summer)	Negligible	Slight Adverse

Key view 4: View from un-named road directly to west of equestrian centre looking West

8.5.40 The Scheme would be visible in this panoramic view as it would be on embankment both to the north and south of the unnamed road. It would be closer to the view than the existing Five Mile Lane and would sever the agricultural fields. There would be loss of existing mature hedgerows and tree planting and the minor road would be realigned to the north. The existing road and the boundary hedges would be retained where possible to provide visual connectivity and provide some initial screening of the Scheme and attenuation ponds. Long views to the west will remain.

8.5.41 During construction the Scheme would be a noticeable feature in the view. In year 1 the embankment to the north of the minor road would remain a noticeable feature in the view although by year 15 with the establishment of hedgerows, woodland planting and individual and groups of trees the Scheme would be perceptible in the view but would not alter the overall balance of features that comprise the existing view.

8.5.42 The Magnitude of Visual Effect and Significance of Visual Impact during each phase of the Scheme are shown below in Table 8.21.

Table 8.21: Key view 4: View from un-named road directly to west of equestrian centre looking West – Magnitude of Visual Effect and Impact Significance

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Construction	Moderate Adverse	Moderate Adverse
Year 1	Moderate Adverse	Moderate Adverse
Year 15 (Winter)	Minor Adverse	Slight Adverse
Year 15 (Summer)	Negligible	Slight Adverse / Neutral

Key view 5: View from Northcliff Cottage looking West

8.5.43 This Scheme would include the upgrading of the tie-in of the minor road east of the junction with associated loss of hedgerows and existing vegetation. This minor road would be moved to the north and further from Northcliff Cottage to which a new access would be provided and screen planting would be included. The Scheme would be on embankment to the north as the Scheme crosses over Moulton Brook which would be screened during construction by existing mature hedgerows.

8.5.44 During construction the Scheme would form a dominant feature of the view, especially due to its proximity to the property and the changes required to the junction. In year 1 it would form a noticeable feature within the view but this would reduce to negligible by year 15.

8.5.45 The Magnitude of Visual Effect and Significance of Visual Impact during each phase of the Scheme are shown below in Table 8.22.

Table 8.22: Key view 5: View from Northcliffe Cottage looking south west – Magnitude of Visual Effect and Impact Significance

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Construction	Major Adverse	Moderate / Slight Adverse
Year 1	Moderate Adverse	Slight Adverse
Year 15 (Winter)	Negligible	Slight Adverse / Neutral
Year 15 (Summer)	Negligible	Slight Adverse / Neutral

Key view 6: Lidmore looking South southwest

8.5.46 The Scheme would be widened online at this location and due to the existing woodland planting there is a restricted lateral view from this viewpoint. During construction the Scheme would be perceptible but this would be minimised by limiting the amount of vegetation to be cleared along the existing carriageway. At year 1 it would be perceptible and by year 15 it would form a barely noticeable feature of the view.

8.5.47 The Magnitude of Visual Effect and Significance of Visual Impact during each phase of the Scheme are shown below in Table 8.23.

Table 8.23: Key view 6: View from Lidmore looking South southwest – Magnitude of Visual Effect and Impact Significance

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Construction	Minor Adverse	Moderate / Slight Adverse
Year 1	Minor Adverse	Moderate / Slight Adverse
Year 15 (Winter)	No change	Neutral
Year 15 (Summer)	No change	Neutral

Key view 7: View from the Millennium Heritage Trail – W2 – 2- 1 looking South west

8.5.48 The Scheme would be widened online at this location and it would be screened by existing vegetation and topography. There would be minimal disturbance during construction and negligible or no impacts at year 1 or year 15.

8.5.49 The Magnitude of Visual Effect and Significance of Visual Impact during each phase of the Scheme are shown below in Table 8.24.

Table 8.24: Key view 7: View from the Millennium Heritage Trail (W2-2-1) looking South west – Magnitude of Visual Effect and Impact Significance

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Construction	Minor Adverse	Moderate / Slight Adverse
Year 1	Negligible	Slight Adverse
Year 15 (Winter)	No change	Neutral

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Year 15 (Summer)	No change	Neutral

Key view 8: View from Brynhill Golf Club looking Southwest

8.5.50 From this high point views of the existing road are predominantly screened by the existing woodland. The Scheme would be widened online. During construction there may be some vegetation clearance that would open up some views to the Scheme but these are considered limited and would form very small components of the view. There would be a minor adverse impact at year 1 and no impact at year 15.

8.5.51 The Magnitude of Visual Effect and Significance of Visual Impact during each phase of the Scheme are shown below in Table 8.25.

Table 8.25: Key view 8: View from Brynhill Golf Club looking south west – Magnitude of Visual Effect and Impact Significance

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Construction	Minor Adverse	Moderate / Slight Adverse
Year 1	Minor Adverse	Moderate / Slight Adverse
Year 15 (Winter)	No Change	Neutral
Year 15 (Summer)	No Change	Neutral

Key view 9: View from the Welsh Hawking Centre looking Northwest

8.5.52 The existing road is clearly visible and the Scheme would be widened online at this location. Due to proximity to the road there would be a significant impact during construction of the Scheme. At year 1 the Scheme would be visible however by year 15 when mitigation vegetation has matured there would be no impact on this view.

8.5.53 The Magnitude of Visual Effect and Significance of Visual Impact during each phase of the Scheme are shown below in Table 8.26.

Table 8.26: Key view 9: View from the Welsh Hawking Centre – Magnitude of Visual Effect and Impact Significance

Phase	Magnitude of Visual Effect	Significance of Visual Impact
Construction	Major Adverse	Large / Moderate Adverse
Year 1	Minor Adverse	Slight Adverse
Year 15 (Winter)	No Change	Neutral
Year 15 (Summer)	No Change	Neutral

Summary of Visual Impact on Views in the Area

8.5.54 In summary, the Scheme would result in a range of visual effects and impacts, determined by distance, aspect, elevation and intervening topography and vegetation.

However, given the local topography, existing woodland cover and the existing Five Mile Lane, the change in views would be limited primarily to the junctions and embankments. By the summer of the design year (year 15) and with mitigation planting in place there would be very limited impact on the visual amenity of the area.

Visual impact on affected individual properties

8.5.55 The approach to visual impact assessment is as described above, through consideration of the identified properties or group of properties likely to be affected by the Scheme, as a consequence of being within the Zone of Visual Influence.

8.5.56 The baseline quality and character of the existing visual quality are assessed in accordance with the criteria shown in Tables 8.7 and 8.8. A summary of the resulting impact from the Scheme during construction, Year 1 and Year 15 is shown in Table 8.27. The location of each of these properties is also shown on Figure 8.5. Refer also to Appendix 9.2.

Table 8.27: Summary of visual impact on affected properties

Property	Magnitude of Effect / Visual Impact Significance	Construction	Year 1	Year 15 winter	Year 15 summer
(P1) Redland Farm	**Magnitude of Effect**	Minor adverse	No change	No change	No change
	Visual Impact Significance	Moderate/ slight	Neutral	Neutral	Neutral
(P2) Redland Court Farm	**Magnitude of Effect**	Minor adverse	No change	No change	No change
	Visual Impact Significance	Moderate/ slight	Neutral	Neutral	Neutral
(P3) Blackland Farm	**Magnitude of Effect**	Minor adverse	No change	No change	No change
	Visual Impact Significance	Moderate/ slight	Neutral	Neutral	Neutral
(P4) Whitton Bush Farm	**Magnitude of Effect**	Minor adverse	No change	No change	No change
	Visual Impact Significance	Moderate/ slight	Neutral	Neutral	Neutral
(P5) Whitton Lodge	**Magnitude of Effect**	Major Adverse	Major Adverse	Moderate Adverse	Moderate Adverse
	Visual Impact Significance	Verge Large/Large	Verge Large/Large	Large/ Moderate	Large/ Moderate
(P6) Northcliff Cottage	**Magnitude of Effect**	Major Adverse	Major Adverse	Moderate Adverse	Moderate Adverse
	Visual Impact Significance	Verge Large/Large	Verge Large/Large	Large/ Moderate	Large/ Moderate
(P7) Grovelands	**Magnitude of Effect**	Moderate Adverse	Minor Adverse	Negligible	Negligible
	Visual Impact	Large/	Moderate/	Slight	Slight

	Significance	Moderate	Slight		
(P8) Sutton Mawr Farm	**Magnitude of Effect**	Moderate Adverse	Moderate Adverse	Minor Adverse	Negligible
	Visual Impact Significance	Large/ Moderate	Large/ Moderate	Moderate /Slight	Neutral
(P9) Brooklands	**Magnitude of Effect**	Minor Adverse	Negligible	Negligible	No change
	Visual Impact Significance	Moderate/ Slight	Neutral	Neutral	Neutral

8.6 Proposed Mitigation

Construction

8.6.1 During construction of the Scheme, landscape and visual impacts will arise from earthworks, temporary construction compounds and construction traffic. Whilst it would not be possible to mitigate the effect of moving and operating site vehicles, there are a number of other measures which could reduce adverse effects. These include:

- Where possible, retaining all existing and established vegetation to help screen construction operations – where appropriate this will involve crown lifting as opposed to the removal of mature trees in order to accommodate construction traffic and machinery. Root protection zones would be marked out around all existing trees to be retained to ensure that a sufficient percentage of the root system is not damaged during construction, providing instant height and maturity once the Scheme is complete
- Careful siting of site offices, compounds and car parks, with screen bunds or hoarding around sensitive boundaries as appropriate
- Sensitive design and placing of site signage, in order to provide the required information whilst limiting wider landscape and visual impacts
- Control of site lighting, minimising light-spill beyond the required area
- Programme planning to ensure exposed earthworks are re-vegetated as soon as possible to accelerate landscape integration
- Temporary seeding of topsoil and subsoil storage heaps
- Where appropriate, undertaking advanced planting to increase the density and width of existing planting blocks to provide more effective screening from the most vulnerable receptors

Operation

8.6.2 The mitigation measures implemented during construction would remove or reduce the adverse landscape and visual effects arising during the operational phase of the Scheme. Operational effects are anticipated from the highway itself, associated earthworks and structures, traffic movement and lighting.

8.6.3 Landscape mitigation elements would include planting, including broadleaf woodland, native mixed-species hedgerows, individual trees, species-rich and amenity grassland and earthworks. In addition the design should be developed in accordance with the

Vale of Glamorgan UDP Supplementary Planning Guidance: Design in the Landscape.

8.6.4 Where the Scheme would connect with the existing Five Mile Lane, careful consideration of the structures and finishes would ensure that they become integrated into the landscape.

8.6.5 The retention of existing trees, woodland and hedgerows to provide screening and help integrate the Scheme into the landscape is a key component of mitigating adverse impacts.

8.6.6 There would be an impact on the Tree Preservation Order (TPO) No 1 1983 which covers trees within Middleton Plantation, part of the Barry Woodlands SSSI. This would be mitigated by working with the Vale of Glamorgan Council Tree Officer to minimise the impact on the TPO during site clearance and identifying areas of woodland adjacent to the TPO such that the designation can be reassigned.

8.6.7 The proposed landscape mitigation measures which would be provided are described below, moving along the Scheme from north to south, and are illustrated in Figures 8.7A to 8.7H. Existing vegetation to be removed is shown on Figures 8.8A and 8.8B.

All planting proposed is contained within the Scheme boundary however there could be an opportunity for offsite planting which would be considered with landowners on an individual basis to provide additional screening and reduce the local impact on individual properties. Sycamore Cross Junction (see Figure 8.7H)

8.6.8 Some minor works would be carried out to the junction at Sycamore Cross. This would include realigning the carriageways and additional signage. The main impact on the landscape and visual setting would be the size of the signs. To minimise the impact at the junction there would be no removal of existing hedgerows or mature trees. The signage would be designed to minimise the overall dimensions within required specifications.

Ch0m to Ch420m (see Figure 8.7A)

8.6.9 The widening would be online and accommodated within the landtake of the existing Five Mile Lane. Hedgerows would be retained to reduce the impact on the landscape and visual amenity. To the east, an attenuation pond would be constructed, existing hedgerows would be retained where possible and new hedgerows and individual trees would be planted to replace those lost to the Scheme and to provide connectivity with the existing hedgerows.

8.6.10 From Ch300m the Scheme would continue offline and would sever existing agricultural fields with the resultant loss of sections of existing hedgerow and the edge of the adjacent woodland block of SINC221. The replacement verges would be re-profiled to tie in with the adjoining verges to the north. Native species hedgerows would be planted along the fencelines within the Scheme boundary tying in to the existing hedges. In addition, where appropriate, it is recommended that any redundant surfaced sections of the existing Five Mile Lane should be removed and planted as an extension of the proposed woodland planting.

Ch420m to Ch560m (see Figure 8.7A)

8.6.11 Continuing south, offline, a short section of the existing hedgerow would be lost where the Scheme crosses an existing field boundary. Mixed native woodland planting

would be carried out in the severed field between Ch 370 – 540. . The proposed woodland would act as compensation for the loss of habitat and would provide screening and landscape integration. A native hedgerow would be planted along the fencelines on both sides of the Scheme which would provide landscape integration with the existing field boundary pattern.

Ch560m to Ch1180m (see Figure 8.7B)

8.6.12 This section of the Scheme continues off line in a south east direction. The junction with the existing Five Mile Lane which would be bounded by hedgerows to tie into the existing field boundaries to provide landscape integration, connectivity and visual screening. Where possible, sections of hedgerow to be removed would be translocated, as this would increase the effectiveness of the hedgerow for initial screening.

8.6.13 Between Ch600m and Ch1180m the Scheme would be on low embankment. Hedgerows would be planted along the fence lines with intermittent groups of trees planted along the embankment to reduce the impact of the Scheme whilst allowing views out from the Scheme to the surrounding countryside. The proposed hedgerows would also provide cover and mitigation for wildlife in association with the mammal pass that would be installed at Ch780m.

8.6.14 The minor road to the east would be realigned to join the Scheme at Ch1100m. There would be land between the existing road and the realigned section of road which would be planted with wild flower mix and native tree and shrub planting. Existing hedgerows would be retained wherever possible and where they are removed they would be replaced by hedgerows to connect remnant field boundaries.

8.6.15 The attenuation ponds to the west of the Scheme at Ch1100m would be partially screened by native tree and shrub planting. Hedgerows would be retained where possible but these would be supplemented by new mixed hedgerows to connect remnant sections and provide screening for Whitton Lodge.

Ch1180m to Ch2300m (see Figures 8.7B to 8.7D)

8.6.16 Between Ch1400m and Ch2000m, the Scheme would be on low embankment and alongside the existing Five Mile Lane. To reduce the landscape and visual impact of the combined infrastructure there would be groups of tree and shrub planting together with wildflower planting. Existing hedgerows along Five Mile Lane would be retained.

8.6.17 As the Scheme crosses over Moulton Brook, on embankment woodland planting would be planted to provide habitat connectivity and screen the traffic as it passes on embankment. Severed fields adjacent to the junction at Ch2000m would be planted with wildflower mix, where possible existing hedgerows would be retained and where they are lost they would be replaced. The entrance to Northcliff Cottage would be realigned and there would be planting and species rich grassland to provide a setting to the entrance to the property. In addition there would be a strip of woodland planting along the eastern edge of the Scheme between Ch2180m and Ch2300m which would provide screening of the property from the mainline.

Ch2300m to Ch3100m (see Figure 8.7D to Figure 8.7E)

8.6.18 The Scheme is in cutting, as it crosses open agricultural land, for much of this section. Hedgerows would be severed where they are crossed by the Scheme and, therefore, hedgerows would be planted along the Scheme boundaries to provide connectivity

and reinforce existing field boundaries. The cutting slopes would be planted with wildflower grass species.

8.6.19 The equestrian route would run along the top of the embankment to the east of the Scheme from Northcliff Cottage and would cross the Scheme at approx. Ch2920m to join the existing section of Five Mile Lane at Ch3120m.

C3100m to Ch4000m (see Figures 8.7E and 8.7F)

8.6.20 The Scheme passes through woodland blocks between Ch3120m and Ch3400m. The vegetation lost would be replaced and connectivity between blocks, to include Sutton Fach Wood and Sutton Wood, would be enhanced through extensive native woodland planting.

8.6.21 In addition Sutton Wood would be linked to the vegetation along the River Waycock and to Middleton Plantation through planting around the attenuation ponds located at Ch3400m to Ch3500m. This planting also helps reduce the impact of the infrastructure where the Scheme rejoins Five Mile Lane at Ch3400m. Existing hedgerows would be retained along Five Mile Lane to ensure initial screening and to help reduce the impact of construction on the setting. Where hedgerows are lost to the Scheme to the east, new hedgerows would be planted.

8.6.22 Where possible the existing field boundary hedgerows would be retained where the Scheme is widened online through this section. Infill planting would be undertaken between Ch3600m and Ch4000m to help integrate the Scheme into the landscape, provide landscape and ecological connectivity and also to mitigate for the loss of Barry Woodlands SSSI habitat as described in Chapter 9 Nature Conservation.

Ch4000m to Ch4850m (see Figures 8.7F and 8.7G)

8.6.23 This section of the Scheme comprises online widening with a cycleway to the west of the Scheme. The Scheme is enclosed to both the east and west by woodlands which form part of the Barry Woodlands SSSI. To minimise the impact on the SSSI the minimum vegetation clearance required would be undertaken. In addition, woodland edge species would be planted to reinforce the existing planting and to improve it where the quality is limited.

8.7 Residual Effects (With Mitigation)

Construction

8.7.1 The impact on the landscape and the changes to the visual amenity would be as stated in Section 8.5 with mitigation. The assessment considered the minimum site clearance and as shown on Figure 8.8. Screening of the construction compounds would have a minor beneficial impact but it unlikely to change the assessment by an order of magnitude.

Operation

8.7.2 The process undertaken for landscape and visual impact assessments requires assessments to be undertaken at year 1, which is taken to be when planting is small and not effective for landscape integration or visual screening. Therefore, it can be considered as the impact without mitigation. By year 15 the planting would have established and would perform a screening and integration function. Therefore, it

could be considered as the impact with mitigation. Refer to section 8.5 for the results of the Scheme with mitigation.

8.8 Cumulative Effects

8.8.1 At the time of preparing the assessment, five Planning Applications had been submitted within 500m of the Scheme. Planning applications within the locality predominantly relate to residential development along the A48 or as infill to Barry settlement or solar farms located in large agricultural fields characteristic of the area. Depending on the size and location, both could fit well within the landscape or have cumulative impacts associated with them. Therefore, careful planning is required.

8.8.2 Each of the developments seeking planning permission is outlined briefly below. A plan illustrating the location of these developments is provided in Figure 16.1.

i 2014/01205/SC1 - (160m from site) Proposed residential development. 60 dwellings to be constructed in 2016. 60 dwellings to be constructed after 2021. EIA REQUIRED

ii 2014/00798/FUL - (120m from site) 6MW Solar PV array. APPROVED

iii 2014/01103/NMA - (300m from site) 8MW Solar farm covering 19ha. APPROVED

iv 2014/00081/FUL - (50m from site) 7MW PV solar farm including one electrical substation, seven power inverter stations and other supplementary works. APPROVED

v 2015/00365/SC1 – (400m from site) 14ha Solar PV array. Screening decision – NO EIA REQUIRED. This application has been approved and is being constructed with a planned opening in March 2016.

8.8.3 Application 2014/01205/SC1 is a proposal for a housing development and while it is likely to include new or upgraded connections to the existing road network, in the vicinity of the north end of Five Mile Lane, it is over 1.5km from the main component of the Scheme (although 160m from the Sycamore Cross junction works). Due to its scale and location adjacent to existing housing, the topography changes between the proposed development and the main section of the Scheme, there is limited visual connectivity. The proposed development is not considered to have a cumulative impact on the character of the landscape or the visual amenity.

8.8.4 Application 2014/00798/FUL for a solar farm has been approved. Although close to the Scheme, the nature and scale of the development is considered to be such that while it may have its own impact on the character of the landscape it will be contained. It is not considered that the cumulative impacts would change the results of this assessment.

8.8.5 Application 2014/00798/FUL is for a minor amendment to an already approved solar farm. Although it is again close to the Scheme, the nature and scale of the amendment is considered to be such that it will not have any significant impact on the character of the landscape. The cumulative visual impacts of this amendment in combination with the road improvements are not considered to change the results of this assessment.

8.8.6 Application 2014/00081/FUL has been approved for a solar farm development towards the southern end of the Scheme. As above, the nature and scale of the

development is considered to be such that while it may have its own impact on the character of the landscape this will not change the results of this assessment. .

8.8.7 Although its location in the Waycock Valley is visible from more locations, the cumulative visual impacts of this solar farm development in combination with the road improvements are considered to be minor.

8.8.8 Application 2015/00365/SC1 has been approved for a solar farm located on land at Derwen Farm Llancarfan. The site covers approximately 14 ha and is located within the Nant Llancarfan SLA. The panels would reach up to 3m in height, at a 20-30 degree angle and the site would be enclosed by a 2m high security fence. The Screening Opinion Report states that the visual impact is not considered likely to have significant effects (i.e. more than local impacts). There are already solar farms constructed and approved within the locality. Given the screening potential of the surrounding topography and surrounding hedgerows and woodland to include Middleton Wood, Coed yr Ychan, Middleton Plantation and Welford Wood it is unlikely that the cumulative landscape or visual impacts would change the results of this assessment.

8.9 Summary & Conclusions

8.9.1 This chapter has assessed the impacts on landscape character and visual amenity of the area associated with the Scheme.

8.9.2 The wider area comprises rolling lowland with plateaux providing some long views including views across the Bristol Channel. The land cover is dominated by medium to large agricultural fields, mainly pasture set within managed hedgerows, blocks of woodland and steep sided wooded river valleys. The main form of settlement is farmsteads scattered across the landscape, with the town of Barry to the south. There is evidence of the historic importance of the landscape and there is a designated Historic Landscape to the west of the Scheme. The overall character of the area is one of agriculture and reflects changes in agricultural practices. It also contains evidence of agricultural diversity which continues in the form of smaller field sizes, barn conversions and infill housing, erection of solar farms and similar activities. Whilst there are some attractive views it is a working landscape and the sensitivity of the landscape to accommodate change is assessed as medium.

8.9.3 The ZVI for the Scheme is narrow and contained by the topography, the existing Five Mile Lane and woodland planting.

8.9.4 The landscape character assessment has assessed the impact of the Scheme on the landscape. The area has been divided into four landscape character areas as defined within the Landscape Character Assessment Study undertaken for the Vale of Glamorgan Council and based on LANDMAP data.

8.9.5 The construction of the Scheme would cause adverse effects where it directly impacts on a landscape character area especially where it is elevated or at junctions where there is greater landtake and severance of agricultural fields. Whilst it is acknowledged that the provision of a road in any rural landscape would have an impact on the landscape setting and visual amenity of the area, the scale of the impacts is reduced in this location due to the nature of the existing land uses and the existing infrastructure. The existing Five Mile Lane is well screened by existing hedgerows and the severed land between the two roads offers opportunities to reduce the impact of both roads and improve connectivity and the visual amenity. With mitigation, by the design year (year 15) there would be an impact of slight

adverse significance for LCA 1 Central Vale Ridges and Slopes and LCA 2 Upper Waycock Valley character areas. The remaining areas would be of neutral significance with mitigation.

8.9.6 The Scheme would result in a range of visual effects and impacts, determined by distance, aspect, elevation and intervening topography and vegetation. However given the local topography, existing woodland cover and the existing land uses the change in views would be limited and mitigation planting can be carried out. By the design year (year 15) and with mitigation planting in place there would be very limited impact on the visual amenity of the area and the main properties affected would be Whitton Lodge and Northcliff Cottage.

8.9.7 There would be approximately 1,538 linear metres (lm) of hedgerow lost to the Scheme and 6,236 lm provided by the Scheme. Therefore, there would be a considerable increase in field boundaries, species rich hedgerows and connectivity. There would be approximately 2.03ha of woodland lost to the Scheme and 6.83ha of proposed woodland planting along the Scheme.

8.9.8 A review on the Scheme's impact on plans and policies has been undertaken as part of the assessment. There would be an impact of the Woodland TPO Order No 1 1984 within Barry Woodlands SSSI. However there would be limited loss of woodland edge planting and it is recommended that the contractor liaises closely with the Vale of Glamorgan officers to ensure that there is minimal loss to important trees within the TPO and to identify trees, preferably within the ownership of the Council, for which the designation could be reassigned. The existing Five Mile Lane forms the boundary of Nant Llancarfan and Dyffryn Basin and Ridge Slopes SLAs and was chosen as such as a defensible boundary. Where the Scheme goes offline the Scheme may appear to be a preferred boundary to the Dyffryn Basin and Ridge Slopes SLA, however the Scheme does not compromise the value or features of either SLA.

9 NATURE CONSERVATION

9.1 Introduction

9.1.1 This chapter considers the ecological effects of the Scheme, by evaluating the baseline conditions on the Scheme route, assessing the potential impacts of the Scheme on key ecological receptors, outlining measures which will be taken to minimise these impacts and identifying and assessing the residual effects of the Scheme after implementation of mitigation measures. The key nature conservation legislation and policy driving the assessment are described, as are the survey and assessment methods used in the study.

9.1.2 Ecological designations are presented in Figure 9.1and the results of the Phase 1 Habitat Survey in Figure 9.2.

9.2 Legislative & Policy Context

European Legislation & Policy

Council Directive 2009/147/EC on the conservation of wild birds (EC Birds Directive)

9.2.1 Council Directive 2009/147/EC on the conservation of wild birds, known as the Birds Directive, provides a framework for the conservation and management of wild birds in Europe. The Directive sets broad objectives and restrictions on a wide range of activities, although the precise legal mechanisms for delivery are at the discretion of each Member State; in the UK, delivery is set via several different statutes (see National Legislation below).

9.2.2 The main provisions of the Directive include the following:

- The maintenance of populations of all wild bird species across their natural ranges;
- The identification and designation of Special Protection Areas for certain vulnerable species listed in Annex I to the Directive, as well as for all regularly occurring migratory species (Article 4); and
- The establishment of a general scheme of protection for all wild birds (Article 5).

Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive)

9.2.3 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, known as the Habitats Directive, was adopted in 1992. The main aim of this directive is to maintain biodiversity within the EU. Under this directive, Member States are obliged to maintain or restore the favourable conservation status of wild species and natural habitats listed on the Annexes to the Directive. In order to achieve this goal, Member States are required to carry out the following measures:

- Designation of Special Areas of Conservation (SACs) for habitats listed on Annex I and species listed on Annex II to the Habitats Directive. This measure also applies to the Birds Directive, for which Special Protection Areas (SPAs) must be designated (see above). Together, SACs and SPAs form the Natura 2000 network of sites;

- Design of conservation measures to appropriately manage Natura 2000 sites;
- Appropriate assessment of plans and projects likely to have a significant effect on the integrity of a Natura 2000 site. Projects likely to have a significant effect on the integrity of a Natura 2000 site may only be permitted if there are no alternatives, and there are imperative reasons of overriding public interest (IROPI) for the project. In such cases, compensatory measures will be required to ensure that the overall coherence of the Natura 2000 network is maintained;
- Member States must also encourage the management of landscape features not located within SACs or SPAs, but which may support the Natura 2000 network (as outlined in Articles 3 and 10);
- Member States must undertake surveillance of habitats and species listed in the Annexes to the Directive (Article 11);
- Member states must ensure strict protection of species listed on Annex IV of the Directive (Article 12 for animals and Article 13 for plants); and
- Member states must report on the implementation of the Directive every six years (Article 17). Reports must include the assessment of the conservation status of species and habitats listed on the Annexes to the Directive.

Council Directive 2004/35/EC on environmental liability with regard to the prevention and remedying of environmental damage (Environmental Liability Directive)

9.2.4 The Environmental Liability Directive (ELD), adopted in April 2004, aims to make those who cause damage to the environment (air, water, land and nature) legally and financially responsible for that damage. The ELD has been transposed into national legislation through the Environmental Damage (Prevention and Remediation) Regulations 2009.

9.2.5 The Directive covers environmental damage to the species and habitats protected under the Habitats Directive and the Birds Directive (see above). Damage to protected species and habitats is defined as “any damage that has significant adverse effects on reaching or maintaining the favourable conservation status of such habitats or species”. The Directive also covers land and water contamination.

9.2.6 For certain high-risk activities listed in Annex III to the Directive, liability for all three categories of environmental damage is covered and strict liability applies, i.e. operators are liable irrespective of whether or not they are at fault. The strict liability is subject to the “mitigating considerations” of Article 8 (4).

9.2.7 Operators of activities other than those listed in Annex III may also be liable for damage to protected species and natural habitats (although not for damages to land and water) if they are at fault or have been negligent. Consequently, if an operator of an un-listed activity causes biodiversity damage without being at fault, the operator will not be liable under the Directive.

9.2.8 An ‘operator’ is any person who controls an occupational activity. An ‘occupational activity’ is one carried out in the course of a business or an undertaking, regardless of its private or public, profit or non-profit character (Article 2 (7)).

9.2.9 Member States may extend the definition of ‘operator’ to include persons to whom decisive economic power over the functioning of such an activity has been delegated.

National Legislation & Policy

The Wildlife and Countryside Act 1981 (as amended)

9.2.10 The Wildlife and Countryside Act (WCA) is the primary piece of legislation relating to nature conservation in Great Britain. This act consolidates and amends existing national legislation to implement various EU conventions and directives.

9.2.11 The WCA governs the designation and protection of Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs), and the protection of various floral and faunal species.

9.2.12 Schedule 1 of the WCA lists protected bird species, Schedule 5 lists other protected animal species, and Schedule 8 lists protected plant species.

9.2.13 The WCA also outlines measures for preventing the establishment or spread of non-native species which may be harmful to native wildlife. The Act prohibits the release of animals and planting of plants listed in Schedule 9 of the Act.

Conservation of Habitats and Species Regulations 2010 (as amended)

9.2.14 The Conservation of Habitats and Species Regulations 2010 (as amended) transposes Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive) and Council Directive 2009/147/EC on the conservation of wild birds (EC Birds Directive) into UK law. These regulations provide for the protection of European protected species as listed in the EC Habitats Directive and the EC Birds Directive and the designation and protection of 'European sites' for the presence of certain species and habitats listed in these directives. The term 'European sites' refers to Special Areas of Conservation (SACs), designated for the presence of habitats listed under Annex I of the EC Habitats Directive or species listed under Annex II of the same directive, and Special Protection Areas (SPAs), designated for the presence of important populations of species listed under Annex I of the EC Birds Directive. These SACs and SPAs across the EU form the 'Natura 2000' network of sites.

Environmental Damage (Prevention and Remediation) Regulations 2009

9.2.15 Environmental Damage (Prevention and Remediation) Regulations 2009 transpose the Environmental Liability Directive (Council Directive 2004/35/EC) into national legislation for England and Wales. The term 'environmental damage' has a specific meaning in these regulations, covering only the most severe cases. Under these regulations, enforcing authorities must determine whether environmental damage has occurred, and decide on appropriate remedial measures for its reversal, for which the operator will be legally and financially responsible.

Countryside Rights of Way Act, 2000 (CRoW Act 2000)

9.2.16 Containing five Parts and 16 Schedules, the CRoW Act deals with public access to certain types of land, increases measures for the management and protection of Sites of Special Scientific Interest (SSSI) and strengthens wildlife enforcement legislation. The Act introduced a new nature conservation offence: the reckless disturbance of certain threatened species.

Natural Environment and Rural Communities (NERC) Act, 2006

9.2.17 The NERC Act provides that any public body or statutory undertaker in England and Wales must have regard to the purpose of conservation of biological diversity in the exercise of their functions. Of particular relevance are the following sections:

9.2.18 Section 40(1) imposes a duty to conserve biodiversity:

"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."

9.2.19 Section 40(3) of the Act explains that:

"Conserving biodiversity includes, in relation to a living organism or type of habitat, restoring or enhancing a population or habitat".

9.2.20 Section 42 of the Act comprises a list of species and habitats of principal importance in Wales – a key reference for all public bodies involved in operations that affect biodiversity in Wales.

The Protection of Badgers Act (1992)

9.2.21 The Protection of Badgers Act (1992) protects badgers against wilful killing, injury, ill-treatment and disturbance in their setts, and prohibits interference with or obstruction of badger setts. To avoid committing an offence, a licence may be obtained for appropriate works. Natural Resources Wales (NRW) is a licensing authority under the Protection of Badgers 1992 Act.

The Hedgerow Regulations (1997)

9.2.22 The Hedgerow Regulations aim to protect important hedgerows in the countryside by controlling their removal through a system of notification. It applies, in particular, to hedgerows over 20 metres long, or which meet another hedgerow at each end. The Regulations set out criteria that must be used by local authorities in determining which hedgerows are important.

Wild Mammals Protection Act (1996)

9.2.23 This act operates in parallel with legislation listed above conferring specific protection on rare or threatened mammal species, by protecting all wild mammals from any actions intended to cause unnecessary suffering.

Key Policies and Plans

9.2.24 The policies and plans most relevant to the Scheme in question are described below.

One Wales: One Planet (May 2009)

9.2.25 The One Wales: One Planet states that sustainable development in Wales means enhancing the economic, social and environmental wellbeing of people and communities, achieving a better quality of life for our own and future generations:

- In ways which promote social justice and equality of opportunity; and

- In ways which enhance the natural and cultural environment and respect its limits using only our fair share of the earth's resources and sustaining our cultural legacy.

9.2.26 It also states that sustainable development is a core principle within the National Assembly's founding statute, and the Welsh Government has a statutory duty under the Government of Wales Act 2006 (Section 79), to make a scheme setting out how they propose, in the exercise of their functions, to promote sustainable development.

9.2.27 Some of the actions set out in the document for achieving this relate to sustaining the environment, including the natural environment.

Environment Strategy for Wales

9.2.28 The Environment Strategy for Wales 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.

National Transport Plan Strategic Environmental Assessment (SEA) Statement and Addendum to Environmental Report, March 2010

9.2.29 This Strategic Environmental Assessment carried out as part of the National Transport Plan included as one of its objectives to ensure that biodiversity is valued, protected and enhanced. A number of sub-objectives were identified within this general biodiversity objective, comprising:

- Avoid transport related damage to designated wildlife sites and protected species;
- Manage the transport network in a way that protects and enhances biodiversity and avoids losses;
- Provide opportunities for all users of the transport system to access, and appreciate, natural heritage;
- Reduce negative impacts of transport on habitats, fauna and flora, including damage and/or fragmentation of designated sites, habitats and protected species, and encourage the enhancement of any positive effects;
- Minimise wildlife casualties due to transport; and
- Help achieve objectives of the UKBAP Action Plan.

Technical Advice Note (TAN) 5, Nature Conservation and Planning (2009)

9.2.30 TAN 5 provides advice to local planning authorities on the application of the law relating to planning and nature conservation and its impact within the land use planning system. The most recent revision of TAN 5 brings it in line with the strategic policy in Planning Policy Wales (PPW, issued in 2002 and revised in 20148.13) and advises how planning policy with regard to ecology needs to be interpreted to be in compliance with Planning Policy Wales.

9.2.31 TAN 5 provides advice on the following:

- Positive planning for nature conservation;
- Nature conservation and Local Development Plans;

- Nature conservation in development management procedures;
- Development affecting protected internationally and nationally designated sites and habitats; and
- Development affecting protected and priority habitats and species.

Planning Policy Wales - Edition 6 (February 2014)

9.2.32 Of particular relevance to this assessment is Chapter 5 - Conserving and Improving Natural Heritage and the Coast which outlines the Welsh Government's commitments to Nature Conservation. The Welsh Government's objectives for the conservation and improvement of the natural heritage are to:

- Promote the conservation of landscape and biodiversity, in particular the conservation of native wildlife and habitats;
- Ensure that action in Wales contributes to meeting international responsibilities and obligations for the natural environment;
- Ensure that statutorily designated sites are properly protected and managed;
- Safeguard protected species; and to
- Promote the functions and benefits of soils, and in particular their function as a carbon store.

Vale of Glamorgan Local Development Plan, 2011-2026

9.2.33 Strategic Policy SP 10 – Built and Natural Environment of the VoG Local Development Plan 2011-2026 states that *'Development proposals must preserve and where appropriate enhance the rich and diverse built and natural environment and heritage of the Vale of Glamorgan…including sites designated for their local, national and European nature conservation importance...'*

9.2.34 Managing Growth Policy MG 19 – Sites of Importance for Nature Conservation states that '*Development which has an unacceptable impact on sites of importance for nature conservation (SINCs) will not be permitted*'.

9.2.35 Paragraph 6.126 of the Plan states that: '*Development will not be permitted where it would have an unacceptable impact upon the particular features for which a SINC has been identified. However there may be instances where the benefits of a particular development outweigh the importance of the SINC, for example where a highway scheme resolves local safety issues or where significant employment is to be provided. In such instances mitigation will be required to compensate for the adverse impact on the site. SINCs within the Vale of Glamorgan have been identified in accordance with the Welsh Government's criteria "Wildlife Sites Guidance Wales: A Guide to Develop Local Wildlife Systems in Wales; Biodiversity Partnership" following extensive investigation and are detailed on the Proposals Map. Further guidance in relation to nature conservation is available in PPW and TAN 5 - Nature Conservation and the Council's Biodiversity and Development Supplementary Planning Guidance (August 2010). Development proposals which affect SINCs will be assessed in accordance with Policy MD 10*'.

9.2.36 Managing Development Policy MD10 – Promoting Biodiversity states the following:

'New residential, commercial and community development will be required, where possible, to positively contribute to biodiversity interests within the Vale of Glamorgan by:

- *Maintaining and enhancing existing important biodiversity features such as woodland, trees, hedgerows, wetland, watercourses, ponds, green lanes, geological features and habitats; and*
- *Incorporating new biodiversity features either on or off site to enable a net gain in biodiversity interest. Where it is demonstrated that the impact of development on biodiversity cannot be addressed on site, developers will be required to provide alternative off-site compensation to maintain net biodiversity interest.*
- *Demonstrating how they maintain features of importance for ecological connectivity, including wildlife corridors and 'stepping stones' that enable migration, dispersal and/or genetic exchange.*

Where proposals have a negative impact on sites shown to be important for biodiversity, developers will need to demonstrate that the development could not be located elsewhere.

United Kingdom Biodiversity Action Plan (UKBAP)

9.2.37 As a signatory to the Convention on Biological Diversity (also known as the Rio Convention), the UK has pledged to develop national strategies for the conservation and sustainable use of biodiversity.

9.2.38 In response to this pledge, the UK produced a document entitled Biodiversity: The UK Action Plan 1994. This document described the biodiversity resource of the UK and identified a number of vulnerable habitats and species for which individual Biodiversity Action Plans (BAPs) were to be prepared. A total of 1150 Priority Species and 65 Priority Habitats have been identified to date (last updated in 2007) as those requiring the most protection.

Local Biodiversity Action Plans (LBAPs)

9.2.39 A report entitled *Biodiversity: The UK Biodiversity Steering Group Report*, published in 1995, recognised the fact that in order to properly implement the UKBAP at a local level, it would be necessary for local authorities throughout to produce Local Biodiversity Action Plans (LBAPs). In these LBAPs, habitats and species listed as 'Priority' in the UKBAP occurring within the area in question are identified, and 'Action Plans' are produced for each. The Vale of Glamorgan LBAP is of most relevance to the Scheme, as is summarised in Table 9.1.

Table 9.1: Vale of Glamorgan Habitat and Species Action Plans

Habitat Action Plans	Species Action Plans
• Coastal & floodplain grazing marsh	**First Phase (completed)**
• Purple moor grass and rush pasture	• Water vole
• Ancient and/or species rich hedgerows	• Brown hare
• Reed beds	• European otter
• Lowland heathland	• Chough
• Fens	• Great crested newt

Table 9.1: Vale of Glamorgan Habitat and Species Action Plans

Habitat Action Plans	Species Action Plans
• Cereal field margins	• Marsh fritillary
• Mesotrophic lakes	• High brown fritillary
• Eutrophic standing waters	• Shore dock
• Lowland calcareous grassland	• Maidenhair fern
• Lowland hay meadow	**Second phase (completed)**
• Lowland wood pastures and parklands	• Dormouse
• Wet woodlands	• Pipistrelle bat
• Beech and yew woodland	• Bats (other species)
• Maritime cliff and slopes	• Aquatic warbler
• Coastal sand dunes	• Skylark
• Coastal vegetated shingle	• Bittern
• Saltmarsh	• Song thrush
• Saline lagoons	• Lapwing
	• Grey Partridge
	• Nightjar
	• Chalk Carpet Moth
	• Staurothele (lichen)
	Third Phase (proposed)
	• Grey Heron
	• Barn Owl
	• Tree Sparrow
	• Dartford Warbler
	• Peregrine Falcon
	• Allis and Twaite Shad
	• Other Moths
	• Other Butterflies including Grizzled Skipper, Small Blue, Wood White, Dark Green Fritillary, Small Pearl-bordered Fritillary, Dingy Skipper, Silver-washed Fritillary and Grayling
	• Downy Emerald dragonfly
	• Shepherds Needle
	• True Service Tree
	• Nettle-leaved bellflower
	• Hoary Stock
	• Horseshoe Vetch
	• Monkshood
	• Nit-grass
	• Red Hemp Nettle
	• Tuberous Thistle
	• Purple Gromwell
	• White horehound
	• Opposite-leaved pondweed
	• Stinking hellebore
	• Green-winged Orchid

9.3 Assessment Methodology

Survey Methods

9.3.1 Methods for ecological survey work conducted as part of the assessment are described below, and where appropriate, in Appendices 9.1 to 9.9. The results from consultation about the Scoping Study are outlined below.

Scoping Study and Study Area

9.3.2 The EIA Scoping Report (Appendix 1.1) defined the study corridor, survey extent and the scope of the assessment of baseline ecological conditions, based upon guidance within DMRB Volume 11, Section 2; DMRB Volume 11, Section 3, Part 4; DMRB Volume 11, Section 4, Part 1; and supplemented by Interim Advice Note (IAN) 130/10 (not adopted in Wales).

9.3.3 For assessing the implications of the Scheme on European designated sites, information was obtained for a radius of 2km, extended to 5km radius for bat species (as these species are wide-ranging so effects may be felt over a wider area). For assessing the implications of the Scheme on nationally designated sites and protected species, desk study information was obtained for a radius of 2km. For assessing the general impacts of the Scheme, a survey corridor of 250m either side was used except for more wide ranging species such as Great Crested Newts and bats where a corridor of 500m was used.

9.3.4 The Scoping Study showed that the Scheme is set within an agricultural landscape comprising mostly of improved, cattle, horse or sheep-grazed pasture and arable land separated by well-managed native hedgerows and scattered trees. There are a number of broad-leaved woodland blocks along the route corridor which link up with the hedgerow network. A few standing and open water habitats also occur within the study area. Between the River Waycock and Waycock Cross are several woodland blocks which fall within the Barry Woodlands SSSI. Protected species that could potentially be affected include amphibians, reptiles, birds, bats, dormice, water voles, aquatic invertebrates and the riverine habitats of the River Waycock. These species are potentially of high value.

9.3.5 To determine the impacts of the Scheme, the Scoping Study identified the need for field surveys to include an Extended Phase I Habitat survey in addition to the following targeted surveys:

- Amphibian survey (including great crested newts)
- Aquatic invertebrate surveys
- Bat activity surveys
- Bat roost inspections / tree climbing inspections
- Dormouse nest tube survey
- Water vole survey

9.3.6 The Scoping Study considered that bird surveys would not be necessary, and it was proposed to use updated records from the South-East Wales Biodiversity Records Centre (SEWBReC) and if necessary contact local recording groups.

9.3.7 Consultation on the EIA Scoping Report was carried out with the Vale of Glamorgan Ecologist and NRW in July / August 2014. These consultations endorsed the general approach but also indicated that surveys for birds, especially ground-nesting species such as lapwing and skylark, and species such as barn owl and yellowhammer, should be carried out; that effects on otters should be included; and that if habitat loss from the Barry Woodlands SSSI habitat was unavoidable then an appropriate and robust mitigation package would be required.

Desktop Survey

9.3.8 Desktop studies for the Scheme were carried out from 2008 to 2010 (Soltys-Brewster Consulting 2011a) and were updated in 2014, focusing on the current Scheme. Existing data about protected species and habitats were derived from SEWBReC, the NRW website and a review of reliable online resources such as the NBN Gateway. These studies highlighted any designated areas within and adjacent to the study area and any protected species that have been recorded in the area previously.

Phase 1 and Extended Phase 1 Habitat Surveys

9.3.9 A Phase 1 Habitat survey was undertaken in 2008 and 2009 for the Stage 1 and Stage 2 assessments (Soltys-Brewster Consulting 2011a). This was updated in June 2014 as an extended Phase 1 Habitat survey concentrating on the Scheme alignment. The main differences were found to be in classification of some grasslands previously noted as improved pasture, which were found to be more diverse in 2014. All habitats within 250m of each of the Scheme were mapped following the guidelines given within the Phase 1 Habitat Survey Handbook. Target notes were taken as appropriate.

9.3.10 No specific hedgerow surveys were carried out, but hedgerow data were collected during the Phase 1 Habitat surveys in 2008 and 2009 and hedges were assessed specifically for their habitat quality for dormice in 2014.

NVC Survey

9.3.11 An NVC, or British Plant Communities, survey was carried out on the woodlands adjacent to the Waycock Road in Barry Woodlands SSSI in 2010 (Soltys-Brewster Consulting 2011b; Appendix 9.9) following the standard method (Rodwell 1991-2000). 15 quadrats were recorded in three woodland blocks and were used to determine the vegetation type.

Vascular Plants, Bryophytes and Lichens

9.3.12 Neither the desk study nor the Phase 1 habitat survey identified any issues relating to vascular plants, bryophytes or lichens so no detailed surveys were undertaken.

Invasive Plant Surveys

9.3.13 The presence of invasive plants listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) was noted during each of the Phase 1 Habitats surveys.

Aquatic Invertebrates

9.3.14 Surveys for aquatic invertebrates were carried out in September 2014. The aim of the aquatic invertebrate sampling was to obtain baseline information on water quality

which could be used to assess the water courses along the Scheme, and monitor changes in the future. After reviewing all watercourses in the catchment, four sampling locations covering the three features with permanent running water were selected for survey (see Figure 9.3).

9.3.15 Site 1, a small stream flowing south towards Sutton Wood, was sampled downstream of the proposed route. This very small stream runs in a deep ditch with a hedge covering most of the water course. Site 2 was in the River Waycock upstream of Five Mile Lane and of the sewage outfall. The river is quite broad and shallow with a relatively stony bottom and shaded by trees. Site 3 was about 30m downstream of Five Mile Lane, in relatively fast flowing shallow water with a stony bottom and shade by trees. Site 4 was the small stream downstream of the Welsh Hawking Centre running northwest along the north-eastern side of Five Mile Lane. It is a narrow stream shaded by trees.

9.3.16 Aquatic invertebrate sampling was carried out by APEM Ltd. on 12th September 2014 following the standard protocol detailed in the Environment Agency's handbook, BT001 and the updated Operational Instruction 018_08 (Environment Agency, 1999; Environment Agency, 2009). At each sampling location, a single three-minute kick/sweep sample was collected to encompass all the in-stream habitats present at the sampling location in proportion to their occurrence over the three-minutes sampling time. In addition, a further one-minute hand search of submerged stones, woody debris, plants, tree roots and other structures was undertaken to capture any animals that might have evaded the kick/sweep sample. Samples were preserved in 90% Industrial Methylated Spirits solution on site for transport to APEM's Cardiff laboratory. All samples were labelled both internally and externally with a unique sample identifier which will then be progressed through the laboratory database system. The samples were analysed to family level and a BMWP (Biological Monitoring Working Party) score and ASPT (Average Score Per Taxon) score calculated using the standard methods.

9.3.17 A BMWP score is an index for measuring the biological quality of rivers using species of macroinvertebrates as biological indicators. The score is calculated from the sum of pollution tolerance scores from the macroinvertebrate families represented in the samples. BMWP scores of 0 – 10 indicate very poor heavily polluted water, scores of 11 – 40 indicate poor polluted water, scores of 41 – 70 indicate moderate polluted water, scores of indicate 71 – 100 good clean but slightly impacted water, and scores over 100 indicate very good unpolluted water.

9.3.18 The ASPT score is an average of the tolerance scores of all macroinvertebrate families found in the samples and ranges from 0 (low quality) to 10 (high quality). ASPT scores of 3.9 or less indicate very poor heavily polluted water, scores of 4-4.9 indicate poor polluted water, scores of 5-5.9 indicate moderate polluted water, scores of 6-6.9 indicate good clean but slightly impacted water and scores over 7 indicate very good unpolluted water.

White-clawed Crayfish

9.3.19 The River Waycock, which is crossed by the Scheme, was identified as potentially supporting White-clawed Crayfish (*Austropotamobius pallipes*). This species has been recorded historically nearby in South Wales. In order to determine the presence/absence of crayfish in the river, a survey was undertaken on 3rd August 2014, which is during the optimal period for crayfish surveys (i.e. mid-July to mid-September). The survey date was chosen because it followed a period of several

days with little or no rainfall, so that flows in the stream were low to enable easy access and searching.

9.3.20 Surveys were conducted in accordance with the latest guidance available on the UK crayfish website, professional channel, hosted by Buglife (https://www.buglife.org.uk/campaigns-and-our-work/crayfish-professionals). A full description of the methods used is provided in the survey report for this species (see Appendix 9.7). No torch surveys were considered necessary as all the features present in the Waycock could be searched effectively by hand during the day. In cases where features cannot be searched effectively (e.g. dense bank-side tree-roots, deep water, deep cavities in stonework or burrows in the riverbank) high power torches can be used to scan the channel and its banks to look for crayfish foraging at night but this was not considered necessary.

Fish

9.3.21 No specific fish studies were carried out for the Scheme, but notes were made of fish species encountered during the river corridor survey carried out by Soltys-Brewster in 2008, and the White-clawed Crayfish survey conducted by TACP in 2014.

Amphibians

9.3.22 Initial surveys for Great Crested Newt were carried out by Soltys-Brewster as part of the Interim Scheme Assessment Report (Soltys-Brewster Consulting 2011a). Following a site walk-over in March 2008 to verify the presence/potential suitability of water bodies identified from desk study, six ponds were subject to further survey work between March and May 2008.

9.3.23 Further surveys were carried out by TACP in 2014. In these surveys, ponds which are likely to be directly affected by the Scheme (i.e. directly under or adjacent to the Scheme footprint) were concentrated on.

9.3.24 All surveys were based on techniques described by English Nature (2001) and involved a series of evening surveys to establish likely presence/absence of Great Crested Newts (*Triturus cristatus*) and other amphibians. A full description of the survey methods used is provided in the survey report for Great Crested Newts (see Appendix 9.1).

Reptiles

9.3.25 There are historical records (SEWBReC data) of Common Lizards (Lacerta vivipara), Adders *(Vipera berus)* and Grass Snakes (*Natrix natrix) within 2 km of the* Scheme.

9.3.26 Soltys-Brewster carried out reptile surveys in the northern section of the study area between May and July 2008, and in the southern section of the study area in the southern part of the Scheme in August/September 2009 (Soltys-Brewster Consulting 2011a). Small populations of slow worm (Anguis fragilis) and grass snake (Natrix natrix) were noted at the northern end of the Scheme.

9.3.27 No specific reptile surveys were conducted, and the majority of the site is considered low potential for reptiles, as it is well grazed or arable land with few suitable features present. The Vale of Glamorgan County Ecologist recommended that reptiles should be assumed as present in all locations with appropriate habitats for these species. Areas of suitable habitat were identified during the Scoping and the Extended Phase 1 Habitat surveys conducted by TACP in 2014 to inform mitigation design.

Breeding Birds

9.3.28 Breeding bird surveys were conducted in 2008 by Soltys-Brewster Consulting as part of the Interim Scheme Assessment Report. Surveys were conducted in June and July 2008 and the survey protocol used was based on the Breeding Bird Survey (BBS) methodology (adapted field method (Bibby *et al*., 1992; BTO, 1995)). Each survey visit commenced at 06:00 and finished at 09:00 and involved transects running parallel along both sides of the road corridor. The direction of the routes was reversed on the second survey visit to avoid disturbance biases.

9.3.29 The timing of the consultation responses (refer to Section 9.3.7) in July/August 2014 meant that is was impractical to implement breeding bird surveys in 2014 as the main breeding season is late March to July. The assessment was therefore based on the 2008 Soltys-Brewster data, SEWBReC records and on birds seen and heard during other field surveys conducted for the Scheme in 2014 by TACP. Full surveys can be carried out in 2016 if required.

Badger

9.3.30 The South East Wales Biodiversity Records Centre (SEWBReC) was contacted and protected species records obtained to identify any existing information on badgers within the study area. In addition to contacting SEWBReC, the local badger group was contacted for records of badgers in the area. No specific field surveys for badger were carried out for the Scheme, but during the Scoping Survey and Extended Phase 1 Surveys, notes were made of any habitats suitable for badgers within the study area. Signs of badger activity, such as setts, latrines, paths or feeding signs, were also recorded. Signs of badger activity recorded during surveys conducted by Soltys-Brewster in 2008 were also taken into account.

Water Vole

9.3.31 The EIA Scoping study identified numerous habitats suitable for water voles (*Arvicola amphibius*), and specific surveys for the presence of this species were conducted on 30th June and 2nd July 2014 (half day each). Surveys were conducted following the guidance in the *Water Vole Conservation Handbook Second Edition* (Strachan and Moorhouse, 2006) by searching for the following characteristic signs:

- Latrines – piles of characteristic droppings;
- Footprints – characteristic shape and size;
- Tunnel entrances – both above and below water level;
- Pathways in vegetation – often running between tunnels and vegetated waterside habitat;
- Cropped grass around tunnel entrances – a distinctive sign of breeding females;
- Feeding remains – large chewed segments of vegetation with distinctive teeth marks.

9.3.32 A full description of the methods used in the water vole survey conducted by TACP is provided in the survey report for this species (see Appendix 9.2).

Dormouse

9.3.33 Six areas within or near the Scheme footprint identified as being of good potential dormouse habitat were targeted for surveys using nest tubes in 2014. A total of 278

nest tubes were installed at 6 different locations. Generally, 50 tubes were used at each location, but where there was insufficient space, less were used.

9.3.34 Nest tubes were attached to horizontal branches using cable ties, at 10-20m intervals throughout the woodland / hedgerow, and were left in place for five months. The tubes were checked for occupancy by dormouse in July and September.

9.3.35 In addition to the direct survey methods described above, the likely suitability of habitats on the route of the Scheme for dormice was also investigated by assessing all hedgerows, woodlands and scrub within the footprint of the Scheme. These surveys were undertaken during the Scoping Study field visit. Categories were assigned to habitats, based on several factors, including diversity of food plant species, connectivity to other habitats, structure and management, as described below:

Category A: optimal habitat for dormice, with a high diversity of food plants, sympathetic management, good structural complexity for creation of nest sites and links to other suitable habitats;

Category B: suitable habitat for dormice, but with a lower diversity, poorer structure, less sympathetic (but not entirely adverse) management, or more isolated;

Category C: sub-optimal habitat for dormice, lacking one or more of the optimal characteristics described above;

Category D: suitable only for dispersal by dormice, due to low diversity or unsympathetic management, these features may be used by dormice dispersing from adjacent habitats but are unlikely to support resident dormice;

Category E: unsuitable for dormice, comprising fences or ditches rather than hedgerow field boundaries.

9.3.36 The approximate extent of habitat affected by the Scheme was also recorded.

9.3.37 During the July 2014 nest tube check, a nut search was carried out at one of the survey sites, Betty Lucas Wood, which was considered the most likely to contain dormice, due to the suitability of habitat. This search comprised five 20 minute searches of 10m by 10m areas below heavily fruiting hazels. The hazel nut survey was carried out outside optimum time (mid-August-December) but nuts persist on the woodland floor for over a year though the tooth marks become progressively less indicative of which mammal gnawed the nut as they decay. The hazel coppice at Betty Lucas Wood, which is about 400 m north of the Scheme, presented the only opportunity to use a second survey method in addition to nest tubes to determine presence of dormice in the area.

9.3.38 Full details of the methods used in dormouse surveys conducted for the Scheme are included in the Dormice survey report (Appendix 9.3).

Otter

9.3.39 As with reptiles, the presence of otters within the study area was assumed and so no specific surveys were undertaken for this species. However, during the Scoping Survey, the Extended Phase 1 Survey and the water vole survey, notes were made of any habitats suitable for otter within the study area. Signs of otter activity, such as spraints, paths, holts or feeding signs, were recorded.

Bats

9.3.40 Results from bat surveys undertaken in 2008 and 2009 to inform the A4226 Five Mile Lane Interim Scheme Assessment Report (Soltys-Brewster Consulting 2011a) were reviewed as part of the current study.

9.3.41 Additionally, further activity surveys were carried out by TACP in 2014. During the initial site visits conducted for the Scoping Study, note was made of any habitats suitable for bats within the study area, and five locations were chosen for bat detector surveys.

9.3.42 Survey methods and timing drew on the best practice guidance given in Hunt (2012). All locations were surveyed on three occasions during the active period for bats in May, July and September 2014.

9.3.43 The locations were surveyed using Pettersson D240x time expansion bat detectors with Roland recording devices or AnaBat II frequency division detectors. Wherever possible, behaviour of bats observed was recorded in order to identify possible commuting routes. Bat calls recorded in the field were later analysed using Bat Sound or AnalookW software and species identification made with reference to Russ (2012).

9.3.44 Trees judged as having potential to support roosting bats during the extended Phase 1 habitat survey were surveyed. The categories of trees were assessed from ground level using Bat Conservation Trust (BCT) guidelines. Any trees categorised as Category 1, 1* and 2 were then subject to an aerial survey by climbing.

9.3.45 Full details of methods used in the study are provided in the bat survey reports included in Appendix 9.4 and Appendix 9.5.

Harvest Mouse

9.3.46 No specific surveys were carried out for this species. However, SEWBReC data were checked for records of this species within 2km of the Scheme.

Evaluation Methods

9.3.47 The DMRB Volume 11, Section 2, Part 5 and IAN 130/10 provide a method for the consideration of significance of impacts for those receptors identified as requiring detailed impact assessment. IAN 130/10 has not been formally adopted in Wales but is considered to provide the most relevant guidance for assessing the ecological impacts of highways schemes, and is used as the reference source here.

9.3.48 Guidelines on ecological impact assessment note that it is difficult to devise valuation criteria that can be applied consistently to all designated sites, habitats and species, and recommend teasing apart the different values that can be attached to each ecological receptors. It is beneficial to give examples of the types of criteria used in the valuation process, summarised in Table 9.2, which has been adapted from a similar table included in several of the current and earlier versions of the CIEEM (2016) guidelines.

Table 9.2: Examples of Criteria used to Evaluate Ecology Receptors

Level of Value	Examples of Definitions
International	An internationally important site, e.g. Special Protection Area (SPA), Special Area of Conservation (SAC) or Ramsar site (or

Level of Value	Examples of Definitions
	a site considered worthy of such designation); a regularly occurring population of an internationally important species (listed on Annex IV of the Habitats Directive); 1% of the known international population of a particular species.
National (UK/Wales)	A nationally designated site, e.g. SSSI, or a site considered worthy of such designation; a viable area of a habitat type listed in Annex 1 of the Habitats Directive, or smaller areas of such habitat which are essential to maintain the viability of a larger whole; any regularly occurring population of a nationally important species, e.g. listed on Schedules 5 and 8 of the Wildlife & Countryside Act (1981); a feature identified as of priority in the UK BAP; 1% of the known UK population of a particular species; ancient woodland.
County (i.e. Vale of Glamorgan)	Areas of internationally or nationally important habitats which are degraded but are considered readily restored; viable areas of key habitat identified in Vale of Glamorgan BAP, or smaller areas of such habitat which are essential to maintain the viability of a larger whole; a site designated as a Site of Importance for Nature Conservation (SINC) or Local Nature Reserve (LNR); a regularly occurring, locally significant number of a nationally important species; 1% of the known population of a particular species within the county.
District	Areas of habitat identified in a sub-county (district/borough) or in the relevant Natural Area profile; district sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves; sites or features that are scarce within the district or borough or which appreciably enrich the district or borough habitat resource; a diverse or ecologically valuable hedgerow network; a regularly occurring population of a species which is large enough to be considered to be of district level importance.
Local	Areas of internationally or nationally important habitats which are degraded and have little or no potential for restoration; a good example of a common or widespread habitat in the local area; a regularly occurring population of a species which is large enough to be considered to be of local level importance.
Neighbourhood (site and its vicinity)	Areas of heavily modified or managed vegetation of low species diversity or low value as habitat to species of nature conservation interest; common and widespread species
Negligible	No intrinsic nature conservation value associated with habitat. Generally these are areas of hard standing or buildings with no nature conservation interest.

9.3.49 DMRB Volume 11, Section 2, Part 5 and IAN 130/10 provide a method for the consideration of significance of effects on receptors identified as requiring detailed assessment) which has been applied in this assessment.

9.3.50 Ecological receptors are usually nature conservation sites, habitats and species. Impacts can be permanent or temporary, direct or indirect, and can be cumulative. These factors are brought together to assess the magnitude of the impact on particular valued ecological receptors and, wherever possible, the magnitude of the impact is quantified. Professional judgment is then used to assign a value to the effects on the receptors to one of four classes of magnitude, defined in Table 9.3.

Table 9.3: Definitions of Magnitude of Environmental Impacts

Magnitude	Definition
High	A permanent or long-term effect on the extent or size or integrity of a site, habitat, species assemblage or community, population or group. If adverse, this is likely to threaten its sustainability; if beneficial, this is likely to enhance its conservation status.
Medium	A permanent or long-term effect on the extent or size or integrity of a site, habitat, species assemblage or community, population or group. A short-term effect which will adversely affect the integrity of a receptor in a permanent manner. If adverse, this is unlikely to threaten its sustainability; if beneficial this is likely to be sustainable but is unlikely to enhance its conservation status.
Low	A permanent, long-term reversible or short-term effect on a site, habitat, species assemblage or community, population or group whose magnitude is detectable but will not threaten/change its conservation status.
Negligible	A short-term reversible effect on the extent, size or integrity of a site, habitat, species assemblage or community, population or group that is within the normal range.

9.3.51 Significance of effects will be deduced from assessing the value of the receptors against any residual impact (taking into account mitigation). In line with the guidelines set out within the DMRB, significance will be addressed as neutral, slight, moderate, large or very large as set out in Table 9.4.

Table 9.4: Significance of Effects (summarised from IAN 130/10)

Significance Category	Typical Descriptors
Very Large	An impact on one or more receptor(s) of International, European, UK or National Value
Large	An impact on one or more receptor(s) of Regional Value
Moderate	An impact on one or more receptor(s) of County Value
Slight	An impact on one or more receptor(s) of Local Value
Neutral	No significant impacts on key nature conservation receptors

9.3.52 The following are considered when the potential impacts are assessed:

- Probability of occurrence: certain, probable, unlikely
- Complexity: whether direct, indirect, cumulative
- Extent: area measures and percentage of total loss, size
- Description of level of severity of effect
- Duration: permanent or temporary in ecological terms
- Timing and frequency: important seasonal and/or life-cycle constraints and any relationship with frequency considered
- Reversible or not reversible
- Beneficial (positive) or adverse (negative)

9.4 Baseline Conditions

Statutorily Designated Sites

9.4.1 Sites designated for their ecological significance within a 2km buffer of the Scheme are shown on Figure 9.1 and are described in Table 9.5.

Table 9.5: Statutorily-designated Sites within 2km of the Scheme

Statutory site	Description of site	Reason for designation	Distance from Scheme
Barry Woodlands SSSI	Series of 14 separate woodland blocks, some connected by hedgerows	Semi-natural broadleaved woodland. Best example of this habitat and one of the most species-rich woodlands in Wales	0km, directly affected
Cliff Wood - Golden Stairs SSSI/Cliff Wood Local Nature Reserve	Mixed woodland with purple gromwell *Lithospermum purpureocaeruleum* which is restricted to a few sites in Wales	Best example of mixed woodland of this type and ungrazed ground flora in Wales	c. 1.5 km southwest of Scheme, not affected
Nant Whitton Woodlands SSSI/Coed Garnllwyd Wildlife Trust Reserve	Narrow woodland on valley side. Includes the uncommon plants Herb Paris *Paris quadrifolia* and Adder's-tongue *Ophioglossum vulgatum*	Broad-leaved woodland	c. 0.9 km west of Scheme, not affected
Cwm Talwg Local Nature Reserve	A series of four small units of woodland, stream, hedge and grassland	Broad-leaved woodland and grassland	c. 0.5 km southeast of Scheme, not affected

9.4.2 There are no European designated sites within 2km of the Scheme. There is one European-designated site within 30km of the Scheme whose designation includes bats, the Exmoor and Quantocks Oakwoods SAC (Barbastelle and Bechstein's bats). This SAC is located about 28 km to the south across the Bristol Channel and the Scheme will not affect these bat populations.

9.4.3 Within 2 km of the Scheme, there are three SSSIs (Figure 9.1 and Table 9.5). The Barry Woodlands SSSI complex is bisected by Five Mile Lane and two blocks of woodland are directly affected. Two other woodlands SSSIs, the Nant Whitton Woodlands SSSI and the Cliff Wood - Golden Stairs SSSI (the latter also designated as Cliff Wood Local Nature Reserve), are not affected.

9.4.4 Within 2 km of the Scheme there are two Local Nature Reserves (LNRs), neither of which are directly affected by the Scheme (Figure 9.1 and Table 9.5). Cliff Wood LNR is part of Cliff Wood - Golden Stairs SSSI (as above), and also part of Porth Kerry Country Park. Cwm Talwg LNR is a small area of deciduous woodland on the edge of Barry managed by Cwm Talwg Woodlands Residents' Group.

Non-statutory Nature Conservation Sites

9.4.5 One South and West Wales Wildlife Trust nature reserve is located within 2km of the Scheme. Coed Garnllwyd Nature Reserve is part of the Nant Whitton Woodlands SSSI (cf. above) and is not affected by the Scheme.

9.4.6 There are 58 Sites of Importance for Nature Conservation (SINCs) within 2km of the Scheme, designated by the Vale of Glamorgan (Vale of Glamorgan, 2013). Those most likely to be affected (generally considered as those which are within 250m of the Scheme or those with species of particular conservation importance, such as Great Crested Newt) are listed in Table 9.6.

Ancient Woodland

9.4.7 There are 51 areas designated as ancient woodlands within 2 km of the Scheme, most of which are not directly affected. Ancient woodlands are sites that are believed to have had a continuous woodland cover for at least 400 years and have high nature conservation value compared to recent woodlands (Forestry Commission, 2011). Ancient woodlands may be described as being of one of four types:

- Ancient Semi-Natural Woodlands (ASNW), which are broadleaved woodlands comprising mainly native tree and shrub species which are thought to have existed for over 400 years
- Plantation on Ancient Woodland Sites (PAWS), which are sites thought to have been continuously wooded for over 400 years but have been replanted with native or non-native species (commonly conifers). They currently have a canopy of more than 50% non-native conifer tree species
- Restored Ancient Woodland Sites (RAWS), which are woodlands predominately broadleaved and continually wooded for over 400 years. They have had a period when the canopy will have been more than 50% non-native conifer tree species and now have a canopy cover of more than 50% broadleaved
- Ancient Woodland Sites of unknown category (AWSU), which are woodlands of unknown status but may be ASNW, RAWS or PAWS.

9.4.8 The only ancient woodlands directly affected by the Scheme are designated as part of the Barry Woodlands SSSI (as above). The woodland by Barry College is listed as Ancient semi-natural woodland (ASNW). Middleton Plantation to the west of the Waycock Road is listed as Restored Ancient Woodland (RAWS). The block of scrub north-west of Waycock Cross is listed as an Ancient Woodland Site of unknown category (AWSU), has recently been cleared and may be best regarded as no longer ancient woodland.

Table 9.6: Sites of Importance for Nature Conservation (SINCs) which may be affected by the Scheme

SINC Number and Name	Description of Site	UK BAP priority habitat/SINC selection criteria	Distance from Scheme	Affected by Scheme?
106 Amelia Trust Woodland Pond	Pond supporting diverse marginal vegetation and amphibian assemblage	Ponds/H13:2 Ponds	188m west of Scheme.	Not directly affected.
107 Amelia Trust Dew Pond	Pond supporting breeding Great crested newts	Ponds/S3 Amphibians: Great crested newts	Side road tie-ins come within approximately 400m of the pond.	Not directly affected; the pond itself is approximately 500m from the main Scheme and separated by the existing Five Mile Lane which acts as a significant barrier to potential eastward movement of newts.
220 Land South of Blackland Farm	Two blocks of predominantly ancient semi-natural broadleaved woodland	Lowland mixed deciduous Woodland/H1:3 Native woodlands	0km	Very narrow strip adjacent to road up to 4m wide, total 0.016 ha
221 Land North of Whitton Rosser Farm	Species-rich purple moor-grass fen meadow	Purple moor-grass and rush Pastures/ H9:3 Purple moor-grass and rush pastures	12m from the Scheme at nearest point, although separated from it by SINC 220	Not directly affected.
222 Land North-east of Whitton Rosser Farm	Semi-natural broadleaved woodland	Lowland mixed deciduous woodland/H1:3 Native woodlands	0km	Directly affected. The Scheme passes through the western end of this site – total area lost 0.09226 ha.
227 Land South of Little Hamston	Ancient semi-natural broadleaved woodland	Lowland mixed deciduous woodland/H1:3 Native woodlands	196m from the Scheme.	Not directly affected.
281 Land to west of Northcliff Farm	Predominantly ancient semi-natural broadleaved woodland	Lowland mixed deciduous woodland/H1:3 Native woodlands	146m from Scheme.	Not directly affected.
283 Sutton Wood	Semi-natural broadleaved woodland on an ancient woodland site	Lowland mixed deciduous woodland/H1:3 Native woodlands	50m from Scheme	Not directly affected but potential for indirect effects.

Table 9.6: Sites of Importance for Nature Conservation (SINCs) which may be affected by the Scheme

SINC Number and Name	Description of Site	UK BAP priority habitat/SINC selection criteria	Distance from Scheme	Affected by Scheme?
285 West of Barry College	Species-rich neutral grassland	Lowland meadows/ H5:1 Lowland meadows	165m east of Scheme (and separated by woodland block).	Not directly affected.
336 Walters Farm	Series of species-rich neutral grasslands, locally damp, with large anthills.	Lowland meadows/H5:1 Lowland meadows	0 km	Directly affected through temporary loss of small area (0.03 ha) of grassland as 10 m strip for essential licence

Phase 1 Habitat Survey

9.4.9 The distribution of habitats along the Scheme alignment and the locations of 'Target Notes' (descriptions of habitats of ecological interest) taken during surveys are shown in Figure 9.2; these habitats are described in detail in the Phase 1 habitat survey report included as Appendix 9.6, with Target Notes and photographs of habitats of interest. A larger scale habitat map is also provided in the Phase 1 Survey Report. The main results of the survey are summarised below.

Semi-natural Broadleaved Woodland

9.4.10 Semi-natural woodlands are composed of locally native trees more than 5m in height with 90% or more broadleaved species in the canopy.

9.4.11 There are numerous semi-natural woodland blocks across the study area, including those belonging to the Barry Woodlands SSSI (see Table 9.5), many of which are also ancient woodland (Figure 9.1). The individual woodlands vary in the combination of species of tree present, depending on their management in the past. Most of the older woodlands have canopies dominated by ash (*Fraxinus excelsior*) and pedunculate oak (*Quercus robur*) and sometimes field maple (*Acer campestre*). There are variable amounts of shrubs such as hawthorn (*Crataegus monogyna*), hazel (*Corylus avellana*), grey willow (*Salix cinerea*) and blackthorn (*Prunus spinosa*) in the shrub layers. The field layers vary too, and may have bramble (*Rubus fruticosus)*, ivy (*Hedera helix*) and a range of woodland herbs such as bluebells (*Hyacinthoides non-scripta*), goldilocks (*Ranunculus auricomus*) and primroses (*Primula vulgaris*).

9.4.12 More disturbed areas of woodland may have more sycamore (*Acer pseudoplatanus*) in the canopy with elder (*Sambucus nigra*) and nettles (*Urtica dioica*) underneath.

Plantation Broadleaved Woodland

9.4.13 This type of woodland consists of planted broad-leaved trees that contribute more than 30% to the overall canopy composition. Mature plantations (more than 120 years) of native species with semi-natural woodland shrub and ground flora are classified as semi-natural rather than as plantation woodland (for example, as its name implies, Middleton Plantation was originally a plantation but is now classed as semi-natural woodland).

9.4.14 There is an area of broadleaved plantation woodland in the southern end of the Scheme, immediately to the south of the existing road (see Figure 9.2). This woodland (termed Sutton Wood) has its core replanted with poplar (*Populus* sp.), but is on an ancient woodland site. The southern-most tip of Lidmore Wood, which lies to the east of the Waycock Road in the Lidmorearea, has also been replanted but the bulk of the woodland is semi-natural.

9.4.15 There are two recent plantations, perhaps only 15 years old, at the southern end of the Scheme on the east side of the Waycock Road (see TN31 and TN36 on Figure 9.2). Both are up to 10m in height, with strips or patches of silver birch (*Betula pendula*), pedunculate oak (*Quercus robur*), field maple (*Acer campestre*) and other species. The field layer in both is very poor, mainly relict grassland species such as hogweed (*Heracleum sphondylium*), meadow buttercup (*Ranunculus acris*) and rough-stalked meadow-grass (*Poa trivialis*), reflecting the grasslands that the trees were planted into.

Semi-natural Mixed Woodland

9.4.16 Semi-natural mixed woodland consists of 10-90% of either broadleaved or conifer naturally regenerating trees in the canopy.

9.4.17 The southern part of Sutton Fach Wood (see TN16 on Figure 9.2) is semi-natural mixed woodland, dominated by 80% deciduous species with 20% conifers (cf. western red cedar, *Thuja plicata* and cf. Scot's pine, *Pinus sylvestris*) but with more conifers under-planted; with time these may come to dominate the canopy.

Dense Scrub

9.4.18 Scrub comprises scattered or dense stands of naturally regenerated locally native tree and shrub species, generally under 5m tall. Dense scrub is predominantly characterised by dense shrub vegetation cover with low species diversity.

9.4.19 Small blocks of scrub are located across the study site, with the largest area filling a field northwest of Waycock Cross (see Figure 9.2). Dogwood (*Cornus sanguinea*) and hawthorn (*Crataegus monogyna*) are locally dominant with abundant patches of English elm (*Ulmus procera*), dog rose (*Rosa canina*), ash (*Fraxinus excelsior*), old man's beard (*Clematis vitalba*) and bramble (*Rubus fruticosus*). Smaller patches occur at the western end of the woodland opposite the Amelia Methodist Trust Farm.

Scattered Scrub

9.4.20 Small patches of scattered scrub occur scattered along the Scheme. For example, bramble (*Rubus fruticosus*) scrub occurred on the west side of Sutton Fach Wood, or blackthorn (*Prunus spinosa*), ash (*Fraxinus excelsior*) and goat willow (*Salix caprea*) scrub was spreading into the narrow fenced strip along the River Waycock north of Waycock Bridge.

Scattered Broadleaved Trees

9.4.21 There are some free-standing mature trees in the study area, possibly relict from old hedge lines. They were predominantly penduculate oak (*Quercus robur*), for example east of Sutton Fach Farm.

Unimproved Neutral Grassland

9.4.22 Unimproved neutral grasslands include meadows and pastures that occur on soils which are neither acid nor basic and that have not been subject to any significant degree of agricultural intensification. They might be rank and neglected, mown or grazed. The flora diversity is often high with low percentage of agricultural species.

9.4.23 The main area of unimproved grassland occurred in the SINC at Walters Farm, where some of the fields are diverse and of good quality.

9.4.24 A few small areas of unimproved grasslands were present elsewhere (see Figure 9.2). Several sections of road verge were unimproved with willowherb (*Epilobium hirsutum*) and hemlock water-dropwort (*Oenanthe crocata*) present. The tall grassland by the picnic site (TN23) was classified as unimproved, although obviously sown relatively recently with species such as common knapweed (*Centaurea nigra*), sainfoin (*Onobrychis viciifolia*), red clover (*Trifolium pratense*) and common mallow (*Malva sylvestris*). The picnic site also now has many weedy species such as nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*) and docks (*Rumex* spp.).

Semi-improved Neutral Grassland

9.4.25 Semi-improved grasslands comprise meadows and pastures that have been modified by some agricultural improvements including intensive grazing, usage of artificial fertilizers and/or drainage. Consequently they have a less diverse range of species than unimproved grasslands.

9.4.26 A few fields of good semi-improved neutral grassland were present within the study area (see Figure 9.2), mainly in areas grazed by horses. There were semi-improved grasslands both sides of Five Mile Lane at the Amelia Methodist Trust Farm, opposite Grovelands Farm, north of the Welsh Hawking Centre and at Walters Farm. Typically these were comprised of Yorkshire fog (*Holus lanatus*), crested dog's tail (*Cynosurus cristatus*), sweet vernal-grass (*Anthoxanthum odoratum*) and perennial rye-grass (*Lolium perenne*) with red clover (*Trifolium pratense*) and creeping buttercup (*Ranunculus repens*), meadow buttercup (*Ranunculus acris*), self-heal (*Prunella vulgaris*), sorrel (*Rumex acetosa*) and ribwort plantain (*Plantago lanceolata*).

Improved Grassland

9.4.27 Improved grasslands are those which have been affected by heavy grazing, drainage or the application of herbicides and fertilisers. They have lost many of the species expected to be present in an unimproved field.

9.4.28 Improved neutral grasslands were widespread in the study area (see Figure 9.2), as expected in this agricultural landscape. These had a limited range of grasses and a few common forbs such as perennial rye-grass (*Lolium perenne*), crested dog's tail (*Cynosurus cristatus*) and white clover (*Trifolium repens*).

Marshy Grassland

9.4.29 Marshy grassland is generally found on permanently damp soils or land with impeded drainage. They may be used for light grazing and are highly susceptible to agricultural modification and reclamation.

9.4.30 Wet grasslands were found in two areas near Blackland Farm (see TN 3 and TN6 on Figure 9.2). A narrow strip associated with a drainage ditch occurred on the east side of Five Mile Lane (TN3), dominated by purple moor-grass (*Molinia caerulea*) and rough-stalked meadow-grass (*Poa trivialis*) with frequent rushes including soft rush (*Juncus effusus*), hard rush (*Juncus inflexus*) and compact rush (*Juncus conglomeratus*). A larger area of marshy grassland was also located in the Amelia Methodist Trust Farm (TN6) with tufted hair-grass (*Deschampsia cespitosa*), purple moor-grass (*Molinia caerulea*) and several species of rushes (*Juncus conglomeratus* and *Juncus articulatus*). This area is designated as a SINC (221 Land North of Whitton Rosser Farm). Herbaceous species present included meadowsweet (*Filipendula ulmaria*), greater bird's-foot trefoil (*Lotus pedunculatus*) and common fleabane (*Pulicaria dysenterica*).

Poor Semi-improved Grassland

9.4.31 The subdivision of semi-improved meadows into 'good semi-improved' and 'poor semi-improved' is optional for Phase 1 surveys. Good semi-improved grassland has a reasonable diversity of herbaceous species and is clearly recognisable as acid, calcareous or neutral in origin. Poor semi-improved grassland has a much more restricted list of species and, being more improved, is more likely to resemble species-poor neutral grassland, irrespective of its origin.

9.4.32 Poor semi-improved grassland occurred in the meadow south-west of Walters Farm (see TN37 on Figure 9.2). It was dominated by grasses such as cock's-foot (*Dactylis glomerata*), meadow foxtail (*Alopecurus pratensis*), rough-stalked meadow-grass (*Poa trivialis*) and Yorkshire fog (*Holcus lanatus*). Herbaceous plants included creeping thistle (*Cirsium arvense*), docks (*Rumex* spp.) and buttercups (*Ranunculus* spp.).

Tall Ruderal Vegetation

9.4.33 Ruderal plants are weedy species that colonize disturbed land. The tall ruderal category comprises stands of tall perennial or biennial dicotyledons, usually more than 25cm high.

9.4.34 One small area by the Welsh Hawking Centre entrance (see TN28 on Figure 9.2) was dominated by tall ruderal plants such as common nettle (*Urtica dioica*), cow parsley (*Anthriscus sylvestris*), great willowherb (*Epilobium hirsutum*) and creeping thistle (*Cirsium arvense*).

Standing Water

9.4.35 Standing water includes a range of water bodies from lakes to ponds and brackish lagoons. Within the study area, two standing water types occurred, ponds and ditches (see Figure 9.2). A number of ponds shown on Ordnance Survey maps are no longer present. Further details of standing waters are given in the Great Crested Newt survey report (see Appendix 9.1).

9.4.36 A pond, 1-2m in depth with a sediment base with approximately 150m perimeter, was located within the Amelia Methodist Trust Farm, 200m to the west of Five Mile Lane (Amelia Trust Pond, Figure 9.3). The margins had willow (*Salix* sp.) scrub and the water was covered with broad-leaved pondweed (*Potamogeton natans*) and occasional patches of white waterlily (*Nymphaea alba*). There was a fringe of good marginal and aquatic vegetation, such as reeds, sedges and rushes, e.g. broad-leaved reedmace (*Typha latifolia*). More ponds occur within the Amelia Methodist Trust Farm further east.

9.4.37 A second pond occurred south-east of the Whitton Lodge crossroads (Pond 2, Figure 9.3). This had a depth of 0.5m and an approximate circumference of 16m. It was 90% shaded by overhanging trees on the eastern fringes. No aquatic vegetation was present within the water body at the time of the survey.

9.4.38 A few drainage ditches held standing water (Appendix 9.1, Figure 1), though most were seasonally dry. Adjacent to Blackland Farm, one small, shaded ditch approximately 3m x 1m had water 0.3m deep. A second ditch (Ch1100m to Ch1200m) opposite the stables on Dyffryn Lane was approximately 16m x 1m had standing water 0.5m deep.

Running Water

9.4.39 Running water comprises rivers and streams. There are six main running water courses in the study site (see Figure 9.3).

9.4.40 The River Waycock is the main river in the study area, draining the eastern side of much of Five Mile Lane. At the north end of the Scheme opposite Blackland Farm, it comprises seasonally-dry ditches which drain to the east of Five Mile Lane before turning south near Dyffryn. Further small streams drain eastwards from Five Mile

Lane and join the main channel. At Lidmore, the river turns south-west and continues flowing south-west under Five Mile Lane at the Waycock Bridge, where it is generally steep-sided, 3-5m wide, with moderate to fast flowing permanent water at a depth of 20-60cm and a bed of gravel and cobbles. It is generally shaded and contains little to no aquatic vegetation.

9.4.41 The Nant Whitton drains the western side of Five Mile Lane at the north end of the Scheme. It flows south-west from Blackland Farm, is 2-2.5m wide, shallow, has a stony base with no marginal or aquatic vegetation and is seasonally dry.

9.4.42 The Ford Brook drains south-west from Whitton Bush Farm, with an upper, small, seasonally dry section to the east of Five Mile Lane arising at Ffynnon Whitton-mawr.

9.4.43 The Moulton Brook drains south-west from near Grovelands Farm, but does not extend to the east of Five Mile Lane.

9.4.44 A small un-named stream runs south along the west side of Sutton Fach Wood and joins the River Waycock downstream of the Waycock Bridge. This seems to be permanently wet (though very shallow in summer) with a stony base up to 50 cm wide.

9.4.45 Finally, a small un-named stream runs north from Walters Farm alongside Five Mile Lane. It is shallow with clay banks up to 1m tall and a base composed of gravel and bedrock. The stream is shaded by trees in most places. Runoff from the Waycock Road drains directly into the stream.

Arable Land

9.4.46 This category includes arable fields, horticultural land, freshly-ploughed land and recently reseeded grasslands.

9.4.47 Most of the northern part of the Scheme is dominated by cultivated arable land (see Figure 9.2). The land is mostly cultivated with wheat (*Triticum aestivum*).

Intact Hedge

9.4.48 This category includes intact hedges that are entire and stock proof.

9.4.49 Hedges are a significant feature of much of the agricultural land along the Scheme (see Figure 9.2). Most are routinely managed by flailing and are relatively short up to 2m tall. Typical woody canopy species include hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*), hazel (*Corylus avellana*), ash (*Fraxinus excelsior*), field maple (*Acer campestre*), common dogwood (*Cornus sanguinea*) and dog rose (*Rosa canina*), with bramble (*Rubus fruticosus*), ivy (*Hedera helix*) and common nettle (*Urtica dioica*) in field layers. Some are relatively species-rich with 5-6 woody species in a 30m section, whilst others are poorer with fewer species. Further details of hedges were collected as part of the dormouse survey (Appendix 9.3).

9.4.50 One Leyland cypress (*Cuprocyparis leylandii*) hedgerow trimmed to 1.5m tall occurs at the Welsh Hawking Centre.

Defunct Hedge

9.4.51 This category includes hedges that are no longer stock-proof as gaps allow stock to pass through.

9.4.52 One improved meadow west of the Waycock Bridge is bisected with defunct hedge (see Figure 9.2). Hawthorn (*Crataegus monogyna*), oak (*Quercus robur*) and ash (*Fraxinus excelsior*) dominated the canopy with common nettle in the understory.

Hedge with Trees

9.4.53 Hedgerows with standard trees or tall-growing hedges more than 5m tall fall into this category.

9.4.54 Hedges with trees are widespread in the catchment area, though less frequent than trimmed hedges. For example there are hedges with pedunculate oak (*Quercus robur*) or ash (*Fraxinus excelsior*) trees near the River Waycock and near Whitton Lodge (see Figure 9.2).

Other Habitats

9.4.55 Other habitats present include buildings, bare ground and fences.

Conclusions from Phase 1 Habitat Survey

9.4.56 The survey identified a number of habitats on the site that have some ecological and nature conservation value. These included:

- Broadleaved semi-natural woodland (especially the Barry Woodlands SSSI complex)
- Standing and running water habitats
- Species-rich hedgerows and mature scrub
- Unimproved neutral grassland
- Semi-improved neutral grassland
- Marshy grassland
- Road verges with rank and unmanaged vegetation.

Invasive Plant Surveys

9.4.57 One large stand of Japanese Knotweed (*Fallopia japonica*) was found in SINC 222: Land North-east of Whitton Rosser Farm (the woodland opposite the Amelia Methodist Trust Farm. It is likely that this infestation has arisen from the dumping of waste materials at this location. The stand of knotweed occurs at the eastern end of the woodland.

9.4.58 Himalayan Balsam was present in small quantity on the north side of the A48 on the north-east side of Sycamore Cross.

NVC Survey

9.4.59 The NVC survey of Barry Woodlands SSSI showed that the woodlands on both sides of Five Mile Lane belonged to the W8d *Fraxinus excelsior – Acer campestre – Mercurialis perennis* (Ash - Field Maple - Dog's Mercury) woodland *Hedera helix* (Ivy) subcommunity (Soltys-Brewster Consulting 2011b; Appendix 9.9). This is a widespread type of broad-leaved woodland on relatively calcareous soils in southern Britain.

9.4.60 Middleton Plantation had some plants indicating more diverse woodland including some species cited in the SSSI schedule such as Herb Paris (*Paris quadrifolia*), Greater Butterfly-orchid (*Platanthera chlorantha*) and Woodruff (*Galium odoratum*). One area near the road at the southern end had evidence of past disturbance with Elder (*Sambucus nigra*) in the understorey.

9.4.61 The wood by Barry College had less diverse ground flora but also included Goldilocks (*Ranunculus auricomus*) and Greater Butterfly-orchid (*Platanthera chlorantha*).

Mammals

Bats (see Appendices 9.4 and 9.5)

9.4.62 Ten species of bat were recorded in total across all the locations surveyed for commuting or foraging bats. Species most commonly recorded were Common and Soprano pipistrelles (*Pipistrellus pipistrellus* and *P. pygmaeus*).

9.4.63 Bats were regularly observed foraging close to and commuting across the existing Five Mile Lane close to where the Scheme is to be on-line at the survey location points south of Blacklands Farm, east of Whitton Rosser Farm and north of Sutton Wood.

9.4.64 A Lesser horseshoe bat was recorded south of Blacklands Farm on one occasion. This is a species of higher conservation concern and more vulnerable to traffic collisions as it flies low. However, it is not considered that the Scheme will have a significant impact on the integrity of the wider population.

9.4.65 At Grovelands Farm, mainly Common and Soprano pipistrelles along with a number of Brown long-eared bats (*Plecotus auritus*) were observed commuting and foraging along a mature section of hedgerow. A roost of at least two Brown long-eared bats (thought to be a day / feeding roost) was identified in a small agricultural shed. Previous surveys (Soltys-Brewster Consulting 2011a) also identified a roost (thought to be *Pipistrellus spp*.) within a bat box on the stable on the northern side of the mature hedgerow, though surveys in 2014 suggested the bat boxes were not being used.

9.4.66 At the River Waycock, the results indicated that the northern side of the river is used for foraging by Daubenton's bats *(Myotis daubentonii)* along with mainly Common and Soprano pipistrelles. This location also provided a safe road crossing opportunity for bats.

9.4.67 Along the route there are many trees which could potentially support bat roosts. Eleven trees on or very close to the route were identified as having potential for bats and were inspected in detail (Appendix 9.5), but 2 could not be surveyed due to access restrictions. No evidence of bat roosts was found in the 9 surveyed, but five trees have high or very high potential (Category 1 and 1*). These Category 1 and 1* trees and the uninspected trees will require preconstruction surveys to ensure no bats are using them before felling.

Dormouse (see Appendix 9.3)

9.4.68 No evidence of dormice was found during the nest tube surveys conducted for the Scheme (although some tubes were found to be occupied by wood mouse). However, the absence of dormice may not be assumed in this case, as dormice are a species

hard to find and detect, especially so if present in low densities. However, the results of surveys indicate that, if dormice are present, they are present in low densities.

9.4.69 No evidence of dormice was recorded during nut searches carried out at Betty Lucas Wood and at Sutton Wood. Characteristically-chewed hazelnuts confirmed the presence of wood mice at both locations.

9.4.70 A total of 61 hedgerows and woodlands on the route of the Scheme were assessed for their potential to support dormice. Roughly half of these features were considered to be suitable for dormice, and six features were considered optimal:

- 6 features were considered optimal for dormice (Category A)
- 28 features were considered suitable for dormice (Category B)
- 24 features were considered sub-optimal for dormice (Category C)
- 3 features were considered suitable only as dispersal corridors (Category D)
- No features were considered unsuitable for dormice (Category E).

9.4.71 Assessment of habitat suitability of features within the Scheme indicates that if dormice are present, they are most likely to occur in the woodland blocks located at either end of the Scheme. A network of hedgerows and treelines provides linkage between these woodlands, and many of the hedgerows (28 in total) were considered suitable for dormice (Category B). Therefore, dormice may be present throughout the route corridor.

Badger

9.4.72 During surveys conducted by Soltys-Brewster in 2008, a suspected road casualty was noted (a carcass was found within 5m of carriageway edge in the southern woodland block close to Barry).There was one record for field signs of badger (no sett was recorded) in the SEWBReC data for the Coed Whitton area, over 500m from the Scheme. The Glamorgan Badger Group had no records for badgers in the vicinity of the Scheme (pers. comm. 3 July 2014).

9.4.73 The extended Phase 1 survey identified numerous habitats suitable for badgers. There are several areas of woodland adjacent to the Scheme which would be ideal for the construction of setts, and the woodlands, pasture fields and hedgerows provide ideal foraging habitat for badgers.

9.4.74 Although very few badger field signs were identified during the Scoping study visit and the extended Phase 1 survey, a latrine and several well used mammal paths were observed at a number of locations along the Scheme. No badger setts were located within the footprint of the Scheme, nor were there any found within 250m of the Scheme.

9.4.75 It is therefore concluded that badgers are present within the study area, but there are no setts within 250m of the Scheme alignment which may be affected.

Otter

9.4.76 During the Scoping study field visit conducted by TACP in 2014, a possible otter spraint was discovered on the River Waycock.

9.4.77 The extended Phase 1 survey identified several small streams and other watercourses which may be used by otters for commuting or for foraging. The River Waycock may be of particular importance in this regard, with a good population of eels and small fish such as bullhead and minnow.

Water Vole (see Appendix 9.2)

9.4.78 Several records of water vole presence and/or water vole activity signs were provided by SEWBReC. There were no historical records of water voles along the route of the Scheme but there are some records within a 5km radius of the site (e.g. at Cosmeston Lakes most recently in 1997). Signs of water vole were more often reported than the animals themselves.

9.4.79 No evidence of water voles was found in the seven water bodies surveyed in 2014 identified as having potential for water voles in the Phase 1 survey (Appendix 9.2) and Pond 2 (Figure 9.3) was not considered as having potential for water voles. The water bodies surveyed within the study area were found to be unsuitable for water voles.

Brown Hare

9.4.80 There were several sightings of brown hare during the Extended Phase 1 habitat survey conducted by Soltys-Brewster in 2008. There are also numerous records for this species in SEWBReC data (the nearest within 369 m of the Scheme). None were seen during the Extended Phase 1 survey in 2014, but they could be present in low densities.

Harvest Mouse

9.4.81 There are several historic SEWBReC records for harvest mouse within 293m of the Scheme. The most relevant record is from 2010, when this species was recorded from a site approximately 2km northwest of the Scheme. Several areas within the site (those with long grasses/cereals) may be suitable for this species, and given that this small species is easily overlooked, it could be present.

Birds

9.4.82 The bird species recorded within the study area during the 2008 breeding bird surveys conducted by Soltys-Brewster and other surveys carried out for the Scheme are listed in Table 9.7. The conservation status of each species is also presented (including BOCC Status, EU Birds Directive Annex 1, WCA Schedule 1, UK BAP, NERC Section 42 and VoG BAP). Bird species of conservation concern (i.e. those that are Red-listed and/or are listed under Annex I of EU Birds Directive / Schedule I of the WCA / priority species of UK BAP/Section 42/VoG) are highlighted in bold and discussed below.

9.4.83 Incidental records of several of the species listed in Table 9.7 were noted during the 2014 surveys conducted by TACP, including the red-listed species yellowhammer and skylark.

Table 9.7: Bird Species Recorded within the survey corridor and their Conservation/Protection Status

Species	BOCC Status	EU Birds Directive Annex I	WCA Schedule I	UK BAP Species	Section 42 Species	VoG Priority Species
Blackbird (*Turdus merula*)	Green	No	No	No	No	No
Blue tit (*Cyanistes caeruleus*)	Green	No	No	No	No	No
Buzzard (*Buteo buteo*)	Green	No	No	No	No	No
Carrion crow (*Corvus corone*)	Green	No	No	No	No	No
Chiffchaff (*Phylloscopus collybita*)	Green	No	No	No	No	No
Collared dove (*Streptopelia decaocto*)	Green	No	No	No	No	No
Coal tit (*Periparus ater*)	Green	No	No	No	No	No
Dunnock (*Prunella modularis*)	**Amber**	**No**	**No**	**Yes**	**Yes**	**No**
Goldfinch (*Carduelis carduelis*)	Green	No	No	**No**	No	No
Great tit (*Parus major*)	Green	No	No	No	No	No
Herring gull (*Larus argentatus*)	**Red**	**No**	**No**	**Yes**	**Yes**	**No**
House sparrow (*Passer domesticus*)	**Red**	**No**	**No**	**Yes**	**Yes**	**No**
Jackdaw (*Corvus monedula*)	Green	No	No	No	No	No
Kingfisher (*Alcedo atthis*)	**Amber**	**Yes**	**Yes**	**No**	**No**	**No**
Linnet (*Carduelis cannabina*)	**Red**	**No**	**No**	**Yes**	**Yes**	**No**
Nuthatch (*Sitta europaea*)	Green	No	No	No	No	No
Meadow pipit (*Anthus pratensis*)	Amber	No	No	No	No	No
Pheasant (*Phasianus colchicus*)	N/A	No	No	No	No	No
Robin (*Erithacus rubecula*)	Green	No	No	No	No	No
Skylark (*Alauda arvensis*)	**Red**	**No**	**No**	**Yes**	**Yes**	**Yes**

Table 9.7: Bird Species Recorded within the survey corridor and their Conservation/Protection Status

Species	BOCC Status	EU Birds Directive Annex I	WCA Schedule I	UK BAP Species	Section 42 Species	VoG Priority Species
Song thrush (*Turdus philomelos*)	**Red**	**No**	**No**	**Yes**	**Yes**	**Yes**
Starling (*Sturnus vulgaris*)	**Red**	**No**	**No**	**Yes**	**Yes**	**No**
Swallow (*Hirundo rustica*)	Amber	No	No	No	No	No
Swift (*Apus apus*)	Amber	No	No	No	No	No
Tawny owl (*Strix aluco*)	Green	No	No	No	No	No
Wood pigeon (*Columba palumbus*)	Green	No	No	No	No	No
Whitethroat (*Sylvia communis*)	Amber	No	No	No	No	No
Yellowhammer (*Emberiza citrinella*)	**Red**	**No**	**No**	**Yes**	**No**	**No**

Bird Species of Conservation Concern

9.4.84 **Skylark** has been recorded in several areas within the survey corridor, mainly in the large arable fields in the mid to northern section of the route, though the presence of this species was noted in one pasture field. This species has suffered a decline in recent years, mainly due to changes in farming practices, such as increased pesticide use, the loss of arable land to grazing, and a shift from spring to autumn sown cereal crops, which reduces the number of available nesting and feeding sites (RSPB website, www.rspb.org.uk, accessed August 2014).

9.4.85 Similarly, the seed-eating species **Yellowhammer** and **Linnet** have all suffered declines in recent years due to changing farming practices, and are now red-listed. The occurrence of these species within the survey corridor also coincides with arable fields, which provide valuable feeding habitat. Hedgerows and scrub are important nesting habitats for these species.

9.4.86 **Song Thrush** has also suffered a decline in the UK in recent years. The reasons behind the decline of song thrush are unclear, but this is probably also partly due to the switch from arable to pasture land and autumn-sown cereal crops (RSPB website, www.rspb.org.uk, accessed August 2014). Other factors which may be involved in the decline of this species are hedgerow destruction, and the increased use of pesticides, which leads to a reduction in prey availability and may result in indirect poisoning.

9.4.87 Reasons behind the decline of **Starling** and **House Sparrow** are relatively unknown, but may also be associated with changing farming practices. Within the Scheme study area, these species were recorded in pasture land in the vicinity of Moulton.

9.4.88 **Herring Gull** are generally considered to be a coastal species, but have increasingly begun to utilise more inland areas, particularly urban areas and landfill sites, which provide a valuable food source. Herring gull populations suffered a massive decline between the 1960s and the 1980s, thought to have been caused by an outbreak of botulism (Madden and Newton, 2004). A decline in the availability of food from fisheries discards and landfill sites has resulted in a shift of populations from remote coastal sites to urban areas in recent years (Furness *et al*., 1992).

9.4.89 **Kingfisher**, a species listed under Annex I of the EU Birds Directive and a WCA Schedule 1 species, was recorded by Soltys-Brewster during surveys of the River Waycock corridor conducted in 2008. As a slow-moving, shallow river with abundant small fish, the River Waycock is an ideal habitat for this species. Kingfishers are top predators in the food chain, and so are highly vulnerable to the build-up of chemicals. Long-term population declines in this species since the 1970s are generally attributed to river pollution, though human disturbance of nesting birds is also a serious problem (RSPB website, www.rspb.org.uk, accessed August 2014).

9.4.90 **Dunnock** was recorded in the vicinity of Whitton Rosser Farm by Soltys-Brewster in 2008. This species inhabits well vegetated areas with scrub, brambles and hedges. Abundance of Dunnock fell significantly between the mid-1970s and mid-1980s. The cause of this decline is unknown, but may be associated with changing forestry practices.

9.4.91 **Barn Owl (*Tyto alba*)**, a WCA Schedule 1 species, was recorded as present in 2008 by Soltys-Brewster (the location was not shown on their Figure 6.7). SEWBReC hold 7 post-2000 records of Barn Owl with 2km of the scheme, two of which relate to breeding adults in 2002 over 900 m from the Scheme. During Phase 1 ecology surveys conducted by TACP in 2014, any trees or structures potentially affected by

the Scheme likely to host barn owl were checked for the presence of, or any signs of breeding barn owl (for example during the bat survey work), but none were found. Barn owls are probably periodically present at low density.

Fish

9.4.92 Though no specific fish surveys were conducted for the Scheme, the following species were noted during other surveys conducted for the Scheme:

Brown Trout (Salmo trutta)

9.4.93 During river corridor surveys conducted by Soltys-Brewster in September 2009, brown trout were seen in the deeper parts of the River Waycock. Brown trout is listed under Annex II of the EU Habitats Directive, and is also a Priority species under the UK BAP and Section 42 of the NERC Act.

Bullhead (Cottus gobio)

9.4.94 During the above-mentioned river corridor survey conducted by Soltys-Brewster in 2009, and surveys for white-clawed crayfish carried out by Sturgess Ecology and TACP in September 2014, bullhead were found to be abundant in riffle areas of the River Waycock. Bullhead is listed under Annex II of the EU Habitats Directive, but is widespread and relatively abundant in the UK, so is not listed as a Priority species under the relevant BAPs.

European Eel (Anguilla anguilla)

9.4.95 European eel were also noted in the River Waycock during the white-clawed crayfish survey conducted by Sturgess Ecology and TACP in 2014. The European eel is a critically endangered species (IUCN, 2014), having undergone a decline of roughly 90% since the 1970s.

Amphibians - Great Crested Newt (see Appendix 9.1)

9.4.96 In surveys conducted by Soltys-Brewster in 2008, the Dew Ponds at Amelia Methodist Trust Farm supported a small population of great crested newts. The Dew Ponds are located 400m west of the existing Five Mile Lane, on the opposite side of the Scheme alignment.

9.4.97 The 2014 surveys conducted by TACP, no great crested newt were found in the three water bodies surveyed (Appendix 9.1). As there is known to be a low population density of this species within the Vale of Glamorgan, their presence within 250m of the Scheme alignment may not be ruled out.

Other Amphibians

9.4.98 During the 2008 amphibian surveys conducted by Soltys-Brewster, palmate newts (*Triturus helveticus*) were recorded in three ponds at the Amelia Methodist Trust Farm, and common frog (*Rana temporaria*) and common toad (*Bufo bufo*) were recorded within two of the ponds on the farm.

9.4.99 Palmate newt was recorded in one of the ponds surveyed for great crested newts by TACP in 2014. During the September 2014 dormouse tube check, a common toad was found in one of the nest tubes in Betty Lucas wood.

Reptiles

9.4.100 Habitat with the potential to support common reptiles was identified on the existing Five Mile Lane road verges in the northern and southern areas of the Scheme corridor. Much of the adjoining land comprising grazed pasture, arable fields and woodland was considered generally unsuitable. None were seen during the Phase 1 survey in 2014.

9.4.101 Surveys carried out by Soltys-Brewster in the northern section of the study area between May and July 2008 recorded small numbers of slow worm (*Anguis fragilis)* (maximum count of 4) and grass snake (*Natrix natrix)* (maximum count of 2) in the road verges alongside the north- and south-bound carriageways (Soltys-Brewster Consulting 2011a).

9.4.102 No reptiles were recorded in a further survey carried out in the road-verge and scrub habitats in the southern part of the Scheme in August/September 2009 (Soltys-Brewster Consulting 2011a).

Aquatic Invertebrates - White-clawed Crayfish

9.4.103 No white-clawed crayfish (or the invasive alien American signal crayfish) were recorded during the white-clawed crayfish survey conducted in 2014 (Appendix 9.7).

Other Aquatic Invertebrates (see Appendix 9.8)

9.4.104 Table 9.8 shows the results from the aquatic water sampling in 2014. The Biological Monitoring Working Party (BMWP) scores are a measure of pollution and ranged from 86 to 148. These indicated good (above Sutton Wood) or very good (other sampling sites) water quality. The Average Score per Taxon (ASPT) ranged from 4.53 to 5.69, which indicated moderate to poor (above Sutton Wood) to moderate water quality (other sampling sites).

Table 9.8: Water Quality Sampling Results at Family Level for Four Sampling Sites (see Figure 9.3 for sampling site locations)

Watercourse	Sample Number	Number of Taxa	BMWP Score	ASPT Score
Site 1 above Sutton Wood	12879	19	86	4.53
Site 2 R Waycock Upper	12880	26	148	5.69
Site 3 R Waycock Lower	12881	26	137	5.27
Site 4 Welsh Hawking stream	12882	26	131	5.04

Summary of UK and Local Biodiversity Action Plan Habitats and Species

Habitats

9.4.105 The habitats recorded within the study area were assessed for their conservation value, particularly any association with UK BAP, Section 42 or Vale of Glamorgan Priority habitats. The results are summarised in Table 9.9.

Table 9.9: Habitats within the Study Area and their Association with Priority Habitats

Habitat	Associated UK BAP Habitat	Associated Section 42 Habitat	Associated VoG Priority Habitat
Semi-natural broadleaved woodland	Corresponds to *Lowland mixed deciduous woodland*	Corresponds to *Lowland mixed deciduous woodland*	N/A
Plantation broadleaved woodland	N/A	N/A	N/A
Semi-natural mixed woodland	N/A	N/A	N/A
Dense scrub	N/A	N/A	N/A
Scattered scrub	N/A	N/A	N/A
Scattered broadleaved trees	N/A	N/A	N/A
Unimproved neutral grassland	Associated with *Lowland Hay Meadows*.	Associated with *Lowland Hay Meadows*.	Associated with *Lowland Hay Meadows*. Walters Farm SINC corresponds to this habitat.
Semi-improved neutral grassland	N/A	N/A	N/A
Improved grassland	N/A	N/A	N/A
Marshy grassland	Corresponds to *Purple moor grass and rush pasture*	Corresponds to *Purple moor grass and rush pasture*	Corresponds to *Purple moor grass and rush pasture*
Poor semi-improved grassland	N/A	N/A	N/A
Tall ruderal vegetation	N/A	N/A	N/A
Standing water	Corresponds to *Ponds*	Corresponds to *Ponds*	One pond to the west of the existing Five Mile Lane is over 0.01ha and so corresponds to the VoG Priority Habitat *Eutrophic standing waters*
Running water	Corresponds to *Rivers*	Corresponds to *Rivers*	N/A
Arable	Associated with *Arable field margins*, but the habitats on site do not correspond to this habitat type.	Associated with *Arable field margins*, but the habitats on site do not correspond to this habitat type.	The field margins on site correspond to the habitat *Cereal field margins*, for which indicator species include skylark and brown

Table 9.9: Habitats within the Study Area and their Association with Priority Habitats

Habitat	Associated UK BAP Habitat	Associated Section 42 Habitat	Associated VoG Priority Habitat
			hare (both recorded within the study area)
Intact hedge	Corresponds to *Hedgerows*	Corresponds to *Hedgerows*	Species-rich examples correspond to *Ancient and/or species rich hedgerows*
Defunct hedge	N/A	N/A	N/A
Hedge with trees	Corresponds to *Hedgerows*	Corresponds to *Hedgerows*	Species-rich examples correspond to *Ancient and/or species rich hedgerows*

Species

9.4.106 A full list of all the UK BAP and Section 42 species found in the study area is summarised in Table 9.10.

Table 9.10: List of UK BAP, Section 42 and VoG Priority Species Recorded within the Study Area

	Species	UK BAP	Section 42	VoG Priority Species
Birds	Dunnock (*Prunella modularis*)	Yes	Yes	No
	Herring gull (*Larus argentatus*)	Yes	Yes	No
	House sparrow (*Passer domesticus*)	Yes	Yes	No
	Linnet (*Carduelis cannabina*)	Yes	Yes	No
	Skylark (*Alauda arvensis*)	Yes	Yes	Yes
	Starling (*Sturnus vulgaris*)	Yes	Yes	No
	Song thrush (*Turdus philomelos*)	Yes	Yes	Yes
	Yellowhammer (*Emberiza citrinella*)	Yes	Yes	No
Fish	European eel (*Anguilla anguilla*)	Yes	Yes	No
	Brown trout (*Salmo trutta*)	Yes	Yes	No
Herpetiles	Slow-worm (*Anguis fragilis*)	Yes	Yes	No
	Grass snake (*Natrix natrix*)	Yes	Yes	No
	Common toad (*Bufo bufo*)	Yes	Yes	No
	Great crested newt (*Triturus cristatus*)	Yes	Yes	Yes

Table 9.10: List of UK BAP, Section 42 and VoG Priority Species Recorded within the Study Area

	Species	UK BAP	Section 42	VoG Priority Species
Mammals	Brown hare (*Lepus europaeus*)	Yes	Yes	Yes
	Hedgehog (*Erinaceus europaeus*)(presence assumed)	Yes	Yes	No
	Otter (*Lutra lutra*) (presence assumed)	Yes	Yes	Yes
	Dormouse (*Muscardinus avellanarius*)	Yes	Yes	Yes
	Noctule (*Nyctalus noctula*)	Yes	Yes	Yes (other bat species)
	Common Pipistrelle (*Pipistrellus pipistrellus*)	No	Yes	Yes
	Soprano pipistrelle (*Pipistrellus pygmaeus*)	Yes	Yes	Yes
	Brown long-eared bat (*Plecotus auritus*)	Yes	Yes	Yes (other bat species)
	Lesser Horseshoe bat (*Rhinolophus hipposideros*)	Yes	Yes	Yes (other bat species)

Summary of Ecological Receptors within the Study Area

9.4.107 The following table outlines the ecological receptors within the study area and their ecological value, based on the criteria set out in Table 9.2, and professional judgement in the context of the study area. Receptors of *Local importance or higher* are selected as Key Ecological Receptors, which will be assessed for impacts in Section 9.5. Unless there are particular concerns, sites outside the 250m study area are not considered.

Table 9.11: Ecological Receptors within the Study Area, Evaluation, and Selection as Key Ecological Receptors

Ecological Receptor	Valuation of Receptor	Selection as Key Ecological Receptor Y/N
Barry Woodlands SSSI	The SSSI is designated for its broad-leaved semi-natural woodland and is of National importance.	Yes
Ancient Woodlands	Semi-natural Ancient woodlands and Restored Ancient Woodlands are of National importance. Most of the best examples in the study area are also designated as part of Barry Woodlands SSSI (cf. above), and most of the others are designated as SINCs (cf. below).	Yes
SINCs	The 10 SINCs in the study area are of County importance.	Yes

Table 9.11: Ecological Receptors within the Study Area, Evaluation, and Selection as Key Ecological Receptors

Ecological Receptor	Valuation of Receptor	Selection as Key Ecological Receptor Y/N
Semi-natural broadleaved woodland	Virtually every large block of woodland in the study area is either designated as SSSI, ancient woodland or a SINC, and is thus considered National importance or County Importance as above. The smaller strips and blocks west of Waycock Bridge are assessed as of Local Importance. These correspond to the *Lowland mixed deciduous woodland* UK BAP.	Yes
Plantation broadleaved woodland	The plantation broadleaved woodlands differ in value, those of Sutton Wood being on an ancient woodland site probably merit District importance value whilst the new plantations south of Barry College merit Local importance.	Yes
Semi-natural mixed woodland	Due to the extensive under-planting with conifers and consequent poor ground flora, Sutton Fach Wood is regarded as of Local importance.	Yes
Dense scrub	The area of dense scrub on what may be an ancient woodland site northwest of Waycock Cross is of Local importance. The dense scrub opposite the Amelia Methodist Trust Farm is part of SINC 222 designated for woodland and thus of County Importance.	Yes
Scattered scrub	The scattered small patches of scrub are of Neighbourhood Importance	No
Scattered broadleaved trees	Individual trees are of Neighbourhood Importance	No
Unimproved neutral grassland	The better grasslands at Walters Farm SINC are at least of County Importance. An environmental assessment for the Walters Farm development proposals (Arup 2014) rated these hay meadows as Regionally/Nationally important as they correspondence to the Lowland Hay Meadows BAP priority habitat and are of a relatively large extent. The other small areas of unimproved grassland are generally associated with the road verges and are of Neighbourhood Importance. The grassland associated with the Waycock Bridge picnic site is larger and more diverse but has been recently created by sowing and is also of Neighbourhood Importance.	Yes
Semi-improved neutral grassland	The more diverse examples of semi-improved grasslands, some with Common fleabane and knapweed, are of Local Importance.	Yes
Improved grassland	The improved agricultural grasslands have very low species diversity and are Neighbourhood Importance.	No

Table 9.11: Ecological Receptors within the Study Area, Evaluation, and Selection as Key Ecological Receptors

Ecological Receptor	Valuation of Receptor	Selection as Key Ecological Receptor Y/N
Marshy grassland	The large purple moor-grass meadow in the Amelia Methodist Trust Farm is a SINC and is of County Importance, whilst the smaller purple moor-grass meadow opposite Blackland Farm is smaller, less diverse and partly improved and is of Local Importance. These grasslands correspond to Purple moor grass and rush pasture BAP habitat.	Yes
Poor semi-improved grassland	The recently ploughed meadow with grassland at Walters Farm has a generally low diversity and is intensively managed as is assessed as of Neighbourhood Importance. Although part of the SINC it is not of the same quality as the other unploughed grasslands within the SINC though it has potential to recover.	No
Tall ruderal vegetation	The patches of tall ruderal plants at the Welsh Hawking centre are of Neighbourhood Importance.	No
Standing water	The large pond in the Amelia Methodist Trust Farm is a SINC and of County Importance, and is a UK BAP habitat. The other ponds are small and isolated in intensive farmland and are of Local Importance.	Yes
Running water	The River Waycock has reasonable water quality and supports fish, kingfisher and probably mammal populations and is assessed as of District Importance. The small tributary running through the Barry Woodlands SSSI is noted as a feature adding ecological diversity in the SSSI schedule but is not a main reason for scheduling the site and is thus assessed as District Importance, at least within the SSSI. The remaining smaller tributaries are of Local Importance. The River Waycock corresponds to the River UK BAP.	Yes
Arable	Although the arable fields may provide feeding and potentially nesting habitat (at margins of fields) for skylark there are generally of Neighbourhood Importance. No field margins are currently managed specifically for wildlife and thus do not correspond to the cereal field margins BAP.	No
Intact hedge	The better quality species-rich hedges which have potential to support species such as dormouse and link to woodlands are of County Importance as they correspond to the *Ancient and/or species rich hedgerows* BAP. The species-poor, heavily managed hedges are generally of Neighbourhood Importance.	Yes
Defunct hedge	Defunct hedges with low connectivity are generally of Neighbourhood Importance.	No

Table 9.11: Ecological Receptors within the Study Area, Evaluation, and Selection as Key Ecological Receptors

Ecological Receptor	Valuation of Receptor	Selection as Key Ecological Receptor Y/N
Hedge with trees	The better quality species-rich hedges which have potential to support species such as dormouse are of County Importance as they correspond to the *Ancient and/or species rich hedgerows* BAP. The species-poor, heavily managed hedges are generally of Neighbourhood Importance.	Yes
Bullhead	Bullhead is listed under Annex II of the EU Habitats Directive, but is widespread and relatively abundant in the UK. In the context of the Scheme, this species is therefore considered to be of Local importance.	Yes (Hereafter considered together as 'Fish')
European eel	European eel is a critically endangered species, and is a UK BAP and Section 42 Priority species. Very low numbers of this species were recorded within the study area, however, and so the population within the River Waycock is considered to be of Local importance.	
Brown trout	Brown trout is listed under Annex II of the EU Habitats Directive, but is relatively widespread in the UK, and was recorded in very low numbers within the study area. In the context of the Scheme, this species is therefore considered to be of Local importance.	
Great-crested newt	Great-crested newt is listed under Annex II of the EU Habitats Directive and is a Priority species under the UK BAP, Section 42 of the NERC Act and the Vale of Glamorgan BAP. It is also a qualifying feature for several SINCs in the vicinity, including the Dew Pond at the Amelia Methodist Trust Farm, approximately 400m from the route alignment. It is therefore considered to be of County importance.	Yes
Other amphibians	Other amphibians found within the study area, including common frog and common toad, are relatively widespread throughout the UK. These species are therefore considered to be of Local importance.	Yes
Reptiles	The reptiles found within the study area, slow worm and grass snake, are relatively widespread species, and occur in low numbers within the study area. Populations of these species within the study area are therefore considered to be of Local importance.	Yes
Aquatic invertebrates	None of the aquatic invertebrate groups identified in the survey are rare or threatened, but the assemblage of species undoubtedly plays an important role in food webs in the immediate locality. This receptor is therefore of Neighbourhood importance.	No

Table 9.11: Ecological Receptors within the Study Area, Evaluation, and Selection as Key Ecological Receptors

Ecological Receptor	Valuation of Receptor	Selection as Key Ecological Receptor Y/N
Skylark	Skylark is a Priority species under the Vale of Glamorgan BAP. As skylark regularly occur within the study area in large numbers, the population within the study area is considered to be of County importance.	Yes
Song thrush	This species was also noted within the study area and is a Vale of Glamorgan BAP Priority species. As no information is available on the numbers of song thrush within the study area, a precautionary approach is taken in assigning it a value of County importance.	Yes
Yellowhammer	Yellowhammer is a red-listed species which is also listed as a Priority species under the UK BAP. This species was recorded on a number of occasions during surveys conducted for the Scheme, and so is considered to have a local stronghold in the area. This population is therefore considered to be of County importance.	Yes
Kingfisher	Kingfisher is listed on Schedule 1 of the WCA and is also an EU Birds Directive Annex I species. Given its conservation and legal status, the presence of even one individual within the Scheme corridor is considered to be of County importance.	Yes
Other breeding birds	Other breeding birds recorded within the study area are either common and widespread species in the UK, or occur in low numbers within the study area. They area therefore considered to be of Local importance.	Yes
Roosting bats	Pipistrelle and brown long-eared bat were recorded roosting within the study area. All bat species are listed as Priority species under the Vale of Glamorgan BAP, and so are considered to be of County importance.	Yes
Commuting and foraging bats	Relatively large numbers of commuting and foraging bats were recorded during surveys conducted for the Scheme. All bat species are listed as Priority species under the Vale of Glamorgan BAP, and so are considered to be of County importance.	Yes
Badgers	This species is protected under national legislation, but is relatively widespread and abundant throughout the UK. It is assumed that badger occurs in low densities within the study area. This species is therefore considered to be of Local importance.	Yes

Table 9.11: Ecological Receptors within the Study Area, Evaluation, and Selection as Key Ecological Receptors

Ecological Receptor	Valuation of Receptor	Selection as Key Ecological Receptor Y/N
Dormice	The hazel dormouse is listed on Annex IV of the European Habitats Directive but is assumed to occur in low densities within the study area, if at all. The population which may be affected by the Scheme is therefore considered to be of Local importance.	Yes
Otters	Otter is listed on Annex II and Annex IV of the European Habitats Directive. It is also a Vale of Glamorgan Priority species. Otter is therefore considered to be of County importance.	Yes
Brown hare	Brown hare, though not afforded a high degree of legal protection, is a Priority species in the UK BAP, Section 42 of the NERC Act, and the Vale of Glamorgan BAP. This species was sighted on several occasions throughout the study area. In relation to the Scheme, brown hare is therefore considered to be of County importance.	Yes

Predicted Changes in Absence of Scheme

9.4.108 The CIEEM (2016) guidelines indicate that the assessment of impacts should be undertaken in relation to the baseline conditions are those existing in the absence of the proposed development, including other developments for which planning consent has been granted or environmental trends such as climate change.

9.4.109 In the absence of the Scheme, it is likely that much of the agricultural land use will continue to be used for similar intensive agriculture. Individual fields may alternate between arable and pasture depending on farming practices. Hedges would continue to be maintained by flailing. The few remaining semi-improved or marshy grasslands are likely to be most at risk of loss through agricultural development, though horse pastures are likely to continue to be grazed.

9.4.110 The woodlands would probably continue as woodlands. The blocks of wood forming Barry Woodlands SSSI are statutorily protected and will continue to be managed for their scientific interest. However, if ash die-back disease (*Chalara fraxinea* and its sexual stage *Hymenoscyphus pseudoalbidus*), which causes widespread damage and death in ash, continues to spread in Britain there could be a significant loss of ash trees from all the woodlands in the short term, which is likely to be replaced by sycamore, oak or field maple regeneration in the medium term. The relatively few ash trees in hedges would be similarly affected.

9.4.111 Although agriculture is likely to continue in the same general way, developments in the study area may result in significant changes. Three Solar Farm developments have already been approved or constructed in the study area (for example, land at Waycock Cross, or Sutton Mawr Farm) and more may be proposed. The proposed Solar Farms would be located in arable or improved pasture (whilst retaining the existing hedgerows), and further Solar Farms would result in further loss of these habitats. The loss of arable land set-aside land to solar farms may adversely affect ground-nesting and seed-eating birds, as these habitats are important feeding and

breeding habitats for such species. However, some of the proposed developments also involve compensatory measures such as sympathetic management of adjacent fields for skylark and other ground-nesting birds, and so these proposed developments may in fact result in a slight beneficial effect on such species.

9.4.112 To predict how the natural environment might change with climate change, predictions have been taken from the UK Climate Projections (UKCP09) as summarized by the Welsh Government (http://wales.gov.uk/topics/environmentcountryside/climatechange/preparing/impacts/projections/?lang=en, accessed November 2014) using the medium emissions scenarios. Compared to the 1961-1990 baseline, the climate is expected to become warmer and wetter in winter and warmer and dryer in summer over the next 60 years (Table 9.12).

Table 9.12: Climate Change Predictions for Wales (from UKCP09)

Climatic variable	2020s	2050s	2080s
Mean annual temperature change	+ 1.3°C	+ 2.3°C	+ 3.3°C
Maximum annual temperature change	+ 1.6°C	+ 2.7°C	+ 3.8°C
Mean winter rainfall (% change)	+ 7%	+ 14%	+ 19%
Mean summer rainfall (% change)	- 6%	- 17%	- 20%

9.4.113 The main predicted ecological impacts to the study area from climate change are effects on the damp woodlands, marshy grasslands and water bodies and their associated fauna during summer. The damp waterlogged soils are a feature of the Barry Woodlands SSSI and other woods, which may dry more in summer, possibly resulting in reductions or loss of moisture-loving ground flora plants like thin-spiked wood-sedge (*Carex strigosa*). These are likely to be replaced by more drought tolerant species already present such as dog's mercury. The woodland trees and shrubs present have broader climatic tolerances and are less likely to be affected.

9.4.114 The marshy grasslands are also likely to become drier in summer and these may then become suitable for agricultural improvement. Some ponds and ditches may dry out in summer, or dry out for longer periods. The upper reaches of the streams are also likely to dry out more regularly and for longer periods and over greater lengths of water course. The lower summer volumes of water may affect the invertebrate assemblage within watercourses such as the River Waycock, with reduced feeding opportunities for fish and resulting knock-on effects on species higher in the food chain, such as kingfisher and otter, which are dependent on rivers as a food resource.

9.4.115 The undulating topography with relatively rapid run-off over clayey surface soils suggests that during winter there may be higher volumes of water in the streams and ditches, resulting from the increased winter rainfall.

9.4.116 As the climate warms, fields may be more suitable for arable crops such as maize rather than for pasture. Increased arable land might suit species such as skylarks.

9.5 Predicted Effects (without Mitigation)

Construction

9.5.1 Predicted impacts during construction vary in their detailed characterisations between individual ecological receptors, however the predicted impacts fall into several discrete types. Potential direct impacts include:

- loss of habitats through clearance of vegetation (e.g. trees/hedgerows for dormice, breeding birds)
- loss of habitats through topsoil stripping and subsequent earthworks (e.g. loss of reptile habitat and badger setts)
- loss of bat roosts through removal of trees
- injury or mortality of key species if present in these habitats at the time of their removal
- severance of retained habitats to either side of the Scheme by the construction site, particularly for less mobile species (e.g. dormice)

9.5.2 Potential indirect impacts include:

- damage to retained habitats adjacent to the Scheme through dust deposition during construction
- small-scale disruptions in hydrology (groundwater) caused by earthworks during construction of the Scheme, for example flooding of hedgerow sections adjacent to the Scheme
- disturbance to individuals of key species which are resident in retained habitats close to the Scheme (e.g. by construction site activities such as noise, construction site lighting)
- similar disturbance which could affect breeding success or survival of these species locally
- potential for pollution events to affect watercourses crossed by the Scheme, and as a result affect key species and downstream habitats.

9.5.3 Some of these impacts, as well as varying between receptors, also vary seasonally. However, appropriate timing of the proposed works (such as removal of vegetation outside the bird breeding season) has been taken into account in the proposed construction programme in order to minimise these effects.

9.5.4 Table 9.13 outlines the magnitude and significance of impacts (in the absence of mitigation) on each of the Key Ecological Receptors identified in Table 9.11 during the Construction phase of the Scheme. Sites which are Designated (e.g. as SINCs) are described first and then excluded from the general description of impacts on the habitats to avoid duplication.

Table 9.13: Impacts on Key Ecological Receptors During Construction of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
Barry Woodlands SSSI	National importance	0.431 ha of ancient semi-natural broad-leaved woodland would be lost permanently, and another 0.469 ha taken under temporary licence and returned after construction. 298m length of watercourse would be realigned and an additional 6 m culverted. Potential increase in off-road cycling in Middleton Plantation.	Medium adverse	Very large adverse
SINC 106 Amelia Trust Woodland Pond	County Importance	Not directly affected, approximately 200m from Scheme. Very minor potential impacts from dust and disturbance.	Negligible adverse	Neutral
SINC 107 Amelia Trust Dew Pond	County Importance	Not directly affected, >250m from Scheme.	N/A	N/A
SINC 220 Land South of Blackland Farm	County Importance	0.016 ha of broad-leaved deciduous woodland lost along edge of road (up to 4m wide). Minor additional potential impacts from dust and disturbance.	Low adverse	Slight adverse
SINC 221 Land North of Whitton Rosser Farm	County Importance	Not directly affected.	N/A	N/A
SINC 222 Land North-east of Whitton Rosser Farm	County Importance	Directly affected with permanent loss of 0.12 ha of scrub, about 9% of the SINC. The SINC is designated for its woodland rather than scrub.	Medium adverse	Moderate adverse
SINC 227 Land South of Little Hamston	County Importance	Not directly affected. Minor road tie-ins within 196m of the woodland.	N/A	N/A
SINC 281 Land to west of Northcliff Farm	County Importance	Not directly affected. Minor road tie-ins within 130m of the woodland.	N/A	N/A
SINC 283 Sutton Wood	County Importance	Not directly affected. Minor potential impacts from dust and disturbance.	Negligible adverse	Slight adverse
SINC 285 East of Barry College	County Importance	Not directly affected.	N/A	N/A

Table 9.13: Impacts on Key Ecological Receptors During Construction of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
SINC 336 Walters Farm	County Importance	A small strip of grassland about 10m wide (0.03 ha) would be taken from the very western edge of the SINC under temporary licence for construction. It would later be restored and replanted.	Low adverse	Moderate adverse
Semi-natural broadleaved woodland	National importance or County Importance Local Importance	A strip of 0.193 ha woodland would be permanently lost at the south end of Middleton Plantation (outside the SSSI) with another 0.231 ha taken for essential licence which would be returned after construction.	Moderate adverse	Moderate adverse
Plantation broadleaved woodland	Local importance	0.16 ha of the western edge of the recent plantations near Barry College along the edge of Five Mile Lane will be lost.	Low adverse	Slight adverse
Semi-natural mixed woodland	Local importance	Sutton Fach Wood would not be directly affected. Minor potential impacts from dust and disturbance.	Negligible adverse	Slight adverse
Dense scrub	Local importance	0.248 ha of scrub is affected north of Waycock Cross at the south end of the scheme and 0.12 ha of the SINC 222 Land North-east of Whitton Rosser Farm (see above).	Low adverse	Slight adverse
Unimproved neutral grassland	Neighbourhood Importance	Very small areas of road verges will be affected where the Scheme ties into existing roads. These are narrow linear features with very small area. Some small areas associated with the junction changes at Sycamore Cross would also be lost.	Low adverse	Slight adverse
Semi-improved neutral grassland	Local Importance	0.35 ha of semi-improved neutral grassland will be lost opposite Amelia Methodist Trust Farm (0.16 ha to drainage, 0.19 ha to road).	Low adverse	Slight adverse
Marshy grassland	Local Importance	No marshy grassland will be directly affected. Minor potential impacts from dust and disturbance.	Negligible adverse	Slight adverse
Standing water	Local Importance	No ponds are directly affected. Potential run-off of contaminants in ponds to may affect the water quality.	Low adverse	Slight adverse
Running water – River Waycock	District Importance	The main River Waycock would not be directly affected. Potential run-off of contaminants and sediment to River Waycock may affect the water quality.	Low adverse	Slight adverse

Table 9.13: Impacts on Key Ecological Receptors During Construction of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
Running Water, other small streams	Local Importance	630m of watercourse would be affected during construction but would have to be replaced at the same time to maintain water flow. Potential run-off of contaminants may affect the water quality.	Low adverse	Slight adverse
Intact hedge	County Importance of Neighbourhood Importance	1,104m of species-rich hedge and 434m of species poor hedge would be lost (total 1,538m).	Low adverse	Moderate adverse
Hedge with trees	County Importance	83m of species-rich hedgerow with trees would be lost.	Low adverse	Moderate adverse
Fish (including bullhead, European eel and brown trout)	Local Importance	Potential run-off of contaminants to River Waycock may affect the habitat of these species.	Low adverse	Slight adverse
		Noise and vibration generated during construction works near the River Waycock may result in disturbance to these species.	Low adverse	Slight adverse
Great-crested newt	County Importance	No impacts are expected on this species. The nearest known population is 400m to the west of the existing road. The existing road acts as a barrier to dispersal, and so it is unlikely that newts would be affected by the Scheme. Surveys for Great Crested Newt revealed low scores for Habitat Suitability Index (HSI) for this species, and no signs of this species were recorded during surveys.	Negligible adverse	Negligible adverse
Other amphibians	Local Importance	Potential mortalities during construction phase, if amphibians were to get into the works area.	Negligible adverse	Slight adverse
		The construction of attenuation ponds may provide more habitat for amphibians than currently exists but as these require regular maintenance any amphibian use would be incidental and short term.	Negligible adverse	Negligible
Reptiles	Local Importance	Potential mortalities during construction phase, if reptiles were to get in to the construction area.	Low adverse	Slight adverse
		Loss of small areas of suitable habitat (rough grass, scrub).	Low adverse	Slight adverse

Table 9.13: Impacts on Key Ecological Receptors During Construction of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
Skylark	County Importance	Damage or destruction of active nests/eggs/dependant young during site clearance/construction works within arable fields/field margins.	Medium adverse	Moderate adverse
		Some small areas of arable fields will be lost under the footprint of the Scheme. Arable fields and their associated field margins represent important feeding and breeding habitat for this species. NOTE: The surrounding area contains abundant arable fields suitable for this species, and this has been taken into account in determining the severity of this impact.	Low adverse	Slight adverse
Song thrush	County Importance	Damage or destruction of active nests/eggs/dependant young during site clearance works in areas with thick vegetation.	Medium adverse	Moderate adverse
		Loss of breeding habitat (hedgerows, woodland and scrub) during site clearance works, including foraging habitat within territories for breeding pairs. NOTE: Only very small areas of suitable breeding bird habitat will be lost under the footprint of the road, and this has been taken into account in determining the severity of this impact.	Low adverse	Slight adverse
Yellowhammer	County Importance	Damage or destruction of active nests/eggs/dependant young during site clearance works in areas with thick vegetation.	Medium adverse	Moderate adverse
		Loss of breeding habitat (hedgerows) during site clearance works, including foraging habitat within territories for breeding pairs. NOTE: Only very small areas of suitable breeding bird habitat will be lost under the footprint of the road, and this has been taken into account in determining the severity of this impact.	Low adverse	Slight adverse
		Some small areas of arable fields will be lost under the footprint of the Scheme. Arable fields and their associated field margins represent important feeding habitat for this species. NOTE: The surrounding area contains abundant arable fields suitable for this species, and this has been taken into account in determining the severity of this impact.	Low adverse	Slight adverse
Kingfisher	County Importance	Pollution of the River Waycock may result in indirect impacts through fish kills which would reduce the food resource for kingfisher.	Low adverse	Slight adverse

Table 9.13: Impacts on Key Ecological Receptors During Construction of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
		Construction works in the vicinity of the River Waycock may cause disturbance to kingfisher.	Low adverse	Slight adverse
Other breeding birds	Local Importance	Damage or destruction of active nests/eggs/dependant young during site clearance works.	Low adverse	Slight adverse
		Loss of breeding bird habitat during site clearance works, including foraging habitat within territories for breeding pairs.	Low adverse	Slight adverse
		Disturbance of birds during construction works will deter birds from nesting near the site. However, there is abundant suitable habitat (in the form of hedgerows, woodland and scrub) in the surrounding area.	Low adverse	Slight adverse
Roosting bats	County Importance	No bat roosts were found in trees on the line of the Scheme, but two category 1 trees which potentially provide very good roost habitat would be lost. The bat roost identified in the shed adjacent to the Scheme would not be lost as a result of the Scheme.	Low adverse	Slight adverse
Commuting and foraging bats	County Importance	Loss of foraging habitat due to site clearance works.	Low adverse	Moderate adverse
		Disruption of commuting routes due to removal of linear vegetation features or construction site lighting.	Low adverse	Moderate adverse
Badgers	Local Importance	Disturbance of badgers in the area through construction site noise, lighting or vibration.	Low adverse	Slight adverse
Dormice	Local Importance	Mortality of dormice during site clearance activities.	Medium adverse	Slight adverse
		Disturbance of dormice in nearby retained habitats through construction site noise, lighting or vibration.	Low adverse	Slight adverse
		Loss of small areas of suitable habitat (hedgerows and treelines, some woodland)	Low adverse	Slight adverse
Otters	County Importance	Disturbance to otters if using lying up sites or passing along watercourses crossed by the Scheme during construction.	Low adverse	Moderate adverse

Table 9.13: Impacts on Key Ecological Receptors During Construction of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
Brown Hare	County Importance	Disturbance to brown hare if using habitats in the vicinity during construction.	Low adverse	Moderate adverse

Impacts on Barry Woodlands SSSI

9.5.5 The most significant impact of the Scheme would be on 2 of the 14 woodlands which together comprise Barry Woodlands SSSI. The Scheme would result in permanent loss of a 0.264 ha strip of vegetation along the length of the road in the SSSI (Ch4100m to Ch4400m) on the west side (Middleton Plantation) and another 0.167 ha on the east side (Barry College Wood), equating to a total loss of 0.431 ha.

9.5.6 A further 0.168 ha would be taken under essential licence for construction in Middleton plantation and 0.301 ha in Barry College Wood, which would be returned after construction, equating to a total loss of 0.469 ha. Not all trees would be removed from these areas, but the ground flora is likely to be affected. A map showing land take for the 'essential licence for construction in the SSSI' is provided in Figure 3.1.

9.5.7 Within the SSSI, there would be removal and replacement of stream banks for 298 m (118 m Middleton Planation, 180 m in Barry College Wood), where the stream banks are adjacent to the road (Ch4200m to Ch4400m). The existing culvert under the road would be extended with the widened road by about 6 m. The stream would be straightened with a new channel created to tie into the existing watercourse. The stream is currently at about 1-1.5 m below the existing road level, and significant earthworks would be needed to stabilise the banks, potentially on both sides of the stream in places.

9.5.8 Loss of the more or less continuous tree canopy over the road in the SSSI may result in a linear canopy gap along the road of c. 200 m. This may, at least in the short term until the canopy grows back across the road, result in increased light penetration to the ground flora (given the extensive cover of ivy already this is unlikely to have further significant effects on the composition of the woodland) and may limit dormice movement across the road through the canopy; however, dormice population numbers appear to be low (none were recorded in nest tube surveys in 2008 or nut searches in 2009; Soltys-Brewster Consulting 2011a), and there would still be connected canopies for part of the road through the SSSI, and dormice are known to cross open ground such as roads. This is likely to be a very minor impact on dormice movement.

9.5.9 Bats are frequent in the area and the canopy gap along the road might attract feeding bats which would then be susceptible to additional mortality from moving traffic; this is difficult to quantify but again is likely to be a minor impact that is most significant at times when peak traffic coincides with dawn and dusk.

9.5.10 Barry Woodlands SSSI has a minor ecological impact unrelated to the Scheme at Middleton Plantation where there has been some off-road mountain biking incursion into the woodland; the provision of easy access via the cycle way along the woodland may acerbate this problem by allowing easier access.

Operation

9.5.11 Predicted effects on key ecological receptors during the operation of the Scheme also vary in their characteristics, but fall into several broad types. Potential direct impacts include:

- the risk of road mortality for a number of species during operation of the Scheme, should these species attempt to cross the Scheme (e.g. bats, otters and badgers);

- the risk of mortality where the verges of the Scheme provide habitat for species which are subsequently at risk from road traffic collisions (e.g. bird species such as barn owl), or from routine management of the verges (e.g. slow worms hit by grass cutters); and
- the potential that some key species may be able to recolonize the verges, and potentially even extend their populations due to the lower intensity of management on the verges compared to the baseline conditions.

9.5.12 The majority of potential effects identified during operation of the Scheme are indirect, and include:

- the risk of adverse effects from pollution incidents on the Scheme entering watercourses;
- the risk of noise and lighting associated with the Scheme causing disturbance to key species in retained habitats close to the Scheme (e.g. nesting birds or roosting bats); and
- the potential for the Scheme to represent a physical or psychological barrier to key species, and therefore to result in fragmentation of populations.

9.5.13 Potential impacts on Key Ecological Receptors during the Operational Phase of the Scheme are outlined in Table 9.14.

Impacts on Barry Woodlands SSSI

9.5.14 The impacts of changes in air quality on Barry Woodlands SSSI have been modelled in Chapter 6 Air Quality.

9.5.15 Existing ambient deposition levels of the order of 22-27 kgN/ha/yr are already in exceedence of the minimum critical load of 5kgN/ha/yr for woodland habitats, and this will continue to 2030 and beyond, whether or not the Scheme proceeds.

9.5.16 In 2017, the Scheme would result in substantial adverse effects of increased annual mean NO_X deposition within 45 m of the carriageway at Middleton Plantation and within 55 m of the carriageway at Barry College Woodland (Table 6-16), falling to insignificant levels beyond 45 m. Lidmore Wood shows a small increased deposition up to 230 m from the road with a slight adverse impact. In contrast, Pencoetre Woods and Cwm Talwyg Woods along Port Road West/East and A4231 have decreased deposition due to lower traffic with slight beneficial effects.

9.5.17 A similar pattern occurs in 2032 with an improvement on 2017 with the substantial adverse impacts occurring within 20 m of the carriageway at Middleton Plantation and within 25 m of the carriageway at Barry College Woodland (Table 6-16).

9.5.18 Given that the existing background NO_X deposition levels already significantly exceed the critical loads, the main effect on the woodland vegetation for which the site is designated will be a small increase in eutrophication of the woodland adjacent to the roadsides with robust competitive ground flora plants such as Enchanter's Nightshade and Nettles increasing.

9.5.19 To minimise any increase in off-road cycling in Barry Woodlands SSSI as a result of the adjacent cycle way, the woodland would be fenced from the cycleway.

Table 9.14: Impacts on Key Ecological Receptors During Operation of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
Barry Woodlands SSSI	National importance	Indirect increases in air pollution (NO_x) and noise from increased traffic on improved road. NO_x will result in eutrophication of vegetation adjacent to carriageway.	Medium Adverse impacts adjacent to road	Very Large
SINC 174 Betty Lucas Wood	County Importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
SINC 106 Amelia Trust Woodland Pond	County Importance	Very minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
SINC 220 Land South of Blackland Farm	County Importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
SINC 221 Land North of Whitton Rosser Farm	County Importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
SINC 222 Land North-east of Whitton Rosser Farm	County Importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
Semi-natural broadleaved woodland	National importance or County Importance Local Importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
Plantation broadleaved woodland	Local importance	The overall increase in woodland would result from the planting of about 5 ha of woodland throughout the Scheme.	Low Beneficial	Slight Beneficial
		Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
Semi-natural mixed woodland	Local importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse

Table 9.14: Impacts on Key Ecological Receptors During Operation of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
Dense scrub	Local importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
Unimproved neutral grassland	Neighbourhood Importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
Semi-improved neutral grassland	Local Importance	2.78 ha of species rich wild flower grassland will be planted along the Scheme.	Low Beneficial	Slight Beneficial
		Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
Marshy grassland	Local Importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
Standing water	Local Importance	Potential run-off of contaminants to may affect the water quality	Low Adverse	Slight Adverse
Running water – River Waycock	District Importance	Potential run-off of contaminants to River Waycock may affect the water quality	Low Adverse	Slight Adverse
Running Water, other small streams	Local Importance	Potential run-off of contaminants to may affect the water quality.	Low Adverse	Slight Adverse
Intact hedge	County Importance of Neighbourhood Importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
	County Importance of Neighbourhood Importance	Scheme planting will result in new hedgerow/treeline creation	Low Beneficial	Slight Beneficial
Hedge with trees	County Importance	Minor indirect increases in air pollution and noise from increased traffic on improved road	Low Adverse	Slight Adverse
	County Importance	Planting scheme will result in new hedgerow/treeline	Low Beneficial	Slight Beneficial
Fish (including bullhead, European eel and brown trout)	Local Importance	No operational impacts expected.	N/A	N/A

Table 9.14: Impacts on Key Ecological Receptors During Operation of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
Great-crested newt	County Importance	The construction of attenuation ponds may provide more habitat for great crested newts than currently exists but as these require regular maintenance any use would be incidental and short term.	Negligible	Negligible
Other amphibians	Local Importance	The construction of attenuation ponds may provide more habitat for amphibians than currently exists but as these require regular maintenance any amphibian use would be incidental and short term.	Negligible	Negligible
Reptiles	Local Importance	Potential for mortality associated with routine management of verges if reptiles recolonize these areas.	Medium Adverse	Slight Adverse
		Newly-created road verges and scrub habitats increase the overall area of habitat for these species.	Medium Beneficial	Slight Beneficial
Skylark	County Importance	Slight reduction in area of arable field habitat available for feeding. NOTE: The surrounding area contains abundant arable fields suitable for this species, and this has been taken into account in determining the severity of this impact.	Low Adverse	Slight Adverse
Song thrush	County Importance	Planting scheme will result in a net increase in the total lengths of hedgerows (an important feeding and breeding habitat for this species) within the study area.	Low Beneficial	Slight Beneficial
Yellowhammer	County Importance	Slight reduction in area of arable field habitat available for feeding. NOTE: The surrounding area contains abundant arable fields suitable for this species, and this has been taken into account in determining the severity of this impact.	Low Adverse	Slight Adverse
		Planting scheme will result in a net increase in the total lengths of hedgerows (an important breeding habitat for this species) within the study area.	Low Beneficial	Slight Beneficial
Kingfisher	County Importance	N/A	N/A	N/A

Table 9.14: Impacts on Key Ecological Receptors During Operation of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
Other breeding birds	Local Importance	Planting scheme will result in a net increase in the total lengths of hedgerows (an important breeding habitat for breeding birds) within the study area.	Low Beneficial	Slight Beneficial
Roosting bats	County Importance	N/A	N/A	N/A
Commuting and foraging bats	County Importance	In locations where the Scheme is close to being on-line, it is considered that the dangers posed to bats by road traffic is unlikely to change significantly from the current situation. Tree felling either side of the carriageway may cause bats to fly lower between the hedges and possibly increase the risk from traffic collision.	Neutral	Neutral
		Where the Scheme is further off-line, such as at Grovelands Farm, severance of known roosts from the network of hedgerows and woodland areas to the east may occur. Bats attempting to access roosting features and foraging habitat on the western side of the Scheme would be vulnerable to road traffic, particularly the Brown long-eared bats, which are low flying and more susceptible to traffic collision.	Low Adverse	Slight Adverse
		The River Waycock provided a safe road crossing opportunity for bats. As the Scheme is on line at this location it is unlikely to have any adverse effects on commuting and foraging bats.	Neutral	Neutral
		Loss of commuting/foraging habitat (hedgerows and treelines)	Low Adverse	Slight Adverse
Badgers	Local Importance	Risk of mortality to badgers crossing the Scheme carriageway	Low Adverse	Slight Adverse
Dormice	Local Importance	Risk of mortality to dormice crossing the Scheme carriageway between hedges and blocks of woodland	N/A	N/A

Table 9.14: Impacts on Key Ecological Receptors During Operation of the Scheme

Key Ecological Receptor	Nature Conservation Value	Description of Impact	Magnitude of Impact	Significance of Impact
		Recent research has shown that dormice can cross road carriageways during seasonal dispersal movements, and therefore could theoretically be at some risk of road traffic mortality. However, it is likely that such dispersal movements are so rare that the risk of dormouse road mortality is negligible. Similarly, as dormice have been shown to nest in habitat very close to active carriageways, including those with lighting columns, no disturbance effects on dormice are predicted.	Low Adverse	Slight Adverse
		Improved foraging resource for dormice along the verges of the Scheme, within areas of scrub and hedgerow creation, as these will be less intensively managed than existing grazed pastures.	Low Beneficial	Slight Beneficial
Otters	County Importance	Risk of mortality to otters crossing the Scheme carriageway.	Low Adverse	Slight Adverse
Brown Hare	County Importance	Risk of mortality to hares crossing the Scheme carriageway.	Low Adverse	Slight Adverse

9.6 Mitigation

Construction

9.6.1 A Construction Environmental Management Plan (CEMP) should be produced, in line with the British Standard 42020.2013 Biodiversity – Code of Practice for Planning and Development, defining all the mitigation measures required during the construction phase of development. For example, impacts of dust deposition on habitats would be minimised by following good construction practice such as damping down haul routes when necessary, and ensuring that all site traffic obeys the site speed limits. The CEMP should be agreed with the Vale of Glamorgan Council prior to construction. Compliance with the CEMP will form part of the remit of the site Environmental Clerk of Works.

Designated sites

9.6.2 The unavoidable loss of 0.431 ha of Barry Woodlands SSSI will be partially mitigated by planting broad-leaved woodland of 2.8 ha at Waycock Bridge. It is proposed to replace the SSSI ancient woodland lost with new woodland of appropriate composition at the northern end of the SSSI in the improved pasture adjacent to Middleton Plantation, opposite the Welsh Hawking Centre. The woodland will be planted to be continuous with Middleton Plantation, and with other planting will extend to Sutton Wood and Sutton Fach Wood, providing a total additional area of 4.7 ha. It is acknowledged that this will not replace the quality of the SSSI woodland lost in the short term, but longer term may prove to be of value, as indeed Middleton Plantation has since it was planted many years ago. The planted woodland will also be fenced off from the adjacent pasture land to minimise grazing pressures.

9.6.3 The topsoil will first be stripped from the pasture land and soil from the affected parts of the SSSI will be spread over the new area. No ground flora will be sown on these areas to allow regeneration from this seed potential bank; if there is no woodland ground flora within 3 years, appropriate species which occur in the SSSI will be planted such as dog's mercury (*Mercurialis perennis*), sweet woodruff (*Galium odoratum*) and wood sedge (*Carex sylvatica*). All species will be grown from locally sourced seed.

9.6.4 Ideally, trees and shrubs will be planted to match the woodland composition as reported in the NVC survey (Soltys-Brewster Consulting 2011b), but as the SSSI woodlands are dominated by ash (which is predicted to be seriously affected by the ash dieback disease), it is proposed to only put a small amount of ash in the canopy, with equal percentages of the other canopy dominants. These are listed below in Table 9.15:

Table 9.15: Proposed canopy and shrub layer composition of new woodland

Latin Name	Common Name	Percentage of Planting
Canopy trees		
Acer campestre	Field maple	10%
Betula pendula	Silver birch	20%
Betula pubescens	Downy birch	2%
Fraxinus excelsior	Ash	20%
Quercus petraea	Sessile oak	2%

Latin Name	Common Name	Percentage of Planting
Quercus robur	Pedunculate oak	20%
Salix caprea	Goat willow	2%
Ulmus glabra	Wych elm	2%
Shrub layer (excluding canopy species)		
Cornus sanguinea	Dogwood	8%
Corylus avellana	Hazel	2%
Crataegus monogyna	Hawthorn	2%
Euonymus europaea	Spindle	2%
Ilex aquifolium	Holly	2%
Malus sylvestris	Crab apple	2%
Lonicera periclymenum	Honeysuckle	2%
Rosa arvensis	Field rose	2%

9.6.5 Bramble (*Rubus fruticosus*) and climbers such as ivy (*Hedera helix*) and traveller's joy (*Clematis vitalba*) are likely to grow rapidly and swamp the woodland in the short term, so will be left to colonise naturally from adjacent populations.

9.6.6 Where the narrow strip of SSSI land has to be taken under essential licence for construction, measures will be taken to protect and restore the ancient woodland soils. Following the appropriate soil standards (BS 3882:2015), top soil will be stripped and stored prior to construction and then replaced after construction to retain the seed banks. Subsoils will not be stripped and will be assessed for compaction remediation prior to reinstating the top soils. As for the new woodland, if there is no or inadequate woodland ground flora within 3 years, appropriate species grown from locally sourced seed will be added subject to agreement from NRW. Replacement trees and shrubs grown from locally collected seeds will planted if required to complete the canopy but with minimum intrusion into the SSSI.

Woodland and Scrub

9.6.7 The unavoidable loss of 0.12 ha of scrub in SINC 222 land north-east of Whitton Rosser Farm will be mitigated through the planting of 0.371 ha of woodland at Ch400m to Ch500m along the Scheme alignment. This woodland will be planted with the aim of matching the composition of woodland canopy and shrub species of the original SINC and will replace the area lost.

9.6.8 In addition to the mitigation for loss of SSSI and SINC as above, further broad-leaved woodland will be created between Sutton Wood and Sutton Fach Wood at Ch3200m to Ch3300m (see Figure 8.7e). These will increase the connectivity between the woodlands at this point which may, with time, provide an overall increase in woodland quality and reduce edge effects. The canopies and shrub layer will be selected to represent the existing semi-natural woodland in these areas, rather than the replanted canopies of both adjacent woods. They will be fenced to prevent grazing by stock.

Grassland

9.6.9 The narrow strip of land between the existing Five Mile Lane and the Scheme to the north of St Lythans Road will be used to create wild flower grasslands using a

conservation seed mix (see Figure 8.7c and 8.7d). All road verges will be re-vegetated using a conservation seed mix where possible, which will be subject to a single annual cut.

Hedges

9.6.10 Where practical, it is proposed to translocate coppice stools of shrubs and trees directly affected by the Scheme into new hedgerows before the growing season commences in March. It is anticipated that the clay-based soils will hold together and that the transplants will be reasonably successful. Failed transplants will be replaced by new plants. This will help to preserve the genetic integrity of woodland and scrub habitats within the Scheme, and allow for rapid establishment of new woodland/scrub habitats. This method has been selected as transplanted coppice stools tend to establish more quickly than newly-planted, nursery-grown shrubs.

9.6.11 It is proposed that new hedgerows will be planted inside the Scheme boundary in locations shown on Figure 8.7. The planting of new hedgerows has a dual ecological purpose:

- To compensate for the loss of habitat for breeding birds, dormouse etc. by providing similar habitat; and
- To link together the ends of retained hedgerows which will be severed by the Scheme and thereby provide a continuous network of 'ecological corridors' for wildlife. Joining the newly-planted hedgerows to existing hedgerows will facilitate the colonisation of a range of plant and animal species associated with this habitat type.

9.6.12 Approximately 6,230 m of hedgerow will be planted, considerably more than the 1,538 m of hedgerow and 83m of hedge and trees that will be removed during construction of the Scheme (refer to Table 9.16). Plans showing locations of hedgerows to be removed for translocation will be drawn up during detailed design. Planting of hedgerows will be carried out using the range of tree and shrub species that are found in the existing hedgerow network (see Phase 1 habitat survey target notes in Appendix 9.6). Care will be taken to ensure that plants of UK and ideally Welsh stock are used, rather than plants sourced from oversees, which may have different ecological characteristics to native-grown stock. Stock will be sourced from as near a location as possible to help minimise the risk of inadvertently introducing an alien pest species to the area.

Drainage

9.6.13 To link the Scheme into the local drainage network, four sets of attenuation ponds/interceptor ponds are proposed (for full details see Chapter 15 Road Drainage and the Water Environment). Whilst the primary purpose of these features is for drainage, they can also provide some wetland habitat. Reeds will be planted within the ponds to help with bioremediation of the road drainage runoff before it enters the water courses.

9.6.14 At the upper River Waycock water course, opposite Blackland Farm (Ch100m), a 0.131 ha reed bed attenuation pond with a separate 0.0241 ha interceptor pond, will be constructed.

9.6.15 At the Ford Brook water course north of Dyffryn Road crossroads (Ch1100m), a 0.093 ha reed bed attenuation pond with a separate 0.0234 ha interceptor pond, will be constructed.

9.6.16 At the Moulton Brook water course north of Northcliff Cottage (Ch1900m), a 0.131 ha reed bed attenuation pond with a separate 0.0241 ha interceptor pond, will be constructed.

9.6.17 At the unnamed water course near Sutton Wood (Ch3600m), a 0.281 ha reed bed attenuation pond with a separate 0.08 ha interceptor pond and a second 0.1649 ha reed bed attenuation pond below, will be constructed.

9.6.18 These ponds will be linked to the existing water courses through the construction of approximately 420 m of interconnected ditches.

River Waycock

9.6.19 Construction operations in the vicinity of the River Waycock may result in the run-off of sediment and pollutants into this watercourse. The risk of this occurring will be minimised by using careful site procedures for pollution control, based on current best practice guidelines. These are described in more detail in the Chapter 15 Road Drainage and the Water Environment, and include:

- Avoiding re-fuelling or parking site vehicles close to watercourses;
- Avoiding machinery working in watercourses as far as is possible;
- Minimising release of sediment during necessary watercourse diversions by use of silt traps downstream of the works;
- Positioning site compounds and welfare facilities at sufficient distance from watercourses to avoid the risk of pollution incidents;
- Using bunded fuel tanks and generators;
- Controlling construction site run-off into watercourses;
- Having spill kits available close to watercourses for rapid deployment in the event of a pollution event.

Fish

9.6.20 The risk of potential impacts to fish species within the River Waycock, including brown trout, European eel and bullhead, will also be minimised through the implementation of the mitigation measures as described above for the River Waycock.

Great Crested Newt

9.6.21 Although there is no evidence that great crested newts will be affected, pre-construction surveys will be carried out as a precautionary measure.

Other Amphibians

9.6.22 To avoid unnecessary mortality, animals seen during searches prior to construction will be removed to a safe place. The attenuation ponds created may provide some additional suitable habitat.

Reptiles

9.6.23 Appropriate measures will be implemented to prevent mortalities to reptiles. Vegetation clearance in areas of suitable reptile habitat is considered to be the activity

most likely to result in harm to reptiles. In order to prevent injury or mortalities to these species, ecological supervision will be required in areas of potential reptile habitat. If reptiles are found during vegetation clearance works, they will be removed from the works area and relocated to a suitable area nearby.

9.6.24 It is important to note that the relocation of slow worms is seasonally constrained, as reptiles are not active during the winter months, and may not need to use basking sites during warm conditions in mid-summer. The most appropriate times of year to undertake this work will therefore be during either spring or autumn. However, the vegetation clearance strategy also has to take the life cycles of other species, such as breeding birds and dormouse, into account – see details below.

Skylark (and other ground nesting birds)

9.6.25 Where possible, works will be timed so as to avoid impacts to ground-nesting birds, particularly skylark and meadow pipit, which were recorded within the arable fields in the north of the study area. Works carried out prior to April 2015 would avoid the nesting season of skylark and meadow pipit. If works in arable fields are to commence in the period April to early August, an ecologist will conduct a thorough search of the affected areas in order to determine the presence of ground-nesting birds. If nests are found, a 10m buffer zone of vegetation will be left around the nests, and such areas will be left undisturbed until such time as the chicks have fledged. In order to avoid accidental damage, such areas will be clearly demarcated and all site staff will be given a 'toolbox talk' to inform them of the concerns regarding nesting birds.

Song Thrush, Yellowhammer and Other Breeding Birds

9.6.26 The best way to avoid impacts to breeding birds is through the appropriate timing of works, to avoid vegetation clearance during the bird nesting season (generally March to August inclusive but varies according to weather conditions and species). If vegetation clearance is unavoidable within the period March to August, all works will be supervised by a suitably qualified ecologist, who will carry out a thorough search for active birds' nests prior to clearance. If any active nests are found, a 10m buffer zone of vegetation will be left around the nests, and such areas will be left undisturbed until such time as the chicks have fledged. In order to avoid accidental damage, such areas will be clearly demarcated and all site staff will be given a 'toolbox talk' to inform them of the concerns regarding nesting birds.

Roosting Bats

9.6.27 Although no bat roosts were found in the seven trees examined along the line of the Scheme, a bat-licensed ecologist will carry out an aerial re-inspection of those trees categorised as Category 1, and those trees that were inaccessible in the original surveys, immediately prior to works commencing and be on site during any works to those trees. A toolbox talk regarding bats will be given to the tree work contractors by the ecologist. If bats are discovered during works, work will stop and not resume until advice has been given by the onsite ecologist. The ecologist will have the necessary equipment to care for any discovered bat(s) and a method statement regarding actions on discovering bats will be in place prior to works commencing. Bright lighting will not be directed to towards the trees identified as having potential of category 1 and 2.

Commuting and Foraging Bats

9.6.28 The most appropriate method to mitigate the impact on the severed mature hedgerow (Survey location 3 in Appendix 9.4), along which there is a known Brown long-eared (*Plecotus auritus)* roost, would be to provide an underpass. However, this is not possible as the ground levels at this location do not allow it. Recent studies have suggested limited success of bat bridges / bat gantries in mitigating severance of flightlines by roads (Berthinussen & Altringham, 2012; Halcrow Group & Green, 2011). Therefore this method is not considered appropriate.

9.6.29 Recent studies also suggest limited success in the use of 'hop overs' (the planting of vegetation either side of the road to encourage bats to cross at canopy height) in maintaining local bat populations (Berthinussen & Altringham, 2012, Russell *et al.,* 2009; Halcrow Group & Green, 2011). However, some success has been demonstrated by these studies. In this situation a 'hop over' solution is considered to be the best option to mitigate the severance of this flightline, as other options are limited.

9.6.30 As Brown long-eared bats are a species which are low flying and will fly through the canopy, hop over planting will be used in conjunction with 4 to 5m high wooden / screen mesh (as suggested by Limpens *et al.*, 2005 reported in Halcrow and Green, 2011). This will be supplemented with planting to guide bats to this safe crossing point.

9.6.31 In conjunction with the above, three Schweglar 2F bat boxes will be provided on the eastern side of the new carriageway, providing roosting opportunity for bats to the east of the carriageway without them having to cross the road. These will be located in existing mature trees along the hedgerow. This particular bat boxes have been specified as they are marketed as being particularly successful for *Plecotus auritus*.

9.6.32 Woodland, scrub and hedgerow planting (described above) will mitigate the loss of foraging habitat.

Badgers

9.6.33 As there were no badger setts identified on, or within 30m of the Scheme footprint, no direct impacts to badgers are foreseen during the construction phase of the Scheme. However, it is possible that badgers may dig setts in the area prior to the commencement of construction. Therefore, a further inspection of the construction corridor, site compound, storage areas and a 50m buffer zone surrounding those areas will be carried out immediately prior to the start of site clearance for construction, to identify whether any new badger setts have been established in the area. If any new badger setts are discovered during this survey, construction work will not proceed in that area until one of the following procedures is followed:

- If a sett is discovered in an area that is required for construction, a licence will be obtained from NRW under the Protection of Badgers Act to permit sett exclusion.
- If a sett is not in an area that is required for construction but is within 30m of such an area, a licence may need to be obtained from NRW under the Protection of Badgers Act to permit disturbance of the sett. Such a licence would impose conditions that cannot be detailed in advance but may include restrictions on working locations and/or certain types of activities in the vicinity of the sett, and may require the presence of an ecologist acting under the licence on site at certain times.

9.6.34 Badger licences are normally granted only for work between July and November and it is necessary to take this into account in work scheduling, or to provide evidence to justify seeking a licence for works outside this period.

9.6.35 In addition to searches for badger setts, the pre-construction surveys will also involve checking for other signs of badger activity, such as dung pits, feeding signs and paths. This will inform the implementation of badger mitigation for the Scheme; in particular, site compounds, storage areas and other activities associated with the development will be positioned so as to avoid known badger commuting and/or foraging areas.

Dormice

9.6.36 The proposed works affecting dormice comprise vegetation clearance at the initial stage of construction works on site. At present, the date for commencement of site clearance works is unknown. If site clearance is to begin in winter/spring 2016 it is proposed that vegetation clearance will be carried out using a 'two stage' method – i.e. above ground vegetation will be coppiced between November and March inclusive, to avoid both the bird nesting season and the period when dormice are most likely to be found above ground, with coppiced areas dug up at a later stage. Coppiced areas should not be dug up any earlier than May (the time when dormice emerge from hibernation). This strategy avoids disturbance to nesting birds, while also avoiding impacts to hibernating dormice (and also to hibernating reptiles).

9.6.37 If site clearance is to be carried out later than spring 2016, a different approach to dormouse mitigation will be required. Summer vegetation clearance may be carried out, by taking out small patches of vegetation on successive days, when animals are active and do not have dependent young. Such clearance will be carried out by hand, with an ecologist carrying out a thorough search for nests prior to clearance. After early June, female dormouse are likely to have young in their nests, and so any clearance in areas with high dormouse potential (i.e. those classified as optimal or suitable; see details in Appendix 9.3) should be prioritised for clearance prior to June 2016. If this is not possible, thorough searches will have to be carried out by an ecologist prior to clearance (see below).

9.6.38 All hedgerows and planting will be inspected by an ecologist prior to vegetation clearance, in order to identify occupied dormouse nests. Where possible, these will be checked to confirm the absence of dependant young, with particular care to be taken in the period June to October, when dormouse are likely to have young. Any nests containing active or torpid dormice that can be removed will be translocated into retained habitat close to the Scheme. In the unlikely event of a dormouse being found, all works would cease and advice would be sought from the on-site ecologist and NRW and the requirement for a mitigation licence ascertained.

9.6.39 In general, vegetation clearance will commence at or close to the western edge of the Scheme footprint, so that dormice, if present, are displaced primarily from the existing road eastwards into the green-field areas that the Scheme bisects. The area to the east of the existing road contains an extensive network of retained habitat suitable for dormouse.

9.6.40 Up to 20m of each hedgerow will be cleared per day, so that dormice are progressively displaced into retained habitat, rather than being immediately removed from their home ranges.

9.6.41 The creation of new habitats, such as hedgerow, scrub and woodland (as described above), will also provide new foraging/commuting areas for dormouse.

Otters

9.6.42 Disturbance to otters will largely be avoided by limiting construction site lighting to specific locations where it is absolutely necessary for public safety or security, and by avoiding light spill onto watercourses. Care will be taken to avoid positioning site compounds or welfare units, generators for traffic management etc., in close proximity to watercourses which may be used by otters. Work immediately adjacent to watercourses will only be carried out during daylight hours.

9.6.43 Approximately 280m of mammal fencing will be installed on either side of the Scheme (total 560m) from the River Waycock west to 100 m beyond the culvert for the small stream from Sutton Fach Wood (Ch3300m) to reduce the chance of otters crossing the road at this location.

Operation

Reptiles

9.6.44 Reptiles that recolonize the verges of the Scheme following construction will be at some risk of mortality during routine grassland cutting. This risk will however be reduced as species-rich grassland will not be created on the verges within 2m of the carriageway, where more regular cutting is required. Habitat likely to be of higher value to reptiles will therefore be limited to cutting and embankment slopes away from the carriageway.

9.6.45 Management of grassland areas supporting reptiles will aim to minimise the risk of mortality through timing of works (i.e. during the winter months, when reptiles will be hibernating underground and therefore at lower risk). If works are necessary during the summer months, a cutting height of no less than 50mm will be set to minimise the risk of reptiles being harmed.

Breeding Birds

9.6.46 Birds breeding close to the Scheme will potentially be at risk of road mortality; although the causes of road mortality vary between bird species, factors increasing risks are the provision of high quality foraging habitat very close to road carriageways, and planting discontinuous blocks of shrub planting which screen birds' views of on-coming traffic. Landscaping of the Scheme will therefore avoid provision of species-rich grasslands within 2 m of the carriageway, and shrub planting will be designed to maintain visibility along the Scheme for birds flying over the verges, as far as is practical.

Mammals

9.6.47 In order to reduce the likelihood of road mortalities, two new crossing points will be provided for the Scheme at Ch800m and Ch1900m (Figure 8.7b and 8.7c). These will be mammal pipes 600 mm diameter under the road with associated fencing and planting to guide the mammals through following the DMRB HA 59/92 specification.

9.7 Residual Effects (with Mitigation)

9.7.1 The residual effects after mitigation are summarised in Table 9.16.

Table 9.16: Summary of Nature Conservation Impacts

Potential Impacts	Nature of Impact	Significance (Without Mitigation)	Mitigation Measures	Residual Impact
Construction				
Barry Woodlands SSSI	0.431 ha of ancient semi-natural broad-leaved woodland would be lost permanently, and another 0.469 ha taken under temporary licence and returned after construction. 298 m of water course would be realigned and an additional 6 m culverted.	Very Large adverse	Planting 2.8 ha of new woodland between Middleton Plantation and Sutton Wood. Movement of soil from SSSI to new area to provide start of new ground flora. Stripping and replacement of topsoil in areas taken under temporary licence Fencing from cycle way.	Very Large adverse
SINC 106 Amelia Trust Woodland Pond	Not directly affected, approximately 200 m from Scheme. Very minor potential impacts from dust and disturbance.	Slight adverse	None proposed as 200 m from the Scheme	Slight adverse
SINC 220 Land South of Blackland Farm	0.016 ha of broad-leaved woodland lost (strip adjacent to road up to 4 m wide). Minor potential impacts from air pollution, dust and disturbance.	Slight adverse	Replacement woodland 0.371 ha will be planted nearby (Ch400m to Ch500m)	Slight adverse
SINC 222 Land North-east of Whitton Rosser Farm	Directly affected with permanent loss of 0.12 ha of scrub, about 9% of the SINC which is designated for its woodland rather than scrub, so overall the magnitude will be low.	Moderate adverse	Replacement woodland 0.371 ha will be planted nearby (as above)	Moderate adverse
SINC 283 Sutton Wood	Not directly affected. Minor potential impacts from dust and disturbance.	Slight adverse	None proposed as 50 m from the Scheme	Slight adverse
SINC 336 Walters Farm	Temporary loss of 0.03 ha grassland at western edge.	Moderate adverse	Grassland to be re-sown with appropriate mixture	Slight adverse
Plantation broadleaved woodland	0.16 ha of the western edge of the recent plantations near Barry College along the edge of Five Mile Lane will be lost.	Slight adverse	Significant areas of woodland will be planted elsewhere as part of the Scheme.	Slight beneficial
Semi-improved neutral grassland	0.35 ha of semi-improved neutral grassland will be lost opposite Amelia Methodist Trust Farm (0.16 ha to drainage, 0.19 ha to road)	Slight adverse	2.78 ha of species rich wild flower grassland will be created throughout the Scheme	Slight adverse

Table 9.16: Summary of Nature Conservation Impacts

Potential Impacts	Nature of Impact	Significance (Without Mitigation)	Mitigation Measures	Residual Impact
Marshy grassland	No marshy grassland will be directly affected. Minor potential impacts from dust and disturbance.	Slight adverse	None	Slight adverse
Standing water	No ponds are directly affected. Potential run-off of contaminants in ponds to may affect the water quality.	Slight adverse	Control measures will be used to minimise silt runoff and contaminants into water.	Neutral
Running water – River Waycock	The main River Waycock would not be directly affected. Potential run-off of contaminants and sediment to River Waycock may affect the water quality.	Slight adverse	Control measures will be used to minimise silt runoff and contaminants into water.	Neutral
Running Water, other small streams	630 m of watercourse would be affected during construction but would have to be replaced at the same time to maintain water flow. Potential run-off of contaminants may affect the water quality.	Slight adverse	Control measures will be used to minimise silt runoff and contaminants into water. Treatment of road drainage water in reed beds and oil inceptors may lead to increase in water quality.	Slight beneficial
Intact hedge	1,538 m of hedge would be lost	Moderate adverse	Planting of 6,230 m of new hedgerow, movement of existing coppice stools in hedges, 4-fold net increase	Moderate beneficial
Hedge with trees	83 m of species-rich hedgerow with trees would be lost	Moderate adverse	Planting of new hedgerow, and movement of coppice stools (as above); through time the new hedges may develop standard trees to replace this habitat	Slight beneficial
Fish (including bullhead, European eel and brown trout)	Potential run-off of contaminants to River Waycock may affect the habitat of these species.	Slight adverse	Control measures will be used to minimise silt runoff and contaminants into water.	Neutral
	Noise and vibration generated during construction works near the River Waycock may result in disturbance to these species.	Slight adverse	None proposed as unavoidable.	Slight adverse

Table 9.16: Summary of Nature Conservation Impacts

Potential Impacts	Nature of Impact	Significance (Without Mitigation)	Mitigation Measures	Residual Impact
Great-crested newt	No impacts are expected on this species; No impacts are expected as nearest population is 400m away and the existing road acts as a barrier to dispersal. Little suitable habitat present.	Negligible	Preconstruction surveys.	Neutral
Other amphibians	Potential mortalities during construction phase, if amphibians were to get into the works area.	Slight adverse	Animals seen during searches prior to construction will be removed to a safe place.	Neutral
	Construction of attenuation ponds	Slight beneficial	The new ponds may provide new habitat.	Slight beneficial
Reptiles	Potential mortalities during construction phase, if reptiles were to get in to the construction area.	Slight adverse	Preconstruction searches supervised by ecologist; if significant problem discovered, construction areas will be fenced	Neutral
	Loss of small areas of suitable habitat (rough grass, scrub)	Slight adverse	New areas of grassland may provide replacement habitat	Neutral
Skylark	Damage or destruction of active nests/eggs/dependant young during site clearance/construction works within arable fields/field margins.	Moderate adverse	Where possible, vegetation clearance will take place outside the nesting season for skylark. If vegetation clearance is to commence in the period April to August, all areas of suitable skylark habitat will be thoroughly searched for the presence of nests prior to clearance. If nests are found, these will be marked off and prevented from harm until chicks have fledged.	Neutral
	Some small areas of arable fields will be lost, an important feeding and breeding habitat.	Slight adverse	None proposed	Slight adverse

Table 9.16: Summary of Nature Conservation Impacts

Potential Impacts	Nature of Impact	Significance (Without Mitigation)	Mitigation Measures	Residual Impact
Song thrush	Damage or destruction of active nests/eggs/dependant young during site clearance works in areas with thick vegetation.	Moderate adverse	Where possible, vegetation clearance will take place outside the nesting season for song thrush. If vegetation clearance is to commence in the period April to August, all areas of suitable skylark habitat will be thoroughly searched for the presence of nests prior to clearance. If nests are found, these will be marked off and prevented from harm until chicks have fledged.	Neutral
	Loss of breeding habitat (hedgerows, woodland and scrub) during site clearance works, including foraging habitat within territories for breeding pairs.	Slight adverse	Additional hedges and woodland will be planted which may provide suitable habitat	Slight beneficial
Yellowhammer	Damage or destruction of active nests/eggs/dependant young during site clearance works in areas with thick vegetation.	Moderate adverse	Where possible, vegetation clearance will take place outside the bird nesting season. If vegetation clearance is to commence in the period April to August, all areas of suitable skylark habitat will be thoroughly searched for the presence of nests prior to clearance. If nests are found, these will be marked off and prevented from harm until chicks have fledged.	Neutral
	Loss of breeding habitat (hedgerows) during site clearance works, including foraging habitat within territories for breeding pairs.	Slight adverse	More hedgerow will be planted, giving more potential nesting habitat	Slight beneficial
	Some small areas of arable fields will be lost, an important feeding habitat.	Slight adverse	None proposed	Slight adverse

Table 9.16: Summary of Nature Conservation Impacts

Potential Impacts	Nature of Impact	Significance (Without Mitigation)	Mitigation Measures	Residual Impact
Kingfisher	Pollution of the River Waycock may result in indirect impacts through fish kills which would reduce the food resource for kingfisher.	Slight adverse	Attenuation ponds help prevent pollutants entering water courses	Slight beneficial
	Construction works in the vicinity of the River Waycock may cause disturbance to kingfisher.	Slight adverse	None proposed	Slight adverse
Other breeding birds	Damage or destruction of active nests/eggs/dependant young during site clearance works.	Slight adverse	Where possible, vegetation clearance will take place outside the bird nesting season. If vegetation clearance is to commence in the period April to August, all areas of suitable skylark habitat will be thoroughly searched for the presence of nests prior to clearance. If nests are found, these will be marked off and prevented from harm until chicks have fledged.	Neutral
	Loss of breeding bird habitat during site clearance works, including foraging habitat within territories for breeding pairs.	Slight adverse	Some new habitat is being created which might provide suitable nesting sites	Slight beneficial
	Disturbance of birds during construction works will deter birds from nesting near the site.	Slight adverse	None proposed. However, there is abundant suitable habitat (in the form of hedgerows, woodland and scrub) in the surrounding area.	Slight adverse
Roosting bats	None anticipated as no roosts found during searches	Neutral	Pre-construction surveys will be carried out on trees with potential to have bat roosts	Neutral
Commuting and foraging bats	Loss of foraging habitat due to site clearance works.	Medium adverse	With time, new habitat may provide additional feeding areas.	Slight adverse

Table 9.16: Summary of Nature Conservation Impacts

Potential Impacts	Nature of Impact	Significance (Without Mitigation)	Mitigation Measures	Residual Impact
	Disruption of commuting routes due to removal of linear vegetation features or construction site lighting.	Medium adverse	'Hop-over' fencing and tree and shrub planting will be used to direct bats up out of the line of the road.	Slight adverse
Badgers	Disturbance of badgers in the area through construction site noise, lighting or vibration.	Slight adverse	None	Neutral
Dormice	Mortality of dormice during site clearance activities.	Slight adverse	Appropriate timing of works and pre-construction searches by a suitably qualified and experienced ecologist.	Neutral
	Loss of potential dormouse habitat (hedgerows and treelines)	Slight adverse	With time, new habitat may provide additional suitable dormouse habitat.	Slight beneficial
	Disturbance of dormice in nearby retained habitats through construction site noise, lighting or vibration.	Slight adverse	None proposed.	Slight adverse (temporary)
Otters	Disturbance to otters if using lying up sites or passing along watercourses crossed by the Scheme during construction.	Medium adverse	Avoidance of working at night and directing lights away from water courses	Slight adverse
Brown Hare	Disturbance to brown hare if using habitats in the vicinity during construction.	Medium adverse	None, hares likely move away	Slight adverse
Operation				
Barry Woodlands SSSI	NOx air pollution will add to exceedance of critical load up to 55 m from road. Minor impacts from disturbance from increased traffic.	Very Large adverse	None proposed	Very Large adverse
SINC 174 Betty Lucas Wood	Very minor potential impacts from dust, air pollution and disturbance from increased traffic.	Slight adverse	None proposed	Slight adverse
SINC 106 Amelia Trust Woodland Pond	Very minor potential impacts from dust, air pollution and disturbance from increased traffic.	Slight adverse	None proposed	Slight adverse

Table 9.16: Summary of Nature Conservation Impacts

Potential Impacts	Nature of Impact	Significance (Without Mitigation)	Mitigation Measures	Residual Impact
SINC 220 Land South of Blackland Farm	Very minor potential impacts from dust, air pollution and disturbance from increased traffic.	Slight adverse	None proposed	Slight adverse
SINC 222 Land North-east of Whitton Rosser Farm	Very minor potential impacts from dust, air pollution and disturbance from increased traffic.	Slight adverse	None proposed	Slight adverse
SINC 283 Sutton Wood	Very minor potential impacts from dust, air pollution and disturbance from increased traffic.	Slight adverse	None proposed	Slight adverse
SINC 336 Walters Farm	Very minor potential impacts from dust, air pollution and disturbance from increased traffic.	Slight adverse	None proposed	Slight adverse
Plantation broadleaved woodland	The planting scheme will result in the creation of about 5 ha of broadleaved plantation woodland throughout the Scheme.	Slight beneficial	N/A	Slight beneficial
	Very minor potential impacts from dust, air pollution and disturbance.	Slight adverse	The overall increase in woodland would result in creation of about 5 ha of woodland throughout the Scheme.	Slight beneficial
Semi-improved neutral grassland	Very minor potential impacts from dust, air pollution and disturbance.	Slight adverse	2.78 ha of species rich wild flower grassland would be provided along the Scheme.	Slight beneficial
Marshy grassland	Very minor potential impacts from dust, air pollution and disturbance.	Slight adverse	N/A	Slight adverse
Standing water	No ponds are directly affected. Potential run-off of contaminants in ponds to may affect the water quality	Slight adverse	Treatment of road drainage water in reed beds and oil inceptors may lead to increase in water quality.	Slight beneficial
Running water – River Waycock	Potential run-off of contaminants and sediment to River Waycock may affect the water quality	Slight adverse	Treatment of road drainage water in reed beds and oil inceptors may lead to increase in water quality.	Slight beneficial
Running Water, other small streams	Potential run-off of contaminants may affect the water quality.	Slight adverse	Treatment of road drainage water in reed beds and oil inceptors may lead to increase in water quality	Slight beneficial

Table 9.16: Summary of Nature Conservation Impacts

Potential Impacts	Nature of Impact	Significance (Without Mitigation)	Mitigation Measures	Residual Impact
Intact hedge	Creation of new hedges through planting.	Slight beneficial	N/A	Slight beneficial
	Very minor potential impacts to existing and newly planted hedges from dust, air pollution and disturbance.	Slight adverse	None proposed	Neutral
Hedge with trees	Creation of new hedges with tall standards through planting.	Slight beneficial	N/A	Slight beneficial
	Very minor potential impacts from dust, air pollution and disturbance.	Slight adverse	None proposed.	Neutral
Fish (including bullhead, European eel and brown trout)	Treatment of road drainage water in reed beds and oil inceptors may lead to increase in water quality.	Slight beneficial	N/A	Slight beneficial
Great-crested newt	No further impacts are expected on this species	Neutral	N/A	Neutral
Other amphibians	Road kill mortality	Slight adverse	Verges immediately adjacent to carriageway kept short to reduce chances of animals crossing	Slight adverse
Reptiles	Road kill mortality	Slight adverse	Verges immediately adjacent to carriageway kept short to reduce chances of animals crossing	Slight adverse
Skylark	Loss of arable habitat	Slight adverse	None proposed, as there is abundant habitat in the surrounding area.	Slight adverse
Song thrush	Net increase in habitat through planting scheme	Slight beneficial	N/A	Slight beneficial
Yellowhammer	Net increase in habitat through planting scheme	Slight beneficial	N/A	Slight beneficial
Kingfisher	N/A	N/A	N/A	N/A

Table 9.16: Summary of Nature Conservation Impacts

Potential Impacts	Nature of Impact	Significance (Without Mitigation)	Mitigation Measures	Residual Impact
Other breeding birds	Planting scheme will result in a net increase in the total lengths of hedgerows (an important breeding habitat for breeding birds) within the study area.	Slight beneficial	N/A	Slight beneficial
Roosting bats	N/A	N/A	N/A	N/A
Commuting and foraging bats	Planting scheme will result in a net increase in the total lengths of hedgerows (an important commuting/foraging habitat for bats) within the study area.	Slight beneficial	N/A	Slight beneficial
	Road kill mortality	Slight adverse	With time as hedges grow, hop-over points will become more effective	Slight adverse
Badgers	Road kill mortality/territory severance	Slight adverse	Two new animal crossing culverts provided.	Slight beneficial
Dormice	Road kill mortality/habitat severance	Slight adverse	None proposed; unlikely to use animal culverts.	Slight adverse
Otters	Road kill mortality	Slight adverse	Existing access along River Waycock maintained, and two new animal crossing culverts provided.	Slight beneficial
Brown Hare	Road kill mortality	Slight adverse	Unlikely to use crossing points; new hedges along road will discourage crossing	Neutral

9.7.3 The key residual impact is to the Barry Woodland SSSI through the loss of 0.431 ha of ancient semi-natural broad-leaved woodland. Although a larger area of replacement woodland is being provided (2.8 ha) adjacent to the SSSI, this is unlikely to be of similar value to the ancient woodland for a considerable time.

9.7.4 Approximately 0.12 ha of scrub at SINC 222 Land North-east of Whitton Rosser Farm and 0.016 ha of broad-leaved woodland lost at SINC 220 Land South of Blackland Farm will be lost but will be replaced with a larger area (0.371 ha) of woodland. The temporary loss of 0.03 ha of grassland in SINC 336 Walters Farm will be replaced with sown grass of similar composition.

9.7.5 There may be slight adverse impacts on a range of other species and habitats, most of which are probably of low significance due to the low populations of species present and the little semi-natural habitat present in the predominantly agricultural area. These are probably balanced with time by the slight beneficial effects after mitigation from improvements to drainage and some habitat creation, especially increases in woodland, hedges, some grasslands and improvement to drainage.

9.8 Cumulative Effects

9.8.1 The cumulative ecological effects of the Scheme, combined with other developments and planning proposals indicating longer term trends were assessed from planning applications listed on the Vale of Glamorgan planning website (http://vogonline.planning-register.co.uk/default.aspx) in May 2015. Not all the applications considered have been granted full planning permission.

9.8.2 The main trends within the study area are for housing and solar farm developments, which could cumulatively have a minor additional impact on the Scheme.

9.8.3 Proposed residential developments for 200 houses south of Waycock Cross (2014/0863/OUT) and 60 houses at Bonvilston north of Waycock Cross (2014/01205/SC1) are unlikely to add to the nature conservation impacts of the Scheme except through increased traffic on Five Mile Lane.

9.8.4 There are three approved solar farm proposals (2014/00798/FUL Whitton Mawr; 2014/00081/FUL Land off Waycock Cross, Waycock Road, Barry; 2015/00365/SC1 Derwen Farm). These solar farm proposals are generally in farmland with improved pasture or arable fields and hedges and together combined with the existing Sutton Farm solar farm development (2014/01103/NMA and 2015/00362/NMA) will result in a significant loss of arable skylark habitat replaced with diverse permanent grasslands under the solar panels. The combined cumulative effect on skylark of these solar farms combined with the relatively very small area lost to the Scheme is estimated to be up to 10% of its arable habitat in the study area which could reduce the skylark population. Similarly, loss of pasture and reduced edge habitat for other bird such as song thrush could also occur.

9.9 Post Construction Monitoring

9.9.1 Post-construction monitoring will be required to ensure that mitigation measures are effective and whether remediation will be required. A proposed outline monitoring schedule is given in Table 9.17.

Table 9.17: Post Construction Monitoring

Feature	Method	Frequency
Barry Woodlands SSSI	10 permanent 2 x 2 m quadrats	Annually for 5 years; if no recovery of woodland ground flora from seed bank in top soil after 3 years, augment with local plants in consultation with NRW
Compensation woodland creation for Barry Woodlands SSSI	10 permanent 2 x 2 m quadrats	Annually for 5 years; if no recovery of woodland ground flora from seed bank in top soil after 3 years, augment with local plants in consultation with NRW
Watercourses (Ecology)	BMWP and ASPT	Annually for 5 years
Vegetation establishment on new channels and ditches	Visual inspection	Annually for 5 years
Bat boxes (cf. 9.6.30)	Inspection (bat dropping analysis if necessary)	Annually for 5 years
Mammal fencing and carcase check	Visual check of fencing and roadside search for carcases at key points	3 monthly for first year, annually thereafter
Bat hop-overs	Survey monitoring	Three times a year for 5 years
Grassland creation	10 permanent 2 x 2 m quadrats	Annually for 5 years
Hedgerow translocation and creation	(Will be undertaken as part of the landscaping establishment)	
Balancing ponds vegetation	(Will be undertaken as part of the landscaping establishment)	

9.10 Summary and Conclusions

9.10.1 This chapter describes the ecological effects of the Scheme.

9.10.2 The key nature conservation legislation and policy such as European Habitats Directive, the Wildlife and Countryside Act 1981 (as amended), Countryside Rights of Way Act, 2000 (CRoW Act 2000), Natural Environment and Rural Communities (NERC) Act, 2006 and the United Kingdom, Wales and Vale of Glamorgan Biodiversity Action have reviewed and applied to the Scheme.

9.10.3 A Scoping study, drawing mainly on data collected 2008-2011, showed that the Scheme is set within an agricultural landscape comprising mostly of improved pasture and arable land separated by hedgerows and broad-leaved woodland blocks. There were very few standing and open water habitats, the main exception being the Waycock River. The road currently divides woodland blocks of the Barry Woodlands SSSI. Protected species that could potentially be affected include amphibians, reptiles, birds, bats, dormice, water voles, aquatic invertebrates and the riverine habitats of the River Waycock.

9.10.4 In order to update the baseline conditions, an extended Phase 1 habitat survey, an amphibian survey (including great crested newts), dormouse nest tube survey, bat activity surveys and roost inspections and aquatic invertebrate surveys were carried out. Updated desk study data was also requested.

9.10.5 There are no European-designated sites within 2 km of the Scheme. The Exmoor and Quantocks Oakwoods SAC designated for bats occurs 28 km to the south across the Bristol Channel and will not be affected.

9.10.6 There are three SSSIs within 2 km of the Scheme, of which the Barry Woodlands SSSI complex is directly affected.

9.10.7 There are two Local Nature Reserves and one Wildlife Trust of South and West Wales within 2 km of the Scheme, none of which are directly affected.

9.10.8 There are 58 Sites of Importance for Nature Conservation (SINCs) within 2km of the Scheme, of which 10 are within 250m of the Scheme.

9.10.9 The Phase 1 Habitat Survey identified a number of habitats on the site that have some ecological and nature conservation value. These included Broadleaved semi-natural woodland (especially the Barry Woodlands SSSI complex); standing and running water habitats; species-rich hedgerows and mature scrub; unimproved neutral grassland; semi-improved neutral grassland; marshy grassland and road verges with rank and unmanaged vegetation.

9.10.10 Ten species of bat were recorded in total across all the locations surveyed for commuting or foraging bats. Bats were regularly observed foraging close to and commuting across the existing Five Mile Lane. No bat roosts were found in the seven trees surveyed by climbing inspection or in bat boxes.

9.10.11 No evidence of dormouse was found during the 2014 nest tube surveys. As there is suitable habitat and they are hard to detect, they are assumed to be present, probably at low densities.

9.10.12 A few signs of badgers were seen in the study area but no setts were found, and the badger population is likely to be small.

9.10.13 One possible otter spraint was seen during 2014 surveys, but no holts were found. Otter may use all watercourses in the study area.

9.10.14 No evidence of water voles was found in the seven water bodies surveyed in 2014 and these were found to be unsuitable for water voles.

9.10.15 There were several sightings of brown hare in 2008; none were seen during the 2014 survey, but they could be present in low densities.

9.10.16 Birds of Conservation Concern such as skylark, yellowhammer, linnet, song thrush, starling, house sparrow, herring gull, kingfisher, and dunnock have been recorded in the study area. There is a 2008 record of Barn owl but no signs were observed in 2014.

9.10.17 No specific fish surveys were conducted but Brown trout, Bullhead and European eel have been recorded in the River Waycock (the latter two found during aquatic invertebrate surveys in 2014).

9.10.18 Amphibians such as palmate newts, common frog and common toad are present. No great crested newts were found during 2014 surveys but their presence cannot be ruled out.

9.10.19 No reptiles were recorded in 2014, but there is some suitable habitat on road verges and field edges. Slow worm and grass snake have previously been recorded and are likely to be present in low populations.

9.10.20 No white-clawed crayfish were found in the River Waycock.

9.10.21 Aquatic invertebrate sampling indicated good or very good water quality using the BWMP methods, and moderate to poor water quality using the ASPT method.

9.10.22 The predicted impacts of the Scheme during construction and during operation were assessed. Mitigation to minimise the impacts is proposed.

9.10.23 The most significant impact of the Scheme will be permanent loss of a strip of vegetation of 0.264 ha along the length of the road in the nationally important Barry Woodlands SSSI on the west side (Middleton Plantation) and 0.167 ha on the east side (Barry College Wood), totalling 0.431 ha. A further 0.168 ha would be taken under essential licence for construction in Middleton plantation and 0.301 ha in Barry College Wood, which would be returned after construction, totalling 0.469 ha.

9.10.24 There would also be substantial adverse effects of increased annual mean NO_X deposition on Barry Woodland SSSI within 45 m of the carriageway at Middleton Plantation and within 55 m of the carriageway at Barry College. Lidmore Wood shows a small increased deposition up to 230 m from the road with a slight adverse impact. In contrast, Pencoetre Woods and Cwm Talwyg Woods decreased deposition due to lower traffic with slight beneficial effects. Given that the existing background NO_X deposition levels already significantly exceed the critical loads, the main effect on the woodland vegetation for which the site is designated will be a small increase in eutrophication of the woodland adjacent to the roadsides.

9.10.25 Although a larger area of replacement woodland is being provided (2.8 ha) adjacent to the Barry Woodlands SSSI woodland with woodland soils being moved, this is unlikely to be of similar value to the ancient woodland for a considerable time. There will be some additional benefits of being part of a much larger woodland block between Middleton Plantation and Sutton Wood and Sutton Fach Wood.

9.10.26 Three sites of county importance (SINCs) would be directly affected through habitat loss but only to a small extent which is unlikely to affect their status as SINCs. 0.12 ha of scrub at SINC 222 Land North-east of Whitton Rosser Farm and 0.016 ha of broad-leaved woodland lost at SINC 220 Land South of Blackland Farm will be lost but will be replaced with a larger area (0.371 ha) of woodland nearby. The temporary loss of 0.03 ha of grassland in SINC 336 Walters Farm will be replaced with sown grass of similar composition.

9.10.27 Six sites of county importance (SINCs) would be indirectly affected by minor dust and disturbance, which would not affect their status as SINCs.

9.10.28 Other habitats of county importance directly affected are broad-leaved woodland, species rich hedges and hedges with trees. In all case more of these habitats will be created which may in the longer term be or replacement or enhanced value for nature conservation.

9.10.29 In total, 5.01 ha of new woodland will be created to replace the 0.50 ha lost.

9.10.30 A total length of 6,230 m of new hedge will be planted to replace 1,538 m lost.

9.10.31 A total area of 2.78 ha of species rich wild flower grassland will be created along the Scheme.

9.10.32 Aquatic habitats such as the River Waycock may improve in water quality as a result of water treatment in the attenuation ponds.

9.10.33 Where possible, vegetation clearance will be carried out during the winter to avoid impacts on nesting birds and reptiles; if this is not possible, all affected areas will be subject to pre-construction surveys by a suitably-qualified ecologist, and appropriate steps will be taken to avoid harm to such species. Birds such as skylark, song thrush and yellowhammer will be affected indirectly by loss of habitat. New hedges and woodlands may provide replacement habitat for song thrush and yellowhammer.

9.10.34 Mitigation for commuting and foraging bats is mainly through provision of 'hop-over screening' at crossing points. To reduce the need for crossing, a roost of 3 bat boxes will be provided east of the new carriageway at Grovelands Farm.

9.10.35 Although no dormice were found, they have been assumed to be present at low densities and appropriate mitigation will be employed. If site works are to commence in winter 2016, a two stage vegetation clearance strategy will be carried out in areas where dormice might be present to minimise potential harm to dormouse. Site clearance in the breeding period (June – October inclusive) will be avoided if possible. All clearance of dormouse habitat will be supervised by a suitably qualified and experienced ecologist, who will take appropriate steps to avoid harm or damage to dormouse.

9.10.36 Two animal underpasses will be constructed as part of the Scheme. Otter fencing will be installed at the River Waycock.

9.10.37 Although possibly present, it unlikely that badgers, otters, kingfisher, brown hare and great-crested newt will be significantly affected.

9.10.38 There may be slight adverse impacts on a range of other species and habitats, most of which are probably of low significance, due to the low populations of species present and the little semi-natural habitat present in the predominantly agricultural area. These are probably balanced with time by the slight beneficial effects after mitigation from improvements to drainage and some habitat creation, especially increases in woodland, hedges, some grasslands and improvement to drainage.

9.10.39 Cumulative impacts with other developments could arise from increased traffic on Five Mile Lane, and loss of skylark habitat.

10 GEOLOGY & SOILS

10.1 Introduction

10.1.1 This chapter assesses the potential impacts on the geology and soils arising from the construction and operation of the Scheme. Consideration will be given to the constraints on the Scheme associated with potential land contaminated issues. The chapter has been prepared following the conclusions of the Screening and Scoping exercise in 2014 (see Appendix 1.1 and 1.2), the preliminary geo-environmental risk assessment completed in January 2015 (see Appendix 10.1) and the ground investigation report (see Appendix 10.2 for the Ground Investigation Factual Report), which will be provided to inform the detailed design.

10.1.2 The geology and soils assessment is closely related to other assessments within this ES including the water environment considered in Chapter 15 Road Drainage and the Water Environment.

10.1.3 This chapter should be read in conjunction with the report titled 'Preliminary Risk Assessment for Five Mile Lane', Parsons Brinckerhoff, June 2015 (Appendix 10.1).

10.2 Legislative & Policy Context

10.2.1 The planning policy documents and the legislative context in relation to the assessment of the environmental effects on the geology and soils are set out below in sections covering European, UK, National and Local level policies. The list is not intended to be exhaustive, but includes the main documents relating to the protection, preservation and, where appropriate, enhancement of the geological environment.

<u>European Legislation & Policy</u>

10.2.2 The EU Directives and guidance of particular relevance to the Scheme with respect to geology and soils are listed below:

Water Framework Directive (2000/60/EC)

10.2.3 This directive, along with the Groundwater Directive (2006/118/EC) is discussed in Chapter 15 Road Drainage and the Water Environment and so is not discussed here but is relevant to this chapter.

EU Thematic Strategy on Soils Protection 2006

10.2.4 The Thematic Strategy for Soil Protection consists of a Communication from the Commission to the other European Institutions, a proposal for a framework directive (a European law), and an Impact Assessment.

10.2.5 The framework directive proposal was prepared for the protection and preservation of soils, essentially a non-renewable resource. The objective is to establish a "*common strategy for the protection and sustainable use of soil based on the principles of integration of soil concerns into other policies, preservation of soil functions within the context of sustainable use, prevention of threats to soil and mitigation of their effects, as well as restoration of degraded soils to a level of functionality consistent at least with the current and approved future use.*"

Waste Framework Directive 2008

10.2.6 The Waste Framework Directive 2008 (WaFD) establishes the legislative framework for the management, recovery and disposal of waste. It also provides a definition of waste: 'waste means any substance or object which the holder discards or intends or is required to discard'.

10.2.7 The most recent revisions to the WaFD are transposed within England and Wales through the Waste (England and Wales) Regulations 2011. Accordingly, where uncontaminated soils and other natural materials (for example, rock) are excavated during earthworks and it is proposed to re-use them in the construction of the Scheme then they would fall outside the definition of waste and so outside the waste management regime. The WaFD specifically excludes from its scope: '*uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated*'.

National Legislation & Policy

Environmental Protection Act 1990

10.2.8 Part 2A of the *Environmental Protection Act (EPA) 1990*[8] deals with contaminated land. The contaminated land regime within Part 2A was first introduced in Wales on the 15th September 2001 and was inserted into the EPA 1990 by Section 57 of the *Environment Act 1995*.

10.2.9 The EPA 1990 defines Contaminated Land as "any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substance in, on or under the land, that -

- Significant harm is being caused or there is a significant possibility of such harm being caused; or
- Pollution of controlled waters is being or is likely to be caused."

10.2.10 Legislation requires the local enforcing authority to require remediation of this land and to identify the appropriate person to bear the responsibility for this.

Planning Policy Wales (PPW) (2014)

10.2.11 PPW, Edition 8, January 2016 sets out the land use planning policies of the Welsh Government (WG) and is supplemented by 21 topic based technical advice notes (TANs).

10.2.12 Section 13.5, discusses dealing with unstable and contaminated land, and how "*the planning system should guide development to lessen the risk from natural or human made hazards, including risk from land instability and land contamination*."

10.2.13 Section 13.6 sets out development plans and contaminated land, where "*local planning authorities should take into account the nature, scale and extent of contamination which may pose risks to health*."

10.2.14 Section 13.7 discusses development management and contaminated land, outlining what planning decisions need to take into account; "*evidence of a detailed*

[8] Environmental Protection Act, 1990, Part 2A Contaminated Land

investigation and risk assessment prior to the determination of the application to enable beneficial use of the land."

10.2.15 Sections 13.8 and 13.9 outline the development plans and development management of unstable land. Land stability must be considered by local planning authorities in the preparation of development plans. Planning decisions need to take into account the potential hazard that instability could create, and the results of a specialist investigation and assessment to determine the stability of the ground.

TAN 5 Nature and Conservation Planning (2009)

10.2.16 TAN 5, September 2009 is a supplementary technical advice note to PPW, providing "advice about how the land use planning system should contribute to protecting and enhancing biodiversity and geological conservation".

Minerals Planning Policy Wales (MPPW) (2000)

10.2.17 The MPPW recognises that extraction is not a permanent land use and restoration should be to a high standard and to a beneficial and sustainable after use. The key principle is to provide and safeguard mineral resources.

10.2.18 British Geological Survey (BGS) produced a Mineral Resources Map of Wales, then a Minerals Safeguarding Map of Wales. This was to enable the local planning authorities (LPA) to delineate safeguarding areas in their development plans and adopt suitable policies for managing development in these areas so that unnecessary sterilisation of identified resources does not take place.

Minerals Technical Advice Note (MTAN) 1 (Wales): Aggregates

10.2.19 MTAN 1 "sets out detailed advice on the mechanisms for delivering the policy for aggregates extraction by mineral planning authorities and the aggregates industry.

Local Planning Policy

10.2.20 The local policies relevant to the geology and soils assessment for the Scheme are expressed in the Vale of Glamorgan current Adopted Unitary Development Plan (UDP), 2006 and detailed below.

10.2.21 Policy 1 describes the Vale of Glamorgan's distinctive rural, urban and coastal character, with particular emphasis for conserving the best and most versatile agricultural land.

10.2.22 Policy ENV2 describes "the best and most versatile agricultural land (Grades 1, 2, and 3a) will be protected from irreversible development, save where overriding need can be demonstrated. Non-agricultural land or land of a lower quality should be used when developments proposed, unless such land has a statutory landscape, nature conservation, historic or archaeological designation which outweighs agricultural considerations.

10.2.23 DMRB Volume 11.3.6 indicates that when a scheme would potentially result in the loss of 20 hectares or more of Best and Most Versatile (BMV) agricultural land the applicant must undertake a land classification survey.

10.2.24 Policy 12 describes the stone resource for aggregate and cement production. This mineral resource is to be protected to maintain the Vale of Glamorgan's share of

regional supplies. The Scheme is not in an area that is protected for minerals in the UDP, however, it is identified as a Minerals Safeguarding area, expressed in the Vale of Glamorgan Draft Local Development Plan (LDP) 2011 – 2026 Minerals Planning – Background Paper, September 2013.

10.2.25 Policy ENV26 describes contaminated land and unstable land. Proposals for the redevelopment of contaminated land and unstable land will be permitted where the contamination and / or instability will be removed or reduced to a level where there is no unacceptable risk to the health and safety of those living or working on the Scheme or nearby, to flora and fauna on the site or nearby, and to the quality of the air and water on these sites or nearby.

Additional Guidance

10.2.26 Additional guidance documents relevant to geology and soils, and contaminated land have been considered when undertaking this chapter:

- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects, August 2008;
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11 Geology and Soils, June 1993;
- Natural Resources Wales (NRW) formerly the Environment Agency Wales (EAW), Pollution Prevention Guidance (PPGs) documents (now revoked but not yet replaced);
- Construction industry research and information association (CIRIA) 113 Control of Groundwater for Temporary Works, 1988;
- CIRIA 692 Environmental Good Practice on Site, 2011;
- British Standards Institution (2011), 'BS 10175:2011: A1+2013. Investigation of potentially contaminated sites: Code of practice';
- Environment Agency (2010a), 'GPLC1 – Guiding Principles of Land Contamination', 'GPLC2 – Frequently Asked Questions, Technical Information, Detailed Advice and References', and 'GPLC3 – Reporting Checklists', all March 2010;
- Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66. Environment Agency / National House-Building Council. Volume 1, 2008;
- Contaminated Land Statutory Guidance, Department for Environment, Food and Rural Affairs, April 2012;
- Contaminated Land Report (CLR) 11: Model Procedures for the Management of Land Contamination. Environment Agency and Defra, 2004; and
- Contaminated Land Risk Assessment, A guide to good practice, CIRIA C552, 2001.

10.3 Assessment Methodology

10.3.1 The assessment considers the Scheme, and assesses an area of up to 250m either side of the Scheme alignment in which potentially polluting off-Scheme activities could impact on the Scheme. The assessment also considers the potential impacts from the

Scheme to off-site receptors within 250m either side of the Scheme alignment. A 1km radius from the Scheme alignment is considered for controlled water receptors.

10.3.2 The approach to the assessment includes the following:

- Establishing the baseline conditions for the Scheme with respect to geology, soils, hydrogeology, and contaminated land;
- Establishing the previous land uses through a review of historical maps;
- Identification of impacts to identified resources and receptors from the construction and operational phases;
- Assessment of the magnitude of impacts likely to results from the Scheme;
- Identification of potential measures for mitigating any impacts resulting from the Scheme; and
- Identification of any residual and / or cumulative impacts.

10.3.3 In accordance with Part 11, Section 3 of the DMRB (Volume 11), this assessment comprises Stage 2 of the assessment. The objective at this stage is to identify the attribute importance of geology and soils, and the significance of potential effects upon them, to be taken into account when refining the Scheme. There is also a requirement to establish the potential for land contamination within the study area.

Consultation

10.3.4 Consultation was undertaken with Welsh Government's Department of Natural Resources (DNR) in February 2015 to provide a more detailed understanding of the agricultural land quality along the Scheme alignment.

Potential for Land Contamination

10.3.5 The potential for land contamination within the study area has been assessed in accordance with the principles of the Environment Agency report CLR11 ('Model Procedures for the Management of Land Contamination'). In the context of current UK Government guidance, qualitative risks on land contamination are to be assessed using a 'Source-Pathway-Receptor' methodology, where the following definitions apply:

- Source: potential source of contamination;
- Pathway: means by which contamination can reach and impact upon a receptor; and
- Receptor: that aspect which may be adversely affected by the presence of contamination.

10.3.6 Such an approach recognises that risks from Scheme-based contaminants can only exist where all three components are present, constituting a complete pollutant linkage. This approach forms the basis of the methodology used in this assessment.

10.3.7 Risks have been evaluated on a qualitative basis, in accordance with the methodology set out within CIRIA C552. This involves the classification of the magnitude of the potential consequence of the risk occurring, and the magnitude of the probability of the risk occurring. These classifications are then compared in order to determine the risk presented by each identified pollutant linkage.

10.3.8 The framework for determining the classification of consequence is detailed within Table 10.1. It is important to note that the 'severe' classification relates only to acute risks (arising from short-term exposure). The 'medium' classification relates to chronic harm (which may still be classified as 'significant harm' under Part 2A).

Table 10.1: Qualitative Risk Assessment – Classification of Consequence

Classification	Definition
Severe	Short term (acute) risks to human health, likely to result in significant harm. Short-term risk of pollution of sensitive water resource. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem.
Medium	Chronic damage to human health (significant harm). Pollution of sensitive water resources. A significant change in a particular ecosystem, or organism forming part of such ecosystem.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or to the environment.
Minor	Harm, not necessarily significant, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health. Easily repairable effects of damage to buildings, structures and services.

10.3.9 The framework for determining the classification of probability is detailed within Table 10.2.

Table 10.2: Qualitative Risk Assessment – Classification of Probability

Classification	Definition
High Likelihood	There is a pollution linkage and an event that appears very likely in the short term, and/or almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	It is probable that an event will occur. Whilst not inevitable, it is possible in the short term, and likely over the long term.
Low Likelihood	Circumstances are possible under which an event could occur, but it is not certain that (even over a long time period) such an event would occur.
Unlikely	It is improbable that an event would occur, even in the very long term.

10.3.10 Once the consequence and probability have been determined for a pollutant linkage, these can be compared to produce a risk category, ranging from 'very high risk' to very low risk' within Table 10.3.

Table 10.3: Comparison of Consequence against Probability

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**Likely**	High Risk	Moderate Risk	Moderate/ Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/ Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/ Low Risk	Low Risk	Very Low Risk	Very Low Risk

Value (Sensitivity) of Resources and Receptors

10.3.11 Environmental values have been assigned to receptors in accordance with the principles established in Volume 11, Section 2, Part 5 of the DMRB (2008). Consideration must also be given to the potential for any post-construction environmental effects, caused by remobilisation of contamination within the ground following disturbance during the construction process. An environmental value has therefore also been assigned to the potential land contamination receptors, as identified within the conceptual site model displayed in Table 10.4.

Magnitude of Impacts (Change)

10.3.12 The magnitude of impacts and typical descriptors are detailed within Table 10.5. They have been adapted from the Volume 11, Section 2, Part 5 of the DMRB (2008).

Significance of Effects

10.3.13 "The approach to assigning the significance of effects relies on reasoned argument, professional judgement and taking on board the advice and views of appropriate organisations" (DMRB Volume 11, Section 2, Part 5, August 2008). In order to aid the decision-making process, each potential impact has been assigned a significance category. The methodology for determining the significance of effect categories is detailed within Table 10.6.

Table 10.4: Defining Attribute Importance (Sensitivity) for Resources / Receptors

Environmental Value (Sensitivity)	Resource		Receptor			
	Geology & Geomorphology	Soils	Controlled Waters	Built Environment	Construction Workers	End Users
High	Geological or geomorphological features of national importance (SSSI).	Good to excellent quality best and most versatile (BMV) agricultural land (Grade 1 and 2)	Principal aquifer beneath site, abstraction wells, and/or major surface water in close proximity	Buildings of high historic value or other high sensitivity	Extensive earthworks including demolition of buildings	Residential development, allotments, play areas
Medium	Regionally Important Geological Sites (RIGS). Within a mineral resources safeguarded area.	Moderate quality BMV agricultural land (Grade 3a)	Secondary aquifer beneath site and/or minor surface water in close proximity	Buildings, including services and foundations	Limited to moderate earthworks	General Public Amenity, landscaping or public open space
Low	No features of importance in close proximity. Brownfield or industrial site.	Very poor quality agricultural land (Grades 3b to 5) Made ground, with little potential for farming use	Aquitard or aquiclude beneath site, no surface water body in close proximity	Not applicable	Minimal disturbance of ground	'Hard' end use (e.g. industrial use, road, car park)

Table 10.5: Criteria for Assessing the Magnitude of Impacts

Magnitude	Typical Criteria Descriptors
Major	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements; exposure to acutely toxic contaminants. Greater than 100ha of BMV land (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; short-term exposure to contaminants with chronic (long-term) toxicity. Between 50 – less than 100ha of BMV land (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. Between 20 - < 50ha of BMV land (Adverse).
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduce risk of negative impact occurring (Beneficial).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements. Less than 20ha of BMV land (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.

Table 10.6: Arriving at the Significance of Effect Categories

		Magnitude of Impact				
		Major	**Moderate**	**Minor**	**Negligible**	**No change**
Value (Sensitivity)	**High**	Large or very large	Moderate or large	Slight or moderate	Slight	Neutral
	Medium	Moderate or large	Moderate	Slight	Neutral or slight	Neutral
	Low	Slight or moderate	Slight	Neutral or slight	Neutral or slight	Neutral

10.3.14 Typical descriptors for effects are summarised within Table 10.7.

Table 10.7: Typical Descriptors of Effects

Significance Category	Typical Descriptors of Effects
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.

Significance Category	Typical Descriptors of Effects
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 of 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.

Assumptions and Limitations

10.3.15 This assessment has been limited to desk-top information, available at the time of writing this ES. Information has also been obtained from the exploratory locations as part of intrusive ground investigation undertaken for the Scheme. This information thereby helps to quantify the significance of effects at this stage.

10.3.16 The local planning authority has been contacted to obtain private water supply records. These have not been obtained prior to the publication of this ES.

10.3.17 This, together with any controls imposed through the CEMP is considered a robust approach and suitable for the management of the likely impacts.

10.3.18 Impacts to ecological and surface water quality receptors have been addressed within Chapters 9 and 15 respectively, and have not been included within this chapter in any detail.

10.4 Baseline Conditions

10.4.1 This section provides a description of the current baseline conditions with respect to geology and soils. The summary is based on information gained through the production of the Preliminary Risk Assessment (Appendix 10.1) and subsequent ground investigation (Appendix 10.2) used to inform detailed design.

10.4.2 A detailed description of the existing site and surrounding land uses is provided within Chapter 2 Existing Conditions and a description of the Scheme is provided in Chapter 3 Scheme Description & Development of Alternatives.

10.4.3 The topography at the northern end of Five Mile Lane, at Sycamore Cross is 107m above Ordnance Datum (AOD). Between Blackland Farm and Ch2500m, it undulates between 80 m and 90 m AOD. Further to the south the topography falls steadily towards the Waycock River to an elevation of approximately 22 m AOD, climbing again towards the Waycock Cross roundabout to an elevation of approximately 60 m AOD (see Figure 1.1).

10.4.4 The widening of the existing sections will mostly involve the removal of material.

10.4.5 The nearest Environmentally Sensitive Area is an area of woodland identified as a Barry Woodlands SSSI between Ch3700m and Ch5000m. The woodland extends

either side of the new road alignment although in this particular section of the Scheme the road alignment is expected to stay on-line with no deviation through the woodland areas themselves.

10.4.6 A detailed summary of ecological receptors including aquatic ecology and habitat is provided within Chapter 9 Nature Conservation. A detailed summary of the water environment is provided in Chapter 15 Road Drainage and the Water Environment.

Geology and Soils

10.4.7 There are no statutory geological designations covering the footprint of the scheme and there are no geological designations located within 2km of the route corridor.

10.4.8 According to BGS GeoIndex mapping the scheme corridor is underlain by the Porthkerry Member, St Marys Well Bay Member and the Lavernock Shales of the Blue Lias Formation comprising thinly interbedded limestone and calcareous mudstone or siltstone. Individual limestones are typically 0.10-0.30m thick. In some areas there are intervening mudstone units with relatively few limestone beds. The northern section of the scheme around Sycamore Cross junction is underlain by the Gully Oolite Formation, described as medium to thickly bedded oolitic limestone.

10.4.9 Overlying the bedrock geology, a narrow alluvial plain following the River Waycock is indicated to be present in the south of the Scheme comprising clays, sands and gravels. The northern part of the Scheme around Sycamore Cross junction is underlain by Glacial Till. With the exception of these superficial deposits, the BGS mapping data suggests superficial deposits along the length of the scheme are unknown or absent. Made Ground is not indicated on BGS records but is likely to be present along the route of the carriageway and any other existing areas of hardstanding.

10.4.10 The Environment Agency's groundwater vulnerability classifications indicate that the soils above the alluvial deposits on the route of the River Waycock have a high leaching potential, whilst soils underlying the Sycamore Cross junction area are classified as having an intermediate leaching potential. Soils in other areas along the Scheme, where the superficial deposits are unknown, are generally classified as having soils of low or intermediate leaching potential.

10.4.11 Soils have been assessed using the Cranfield University's online Soilscapes tool (Cranfield Soil and AgriFood Institute, 2015). This indicates over half of the length of Waycock Road lies on loamy and clayey soils, described as slowly permeable and seasonally wet with impeded drainage. Along the route of the River Waycock, soils are described as loamy and clayey floodplain soils with naturally high groundwater. North of the River Waycock and at the most northern end of the road, including Sycamore Cross junction, soils are described as loamy and freely draining.

10.4.12 A number of historic logs for boreholes within close proximity to the Scheme's boundaries are held in BGS. The following borehole logs were selected to provide a good representation of the varied ground conditions around the scheme.

10.4.13 Borehole ST07SE15 located 270m south east of Sycamore Cross junction, describes a reddish brown soil to 2m below ground level (bgl) overlying grey and black limestone to the base of the hole at 80m bgl.

10.4.14 Trial pits ST06NE20 and ST06NE19 are located towards the southern part of the Scheme, approximately140m and 360m west of the carriageway respectively. Both pits show clayey, silty sand and limestone to the base at around 3.4m bgl.

10.4.15 The borehole at the southernmost extent of the carriageway ST06NE25 shows topsoil to 0.2m bgl overlying brown grey silty clay 0.8m bgl, which in turn overlies grey limestone to the base of the hole at 1.5m bgl.

10.4.16 During the ground investigation undertaken by Parsons Brinckerhoff in December 2014, exploratory hole depths ranged between 0.9m to 10.0m. The investigation comprised nine boreholes, nineteen trial pits and ten CBR test pits.

10.4.17 Table 10.8 presents a summary of the geology and soils encountered during the ground investigation (see Appendix 10.2 for further information).

Table 10.8: Summary of Geology

Strata		Average Thickness (m)	Comments
Superficial	Topsoil	0.1 - 0.3m	Soft dark brown / grey brown slightly sandy slightly gravelly clay.
	Clay	1.3 – 3.5m	Soft orange brown slightly sandy, slightly gravelly clay with frequent rootlets an at depth cobbles.
Bedrock	Interbedded limestone and mudstone (Blue Lias Formation)	Not proven	Interbedded limestone and mudstone, with some clay beds. The limestone is grey and medium strong to strong, the mudstone is calcareous dark grey and the clay is calcareous and hard to stiff. The beds are sub horizontally and sub vertically fractured.

10.4.18 Topsoil was identified in all but three exploratory hole locations, comprising soft dark brown or greyish brown, slightly sandy to slightly gravelly clay, with frequent rootlets, typically to a maximum depth of 0.3m. Underlying this, the soil comprised soft orange brown slightly sandy, slightly gravelly clay, with frequent rootlets and at depth cobbles to depths ranging between 0.9m bgl in TP211 and TP212 to 3.4m bgl in TP219. In BH104 orange brown and grey slightly sandy gravel was encountered which may be associated with the alluvium from Moulton Brook.

10.4.19 The clay was found to be overlying highly weathered bedrock, of mudstone and limestone cobbles. Rock head was encountered in all the exploratory holes at depths ranging between 0.9m in TP211 and TP212 and 3.4m in TP219. Competent bedrock recovered from rotary boreholes BH101 to BH109 was described as interbedded limestone and mudstone, with some clay beds.

10.4.20 The limestone was described as grey and medium strong to strong, with sub horizontal and sub vertical discontinuities that are undulating rough and medium to very closely spaced. The mudstone was noted as calcareous dark grey to orange brown and extremely weak to medium strength with discontinuities that are sub horizontal and sub vertical, very closely spaced to extremely closely spaced planar and undulating rough. In addition the clay is interpreted as calcareous hard to stiff, thinly laminated dark grey to orange brown slightly sandy and slightly gravelly. Both stratum are beds of the Blue Lias Formation.

10.4.21 Geological hazards along the Scheme have been identified within the Envirocheck Report presented within the Preliminary Risk Assessment (PRA) report in Appendix 10.1 and are detailed in Table 10.9.

Table 10.9: Geological Hazards

Stability	**Collapsible ground**	No Hazard - Very Low
	Compressible ground	No Hazard – Moderate
	Ground dissolution	No Hazard – Low
	Landslide	Very low – Low
	Running sand	No Hazard – Low
	Shrinking or swelling clay	No Hazard – Low
Radon hazards		The Envirocheck report indicates that the radon risk to housing along the route corridor is variable; from no radon protection measures required to between 5-10% of houses above action value based on information from the British Geological Survey, National Geoscience Information Service. The Scheme will not include the construction of any above ground structures or residential dwellings, therefore the potential risk of radon intrusion are absent.

Mineral Extraction and Mining

10.4.22 According to the Envirocheck Report presented within the PRA (Appendix 10.1) the Scheme corridor is not located within an area that might be affected by coal mining, and there are no coal measures within the vicinity of the Scheme.

10.4.23 The local Porthkerry Limestone has been exploited in at least five locations for the manufacture of lime with a series of opencast limestone quarrying operations evident, and lime kilns shown on many of the historical maps. The Scheme and surrounding area has been identified as a Minerals Safeguarding area in the Draft LDP.

10.4.24 The Scheme alignment overlies a limestone (category 2) safeguarded area. In addition, towards the southern part of the Scheme, the sand and gravel (category 2) is safeguarded, and in the northern part of the Scheme, a limestone (category 1) is safeguarded within the LDP.

10.4.25 Category 1 is classified by the BGS as a resource of national importance to Wales and possibly the UK, limited in occurrence, susceptible to sterilisation or economically important due to their high quality. Category 2 is classified as selected resources to be more than of local importance and may have some regional significance.

Agriculture

10.4.26 The Scheme is surrounded by agricultural land, and part of the central section of the Scheme will be offline to the existing carriageway. As a consequence, there will be a requirement for agricultural land take. The total agricultural land take required permanently by the Scheme is 27.3ha.

10.4.27 The majority of the route has not been surveyed in detail, with only a small section in the north classified as Agricultural Land Classification (ALC) Grade 3. Correspondence received from Welsh Government's Department for Natural Resources (DNR) in February 2015 indicated that approximately 3.5 ha of the total area of land take has a moderate probability of being Grade 3 BMV land. The DNR did not make the distinction as to whether the Grade 3 land is comprised of sub-Grade 3a or sub-Grade 3b land. For the purposes of this assessment, this area has been assumed to be the more highly valued sub-Grade 3a land (i.e. BMV land). As this area is less than the 20 ha trigger for a detailed agricultural assessment outlined in DMRB 11.3.6, a detailed agricultural assessment has not been undertaken. Nonetheless, as this 3.5 ha area of agricultural land has been assumed as Grade 3a (BMV) agricultural land, it is considered of Medium sensitivity. The Scheme's effects on non-BMV agricultural land are not considered further in this assessment.

Hydrogeological Conditions

10.4.28 The superficial deposits underlying the scheme corridor around the River Waycock, the Alluvium is classified as a Secondary A aquifer, and the Glacial Till in the area around Sycamore Cross junction is classified as unproductive strata. The Environment Agency has classified the Gully Oolite Formation located in the area around Sycamore Cross as a Principal aquifer. The Porthkerry Member and St Marys Well Bay Member has been classified as a Secondary A aquifer and the Lavernock Shales as a Secondary B aquifer.

10.4.29 Principal aquifers have high intergranular and / or fracture permeability, usually providing a high level of water storage, supplying water and or river base flow on a strategic scale. Secondary A aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. Secondary B aquifers are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

10.4.30 Records from one historical BGS borehole (ST07SE15) towards the north of the scheme indicate that resting water level was at 17.5m bgl. Groundwater was not reported on the other BGS logs.

10.4.31 Groundwater was not encountered in any of the trial pits during the Parsons Brinckerhoff ground investigation in December 2014, but seepage was noted in the base of all the trial pits which ranged from 0.9m bgl to 3.4m bgl.

10.4.32 During the ground investigation groundwater was only encountered in BH101, BH107 and BH108. In BH101 the groundwater level was 0.60m bgl (89.47m AOD), in BH107 the groundwater level was 0.6m bgl (56.73m AOD) and in BH108 the groundwater level was measured as 3.0m bgl (41.21m AOD). The borehole locations are presented in Figure 10.1a to f.

10.4.33 Borehole installations were dipped using an interface probe during a separate monitoring round undertaken between 18th and 23rd December 2014 and an additional round on 27th February 2015. The recorded resting water levels are displayed below in Table 10.10.

Table 10.10: Summary of Site Groundwater Level Measurements

Borehole no.	Date	Water Level (m bgl)	Depth to Base of Installation (m bgl)
BH101	19/12/14	3.38*	6.00
	27/02/15	3.75	6.23
BH102	19/12/14	0.52*	6.00
	27/02/15	0.61	6.21
BH103	18/12/14	0.0**	6.00
	27/02/15	0.31	6.25
BH104	23/12/14	0.15*	6.00
BH105	18/12/14	7.76*	10.00
BH106	18/12/14	6.69*	10.00
	27/02/15	7.08	10.31
BH107	18/12/14	8.34*	10.00
	27/02/15	9.52	10.08
BH108	23/12/14	3.96*	10.00
	27/02/15	4.14	9.27
BH109	23/12/14	3.17*	10.00

Note: ** These are recharged groundwater levels, acquired after borehole purging.*
*** Low lying ground in this area therefore subject to surface flooding*

10.4.34 In-situ testing of five well installations indicated permeability results for the limestone dominated strata was 0.03 to 0.6 metres per day (m/d), whilst mudstone dominated strata ranged from 0.07 to 1.30m/d. It should be noted that these results relate directly to the rock in close proximity to the well and may not reflect overall mass characteristics of either strata.

10.4.35 According to the Envirocheck Report for Sycamore Cross junction (June 2015), there are two licensed groundwater abstractions within 205m of the scheme. These are located at Sheepcourt 134m west, for general farming and domestic purposes, and at Sheepcourt Farm, located 205m north used for agricultural spray irrigation use.

10.4.36 According to the Envirocheck Report there is one licensed sewage discharge to groundwater consent located 817m north east of the Scheme at Cottrell Park golfing facility.

10.4.37 The scheme is not situated within a groundwater Source Protection Zone (SPZ), with no SPZs located within 1km of the Scheme. The nearest SPZ is an area approximately 3km to the east of the southern end of the Scheme, designated as SPZ1.

10.4.38 Local discharge to rivers, streams and springs will drain groundwater locally; whereas topographic highs will act to divide groundwater flow paths. Several streams and springs are present within and around the Scheme corridor; however the general "regional" groundwater drainage is expected to be to the south towards the coast which is approximately 2km south of the southernmost point of the Scheme.

10.4.39 Groundwater resources have been classified by the Environment Agency in accordance with the Groundwater Directive. In summary, the groundwater is classified as good chemical quality and poor quantity.

Hydrological Conditions

10.4.40 There are two primary watercourses within the Scheme area; the largest is the River Waycock that crosses beneath the existing carriageway flowing north east to south west towards the south of the Scheme. The other is the Ford Brook which flows beneath the carriageway east to south west towards the centre of the Scheme. There are numerous secondary and tertiary watercourses along the carriageway alignment and in the surrounding area. Further information on surface water bodies is detailed in Chapter 15 Road Drainage and the Water Environment.

10.4.41 According to the Envirocheck Report there are no licensed surface water abstractions within 1km of the scheme.

10.4.42 According to the Envirocheck Report there are ten licensed discharge consents to surface within 500m of the scheme. The closest is located approximately 4m east of the scheme towards the south end of the carriageway for Dwr Cymru Cyfyngedig, a sewage disposal works discharging final/treated effluent to a freshwater stream/river.

10.4.43 Further details on hydrological conditions and flooding are discussed in Chapter 15 Road Drainage and Water Environment.

Historical Development

10.4.44 Historical maps are provided in the Envirocheck Report within Appendix A of the Preliminary Risk Assessment Report (Appendix 10.1). The historical development of the Scheme is summarised in Table 10.11.

Table 10.11: Historical Development

Dates/Sources	On-site	Off-site
1885 1:10,560 1878 1:2,500	A road is shown along the existing route of the A4226 (Five Mile Lane), and A48 (Sycamore Cross junction) in an agricultural setting.	The surrounding area is predominantly forestry and agricultural land with a small number of farms and cottages. There is a small quarry to the immediate west of the Scheme around the centre of the Scheme in the Whitton-Mawr area and to the northern part of the Scheme, west of the Redland area.
1900 - 1901 1:10,560 1900 1:2,500	No significant changes.	Five quarries are now labelled within 500m of the site, two as old and three in use located to the west of the site in the Whitton-Mawr area. The use of these quarries is not specified. An old trial shaft is labelled east of the scheme footprint, east of Redland Wood.
1919 1:2,500 1921 1:10,560	No significant changes.	There is a reservoir approximately 1km east of the north of the site and a limekiln approximately 600m west of the centre of the site. All of the quarries within 500m of the site are labelled as 'old'.

Table 10.11: Historical Development

Dates/Sources	On-site	Off-site
1964 1:10,000	No significant changes.	No significant changes.
1972 1:2,500 1975 1:10,000	A48 and junction widened at Sycamore Cross.	The old quarry and limekiln located immediately west of the centre of the Scheme are no longer identified and assumed in filled/removed.
1989 1:10,000 and 1:2,500	A4226 (Five Mile Lane) widened at Sycamore Cross junction.	No significant changes.
1993 1:2,500 1999 1:10,000	No significant changes.	No significant changes.
2006 1:10,000	No significant changes.	No significant changes.
2013 1:10,000	No significant changes.	No significant changes.

Recorded Landfill Sites

10.4.45 Environmental Agency data shows one historic landfill located within 1km of the Scheme corridor. This is located 170m east of the Scheme named Blacklands Farm. It was open between 1990 and 1991 and is recorded to have received only 'inert' waste.

Potential for Contaminated Land

10.4.46 The location and further details on the potentially contaminative land uses and associated contaminants are summarised in Table 10.12.

Table 10.12: Potentially Contaminative Land Uses

Process/ Land use	Location	Contaminant Groups Potentially Present On-site
Made Ground associated with the construction of the existing road	On-Scheme	Possible hydrocarbons, asbestos, coal tar asphalt and unknown contaminants. The quantity and condition of any Made Ground is unknown.
Made Ground associated with the potential infilling of surrounding quarries	Associated with at least 5 quarries within 500m of the Scheme	Unknown contaminants. The quantity and condition of any Made Ground is unknown. Possible hydrocarbons, solvents, asbestos, heavy metals.
Landfilling (inert waste)	Blacklands Farm Landfill 170m east of the site	Unknown. Possible hydrocarbons, solvents, asbestos, heavy metals.

Table 10.12: Potentially Contaminative Land Uses

Process/ Land use	Location	Contaminant Groups Potentially Present On-site
Agricultural land	Within and surrounding the Scheme	Hydrocarbons and lubricating oils associated with machinery. Potential pesticides and herbicides.
Landfilling (inert waste)	Blacklands Farm Landfill, 170m east of the Scheme.	Unknown. Possible hydrocarbons, solvents, asbestos, heavy metals.

10.4.47 The most likely sources of contamination for the Scheme are:

- Contamination associated with potential Made Ground i.e. potentially in-filled quarries and carriageway construction;
- Contamination from agricultural land use, most likely spills of fuels associated with machinery and possible pesticides and/or herbicides; and
- Mobile contamination associated with the historic off-Scheme landfill.

Contamination Assessment: Soils

10.4.48 A quantitative risk assessment has been undertaken in general accordance with guidance issued by the Environmental Agency and comprises a Generic level Quantitative Risk Assessment (GQRA) which screens analyte concentrations against Generic Assessment Criteria (GAC) for the Scheme.

10.4.49 Soil samples were collected from the recent Parsons Brinckerhoff ground investigation and submitted for chemical laboratory analysis. The full assessment will be presented within the GIR.

10.4.50 Results were compared against the relevant GAC where concentrations were found at levels greater than the laboratory limit of detection (LOD).

10.4.51 There were no exceedences of the relevant GACs in the soil samples analysed. Concentrations were generally below the limit of detection and significantly lower than GAC values.

Contamination Assessment: Water

10.4.52 The range of GAC used for the screening of determinants within groundwater are based on Environmental Quality Standards (EQS) and Drinking Water Standards (DWS) using the most stringent standards where both are available in order to protect both the groundwater and the surface waters.

10.4.53 A total of four groundwater samples were recovered from BH103, BH104, BH105 and BH109 on 23rd December 2014 and scheduled for laboratory testing. Samples were taken following purging of three well volumes of water.

10.4.54 Five surface water samples were collected on 18th December 2014 from locations along the route of the Scheme presented in Figure 10.1 a-f.

10.4.55 Groundwater and surface water concentrations, where they were above the laboratory limit of detection (LOD) were generally low and there were no exceedences

of generic assessment criteria. The risk to controlled waters risk receptors is considered to be minimal.

Waste Assessment

10.4.56 Excavated material arising from the existing road will be reused within the works and landscaping areas along the Scheme if and where possible. An assessment of the soils along the route of the Scheme was carried out to establish what disposal options would be available, should it be required to be disposed off-site. Two separate assessment exercises were undertaken.

10.4.57 The first was the use of the Parsons Brinckerhoff Waste Characterisation Tool which assesses whether the soil is hazardous or non-hazardous based on all the soil samples taken along the Scheme, and identifies whether the soil possesses any hazardous properties including ecotoxicity, corrosiveness, toxicity etc. Using this characterisation tool the Scheme soils have been assessed as non-hazardous.

10.4.58 The second is an assessment of the Waste Acceptance Criteria (WAC) data which is used to assess whether a landfill will accept the waste after it has been classified as inert, non-reactive hazardous or hazardous.

10.4.59 Waste characterisation legislation is in a state of flux and it can therefore change in the future. Further waste assessment would be required on any excavated wastes generated which required treatment or disposal. Additional testing and assessment would have to be undertaken at the time of excavation to confirm the status of the waste.

10.4.60 The samples collected, analysed and assessed to date would classify the Scheme soils as non-hazardous if disposed off-site.

10.4.61 Three samples for WAC analysis were taken from the superficial deposits. These samples were analysed for an inert WAC suite which comprised total organic carbon (TOC), BTEX, PCBs, mineral oil, PAHs, inorganics, dissolved metals and phenol at 2:1, 8:1 and 10:1 leachate ratios.

10.4.62 The results were screened against Landfill Waste Acceptance Criteria for an inert waste landfill, stable non-reactive hazardous waste in non-hazardous landfill and hazardous waste landfill criteria.

10.4.63 All determinants of the samples analysed were detected at low concentrations, all of which were below the landfill criteria for all three landfill types, however, no assessment of the existing road material has been undertaken at this stage.

Ground Gas

10.4.64 With the potential presence of Made Ground along the Scheme, and an inert landfill approximately 170m east of the Scheme corridor, there is a potential for ground gas to be present. Ground gases have the potential to accumulate in confined spaces representing a risk to human health and property through both inhalation and combustion. However, no above ground structures are proposed and the risk areas are limited to sub surface voids such as service corridors.

10.4.65 Methane present in ground gases is known to be lighter than air, and is flammable in air at concentrations of 5% to 15% by volume. Carbon dioxide is a dense gas that collects in depressions and excavations and acts as an asphyxiant.

10.4.66 Ground gases have been monitored once since the completion of the ground investigation. Peak and steady readings were taken for methane, carbon dioxide, oxygen, carbon monoxide and hydrogen sulphide concentrations from the borehole installations. BH103 and BH104 were not monitored as groundwater was observed to be at ground level.

10.4.67 In summary, methane and carbon dioxide were consistently low. Concentrations of methane did not exceeding 0.0% and concentration of carbon dioxide was a maximum of 4.4% (in BH107). Carbon monoxide was recorded at 0.0ppm with the exception of BH108 and BH109 measured at 4.4ppm and 2.0ppm respectively. Hydrogen sulphide was not detected in any boreholes along the Scheme. Flow rates were also low, generally recorded at 0.0 l/hr, with the exception of BH105, BH107 and BH108 with flows up to 2.7 l/hr.

10.4.68 The results encountered during the monitoring round have been assessed using the Gas Screening Values (GSVs). CIRIA guidance (CIRIA C665) supports the method derived by NHBC, which utilises GSVs to assess the risk posed by ground gases to buildings. The method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the GSV's for methane and carbon dioxide (CIRIA C665).

10.4.69 Although no buildings are proposed, this method enables quantification of the risk. The full assessment will be presented in the GIR. It should be noted that gas concentrations change with time and a conclusive recommendation should not be made based on one set of readings. However, the characteristic situation (a product of flow rate and gas concentration) is generally 1, (a very low risk) with the exception of BH105 and BH107. These two boreholes were characterised with a characteristic situation 2 (low risk) resulting from carbon dioxide readings.

10.4.70 Given the readings to date, based on one round of monitoring data, and the form of the proposed development it is considered that the risk to construction workers and end users is low. The Scheme will be predominantly hardstanding, have no permanent buildings and the underpass will be well ventilated. Where culverts are present the likelihood of gas build up is higher, and appropriate mitigation measures (discussed in Section 10.6.10) should be taken before entry into confined spaces.

Geotechnical Assessment

10.4.71 Water soluble sulphate concentrations within a sample population of 18 No. shallow site soils range between 0.009g/l and 0.73g/l. The average water soluble sulphate concentration was found to be 0.071g/l. Soil pH within the same sample population ranges between 6.6 and 7.8, with an average of 7.3.

10.4.72 Based on the available dataset, the overall design sulphate class is most likely to be DS-1, with an overall Aggressive Chemical Environment Class (ACEC) of AC-1. However, assuming the worst case condition encountered, the sulphate and corresponding ACE class may need to rise to Class 2.

10.4.73 The construction of all earthworks and rock cuttings along the line of the Scheme will be designed to an appropriate factor of safety to minimise the potential for slope instability. These profiles should maintain long term slope stability and obviate the need for direct, active slope stabilisation measures during construction.

10.4.74 Further details on the geotechnical assessment will be presented within the Ground Investigation Report (GIR) which will be produced prior to the commencement of construction.

Conceptual Site Model (CSM)

10.4.75 Risks to human health receptors are considered to be low. The Scheme will comprise predominantly hardstanding, cuttings and embankments and treatment and attenuations ponds with no occupancy on the Scheme.

10.4.76 From a human health perspective, the hard road surfacing would prevent end users coming into contact with any unidentified contaminated soils, effectively breaking the pollutant linkage and managing any residual long term risk. Similarly, with respect to ground gases, long term risks are considered low. Any short term risks from either ingestion or inhalation routes will remain during the construction phase of works, but these should be straightforward to mitigate through appropriate control measures and following best practice procedures.

10.4.77 Risks to the water environment receptors along the Scheme are considered moderate to low. The soil and groundwater quality data does not indicate any pre-existing impact from contamination. Best practice procedures and mitigation measures should be followed during the construction works to ensure no pollution (contaminative materials or silt) will impact on the land and water environment. Table 10.13 presents the updated CSM, reflecting the residual risks of the Scheme.

10.4.78 This risk assessment considers risks following construction of the road. Site workers may be exposed to contaminated materials during construction, although exposure durations are likely to be relatively short-term and therefore not considered chronic. However, adoption of standard best practice including the correct PPE and working procedures will reduce the risk significantly.

10.4.79 A further risk for consideration is the potential for some of the old and existing surfacing to be coal tar derived which may result in the material being classified as hazardous if disposed of off-site, may potentially rule out its re-use and may necessitate more stringent health and safety precautions.

Table 10.13: Updated Conceptual Site Model (CSM) Post-construction

Source(s)	Pathway(s)	Receptor(s)	Residual risk
Potential fuel spills during operation: petroleum hydrocarbons	Direct contact, ingestion and inhalation of dust	Human Health: Road users	(Severity: Minor, Probability: Unlikely), Very low risk: The potential for fuel spills along the Scheme is possible, however, the likelihood of end users coming into direct contact with the associated contaminants is low. The duration will also be minimal.
	Surface run-off	Controlled waters: Water bodies within the Scheme corridor	(Severity: Medium, Probability: Low likelihood), Moderate to low risk: Water bodies flow across the Scheme generally from north east to south west. The Scheme will include a drainage system within the detailed design stage to ensure any contaminated surface run off is diverted away from surface water bodies.

Table 10.13: Updated Conceptual Site Model (CSM) Post-construction

Source(s)	Pathway(s)	Receptor(s)	Residual risk
	Leaching of soils and subsequent migration to controlled waters	Controlled Waters: Groundwater, including principal aquifer and groundwater abstractions, and numerous water bodies within the scheme corridor	(Severity: Severe, Probability: Unlikely), Moderate to low risk: It is possible that following a spill the underlying soils would be contaminated and slowly release contamination over time. The presence of the road surfacing and appropriate highway drainage would minimise the risk of the soils being contaminated in the first place. The deep groundwater level would also minimise the potential for any leaching. The northern part of the scheme is underlain by a Principal Aquifer (although overlain by Till) together with the presence of abstractions and so the impact of any contamination entering this aquifer is considered to be severe. Away from the Gully Oolite the severity would be considered to be Medium.
Made Ground from the historic landfill and potentially infilled quarries: unknown non-volatile and volatile contaminants	Migration of ground gas	Sub-surface features	(Severity: Minor, Probability: Unlikely), Very low risk: The receptor associated with this will be services beneath the carriageway. Monitoring results to date do not indicate concentrations or flow rates of gas that would present a risk to the proposed Scheme.
		Above ground features	(Severity: Mild, Probability: Low likelihood), Low risk: Although there are no proposed buildings along the Scheme, the underpass will be well ventilated; culverts will be present, which increases the risk of ground gas accumulation slightly as they are not so well ventilated structures. However, the risk remains low due to construction and maintenance workers following best practice procedures.

Resource / Receptor Sensitivity

10.4.80 The following section considers the potential impact that the Scheme could have on the identified receptors.

10.4.81 The attribute sensitivity of receptors has been identified in line with the approach set out in Section 10.3.

10.4.82 Where a receptor (e.g. groundwater) could be allocated more than one level of sensitivity, the more sensitive level will be taken through for initial consideration of the significance of any impacts. If a requirement for mitigation measures are identified consideration will then be given to whether those measures are required across the whole scheme or only where the receptor sensitivity is the highest.

10.4.83 The geology and soils, including agricultural soils are considered to be of medium sensitivity due to the scheme being in a minerals safeguarded area in the draft LDP 2011-2026, and the likely agricultural grade 3 to 4 classifications.

10.4.84 For the purpose of this chapter, effects on ecological systems (including the Barry Woodlands SSSI) within the vicinity of the scheme have not been considered in this Chapter. The effects on ecological systems are considered in Chapter 9.

10.4.85 The groundwater beneath the scheme has been considered as high sensitivity as the aquifers beneath the scheme have been classified as a Principal aquifer with abstraction wells located in the at Sycamore Cross area. Secondary A and Secondary B aquifers have been classified along the majority of the route considered which are medium sensitivity. The Scheme is not located within any SPZ's.

10.4.86 Impacts on surface water bodies are considered from the point of view of impacts from soil and / or contamination. Drainage issues are addressed in Chapter 15. The surface water receptors are considered to be of high sensitivity as the River Waycock is a primary watercourse.

10.4.87 The built environment / end use of the Scheme is a carriageway, and therefore is considered to be low sensitivity, with the sensitivity of end users also low. Further consideration of the Scheme impact on cultural heritage built environment is presented in Chapter 7.

10.4.88 The sensitivity of construction workers at the scheme is considered to be medium due to the moderate earthworks.

10.4.89 The sensitivity of end users of the Scheme is considered to be low as it is predominately a 'hard end use', will little exposure to the underlying soils and geology.

10.5 Predicted Effects (without Mitigation)

10.5.1 A detailed description of the Scheme is included in Chapter 3. To summarise, the Scheme is expected to follow the route of the existing carriageway in places with widening and newly constructed access lanes into the surrounding Greenfield land. The central section of the Scheme will go off-line and include more moderate earthworks including rock cuttings to widen the carriageway and embankments.

Construction

10.5.2 This section considers the potential impact that the Scheme could have on the geology, soils and hydrogeology during the construction works.

Geology

10.5.3 There are no geological features of importance such as SSSI's or RIGS within the scheme corridor. However, the mineral resources are in a safeguarded area within the Vale of Glamorgan draft LPD 2011-2026. Therefore, the construction phase of the scheme may result in the removal or sterilisation of a certain quantity of the safeguarded minerals. This is anticipated to be a minor loss resulting in a minor adverse impact to this attribute. The significance of the effect on geology and mineral resources (medium sensitivity) is considered slight adverse.

Soils

10.5.4 The surrounding land is agricultural. The Welsh Government indicated that approximately 3.5ha of the total area of land take has a moderate probability of being Grade 3 BMV land, for the purpose of this assessment has been assumed to be more highly valued sub-grade 3a land. There will be a potential loss of approximately 3.5ha of BMV agricultural land, which may be Grade 3a. The magnitude of impact is considered to be negligible due to the small scale loss of BMV land, and the significance of effect on a receptor on medium sensitivity is anticipated to be neutral to slight adverse.

Land and Controlled Waters

10.5.5 There is potential for introduction of contaminated materials to the ground or groundwater during the construction phase. This may occur due to incorrect storage or spillages of materials such as fuels and low volumes being released accidentally into the surrounding environment. Depending on the location of the spill, pollutants could infiltrate into the ground and contaminate the land, groundwater, or run-off directly to the watercourses or via drainage systems. The magnitude of this impact is considered major adverse, and the significance of such an effect is anticipated large adverse, based on the sensitivity of the Principal Aquifer at the northern end of the site.

Controlled Waters

10.5.6 During the construction phase of the scheme there is potential for the creation of new migration pathways for any existing contamination. However, soil quality data does not indicate the presence of elevated contaminant concentrations within the scheme corridor, relative to background, and groundwater quality is not expected to be impacted by potentially existing land contamination during the construction phase of the scheme. The magnitude of impact is considered negligible and the significance of effect slight adverse.

10.5.7 There is potential for the mobilisation of soil contamination or silt which could impact on surface waters. Although soil quality data does not indicate the presence of elevated contaminant concentrations within the scheme corridor, relative to background, site run off with elevated suspended sediment loads is a risk common to all earthworks schemes. Surface water quality has the potential to be impacted by land contamination during the construction of the Scheme. The magnitude of impact is considered major adverse and significance of effect large adverse.

Built Environment

10.5.8 Chemicals that are destructive to concrete have the potential to constrain the design of the Scheme corridor. The chemicals most likely to attack concrete are sulphates and acids. However, analytical data does not indicate the likely presence of aggressive ground conditions along the Scheme corridor and the Ground Investigation Report does not recommend specific protection measures for construction. Therefore the Scheme will have no change and the significance of effect neutral.

Construction Workers

10.5.9 Any ground disturbance has the potential to impact health arising from oral, inhalation or dermal contact with potential contaminants within any Made Ground. Existing soil

conditions are not anticipated to negatively impact upon construction workers as a result of the construction phase of the Scheme, therefore the magnitude of impact is considered negligible adverse. The significant of effect is assessed as slight adverse.

Operation

10.5.10 This section considers the potential impact that the Scheme could have on the geology, soils and hydrogeology during the operational phase.

Geology

10.5.11 The mineral resources are in a safeguarded area within the Vale of Glamorgan draft LPD 2011-2026. Safeguarded minerals would become sterilised during the construction phase and will continue to be sterilised for the duration of the operational phase of the Scheme. It is anticipated to result in a minor adverse impact to this attribute for the duration of the operational phase. The significance of the effect on geology is considered slight adverse.

Soils

10.5.12 There is potential for an increase in vehicle emissions (due to increased capacity following improvement of the carriageway), increasing the likelihood of fuel spillages or leakages from vehicles. This may result in an adverse impact on the agricultural land and soil quality. This is considered negligible adverse and the significance of the effect is assessed as slight adverse.

Controlled Waters

10.5.13 Adverse impacts associated with the potential mobilisation of existing soil contamination are likely to occur during the construction phase, rather than the operational phase of the Scheme. There are not anticipated to be any adverse impacts to groundwater quality or surface water quality during the operation phase of the Scheme as a result of existing land contamination. Potentially contaminated ground has not been identified within the scheme corridor, therefore, beneficial impacts associated with ground improvement works are not anticipated and the impact is considered no change, with a neutral significance of effect.

10.5.14 The operational phase of the Scheme will result in a greater volume of traffic, this would bring an increased likelihood of fuel spillages / leakages from vehicles. The impact is considered moderate adverse. The significance of this effect is considered moderate adverse.

Built Environment

10.5.15 Aggressive ground conditions have the potential to cause adverse impacts during the operational phase of the scheme by damaging and reducing the design life of structures. The analytical data for the Scheme does not however indicate the likely presence of aggressive ground conditions. The magnitude of impact therefore is considered no change and the significance of effect neutral.

End Users

10.5.16 The existing soil quality data does not indicate the presence of elevated contaminant concentrations within the Scheme corridor. The only plausible exposure pathway which would exposure future end users to potential sources of contamination along

the Scheme are associated with the increased potential for fuel spillages leading to direct pathways to cyclists and riders. The impact is considered negligible adverse. The significance of the effect is assessed as slight adverse.

10.6 Mitigation

10.6.1 This section provides a summary of recommended mitigation measures to control or reduce the potential impacts identified in Section 10.5.

Construction

Design Best Practice and the Construction Environmental Management Plan

10.6.2 Construction techniques will need to take into consideration the requirement to mitigate for the potential impacts (e.g. disturbance of contamination, depth to groundwater and the creation of preferential pathways). The design and implementation of the construction works will be undertaken in accordance with ISO 14001. Measures need to be included in all works in relation to contaminated land, such as:

- Preparation and implementation of a Construction Environmental Management Plan (CEMP) for the Scheme;
- Incidence Response Plans;
- Environmental training for personnel;
- Record keeping; and
- The identification, mitigation and remediation of contaminated land.

10.6.3 The handling, storage and removal of potentially contaminated material on the Scheme route will be subject to waste management legislation and guidance, and appropriate disposal or reuse of materials, including the need for pre-treatment, should be considered as part of the earthworks design.

Geology and Soils

10.6.4 Currently there is a planned permanent land take of 27.3ha of agricultural land, of which only 3.5ha is considered Best and Most Versatile (BMV) agricultural land. Based on the fact that land take over BMV agricultural land is less than 20ha, an agricultural survey is not required for these works.

10.6.5 The Scheme is within a minerals safeguarded area for category 1 and 2 limestone, and category 2 sand and gravel aggregates. The completion of a mineral resources survey should be considered to quantitatively determine the potential loss/sterilisation of resource prior to the construction phase. It is currently anticipated to be a minor loss as the majority of the Scheme alignment is on the current highway alignment.

10.6.6 During the construction there is potential that previously unidentified contamination is encountered during earthworks. This material should be chemically tested and assessed against derived criteria (completed during the ground investigation) before being removed or remediated.

10.6.7 From the bulk earthworks calculations an assumption has been made that 50% of the excavated material will be unacceptable for reuse. If this is the case, suitable material will be imported to site to increase ground levels. Import criteria should be

derived that will protect human health and the environment. This in turn will mitigate many of the risks associated with the presence of potential contamination in the ground and contact with construction works / end users. If 50% of the excavated material is not suitable for reuse it will have to be removed and disposed of off-site. In these circumstances, the waste will be characterised and classified before disposal off-site.

Controlled Waters

10.6.8 Other adverse effects have been identified that have the potential to impact controlled waters during construction. The mitigation measures will include:

- Bunds will be used to prevent run-off, including silt, entering watercourses;
- A procedure will be in place to manage previously unidentified contaminated ground that is encountered during the construction phase;
- Any soil arisings that have visual or olfactory evidence of contamination will be stored on a bunded sheeted stockpile on hardstanding or in a covered skip;
- If shallow groundwater is encountered during the earthworks, suitable consideration should be given for the storage and disposal of groundwater from any likely dewatering activities that may be required; and
- Suitable drainage design including the provision of filter drains, wetlands and attenuation ponds will provide a high degree of treatment to surface water runoff from the road prior to infiltration or discharge, in accordance with the recommendations of the Draft National Standards for Sustainable Drainage.

Land and Controlled Waters

10.6.9 There is the potential for the introduction of contaminated materials to the ground or controlled waters due to incorrect storage or spillages of construction materials and fuels. These impacts will be mitigated by:

- Compounds where materials and fuels are stored will be on hardstanding to prevent infiltration in case of spillage;
- Spill kits will be readily available;
- Designated refuelling areas on hardstanding with interceptor drainage, bunds or similar;
- Storage area for materials will be identified; and
- A site management plan will be produced.

Built environment

10.6.10 The aggressivity of the soils was determined within the Ground Investigation Report, recommending the concrete type to be used. This must be input into the detailed design and implemented during construction works.

Construction workers

10.6.11 Risks to construction workers during the construction phase of the Scheme will be mitigated by the correct implementation of Health and Safety measures, such as suitable working methods and the correct use of personal protective equipment.

These will be developed as part of the CEMP for the Scheme. For further guidance, reference should be made to the Health and Safety Executive document EH40 'Workplace Exposure Limits'. The protective measures are considered standard practice and should include the following:

- Selection of appropriate PPE (e.g. gloves and overalls);
- Gas testing prior to entry of confined spaces;
- Implementation of best practice procedures such as washing hands before eating, no eating in the work area;
- Clear signage of contaminated land if encountered; and
- Adequate site security is required to prevent trespassers gaining access to the Scheme corridor during the construction phase.

Operation

Controlled waters

10.6.12 Risks to controlled waters during the operational phase of the Scheme will be mitigated by correct; and regular maintenance of highway drainage and best practice procedures. This will ensure efficient removal of sediment, and other contaminants such as potential fuel spills, which will reduce the risk of pollution posed to controlled water (groundwater and surface water bodies).

10.7 Residual Effects (with Mitigation)

Construction

10.7.1 Following the implementation of mitigation measures along with best practice during construction, residual impacts to geology, soils and hydrogeology are considered to be negligible to no change, with an overall impact significant to all receptors of slight adverse to neutral.

Operation

10.7.2 Following the implementation of design based on best practice taking into account mitigation measures described above, there are no predicted residual impacts to geology, soils and hydrogeology. The impacts magnitude to all identified receptors is no change.

10.8 Cumulative Effects

10.8.1 Many environmental aspects are interrelated. As such impacts from contamination have the potential to have an adverse effect on sensitive receptors in other environmental topics resulting in cumulative effects. This may include effects on air quality from contaminated soil bourn dust, the quality of surface water and groundwater, or ecological receptors. However, as the soil quality data along the Scheme corridor does not indicate the presence of elevated contaminant concentrations, relative to background, and groundwater quality is not expected to be impacted by land contamination no specific cumulative effects have been identified.

10.8.2 The cumulative assessment also considers potential cumulative effects on soils, geology and hydrogeological receptors arising from other developments within 500m of the Scheme, as well as these developments impacting upon the Scheme, or the

Scheme impacting on other developments. At the time of writing, there are five developments seeking planning permission.

10.8.3 Each of the developments seeking planning permission is outlined briefly below.

- 2014/01205/SC1 - (160m west from Sycamore Cross). Proposed residential development. 60 dwellings to be constructed in 2016. 60 dwellings to be constructed after 2021;
- 2014/00798/FUL - (120m east of the Scheme) 6MW Solar PV array;
- 2014/01103/NMA - (300m west of the Scheme) 8MW Solar Farm covering 19ha;
- 2014/00081/FUL - (50m east of the Scheme) 7MW Solar farm, one electrical substation, seven power inverter stations and other supplementary works; and
- 2015/00365/SC1 – (400m south-west of the southern extent of the offline component of the Scheme) solar photovoltaic array covering a14ha area.

Construction

10.8.4 Four out of the five schemes detailed above are to be situated on poor quality agricultural land. The scheme 2014/01/01205/SC1 is potentially located on BMV land of Grade 3a. If the agricultural land take of this development, along with this scheme (of approximately 3.5ha BMV land take) has a cumulative total of greater than 20ha, a soil classification survey should be completed.

10.8.5 The proposed developments detailed above are all within the mineral resources safeguarded area within the Vale of Glamorgan draft LPD 2011-2026. Therefore, if all developments get constructed it may result in the removal or sterilisation of safeguarded minerals for a substantial area of land. This is anticipated to be a moderate loss resulting in a moderate adverse impact to this local to regional attribute. The significance of the effect on geology and mineral resources (medium sensitivity) is considered medium adverse.

10.8.6 There is considered no further cumulative impacts on the geology, soils and hydrogeology upon the construction of other developments surrounding the Scheme, or vice versa. This assumes industry best practice procedures are followed and a CEMP is developed which will apply to each of the key construction elements of the individual Schemes.

Operation

10.8.7 When the proposed developments surrounding the Scheme are operational, and mitigation measures and best practise procedures are followed, the only remaining cumulative impact on the geology, soils and hydrogeology of the Scheme is considered to be the sterilisation of safeguarded minerals. The minerals will remain sterilised during the operational phase of the developments, which are anticipated to be a moderate adverse impact, and a moderate adverse significance of effect.

10.9 Summary & Conclusions

10.9.1 An assessment of the potential impacts associated with construction and operational phases of the Scheme has been undertaken in relation to geology, soils and hydrogeology (including land contamination). The assessment identified potential effects that the Scheme may have on geology, soils and hydrogeology within the

Scheme corridor and surrounding area. Mitigation measures have been proposed to minimise the scale of the impacts identified where necessary.

10.9.2 Previous ground investigation did not identify any contamination, nor the presence of Made Ground. The scheme is in a 'safeguarding minerals area', and where the agricultural soils are classified Grade 3 to 4. The scheme is underlain by a Principal aquifer to the north, and also Secondary A and B aquifers along the majority of the route, with two primary watercourses flowing below the existing road.

10.9.3 The sensitivity of resources and / receptors are considered to range from low to high. Significance of impacts without mitigation is considered to range from major to neutral.

10.9.4 Following the implementation of a sufficient design to take into account mitigation measures, there are no predicted residual impacts to geology, soils and hydrogeology, with the significance of effect assessed as neutral, with a slight adverse residual effect for the loss of BMV agricultural land and sterilisation of an area of the minerals safeguarded area. Under the EIA regulations these residual effects to soils and geology are considered not significant.

Table 10.14: Summary of Geology & Soils Impacts

Potential Impacts	Nature of Impact	Predicted Effect (without Mitigation)	Mitigation Measures	Residual Effects (with Mitigation)
Construction				
Impact upon geological features and removal of mineral resource in safeguarded area	Minor adverse as a very minor loss of mineral resource in safeguarded area	Slight Adverse	None required as it is anticipated to be a minor loss. However, a mineral resources survey should be considered.	Slight Adverse to Neutral
Impact upon Grade 3a agricultural land	Negligible adverse	Slight Adverse to Neutral	None required	Neutral to Slight Adverse
Incorrect storage / transport / use of materials such as fuels and oils leading to leakages / spills of pollutants to ground and controlled waters.	Major adverse impact on shallow groundwater, and primary watercourses	Large Adverse	Follow best practice procedures, develop and implement CEMP	Neutral Adverse
Creation of new migration pathways for contamination	Negligible adverse impact. Soil quality data does not indicate elevated contaminant concentrations. Groundwater quality not expected to be impacted by existing land contamination.	Slight Adverse	Follow best practice procedures, develop and implement CEMP	Neutral
Mobilisation of existing soil contamination or creation of silt by the earthworks	Major adverse. Although soil quality data does not indicate elevated contaminant concentrations, site run off with elevated suspended sediment loads is a risk.	Large Adverse	Follow best practice procedures, develop and implement CEMP	Neutral
Chemicals that are destructive to concrete have the potential to constrain the design of the scheme corridor	No change	Neutral	Scheme design	Neutral
Contaminant exposure (dust inhalation / dermal contact with soils)	Negligible adverse. Existing soil conditions are not anticipated to negatively impact upon construction workers.	Slight Adverse	Follow industrial best practice procedures, develop and implement CEMP	Neutral

Table 10.14: Summary of Geology & Soils Impacts

Potential Impacts	Nature of Impact	Predicted Effect (without Mitigation)	Mitigation Measures	Residual Effects (with Mitigation)
Operation				
Impact upon geological features and mineral resources	Minor adverse	Slight Adverse	None required	Neutral
Increase in vehicle emissions / spillages resulting in impact to soil quality	Negligible adverse	Slight Adverse	Scheme design	Neutral
Mobilisation of existing soil contamination to surface waters and groundwater	No change	Neutral	None	Neutral
Increased likelihood of fuel leakages / spills from vehicles, from increased traffic volume	Moderate adverse impact on reduction in soil quality along Scheme as increase in traffic flow if any is likely to be minimal	Moderate Adverse	Design of the drainage on the scheme.	Neutral
Chemicals that are destructive to concrete have the potential to constrain the design of the scheme corridor	No change	Neutral	Scheme design	Neutral
Nature of ground conditions upon the end users	Negligible adverse	Slight Adverse	Scheme design	Neutral
Cumulative Impacts				
Impact upon geological features and removal of mineral resource in safeguarded area	Moderate Adverse	Moderate Adverse	Mineral resources survey	Slight Adverse to Neutral

11 MATERIALS

11.1 Introduction

11.1.1 This chapter provides an assessment of the potential effects from the use of materials and generation of waste associated with the proposed Scheme. It follows guidance in Interim Advice Note (IAN) 153/11: Guidance in the Environmental Impact Assessment of Materials and Technical Advice Note (TAN) 21 Waste (Welsh Government, 2014).

11.1.2 The assessment of the potential impacts on materials and waste from the Scheme has focused on the construction phase. It is anticipated that most of the impacts are likely to arise during construction. Operational activities such as repairing potholes, clearing out drains and general road surface maintenance are relatively minor scale and not likely to cause significant effects.

11.1.3 The construction of the Scheme has the potential to use large amounts of raw materials and generate quantities of waste. The consumption of material resources and the management of waste give rise to environmental impacts that need to be managed and mitigated. This chapter does not cover indirect materials and waste impacts which occur off-site and may possibly occur outside the UK, including the depletion of non-renewable resources and the production of waste at the point of extraction and during manufacturing. These impacts are outside the scope of this assessment.

11.1.4 The impacts of primary raw materials, secondary or reused/recycled materials and manufactured construction products during construction of the Scheme are considered. Mitigation measures for any detrimental impact are described. The assessment considered the following factors:

- Earthworks movements (including extent, method and programme of the proposed earthworks and construction activities);
- Quantities of materials to be imported;
- Quantities of materials to be exported or disposed of;
- Required lorry movements;
- Required treatment; and
- Storage on site.

11.1.5 It is assumed that the construction of the Scheme would be carried out in accordance with normal good working practice implemented on such projects.

11.1.6 The assessment of impacts of the Scheme on the Geology and Soils, together with contamination is presented in Chapter 10 of this ES.

11.2 Legislative & Policy Context

<u>European Legislation & Policy</u>

EU Waste Framework Directive 2008/98/EC

11.2.1 The EU Waste Framework Directive 2008/98/EC provides the overarching legislative framework for the collection, transport, recovery and disposal of waste, and includes a common definition of waste. It lays down measures to protect the environment and

human health by preventing or reducing the adverse effects of the generation and management of waste and by improving the efficiency and reducing the overall impacts of resource use. The Waste Framework Directive requires all Member States (including Wales) to take the necessary measures to ensure that waste is recovered or disposed of without endangering human health or causing harm to the environment.

11.2.2 The Directive also mandates the waste hierarchy, which requires that where waste is unavoidable, products and materials should, subject to regulatory controls, be used again, for the same or a different purpose (re-use). Otherwise resources should be recovered from waste through recycling. Value can also be recovered by generating energy from waste and only if none of the above offer an appropriate solution should waste be disposed of.

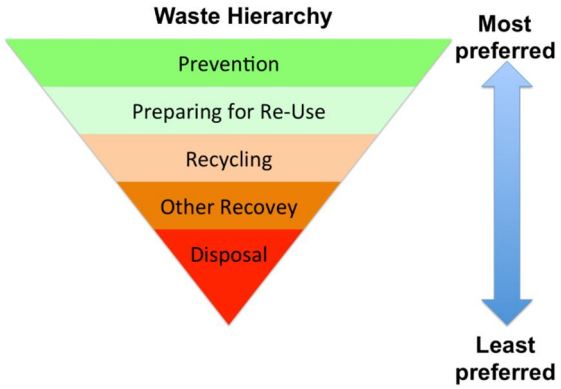


Figure 11.1: The European Waste Hierarchy (source: Waste Framework Directive, Defra)

EU Landfill Directive 1999/31/EC

11.2.3 Where the reuse, recycling or recovery of waste is not possible or will cause greater harm to human health and the environment, disposal of such waste remains the appropriate management option. The EU Landfill Directive sets stringent requirements for the landfilling of wastes in Wales. The key requirements of the Directive are:

- The separation of wastes through a classification approach to landfills: landfill for hazardous waste; landfill for non-hazardous waste and landfill for inert waste
- The treatment of wastes prior to landfilling;
- Banning of certain wastes from being landfilled for example, liquid wastes, explosive and flammable wastes; clinical and veterinary wastes and whole or shredded waste tyres;
- Reduction in the amount of biodegradable municipal waste going to landfill; and
- Landfill location requirements.

National legislation & policy

11.2.4 There are a number of primary legislative instruments in the UK on waste listed below which enact a wide range of secondary legislation that governs the storage, collection, treatment and disposal of waste:

- The Control of Pollution Act 1974;
- The Control of Pollution (Amendment) Act 1989;
- Environmental Protection Act 1990 (EPA);
- The Environment Act 1995;
- The Finance Act 1996;
- Waste Minimisation Act 1998;
- The Waste and Emissions Trading Act 2003;
- The Clean Neighbourhoods and Environment Act 2005; and
- The Hazardous Waste (England and Wales) Regulations 2005

11.2.5 This chapter has been compiled with consideration of the above legislation and the regulations and strategies below.

The Waste (England and Wales) Regulations 2011

11.2.6 These Regulations transpose, for England and Wales, The EU Waste Framework Directive. These regulations require:

- The establishment of waste prevention programmes;
- Waste management plans for England and Wales;
- The waste hierarchy in the Directive to be applied as a priority order; and
- The separate collection of paper, metal, plastic and glass waste.

11.2.7 They impose duties in relation to the improved use of waste as a resource and duties on planning authorities when exercising certain functions under Welsh planning legislation. They also make provisions in relation to carrying and brokering in waste, and enforcement.

The Waste (Miscellaneous Provisions) (Wales) Regulations 2011

11.2.8 These Regulations are supplementary to the Waste (England and Wales) Regulations 2011. They make amendments to several Welsh statutory instruments for the purposes of transposing, in relation to Wales, The EU Waste Framework Directive 2008/98/EC (summarised above).

The Landfill (England and Wales) Regulations 2002

11.2.9 These Regulations set out a pollution control regime for landfills for the purpose of implementing the EU Landfill Directive 1999/31/EC in England and Wales.

Towards Zero Waste – One Wales: One Planet 2010

11.2.10 Towards Zero Waste is the overarching waste strategy document for Wales (as required under the Waste (England and Wales) Regulations 2011). It sets out a long term framework for resource efficiency and waste management in Wales up until 2050, taking into account social, economic and environmental outcomes.

Local legislation & policy

11.2.11 The Vale of Glamorgan Adopted Unitary Development Plan (2005) and the Vale of Glamorgan Local Development Plan (2013) (deposit draft) have been reviewed and considered during preparation of this chapter. Once adopted (programmed for January 2016) the Vale of Glamorgan Local Development Plan (2013) will replace the current Unitary Development Plan. The council's Municipal Waste Management Strategy for Vale of Glamorgan Council (2004) has also been reviewed and considered.

11.3 Assessment Methodology

Study Area

11.3.1 The study area for the assessment comprises the Scheme and local road networks. Many material resources will originate off-site but others will arise on site during construction, such as excavated soil and rock or recycled elements of existing features. The latter are included within the Scheme boundary.

Scope and Guidance

11.3.2 A detailed assessment has been undertaken in accordance with IAN 153/11. The assessment is a quantitative exercise, which aims to identify and quantify the effects associated with material use and waste, during the construction of the Scheme. The guidance in IAN 153/11 is not prescriptive or exhaustive in order to provide a flexible approach enabling those undertaking the assessment to tailor their approach to the specific characteristics of each Scheme.

11.3.3 The assessment of the effects of constructing the Scheme on materials considers the extent, method and programme of the proposed earthworks and construction activities required to complete the Scheme. The impacts have been assessed before and after mitigation measures are applied.

11.3.4 For the purpose of assessing the effects associated with material use and waste, the assessment has identified and quantified the following where possible:

- The types and quantities of materials required for the project;
- Details of the source of materials;
- The cut and fill balance;
- The types and quantities of forecast waste arising from the project, including the identification of any forecast hazardous waste;
- Waste that requires storage on site prior to re-use, recycling or disposal;
- Waste to be pre-treated on site for re-use within the project;
- Waste requiring treatment and/or disposal off site; and
- The impacts that will arise from the issues identified in relation to materials and waste.

Significance Criteria

11.3.5 There are no specific significance criteria used in the DMRB for assessment of materials and waste. The sensitivity of the receptor is dependent on the capacity of

the local environment to provide materials or dispose of waste. The quantities of materials to be used and the waste forecasts have been used to identify the magnitude for change.

11.4 Baseline Conditions

Geology and Contamination

11.4.2 A detailed description of the geological conditions and soils beneath the Scheme is provided in Chapter 10. A brief description of the type of materials that would be excavated during construction of the Scheme is provided below.

11.4.3 The Scheme corridor is underlain by thinly interbedded limestone and calcareous mudstone or siltstone. Overlying the bedrock geology, a narrow alluvial plain following the River Waycock is indicated to be present in the south of the Scheme comprising clays, sands and gravels. With the exception of this, superficial deposits along the length of the Scheme are unknown or absent. Made Ground is likely to be present along the route of the carriageway and any other existing areas of hardstanding.

11.4.4 Over half of the length of Five Mile Lane lies on loamy and clayey soils described as slowly permeable and seasonally wet with impeded drainage. Along the route of the River Waycock, soils are described as loamy and clayey floodplain soils with naturally high groundwater. North of the River Waycock and at the most northern end of the road, soils are described as loamy and freely draining. Generally sub-soils range between 1.3 and 3.5m thickness. These are overlain by topsoil between 0.1 and 0.3m in thickness.

Traffic

11.4.5 Five Mile Lane stretches from the A48 at Bonvilston and Sycamore Cross in the north to the north-west of Barry and Waycock Cross in the south. The existing road runs south from Sycamore Cross for approximately 7km, where it connects with Waycock Cross Roundabout. Sycamore Cross is a staggered signalised junction that is well lit and has a good quality surface. The existing Five Mile Lane is a single lane carriageway, operating at national speed limit and 40mph at varying locations due to tight bends and residential properties. It is a rural road, which has a number of farm accesses and minor roads connecting from it. The southern part of the road runs through Coed Mawr Forest.

11.4.6 It is anticipated that material deliveries will be directed to the main construction compound located towards the northern end of the Scheme, approximately 100m south of the entrance to the Amelia Methodist Trust Farm. However some secondary site accesses for material deliveries to the north and south of the compound are likely. It is anticipated that the majority of HGV access will be from the A48 / A4226 Sycamore Cross junction along the less sinuous northern section of the existing Five Mile Lane. Appropriate site access, public information requirements and traffic management will be developed with the appointed principal contractor and the Highway Authority.

Waste Management Facilities

11.4.7 IAN 153/11 specifies that an assessment of the following available waste management infrastructure should be undertaken, including:

- Types of waste management facilities, including landfill sites, materials recovery facilities, transfer stations;
- Locations of waste management facilities in relation to the site; and
- Capacities of identified waste management facilities for each type of waste forecast to be produced.

11.4.8 Table 11.1 identifies materials recovery facilities and Waste transfer stations within the Vale of Glamorgan.

Table 11.1: Materials recovery facilities and Waste transfer stations within the Vale of Glamorgan

Name of Waste Facility	Category	Address	Distance from Scheme
Andrew Brown & Lee Walter Peacock	Transfer	Llandough CF63 3RF	4km south east
Cowbridge Compost	Treatment	Llwynhelig, Cowbridge CF71 7FF	9km north west
Simply Fill Limited	Transfer	Old Tunnel Yard Wenvoe CF5 6AB	4km east
Site Serv Limited	Transfer	Triple Crown House, Llandow Trading Estate, Cowbridge CF71 7PB	12km west

Landfills

11.4.9 The Landfill (England and Wales) Regulations 2002 require that disposal sites are classified into one of three categories dependent on the chemical composition of the material they receive. These are:

- Hazardous waste - This is waste that may be harmful to human health or the environment e.g. asbestos, chemicals, healthcare waste, electrical equipment, lead-acid batteries, oily sludge and pesticides;
- Non-hazardous waste - This may include municipal waste, general office waste and catering waste; and
- Inert waste - This is waste that does not undergo any significant physical, chemical or biological transformation such as construction and demolition waste.

11.4.10 Prior to disposal, if material is deemed hazardous it must be pre-treated to meet the Waste Acceptance Criteria. Further stipulations within the Landfill Regulations are as follows:

- Higher engineering and operating standards to be followed;
- Hazardous liquids, flammable, corrosive, explosive, oxidising and infectious wastes have been banned from landfill since July 2002;
- Non-hazardous liquids have been banned since 2007;
- Co- disposal has been banned since 16 July 2004;

- Whole tyres were banned from 2003, and shredded tyres have been banned since 2006;
- Waste will be required to be pre-treated prior to landfilling; and
- Operators must demonstrate that they and their staff are technically competent to manage the site, and have made adequate financial provision to cover the maintenance and aftercare requirements.

11.4.11 Table 11.2 identifies landfill sites for construction waste within a reasonable proximity of the Scheme.

Table 11.2: Landfill Sites for Construction Waste in Proximity to the Scheme

Name of Landfill Site	Waste Class Received	Address	Distance from Scheme
Morfa Hazardous Landfill (ppc)	Hazardous waste	Port Talbot Works, Port Talbot, NPT, SA13 2NG	33km north west
Morfa Non-hazardous Landfill (ppc)	Non-hazardous waste	Port Talbot Works, Port Talbot, NPT, SA13 2NG	33km north west
JLA Disposal	Non-hazardous waste	Glyncynwal Uchaf Farm, Lower Cwmtwrch, West Glamorgan, SA9 2QQ	48km north west
Whitehall Landfill	Inert waste	Old Port Rd, Wenvoe,Cardiff,South Glamorgan,CF5 6AW	4km east
Derwen Waste Management & Resource Recovery	Inert waste	Neath Abbey Wharf, Neath Abbey, Neath, West Glamorgan, SA10 6BL	40km north west

Source: Environment Agency, 2015[9]

11.5 Predicted Effects (without Mitigation)

Overview

11.5.1 Material resources encompass the materials and construction products required for the construction of the Scheme. The potential environmental effects are associated with the extraction and transport of primary raw materials, the manufacture of products, and their subsequent transport to and use on construction sites. Many material resources will originate off site, purchased as construction products, and some will arise on site such as excavated soils or vegetation.

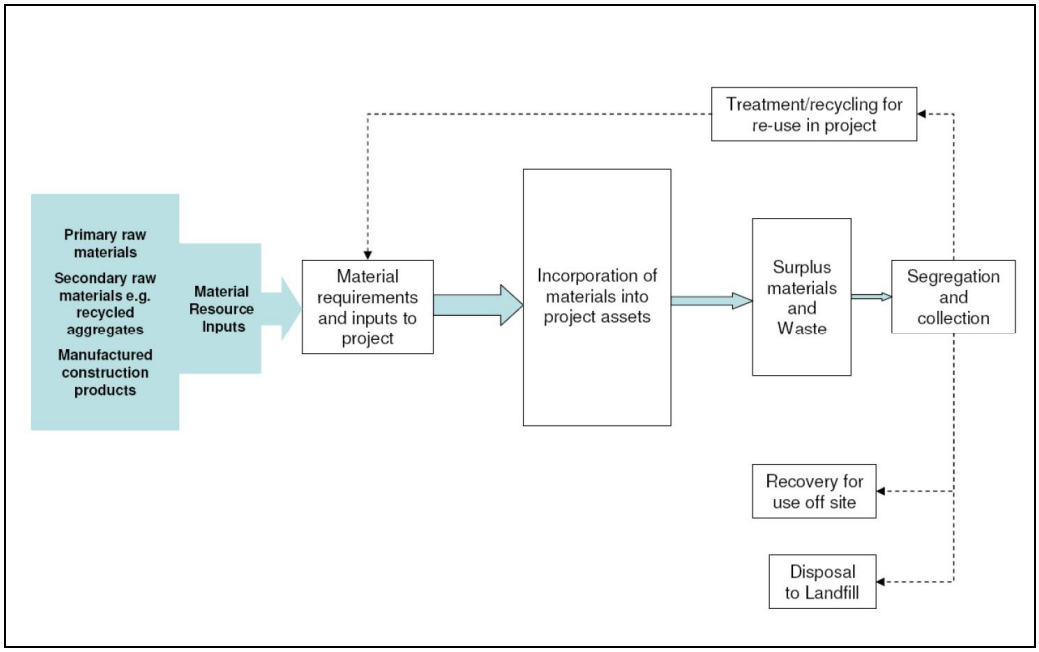
11.5.2 Waste will arise where there are surplus materials either from demolition of existing features, surplus excavated material from earthworks, or from materials brought on to site but not used for the original purpose e.g. damages, off cuts, surplus. The potential environmental effects are associated with the production, movement, transport, processing, and disposal of such waste stream from site. The assessment below has identified and quantified the types and quantities of waste arising from the construction of the Scheme where possible. This can be determined in more detail during detailed design when a Contractor has been appointed.

[9] Environment Agency (2015). Register of authorised landfill sites. http://maps.environment-agency.gov.uk/wiyby/

11.5.3 The Scheme will inevitably result in some surplus material which will need to be disposed of as waste. This is most likely to arise from:

- Existing site materials e.g. excavation of material from earthworks which cannot be reused within the site; or
- Materials brought on to site but not used for its intended purpose e.g. damaged goods or residual amounts not used.

11.5.4 Inset 11.1, reproduced from IAN 153/11, illustrates how materials and waste are used in the process.



Inset 11.1: Scheme Material Flow Diagram (source: IAN 153/11[10])

Materials

11.5.5 Importing materials for construction and the onsite excavation and stockpiling of materials has the potential to have an adverse effect in relation to landscape, traffic and dust. Effects on dust (air quality) and landscape are discussed in Chapters 6 and 8 respectively of this ES. The potential environmental effects of importing materials to site are associated with the extraction and transport of primary raw materials. This chapter does not cover indirect materials and waste impacts which occur off-site and may possibly occur outside the UK, including the depletion of non-renewable resources and the production of waste at the point of extraction and during manufacturing. These impacts are outside the scope of this assessment.

11.5.6 Types of materials required to construct the Scheme are listed below:

- Blacktop;
- Fill material;

[10] Highways Agency (2011) Interim Advice Note 153/11 Materials.

- Topsoil;
- Reinforced concrete;
- Structural steelwork; and
- Masonry.

11.5.7 Table 11.3 summarises the approximate quantity of materials required to construct the Scheme, material won on site and material to be imported.

Table 11.3: Quantity of Materials Required and Likely HGV Movements

Type of Material	Approx. Quantity Required	Approx. Quantity Won	Approx. Quantity Imported	Max. Vehicle Movements Per Day (2 way trips)	Number of Day Movements Required
Blacktop	20,000m^3	-	All imported	20	100
Fill Material	81,570m^3	31,240m^3	50,330m^3	40	125
Topsoil	24,260m^3	18,220m^3	6,040m^3	40	15
Reinforced Concrete	Eight 1.5m x 3m x 500mm precast headwalls	-	All imported	1	4
	Two 600mm x 15m and two 450mm x 15m precast pipe culverts	-	-	1	4
	Two 2.5m x 4m x 6m wing walls (cast in-situ)	-	-	1	2
	40m x 6m x 500mm pre-cast sections of concrete deck slab	-	-	4	5
	80m of concrete kerbing (cast in-situ)	-	-	1	1
Structural Steel	2 x 40m prefabricated steel plate girders (in sections, assembled on-site)	-	All imported	2	4
Masonry	20m^3 of random rubble masonry	-	All imported	1	2

11.5.8 The Scheme will be constructed via a combination of cut and fill earthworks using site won and imported material. Embankments will be formed using approximately 81,570m³ of general fill, of which approximately 50,330m³ will need to be imported. It is estimated that the remaining 31,240m³ will be site won.

11.5.9 Total cut for the Scheme is estimated to produce a material quantity of 62,480m^3. Assuming 50% of this is suitable for engineering works, it is estimated that as a worst case, the remaining 31,240m^3 will require off-site recycling or disposal. However, where possible, this material will be reused on-site for landscaping.

11.5.10 Slopes and verges will require approximately 24,260m³ of topsoil to ensure adequate coverage. To meet this requirement, approximately 6,040m³ of topsoil will need to be imported. The remainder will be site won.

11.5.11 In addition, flexible pavement will be required which will have a granular sub-base overlain with an asphaltic running surface (i.e. blacktop). Culverts, headwalls and bridge decking will be constructed of pre-cast reinforced concrete. Wing walls and kerbing for the accommodation bridge adjacent to Sutton Fach Farm will be constructed of reinforced concrete cast in situ (refer to Figure 3.3). The bridge will be braced together with two steel girders made composite with the concrete decking.

Waste

11.5.12 The majority of the waste generated during construction of the Scheme is likely to be excess fill material from earthworks and construction site waste from the Contractor Compounds (for example packaging and residual materials). The waste streams anticipated during construction of the Scheme and their corresponding classifications are listed below in Table 11.4.

Table 11.4: Anticipated Waste Streams during Construction

Waste Stream	Waste classification
Excess excavated material unsuitable for engineered fill	Inert waste
Structures waste – rubble and building materials	Inert waste / non-hazardous waste
General non-putrescible waste	Non-hazardous waste
General putrescible waste	Non-hazardous waste
Contaminated soil from spills of fuels, oils and lubricants	Hazardous waste
Waste oil and lubricants	Hazardous waste
Green waste from vegetation removal and construction timber	Non-hazardous waste
Solid and liquid waste from temporary ablution facilities	Non-hazardous waste

11.6 Mitigation

Mitigation through Design

11.6.1 To limit potential impacts upon resources, decisions made during design have demonstrated materials resource efficiency and consideration of waste management. The design of the Scheme aims to minimise the volume of imported material required whilst balancing the need for appropriate construction.

11.6.2 Specific design-related mitigation measures include:

- Gradient of embankments designed to minimise material requirements;
- Construction compounds and site accesses are provisionally located to allow for the movement of material from one section of the site to another during construction;
- Structures have been designed using pre-cast concrete and steel materials where practicable;
- Incorporating online road improvements wherever possible to minimise the need for offline construction and associated materials use; and
- Retaining significant sections of the existing Five Mile Lane for use as a local road to minimise the need for road decommissioning and demolition.

Construction

Materials

11.6.3 The reuse of cut material from earthworks activities will be employed to minimise the volume of imported fill required and the volume of waste removed from site for disposal. Using site-won material within the Scheme will mitigate the potential impacts of using large quantities of raw materials and limiting HGV trips associated with construction.

11.6.4 Materials will be from approved sources and sourced as locally as possible to the proposed Scheme. Where feasible, imported material will be sourced from other construction sites in the Vale of Glamorgan, where those sites have a surplus of material from earthworks. This would mitigate the potential impacts on natural resources and also be beneficial to the impacts of the third party development by re-using material that may otherwise require disposal to landfill. Details of where the imported materials will be sourced from will be confirmed by the Principal Contractor when appointed.

11.6.5 To mitigate the potential impacts of transporting fill to site, material will be sourced from the nearest available and suitable location to keep HGV journey distances to a minimum. Furthermore, HGV routes to and from the Scheme will be agreed by the appointed contractor in consultation with the Vale of Glamorgan Council within the Construction Traffic Management Plan (CTMP) to provide routes which have the least air and noise impacts on sensitive receptors. This approach will be balanced with keeping journeys to the minimal distance.

Waste

11.6.6 Consideration of materials and waste at the preliminary design stage has allowed mitigation to be incorporated into the design and for such measures to become part of the Scheme. This approach would continue into the detailed design stage and would minimise the scale of additional measures required to mitigate residual effects. This approach helps to identify opportunities to ‘design out’ waste prior to construction.

11.6.7 These design-based waste mitigations will be incorporated into a Site Waste Management Plan (SWMP) developed by the Principal Contractor prior to construction. The purpose of the SWMP will be to facilitate the principles of the waste hierarchy and minimise the production of waste from the outset of the Scheme. Such measures are to be incorporated into the design of the Scheme and implemented during construction. This will be achieved by ensuring that, wherever possible, materials on site are reused. Where waste cannot be re-used or recycled, it shall be

disposed of in accordance with the Landfill Directive (1999/31/EC) and Landfill (England and Wales) Regulations 2002.

11.6.8 The SWMP will aim to ensure that:

- Building materials are managed efficiently;
- Waste is disposed of appropriately; and
- Opportunities for materials recycling, reuse and recovery are maximised.

11.6.9 Reference will be made in the construction tender documentation to good practice guidance such as from Waste and Resources Action Programme (WRAP) Quality Protocol for the production of aggregates from inert wastes and the Contaminated Land: Application in Real Environments (CL:AIRE) Definition of Waste Development Industry Code of Practice (DoWCoP).

11.6.10 WRAP provides guidance on reducing waste and using resources efficiently and has specific, web-based tools to enable construction projects to minimise waste and uses five key principles, namely:

- Design for reuse and recovery;
- Design for off-site construction;
- Design for materials optimisation;
- Design for waste efficient procurement; and
- Design for deconstruction and flexibility.

11.6.11 It is essential that the construction work is carried out closely with waste management contractors, in order to determine the best techniques for managing waste and to ensure a high level of recovery of materials for recycling.

11.6.12 In accordance with good practice waste management, opportunities to minimise waste are outlined in Table 11.5. These opportunities form the basis of the mitigation of construction waste impacts and will be taken forward into the SWMP and CEMP prior to construction. The agreement of, and compliance with the SWMP, will be secured by requirements in the planning permission for the Scheme.

Waste production and management would be monitored during construction and records will be kept of any incidents of deviations from the arrangements set out in the SWMP.

Table 11.5: Opportunities to Minimise Construction Waste

Waste	Management Strategy	Waste Hierarchy
Excavated fill material from earthworks	Re-use within the Scheme as fill for embankments or in landscaping	Re-use
	Residual amount sent to landfill	Disposal
Topsoil from earthworks	Re-use on verges, cuttings, embankments or elsewhere within the Scheme	Re-use
Stones from earthworks	If feasible, sieved out and reused as sub base for the road or graded and used in the drainage system.	Re-use
Removed vegetation	Shredded, stored/composted on site and reused as soil cover mulch in replanted areas.	Re-use

Waste	Management Strategy	Waste Hierarchy
Structures waste – rubble and building materials	Sorted and rubble crushed/graded for reuse in the drainage system and remaining material sent to landfill.	Re-use/Disposal
Waste oil and other liquids	Careful temporary storage and segregation of drums at the contractor's compound in bunded areas so that these can be recycled or returned to the supplier.	Recycling/Re-use
General putrescible waste	Paper, metal, plastic, glass sorted and sent for recycling	Recycling

11.6.13 In accordance with legislation and good practice, the Vale of Glamorgan Council and the Principal Contractor will take all reasonable steps to ensure that all waste from construction of the Scheme is dealt with in accordance with the relevant legislative requirements (as described above in Section 11.2).

Operation

11.6.14 Material and waste effects occurring once the Scheme is operational will be mitigated primarily through an efficient maintenance programme. Materials required for maintenance will be sourced using good practice such that waste is kept to a minimum and re-used or recycled where possible. Waste from on-going vegetation management will be disposed of at a suitable landfill facility.

11.7 Residual Effects (with Mitigation)

Construction

11.7.1 As shown in Table 11.3, the main materials required to construct the Scheme are aggregates for use in earthworks and concrete, steel and masonry construction products. Approximately 50,330 m^3 of fill material will need to be imported to site. The majority of concrete and steel units for drainage and bridge construction will be pre-cast, which will minimise on-site waste.

11.7.2 It is anticipated that approximately 50% of the cut material produced on site will be able to be reused on site as general fill. The remaining 31,240m^3 will be reused in site landscaping where possible, or disposed of at a suitable landfill facility.

11.7.3 Other waste that will go to landfill includes some municipal (putrescible and non-putrescible) waste from the construction compound, vegetation and damaged or residual products or components that cannot be recycled. It is not known at this stage which landfill sites wastes would be disposed at as this will be determined during the preparation of the SWMP prior to construction.

11.7.4 Provided that the construction works are programmed to provide resource efficiency in the use of raw material, that minimal waste is generated and that materials and appropriate waste treatment facilities are sourced as locally as possible the residual effect of the Scheme on materials and waste would be minor. Residual effects will be mainly limited to minor, infrequent and temporary traffic, noise and vibration impacts from the transportation of materials to the site and the transportation of waste streams to waste facilities for recycling and disposal.

Operation

11.7.5 Residual operational effects will be kept to a minimum through an appropriate road maintenance programme and by using good practice to obtain natural resources. Adverse impacts in relation to materials and wastes associated with operation of the Scheme are considered to be negligible.

11.8 Cumulative Effects

11.8.1 The requirement for materials and generation of waste will largely be confined to the construction phase of the Scheme. The proposed developments in the vicinity of the Scheme (as illustrated on Figure 16.1) are generally residential developments and photovoltaic arrays, which would increase the requirement for a range of materials, including aggregates, concrete, steel and masonry. These would need to be sourced locally or imported. Similarly, there will be a cumulative increase in the volume of construction and demolition waste produced in the area. Nonetheless, the extent of material and waste effects from the Scheme, are likely to contribute to only a minor increase in the total cumulative effects of the proposed developments in the area. As such, adverse cumulative effects are considered to be minor during construction and negligible during operation.

11.9 Summary & Conclusions

11.9.1 The construction of the Scheme requires a large amount of raw materials and would generate some waste. The consumption of material resources and the generation of waste give rise to environmental impacts that would need to be managed and mitigated.

11.9.2 The bulk of the material requirements are for the earthworks. It is currently estimated that approximately 50,330m^3 of fill material will need to be supplied from quarry sources, however, a significant volume of fill, approximately 31,240m^3, will be site-won and re-used within the Scheme. On balance, the significance of the effect is assessed as being minor adverse and will become insignificant following completion of the construction stage.

11.9.3 In addition to fill and aggregate being required, other materials such as pre-cast concrete culverts and steel plate girders will be used for new drainage structures and the accommodation bridge associated with the Scheme. The impact of the manufacturing process of these products is not included in this assessment and the potential impacts of the use of road construction products such as these is considered as limited to the transportation to site and the associated effects of noise and air pollution on sensitive receptors from HGVs. The significance of the effect is temporary and minor adverse.

11.9.4 It is predicted that, as a worst case, there will be approximately 31,240m^3 of excess fill material that will go to landfill if it cannot be reused elsewhere. This is based on the expectation that approximately 50% of the total 62,480m^3 of cut material will be unsuitable for use as general fill. The quantity of material exported to landfill may be able to be reduced if a greater proportion of the total cut is suitable for reuse as general fill or for landscaping. Further reuse of cut material as general fill would also reduce the amount of fill that needed to be imported to site. Other waste that will go to landfill will include putrescible and non-putrescible waste, green waste (that is unable to be reused in onsite landscaping) and residual / unused construction products. The effect is considered to be minor adverse during construction and negligible during operation.

11.9.5 As the Scheme is in an early stage in terms of resource use and estimation of waste generated, there are opportunities to improve the results of this assessment, principally by reducing waste generated. This may be through efficient product sourcing in relation to the recycled content of materials used and the re-use or recycling of waste materials. The SWMP will be crucial in implementing the mitigation measures identified and will provide an opportunity to further improve the environmental performance of the project.

11.9.6 Overall, it is considered that the effects of the Scheme in relation to materials and waste will be no more than minor adverse, provided the detailed design provides for natural resource efficiency, that materials and appropriate waste treatment facilities are sourced as locally as possible and the CEMP and SWMP are implemented.

12 NOISE & VIBRATION

12.1 Introduction

12.1.1 This chapter assesses the likely noise and vibration impacts arising from the construction and operation of improvements to the A4226 Five Mile Lane, west of Cardiff and north-west of Barry.

12.1.2 This chapter presents the baseline noise climate at the site and surroundings. It continues to identify and assess the likely noise and vibration impacts from the Scheme. A mitigation measure strategy is proposed, where necessary, and the residual effects are described.

12.1.3 A glossary of the noise and vibration terminology is presented in Appendix 12.1.

12.2 Legislative & Policy Context

National Legislation & Policy

Planning Policy Wales (PPW), 2014

12.2.2 The PPW sets out the land use planning policies of the Welsh Government. This document is supplemented by a series of Technical Advice Notes (TANs). It communicates the approach from the Welsh Government to sustainable development.

12.2.3 Chapter 4 'Planning for Sustainability' recognises the strengths of urban communities through an integral approach to foster sustainable change, in particular making it possible to live with less noise, congestion and traffic pollution, and improving the quality of life. Chapter 8 'Transport' indicates that great care must be taken to minimise the adverse impacts of new transportation infrastructure, or improvements to existing infrastructure. It mentions that routes should make the best use of existing landforms and other landscapes features to reduce noise and visual effects, subject to safety and other environmental considerations.

12.2.4 Chapter 13 'Minimising and Managing Environmental Risks and Pollution' states that local authorities may use planning conditions to meet planning aims to protect the environment where these are pertinent to the development proposed. Proposed development should be designed wherever possible to prevent adverse effect to the environment but, as a minimum, to limit or constrain any effects that do occur. Noise Action Plans, written by the Welsh Ministers under the Environmental Noise Directive, aim to prevent and reduce environmental noise where necessary and preserve where it is good.

12.2.5 Chapter 13 also states that policies should be designed to ensure that potentially noisy developments are located in areas where noise will not be such an important consideration or where the impact can be minimised. Noise can be a material planning consideration where a proposed new development is likely to generate noise. Special consideration should be given to noise generating developments which could potentially affect protected species, or proposed statutorily designated areas, including quiet areas designated in Noise Action Plans.

12.2.6 The PPW refers to Technical Advice Note 11 'Noise' and The Environmental Noise (Wales) Regulations 2006.

Technical Advice Note (Wales) 11, Noise, 1997

12.2.7 TAN 11 provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on the development.

12.2.8 The note refers to the 'Calculation of Road Traffic Noise' and Design Manual for Roads and Bridges Volume 11, Section 3, Part 7, for guidance on noise & vibration from road traffic.

Vale of Glamorgan Local Development Plan 2011 – 2026,

12.2.9 The Local Development Plan is the policy document which provides the framework for sustainable development up to 2026.

12.2.10 Section 7 deals with the management of all forms of development proposals. Policy MD8 'Environment Protection' requires that development proposals will be required to demonstrate that they will not result in an unacceptable impact on people, residential amenity, property and /or the natural environment from noise and vibration among others. The Council encourages developers to assess any impact at the earliest sage so that the development proposals reduce any impact present to an acceptable level.

The Noise Insulation Regulations 1975, amended 1988

12.2.11 The Noise Insulation Regulations (NIR) 1975, amended 1988, provides the framework to determine the entitlement to noise insulation treatment at eligible buildings (i.e. dwellings and other building used for residential purposes within 300m from the nearest point on the new or altered highway). The following three conditions should be met:

- The combined expected maximum noise traffic level, i.e. the relevant noise level from the new or altered highway together with any other traffic in the vicinity must not be less than the specified noise level, $L_{A10,18h}$ 68 dB;
- The relevant noise level is at least 1.0 dB(A) more than the prevailing noise level, i.e. the total traffic existing before the works to construct or improve the highway were begun;
- The contribution to the increase in the relevant noise level from the new or altered highway must be at least 1.0 dB(A).

12.2.12 The noise should be assessed at a reception point located 1 metre in front of the most exposed façade part of an external window or door of an eligible room. Traffic flows used in the calculations should be the maximum expected in a period of 15 years after opening to traffic. The predictions will be normally undertaken using the Annual Average Weekday Traffic (AAWT).

Guidance

Design Manual for Roads and Bridges, Volume 11, Section 3, 2011

12.2.13 Part 7, Noise and Vibration (HD 213/11) advises on the appropriate level of noise and vibration assessment for road schemes.

12.2.14 The procedure to assess impact uses three levels: a) scoping, b) simple and c) detailed. Selecting the appropriate level of assessment depends on the following threshold criteria:

- Permanent change in magnitude of 1 dB(A) in the short term (i.e. on opening);
- Permanent change in magnitude of 3 dB(A) in the long term (i.e. between opening and future assessment years);
- The predicted noise level during night-time $L_{night,outside}$ being greater than 55dB in any scenario. The night-time noise level has been calculated in line with the methodology prepared by TRL, introduced later in the chapter.

12.2.15 A simple assessment is undertaken when the threshold values above are not expected to be exceeded. A detailed assessment will be appropriate when thresholds are expected to be exceeded at the affected receptors.

12.2.16 The assessment is based upon the criteria for short-term and long-term noise impacts outlined in Tables 12.1 and 12.2 below.

Table 12.1: Magnitude of Operational Noise Impacts in the Short Term

Noise Change, $L_{A10,18h}$	Magnitude of Impact
0	No Change
0.1 - 0.9	Negligible
1 - 2.9	Minor
3 - 4.9	Moderate
5+	Major

Table 12.2: Magnitude of Operational Noise Impacts in the Long Term

Noise Change, $L_{A10,18h}$	Magnitude of Impact
0	No Change
0.1 - 2.9	Negligible
3 - 4.9	Minor
5 – 9.9	Moderate
10+	Major

12.2.17 Based on Tables 12.1 and 12.2, a change in road traffic of 1 dB(A) in the short-term, when the project is opened, is the smallest considered perceptible. In the long-term, a 3 dB(A) change is considered perceptible.

Welsh Transport Planning and Appraisal Guidance, 2008

12.2.18 The Welsh Government requires that major transport initiatives seeking government funding are appraised with this guidance. WelTAG refers to the methodology in WebTAG which provides guidance on undertaking an Environmental Impact Appraisal as part of the Transport Appraisal process in England. The noise assessment involves 5 steps:

- Scoping;
- Quantification of noise impacts;

- Estimation of the change in noise annoyance;
- Monetary valuation of changes in noise impact; and
- Consideration of the distributional impacts of changes in noise.

12.2.19 WelTAG advises that Planners in Wales are not currently required to estimate the net present value of noise from new proposals but that they are free to do so. The quantification of noise impacts is determined using the methodology in DMRB 11.3.7 described previously. However, the noise TAG worksheet is assessed in terms of the descriptor $L_{Aeq,18h}$. Therefore, a correction of -2.5dB has been applied to the façade $L_{A10,18h}$ noise levels. The estimation of changes in annoyance is determined using a response relationship for road noise. The monetary valuation of noise impacts is based on the effect of noise on house pricing.

BS5228:2009+A1:2014

12.2.20 BS5228 'Code of practice for noise and vibration control on construction and open sites' gives recommendations on noise control relating to construction activities. The standard provides advice on prediction methods, noise measurements and assessment for the associated impact.

12.2.21 Construction noise levels are predicted as a 'free field' equivalent continuous noise level averaged over a one-hour period ($L_{Aeq,1h}$), and then subsequently averaged over a 12-hour working day to give the $L_{Aeq,12h}$.

12.2.22 Construction noise limits are specific to each scheme, and are agreed in consultation with the local authority. These limits take many factors into account, including the nature of the works, the times and durations of the activities, and the sensitivities of the closest receptors. The limits are expressed as an average level for a period of time (usually averaged over the working day), and thus it is possible that peak levels are in excess of the average levels.

Calculation of Road Traffic Noise (CRTN), 1988

12.2.23 The CRTN memorandum describes the methodology to calculate the road traffic noise at a given distance from the highway.

12.2.24 The methodology takes into the intervening ground cover, road configuration and road layout. The calculation assumes a typical traffic and noise propagation conditions. Noise levels are presented in terms of the noise descriptor $L_{10,18h}$ which is the noise level exceeded for just 10% of the time between 06:00 and 24:00 hours.

12.2.25 The variables used in the calculation of the traffic noise level are:

- the annual average week day traffic flow (AAWT) for the 18-hour period from 06:00 to 24:00 hours;
- mean traffic speed;
- percentage heavy vehicles
- road gradient;
- type of road surface;
- distance of the receptor from the road; and
- nature of the ground cover between the road and the receptor.

12.2.26 Section III of the memorandum provides guidance on the measurement method. As part of this, a shortened measurement procedure is described. Measurements of L10 are made over any three consecutive hours between 10:00 and 17:00 hours. Subsequently, the $L_{A10,18h}$ value can be calculated by subtracting 1 dB.

Method for Converting the UK Road Traffic Noise Index $L_{A10,18h}$ to the EU Noise indices for Road Noise Mapping, 2002

12.2.27 The national method for predicting road traffic noise is described in CRTN. The TRL report provides a method to convert the UK road traffic noise indicator to those utilised in the strategic noise maps (EU noise indices).

12.2.28 The conversion from $L_{A10,18h}$ to Ln ($L_{Aeq,8h}$) has been used. It should be noted that this value is extrapolated from the value predicted for daytime (18 hours).

12.3 Assessment Methodology

Consultation with Vale of Glamorgan Council

12.3.1 A scoping report was submitted to Vale of Glamorgan Council (VoGC) including the methodology proposed to undertake the noise and vibration assessment. The Scoping Opinion received on 7th July 2014 requested that a noise assessment is included in the ES to determine the impact as a consequence of the traffic associated with the development. Furthermore, the Environmental Health Section requested that the properties near the Hawking Centre and Barry College should be considered in the assessment.

12.3.2 Consultation was undertaken with the Environmental Health Officer (EHO) at VoGC on 8th July 2014. The methodology was discussed and agreed as below:

- Road traffic noise measurements will be taken at two locations along the A2446 following methodology in accordance with the shortened method procedure described in CRTN;
- Additional short-term ambient noise measurements will be taken at four locations during day, evening and night-time;
- The noise survey will be undertaken in accordance with BS7445, CRTN and BS5228.

Baseline Noise Survey

12.3.3 A brief summary of the noise survey methodology is presented below. A full description of the methodology and results are presented in Appendix 12.2.

12.3.4 A baseline noise survey was undertaken during typical weekdays between 9th and 10th July 2014 to establish the existing noise climate on site and surroundings. The survey was undertaken in accordance with CRTN and BS7445.

12.3.5 Two noise measurements were taken along the A2446 following the shortened measurement procedure in CRTN (see Figure 1 in Appendix 12.2). Two separate measurements were undertaken due to the extent of the road and speed limit changes along the route. Both locations were positioned 10m from the nearest edge of the carriageway.

12.3.6 A series of short-term measurements were carried out at four locations at various distances from the A2446 during daytime, evening and night-time (see Figure 1 in Appendix 12.2). The following measurements were undertaken:

- Day (0700 – 1900): 2 x 15 min
- Eve (1900 – 2300): 1 x 10 min
- Night (2300 – 0700): 2 x 15 min

Construction Assessment

12.3.7 The likely noise and vibration impacts arising from the construction of the scheme have been determined in accordance with BS5228. In absence of specific plant and programme information, a generic assessment has been undertaken based upon data presented in BS5228 and experience in other highway schemes of similar size.

12.3.8 It is expected that construction will commence in Summer 2016 and will be completed in Winter 2017.

12.3.9 Sensitive receptors potentially subject to noise and vibration impact during the construction of the Scheme have been identified as shown in Table 12.3.

Table 12.3: Construction Noise Receptors

Receptor / Location	Distance to Scheme (m)
R1: Whitton Lodge Lane	120
R2: Sutton Fach Farm	150
R3: Grovelands Farm	170
R4: Grovelands House	140
R5: Northcliffe Cottage	35
R6: Cwm Derwyn Farm	100

12.3.10 The assessment has been based upon the 'ABC' method described in Annex E of BS5228. This method takes into account the potential significance based on change in the ambient noise level. The baseline ambient noise level has been obtained from the validated noise model. Categories of threshold values are assigned to daytime; evening/weekends and night-time depending on the existing noise climate (see Table 12.4).

12.3.11 If the construction noise level exceeds the thresholds for the appropriate category, then a significant impact is determined as follows:

- negligible (<1dB);
- low (1-3dB);
- medium (3-5dB);
- high (5-10dB);
- very high (>10dB);

Table 12.4: Assessment Category and Threshold Value

Evaluation Period	Assessment Category (dB L_{Aeq})		
	A	B	C
Night-time (23:00-07:00)	45	50	55
Evening and Weekends*	55	60	65
Daytime (07:00-19:00)	65	70	75

* 19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00-23:00 Sundays.

Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as Category A values.

Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than Category A values.

The Category (A, B or C) is to be determined separately for each time period and the lowest noise category is then used throughout the 24-hour cycle, e.g. a site which is category A by day and category B or C in the evening and night will be treated as category A for day, evening and night.

Operational Assessment

12.3.12 The likely noise and vibration impacts arising from the operation of the scheme have been determined in accordance with DMRB Volume 11 HD 213/11. It is expected that thresholds set in DMRB for short and long term would be exceeded; therefore, a detailed assessment has been carried out.

12.3.13 A road traffic noise model using Computer Aided Noise Abatement (CadnaA) has been prepared. Calculations in the model have been setup using CRTN. A calculation area has been created in accordance with DMRB taking the following steps into account:

- The start and end points of the physical works associated with the scheme were identified;
- The existing routes that are being bypassed or improved, and any proposed new routes, between the start and end points were identified;
- A one kilometre boundary from the carriageway edge of the routes defined above was defined;
- A 600m boundary from the carriageway edge around each of the routes identified in (2) and also 600m from any other affected route within the boundary defined in (3) were identified. An affected route is where there is a possibility of a change of 1dB(A) in the short term and 3 dB(A) in the long term.

12.3.14 Ordnance survey and topographical data have been incorporated into the model. An address database layer has been used to obtain location and use of properties within the calculation area. A total of 2,208 noise sensitive receptors have been included in the model (i.e. 2,207 dwellings and Barry College). Noise levels have been calculated free-field at the façade of each sensitive building. A façade correction of +2.5dB has been added to the results.

12.3.15 As part of the design, a low noise road surface has been modelled to the whole extent of the scheme. Advice on DMRB has been followed to assign correction to a thin – low noise road surface as per below:

- - 3.5dB correction for segments of the scheme where speed is equal or higher to 75 km/h;
- - 1dB correction for segments of the scheme where speed is below 75 km/h.;

12.3.16 Traffic data has been included in the model and the following scenarios have been prepared:

- Baseline year 2013;
- Opening year 2017 – do-minimum (without scheme);
- Opening year 2017 – do-something (with scheme);
- Design year 2032 – do-minimum (without scheme);
- Design year 2032 – do-something (with scheme).

12.3.17 The baseline year 2013 scenario has been used to validate the noise model against the noise survey results. The baseline noise modelling results differ from the survey results by less than 2dB, therefore, it is considered to be a good correlation for the purposes of this assessment. It should be noted that the survey was undertaken in 2014, however, it is not expected that the traffic growth will be significant between these two years.

12.3.18 The development of the noise model relies upon the validity of the input traffic data which has not been modified for either the validation of the noise model or the overall assessment. Therefore, any uncertainties which may be part of the baseline noise monitoring have not altered the outcome of the assessment presented in this chapter.

12.3.19 The following comparisons have been made, in accordance with guidance in DMRB:

- Do-minimum scenario in the opening year 2017 against Do-minimum scenario in the design year 2032 ;
- Do-minimum scenario in the opening year 2017 against Do-something scenario in the opening year 2017; and
- Do-minimum scenario in the opening year 2017 against Do-something in the design year 2032.

12.3.20 Contour noise levels and tables have been prepared to present the results of the above comparisons. A night-time noise assessment has also been prepared using the methodology in the TRL report. The following formula (Method 3) has been used to convert the $L_{A10,18h}$ into $L_{Aeq,8h}$ values:

$$L_{night} = 0.90 \; x \; L_{A10,18h} - 3.77dB$$

12.3.21 It should be noted that a correction of -2.5dB has been applied to the expression above to convert the night-time noise levels into free field values, in accordance with guidance in DMRB.

12.3.22 The noise calculations have been also used to determine the entitlement for noise insulation treatment in accordance with NIR 1975. The study area has been re-defined to include eligible buildings within 300m from the nearest point of the

proposed physical changes of the improvement. Scenarios have been prepared to determine whether any of these eligible dwellings would be likely to meet the three criteria described in the National Legislation & Policy section earlier in this chapter. A total of 15 dwellings within the 300m have been included in the assessment. A façade correction of +2.5 dB has been applied to all buildings. The following scenarios have been used in the NIR assessment:

- Prevailing noise level: Do minimum opening year 2017; and
- Relevant noise level: Do something design year 2031.

12.3.23 A WelTAG appraisal was undertaken using the noise prediction results obtained from the DMRB assessment. The appraisal results are presented and a net monetary value has been determined.

12.4 Baseline Conditions

12.4.1 A baseline noise level survey was carried out in accordance with the methodology agreed with VoGC between 9th and 10th July 2014.

12.4.2 Weather conditions were suitable for noise measurements: dry with wind speeds between 0 and 3 m/s. The average temperature was 22°C and 16°C during daytime and night-time respectively.

12.4.3 Table 12.5 presents a summary of the noise measurements results for the road traffic (CRTN) locations. Results for the hourly measurements are presented along with the calculated $L_{A10,18h}$, in accordance with CRTN guidance (subtracting 1 dB from the three-hour measurement).

Table 12.5: CRTN Summary Table

Location	Start Time (hh:mm)	Measured $L_{A10, 1h}$ dB	Calculated $L_{A10, 18h}$ dB
CRTN A	12:26	68.1	67.2
	13:26	68.0	
	14:26	68.6	
CRTN B	09:17	63.6	62.5
	10:17	62.6	
	11:17	64.4	

12.4.4 Table 12.5 shows that there is approximately 5dB difference between the two measurements at the A4226 and this is attributed to the difference in speed in the two segments, angle of view and slope.

12.4.5 Table 12.6 presents a summary of the ambient noise level measurements during daytime, evening and night-time. It should be noted that only the lowest $LA_{eq,T}$ noise levels have been reported.

Table 12.6: L_{Aeq} Ambient Noise Levels Summary

	Location	Lowest L_{Aeq} dB
Day (0700-1900)	Short Term 1	55
	Short Term 2	52
	Short Term 3	47
	Short Term 4	62
Evening (1900-2300)	Short Term 1	62
	Short Term 2	41
	Short Term 3	51
	Short Term 4	49
Night (2300-0700)	Short Term 1	38
	Short Term 2	29
	Short Term 3	26
	Short Term 4	44

12.5 Predicted Effects (Without Mitigation)

Construction

12.5.1 Noise and vibration predictions have been undertaken to determine the likely impacts arising during the construction phase. In absence of detailed data the calculations have been based on a typical configuration of plant items representative of highway construction.

Table 12.7: Indicative Construction Noise Levels at 10m

Construction Activity / Associated Plant	(dB $L_{Aeq, 12h}$) at 10m	Number of Plant Items	% On Time	Corrected LAeq 10m, dB
Site Preparation				
Dozer	75	2	40	74
Tracked Excavator	78	2	40	77
Chainsaw	86	3	40	87
Wheeled Backhoe Loader	68	2	40	67
Excavation				
Dozer	81	2	40	80
Tracked Excavator	79	2	40	78
Loading Lorry	80	2	40	79
Articulated Dump Truck	81	2	40	80

Construction Activity / Associated Plant	(dB $L_{Aeq, 12h}$) at 10m	Number of Plant Items	% On Time	Corrected LAeq 10m, dB
Total				**90**
Piling and Drainage				
Piling				
Large Sheet Piling Rig	88	1	40	84
Drainage Works				
Dozer	81	2	40	80
Tracked Excavator	79	2	40	78
Loading Lorry	80	2	40	79
Generator	74	1	100	74
Large Lorry Concrete Mixer	77	2	40	76
Concrete Pump (Discharging)	67	2	40	66
Total				**88**
Road Construction				
Rolling and Compaction				
Roller	80	2	40	79
Vibratory Plate	80	2	40	79
Other				
Large Lorry Concrete Mixer	77	2	40	76
Loading Lorry	80	1	30	75
Paver	77	2	40	76
Road Planer	82	2	40	81
Tracked Excavator	79	2	40	78
Concrete Pump (Discharging)	67	2	30	65
Tower Crane	77	1	30	72
Total				**87**

12.5.2 Table 12.8 present construction noise levels predicted at the nearest receptors. The location of the receptors can be seen in Figure 12.1.

Table 12.8: Predicted Construction Noise Levels at Closest Receptors

Construction Activity / Associated Plant	dB $L_{Aeq,12h}$					
	R1	R2	R3	R4	R5	R6
Site Preparation	68	66	65	67	79	70
Piling and Drainage	66	64	63	65	77	68
Road Construction	65	63	62	64	76	67

12.5.3 The assessment has been undertaken in accordance with the ABC method in BS5228. Based on a daytime baseline noise level (see Table 12.6), then all the receptors are within construction noise Category A (see Table 12.4). Furthermore, based on the significance criteria for construction noise, then the difference of the predicted noise levels in Table 12.8 against the threshold for Category A defines the noise impact as presented in Table 12.9 (without Mitigation).

Table 12.9: Construction Noise Impact – without Mitigation

Construction Activity / Associated Plant	R1	R2	R3	R4	R5	R6
Site Preparation	Medium	Low	Neg.	Low	V. High	Medium
Piling and Drainage	Low	Neg.	Neg.	Neg.	V. High	Medium
Road Construction	Neg.	Neg.	Neg.	Neg.	V. High	Low

12.5.4 It can be seen that the nearest receptor (Northcliffe Cottage) would be potentially subject to a very high noise impact. It should be noted that this assessment should be refined once a construction programme and a schedule of plant items are available from the Principal Contractor.

12.5.5 For piling activities, the vibration levels, Peak Particle Velocity (PPV), would be less than 1mm/s at distance of 100m. At this level, vibration may just be perceived. For the nearest receptor at 35m there is potential that vibration will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.

12.5.6 Cosmetic or structural damage is unlikely to be an issue at any of the properties listed in Table 12.3, based upon advice in BS5228.

Operation

12.5.7 Five road traffic scenarios have been modelled to assess noise sensitive receptors within the study area.

DMRB Assessment

12.5.8 The short-term and long-term impacts have been determined using results of the validated noise model. Tables 12.10 to 12.14 present the number of sensitive properties subject to change in noise levels in accordance with the significance of impacts described in DMRB.

12.5.9 Table 12.10 presents the likely changes in noise levels experienced by the assessed receptors in the long term without taking the Scheme into account. This scenario compares the impact due to the traffic growth between the opening and design years.

Table 12.10: Long-term Noise Impact – Do Minimum

Scenario/Comparison: DM in Opening Year vs. DM in Design Year			
		Daytime	
Change in Noise Level		Number of Dwellings	Number of Other Sensitive Receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	2124	1
	3 - 4.9	0	0
	5 - 9.9	0	0
	10 +	0	0
No Change	0	37	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	47	0
	3 - 4.9	0	0
	5 - 9.9	0	0
	10 +	0	0

12.5.10 Table 12.10 shows that the majority of dwellings would experience a negligible increase in noise levels if the scheme does not go ahead. However, this increase would not be significant in the long term. Figure 12.2 presents the noise contours associated with Table 12.10.

12.5.11 Table 12.11 presents the likely noise impacts experienced by sensitive receptors in the short-term due to the operation of the Scheme. The comparison is made between the do-minimum and do-something scenarios in the opening year.

Table 12.11: Short-term Noise Impact

Scenario/Comparison: DM in Opening Year vs. DS in Opening Year			
		Daytime	
Change in Noise Level		Number of Dwellings	Number of Other Sensitive Receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 0.9	660	0
	1 - 2.9	25	1
	3 - 4.9	7	0
	5 +	1	0
No Change	0	404	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 0.9	1078	0
	1 - 2.9	30	0
	3 - 4.9	3	0
	5 +	0	0

12.5.12 It can be seen from Table 12.11 that in the short term, the majority of properties (i.e. 1125) assessed will experience a negligible decrease in noise levels. A total of 693 dwellings will experience an increase in noise levels, but this will be significant at 33 dwellings only. Barry College (other sensitive receptors) would experience an adverse

minor effect. A total of 404 properties will experience no change. On the other hand, 33 properties would experience a significant beneficial impact in the short-term.

12.5.13 Figure 12.3 presents the noise contours illustrating the noise impact likely to be experienced by nearby residents in the short term. As expected, noise level increases will be mainly concentrated in areas with a lower density of population.

12.5.14 Table 12.12 presents the likely impact experienced by sensitive receptors in the long term. The comparison is made between the do-minimum scenario in the opening year against the do-something scenario in the design year.

12.5.15 Table 12.12 also presents the number of dwellings likely to experience an impact during night-time. Only properties that are expected to be subject to a L_{Aeq} 55dB during night-time are reported.

Table 12.12: Long-term Noise Impact – Do Something v/s Do Minimum

Scenario/Comparison: DM in Opening Year vs. DS in Design Year				
		Daytime		**Night-time**
Change in Noise Level		**Number of Dwellings**	**Number of Other Sensitive Receptors**	**Number of Dwellings**
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	2115	1	342
	3 - 4.9	2	0	2
	5 - 9.9	6	0	0
	10 +	0	0	0
No Change	0	8	0	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	75	0	9
	3 - 4.9	2	0	0
	5 - 9.9	0	0	0
	10 +	0	0	0

12.5.16 It can be seen from Table 12.12 that most dwellings surrounding the scheme will be subject to an increase in noise levels. However, it should be noted that the only 8 properties will experience a significant adverse impact during the daytime. Barry College (other sensitive receptors) would experience a negligible effect. During the night-time period, only 2 properties will experience a significant adverse impact.

12.5.17 Properties will be also subject to a decrease in noise levels, a total of 77 dwellings during daytime and 9 during night-time. Only 2 properties will be subject to a significant beneficial impact.

12.5.18 Figure 12.4 presents the noise contours illustrating the noise impact in the long term. Similar to the short term, it can be seen from Figure 12.4 that areas with dense population will be subject to a negligible impact.

12.5.19 Table12.13 presents the traffic noise nuisance changes due to the operation of the Scheme expected in the long term.

Table 12.13: Traffic Noise Nuisance Reporting Table

Scenario/Comparison: DM in Opening Year vs. Design Year			
		Do-Minimum	**Do-Something**
Change in Nuisance Level		**Number of Dwellings**	**Number of Dwellings**
Increase in nuisance level	< 10%	2105	1699
	10 < 20%	0	328
	20 < 30%	0	42
	30 < 40%	0	8
	> 40%	0	0
No Change	0%	59	62
Decrease in nuisance level	< 10%	44	69
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

12.5.20 Table 12.13 presents the noise nuisance changes in the long term. If the scheme was not to proceed, 2105 properties would be subject to an increase in nuisance of less than 10%.

12.5.21 If the Scheme is operational, during the future design year, all properties would experience an increase in nuisance level of less than 40%, the majority concentrated on less than 20%. 42 properties would be subject to an increase in nuisance of between 20% and 30%. The effect is considered to be minor.

12.5.22 Table 12.14 presents the traffic vibration nuisance changes due to the operation of the Scheme expected in the long term.

Table 12.14: Traffic Vibration Nuisance Reporting Table

Scenario/Comparison: DM in Opening Year vs. Design Year			
		Do-Minimum	**Do-Something**
Change in Nuisance Level		**Number of Dwellings**	**Number of Dwellings**
Increase in nuisance level	< 10%	641	662
	10 < 20%	0	2
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0
No Change	0%	31	5

Table 12.14: Traffic Vibration Nuisance Reporting Table

Scenario/Comparison: DM in Opening Year vs. Design Year			
		Do-Minimum	**Do-Something**
Change in Nuisance Level		**Number of Dwellings**	**Number of Dwellings**
Decrease in nuisance level	< 10%	33	36
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

12.5.23 Table 12.14 presents the vibration nuisance changes in the long term. If the Scheme was not to proceed, 641 properties would be subject to an increase in vibration nuisance of less than 10%. A number of 31 properties would not experience any change. 33 properties would experience a decrease in vibration nuisance of less than 10%.

12.5.24 If the scheme is operational, during the future design year, similar to the previous case, the majority of properties would experience an increase in vibration nuisance level of less than 10%.

Noise Insulation Regulations 1975, as amended 1988

12.5.25 A total of 15 eligible properties were assessed for the qualification under the Noise Insulation Regulations 1975. The assessment concluded that none of the dwellings assessed would qualify.

WelTAG

12.5.26 A WelTAG appraisal was undertaken using the traffic data and the noise model results to obtain a monetary valuation of the likely noise impacts arising from the operation phase of the scheme. The results of the study conclude that the net present value for the noise of the Scheme is beneficial (i.e. noise reduction) and the value estimated is £563,764. The estimated population annoyed would be reduced from a number of 596 people annoyed (i.e. without Scheme) to 548 (i.e. with Scheme). Summary results of the appraisal are presented in Appendix 12.3.

12.6 Mitigation

Construction

12.6.1 The Contractor should apply Best Practicable Means (BPM's) to minimise any residual noise impact. General methods of noise control include:

- The appropriate selection of plant, construction methods and programming: Only plant conforming with or better than relevant national or international standards, directives or recommendations on noise or vibration emissions will be used. Construction plant will be maintained in good condition with regards to minimising noise output and workers exposed to harmful noise and vibration;
- Construction plant will be operated and maintained appropriately, having regard to the manufacturer's written recommendations or using other appropriate

operation and maintenance programmes which reduce noise and vibration emissions. All vehicles and plant will be switched off when not in use;

- Design and use of site hoardings and screens, where necessary, to provide acoustic screening at the earliest opportunity. Where practicable, gates will not be located opposite buildings containing noise sensitive receptors;
- Choice of routes and programming for the transport of construction materials, spoil and personnel to reduce the risk of increased noise and vibration impacts due to the construction of the project;
- Vehicle and mechanical plant used for the purpose of the works should be fitted with effective exhaust silencers, to be maintained in good working order and operated in such a manner as to minimise noise emissions. Plant items that comply with the relevant EU/UK noise limits applicable to that equipment will be used;
- The positioning of construction plant and activities to minimise noise at sensitive locations;
- Equipment that breaks concrete by munching or similar, rather than by percussion, will be used as far as is practicable;
- The use of mufflers on pneumatic tools;
- Where practicable, rotary drills actuated by hydraulic or electrical power should be used for excavating hard materials;
- The use of non-reciprocating construction plant where ever practicable;
- The use, where necessary, of effective sound reducing enclosures.

12.6.2 Details of specific noise mitigation should be included in the Construction Environmental Management Plan (CEMP). It is recommended that local and boundary screening is considered, should night-time activities be required. It is expected that noise barriers would provide a noise attenuation of between 5 to 10 dB.

12.6.3 It is recommended that the construction methodologies and the need for mitigation measures are agreed using the consent mechanism under Section 61 of the Control of Pollution Act 1974.

Operation

12.6.4 No further mitigation is required other than the low noise road surface considered as part of the design. Should this mitigation be removed, then localised noise barriers should be considered to maintain the significant noise impact to a minimum.

12.7 Residual Effects (With Mitigation)

Construction

12.7.1 It is expected that implementation of BPM and additional localised noise barriers (temporary) where required, the noise attenuation at the sensitive receptors would be between 10 to 15dB. Based on this, the residual effects due to construction noise are presented in Table 12.15.

Table 12.15: Construction Noise Impact – with Mitigation

	R1	R2	R3	R4	R5	R6
Site Preparation	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Piling and Drainage	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Road Construction	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

12.7.2 It can be seen from Table 12.15 that with mitigation in place the construction noise could be minimised to a negligible effect.

Operation

12.7.3 It is considered that mitigation measures to minimise the noise impact during the operational phase of the Scheme are not required. Residual effects are those presented earlier in this chapter.

12.8 Cumulative Effects

Construction

12.8.1 The possibility of cumulative effects due to construction of other schemes in the vicinity of the site should be assessed once details on the programme, methodology, and plant items are available from the Principal Contractor. This information should form part of the Section 61 submission.

Operation

12.8.2 The traffic scenarios used in the assessment consider a number of developments. A list of all developments included in the traffic scenarios is presented below:

- Application 2014/01205/SC1: proposed residential development 160m west from Sycamore Cross;
- Application 2014/00798/FUL: 6 MW Solar PV array, 120m east of the scheme;
- Application 2014/01103/NMA: 8 MW Sola farm, 300m west of the scheme;
- Application 2014/00081/FUL: 7 MW solar farm, 50m east of the scheme;

12.9 Summary and Conclusions

12.9.1 A noise and vibration assessment has been undertaken to determine the likely impacts arising from the construction and operation of the Scheme.

12.9.2 A baseline noise survey was conducted between 9th and 10th July 2014 to establish the existing noise climate at the surroundings of the scheme. The survey was undertaken in accordance with BS7445 and Calculation of Road Traffic Noise (CRTN).

12.9.3 The likely noise and vibration effects arising from the construction phase of the scheme has been assessed in accordance with BS5228. The residual noise and vibration effects are not considered to be significant.

12.9.4 A Construction Environmental Management Plan (CEMP) will be prepared including more details on the construction programme and methodology. The Contractor should use Best Practicable Means (BPM) and local screening to ensure that construction

effects are minimised. It is recommended that consent using Section 61 of the Control of Pollution Act 1974 is sought once details on the methodology, programme and plant are available.

12.9.5 A computer noise model has been prepared to determine the likely noise effects arising from the operation of the Scheme. The assessment has been undertaken in accordance with guidance in HD213/11 of the Design Manual or Roads and Bridges (DMRB). Thirty three properties will experience a significant adverse effect during the day-time in the short-term and eight properties will experience a significant adverse effect during the day-time in the long-term. The majority of dwellings assessed will not experience a significant effect during both the short and long-term of the scheme.

12.9.6 An assessment of qualification under the Noise insulation Regulations 1975, as amended 1988, was undertaken. The study concluded that none of the dwellings assessed would qualify for noise insulation due to the operation of the scheme.

12.9.7 A WelTAG assessment has been undertaken to determine the monetary valuation of the scheme with respect to the likely noise impact during operation. The results of the study conclude that the net value of the noise of the scheme is beneficial.

12.9.8 The scheme design incorporates a low noise road traffic surface on part of the scheme. Further mitigation measures are not required during the operation of the scheme.

Table 12.16: Summary of Noise and Vibration Impacts

Potential Impacts	Nature of Impact	Predicted Effects (without Mitigation)	Mitigation Measures	Residual Impact (with Mitigation)
Construction				
Site preparation	Temporary	Negligible – very high	Best practicable means and localised noise barriers	Negligible
Piling & drainage	Temporary	Negligible – very high	Best practicable means and localised noise barriers	Negligible
Road construction	Temporary	Negligible – very high	Best practicable means and localised noise barriers	Negligible
Operation				
Road traffic noise	Permanent – long term	Majority of receptors would experience a negligible effect. A limited number of receptors will experience minor adverse and moderate adverse effects.	No further required – low noise road surface integrated in the design.	Majority of receptors would experience a negligible effect. A limited number of receptors will experience minor adverse and moderate adverse effects.

13 EFFECTS ON ALL TRAVELLERS

13.1 Introduction

13.1.1 This section adopts the DMRB heading of "Effects on All Travellers" as it appears in Interim Advice Note (IAN) 125/09(W). Due to the current transitional stage of the DMRB, it combines the Non-Motorised Users (NMUs) component of 11.3.8 - Pedestrians, Cyclists, Equestrians and Community Effects, with 11.3.9 - Vehicle Travellers. It considers any impacts the Scheme may have on Motorised Travellers (MTs) (drivers and passengers of both public and private vehicles) and NMUs (pedestrians, cyclists and equestrians).

13.2 Legislative & Policy Context

13.2.1 Relevant national, regional and local regulatory and policy framework is summarised in the following subsections.

National Legislation & Policy

Planning Policy Wales (PPW) (2014)

13.2.2 Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government (WG). PPW is also supplemented by a series of Technical Advice Notes (TA). With regards to MTs and NMUs, PPW states that land use planning should help to achieve the WG's objectives through:

- Reducing the need to travel, especially by private car, by locating development where there is good access by public transport, walking and cycling;
- Locating development near other related uses to encourage multi-purpose trips and reduce the length of journeys;
- Improving accessibility by walking, cycling and public transport;
- Ensuring that transport is accessible to all, taking into account the needs of disabled and other less mobile people;
- Promoting walking and cycling;
- Supporting the provision of high quality public transport;
- Supporting traffic management measures;
- Promoting sustainable transport options for freight and commerce;
- Supporting sustainable travel options in rural areas;
- Supporting necessary infrastructure improvements; and
- Ensuring that, as far as possible, transport infrastructure does not contribute to land take, urban sprawl or neighbourhood severance.

Technical Advice Note 18 (Transport)

13.2.3 TAN 18 was published by the WG in March 2007 and is a supplementary document to PPW. It provides the WG's planning policies which relate to transport. The TAN's primary focus is to describe the role of transport infrastructure within new development, however it also sets the standards for new trunk roads, requiring that these should be designed according to the standards provided in the Design Manual

for Roads and Bridges, and also requires that design for new roads should feature a consideration of the following:

"The adverse impact of transport infrastructure on the environmental, social and economic wellbeing of urban areas, towns, and villages also requires careful consideration."

Wales Transport Strategy (2008)

13.2.4 The Wales Transport Strategy provides an overarching strategy to drive coordinating of improvement to the transport system in Wales. The Strategy also sets out a range of methods designed to improve travel patterns, and to make them more sustainable. The main goal of this strategy is to *'promote sustainable transport networks that safeguard the environment while strengthening our country's economic and social life'.*

13.2.5 The following themes are identified as underpinning the strategy, and are relevant to MTs and NMUs:

- Achieving a more effective and efficient transport system;
- Achieving greater use of the more sustainable and healthy forms of travel;
- Improving access to shops and leisure facilities; and
- Minimising demands on the transport system.

The National Transport Plan (2009)

13.2.6 The NTP sets out the WG's proposals to ensure the delivery of a transport system that is highly integrated and to ensure the transport system is used efficiently and sustainably. The NTP sits alongside the Regional Transport Plans in delivering the Wales Transport Strategy.

13.2.7 The National Transport Plan commits the WG to the various policy interventions, including committing to safety improvement on the A4226:

"87: Introduce a high-quality, express bus service between Cardiff and Cardiff Airport, and, working with the local authority, take forward safety improvements on the A4226 Five Mile Lane."

13.2.8 This intervention is designed to improve the functioning of the east-west corridor road network in south Wales, where there is an identified issue with congestion, particularly on the M4 (approximately 6km north of the Scheme), which the A4226 connects to via the A48 and A4232 to the east. The Scheme will deliver the improvements that are identified above.

Wales Infrastructure Investment Plan

13.2.9 The WG is responsible for planning, constructing, and maintaining Wales' Trunk Roads and Motorways. The Plan 'sets out the WG strategic investment priorities' through to 2014/15. The relevant priorities, which relate to MTs and NMUs are:

- Economic growth – addressing urban congestion and improving access to key areas;
- Improving inter-modal transport links;

- Delivering more efficient and economical public services; and
- Improving the quality of the educational estate, particularly schools.

13.2.10 The Five Mile Lane Improvement Scheme is identified as a priority, with funding from the WG to improve access to the St Athan and Cardiff Enterprise Zones from Culverhouse Cross.

South East Wales Transport Alliance Regional Transport Plan (March 2010)

13.2.11 South East Wales Transport Alliance (SEWTA), which includes ten constituent councils, produced a 15 year long Transport Plan in 2010, and thus details the regional transport strategy from 2010 to 2025. The vision of the plan is to develop a 'modern, accessible, integrated and sustainable transport system for South East Wales which increases opportunity, promotes prosperity for all, and protects the environment'. (SEWTA Regional Transport Plan, Page 18).

13.2.12 The Regional Transport Plan outlines thirteen main objectives, those that relate to the Scheme and to provision for MTs and NMUs are summarised below:

Safety and Security

- To reduce the number and severity of road traffic casualties; and
- To improve actual and perceived levels of personal security when travelling.

Connectivity and Accessibility

- To improve access for all to employment opportunities, services, healthcare, education, tourism and leisure facilities; and
- To improve connectivity by sustainable transport between South-East Wales and the rest of Wales, the UK and Europe.

Quality and Efficiency

- To improve interchange within and between modes of transport;
- To improve the quality, efficiency and reliability of the transport system; and
- To reduce traffic growth, traffic congestion and to make better use of the existing road system.

Environment

- To achieve a modal shift towards more sustainable forms of transport for moving both people and freight;
- To reduce significantly the emission of greenhouse gases from transport;
- To reduce the impact of the transport system on the local street scene and the natural, built and historic environment; and
- To promote sustainable travel and to make the public more aware of the consequences of their travel choices on climate, the environment and health.

13.2.13 In order to fulfil these objectives, the Regional Transport Plan set out planning policies and actions to be taken by the organisation. The action that relates to MTs, NMUs and the proposed Scheme is PLP5. This action states:

"SWTRA supports the transport elements of regeneration and development programmes where they are to the benefit of RTP objectives make provision for pedestrians, cyclists and public transport and do not adversely affect the operations of the highway network."

The Countryside and Rights of Way Act 2000 (CRoW Act)

13.2.14 The CRoW Act regulates all PRoW and ensures access to them. It requires local highway authorities to publish a Rights of Way Improvement Plan (RoWIP), which should be reviewed every 10 years. The Act also obliges the highway authority to recognise the needs of the mobility impaired when undertaking improvements. Vale of Glamorgan Council produced its RoWIP in 2007.

The Disability Discrimination Act 1995 (amended in 2005)

13.2.15 The Act requires Design Organisations to ensure that, where possible, accessibility for disabled people is equal to that of other NMUs. Disabled people, defined as those having a range of physical, sensory or mental impairments, represent approximately 14% of the UK's population.

Local legislation & policy

Vale of Glamorgan Adopted Unitary Development Plan (UDP) (1996 - 2011)

13.2.16 The UDP was adopted in 2006 and remains the adopted local planning policy framework for Vale of Glamorgan Council, until its policies are replaced by adopted planning policies within the emerging Vale of Glamorgan Local Plan.

13.2.17 Table 13.1 outlines those saved UDP policies that directly relate to MTs and NMUs. The plan encourages development that will include provision for public transport, cyclists and pedestrians.

Table 13.1: Saved UDP Policies that Relate to MTs and NMUs

Policy		Description
No.	Name	
7	Transportation	Improvements to the transportation network will consist of: • Strategic transport schemes within and adjoining the existing urban areas of the waterfront strip of Penarth, Dinas Powys, Barry and Rhoose; • Local schemes necessary for environmental and safety reasons; and • Schemes to encourage travel by cyclists and pedestrians.
27	Design of New Developments	Proposals for new developments must have full regard to the context of the local natural and built environment and its special features. New development will be permitted where it: • Complements or enhances the local character of buildings and open spaces; • Meets the council's approved standard of amenity and open space, access, car parking and servicing; ensures adequacy or availability of utility services and adequate provision for

Table 13.1: Saved UDP Policies that Relate to MTs and NMUs

Policy		Description
No.	Name	
		waste management; • Minimises and detrimental impact on adjacent areas • Ensures existing soft and hard landscaping features are protected and complemented by new planting surface or boundary features; • Ensures clear distancing between public and private spaces; • Provides a high level of accessibility, particularly for public transport, cyclist pedestrians and people with impaired mobility; • Has regard to energy efficiency in design, layout material and technology; and Has regard to measures to reduce the risk and fear of crime.
REC 12	Public Rights of Way and Recreational Routes	During the plan period the Council will maintain and improve the existing pattern of public rights of way (including bridleways). Land will be protected and provision made for the establishment of the following routes as a framework for a network of linkages for the enjoyment of the countryside. NOTE: List of schemes omitted for brevity. None relevant to the proposed development. Where appropriate the Council will favour the incorporation into these routes of bridleways, cycleways and facilities for users.

Draft Vale of Glamorgan Local Development Plan (LDP) (2014)

13.2.18 The Draft LDP is currently being amended following an additional site selection process, and is due to be submitted to the Welsh Government for inspection in 2015. The Draft LDP contains the following objectives, which relate to MTs and NMUs:

- *"Objective 1: To sustain and further the development of sustainable communities within the Vale of Glamorgan, providing opportunities for living, learning, working and socialising for all."*; and
- *"Objective 3: To reduce the need for Vale of Glamorgan residents to travel to meet their daily needs and enabling them greater access to sustainable forms of transport."*

13.2.19 The generic policies provided in the Draft LDP are expected to provide a strong indication of the policies which will be adopted. The Draft LDP identifies Five Mile Lane as a Strategic Transport Corridor and includes a range of policies designed to improve accessibility to St Athan, which is designated as a Strategic Opportunity Area and an Enterprise Zone.

13.2.20 Policies MD3, MG16, SP7 encourage development that will improve access along Five Mile Lane for MTs. MG16 in particular, supports the development of the improvements to Five Mile Lane. However, the Draft LDP also includes policies that encourage development that provides safe access for NMUs.

13.2.21 Table 13.2 outlines those Draft LDP policies that relate to MTs and NMUs.

Table 13.2: Draft LDP Policies that Relate to MTs and NMUs

Policy		Description
No.	Name	
MD 3	Design of new development	Development proposals will be permitted where: 6. They promote the creation of healthy and active environments and reduce the opportunity for crime and anti-social behaviour; 7. They provide a safe and accessible environment for all users, giving priority to pedestrians, cyclists and public transport users; 9. They would have no unacceptable impact on highway safety and would not cause or exacerbate existing traffic congestion.
MG 16	Transport Proposals	Walking and cycling 1. National cycle network route 88 and associated local urban and rural connections. Highways 14. Northern access road (St Athan Enterprise Zone). 16. Improvements to the A4226 (Five Mile Lane) between Waycock Cross, Barry and Sycamore cross, A48. Highway improvement works In addition, to mitigate the impact of development on the highway network, highway improvement works in the form of corridor or junction improvement schemes will be required.
SP 7	Transportation	Sustainable transport improvements that serve the economic, social and environmental needs of the Vale of Glamorgan and promote the objectives of the South East Wales Regional Transport Plan will be favoured. Key priorities for the delivery of strategic transportation infrastructure will be: 3. Improvements to the A4226 (Five Mile Lane); between Waycock Cross, Barry and Sycamore Cross, A48. Priority will also be given to schemes that improve highway safety and accessibility, public transport, walking and cycling.

Rights of Way Improvement Plan (RWIP) (Vale of Glamorgan Council, 2007)

13.2.22 The RWIP was produced in 2007 in accordance with the CRoW Act. It sets out the improvements required to meet the current and future needs of Public Rights of Way (PRoW) users. The Local Transport Plan and the Rights of Way Improvement Plan share common objectives relating to accessibility, in particular to:

- Provide, maintain and improve the network of Public Rights of Way and countryside access for everyone; and
- Enable and encourage increasingly convenient and responsible use and enjoyment of the Vale's countryside and coast.

13.3 Assessment Methodology

Study Area

13.3.1 The study area comprises the roads, connecting roads and Public Rights of Way (PRoW) located within 1km of the Scheme.

Temporal Scope

13.3.2 The assessment is based on construction occurring from the start of 2016, and the Scheme being completed in 2017. Traffic figures have been calculated for the future years 2017 and 2032. The study considers the impact of the Scheme firstly in isolation, and then cumulatively with other nearby development. This change in the physical context of the Scheme is therefore also a temporal distinction.

13.3.3 In terms of MTs, the Simple Assessment adheres to DMRB 11.3.9 Vehicle Travellers guidance and considers impacts on views from the road and driver stress. Site visits and assessment of aerial photography provided the baseline data of views from the road.

13.3.4 For NMUs, the Simple Assessment adheres to the Pedestrians, Cyclists, and Equestrians component of DMRB 11.3.8 and, as such, focuses on changes in journey lengths and times, the effect on the amenity value of journeys and changes in community severance. Data collection involved a desk study of PRoW routes and facilities. NMU surveys of PRoW were not undertaken. Vale of Glamorgan Council's online Definitive Map (2014) provided baseline data for the PRoW assessment. It is noted that key stakeholders including local walking, riding and cycling groups, and the relevant local authorities' PRoW Officers would have an opportunity to comment on the Scheme during future Public Consultations.

13.3.5 Guidance in DMRB 11.2.5 (August, 2008) on methods for establishing the significance of effects was used for the assessment for both MTs and NMUs.

13.3.6 The assessment methodologies applied to each traveller type are described below.

Motorised Travellers

View from the Road

13.3.7 The 'View from the Road' is defined as the extent to which MTs are exposed to the different types and qualities of scenery along the route. Four aspects of 'View from the Road' are normally reviewed:

- The types of scenery or the landscape character as described and assessed for the baseline studies;
- The extent to which travellers may be able to view the scene;
- The quality of the landscape as assessed from baseline studies; and
- Features of particular interest or prominence in the view.

13.3.8 The extent to which MTs can perceive the landscape through which they are passing varies with the relative level of the road corridor and the surrounding land use and vegetation cover. The DMRB outlines four categories for assessing traveller's ability to see the surrounding landscape (Table 13.3). Based on these descriptions, the sensitivity or value of the view as a resource is also applied.

13.3.9 The DMRB also states that views from the road may provide interest which may help to alleviate driver stress and will be considered as part of the assessment of levels of driver stress.

Table 13.3: DMRB Categories for Assessing Traveller's Ability to See the Landscape and Associated Sensitivity / Value

DMRB 'View' category	Description	Sensitivity / Value
No View	Road in deep cutting or contained by earth mounds, environmental barriers or adjacent structures	Negligible
Restricted View	Frequent cuttings or structures blocking the view	Low
Intermittent view	Road generally at ground level but with shallow cuttings or barriers at intervals	Medium
Open View	View extending over many miles, or only restricted by existing landscape features.	High

13.3.10 The assessment of potential impacts of the Scheme on MT views should be read in conjunction with Chapter 8: Landscape.

13.3.11 Table 13.4 provides a framework for assessing magnitude of impact on 'View from the Road' from the Scheme. Table 13.4 complements DMRB methodology by applying the typical criteria to define the magnitude of an impact, as provided in DMRB 11.2.5 (HD 205/08), to this topic. The table indicates the change in view, for example, a change in view from 'Intermittent' to 'Open' would result in a Minor Beneficial Impact.

Table 13.4: Magnitude of Impact on Views from the Road

Magnitude of Impact	Beneficial	Adverse
No change	Views remain the same	
Minor	No view - Restricted	Restricted – No view
	Restricted – Intermittent	Intermittent – Restricted
	Intermittent – Open	Open- Intermittent
Moderate	No view - Intermittent	Intermittent – No view
	Restricted - Open	Open – Restricted
Major	No View - Open	Open – No View

Driver Stress

13.3.12 Driver Stress is defined in the DMRB as 'the adverse mental and physiological effects experienced by a driver traversing the road network. Factors influencing the level of stress a traveller experiences include: road layout and geometry, surface riding characteristics, junction frequency, and speed and flow per lane'.

13.3.13 Driver Stress has three main components: Frustration, Fear of Potential Accidents and Route Uncertainty. A description of each is provided in Table 13.5.

Table 13.5: DMRB Driver Stress Components

Drive Stress Component	Description
Frustration	This is caused by a driver's inability to drive at speeds consistent with their own wishes in relation to the general standard of the road. Congestion can lead to frustration by creating a situation in which the driver does not feel in control of their journey time or speed.
Fear of potential accidents	This is primarily caused by adverse driving conditions. The perception of what constitutes 'adverse driving conditions' can vary between MTs, however they are often related to factors such as adverse weather conditions, presence of NMUs, restricted sight distances, heavy traffic and poorly maintained, narrow or inadequately lit roads.
Route uncertainty	Inadequate way markings and signage are the primary factors relating to route uncertainly. Additionally an individual drivers' familiarity with the route can impact the level of driver stress experienced. Unless a consensus has been made on the adequacy of existing signage at a specific site, assessing the effect of this factor on driver stress is not possible.

13.3.14 For the purposes of this assessment and with consideration of the DMRB components described in Table 13.5, Driver Stress has been based upon the following parameters:

- Frustration: assessing the delays effecting MTs on the routes around the proposed Scheme;
- Fear of potential accidents: assessing the actual occurrence of accidents on MTs on the routes surrounding the Scheme; and
- Route Uncertainty: assessing route uncertainty has been based on a qualitative assessment of a number of factors effecting MTs, however this is not a central part of the assessment.

13.3.15 The effect of each of these variables on Driver Stress is described as Low, Medium or High. For the purposes of this assessment, the level of driver stress is directly correlated with the sensitivity of receptors. In other words, high driver stress, as calculated from Table 1 of the DMRB guidance, represents a high sensitivity, moderate driver stress represents a medium sensitivity, and low driver stress represents a low sensitivity.

13.3.16 The DMRB states that Driver Stress should be assessed for the worst year in the first fifteen after opening. However, as the future years for traffic data are 2017 and 2032, these are the years on which the assessment is based.

13.3.17 Table 13.6 provides a framework for assessing the magnitude of impact of Driver Stress. This table complements the DMRB methodology by applying the typical criteria to define the magnitude of an impact, as provided in DMRB 11.2.5 (HD 205/08), to this topic. The table indicates the change in Stress, for example, a change from 'High' to 'Moderate' would result in a Moderate Beneficial Impact.

Table 13.6: Magnitude of Impact on Driver Stress

Magnitude of Impact	Beneficial	Adverse
No change	Stress remains the same	
Minor	Moderate – Low	Low – Moderate
	High – Moderate	Moderate – High
Moderate	High – Moderate/Low	Low – Moderate/High
Major	High – Low	Low – High

Non-Motorised Users

Journey patterns and changes in amenity

13.3.18 A qualitative assessment of changes in journey lengths/times has been undertaken and assessment of the Scheme's effect on the amenity value of NMU journeys was undertaken based on available desktop information. Changes in journey lengths and times can be temporary or permanent. This depends on whether the identified changes are associated with construction, such as temporary PRoW closures or route diversions, or if they relate to permanent severance or route changes.

13.3.19 NMU amenity is considered to be the pleasantness of a journey, including: exposure to traffic; fear/safety; noise; air quality and visual intrusion. Amenity factors can affect NMUs in different ways. For example, the DMRB states that landscape quality is generally an important factor to equestrians, whereas footpath width and the quality of street furniture may be more important for pedestrians.

13.3.20 For this assessment, sensitivity of NMU routes was described as Negligible, Low, Medium, High or Very High. These scores were determined by considering the type of NMU routes, their accessibility and the type of NMU travel for which they are used.

Table 13.7: Assessment of the Sensitivity of NMU Routes

Sensitivity	Description
Very High	NMU routes* that: • are used for both recreational and utility** journeys, and • are suitable for all types of NMU, are lit and are provided with all-weather surfaces • National strategic routes and long-distance trails (e.g. the Pennine Way)
High	NMU routes* that: • are used for both recreational and utility** journeys, and • whose use at night or in bad weather is limited by the nature of the surface or lack of lighting, or • which are not suitable for all types of NMUs • Named and/or way marked trails designated on a local or regional basis • Other routes whose use by NMUs is principally for recreational journeys, whose amenity value is enhanced by the quality of the landscape to which they provide access (including landscapes protected by designations at national, regional or local level)

Table 13.7: Assessment of the Sensitivity of NMU Routes

Sensitivity	Description
Medium	NMU routes* used principally for recreational journeys that: • are provided with all-weather surfaces, and are not obstructed by stiles; or • other barriers that restrict the accessibility of the route; or • act as 'feeder routes' to other NMU routes of 'Very High' or 'High' sensitivity***
Low	PRoW whose accessibility is restricted by the nature of the surface or by barriers such as stiles, and which meet none of the other criteria detailed above
Negligible	Roads carrying little non-motorised traffic, or not suitable for non-motorised use**** PRoW shown on the Definitive Map, but already severed or otherwise permanently unusable

Notes:

** including roads suitable for non-motorised use, PRoW or any other route on which there is a right of way and that is suitable for use by any category of NMU*

*** utility journeys are those that are made for non-recreational purposes, such as commuting, to access a community facility either within the same community or elsewhere, or to travel between communities*

**** feeder routes are those that link two other routes of higher degrees of sensitivity, or that link a community to a more sensitive route*

***** routes such as busy dual carriageways, where non-motorised use is not restricted by law but on which such use is rare or dangerous due to the volume and speed of traffic and where no dedicated facilities are provided.*

13.3.21 For this assessment, the magnitude of impacts on PRoW has been described as No Change, Negligible, Minor, Moderate, or Major. This assessment considers effects on journey time, accessibility and amenity.

Table 13.8: Typical Criteria for Magnitude of Impacts on NMUs

	Adverse Impacts	Beneficial Impacts
Major	Permanent closure of a NMU route. Permanent severance of any NMU route that would prevent access between the parts.	Provision of new surfaced NMU route. Provision of new linkage between communities that is shorter or safer for NMU than existing links.
Moderate	Temporary closure of any NMU route for more than 1 month Increase in journey time of 10% or more. Introduction of new intersection with a highway, with at-grade road crossing that is not controlled by signals. Permanent severe loss of amenity on any PRoW.	Reduction in journey time of 10% or more for utility journeys. Replacement of existing at-grade, uncontrolled crossing with signal-controlled or grade-separated facilities. Two or more improvements in accessibility on a public right of way, through removal of stiles or other barriers, improvements in surface, provision of lighting, etc. Substantial improvements to amenity on any NMU route.

Table 13.8: Typical Criteria for Magnitude of Impacts on NMUs

	Adverse Impacts	Beneficial Impacts
Minor	Temporary closure of any NMU route for 1 month or less. Increase in journey time of less than 10%. Introduction of new intersection with a highway, with at-grade road crossing that is controlled by signals or a grade-separated crossing. Minor permanent loss of amenity or any temporary loss of amenity, on any NMU route.	Reduction in journey time of less than 10% for utility journeys. Improved accessibility on a public right of way, through removal of stiles or other barriers or improvements in surface or provision of lighting etc. Minor improvements to the amenity of any NMU route.
Negligible	Temporary closure of any NMU route for up to 1 day.	N/a
No change	Changes in the physical environment on a NMU route that do not affect journey time, accessibility or amenity.	

Community severance

13.3.22 This chapter considers severance or relief of severance of journeys between communities and the wider area during both the construction and the operational phases. Severance may occur where access is adversely affected, for example, through diversions of NMU routes, or where access is completely cut off. Community severance within communities is considered in Chapter 14: Community and Private Assets.

Significance criteria

13.3.23 The significance of effects on MTs and NMUs in terms of views from the road, driver stress, journey times and amenity were derived from the sensitivity and value of resources and receptors, and the potential magnitude of impacts following mitigation. The DMRB 11.2.5 (HD 205/08) provides a matrix for determining the significance of effects (Table 2.4 Arriving at Significance of Effect Categories). This matrix is reproduced as Table 4.3 in Chapter 4 of this ES. For certain cells in the matrix, the guidance presents more than one significance criteria, in which case a precautionary approach has been applied, in line with the guidance in HA205/08, to identify the worst case scenario given this early stage of the Scheme.

13.4 Baseline Conditions

Motorised Travellers – Views from the Road

13.4.1 The Scheme will reroute traffic that currently travels along the existing A4226 Five Mile Lane. The proposed improvements will be between Blackland Farm, in the north, and the junction with the Waycock Cross Roundabout, in the south, outside Barry. The View from the Road is assessed as the view experienced by MTs whilst travelling between these two locations. The views experienced by MTs on this route can be divided into three categories, starting from the northernmost section, these are described below:

Rural Plateau – Blackland Farm to Sutton Fach Farm (south west of Moulton) – 2.8km

13.4.2 Between Blackland Farm and Sutton Fach Farm, the existing A4226 carriageway travels across a gently undulating plateau. From the perspective of a MT, the views either side are partially restricted by hedges on either side of the road. The high hedges and sharp bends regularly restrict MT's view of the road ahead.

13.4.3 The views either side of the road are of a pastoral landscape, interrupted by occasional farm buildings, stands of trees or small copses. Because of the height of this plateau above the surrounding landscape, there are regular but intermittent views over long distances, these are occasionally open on both sides. These open views of the landscape give the MTs a pleasant experience of the landscape.

Rural River Valley – Sutton Fach Farm to the Welsh Hawking Centre – 1.2km

13.4.4 Between Sutton Fach Farm and the Welsh Hawking Centre, the route travels through a valley containing the River Waycock. The views remain predominantly rural, but are at a lower elevation and therefore views extend over shorter distances than the northern section described above. To the east, there are views across the valley into the middle distance. Views to the west are restricted by high hedges. The high hedges and regular bends occasionally restrict MT's view of the road ahead.

Wooded Hillside – Welsh Hawking Centre to Waycock Cross Roundabout – 900m

13.4.5 This is the southernmost, and shortest section of the route, south of the Welsh Hawking Centre and Waycock Cross Roundabout. The road travels on a gradient through a wooded area. Views to both sides are restricted by tall trees and shrubs.

Summary of the existing View from the Road

13.4.6 Overall, 'Views from the Road' along the existing road network on the periphery of the study area are open due to the rural character of the road. Several points on the route feature long distance views of surrounding farmland. However, the road features regular bends and some high hedges. Existing views from the road are considered to be Intermittent, and the impact of these interruptions on MT's experience means that MTs will be Medium sensitivity.

Motorised Travellers - Driver Stress

13.4.7 The baseline assessment for Driver Stress is a combination of three components, frustration, fear of potential accidents and route uncertainly.

Frustration

13.4.8 The Link Analysis for the Transport Assessment (TA) (Appendix 13.1) considers the future baseline for traffic in the Vale of Glamorgan, factoring in projected housing and employment growth. The Link Analysis is based on two projected alternatives, 'Do Minimum (DM)' (without Scheme); or 'Do Something (DS)' (with Scheme) for the year 2032. The Link Analysis provides a model, which estimates the Degree of Saturation on the road, which refers to the ratio of demand and capacity on the route. A high saturation level is expected to result in delays, and therefore increase Driver Stress experienced by MTs. For the purpose of this analysis, the Degree of Saturation described in the TA provides a baseline scenario for Frustration.

13.4.9 The Degree of Saturation indicates that with the higher amount of traffic on Five Mile Lane, Sycamore Cross becomes more congested compared to the DM scenario, which is especially the case in the PM peak in the design year (2032).

13.4.10 It is therefore concluded that the delays which will be experienced by drivers in the DM scenario are likely to have a high impact on Frustration, adversely effecting Driver Stress.

Fear of potential accidents

13.4.11 Fear of accidents is expected to affect Driver Stress as a result of the alignment of the route. Personal Injury Collisions (PIC) data have been obtained from the Vale of Glamorgan Council for the five year period from January 2009 to December 2013. Over the assessment period there was one serious accident and eleven slight accidents recorded along Five Mile Lane, four slight accidents at Sycamore Cross and three slight accidents at Wycock Cross.

13.4.12 Vale of Glamorgan Council has employed various methods to improve safety on the road through the introduction of speed limits, which the Safety Camera Partnership enforce with a static camera, re-surfacing, improved signage, lighting, and solar powered LED cats eyes. However, the road still contains a number of sharp bends, has substandard forward visibility and is too narrow in places for two large vehicles such as farm traffic, lorries or buses to pass. Along most of its length, the speed limit is 40 miles per hour and overtaking is not permitted.

13.4.13 There are also many existing junctions and access points onto the route at various points along its length. These include four junctions with minor roads, and nine access points for residential properties or farms. Particularly where these junctions or access points are close to bends in the road, these are expected to increase MT's fear of potential accidents

13.4.14 The combination of a history of accidents, and the quantity of safety measures demonstrate the existing safety issues on this section of road. Along with the regular junctions and access points on the road, these are expected to combine as contributory factors to increase the fear of potential accidents experienced by MTs using the road.

Route Uncertainty

13.4.15 The majority of MTs travelling along the route will be moving between the A48 at Sycamore Cross and the Waycock Cross roundabout. As described above the road contains a number of sharp bends, has substandard forward visibility and is too narrow in places for large vehicles. However the route that the majority of motorised travellers will be taking is direct from without the need to make any turns at junctions. Albeit there is a level of uncertainty on this route due to it being substandard MTs travelling along the route are not expected to experience a high degree of route uncertainty. However, it is not possible to determine the sensitivity of this factor without consensus on the clarity of the existing signage on the roads around Five Mile Lane.

Summary

13.4.16 The assessment of Driver Stress relies both upon the Degree of Saturation data provided for the Baseline of the Frustration component, and also upon the poor safety

record of the road, which is a key driver for the Scheme. The baseline scenario for the road system as a whole is therefore expected to be High sensitivity.

Non-Motorised Users

13.4.17 There are no footways or cycle paths along the length of the existing Five Mile Lane. There is a footway / cycle path running adjacent to the northern edge of the A48 at the Sycamore Cross junction.

13.4.18 PRoW FP-L5-20-1 and FP-L5-25-1 (see Figure 8.1) intersect the existing Five Mile Lane at Whitton Rosser Farm and Suddon Mawr Farm respectively from the west. There are no PRoWs on the east side of the road at either intersection, and therefore the PRoWs on the west side do not provide a direct link for NMUs travelling between any nearby settlements. PRoW FP-L5-20-1 travels along an unclassified road heading west as far as Amelia Methodist Trust Farm before heading south, as a footpath, to the unclassified road which heads to Walterston. PRoW FP-L5-25-1 travels along a track heading west to Sutton Mawr Farm before heading north east, as a footpath to Moulton. There is no provision for cyclists along these routes.

13.4.19 There is no current dedicated equestrian access or bridleways to Five Mile Lane or Sycamore Cross. However, following consultation with landowners there is anecdotal evidence that equestrians travel from Moulton and Walterston in the west to Dyffryn in the east and vice versa using the unclassified road network. Equestrians are known to cross over the existing Five Mile Lane at two locations. The first is at Whitton Lodge where an unclassified road travels from Walterston to Dyffryn. The second crossing point is at Northcliffe Cottage where equestrians travel along an unclassified road from Moulton to Five Mile Lane, travel north along Five Mile Lane until Northcliff Cottage and then head along an unclassified road toward Dyffryn.

13.4.20 As any existing routes that directly connect to the Scheme do not offer any direct connections between settlements and facilities, the sensitivity of NMUs is expected to be Low.

13.5 Predicted Effects (without Mitigation)

Construction

Motorised Travellers - Views from the Road

13.5.1 Temporary effects are anticipated from the clearing of small sections of roadside hedging and woodland vegetation to accommodate the highway improvement works. Clearing of hedges will be required to allow for the new junctions and offline connections to the existing road. There will also be 0.016 ha of broad-leaved woodland and 0.12 ha of scrub cleared for online widening to the north of the Scheme near Blacklands Farm and 0.431 ha of broad-leaved woodland cleared for drainage improvement works to the south of the Welsh Hawking Centre. The removal of these small sections of roadside hedge and woodland will result in a Minor Adverse impact to Views from the Road.

Motorised Travellers - Driver Stress

13.5.2 Although it is not yet possible to be precise about the number and frequency with which construction vehicles will use the Scheme, it is anticipated that these vehicle will have an adverse effect on the delays currently experienced by MTs.

13.5.3 Phasing of the works is to be developed with the Principal Contractor. The aim will be to maintain traffic on the existing highway whilst the majority of the works are constructed off-line. However, temporary traffic management measures will be necessary to undertake the works at the tie-ins and during the on-line improvements

13.5.4 During the off-line construction works (which comprises approximately 75% of the Scheme length) it is not anticipated that MTs will significantly change their existing routes. During the on-line works where the route will be controlled using temporary traffic management measure MTs may change their existing routes. Therefore the construction of the Scheme is not expected to significantly affect route uncertainty, or the occurrence of accidents.

13.5.5 Without mitigation, Driver Stress expected to increase during construction, and the impact is expected to be Minor to Moderate Adverse.

Non-Motorised Users

13.5.6 The footpath which joins with the northern side of the A48 at Sycamore Cross will require a minor realignment (<5m to the north) to accommodate the additional bus lane proposed at the junction. A temporary diversion of the existing footpath will be established to allow NMUs to continue to use the footpath during construction works.

13.5.7 PRoW FP-L5-20-1 and FP-L5-25-1 (see Figure 8.1) will not be affected during construction.

13.5.8 The two locations, at Whitton Lodge and Northcliff Cottage, where equestrians are known to cross over the existing Five Mile Lane would be disrupted by construction activity. Access along the unclassified road network will be maintained during construction however there may be a requirement for the temporary diversion of equestrian users. Construction will therefore result in Minor Adverse effect on NMUs.

Operation

Motorised Travellers - Views from the Road

13.5.9 Views from the Road are expected to change during the operational phase of the Scheme. For the purposes of this part of the assessment, MTs have been divided into the three receptors described in Section 13.4.2, 13.4.3, and 13.4.4 respectively. The impact on each group is set out below:

Rural Plateau – Blackland Farm to Sutton Fach Farm (south west of Moulton) – 2.8km (Ch0m to Ch2800m)

13.5.10 Between Ch0m and Ch120m (120m), the new carriageway will be online. This section of carriageway runs from Blackland Farm to 120m south of Blackland Farm. The Scheme would result edge of the existing woodland being cut back but the majority of the woodland will remain intact and therefore landscape will remain the same. MTs using this route will experience the same view of the surrounding landscape.

13.5.11 Between Ch120m and Ch2800m, the new carriageway will be offline. The new carriageway runs south of Blackland Farm, to the south of Sutton Fach Farm. The sharp bends and high hedges obscuring views ahead along this section of the route would be removed. The boundaries of the Scheme would be planted with native hedgerow that would be similar in appearance to the hedgerow alongside the existing

Five Mile Lane. MTs using this route will experience a similar open view of the surrounding landscape.

Rural River Valley – Sutton Fach Farm to the Welsh Hawking Centre – 1.2km

13.5.12 Between Ch2800m and Ch4000m the new road alignment road travels into a valley, the Views from the Road will be restricted by surrounding hills and vegetation, and woodland. However, the view ahead will be much improved from the previous arrangement, as the road will be straightened.

Wooded Hillside – Welsh Hawking Centre to Waycock Cross Roundabout – 900m

Between Ch4000m and Ch4900m, any improvements will be made to the existing alignment. The Scheme would result edge of the existing woodland being cut back but the majority of the woodland will remain intact and therefore landscape will remain the same. Views from the Road experienced by MTs will remain broadly unchanged.

13.5.13 In summary, it is expected that MTs travelling through Five Mile Lane will experience a Minor Beneficial effect on the View from the Road, as the view will change from Intermittent to Open.

Motorised Travellers - Driver Stress

13.5.14 The baseline assessment states that Frustration and Fear of Accidents are likely to be the most significant factors in determining the level of Driver Stress experienced by MTs travelling on routes around the Scheme.

13.5.15 The impact on Fear of Accidents and Route Uncertainty cannot be determined precisely as there is no method for projecting improvements. However, the past record of accidents on the road, as set out in paragraph 13.4.11,indicates that a large proportion of these were associated with drivers making mistakes exacerbated by the existing arrangements (blind bends/ narrow carriageway, poor visibility). The new road and associated junctions will be constructed to modern safety standards and will be DMRB compliant. It will provide a clear view ahead with less sharp and narrow bends which will decrease MT's Fear of Accidents. The straightening of the road is expected to reduce route uncertainty, and access to connecting minor roads will be improved. In addition, the provision of cycleway / footpath and bridleway provides a formal and safe provision for NMUs along the route. This should prevent NMUs using the road or verge and further reduce fear of accidents.

13.5.16 It is therefore expected that the Scheme will have a beneficial effect on the Fear of Accidents components of Driver Stress. In conclusion, the improvements to safety and congestion will reduce Driver Stress and therefore the overall effect is expected to be Major Beneficial.

Non-Motorised Users

13.5.17 Various pedestrian and cyclist improvements are proposed and will be enabled by the Scheme.

13.5.18 1km of dedicated shared cycle path / footpath will be constructed between Waycock Cross and the Welsh Hawking centre (Ch3900m to Ch4850m). This will connect to the old A4226 alignment at Ch3700m. An additional 200m of dedicated shared cycle path / footpath will also be constructed between the existing A4226 carriageway and the new alignment (Ch0m to Ch200m).

13.5.19 The existing A4226 carriageway between Ch120m to Ch3700m (from south of Blackland Farm, to the south of Sutton Fach Farm) will be retained. Although this will not be exclusive to cyclists or pedestrians the volume of traffic will be greatly reduced. Signs will be put up to warn motorists of cyclists and pedestrians on the route.

13.5.20 A bridleway is also proposed along the boundary of the Scheme between Ch2180 and Ch3120 that can be used by both equestrians and pedestrians. An accommodation bridge will also cross over the Scheme at Ch2920 allowing a safe crossing point over the Scheme for both equestrians and pedestrians.

13.5.21 The primary purpose of the accommodation bridge is to allow the landowner who resides in Sutton Fach Farm to access their fields east of the Scheme. Equestrians and pedestrians would also be allowed to use the accommodation bridge to safely cross over the Scheme.

13.5.22 Equestrians heading from Moulton to Dyffryn would now travel from Moulton along an unclassified road, then travel south along the old Five Mile Lane (which will become an unclassified road for access only) past Sutton Fach Farm and will then pick up the new bridleway. The bridleway would safely cross the Scheme, via the accommodation bridge, and link up the unclassified road as Northcliffe Cottage to head towards Dyffryn. This route would be longer compared to the existing route described in paragraph 3.4.19 but would be much safer for equestrians allowing them to travel along lower trafficked unclassified roads, along a bridleway and safely cross the Scheme.

13.5.23 Equestrians heading from Walterston to Dyffryn would access the old Five Mile Lane, when travelling from Walterston. They then have three possible options to travel to Dyffryn.

13.5.24 They may decide to travel north along the old Five Mile Lane (which will become an unclassified road for access only) and access the Scheme at the new junction at Ch650, travel south along the Scheme and the access the unclassified road to Dyffryn at the new junction at Ch1120 by Whitton Lodge. They can travel south along the old Five Mile Lane and cross over the Scheme at the staggered junction located at Ch2200 by Northcliffe Cottage and travel along the unclassified road to Dyffryn. Alternatively they can travel south along the old Five Mile Lane past Sutton Fach Farm and will then pick up the new bridleway and travel on to Dyffryn via the route described in paragraph 13.5.22.

13.5.25 All routes from Walterston to Dyffryn would be longer compared to the existing route described in paragraph 3.4.19. The first two routes are the shortest new routes but are considered to be more dangerous as they will require equestrians to cross over and travel along the Scheme which will have a 60mph speed limit albeit with improved sight lines compared to the existing Five Mile Lane. The third route is the longest but is the safest route as it will allow equestrians to travel along lower trafficked unclassified roads, along a bridleway and to safely cross the Scheme. In summary, due to the enhancements and provision of safe access routes for NMUs in the area the connectivity between communities and facilities in the local area has been significantly improved. The journey length and subsequent travel times for equestrians will increase however compared to the existing routes the journey would be safer allowing equestrians to travel along lower trafficked unclassified roads, along a bridleway and to safely cross the Scheme via the accommodation bridge.

13.5.26 This is likely to result in an increase in NMUs accessing the area around the Scheme. Therefore the Scheme is expected to have Major Beneficial effect on NMUs.

13.6 Mitigation

Construction

Motorised Travellers - Views from the Road

13.6.1 Where possible, open views from the road would be maintained and the sensitive location of signs would be considered with landscape and ecological planting mitigation as appropriate.

Motorised Travellers - Driver Stress

13.6.2 Traffic management, diversions and lane closures on the existing roads surrounding the Scheme would be minimised and simplified as far as possible. These measures would assist in mitigating some of the adverse impact on Driver Stress due to route uncertainty.

13.6.3 Construction traffic associated with the Scheme will be managed through a Construction Traffic Management Plan (CTMP) to mitigate the expected increase in delays, reducing frustration and the adverse effect this has on Driver Stress. Mitigation will include measures to ensure that peaks in construction traffic do not coincide with peak journey times on existing routes. The CTMP will be produced by the appointed contractor in consultation with the Vale of Glamorgan Council.

Non-Motorised Users

13.6.4 Where necessary, temporary diversions will be put in place to ensure equestrians can safely travel around construction activities at the two new road junctions on Thorpeville Road and Overstone Lane. These measures will be set out in the CEMP.

Operation

Motorised Travellers - Views from the Road

13.6.5 The operational effects of the Scheme on Views from the Road are expected to be beneficial, so no further mitigation is proposed.

Motorised Travellers - Driver Stress

13.6.6 The operational effects of the Scheme on Driver Stress are expected to be beneficial, so no further mitigation is proposed.

Non-Motorised Users

13.6.7 The impact on pedestrian and cyclists NMUs during operation is expected to be beneficial, so no mitigation is proposed.

13.6.8 To mitigate any potential impacts on equestrian users, a bridleway will be constructed linking the existing Five Mile Lane alignment with the new accommodation bridge at Sutton Fach Farm (refer to Figure 3.3). This will enable equestrian users to safely traverse the new highway during the operation of the Scheme.

13.7 Residual Effects (with Mitigation)

Construction

Motorised Travellers - Views from the Road

13.7.1 During construction, MTs will continue to use the existing alignment. The only point at which the view from the road will change will be the junctions associated with the Scheme. The effect of any mitigation on this small section is not considered likely to affect MTs experience of the view from the road. The construction of the Scheme itself will result in a temporary Minor Adverse effect on Views from the Road for MTs.

Motorised Travellers - Driver Stress

13.7.2 The additional impact on MTs caused by construction traffic will be partially mitigated by the CTMP. However, Driver Stress is expected to remain high due to the delays caused by existing congestion on the route, and therefore there would be temporary Minor Adverse effect during construction.

Non-Motorised Users

13.7.3 It is not anticipated that there will any significant obstructions to pedestrian and cyclists during construction of the Scheme. Equestrian users crossing Five Mile Lane will be diverted to alternative routes as necessary depending on the stage of the construction activities. Where possible the length of any diversions will be minimised and access will be maintained. Construction is therefore expected to result in No Change to the NMU routes identified.

Operation

Motorised Travellers - Views from the Road

13.7.4 Although the views of MTs will change, the level of openness will remain similar to existing conditions and the landscape will remain predominantly rural, with intermittent views of the gently undulating countryside along the majority of the Scheme. The new alignment will be straighter than the existing Five Mile Lane, which will act to improve forward visibility along the route. As a result, the effect on the Views from the Road for MTs is expected to be Minor Beneficial.

Motorised Travellers - Driver Stress

13.7.5 The lengths of delays currently experienced by MTs are expected to reduce significantly once the Scheme is operational. In addition, the route for MTs travelling to the St Athan and Cardiff Airport Enterprise Zones will be clearer, reducing the route uncertainty currently experienced. This suggests that stress levels for MTs will reduce significantly, having a Major Beneficial effect on driver stress.

Non-Motorised Users

13.7.6 The Scheme will incorporate new pedestrian and cycle routes that open access to NMUs. The sections of Five Mile Lane that will be retained for local access will, subject to completion of a safety review, serve a dual purpose as a pedestrian and cycleway for NMUs. These sections will link with the new pedestrian and cycle routes that are being provided by the Scheme to provide a safe route option for NMUs between the A48 at Sycamore Cross and Waycock Cross. The new NMU (pedestrian

and cycle) routes provided along the length of the Scheme will provide new links between villages such as Walterstone, Moulton and Dyffryn and Barry.

13.7.7 The bridleway linking the existing Five Mile Lane with the proposed accommodation bridge at Sutton Fach Farm will mitigate any potential adverse impacts on equestrian users. The accommodation bridge will also provide a safer alternative for equestrian users crossing the road.

13.7.8 There will subsequently be a Major Beneficial effect on NMUs.

13.8 Cumulative Effects

13.8.1 The proposed developments in the vicinity of the Scheme (as illustrated on Figure 16.1) are generally residential developments and photovoltaic arrays.

Construction

Motorised Travellers - Views from the Road

13.8.2 During construction, the new section of the Scheme will not be accessible to MTs, and consequently, traffic will continue to use existing routes. No cumulative effects have been identified. There will be No Change to the View from the Road.

Motorised Travellers - Driver Stress

13.8.3 Construction of the Scheme will take place concurrently with the construction of the housing and employment development that is planned elsewhere within the Vale of Glamorgan. However, the growth in traffic that is expected to be associated with this development has been considered as part of the Transport Assessment and no further cumulative effects are anticipated. There will be No Change to Driver Stress.

Non-Motorised Users

13.8.4 No cumulative effects on NMUs due to concurrent construction of nearby developments have been identified. There is consequently expected to be No Change to cumulative effects on NMUs.

Operation

Motorised Travellers - Views from the Road

13.8.5 Potential future development which is adjacent to the Scheme is expected to restrict distant views from the Road. Cumulative effects on MTs are considered to be Minor Adverse.

Motorised Travellers - Driver Stress

13.8.6 The TA, which is the basis for the assessment of Driver Stress, incorporates the traffic growth that is expected to be associated with nearby development. The significance of the beneficial impact that is expected to be associated with the Scheme will not be reduced by the anticipated housing and employment growth within the region. There is consequently expected to be No Change to cumulative effects on NMUs.

Non-Motorised Users

13.8.7 The development of the Scheme will create a range of new routes for NMUs, including on and off road cycleways / footpaths and bridleways. These routes will benefit residents and businesses located within future development located in proximity to the Scheme, or in nearby villages. The cumulative effect for NMUs accessing development in these villages using the proposed cycle path and footpath is expected to be Moderate Beneficial.

13.9 Summary & Conclusions

13.9.1 The significance of the impacts on NMUs, and MTs are summarised and concluded in Table 13.9. This summary brings together the assessments of the various impacts and presents them in a single table. The Scheme will deliver improvements for both NMUs and MTs. NMUs are expected to benefit from the provision of safer segregated cycle paths / footpaths and bridleways, and also from access to the existing Five Mile Lane alignment. MTs are expected to benefit from reduced congestion and delays, and also from safety measures which are expected to reduce accidents on the route. These improvements are expected to encourage NMU transport between neighbouring rural communities.

Table 13.9: Summary of Effects on All Travellers Impacts

Potential Impacts	Nature of Impact	Predicted Effects (without Mitigation)	Mitigation Measures	Residual Effects (with Mitigation)
Construction				
MTs: View from the Road	The extent to which MTs are exposed to the different types and qualities of scenery along the route section	Minor Adverse	Open views to be maintained, temporary signs to be sited appropriately (not obstructing the view)	Minor Adverse
MTs: Driver Stress	The adverse mental and physiological effects experienced by a driver traversing the road network	Minor Adverse	Traffic management to be minimised and simplified	Minor Adverse
NMUs	The changes in journey lengths/times and the effect on the amenity value of Non-Motorised User journeys	Minor Adverse	Temporary diversions to ensure safe access is maintained	No Change
Operation				
MTs: View from the Road	The extent to which MTs are exposed to the different types and qualities of scenery along the route section	Minor Beneficial	None	Minor Beneficial
MTs: Driver Stress	The adverse mental and physiological effects experienced by a driver traversing the road network	Major Beneficial	None	Major Beneficial
NMUs	The changes in journey lengths/times and the effect on the amenity value of Non-Motorised User journeys	Major Beneficial	None	Major Beneficial

14 COMMUNITY & PRIVATE ASSETS

14.1 Introduction

14.1.1 This section adopts the DMRB heading of "Communities and Private Assets" as it appears in Interim Advice Note (IAN) 125/09(W). It combines the published Land Use guidance within DMRB 11.3.6 (incorporating Amendment No.1 dated August 2001), with the Community Effects component of DMRB 11.3.8.

14.1.2 This Simple Assessment considers the potential impact of the Scheme on:

- Temporary and permanent land take from private, community, agricultural and development land assets; and
- Community severance, defined as the separation of residents from facilities and services within their community. Severance between communities is considered in Chapter 13: Effects on All Travellers.

14.2 Legislative & Policy Context

14.2.1 This section summarises the relevant national, regional and local regulatory and policy framework.

National Legislation & Policy

Planning Policy Wales Edition 8 (PPW) (2016)

14.2.2 PPW outlines the land use planning polices of the Welsh Government (WG) and is supplemented by a series of Technical Advice Notes (TANs). PPW contains a schedule of objectives for planning policies, decisions and proposals, and requires that these should:

"Contribute to the protection and improvement of the environment, so as to improve the quality of life, and protect local and global ecosystems. In particular, planning should seek to ensure that development does not produce irreversible harmful effects on the natural environment and support measures that allow the natural heritage to adapt to the effects of climate change. The conservation and enhancement of statutorily designated areas and of the countryside and undeveloped coast; the conservation of biodiversity, habitats, and landscapes; the conservation of the best and most versatile agricultural land; and enhancement of the urban environment all need to be promoted (4.10, 4.11.10, Chapters 5 and 13)…

"…Foster improvements to transport facilities and services which maintain or improve accessibility to services and facilities, secure employment, economic and environmental objectives, and improve safety and amenity. In general, developments likely to support the achievement of an integrated transport system should be encouraged (Section 4.7 and Chapter 8)."

14.2.3 Later, in Chapter 8, PPW states that land use planning should help achieve the WG's objectives by:

"…ensuring that, as far as possible, transport infrastructure does not contribute to land take, urban sprawl or neighbourhood severance."

Vale of Glamorgan Adopted Unitary Development Plan (UDP) (1996 - 2011), 2005

14.2.4 The UDP was adopted in 2006 and remains the adopted local planning policy framework for Vale of Glamorgan Council, until its policies are replaced by adopted planning policies within the emerging Vale of Glamorgan Local Plan.

14.2.5 Table 14.1 outlines those saved UDP policies that directly relate to Community and Private Assets.

Table 14.1: UDP Policies that Relate to Community and Private Assets

Policy	Description
1 - The Environment	The Vale of Glamorgan's distinctive rural, urban and coastal character will be protected and enhanced, particular emphasis will be given to conserving areas of importance for landscape, ecology and wildlife, the best and most versatile agricultural land and important features of the built heritage. Proposals which enhance these areas will be favoured.
Env 2 - Agricultural Land	The Best and Most Versatile Agricultural Land (Grades 1, 2 and 3a) will be protected from irreversible development, save where overriding need can be demonstrated. Non-agricultural land or land of a lower quality should be used when development is proposed, unless such land has a statutory landscape, nature conservation, historic or archaeological designation which outweighs agricultural considerations.

Draft Vale of Glamorgan Local Development Plan (LDP), 2013

14.2.6 The Draft Local Development Plan (LDP) is currently being amended following an additional site selection process, and is due to be submitted to the Welsh Government for inspection in 2015. The Draft LDP contains the following objectives, which relate to Community and Private Assets:

Objective 1: To sustain and further the development of sustainable communities within the Vale of Glamorgan, providing opportunities for living, learning, working and socialising for all.

Objective 5: To maintain, enhance and promote community facilities and services in the Vale of Glamorgan.

Objective 10: To ensure that development within the Vale of Glamorgan uses land effectively and efficiently and to promote the sustainable use and management of natural resources.

14.2.7 The draft policies provided in the Draft LDP will provide a strong indication of the policies that will be adopted once the plan is finalised. Table 14.2 outlines those Draft LDP policies that relate to Community and Private Assets.

Table 14.2: Draft LDP Policies that Relate to Community and Private Assets

Policy	Description
MD1 - Design of new development	Development proposals will be permitted where: 6. They promote the creation of healthy and active environments and reduce the opportunity for crime and anti-social behaviour; 7. They provide a safe and accessible environment for all users, giving priority to pedestrians, cyclists and public transport users; 9. They would have no unacceptable impact on highway safety and would not cause or exacerbate existing traffic congestion.
MD1 - Location of new development	To ensure that new development on unallocated sites assists in delivering the strategy, development will be favoured where it: 1. Has no unacceptable impact on the countryside; 2. Reinforces the role and function of the key settlement of Barry, the service centres settlements, primary settlements and minor rural settlements as key providers of commercial, community and healthcare facilities; 3. Promotes new enterprises, tourism, leisure and community facilities in the rural Vale of Glamorgan; 4. In the case of residential development, supports the delivery of affordable housing in areas of identified need; 5. Has access to or will promote the use of sustainable modes of transport; 6. Will benefit from existing infrastructure provision or where new infrastructure can be provided without any unacceptable effect on the natural or built environment; 7. Promotes sustainable construction and makes beneficial use of previously developed land and buildings; 8. Provides a positive context for the management of the water environment by minimising or avoiding areas of flood risk and safeguards resources; and 9. Does not have an unacceptable impact on green wedges, sites of importance for nature conservation, special landscape areas and / or the Glamorgan Heritage Coast.
MG16 - Transport proposals	<u>Walking and cycling</u> 1. National cycle network route 88 and associated local urban and rural connections <u>Highways</u> 14. Northern access road (St Athan Enterprise Zone) 16. Improvements to the A4226 between Waycock Cross, Barry and Sycamore cross, A48 (Five Mile Lane) <u>Highway improvement works</u> In addition, to mitigate the impact of development on the highway network, highway improvement works in the form of corridor or junction improvement schemes will be required.
SP7 - Transportation	Sustainable transport improvements that serve the economic, social and environmental needs of the Vale of Glamorgan and promote the objectives of the South East Wales Regional Transport Plan will be favoured. Key priorities for the delivery of strategic transportation infrastructure will be: 3. Improvements to the A4226 between Waycock Cross, Barry and Sycamore Cross, A48 (Five Mile Lane); Priority will also be given to schemes that improve highway safety and accessibility, public transport, walking and cycling.

14.3 Assessment Methodology

14.3.1 The assessment examines the potential impacts of the Scheme on existing and future community and private assets. It will address the following:

- Demolition of private property and associated land-take;
- Loss of land used by the community;
- Effects on development land;
- Effects on agricultural land; and
- Effects of severance within communities.

14.3.2 The methodology followed to assess each of these community and private assets has been derived through consideration of the general environmental impact assessment methodology described in DMRB 11.2.5, the specific land use impact assessment methodology described in DMRB 11.3.6 Amendment No.1 and the community severance impact assessment methodology described in DMRB 11.3.8. The need to consider Waterway Restoration Projects (as required by DMRB 11.3.6) has been scoped out of this assessment.

Study Area

14.3.3 The study area for 'private assets' consists of those temporary and permanent land parcels potentially required to accommodate infrastructure associated with the Scheme.

14.3.4 The study area for 'community' is extended to include those communities that may be directly affected by the Scheme, for example through severance or loss of community facilities.

14.3.5 Therefore the study area for this chapter is defined by the red line boundary in Figure 3.1.

Demolition of Private Property and Associated Land-take

14.3.6 In accordance with DMRB 11.3.6, paragraph 2.7, private property has been considered to include any property at risk of demolition or land-take that does not accommodate public open space or any other community facility or asset. It can be residential, commercial (including farming) or industrial land. The exact number of properties at risk of demolition or land-take has been calculated through the Land Referencing process undertaken for the Scheme for each of these categories.

Loss of Land Used by the Community

14.3.7 In accordance with DMRB guidance, community land has been considered to be any area used by the community including Common Land, Town or Village Green, Fuel and Field Garden Allotments and Public Open Space, or other facility such as a school, hospital, library or recreational centre that is relied upon for community health and well-being. The assessment requires an estimate of the likely land take from land used by the public. Where land take is likely to occur, information should be obtained regarding the number of users, either through consultation with the Local Authority, or completion of a site visit to undertake a formal count. A desktop study should also be undertaken to determine any cultural associations of the land in question. If land-take

is required on public open space, any land in the vicinity of the Scheme that could be offered as exchange land, should be identified.

Effects on Development Land

14.3.8 In accordance with DMRB guidance, development land has been considered to be land that has been designated within the Local Plan for certain development purposes, or for which planning permission has been granted or is pending. The assessment requires an estimate of the effects that the Scheme is likely to have on land that has been designated for development within the Vale of Glamorgan's Adopted UDP or Draft LDP. The Scheme's effects on other developments within the Vale of Glamorgan are also discussed in detail within Chapter 16: Cumulative Effects.

Effects on Agricultural Land

14.3.9 Agricultural land has been classified by the Ministry for Agriculture, Fisheries and Food (MAFF) (now Defra) by grade according to the extent to which it's chemical and physical characteristics impose long term limitations on agricultural use for food production. In accordance with DMRB guidance, only land potentially falling within Agricultural Land Classification (ALC) grades 1, 2 and 3a, is considered to be "Best and Most Versatile" (BMV). BMV land is best suited to adapting to the changing needs of agriculture and maintaining the competitiveness of UK agriculture against international competitors. In Wales, land in sub-grade 3b and grades 4 and 5 is of lesser importance in agricultural terms, except in areas where particular agricultural practices themselves contribute to the quality of the environment or to the rural economy in some special way.

14.3.10 DMRB 11.3.6 requires an agricultural impact assessment for schemes where over 20 ha of land take on BMV agricultural land (i.e. Grades 1, 2, 3a) is proposed. In these instances, the assessment is required to cover the following:

- The type of husbandry currently employed in the vicinity of the Scheme;
- The value and amount of agricultural land that the Scheme is likely to take. This includes land that will be taken directly by the Scheme and land that will no longer be viable for agricultural use as a result of the Scheme (e.g. loss of productivity through severance);
- The likely impacts of severance arising from the Scheme; and
- The likely impacts of major accommodation works for access, drainage and water supply.

14.3.11 For the purposes of this assessment, land take includes all areas proposed to be used for construction (including major accommodation works for access, drainage and water supply) and the operational footprint of the Scheme.

Community Severance

14.3.12 Community severance is defined as the separation of residents from the facilities and services that they use within their community as a result of the Scheme. The nearest communities to the Scheme are the suburbs of Barry and Colcot immediately to the south and south-east of Wycock Cross Roundabout, the hamlet of Dyffryn approximately 1.5 km to the east, and, Moulton and Walterson approximately 0.5km and 1km to the west respectively. The villages of Bonvilston and St Nicholas are located to the north, approximately 0.5km west and 1.2km east of Sycamore Cross junction respectively (see Figure 2.1).

14.3.13 The Scheme will not directly bisect any of these communities. Furthermore, the design of the Scheme provides for continued and indeed improved access to community facilities within the study area through the provision of cycleways, footways and bridleways and through the provision of an accommodation bridge over the Scheme. As such, community severance *within* communities is not considered further in this assessment. Chapter 13: Effects on All Travellers considers access *between* communities and the wider area.

Value (Sensitivity) Criteria

14.3.14 The values (or sensitivity) of community and private assets potentially affected by the Scheme were determined with consideration to DMRB 11.2.5 (Section 2.4, Table 2.1). The criteria that have been used to determine each value (or sensitivity) category for assessment are outlined in Table 14.3.

Table 14.3: Criteria for Value (Sensitivity) of Community and Private Assets

Asset	Value	Assessment criteria
Private property	High	Currently occupied dwellings and associated land. Buildings and associated land housing a business currently in use and which is essential to the day-to-day running of that business.
	Medium	Dwellings and associated land not permanently occupied. Buildings and associated land housing a business not currently in use or which is not essential to the day-to-day running of that business.
	Low	Dwellings or other buildings and associated lands that is derelict.
Community land	High	Buildings and/or land that the public have the right to access and which is frequently used by the community.
	Medium	Buildings and/or land that the public have the right to access and which is infrequently used by the community.
	Low	Buildings and/or land that the public have the right to access and which is seldom used by the community.
Development land	High	A site designated for development within the Vale of Glamorgan's Local Plan, where planning permission has been granted to develop.
	Medium	A site designated for development within the Vale of Glamorgan's development plan, but where no proposals to develop have currently been made.
	Low	Land that could potentially be considered for future development but is not designated within the Vale of Glamorgan's Local Plan.
Agricultural land	High	Grade 1(excellent quality) and Grade 2 (very good quality) agricultural land.
	Medium	Grade 3a (good quality) agricultural land.
	Low	Grades 3b, 4 and 5 agricultural land.

Magnitude of Impact

14.3.15 The magnitude of impact on community and private assets can be assessed quantitatively by identifying the number of properties affected, the area of land take likely to be required from those assets, and consideration of whether construction or operation of the Scheme is likely to jeopardise the viability of existing businesses, community facilities or future developments. The magnitude of impact is also determined by assessing the part of an asset lost to the Scheme, the subsequent impact on the quality of the asset, and its future viability or continued use. On this basis, a combination of quantitative and qualitative assessment has been used to determine the magnitude of impact, expressed as either Major, Moderate, Minor, Negligible or No Change, in accordance with DMRB 11.2.5 (see Section 2.5, Table 2.2 Magnitude of Impact and Typical Descriptors). The criteria that have been used to assess the magnitude of impacts on private property, and agricultural, community, and development land are outlined in Table 14.4.

Significance of Effects

14.3.16 Having established both the value (or sensitivity) of affected assets and the magnitude of impact resulting from the Scheme, the significance of effects on each asset was determined following a methodology similar to that described in DMRB 11.2.5 (see Section 2.7, Table 2.4 Arriving at the Significance of Effect Categories). The matrix used to determine the significance of effects on community and private assets from the Scheme is shown below in Table 14.5.

Assumptions and Limitations

14.3.17 There is no specific guidance that has been published with regard to assigning magnitude of impact and receptor value (or sensitivity) for effects on community and private assets. The criteria on which this assessment is based (as described above) have been developed generally in accordance with those outlined in DMRB 11.2.5. The minor modifications to these criteria include the grouping of value (or sensitivity) criteria into either 'Low', 'Medium' or 'High' categories, as opposed to the five categories outlined in the Guideline (i.e. 'Very High', 'High', 'Medium', 'Low', 'Negligible'). This reduction in the number of criteria has been made to simplify the definitions of specific community and private assets under each category.

14.3.18 The community asset value of areas of open space potentially affected by the Scheme has been assigned on the basis of site observations and information from desktop research.

14.3.19 BMV agricultural land (i.e. grades 1, 2 & 3a on MAFF's 1988 Agricultural Land Classification system) is considered to be a finite national resource that is given special consideration in national policy. It is also considered to be of higher sensitivity than Grade 3b, 4 and 5 agricultural land. The actual sensitivity category assigned will vary regionally. In areas where BMV land is not uncommon, Grade 1 and 2 land can be considered to be of high sensitivity, sub-Grade 3a of medium sensitivity, sub-Grade 3b and Grades 4 and 5 of low sensitivity. In areas with little BMV land, sub-Grade 3a might be of high sensitivity and sub-grade 3b of moderate sensitivity. The sensitivity criteria adopted for this assessment (as outlined above in Table 14.2) have been based on a desktop review of the regional abundance of BMV in the Vale of Glamorgan.

Table 14.4: Criteria for Assessing Magnitude of Impacts on Community and Private Assets

Asset	Magnitude of Impact (Adverse)	Assessment Criteria
Private property	Major	Dwellings would be demolished, become uninhabitable and inaccessible or lose more than 50% of their garden land. The viability of a business is threatened due to land take.
	Moderate	A property would suffer permanent negative impact from the loss of between 10 and 50% of their garden land, but no dwellings would be demolished. The viability of a business is not threatened, but significant changes may be experienced in its day-to-day running and/or its size and scale.
	Minor	A property would suffer a minor loss of garden land (less than 10%), but no dwellings would be demolished. The viability of a business using the land is not threatened and land-take involves only the acquisition of redundant or infrequently used land or buildings not essential to the running of the business.
	Negligible	A property would suffer a very minor loss of garden land (less than 1%), but no dwellings would be demolished. The viability of a business is not threatened and land-take is negligible.
	No Change	A property would lose none of their garden land and no dwellings would be demolished. There would be no land-take or impacts on businesses.
Community land	Major	A significant proportion of the land or buildings used by the community are threatened due to land take.
	Moderate	A moderate proportion of land used by the community would be threatened due to land take.
	Minor	A minor proportion of land or buildings used by the community would be threatened due to land take.
	Negligible	The viability of a business, community facility or future development within the Vale of Glamorgan's development plan is not threatened and land-take is negligible.
	No Change	There would be no land-take or impacts on businesses, community facilities or land designated for future development within the Vale of Glamorgan's development plan.
Development land	Major	The viability of a site designated for future development is threatened due to land take.
	Moderate	A site designated for development within the Vale of Glamorgan's Local Plan is still viable, but the developable area is reduced by between 25 and 50%.

Table 14.4: Criteria for Assessing Magnitude of Impacts on Community and Private Assets

Asset	Magnitude of Impact (Adverse)	Assessment Criteria
	Minor	A site designated for development within the Vale of Glamorgan's Local Plan is still viable, but the developable area is reduced by 25% or less.
	Negligible	The viability of a future development within the Vale of Glamorgan's Local Plan is not threatened and land-take is negligible.
	No Change	There would be no land take or impact on the viability of a future development within the Vale of Glamorgan's Local Plan.
Agricultural land	Major	The Scheme would result in the loss of more than 20ha of BMV land (grades 1, 2 or 3a). The Scheme would render a full-time agricultural business unviable.
	Moderate	The Scheme would result in the loss of between 5 and 20 ha of BMV land (grades 1, 2 or 3a). The Scheme would impact a full-time agricultural business such that significant changes in the day-to-day management would be required.
	Minor	The Scheme would result in the loss of less than 5 ha of BMV land (grades 1, 2 or 3a). Land take for the Scheme would result in only minor changes to the day-to-day management of a full-time agricultural business or result in a significant impact on a part-time agricultural business.
	Negligible	There would be no direct impact on BMV land (grades 1, 2 or 3a). Land take for the Scheme would result in only negligible changes to an agricultural business.
	No Change	There would be no agricultural land take or impacts to an agricultural business.

Table 14.5: Matrix Used to Determine Significance of Effects on Private Property, Agricultural, Community and Development Land

		Magnitude of Impact (Adverse)				
Value (Sensitivity)		No change	Negligible	Minor	Moderate	Major
	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

14.4 Baseline Conditions

14.4.1 In total the Scheme requires approximately 415,600m^2 (41.6 ha) of land to construct the Scheme including agricultural land, private property and other land (highway land).

14.4.2 The value (or sensitivity) of agricultural land is described below in Sections 14.4.8 to 14.4.14 and impacts on the SSSI woodland are dealt with separately in Chapter 9: Nature Conservation. All land take will be associated with the works along Five Mile Lane. No land take is proposed at the Sycamore Cross junction as the works will be contained with the existing Highway Boundary.

Private Property

14.4.3 There are a number of dwellings and private businesses in the vicinity of the Scheme. Three properties will be directly impacted by the Scheme including the Welsh Hawking Centre, Barry College of Further Education and Northcliffe Cottage.

14.4.4 The property known as the Welsh Hawking Centre is a visitor attraction showcasing birds of prey, located immediately adjacent to the existing Five Mile Lane.

14.4.5 Barry College of Further Education is a site owned by the Cardiff and Vale College of Further Education located to the east of File Mile Lane which is accessed by its own private access road.

14.4.6 Northcliffe Cottage is a private dwelling with an adjacent enclosed garden and a large field used for pasture located between Five Mile Lane and unclassified road leading from Five Mile Lane to Dyffryn.

14.4.7 The location and extent of these properties relative the Scheme is shown in Figure 3.1.

Agricultural Land

14.4.8 According to the Vale of Glamorgan Local Development Plan (Deposit Plan, November 2013) 85% of the Vale of Glamorgan is agricultural land, which primarily comprises improved sheep-grazed pasture and arable land separated by well

managed native hedgerows and scattered trees. The Scheme is located within this agricultural setting.

Community Land

14.4.9 A review of the Vale of Glamorgan's Background Paper on Open Space (Vale of Glamorgan, September 2013) has confirmed that there is no common land, village greens, allotments or public open space within 1km of the Scheme.

14.4.10 There is one community facility approximately 400m west of the Scheme known as the Amelia Methodist Trust Farm (or Whitton Rosser Farm). The location and extent of this facility relative the Scheme is shown on Figure 3.1.

14.4.11 The Amelia Methodist Trust Farm is a volunteer charity that supports adults within learning difficulties and disadvantaged young people. It is open to the public with no admission charge. The entrance to the Farm is located immediately adjacent to the northernmost intersection proposed under the Scheme at Ch650, which will provide access from the existing Five Mile Lane to the new highway alignment.

14.4.12 There are no existing cycle paths, or cycling facilities anywhere in the study area.

Development Land

14.4.13 There are no proposed employment or housing sites allocated in the Vale of Glamorgan UDP (2006-2011) or Draft LDP (2013) within the area affected by the Scheme.

14.4.14 Committed developments and proposed growth in the Vale of Glamorgan is discussed in Chapter 16: Cumulative Effects. Committed and proposed developments in proximity to the Scheme that have been considered for the purposes of this assessment are as follows:

- 2014/01205/SC1 - (160m west of Sycamore Cross (located approximately 1 miles to the north of Scheme). Proposed residential development. 60 dwellings to be constructed in 2016. 60 dwellings to be constructed after 2021;
- 2014/00798/FUL - (120m east of the Scheme) 6MW Solar PV array;
- 2014/01103/NMA - (300m west of the Scheme) 8MW Solar Farm covering 19ha;
- 2014/00081/FUL - (50m east of the Scheme) 7MW Solar farm, one electrical substation, seven power inverter stations and other supplementary works;
- 2015/00365/SC1 – (400m south-west of the Scheme) solar photovoltaic array covering a 14ha area.

14.5 Predicted Effects (without Mitigation)

14.5.1 In total the Scheme requires approximately 415,600m^2 (41.6 ha) of land to construct the Scheme. Approximately 311,800m^2 (31.2 ha) of this land would be permanent land take and approximately 103,800m^2 (10.4 ha) required as temporary land take. The type of land required is set out in Table 14.6.

Table 14.6: Permanent and temporary land take required for the Scheme

Land Type	Permanent	Temporary	Total
Agricultural	272,900m^2	100,800m^2	**373,700m^2**
Private (including Commercial)	6,000m^2	200m^2	**6,200m^2**
Other (e.g. Highways etc)	32,900m^2	2,800m^2	**35,700m^2**
Total	**311,800m^2**	**103,800m^2**	**415,600m^2**

Private Property

14.5.2 The total private land required by the Scheme is approximately 6,200m^2 of which 6,000m^2 would be acquired permanently and 200m^2 temporarily acquired.

14.5.3 Approximately 570m^2 of land would be permanently acquired from the Welsh Hawking Centre. The Scheme will involve the widening of the existing road corridor at this location resulting in approximately 570m^2 of land take in the parking area along the south-western boundary of the property. Access to the Welsh Hawking Centre and its car park will be maintained throughout the construction of the Scheme. The loss of part of the car park may result in reduced visitor numbers to the Welsh Hawking Centre. The potential economic loss associated with such an event will be addressed as part of the CPO process for the Scheme. However, the Scheme will also result in improved access by Non-Motorised Users.

14.5.4 As the parking area is considered non-essential to the day-to-day running of the business (see definition in Table 14.3), this receptor has been considered of Medium value. The small (approximately 570m^2) area of land take required along the edge of the parking area of this property will not affect the viability of the business and renders the magnitude of the impact as Minor. When matched with a Medium value for this receptor, the significance of the Scheme's effects on private property have been assessed as Slight Adverse.

14.5.5 Approximately 48m^2 of woodland (part of Middleton Plantation SSSI) including part of the access track leading to Barry College of Further Education will be permanently acquired. Approximately 201m^2 of woodland would be temporarily acquired in the same area. The land is required as part of the road widening and drainage works. Access to the property will be maintained during construction and the small area of land take required at the entrance of this property will not affect the access to the property or viability of the property to function and renders the magnitude of the impact as Negligible. When matched with a Medium value for this receptor, the significance of the Scheme's effects on this property have been assessed as Slight Adverse.

14.5.6 Approximately 5,418m^2 of pasture land would be permanently acquired from Northcliff Cottage. The pasture land includes a hedgerow and is located east of Five Mile Lane and south west of the property. The property and its enclosed garden will not be directly affected by the Scheme. The Scheme would acquire the edge of the field up and including the field / hedgerow boundary owned Northcliff Cottage and would not sterilise any land. The magnitude of impact is considered to be Moderate as the property would suffer permanent negative impact from the loss of between 10 and 50% of their garden land. When match with a High value for this receptor, the significance of the Scheme's effects this property have been assessed as Moderate Adverse.

Agricultural Land

14.5.7 The total agricultural land required by the Scheme is approximately 373,700m^2 (37.4 ha) of which 272,900m^2 (27.3 ha) would be acquired permanently and 100,800m^2 (10.1 ha) would be temporarily.

14.5.8 Correspondence received from Welsh Government (Land, Nature, Forestry Division of Department for Natural Resources) in February 2015 indicated that approximately 3.5 ha of the total area of land take has a moderate probability of being Grade 3 agricultural land, with the balance being Grade 4. Welsh Government did not make the distinction as to whether the Grade 3 land is comprised of sub-Grade 3a or sub-Grade 3b land. For the purposes of this assessment, this area has been assumed to be the more highly valued sub-Grade 3a land (i.e. BMV land). As this area is less than the 20 ha trigger for a detailed agricultural assessment outlined in DMRB 11.3.6, a detailed agricultural assessment has not been undertaken. Nonetheless, as this 3.5 ha area of agricultural land has been assumed as Grade 3a (BMV) agricultural land, it is considered Medium value. Approximately 3.5 ha of Grade 3a BMV land will be subject to permanent land take by the Scheme. This BMV land forms the end portion of two fields and dissects another. The remaining field parcels are all of adequate size such that they will remain viable despite the loss of this area. Therefore this area of BMW Agricultural Land is considered to be of Medium value.

14.5.9 The remaining 33.9 ha is Grade 4 with 10.1 ha of this land only being temporarily acquired and returned to agricultural use following the construction of the Scheme. The remaining 23.8 ha are all of adequate size such that they will remain viable despite the losses to the Scheme. Therefore this area of non-BMW Agricultural Land is considered to be of Low value.

14.5.10 Given the loss of BMV agricultural land is less than 5ha, the magnitude of impact on the BMV Agricultural Land is considered to be Minor. When matched with a Medium value, the significance of the Scheme's effect on agricultural land has been assessed as Slight Adverse.

Community Land

14.5.11 No land take is proposed over any portions of Amelia Methodist Trust Farm. The Scheme will bring a new and improved footway/cycleway which will increase the safety for cyclists and pedestrians. The Scheme's impacts on Public Rights of Way (PRoW) are dealt with separately in Chapter 13: Effects on all Travellers. In summary, due to the enhancements and provision of safe access routes for Non-Motorised Users in the area the connectivity between communities and facilities in the local area has been significantly improved.

14.5.12 Due to the fact that no community land will be taken as a result of the Scheme, the magnitude of the impact from the Scheme is considered to be No Change. When matched with a Low value, the significance of the Scheme's effect on community land has been assessed as Neutral.

Development Land

14.5.13 The Scheme will not involve land take from any of the developments identified in paragraph 14.4.7. Due to the fact that no development land will be taken as a result of the Scheme, the magnitude of the impact on development land is considered to be No Change therefore the significance of the Scheme's effect on development land has been assessed as Neutral.

Other Land

14.5.14 The total Other land required by the Scheme is approximately 35,700m^2 of which 32,900m^2 would be acquired permanently and 2,800m^2 temporarily acquired. This land is currently owned by the Vale of Glamorgan and primarily comprises highway land.

14.6 Mitigation Measures

14.6.1 The extent of the loss of private and agricultural land has been reduced through development of a Scheme alignment that minimises land take and severance on areas of BMV land. A number of alternative routes were considered during the planning stage of the Scheme. The proposed Scheme is regarded the best option in terms of benefits to be gained, so the loss of agricultural land is regarded as unavoidable.

14.7 Residual Effects

14.7.1 There are no additional effects of the Scheme in addition to community and private assets to those assessed in the Predicted Effects section.

14.8 Cumulative Effects

14.8.1 Cumulative effects on community and private assets are anticipated from the Scheme's impacts on agricultural land in combination with the loss of agricultural land from the surrounding solar farms and housing development project. However due to the extent of agricultural land loss relative to the total available area of agricultural land in the wider area surrounding the Scheme, these impacts are expected to be relatively minor.

14.9 Summary & Conclusions

14.9.1 In total the Scheme requires approximately 415,600m^2 (41.6 ha) of land to construct the Scheme. Approximately 311,800m^2 (31.2 ha) of this land would be permanent land take and approximately 103,800m^2 (10.4 ha) required as temporary land take.

14.9.2 The Scheme will require approximately 37.4 ha of agricultural land. 27.3 ha would be acquired permanently and 10.1 ha would be temporarily and return to agricultural use after the Scheme has been constructed. 3.5 ha of the permanently acquired land is considered Grade 3a (BMV agricultural land). This will result in a Slight Adverse effects to agricultural land. This land loss is considered unavoidable given the benefits of the Scheme.

14.9.3 The Scheme requires approximately 5,418m^2 of pasture land permanently from Northcliff Cottage, which will result in a Moderate Adverse effect on this property. The Scheme requires approximately 570m^2 of permanent land take from the parking area of the Welsh Hawking Centre and 48m^2 of permanent land take and 201m^2 of temporary land take from the access track to Barry College of Further Education. This will result in a Slight Adverse effect on these properties.

14.9.4 The will also permanently require 32,900m^2 and temporarily acquire 2,800m^2 of highway land currently owned by the Vale of Glamorgan.

14.9.5 No changes are expected on community land or development land from the Scheme having a Neutral effect.

14.9.6 The significance of the impacts on community and private assets are summarised and concluded in Table 14.7. This summary brings together the assessments of the various impacts and presents them in a single table.

Table 14.7 Summary of impacts to Community and Private Assets

Potential impacts	Value (Sensitivity)	Magnitude of potential impact	Predict Effects (without mitigation)	Mitigation measures	Residual Effects (with Mitigation
Construction and Operation					
Private Property land take – Northcliff Cottage	High	Moderate	Moderate Adverse	N/a	Moderate Adverse
Private Property land take – Welsh Hawking Centre & Barry College of Further Education	Medium	Minor	Slight Adverse	N/a	Slight Adverse
Agricultural Land loss of viability/land take	Medium	Minor	Slight Adverse	N/a	Slight Adverse
Community Land loss of viability/land take	Low	No Change	Neutral	N/a	Neutral
Development Land loss of viability/land take	Low	No Change	Neutral	N/a	Neutral

15 ROAD DRAINAGE & THE WATER ENVIRONMENT

15.1 Introduction

15.1.1 This chapter provides an assessment of the potential hydrological effects that the Scheme may have on the surrounding area and assesses the potential implications of any such hydrological effects on the Scheme. The assessment includes a summary of the current local conditions and, where appropriate, identifies mitigation measures for any significant effects that may arise as part of the Scheme.

15.1.2 The aspects of the water environment considered within this chapter include surface water features, flood risk, surface water drainage and foul water drainage. Impacts to groundwater associated with the discharge of surface water runoff are assessed in this chapter but impacts to groundwater resources associated with hydrogeology, groundwater flows and the release of contaminants contained in the ground are discussed in Chapter 10: Geology and Soils. Ecological impacts, including sensitive and/or important aquatic species and habitats, are discussed in Chapter 9: Nature Conservation.

15.1.3 The assessment has been conducted in accordance with the response to the Scoping Opinion received from the Vale of Glamorgan Council on 29th August 2014 and Natural Resources Wales (NRW) on 31st October and 15th December 2014. Concerning the water environment, specific issues to be addressed within the ES chapter include management of flood risk arising because of the proposals and reduction of pollution and sediment runoff to watercourses near the site.

15.1.4 A Flood Consequences Assessment (FCA) has also been completed in accordance with the requirements of TAN15. The FCA is provided in Appendix 15.1 of this ES.

15.1.5 A detailed description of the Scheme is provided within Chapter 3: Scheme Description & Development of Alternatives. In summary, it is proposed to:

- Develop the existing road between the A4226 and the A48 by widening an 852m stretch of road from the A4226 in the south through Barry Woods;
- Create 3700m of new road to the east of the existing Five Mile Lane between the north of the River Waycock and the south of Blacklands Farm; and
- Alter Sycamore Cross junction, marginally widening the A48 at the junction of the A48 and the A4226 and changing the layout of the road at this location to capitalise on the benefits derived from improvements elsewhere along Five Mile Lane.

15.1.6 The total length of works being undertaken along Five Mile Lane is 4,552m and the width of the single carriageway construction varies along this length as the proposed road goes into cutting or onto an embankment. The post development footprint is 10.10ha and the total increase in impermeable area of the Scheme is 4.33ha. The road widening works at Sycamore Cross Junction are estimated to increase the impermeable area of this junction by approximately 650m^2.

15.1.7 The watercourse locations plan (Figure 15.1) provides an indication of the proposed development area.

15.1.8 The following points summarise the key aspects of the development in relation to the water environment:

- The existing and proposed road passes through areas classified as Zone B and C2 in terms of predicted flood risk;
- The existing road crosses the River Waycock, although noting that no works to this section of road are proposed;
- The existing and proposed road crosses a number of unnamed tributaries of the River Waycock;
- The existing and proposed road passes within close proximity to a number of other water features, including Mouton Brook, Ford Brook and Ffynnon Whitton-mawr;
- Surface water from the proposed road will discharge into the River Waycock, Mouton Brook, Ford Brook and an unnamed tributary to the River Waycock near Blackland Farm via wetlands and balancing ponds;
- Surface water from Sycamore Cross junction will continue to discharge in the same manner as existing.

15.2 Legislative & Policy Context

15.2.1 The management of water resources is governed by a range of legislative guidance set out in international, national and regional policies and plans. This assessment has been prepared whilst taking these plans and policies into account.

15.2.2 Many flood risk and water quality requirements are set at European level, which are then transposed into UK law. The enforcement of flood risk and water quality requirements in Wales is managed by Natural Resources Wales (NRW).

European Legislation & Policy

Water Framework Directive (2000/60/EC)

15.2.3 The overall objective of the Water Framework Directive (WFD) (European Parliament and Council, 2000) is to bring about the effective co-ordination of water environment policy and regulation across Europe. The main aims of the legislation are to ensure that all surface water and groundwater reaches 'good' status (in terms of ecological and chemical quality and water quantity as appropriate), promote sustainable water use, reduce pollution and contribute to the mitigation of flood and droughts.

15.2.4 The WFD also contains provisions for controlling discharges of dangerous substances to surface waters and groundwater and includes a 'List of Priority Substances'. Various substances are listed as either List I or List II substances, with List I substances considered the most harmful to human health and the aquatic environment. The purpose of the directive is to eliminate pollution from List I substances and reduce pollution from List II substances.

Floods Directive (2007/60/EC)

15.2.5 The key objective of the Floods Directive (European Parliament and Council, 2007) is to coordinate the assessment and management of flood risks within Member States. Specifically it requires Member States to assess if all watercourses and coastlines are at risk from flooding, map the flood extents, assets, and humans at risk in these areas, and take adequate and coordinated measures to reduce this flood risk. The directive also reinforces the rights of the public to access this information and to have a say in the planning process.

Groundwater Directive (2006/118/EC)

The Groundwater Directive (European Parliament and Council, 2006) aims to set groundwater quality standards and introduce measures to prevent or limit pollutants entering groundwater, including those listed with the 'List of Priority Substances'. The directive has been developed in response to the requirements of Article 17 of the WFD, specifically the assessment of chemical status of groundwater and objectives to achieve 'good' status.

National Legislation & Policy

Planning Policy Wales Edition 8 (PPW) (2016)

15.2.6 PPW sets outs the land use planning policies of the Welsh Government. In regards to environmental management, PPW states that the Welsh Government's objectives are to:

- Maximise environmental protection for people, natural and cultural resources, property and infrastructure; and
- Prevent or manage pollution and promote good environmental practice.

15.2.7 PPW states that planning authorities should adopt a precautionary approach that avoids the location of development in areas defined as being of flood hazard. This principle should be applied on the basis that climate change is likely to increase the risk of coastal and river flooding, sea levels and rainfall intensity. PPW also instructs local planning authorities to take a strategic approach to flood risk on a catchment wide scale.

15.2.8 PPW considers that that improvement of the quality of water and air is a material consideration in development control. PPW looks to pollution control authorities operating under the Environmental Protection Act (1990) and Water Resources Act (1991) for proper application of these regimes.

Technical Advice Note (TAN) 15 (2004)

15.2.9 PPW is supported by TAN 15 (Welsh Assembly Government, 2004) which considers development and flood risk and is accompanied by a development advice map (DAM) (Welsh Assembly Government, 2015) containing three zones of flood risk. TAN 15 aims to locate new development away from those areas that are at high risk of flooding. Considering the vulnerability of development and the risk of flooding, justification must be given for the chosen location of new development in flood risk areas and the consequences of flooding to a development must be considered in the planning process.

Flood Risk Regulations 2009 and Flood and Water Management Act 2010

15.2.10 The Flood Risk Regulations (Crown Copyright, 2009) transposes the EC Floods Directive into UK law. Specifically, the Flood Risk Regulations places duties on NRW and Lead Local Flood Authority (LLFA) to prepare a Preliminary Flood Risk Assessment, flood risk maps, flood hazard maps and flood risk management plans for areas at significant risk.

15.2.11 The *Flood and Water Management Act 2010* (Crown Copyright, 2010) (FWMA) was prepared following the Pitt Review in 2007 (Pitt, 2008). The Act created the role of the

LLFA (typically the unitary authority or county council, as applicable) to take responsibility for leading the co-ordination of local flood risk management in their areas. The LLFA relevant to the Scheme is the Vale of Glamorgan Council.

15.2.12 The Act also establishes a Sustainable Drainage Systems Approving Body (SAB) within the LLFA to promote, approve and (where appropriate) adopt sustainable drainage systems in new developments and re-developments (predicted to come into force in Wales in 2016).

15.2.13 Together these documents have made significant changes to the way in which flood risks are assessed and managed throughout the UK.

Water Resources Act 1991

15.2.14 *The Water Resources Act 1991* (WRA) (Crown Copyright, 1991) consolidated previous water legislation in respect of both the quality and quantity of water resources and remains the key legislation for the management of water resources in the UK. Under Section 85 of the WRA 1991 it is an offence to cause or knowingly permit polluting matter to enter into "controlled waters", that is rivers, estuaries, coastal waters or groundwater, without permission. Permission is generally obtained as a permit to discharge granted by NRW. NRW sets conditions that may control volumes and concentrations of particular substances or impose broader controls on the nature of the effluent, taking into account any relevant water quality standards from EC Directives.

Pollution Prevention Guidelines (PPGs)

15.2.15 PPGs were previously issued by the Environment Agency (EA) and a number of these guidelines are relevant to design and construction of the Scheme. These PPGs were revoked in December 2015 but no replacement guidance has been issued by the EA. It is therefore considered that the advice contained within the PPGs still constitutes current best practice. In particular, PPG 1 (Environment Agency, 2013) provides practical advice on site drainage, PPG5 (Environment Agency, 2014) provides guidance for works in, near or liable to affect watercourses, and PPG 6 (Environment Agency, 2014) provides guidance on the control of water pollution during construction and demolition stages of works. Compliance with these PPGs will need to be considered as part of the CEMP developed for construction and operational phases of the Scheme.

Local Policy

Vale of Glamorgan Council Local Development Plan

15.2.16 The Local Development Plan (LDP) (Vale of Glamorgan Council, 2013) is the primary documentation referred to by the Council when determining planning applications. There are a number of policies within the LDP which refer to flood risk, surface water disposal and pollution control.

15.2.17 In summary, Policy MD1 states that development will be favoured where it provides a possible context for the management of the water environment by minimising or avoiding areas of flood risk and safeguarding water resources.

15.2.18 Policy MD8 states that development is required to demonstrate that it will not result in unacceptable impact on people, residential amenity, property and/or the natural

environment as a result of pollution of land, surface water, ground water and air or as a result of flood risk and flood consequences.

15.2.19 With a wider view than just the water environment, the Vale of Glamorgan's LDP Strategy is:

"To promote development opportunities in Barry and the South East Zone. The St.Athan area to be a key development opportunity and Cardiff Airport to be a focus for transport and employment investment. Other sustainable settlements to accommodate further housing and associated development"

Recognising that some settlements within the South East Zone and within the Rural Vale are partially affected by flooding as indicated on Map 1, objective 2 of the LDP aims "To ensure that development within the Vale of Glamorgan makes a positive contribution towards reducing the impact of, and mitigating the adverse effects of, climate change".

Other Relevant Documents

Preliminary Flood Risk Assessment (PFRA)

15.2.20 A PFRA for the Vale of Glamorgan (Vale of Glamorgan Council, 2011) has been prepared to satisfy the requirements of the FWMA, which, amongst other requirements, places responsibility on the LLFA for the management of flooding from ordinary watercourses, groundwater, surface water, sewer flooding above normal operating flows and other artificial sources.

15.2.21 The PFRA considers flooding from all sources and concludes that no locally significant flood events, as defined by the Welsh Government, have been recorded within the vicinity of the site, which is the subject of this report.

15.2.22 The PFRA also considers future flooding based on the EA's flood maps for surface water. As defined by the Welsh Government, no locally significant flood events are expected within the vicinity of the site.

Local Flood Risk Management Strategy (LFRMS)

15.2.23 A LFRMS (Vale of Glamorgan Council, 2012) has been prepared by the Vale of Glamorgan Council to satisfy the requirements of the FWMA for LLFAs to assess flood risk and prepare a strategy for the management of that risk.

15.2.24 The LFRMS identifies historical flood events with locally significant harmful consequences. In respect to the site that is the subject of this report, these consequences are defined as events that impact:

- 750m of road (A or B);
- Internationally / nationally environmentally designated sites.

15.2.25 The report provides an overview of the current flood risks in the Vale of Glamorgan and considers the following:

- Fluvial flooding as illustrated on the DAM;
- Surface water flooding as illustrated on the EA's surface water flood map;
- Sewer flooding and artificial sources of flooding

15.2.26 The LFRMS provides a methodology to implement local objectives to realise national objectives for flood and coastal risk management in the Vale of Glamorgan. One of the ways of implementing these is through development control.

Local Flood Risk Management Strategy Volume 2: Strategic Environment Assessment (SEA)

15.2.27 The SEA (Vale of Glamorgan Council, 2012) was prepared to satisfy the requirements of the Strategic Environment Assessment Directive (European Parliament and Council, 2001).

15.2.28 The SEA highlights specific environmental risks in the Vale of Glamorgan and has been reviewed with respect to the site that is the subject of this report.

15.2.29 The limestone aquifers in the area have been highlighted as providing significant short-term groundwater storage but poor long-term storage and poor base flow resulting in natural periods of low flows in rivers.

15.2.30 The ecological status of water bodies is highlighted by the SEA as being important to maintain and enhance water resources and quality in the area.

15.2.31 Likewise, the risks posed to environmentally designated sites, including SSSIs are highlighted as important along with the need to protect these sites.

15.3 Assessment Methodology

Approach

15.3.1 This chapter provides a summary of existing baseline conditions concerning the water environment, and assesses the potential impacts of the Scheme on the baseline water environment. The chapter will also advise on recommended mitigation measures, if required, and summarise any likely residual impacts.

15.3.2 In summary, the approach adopted for this assessment comprises:

- Review of international, national and local legislation, policies and guidelines in relation to water resources, water quality and flood risk.
- Establish baseline conditions on and around the site through discussions with the client and design team, literature review, consultation with relevant authorities, Envirocheck report (December 2013) and site walkover (October 2014).
- Identify sensitive receptors and likely key issues.
- Identify risks to water resources, water quality and flood risk from the Scheme and hence the likely impacts, magnitude of change and significance of impact during both the construction and operational phases.
- Develop mitigation strategies through consultation with the client, design team and relevant authorities.
- Identify opportunities for enhancement of water quality and water management through design and mitigation.
- Identify residual effects and cumulative impacts.

15.3.3 The spatial scope of this assessment encompasses the area within the planning application boundary and features with 0.5km of the site boundary that could be affected by the Scheme.

15.3.4 Note that areas that may be affected by increased flood risk could be greater than 0.5km from the Scheme. The areas that could be significantly affected by development of the site in terms of flood risk are therefore based on judgement of appropriately qualified professionals.

15.3.5 Impacts are also assessed against whether they are permanent, temporary, direct or indirect.

Consultation

15.3.6 Consultation has been undertaken with Vale of Glamorgan Council and NRW to understand the requirements of these two parties in relation to the water environment. Their responses to this consultation outline their requirements for both this ES chapter and the FCA (Appendix 15.1).

15.3.7 A summary of the consultation responses from these parties has been provided in Table 15.1 and copies of their responses are provided in Appendix 15.2.

Table 15.1: Summary of Consultation Responses

Consultee	Date	Summary of Response
Vale of Glamorgan Council	7th July	In their scoping opinion, the Vale of Glamorgan Council noted that if any changes are made to the road at locations that could affect flood storage or conveyance, they should be investigated as part of a FCA. If the EIA concludes that an FCA is to be undertaken, this should include an assessment of water features.
Natural Resources Wales	31st October 2014	NRW confirmed that there is an existing flood risk to the road from the River Waycock. No detailed modelling of the River Waycock exists at this location and any new works to this area and other areas at risk of flooding will need some hydraulic analysis (modelling) to inform the FCA, which can then demonstrate pre and post construction scenarios up to and including the 1 in 1000 (0.1%) year event. It is important to ascertain if there are any increases in flood risk elsewhere in line with TAN 15. The assessment should demonstrate how flood consequences can be managed. A Surface Water assessment should be undertaken, which should include the design of the surface water drainage system. The following information is produced: Demonstrate how the principles of SUDS have been applied to the development identifying what techniques will be used. Set aside land specifically for SUDS. Estimate the discharge rate for the site. Greenfield discharge rates should be sought on Greenfield sites. Estimate the volume of 1 in 100 year attenuation to be provided and what techniques will be used to provide the attenuation. Take into account TAN 15 climate change requirements. Reductions in the peak rates of run-off from the existing site characteristics are required. The maximum discharge rate and

Table 15.1: Summary of Consultation Responses

Consultee	Date	Summary of Response
		provision of attenuation will normally apply to all parts of the road where the existing run-off characteristics are altered by the proposed development. Watercourses near the site have relatively high levels of nutrients including phosphate. Therefore, any additional inputs received from the surrounding land and/or associated with inputs of sediment from the development (i.e. construction) would not be encouraged. Impacts from fuel / oils from heavy plant machinery during construction and once operational also need to be considered for their impacts on water quality. The risk of sediment runoff is likely to be high during the construction phase and adequate provisions will need to be considered in the ES to reduce such risk for whatever discharge method is agreed.
Natural Resources Wales	15th December 2014	Following further consultation and further explanation of the development proposals, NRW provided the following guidance: Based on the information and the justification provided in your [Parson Brinckerhoff] email dated 30 October 2014, no hydraulic modelling of the River Waycock at the location of the new road to the north of the river crossing is required. However if the route does change, modelling may be required, if this is the case please contact us for further advice. In principle the use of SUDS and attenuation storage is acceptable, and NRW appreciates that full detailed design may not be available at early stages of the project. It is advised that full details and any calculations are submitted when they become available.

Methodology

15.3.8 The methodology adopted for the assessment of impacts of the Scheme on the water environment is based on the methodology outlined within the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10: Road Drainage and the Water Environment HD 45/09, November 2009.

15.3.9 In accordance with the DMRB's quantitative methodology, the effects of routine runoff from surface waters and the pollution impacts from accidental spillages will be assessed using the Highways Agency Water Risk Assessment Tool (HAWRAT) for the Scheme. NRW have approved this method of assessment and have agreed that the outputs from the tool can be used in Environmental Impact Assessment. The risk of pollution to groundwater from routine runoff will be quantified using the matrix provided within the same DMRB volume.

15.3.10 A qualitative assessment will be adopted to assess the potential effects of the proposed works to Sycamore Cross junction on the water environment to reflect the scale of the works proposed and the availability of data at the time of completing the assessment.

15.3.11 The level of assessment of impacts, as guided by DMRB methodology, is consequential and progressive. Where a simple assessment identifies that there are likely to be no impacts on the water environment, no further assessment will usually be required.

15.3.12 The DMRB promotes the following approach in reporting the results of an assessment:

- Estimation of the importance of the attribute;
- Estimation of the magnitude of impacts through the results of assessments for each of the areas considered of the impact; and
- Assessment of the significance of the impact based on importance of the attribute and magnitude of the impact.

15.3.13 Guidance for estimating these factors is provided in Table 15.2, Table 15.3 and Table 15.4.

Table 15.2: Estimating the Importance of Water Environment Attributes

Importance	Criteria	Example
Very High	Attribute has a high quality and rarity on regional or national scale	• Water body of very good chemical or biological quality, i.e. Water Framework Directive (WFD) Class 'High'. • Site protected/designed under EC or UK habitat legislation (Special Areas of Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interests (SSSI), Water Protection Zone (WPZ), Ramsar site, species protected by EC legislation. • EC designated Salmonid fishery. • Principle aquifer providing a regionally important resource or supporting site protected under EC and UK habitat legislation. • Source Protection Zone (SPZ) 1. A source used for public or local potable water supply. • Water body of high amenity value, including areas of bathing and where water emersion sports are regularly practised. • Floodplain or defence protecting more than 100 residential properties from flooding. • Areas which must be operational during a flood. With reference to TAN15, these include the emergency services.
High	Attribute has a high quality and rarity on local scale	• Water body of good chemical and biological quality, i.e. WFD Class 'Good' • Species protected under EC or UK habitat legislation • EC designated Cyprinid fishery. • Principle aquifer providing locally important resource or supporting river ecosystem. SPZ 2. A source used for domestic non-potable water supply. • Water body of a moderate amenity value including public parks, boating, non-contact water sports, popular footpaths adjacent to watercourses, or watercourses running through housing developments/town centres. • Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding. • Areas which are highly vulnerable to flooding. With reference to TAN 15, these can include power stations, residential units, educational facilities and waste management sites.

Table 15.2: Estimating the Importance of Water Environment Attributes

Importance	Criteria	Example
Medium	Attribute has a medium quality and rarity on local scale	• Water body of fair chemical or biological quality, i.e. WFD Class 'Moderate'. • Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ 3. • Water body of particular local social/cultural/educational interest. Water body of low amenity value with only casual access, e.g. along a road or bridge in a rural area. • Floodplain or defence protecting 10 or fewer industrial properties from flooding. • Areas which are less vulnerable to flooding. With reference to TAN 15, these can include retail, commercial, general industry, transport and utilities infrastructure.
Low	Attribute has a low quality and rarity on local scale	• Water of poor or bad chemical or biological quality, i.e. WFD Class 'Poor' • Low sensitivity aquatic ecosystem. • Non-Aquifer. • Water body of no amenity value, seldom used for amenity purposes, in a remote or inaccessible area. • Floodplain with limited constraints and a low probability of flooding of residential and industrial properties. • Areas which are considered to be water-compatible. With reference to TAN 15, these can include flood control infrastructure, boatyards and marinas.

Table 15.3: Estimating the Magnitude of Impact

Magnitude	Criteria	Example
Major Adverse	Results in loss of attribute and / or quality and integrity of the attribute	• Loss or extensive change to a fishery / designated Nature Conservation Site. • Loss or extensive change to an aquifer / groundwater supported designated wetlands. • Change to the environmental status/classification of a water feature, including water quality classification. • Changes to site resulting in an increase in discharge/runoff of > 75% with flood/sewerage exceedence potential. • Increase in peak flood level (1% annual probability event) > 100mm. • Loss of flood storage areas.

Table 15.3: Estimating the Magnitude of Impact

Magnitude	Criteria	Example
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	• Partial loss or change to a fishery / designated Nature Conservation Site. Loss in the productivity of a fishery. • Partial loss or change to an aquifer/ groundwater supported designated wetlands. • Pollution of a receiving water body, but insufficient to change the environmental status/classification, including water quality classification. • Changes to site resulting in an increase in discharge/runoff of > 50% with flood/sewerage exceedence potential. • Increase in peak flood level (1% annual probability event) > 50mm.
Minor Adverse	Results in some measurable change in attributes quality or vulnerability	• Potential low risk of some pollution to a surface water or groundwater body, but insufficient to cause loss in quality, fishery productivity or biodiversity. • Changes to site resulting in an increase in discharge/runoff of > 25% with flood/sewerage exceedence potential. • Increase in peak flood level (1% annual probability event) > 10mm.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use of integrity	• The Scheme is unlikely to affect the integrity of the water environment. • No measurable impact upon an aquifer • Negligible change in peak flood level (1% annual probability event) < +/-10mm
Minor Beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring	• Potential for slight reduction in pollution to a surface water or groundwater body, but insufficient to cause noticeable benefit in quality, fishery productivity or biodiversity. • Changes to site resulting in a decrease in discharge/runoff > 25%. • Reduction in peak flood level (1% annual probability event) > 10mm.
Moderate Beneficial	Results in moderate improvement of attribute quality	• Moderate improvement to a fishery / designated Nature Conservation Site. Potential increase in the productivity of a fishery. • Reduced pollution of a receiving water body, but insufficient to change the environmental status/classification, including water quality classification. • Changes to site resulting in a decrease in discharge/runoff > 50%. • Reduction in peak flood level (1% annual probability event) > 50mm.

Table 15.3: Estimating the Magnitude of Impact

Magnitude	Criteria	Example
Major Beneficial	Results in major improvement of attribute quality	• Significant improvement to a fishery / designated Nature Conservation Site. • Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring. • Change to the environmental status/classification of a water feature, including water quality classification. • Changes to site resulting in a decrease in discharge/runoff of > 75%. • Reduction in peak flood level (1% annual probability event) > 100mm.

Table 15.4: Estimating the Significance of Potential Effects

		Magnitude of Impact			
		Negligible	**Minor**	**Moderate**	**Major**
Value	**Very High**	Slight	Moderate or Large	Large or Very Large	Very Large
	High	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
	Medium	Neutral or Slight	Slight	Moderate	Moderate or Large
	Low	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate

Assumptions and Limitations

15.3.14 The local planning authority has been contacted to obtain private water supply records. These have not been obtained prior to the publication of this ES.

15.3.15 The controls imposed through the CEMP is considered a robust approach and suitable for the management of the likely impacts.

15.3.16 Impacts to ecological and groundwater receptors have been addressed within Chapters 9 and 10 respectively, and have not been included within this chapter in any detail.

15.4 Baseline Conditions

15.4.1 This section provides a description of the current baseline conditions with respect to the water environment.

15.4.2 Figure 15.1 identifies the region of the existing Five Mile Lane and Sycamore Cross junction that is proposed to be modified and the key surface water features that have been considered in this assessment.

Site Description and Topography

15.4.3 The total land take required for the Scheme will be 41.5ha, of which approximately 10.10 ha will be required for the post development area (i.e. new road surface and embankments, etc.). This area is generally comprised of existing road and agricultural land.

15.4.4 The southern end of the existing Five Mile Lane has an elevation of c.61m above ordinance datum (AOD). From here the ground falls gently towards residential development to the south of the road and north along the existing road. Approximately 1 km north of the Waycock Cross junction, the existing road has descended into a valley at c.20m AOD where it crosses over the River Waycock. 1km further north along the existing road, the level increases to c.70m AOD. Between this point and the connection with the A48 the existing road gently climbs to the A48 at c.105m AOD. This section of the existing road is generally located along a crest in local elevations with land gently falling away to the east and west. Beyond the northern extents of the Scheme land continues to rise toward the north.

15.4.5 At Sycamore Cross junction, where Five Mile Lane meets the A48, the existing A48 is at a high point and the road level decreases to the east and west. The level of Five Mile Lane also decreases to the south. The minor road to the north of the Sycamore Cross junction increases in level toward the north.

15.4.6 Land to the south of the existing Five Mile Lane is predominantly developed with residential dwellings whilst the rest of the existing road is generally bordered by grassland or woodland with the occasional access to developments on either side.

15.4.7 The existing road passes through the Barry Woodlands SSSI to the south of the River Waycock. Barry Woodlands is a semi-natural broadleaved woodland and is the best example of this habitat in Wales.

15.4.8 Further north, the road passes Nant Whitton Woodlands SSSI, a designated broad-leaved woodland, approximately 1km to the west of the road along the route of the Nant Whitton.

15.4.9 There are an additional 10 non-statutory Sites of Importance for Nature Conservation (SINC) within 500m of the Scheme. Five of these SINCs are classified due to the woodland in the area, three are classified due to the meadows/pastures they contain and two contain ponds that support marginal vegetation and amphibians and suitable breeding habitat for Great Crested Newts respectively. Chapter 9: Nature Conservation of this ES notes that neither of these ponds is directly affected by the development as they are located to the west of the Scheme.

15.4.10 Further information on the SINCs and SSSIs in the area is provided in Chapter 9: Nature Conservation.

Ground Conditions

15.4.11 Review of the British Geological Society (BGS) online geology mapping indicates that bedrock along the existing Five Mile Lane alignment is classified as ‘interbedded limestone and mudstone crossed by narrow bands of mudstone’. At Sycamore Cross junction bedrock is indicated to consist of varying limestone formations.

15.4.12 Along the route of the River Waycock, the bedrock is overlain by superficial deposits of alluvium (clay, silt, sand and gravel). At the very northern end of Five Mile Lane

and at Sycamore Cross junction, superficial deposits are classified as tills. Superficial deposits along the rest of the road alignment are unknown.

15.4.13 The EA's online groundwater maps have been viewed and bedrock is classified as Secondary A or Secondary B aquifer along almost the full length of the existing Five Mile Lane. At the very northern end of Five Mile Lane and at Sycamore Cross junction, the bedrock is classified as principal aquifer.

15.4.14 Superficial alluvial river deposits are classified as Secondary A aquifer. The EA's groundwater vulnerability classifications indicate that the soils on the route of the River Waycock have a high leaching potential whilst soils at the northern end of the road and Sycamore Cross junction have intermediate leaching potential. Other areas along the road are generally classified as having soils of low or intermediate leaching potential.

15.4.15 The EA's classification of the aquifers is illustrated on the water constraints map (Figure 15.2).

15.4.16 There are no Source Protection Zones (SPZ) near the existing Five Mile Lane and Sycamore Cross junction. The nearest SPZ is an area c.3km to the east of Five Mile Lane designated as SPZ1.

15.4.17 A review of Ordinance Survey (OS) mapping indicates that there are multiple springs throughout the area.

Soil Infiltration

15.4.18 Soils have been assessed using the Cranfield University online Soilscapes tool (Cranfield Soil and AgriFood Institute, 2015). This indicates over half of the length of Five Mile Lane lies on loamy and clayey soils, described as slowly permeable and seasonally wet with impeded drainage. Along the route of the River Waycock, soils are described as loamy and clayey floodplain soils with naturally high groundwater. North of the River Waycock and at the most northern end of the road, at Sycamore Cross junction, soils are described as loamy and freely draining.

15.4.19 Soil infiltration tests have not been undertaken but the nature of the soils and the potential for a high groundwater table are assumed at this stage to limit infiltration of surface water to ground along the majority of the road alignment.

15.4.20 A more detailed discussion of the site geology and its implications on the development can be found in Chapter 10: Geology and Soils**.**

Groundwater Features

15.4.21 Permeability testing was undertaken across the site, which indicated groundwater levels across the site. The range of depths to groundwater was between 0.31 to 7.08m bgl. The permeability testing results summary included in Appendix 15.7 illustrates the locations of boreholes and Table 1 of this report details the depth to groundwater at each test location.

15.4.22 There are no Source Protection Zones (SPZ) near the existing Five Mile Lane and Sycamore Cross junction. The nearest SPZ is an area approximately 3km to the east of the Five Mile Lane designated as SPZ1.

15.4.23 A review of Ordinance Survey (OS) mapping indicates that there are multiple springs throughout the area.

15.4.24 Groundwater in the Scheme area is generally believed to flow toward the south.

15.4.25 Groundwater resources have been classified by NRW in accordance with the Groundwater Directive, a daughter directive to the WFD. A summary of this classification is provided in Table 15.5.

Table 15.5: WFD Assessment of Groundwater

Criteria	Assessment
Current Quantitative Quality	Poor
Current Chemical Quality	Good
Upward Chemical Trend	No
2015 Predicted Quantitative Quality	Poor
2015 Predicted Chemical Quality	Good
Overall Risk	At Risk
Protected Area	Yes

15.4.26 A more detailed discussion of groundwater can be found in Chapter 10: Geology & Soils.

Surface Water Features

15.4.27 Along the route of the existing road, there are several surface water bodies, which either cross the road, run adjacent to the road or are in proximity to the road such that they have potential to be affected by surface water runoff or groundwater base flow. A list of these water bodies is provided in Table 15.5 and illustrated on Figure 15.1.

Table 15.6: Surface Water Features within 500m of the Scheme

Name	Type	Location (Easting, Northing)	Approx. Distance from Site (m)	Direction of Flow	Description	Envirocheck Slice (X) & Object Reference (#)[17]
Nant Talwg	Ordinary watercourse	309968 168271	358	NE to SW	An ordinary watercourse to the south of the southern end of existing road.	B25, B28, B30, B38, B39, B50, B49, B48, B34, B32
Tributary of River Waycock flowing north parallel to Five Mile Lane	Ordinary watercourse	309381 168876	6	SE to NW	A tributary of the River Waycock running alongside the A4226, culverted under the entrance to the Hawking Centre at 309077 169221 (A13)	B20, B18, B17, A14, A9, A13, A11, A12, A15, A16
River Waycock	Main River	308883 169419	0	NE to SW	A main river crossing beneath the existing road.	B18, B16, B7, B29, B53, B58
Tributary of River Waycock flowing south and crossing beneath Five Mile Lane	Ordinary watercourse	308693 169512	0	NE to SW	A tributary of the River Waycock, which crosses beneath the existing road.	D24, B38, B36, B20, B21, B26, B28
Moulton Brook	Ordinary watercourse	308040 170868	1	NE to SW	A tributary to the River Waycock via Nant Llancarfan	D6, D47, D46
Ffynnon Whitton-mawr	Pond/Detention Basin	307873 171596	50	-	Vegetated pond/detention basin area.	-
Ford Brook	Main River	307843 171578	0	E to W	Has its source at Ffynnon Whitton-mawr. The tributary then crosses beneath the existing road and flows to a confluence with Moulton Brook west of the road.	D7, D5, D13, D12, D14, D16
Nant Whitton	Ordinary watercourse	307313 172385	341	NE to SW	A tributary of Nant Llancarfan, which flows through a SSSI area of woodland to the west of the road.	D17, D15, D18, D23, D30, D32, D41, D28, D39, D35, D48

Table 15.6: Surface Water Features within 500m of the Scheme

Name	Type	Location (Easting, Northing)	Approx. Distance from Site (m)	Direction of Flow	Description	Envirocheck Slice (X) & Object Reference (#)[17]
Nant Llancarf-an	Main River	305192 170057	1800	N to S	A main river into which Nant Whitton, Ford Brook and Moulton Brook discharge. Discharges to the River Waycock.	-
Tributary of River Waycock flowing around the south side of Blackland Farm	Ordinary watercourse	307856 172618	11	W to E	Tributary of the River Waycock which crosses from east to west beneath the A4226 and continues to the east.	D10, D9, D20, D25, D37, D38, D36, D40
Tributary of River Waycock flowing from the east side of Blackland Farm	Ordinary watercourse	307928 172816	0	W to E	A tributary of the River Waycock, which crosses from west to east beneath the A4226 and continues to the east.	D4
Tributary of River Waycock to the north-east of Blackland Farm	Ordinary watercourse	307827 173429	35	NW to SE	A tributary of the River Waycock in the vicinity of Blackland Farm.	G5, G8, G9, G10, G11, G13
Tributaries of Nant Llancarfan from Redland Wood	Ordinary watercourse	307287 173747	341	NE to SW	Upstream extent of tributary of Nant Llancarfan culverted for approximately 150m before joining additional tributaries prior to discharge.	A7, A8, A9, A10, A12 (Sycamore Cross report)
Offline watercourse north of Sycamore Cross junction	Ordinary watercourse	307414 174203	26	W to E	Unknown offline watercourse running parallel to the A48 from Sycamore Cross junction into an unnamed pond adjacent to the track leading to Cottrell	A13, A14, A15, A16, A17 (Sycamore Cross report)
Golf course ponds	Ponds	307445 174300	161		10 ponds within the golf course	-

Table 15.6: Surface Water Features within 500m of the Scheme

Name	Type	Location (Easting, Northing)	Approx. Distance from Site (m)	Direction of Flow	Description	Envirocheck Slice (X) & Object Reference (#)[17]
Unnamed pond at outfall of watercourse north of Sycamore Cross junction	Pond	307954 174209	266		Pond at outfall of watercourse north of Sycamore Cross with an unknown function	-
Unnamed ponds / detention basins in woodland adjacent to A48	Ponds / detention basins	308020 174165	490		Unknown ponds / detention basins in woodland areas either side of the A48	-

15.4.28 A list of all surface water bodies within 500m of the existing road is provided in Appendix 15.3. For ease of reference, water bodies in both of these tables have been listed in the order in which they occur along the alignment of the road from south to north.

15.4.29 A brief description of these watercourses is provided below in order of watercourse from south to north.

Nant Talwg

15.4.30 Nant Talwg crosses the B4266 south of the roundabout at the southern end of the existing Five Mile Lane (A4226). Its source appears to be located approximately 750m to the east of this roundabout. The watercourse flows toward the south-west where is joins Barry Brook then Whitelands Brook before discharging into the Bristol Channel. The watercourse flows through an area of woodland designated as a SSSI and a local nature reserve.

15.4.31 Downstream of its confluence with Barry Brook, Nant Talwg is classified under the Water Framework Directive (WFD) as having moderate ecological quality, which is not expected to change by 2015. The chemical quality does not require assessment under the WFD and the watercourse is not designated as a Highly Modified Water Body. The watercourse is classified as 'Probably at Risk' and in a protected area.

Tributary of River Waycock flowing north parallel to Five Mile Lane

15.4.32 This unnamed watercourse flows toward the north-west adjacent to Five Mile Lane for approximately 900m before discharging into the River Waycock immediately prior to the River Waycock's crossing under the existing road. Other minor tributaries feed into this watercourse from the north-east of the road. The watercourse is culverted for approximately 40m beneath the entrance to the Hawking Centre off Five Mile Lane.

15.4.33 The watercourse passes through an area of woodland which is designated a SSSI (Barry Woodland). This tributary running through the Barry Woodlands SSSI is a feature adding ecological diversity in the SSSI schedule but it is not key to the site's designation. The watercourse is therefore assessed as being of District Importance within the SSSI. The watercourse is not classified under the WFD.

15.4.34 Figure 15.3 shows a photograph of a typical section along the channel of this watercourse and Figure 15.4 shows its outfall into the River Waycock.

Figure 15.3 Typical section of unnamed watercourse

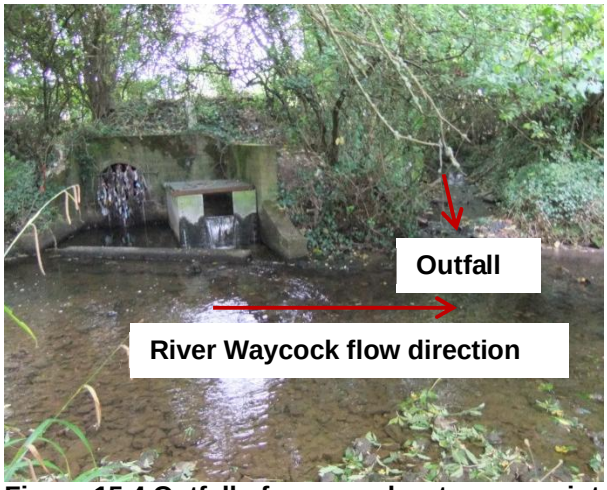


Figure 15.4 Outfall of unnamed watercourse into the River Waycock

River Waycock

15.4.35 The River Waycock is the most significant water body in the immediate vicinity of the Scheme. Its source is near Blackland Farm, adjacent to the existing road. It is fed by multiple tributaries to the west of the existing road. The River Waycock flows south / south-west, from its source, crosses beneath Five Mile Lane and discharges into the Kenson River approximately 4km to the west of the existing Five Mile Lane. The Kenson River discharges into the River Thaw approximately 6km to the west of the existing road just prior to the River Thaw's discharge into the Bristol Channel.

15.4.36 The Waycock River is classified as a main river under the jurisdiction of NRW. It has been assessed under the WFD as having moderate ecological quality, which is not expected to change by 2015. The chemical quality has been assessed as moderate and the watercourse is not designated as a 'Highly Modified Water Body'. The watercourse is classified as 'Probably At Risk' and as being in a protected area.

15.4.37 Table 15.7 summarises the classifications of the River Waycock between 2009 and 2013. The original classification data is provided in Appendix 15.4 of this ES.

Table 15.7: WFD Classifications of the River Waycock between 2009 and 2013

Year	Overall	Ecological	Chemical	Invertebrates	Phosphate	Ammonia	Dissolved Oxygen	pH
2009	Moderate	Moderate	N/A	High	Moderate	High	High	High
2010	Moderate	Moderate	N/A	High	Moderate	High	High	High
2011	Moderate	Moderate	N/A	High	Moderate	High	High	High
2012	Moderate	Moderate	N/A	High	Moderate	High	High	High
2013	Poor	Poor	N/A	High	Moderate	High	High	High

15.4.38 The EA have provided reasons why 'Good' status has not been achieved for this watercourse under the WFD. Crucially, phosphate levels are high due to discharges into the River Waycock and its tributaries from agricultural land and sewage discharges.

15.4.39 The results of the most recent WFD for the River Waycock assessment are highlighted in Table 15.8.

Table 15.8: WFD Assessment of the River Waycock

Criteria	Assessment
Hydromorphological status	Not Designated a Highly Modified Water Body
Current Ecological Quality	Moderate
2015 Predicted Ecological Quality	Moderate
Current Chemical Quality	Moderate*
Overall Risk	At Risk
Protected Area	Yes
Hydromorphological status	Not Designated a Highly Modified Water Body

*Note: * The chemical quality of the watercourse does not require assessment under the WFD but has been provided for information.*

15.4.40 In addition to the WFD assessment provided by the EA, water sampling was undertaken by CC Ground Investigation on the River Waycock where the existing road crosses the river. This was completed in January 2015. The results of the sampling are summarised in Table 15.9 along with the results for other watercourses in the area.

Table 15.9: River Waycock Water Sampling Results

Analytical Parameter (Water Analysis)	Units	Ford Brook at culvert beneath existing road	Nant Whitton at source	Tributary of the River Waycock crossing beneath road at culvert beneath the existing road	Tributary of the River Waycock crossing beneath road at upstream location	River Waycock at crossing beneath existing road
General Inorganics						
Sulphate as SO_4	µg/l	9520	5540	9880	8930	9770
Total Sulphur	µg/l	3200	1800	3300	3000	3300
Chloride	mg/l	8.5	9.8	28	25	20
Total Phenols						
Total Phenols (monohydric)	µg/l	< 10	< 10	< 10	< 10	< 10
Heavy Metals / Metalloids						
Arsenic (dissolved)	µg/l	< 0.15	1.05	0.74	0.33	0.77
Boron (dissolved)	µg/l	22	17	34	34	33
Cadmium (dissolved)	µg/l	0.02	< 0.02	< 0.02	< 0.02	0.02

Analytical Parameter (Water Analysis)	Units	Ford Brook at culvert beneath existing road	Nant Whitton at source	Tributary of the River Waycock crossing beneath road at culvert beneath the existing road	Tributary of the River Waycock crossing beneath road at upstream location	River Waycock at crossing beneath existing road
Chromium (hexavalent)	µg/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.6	2.3	0.6	0.3	0.7
Copper (dissolved)	µg/l	15	15	17	15	14
Lead (dissolved)	µg/l	0.2	1.1	0.3	0.2	0.5
Mercury (dissolved)	µg/l	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	4.3	4.2	5.0	5.0	3.8
Selenium (dissolved)	µg/l	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
Zinc (dissolved)	µg/l	2.4	4.0	3.2	1.3	4.5

15.4.41 Near the location of the crossing of the River Waycock and Five Mile Lane the river valley contains eight areas of woodland known as 'Barry Woods' which have been designated a SSSI. The SSSI is often waterlogged and streams and swamp areas add to the ecological diversity of the woodlands.

15.4.42 Chapter 9: Nature Conservation notes that the River Waycock may be of particular importance for Otters commuting or foraging in the area due to the good population of eels and small fish in the watercourse. The chapter notes the presence of Kingfisher birds and the following fish species:

- Brown Trout, listed as a priority species under the UK Biodiversity Action Plan (BAP);
- Bullhead, which are abundant in the UK; and
- European eel, a critically endangered species.

15.4.43 The River Waycock is classified in Chapter 9 as being of District Importance.

15.4.44 Figures 15.5 to 15.7 show the River Waycock to the north of its crossing beneath Five Mile Lane, at this crossing and downstream of this crossing.

Figure 15.5 River Waycock to the north of Five Mile Lane

Figure 15.6 Five Mile Lane crossing the River Waycock

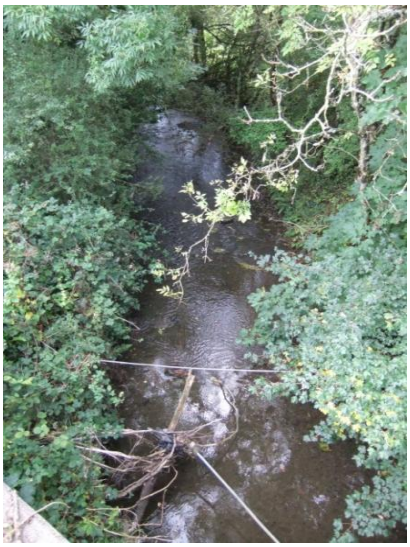


Figure 15.7 River Waycock downstream of Five Mile Lane

Tributary of River Waycock flowing south and crossing beneath Five Mile Lane

15.4.45 An unnamed tributary to the River Waycock crosses beneath Five Mile Lane approximately 300m north of the River Waycock crossing. The watercourse flows adjacent to the road in an artificially straightened channel for approximately 100m before passing through a culvert beneath the road and continuing south to discharge into the River Waycock. The watercourse is not classified under the WFD.

15.4.46 Water sampling has been undertaken on this watercourse at the location of the crossing beneath Five Mile Lane and upstream of this location. The results are provided in Table 15.8, which shows that concentrations of sulphates and some heavy metals are greater adjacent to the road. It is anticipated that pollutant levels, especially heavy metals, are the result of vehicle emission pollutants that are contained in surface water runoff from the carriageway.

Figure 15.8 Unknown tributary to the River Waycock in woodland to the north-east of Five Mile Lane

Figure 15.9 Unknown tributary to the River Waycock adjacent to Five Mile Lane

Figure 15.10 Unknown tributary to the River Waycock to the south-west of Five Mile Lane

Moulton Brook

15.4.47 Moulton Brook is a tributary of Nant Llancarfan which discharges into the River Waycock approximately 3.5km south-west of the source of Moulton Brook. Moulton Brook has its source immediately adjacent to Five Mile Lane and flows away from the road to the south-west.

15.4.48 A site inspection showed Moulton Brook to be small, seasonally wet watercourse. The watercourse is not classified under the WFD.

Figure 15.11 Moulton Brook downstream of Five Mile Lane to the west

Ffynnon Whitton-mawr pond and Ford Brook

15.4.49 A detention area / wetland area known as Ffynnon Whitton-mawr is located approximately 50m to the east of Five Mile Lane as illustrated in Figure 15.2. The heavily vegetated pond is approximately 0.1ha in area and discharges into Ford Brook, which crosses beneath Five Mile Lane through a culvert. Ffynnon Whitton-mawr is shown in Figure 15.12.

15.4.50 Ford Brook flows away from Five Mile Lane toward the south-west before discharging into the Nant Llancarfan (a tributary of the River Waycock) approximately 2km to the west of Five Mile Lane. The watercourse is not classified under the WFD.

15.4.51 Figures 15.12 shows the vegetated area to the west of the A4226 where Ford Brook has its source and Figure 15.13 shows Ford Brook downstream of Five Mile Lane.

Figure 15.12 Fynnon Whitton-mawr downstream of Five Mile Lane

Figure 15.13 Ford Brook downstream of Five Mile Lane

Nant Whitton

15.4.52 Springs approximately 150m to the west of Five Mile Lane and north of Whitton Rosser Farm discharge into Nant Whitton, an ordinary watercourse that flows south-west through an area of woodland designated as a SSSI. The watercourse discharges into Nant Llancarfan, which in turn discharges into the River Waycock. Nant Whitton itself is seasonally dry with no significant marginal or aquatic vegetation.

15.4.53 These springs are approximately 10m below the level of the road at their nearest point. The watercourse is not classified under the WFD.

Nant Llancarfan

15.4.54 Nant Llancarfan is a main river that has its source at springs near Green Down, approximately 1.75km west of Blackland Farm. It is fed by Nant Whitton, Ford Brook and Moulton Brook and discharges into the River Waycock approximately 3.8km south of its source.

15.4.55 The watercourse is classified under the WFD and has good ecological status, which is predicted to remain until 2015. It is not designated a 'Heavily Modified Water Body' and is classified as being 'At Risk' and in a protected area.

Tributary of River Waycock flowing around the south of Blackland Farm

15.4.56 An unnamed tributary of the River Waycock originates approximately 100m to the west of Five Mile Lane near Blackland Farm. This watercourse flows to the south of Blackland Farm and is culverted beneath the existing road before flowing to the east to form the source of the River Waycock. This watercourse is seasonally dry with little or no aquatic vegetation. The watercourse is not classified under the WFD.

Tributary of River Waycock flowing from the east side of Blackland Farm

15.4.57 A tributary to the River Waycock has its source adjacent to Five Mile Lane at the access road adjacent to Blackland Farm. The watercourse flows south along the

western side of Five Mile Lane for approximately 30m before being culverted beneath Five Mile Lane and flowing east away from the road. The watercourse discharges into the River Waycock approximately 500m to the east of Five Mile Lane. The watercourse is not classified under the WFD.

Tributary of River Waycock to the north-east of Blackland Farm

15.4.58 A tributary to the River Waycock has its source approximately 20m to the east of Five Mile Lane with levels falling away from Five Mile Lane toward the watercourse. The watercourse flows toward the south-east before discharging into the River Waycock approximately 650m south-east of the source of the tributary. The watercourse is not classified under the WFD.

Tributaries of Nant Llancarfan from Redland Wood

15.4.59 Two tributaries of Nant Llancarfan have their sources approximately 180m / 380m south of Sycamore Cross junction, near Redland Wood. Topography falls away from Sycamore Cross junction toward the tributaries. The watercourses generally flow south-west where they are culverted for approximately 150m in length before joining additional tributaries that finally discharge into the Nant Llancarfan approximately 1.6km downstream. The tributaries are not classified under the WFD.

Watercourse north of Sycamore Cross junction

15.4.60 An unnamed watercourse runs parallel to the A48 approximately 25m north of the A48 at Sycamore Cross junction. Envirocheck data reviewed for the watercourse lists the watercourse as 'offline drainage' which suggests that this watercourse may not be hydraulically connected to other surface water features within the area.

15.4.61 The ecological site walkover identified this watercourse as a shallow, incomplete dry ditch that flows toward the east adjacent to the A48 for approximately 0.6km. It is considered likely that this watercourse discharges into an unnamed pond/detention basin as discussed below. The watercourse is not classified under the WFD.

Unnamed pond at outfall of watercourse north of Sycamore Cross junction

15.4.62 An unnamed pond is located adjacent to the eastern extents of the unnamed watercourse to the north of Sycamore Cross junction. An outfall from the watercourse to the pond was not visible during the ecological site walkover and no outfall from the pond is known to exist, although it is believed that this pond may form part of the highway drainage system as a detention basin/infiltration basin. The pond is located approximately 260m from Sycamore Cross junction. The pond is not classified under the WFD.

Unnamed ponds adjacent to A48

15.4.63 Two further ponds are located approximately 500m east of Sycamore Cross junction adjacent to the A48 on the north and the south of the road alignment. These ponds may form part of the highway drainage system as detention basins. Ground levels gently fall along the A48 toward these ponds.

15.4.64 The nature and location of the outfalls from these ponds are unknown but the EA's Risk of Flooding from Surface Water map indicates that these ponds may discharge to the upstream extent of the River Waycock south of the A48. The ponds are not classified under the WFD.

Golf course ponds

15.4.65 Ten small ponds are located within a golf course located to the north of the A48 at Sycamore Cross junction. Any inflows/outflows to these ponds are unknown. The ponds are located between 75m and 500m of Sycamore Cross junction.

15.4.66 Ground levels typically fall from the north of the golf course toward the A48 at Sycamore Cross junction in the south and therefore the ponds are likely to be at a slightly higher elevation than the road. The ponds are not classified under the WFD.

Historic Pollution Incidents

15.4.67 Envirocheck data (Appendix 15.3) has also been reviewed to provide any information available on pollution incidents to controlled waters. Within 500m of the Scheme, no unlicensed discharges causing pollution to controlled waters have been recorded more recently than 1996/1997 when diesel, light oil and crude sewage were split to unknown waters. The current impacts of these events on water quality will be negligible.

Surface Water and Groundwater Abstractions

15.4.68 Within 500m of the Scheme, there are two active water abstraction licenses. These are located to the north and west of the northern end of Five Mile Lane respectively as illustrated in Figure 15.2. The latter of these two abstractions is for farming and domestic purposes. It is assumed that domestic purposes include potable water supply. The other abstraction is for agricultural purposes only. Details of these two abstractions are provided in Table 15.10.

Table 15.10: Water Abstraction Licences within 500m of the Scheme

Location (OS Easting and Northings)	Source Type	Use	Estimated Distance from Site (m)	Envirocheck Slice/Object Reference
307420 174400	Groundwater	General Agriculture: Spray Irrigation	226	G3
307100 174100	Groundwater	General Farming and Domestic	312	G4

Existing Drainage Systems

15.4.69 The following existing foul and surface water drainage has been identified within the site and immediate surrounding area:

Public infrastructure

15.4.70 No public drainage infrastructure has been identified along the road alignment. Existing surface water drainage has been identified at Sycamore Cross junction as discussed below.

On-site Surface Water Drainage

15.4.71 Surface water from the existing Five Mile Lane is drained via an over-the-edge system and no formal below ground drainage system is known to exist.

15.4.72 Based on topography, the length of Five Mile Lane being modified has been split into different catchments (referred to as networks). The greenfield rates from each network have been calculated for different return periods and are included in the FCA (Appendix 15.1).

15.4.73 Surface water from Sycamore Cross junction is drained into road gullies which discharge to an unknown location. Based on topography, it is assumed however that surface water flows from Sycamore Cross junction may eventually discharge to enter one or both of Nant Llancarfan and the River Waycock via an unknown upstream networks of pipes and/or watercourses.

Discharge Consents

15.4.74 A number of active discharge consents exist within 500m of Five Mile Lane and Sycamore Cross junction as illustrated on Figure 15.2. These have been listed in Table 15.11. All have potential to impact the groundwater resources and watercourses discussed above.

Table 15.11: Active Discharge Consents within 500m of the Scheme

Location (OS Easting and Northings)	Receiving Water Body	Discharge Type	Estimated Distance from Site (m)	Envirocheck Slice/Object Reference
309796 168177	Nant Talwg	Sewage Discharges - Pumping Station	406	B6
309730 168080	Nant Talwg	Sewage Discharges - Pumping Station	492	B7
309300 169100	Tributary of River Waycock	Sewage Discharges - Final/Treated Effluent - Not Water Company	93	A3
309100 169200	River Waycock	Sewage Discharges - Final/Treated Effluent - Not Water Company	7	A2
309080 169500	River Waycock	Sewage Discharges - Final/Treated Effluent - Water Company	193	A5
308870 169430	River Waycock	Sewage Discharges - Final/Treated Effluent - Water Company	7	A1
307714 172720	To Land	Sewage Discharges - Final/Treated Effluent - Not Water Company	74	D1
307700 172800	To Land	Unspecified - domestic property	90	D2
307500 173700	To Ground	Sewage Discharges - Final/Treated Effluent - Not Water Company	182	G1 (and A1 Sycamore Cross Envirocheck)

Table 15.11: Active Discharge Consents within 500m of the Scheme

Location (OS Easting and Northings)	Receiving Water Body	Discharge Type	Estimated Distance from Site (m)	Envirocheck Slice/Object Reference
308200 173700	Tributary of Nant Llancarfan	Sewage Discharges - Final/Treated Effluent - Water Company	421	G2 (and A2 Sycamore Cross Envirocheck)

Flood Risk

15.4.75 A FCA has been completed in accordance with PPW and TAN15 and is provided in Appendix 15.1.

15.4.76 In summary, the greatest risk to the existing Five Mile Lane and the Scheme arises from the following sources:

- Approximately 350m of the existing road at the crossing with the River Waycock is shown to lie in an area at risk of fluvial flooding in the 1 in 1000 year flood event (Zone C2). Flooding is also indicated to have happened here in the past, as evidenced by sedimentary deposits (Zone B), associated with the tributary that is now culverted beneath the existing road;
- At the location of the crossing with the River Waycock, the EA's Risk of Flooding from Surface Water map indicates an area at high risk of surface water flooding most likely attributable to the tributaries that discharge into the River Waycock at this location, as well as the natural depression in local topography and the potential barrier to flow created by Five Mile Lane. Fluvial and surface water flooding will be almost indistinguishable as surface water flows into the network of tributaries that discharge into the River Waycock;
- To the south of the River Waycock, surface water is shown to follow the alignment of the unnamed tributary which runs adjacent to the existing road for approximately 900m. Mapping indicates flood risk to the existing road immediately south of the crossing of the River Waycock that could coincide with the entrance to the Hawking Centre and the culvert at this location;
- An area of high risk flooding from surface water is indicated adjacent to the existing Five Mile Lane to the south of Blackland Farm. Surface water is illustrated to flow south adjacent to the western verge and pond to the west of the road in close proximity to the minor watercourse that flows beneath the road at this location. The ponding is most likely an indication of a natural depression and/or barrier to flow created by the Five Mile Lane. The mapping indicates that water could flow across the road to the tributaries of the River Waycock to the east. The path of flow across the road itself is shown to be low risk;
- Surface water flood risk is indicated along the alignment of Ffynnon Whitton-mawr and Ford Brook. The catchment of the Ford Brook is very small hence this risk is most likely attributable to culvert blockage beneath Five Mile Lane during extreme events;
- The greatest risk of groundwater flooding is likely to occur in the vicinity of the River Waycock where bedrock and superficial deposits are classified by the EA as Secondary A aquifer, soils are classified by the EA as having high leaching potential and Cranfield University have also indicated that there may be naturally

high groundwater. However, any groundwater that emerges in this area will drain toward the River Waycock;

15.4.77 There are no known significant flood risks to Sycamore Cross junction.

15.4.78 Fluvial and surface water flood risk areas, along with aquifer classifications, are shown on Figure 15.2.

Receptor Sensitivity

15.4.79 Potential receptors have been identified through investigation of baseline conditions. The relative importance of these receptors has been defined based on guidance provided in Table 15.2 and is summarised in Table 15.12.

Table 15.12: Summary of Receptor Importance

Receptor	Description	Importance
Nant Talwg	An ordinary watercourse river flowing through SSSI and Local Nature Reserve designated woodland.	Very High
Tributary of River Waycock flowing north parallel to Five Mile Lane	A tributary to the River Waycock, flowing through SSSI designated woodland.	High
River Waycock	A main river flowing adjacent to multiple SSSI designated woodlands with a moderate WFD classification. The watercourse supports Otter foraging and commuting activities, as well as other important aquatic BAP and EC designated species.	Very High
Tributary of River Waycock flowing south and crossing beneath Five Mile Lane	A tributary to the River Waycock, flowing near to SSSI designated woodland. There is little access and associated amenity value to the watercourse	Medium
Moulton Brook	A tributary of Nant Llancarfan with no known amenity value. The watercourse is in a remote area with no known access. The watercourse discharges to the River Waycock approximately 4.5km downstream.	Low
Ffynnon Whitton-mawr	A pond/detention basin with no known amenity value. The water body discharges to Ford Brook, which feeds the River Waycock approximately 4.7km downstream.	Low
Ford Brook	A tributary to the River Waycock approximately 4.7km downstream. There is limited access alongside the watercourse at downstream extent.	Low
Nant Whitton	An ordinary watercourse and its tributaries that flow through SSSI designated woodland.	High
Nant Llancarfan	A main river, classified as good under the WFD. The watercourse flows through Llancarfan village.	High

Table 15.12: Summary of Receptor Importance

Receptor	Description	Importance
Tributary of River Waycock flowing around the south side of Blackland Farm	The source of the River Waycock. There is no known access alongside watercourse and no known amenity value.	Low
Tributary of River Waycock flowing from the east side of Blackland Farm	A tributary to the River Waycock. There is no known access alongside the watercourse and no known amenity value.	Low
Tributary of River Waycock to the north-east of Blackland Farm	A tributary to the River Waycock. There is no known access alongside watercourse and no known amenity value.	Low
People and Property Downstream	People and property located adjacent to watercourses downstream of the site, including Llancarfan, Penmark, Llancadle and Aberthaw.	High
Groundwater resources	Groundwater has been classified as having good chemical quality under WFD. Groundwater is used for agriculture and domestic purposes, assumed to include potable purposes within 500m of Five Mile Lane.	Very High
Tributaries of Nant Llancarfan from Redland Wood	A tributary of Nant Llancarfan with no known amenity value. The watercourse is in a remote area with no known access. The watercourse discharges to the River Waycock approximately 6.5km downstream.	Low
Offline watercourse north of Sycamore Cross junction	An offline watercourse / ditch with no known amenity value or access. The watercourse may form part of the A48 highway drainage system and may discharge to a pond downstream but this has not been confirmed.	Low
Unnamed pond at outfall of watercourse north of Sycamore Cross junction	An unnamed pond with no known amenity value and little access. The watercourse may collect flows from the outfall of the offline watercourse north of Sycamore Cross junction and act as a detention basin but this has not been confirmed.	Low
Golf course ponds	Offline series of ponds providing moderate amenity value for users of the golf course.	High
Unnamed ponds in woodland adjacent to A48	Unnamed ponds either side of the A48 may form part of highway drainage system as detention ponds but this has not been confirmed. There is no known amenity value and limited access to the ponds.	Low

15.5 Predicted Effects (without Mitigation)

Construction

15.5.1 This section considers the potential impacts that the Scheme will have on the water environment during the construction between the summer 2016 and the winter of 2017.

15.5.2 The key risks to the water environment during construction include:

- Pollution risks associated with:
  - Increased sediment loads caused by site runoff containing elevated suspended sediment levels. This can result from works within watercourse channels, land clearance, excavation, dewatering of excavations, stockpiles, wheel washings and movement of materials to and from the site.
  - The release of hydrocarbons and oils due to a large number of vehicles accessing the site, leakage from oil/fuel storage tanks and accidental spillages.
  - Accidental leaks of hazardous materials, particularly concrete and cement products, which can be contained in uncontrolled wash-down water and surface water runoff.
- Dust and debris caused by poor site management and demolitions works.
- Flood risk to construction workers and construction plant, particularly if works are being carried out within an area at risk from flooding.
- Flood risk to construction workers and construction plant due to blockage or failure of temporary diversion or over-pumping of flows during construction.

15.5.3 Impacts associated with works within or adjacent to watercourse channels that may reduce the capacity of the channel are discussed as operational impacts.

15.5.4 Specific risks relating to the water environment arising because of construction are discussed below. These risks are assessed before mitigation measures are considered. The magnitude of the impact and subsequent significance of the effect is determined in accordance with the methodology as set out in Table 15.3 and Table 15.4, and through consideration of receptor sensitivity as summarised in Table 15.12.

15.5.5 Specific risks to hydrogeology, including groundwater movement and quality, are addressed in detail in Chapter 10: Geology & Soils. Specific risks to ecology, including aquatic and terrestrial species and habitats, are addressed in detail in Chapter 9: Nature Conservation.

15.5.6 Works within 8m of ordinary watercourses or main rivers will require ordinary watercourse consent or flood defence consent respectively from the LLFA or NRW. Temporary discharges to watercourses or groundwater may require discharge consent from NRW.

Pollution Risks

Increased Sediment Loads

15.5.7 Site runoff containing elevated suspended sediment levels can result from works within watercourse channels, land clearance, excavation, dewatering of excavations, stockpiles, wheel washings and movement of materials to and from the site. Runoff with high sediment loads can have direct adverse effects on adjacent water bodies by increasing turbidity (thus reducing light penetration and reducing plant growth), and by

smothering vegetation and bed substrates (thus impacting on invertebrate and fish communities through the destruction of feeding areas, refuges and breeding / spawning areas). Indirect adverse effects can also be associated with suspended sediments that have inorganic or organic contaminants (e.g. heavy metals and pesticides, respectively).

15.5.8 The magnitude of the impact is likely to be most significant when working in areas within or adjacent to a water body and in periods of heavy rainfall. The impacts will be direct and temporary - water quality within the affected water body will improve over time as sediments settle or are trapped by vegetation.

Release of Hydrocarbons and Oils

15.5.9 The release of hydrocarbons and oils into on-site drainage systems or from direct runoff and infiltration to groundwater is the second most common form of pollution after increased sediment loading. This is likely to increase during the construction period due to a large number of vehicles, including heavy vehicles, accessing the site, refuelling of vehicles and plant, leakage from oil/fuel storage tanks and accidental spillages.

15.5.10 Hydrocarbons form a film on the surface of the water body, deplete oxygen levels and can be toxic to freshwater fish. Even at very low concentrations the film can negatively impact the visual appearance of the water body. The impact will be direct and temporary - water quality within the affected water body will improve over time as pollutants disperse and are treated by natural processes.

15.5.11 The dispersion and impact of hydrocarbons that enter groundwater resources is dependent on the type of overlying geology, depth to groundwater table and characteristics of the aquifer. However, groundwater contamination is difficult to treat and can have an adverse indirect effect on the quality of abstracted water or rivers that receive groundwater base flow.

Use of Hazardous Materials

15.5.12 The use of hazardous products on site can present a pollution risk because of the potential for accidental spillages, and the uncontrolled release of wash-down water and runoff. If materials and activities are not stored and carried out in designated areas, runoff and wash-down may enter a water body, adversely affect the aquatic environment or contaminate surface and groundwater water abstractions.

15.5.13 The most common source of pollution is from concrete and cement products. These products are highly alkaline and corrosive - fish can be physically damaged and their gills blocked, and both vegetation and the bed of the receiving water body can be smothered.

15.5.14 The dispersion and impact of hazardous products that enter groundwater resources is dependent on the type of overlying geology, depth to groundwater table and characteristics of the aquifer. However, groundwater contamination is difficult to treat and can have an adverse indirect effect on the quality of abstracted water or rivers that receive groundwater base flow.

15.5.15 During construction, there is an elevated risk of potential leaks or accidental spillage of hazardous chemicals used on site infiltrating to groundwater or migrating to nearby water bodies and resulting in an adverse impact.

15.5.16 For the most part, it is only when large quantities of hazardous substances are spilled, or the spillage is directly into the water body, that a significant risk of acute toxicity will arise in the receiving water. The magnitude of any impact will depend on the scale and nature of any potential incident and is therefore difficult to predict.

15.5.17 For the most part, impacts will be direct and/or indirect and temporary to long term - water quality within the affected water body will improve over time as pollutants are dispersed and diluted. However, a significant direct spillage of a toxic substance could cause long-term damage to the receiving water body.

Summary

15.5.18 Table 15.13 provides a summary of the likely impacts to each relevant water feature identified in Table 15.12.

Table 15.13: Impacts during Construction arising from Increased Sediment Load, Discharge of Hydrocarbons and Use of Hazardous Materials

Receptor	Description	Magnitude	Significance
Nant Talwg	No direct or indirect runoff from construction is likely to impact the receptor due to the distance from the proposed works.	Negligible	Neutral
Tributary of River Waycock flowing north parallel to Five Mile Lane	Direct runoff from heavily sediment-laden flows may occur due to the excavation required for the road widening works occurring adjacent to the receptor and the re-alignment of the receptor. Direct runoff from the road widening works adjacent to the receptor may contain hydrocarbons and hazardous pollutants during construction.	Major Adverse	Large Adverse
River Waycock (from Five Mile Lane works)	Risk of direct runoff of polluted flows from works to the north of the receptor. Indirect impacts from tributaries out falling into the River Waycock. No construction works are proposed adjacent to river.	Moderate Adverse	Large to Very Large Adverse
River Waycock (from Sycamore Cross junction works)	It is assumed that indirect discharge into this watercourse may occur from the surface water drainage network at Sycamore Cross junction. The upstream end of the River Waycock is located approximately 1km downstream from the junction and therefore some treatment of pollutants contained in discharge may occur. Despite this, without further knowledge of specific surface water treatment provided for highway discharge, it is assumed that there may be an adverse impact on the receptor.	Minor Adverse	Moderate to Large Adverse

Table 15.13: Impacts during Construction arising from Increased Sediment Load, Discharge of Hydrocarbons and Use of Hazardous Materials

Receptor	Description	Magnitude	Significance
Tributary of River Waycock flowing south and crossing beneath Five Mile Lane	Direct construction over the tributary and re-alignment of approximately 100m length of the tributary is liable to result in heavy sedimentation, as well as increased risk of hydrocarbon and hazardous runoff to the watercourse.	Major Adverse	Large Adverse
Moulton Brook	Minimal direct discharge is anticipated from the construction area to Moulton Brook due to the distance between the works and the receptor and the presence of the existing road, which will provide a barrier to flows from the east.	Negligible	Neutral
Ffynnon Whitton-mawr	Direct runoff of sediment, hydrocarbon and hazardous flows is more likely due to topography and earthworks for road embankment and drainage detention ponds adjacent to the receptor. Some filtration and settlement of pollutants may occur as runoff flows over the fields prior to discharge.	Moderate Adverse	Slight Adverse
Ford Brook	Indirect runoff from Ffynnon Whitton-mawr is more likely. Some filtration and settlement of pollutants in the heavily vegetated Ffynnon Whitton-mawr is likely so pollution of flows will be somewhat reduced.	Minor Adverse	Neutral
Nant Whitton	No direct runoff from construction is likely to impact the receptor due to the distance between the works and the receptor.	Negligible	Neutral
Nant Llancarfan (from Five Mile Lane works)	No direct runoff due to the distance between the works and the receptor. Indirect impacts are unlikely to occur as the watercourse is approximately 4km downstream of the site.	Negligible	Neutral
Nant Llancarfan (from Sycamore Cross junction works)	It is assumed that indirect discharge into this watercourse may occur from the surface water drainage network at Sycamore Cross junction. The upstream end of the Nant Llancarfan is located approximately 2km downstream the junction and therefore treatment of pollutants contained in discharge into the Nant Llancarfan is likely to occur. Despite this, without further knowledge of specific surface water treatment provided for highway discharge, it is assumed that there may be an adverse impact on the receptor.	Minor Adverse	Slight to Moderate Adverse

Table 15.13: Impacts during Construction arising from Increased Sediment Load, Discharge of Hydrocarbons and Use of Hazardous Materials

Receptor	Description	Magnitude	Significance
Tributary of River Waycock flowing around the south side of Blackland Farm	Direct pollution of the watercourse is likely as works will be undertaken on the section of watercourse that is culverted beneath the existing road.	Moderate Adverse	Slight Adverse
Tributary of River Waycock flowing from the east side of Blackland Farm	No direct runoff from construction is likely to impact the receptor as the proposed works do not extend to where this watercourse is culverted beneath the existing road.	Negligible	Neutral
Tributary of River Waycock to the north-east of Blackland Farm	No direct runoff from construction is likely due to the distance between the receptor and the works and elevation above the nearest area of works.	Negligible	Neutral
Tributaries of Nant Llancarfan from Redland Wood	No direct runoff from construction is likely due to the distance between the receptor and the works area. Any polluted surface water would have to flow across a field area filtering out pollutants prior to entry into watercourse.	Negligible	Neutral
Offline watercourse north of Sycamore Cross junction	Direct runoff from construction may occur due to proximity of watercourse adjacent to road widening works at Sycamore Cross junction. Some filtration and settlement of pollutants will occur in the vegetated verge prior to discharge into watercourse.	Minor Adverse	Neutral
Unnamed pond at outfall of watercourse north of Sycamore Cross junction	Indirect runoff from construction may enter the water body via the offline watercourse north of Sycamore Cross junction. Flow will pass through approximately 300m of watercourse prior to discharge into this body providing some treatment of pollutants.	Minor Adverse	Neutral
Golf course ponds	No direct runoff from construction is likely due to the distance between the receptor and the increase in elevation between the receptor and the works area.	Negligible	Neutral
Unnamed ponds in woodland adjacent to A48	There is unknown hydraulic connectivity between the works area at Sycamore Cross junction and these ponds but the ponds may form part of the highway drainage system. The ponds are located approximately 400m downstream of the works so some treatment of pollutants may occur prior to discharge.	Minor Adverse	Neutral

Table 15.13: Impacts during Construction arising from Increased Sediment Load, Discharge of Hydrocarbons and Use of Hazardous Materials

Receptor	Description	Magnitude	Significance
Groundwater resources	Increased risk from hydrocarbons and hazardous materials infiltrating in permeable areas of the site, although groundwater believed to flow south away from domestic water supply.	Minor Adverse	Moderate to Large Adverse

Dust and Debris

15.5.19 Construction activities located on site have the potential to release dust and debris that may be blown into adjacent water features.

15.5.20 Increased dust levels in water bodies may reduce the levels of light reaching aquatic plant and animal species. Debris blown into water bodies can decrease the recreational and aesthetic quality of the water body. Impacts will be direct and temporary.

15.5.21 Table 15.14 provides a summary of the likely impacts of dust and debris on the receptors identified in the baseline section of this chapter along with the magnitude and significance of the potential impacts.

Table 15.14: Impacts of Dust and Debris during Construction

Receptor	Description	Magnitude	Significance
Nant Talwg	It is unlikely that dust would have any impact due to the distance of the receptor from the Scheme.	Negligible	Neutral
Tributary of River Waycock flowing north parallel to Five Mile Lane	Dust and debris are likely to enter the watercourse directly adjacent to the location of road widening, which requires an element of road demolition.	Moderate Adverse	Moderate Adverse
River Waycock	Dust and debris are likely to enter the watercourse directly. The watercourse is close to where the Five Mile Lane widening is being undertaken (which requires an element of demolition) and new road being constructed.	Minor Adverse	Moderate Adverse
Tributary of River Waycock flowing south and crossing beneath Five Mile Lane	Dust and debris is likely to enter the watercourse directly due to work undertaken over tributary.	Minor Adverse	Slight Adverse
Moulton Brook	Debris is unlikely to enter the watercourse due to the distance from site but dust has the potential to be blown into watercourse.	Minor Adverse	Neutral
Ffynnon Whitton-mawr	Dust and debris are likely to enter the receptor directly. The receptor is close to an area of earthworks for the road and the detention ponds.	Minor Adverse	Neutral

Table 15.14: Impacts of Dust and Debris during Construction

Receptor	Description	Magnitude	Significance
Ford Brook	Dust and debris may enter the watercourse directly due to the short distance from an area of proposed earthworks.	Minor Adverse	Neutral
Nant Whitton	Dust and debris are unlikely to enter the watercourse due to the distance from the works.	Negligible	Neutral
Nant Llancarfan	No impacts are expected due to the distance from the site as the watercourse is approximately 2km downstream of Sycamore Cross junction and approximately 4km downstream of Five Mile Lane.	Negligible	Neutral
Tributary of River Waycock flowing around the south side of Blackland Farm	Dust and debris may enter the watercourse due to construction above and adjacent to the receptor.	Minor Adverse	Neutral
Tributary of River Waycock flowing from the east side of Blackland Farm	No debris is likely to impact the receptor as no works are proposed in the immediate vicinity of the watercourse but dust may be blown into receptor.	Minor Adverse	Neutral
Tributary of River Waycock to the north-east of Blackland Farm	Dust and debris is unlikely to enter watercourse due to the distance of the receptor from works.	Negligible	Neutral
Tributaries of Nant Llancarfan from Redland Wood	No debris is likely to enter watercourses due to the distance from the construction area. Dust may be blown into the watercourse in low concentrations, however minor impact as the watercourse is approximately 350m from the works area.	Minor Adverse	Neutral
Offline watercourse north of Sycamore Cross junction	Dust and debris is likely to enter the watercourse due to the proximity of the watercourse to the road widening works at Sycamore Cross junction.	Minor Adverse	Neutral
Unnamed pond at outfall of watercourse north of Sycamore Cross junction	No debris is likely to enter pond due to the distance from the construction area. Dust may be blown into the pond in low concentrations, however minor impact as the pond is approximately 300m from the works area.	Minor Adverse	Neutral

Table 15.14: Impacts of Dust and Debris during Construction

Receptor	Description	Magnitude	Significance
Golf course ponds	Debris unlikely to enter ponds due to distance from works and difference in elevation between receptor and works area. Some dust may reach the ponds nearest the works area but the distance between receptors and the works area and a bank of trees between the receptors and the works area will reduce dust concentrations reaching the receptors.	Negligible	Neutral
Unnamed ponds in woodland adjacent to A48	No debris is likely to enter ponds due to the distance from the construction area. Dust may be blown into the pond in low concentrations, however minor impact as the ponds are approximately 400m from the works area.	Minor Adverse	Neutral

Flood Risk

15.5.22 Flooding of the site during the construction phase could cause damage to plant and other equipment and could restrict emergency access and egress routes putting construction operatives at risk.

15.5.23 Flooding may occur due to construction in areas at risk of flooding or due to blockage or failure of temporary diversion or over-pumping of flows during construction.

15.5.24 The majority of the Scheme is located outside of areas deemed to be at flood risk. However, works located in close proximity of the River Waycock may be within areas classified as Zones C2 (areas of the floodplain without significant flood defence infrastructure) and Zone B (areas known to have been flooded in the past, evidenced by sedimentary deposits). Similarly, works in close proximity to the minor watercourses and tributaries and/or within overland flow routes within the Scheme area may be at risk from surface water flooding or fluvial flooding.

15.5.25 Where it is proposed to construct culverts and crossings on watercourses (namely the watercourse flowing south and crossing beneath Five Mile Lane prior to discharge to the River Waycock) there may be a need to temporarily divert flows through these watercourses during construction. Diversion of flows can be achieved by stopping up the channels and providing temporary channels adjacent to these, or by stopping up the channels and pumping around the area in which construction is occurring.

15.5.26 Should the temporary channels or pumps become blocked or fail to operate as required, there might be a direct flood risk in all of these areas to construction operatives and plant located in the area.

15.5.27 Flood risk impacts are direct and temporary - construction operatives and construction plant would only be at flood risk during particular storm events.

15.5.28 Table 15.15 provides a summary of the likely impacts of flooding during construction on local receptors along with the magnitude and significance of the potential impacts.

Table 15.15: Impacts of Flood Risk during Construction

Receptor	Description	Magnitude	Significance
Site operatives and plant	For works near the River Waycock, site operatives will be working in areas classified as Zones C2 and Zone B. The risk of flooding to site operatives and plant is therefore considered high at this location. For works near minor watercourses and overland flow paths, including diversion and over-pumping, the risk and impact of flooding is considered less.	Major Adverse	Very Large Adverse
People and property on third party land and downstream	A failure in the pumps required for over-pumping could lead to local flood risk but this will not affect any people or property outside the site area.	Negligible	Neutral

Summary of Impacts during Construction

15.5.29 Table 15.16 provides a summary of key risks to the water environment during construction and the associated magnitude and significance of these risks to identified receptors.

Table 15.16: Summary of Impacts during Construction

Receptor	Importance	Impact	Magnitude	Significance
Nant Talwg	Very High	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Tributary of River Waycock flowing north parallel to Five Mile Lane	Very High	Increased pollution from sediment, hydrocarbons and hazardous materials	Major Adverse	Large Adverse
		Dust and debris	Moderate Adverse	Moderate Adverse

Table 15.16: Summary of Impacts during Construction

Receptor	Importance	Impact	Magnitude	Significance
River Waycock	Very High	Increased pollution from sediment, hydrocarbons and hazardous materials	Moderate Adverse (Five Mile Lane)	Large to Very Large Adverse (Five Mile Lane)
			Minor Adverse (Sycamore Cross junction)	Moderate to Large Adverse (Sycamore Cross junction)
		Dust and debris	Minor Adverse	Moderate Adverse
Tributary of River Waycock flowing south and crossing beneath Five Mile Lane	Medium	Increased pollution from sediment, hydrocarbons and hazardous materials	Major Adverse	Large Adverse
		Dust and debris	Minor Adverse	Slight Adverse
Moulton Brook	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Minor Adverse	Neutral
Ffynnon Whitton-mawr	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Moderate Adverse	Slight Adverse
		Dust and debris	Minor Adverse	Neutral
Ford Brook	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Minor Adverse	Neutral
		Dust and debris	Minor Adverse	Neutral
Nant Whitton	High	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Nant Llancarfan	High	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible (Five Mile Lane)	Neutral (Five Mile Lane)
			Minor Adverse (Sycamore Cross junction)	Slight to Moderate Adverse (Sycamore Cross junction)

Table 15.16: Summary of Impacts during Construction

Receptor	Importance	Impact	Magnitude	Significance
		Dust and debris	Negligible	Neutral
Tributary of River Waycock flowing around the south side of Blackland Farm	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Moderate Adverse	Slight Adverse
		Dust and debris	Minor Adverse	Neutral
Tributary of River Waycock flowing from the east side of Blackland Farm	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Minor Adverse	Neutral
Tributary of River Waycock to the north-east of Blackland Farm	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Tributaries of Nant Llancarfan from Redland Wood	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Minor Adverse	Neutral
Offline watercourse north of Sycamore Cross junction	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Minor Adverse	Neutral
		Dust and debris	Minor Adverse	Neutral
Golf course ponds	High	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Unnamed pond at outfall of watercourse north of Sycamore Cross junction	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Minor Adverse	Neutral
		Dust and debris	Minor Adverse	Neutral
Unnamed ponds/detention basins in woodland adjacent to A48	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Minor Adverse	Neutral
		Dust and debris	Minor Adverse	Neutral
Groundwater resources	Very High	Increased pollution from release of hydrocarbons and hazardous materials	Minor Adverse	Moderate to Large Adverse
Site operatives	Very High	Flood risk	Major Adverse	Very large to

Table 15.16: Summary of Impacts during Construction

Receptor	Importance	Impact	Magnitude	Significance
and plant				Large Adverse
People and property on third party land and downstream	High	Flood risk	Negligible	Neutral

Operation

15.5.30 This section considers the potential impacts that the Scheme will have on the water environment after construction and during occupation.

15.5.31 The key risks to the water environment during the operation of the Scheme include:

- Pollutants contained within surface water runoff that will be discharged to water bodies through the proposed surface water drainage system;
- Pollutants contained within surface water runoff that will be discharged to ground via infiltration;
- Increased flood risk as a result of the location of the Scheme within an area at risk and/or the loss of existing flood plain storage;
- Increased flood risk as a result of increased surface water runoff and/or exceedence of surface water drainage systems;
- Flood risk caused by poorly maintained surface water management features and drainage systems;
- Impacts to hydromorphology and channel hydraulics as a result of realignment, culverting and crossing watercourses.

15.5.32 Specific risks related to the water environment during the operation of the Scheme are discussed below. The magnitude of these impacts will be significantly reduced through measures embedded in the design of the surface water drainage systems. A summary of these key elements is provided below and must be taken into consideration before the impact magnitude and resultant impact significance can be assessed.

Five Mile Lane

15.5.33 The Scheme will be drained by road edge filter drains. This use of SUDS will provide benefits by limiting flow rates, providing storage and allowing some infiltration as well as filtration and bacteriological water quality benefits.

15.5.34 Surface flow wetlands in accordance with DMRB HA 103/06 have been incorporated upstream of balancing ponds which are expected to provide good removal of suspended solids and oil and grease prior to discharge to receiving watercourses. These will also incorporate a means of isolation for emergency control of spillages.

15.5.35 The proposed carriageway drainage system and detention basins will attenuate the rate of flow into watercourses to pre-developed greenfield rates and ensure no flood risk up to and including the 1 in 100 year event and allowing for the potential effects of climate change.

Sycamore Cross Junction

15.5.36 Proposed works to Sycamore Cross junction will continue to discharge as per the current configuration to the existing drainage network via a number of road gullies.

15.5.37 The downstream drainage system serving the existing Sycamore Cross junction is unknown at this stage, but review of the area indicates that surface water may be discharge to the two ponds located in the woodland adjacent to the A48 and/or to the Nant Llancarfan or the River Waycock.

15.5.38 A FCA and a drainage strategy for this development have been prepared and are provided in Appendix 15.1.

15.5.39 Specific risks to hydrogeology, including groundwater movement and quality, are addressed in detail in Chapter 10: Geology and Soils. Specific risks to ecology, including aquatic and terrestrial species and habitats, are addressed in detail in Chapter 9: Nature Conservation.

Pollutants Contained in Surface Water Runoff

15.5.40 Surface water runoff has the potential to contain silts and hydrocarbons that are washed off hard paved areas and vehicular areas. These can increase water turbidity, deplete oxygen levels and be toxic to the aquatic environment. Uncontrolled discharge via infiltration to ground can also cause permanent deterioration of groundwater quality.

15.5.41 Pollution of water bodies from surface water runoff containing silts and hydrocarbons is considered a direct permanent impact - although pollutants can be treated by natural processes in the water body, the absence of adequate mitigation would result in a continuous discharge of polluting substances to water bodies.

15.5.42 A separate assessment of potential impacts has been made for works at Five Mile Lane and works at Sycamore Cross junction as the impacts as highly dependent on the operational surface water drainage system.

Five Mile Lane

15.5.43 As described in Section 15.6 and in the FCA (Appendix 15.1), the infiltration potential of ground along the road alignment is believed to be limited due to the nature of the soils and the high groundwater table along the road alignment. Infiltration potential and groundwater levels at the two detention basins will need to be explored further prior to construction.

15.5.44 Where infiltration is considered feasible and groundwater levels are low enough to enable infiltration and ensure direct paths for pollutants to groundwater do not exist, detention basins will be unlined to promote the maximum infiltration of surface water possible. In this instance, it is envisaged that a significant proportion of surface water will be discharged to the ground but that surface water flows occurring in higher return period events will still discharge to watercourses.

15.5.45 However, where groundwater levels are high, detention basins will be lined with an impermeable layer to prevent loss of storage and direct contamination of groundwater. In this instance, or if infiltration rates are low, almost all surface water will be discharged via wetlands and detention basins to the River Waycock via the

tributary flowing north parallel to the existing road, the tributary flowing south that crosses beneath the existing road, Moulton Brook and Ford Brook.

15.5.46 The provision of filter drains, wetlands and detention ponds will provide a high degree of treatment to surface water runoff from the road prior to infiltration or discharge in accordance with the recommendations of the Draft National Standards for Sustainable Drainage.

15.5.47 In accordance with DMRB Volume 11, Part 10, Section 3 methodology, the HAWRAT tool has been used to assess the risks to the larger watercourses in the vicinity of the Scheme.

15.5.48 To enable application of the HAWRAT tool the following information has been used:

- Predicted Annual Average Daily Traffic (AADT) flows for the 2032 scenario and the percentage of this figure constituting HGVs is based on an extrapolation from traffic counts undertaken to inform this Scheme;
- Standard Annual Average Rainfall (SAAR) and Base Flow Index (BFI) for River Waycock, Ford Brook and Moulton Brook catchments taken from FEH descriptors;
- Rainfall intensity has been taken from the maps provided in FEH Volume II;
- Annual 95 percentile river flow in the River Waycock, Ford Brook, Moulton Brook and Nant Llancarfan have been calculated using IH108 Low Flow Estimation methodology;
- Water hardness for watercourses is unknown but sensitivity testing showed that this made no impact on the overall results of the assessment tool for the above watercourses;
- Typical dimensions of Ford Brook and Moulton Brook were based on visual inspection during a site visit;
- The response time to spillages that might occur on the road is unknown but due to the rural location of the road the worst case scenario was assumed in the assessment (>1 hour response time);
- The depth to the groundwater table is unknown but may be shallow as described above and therefore a worst case scenario (<5m) has been assumed in the HAWRAT assessment;
- Flow type through the ground, effective soil grain size and lithology has been selected from the categories available in the HAWRAT assessment based on information reviewed from the BGS, EA and Cranfield University's Soilscapes mapping.

15.5.49 Full results of the assessment undertaken with the HAWRAT tool are provided in Appendix 15.5 and summarised in Table 15.17 and Table 15.18.

Table 15.17: Summary of HAWRAT Assessment of Pollution and Sedimentation Risks to the River Waycock, Ford Brook, Moulton Brook and Nant Llancarfan

	Pollution Impacts		Sedimentation Impacts		Spillage Risk
Receiving watercourse	Annual average conc. of copper (mg/L) due to road runoff	Annual average conc. of Zinc (mg/L) due to road runoff	Deposition index (without SUDS mitigation)	Settlement needed to avoid chronic sedimentat-ion impact	Risk of a pollution incident from spillage on road discharging to watercourse
River Waycock (from network 1)	0.25 (PASS)	0.94 (PASS)	98 (PASS)	-	N/A
Ford Brook (from network 2)	0.32 (PASS)	1.19 (PASS)	161 (FAIL)	38%	0.00000 (PASS)
Moulton Brook (from network 3)	0.26 (PASS)	0.96 (PASS)	99 (PASS)	-	0.00000 (PASS)
River Waycock (from network 4)	0.11 (PASS)	0.41 (PASS)	24 (PASS)	-	N/A
River Waycock (from network 5)	0.06 (PASS)	0.22 (PASS)	45 (PASS)	-	N/A
River Waycock (cumulative)	0.19 (PASS)	0.70 (PASS)	N/A	N/A	0.0002 (PASS)
Nant Llancarfan (cumulative)	0.10 (PASS)	0.37 (PASS)	27 (PASS)	N/A	0.00000 (PASS)

15.5.50 The HAWRAT tool indicates that the concentrations of pollutants in the River Waycock, Ford Brook, Moulton Brook and Nant Llancarfan are likely to be below the acceptable threshold values set by DMRB methodology as a result of the Scheme.

15.5.51 The HAWRAT tool indicates that there will be no accumulation of sediment in Moulton Brook, at the individual outfalls to the River Waycock or in the Nant Llancarfan as a result of the Scheme. The tool also indicates no cumulative sedimentation will occur in Nant Llandcarfan. No assessments of the cumulative risk of sedimentation in the River Waycock was undertaken as the outfalls from the various discharge points into this watercourse are spaced at intervals between 200m and approximately 3.5km and the cumulative sedimentation impact from these discharges is therefore considered negligible relative to the size of the watercourse.

15.5.52 The tool does however indicate that sediment may accumulate in Ford Brook as a result of runoff from the Scheme. The tool indicates that at minimum, 38% of sediment needs to be removed from runoff prior to discharging into Ford Brook to prevent chronic sedimentation of the watercourse. This HAWRAT assessment has been made without regard to the presence of the filter drains, wetlands and detention ponds proposed as part of the Scheme. Table 3.2 in DMRB methodology Volume 4, Section 2 Part 1 (The Highways Agency, 2006) indicates that wetland areas and balancing ponds can remove up to approximately 83% of total suspended solids from discharge. The sedimentation risk to Ford Brook is therefore not considered a significant impact.

15.5.53 The HAWRAT tool also indicates that the risk of pollution posed to the watercourses based on accidental spillages is negligible.

15.5.54 The risks posed to groundwater have also been assessed according to the risk determination matrix outlined in DMRB Volume 11, Part 3, Section 10. Table 15.18 outlines the risk of polluted runoff finding a pathway to the groundwater receptor.

Table 15.18: Summary of DMRB Groundwater Risk Determination Matrix Score Assessing the Risk to Groundwater from Polluted Runoff

Components listed in Table C1.1 (DMRB)	Weighting factor	Property / parameter	Property Parameter value	Associated score listed in Table C1.2 (DMRB)	Total score (weighting x score)
Source					
1	15	Traffic density	Max two way AADT along new road = 19,657	1	15
2	15	Rainfall volume (annual averages)	Max SAAR in catchments along road = 1058	2	15
		Rainfall intensity	100Yr - 1hr rainfall = 39-43mm (FEH Vol II)	2	30
Pathway					
3	15	Soakaway geometry	Continuous linear filter drain and point detention ponds	2	30
4	20	Unsaturated zone	Unknown depth to water table. Assume <5m	3	60
5	20	Flow type	Interbedded limestone and mudstone crossed by narrow bands of mudstone	2	40
6	7.5	Effective grain size		1	7.5
7	7.5	Lithology	Slowly permeable and seasonally wet loamy and clayey soils with impeded drainage	2	15
TOTAL SCORE (<150: Low risk) (150-250: Medium risk) (>250: High Risk)					**212.5**

15.5.55 In accordance with DMRB methodology, a total risk score of 212.5 indicates that groundwater is at medium risk from pollutants in runoff infiltrating to the ground. However, once again, this assessment does not take into account the filter drains, or wetlands and detention basins provided to treat surface water prior to infiltration and

reduce the risk posed to groundwater. The overall risk magnitude to groundwater is therefore considered negligible.

15.5.56 The above methodology does not consider the risk to groundwater from accidental spillages and therefore a separate assessment has been made of this risk using the HAWRAT tool. This assessment has been undertaken for the Scheme where the worst-case spillage risk might exist (where networks 4a, 4b and 5 discharge into the same detention pond). Full results of this assessment are provided in Appendix 15.5. In summary, the maximum risk of an accidental pollution incident to groundwater is evaluated to be 0.0001 (less than the threshold value of 0.010) and therefore the risk to groundwater from accidental spillage on this road is considered low.

15.5.57 Based on this HAWRAT assessment, the magnitude and significance of impacts from pollutants contained in runoff to the River Waycock, Ford Brook, Moulton Brook and Nant Llancarfan are summarised in Table 15.19.

15.5.58 The water bodies listed below have not been assessed using the HAWRAT tool:

- Nant Talwg;
- Tributary of River Waycock flowing north parallel to Five Mile Lane;
- Tributary of River Waycock flowing south and crossing beneath Five Mile Lane;
- Ffynnon Whitton-mawr;
- Nant Whitton;
- Tributary of River Waycock flowing around the south side of Blackland Farm;
- Tributary of River Waycock flowing from the east side of Blackland Farm;
- Tributary of River Waycock to the north-east of Blackland Farm.

15.5.59 No quantitative assessment was undertaken of Nant Whitton because no runoff from the road is anticipated to reach this watercourse.

15.5.60 No quantitative assessment was undertaken of the other minor tributaries or Ffynnon Whitton-mawr because discharge to these watercourses occurs a short distance upstream of where they outfalls into a more significant watercourse, hence the assessment considered the more significant watercourse instead.

15.5.61 No quantitative assessment was undertaken of the tributary of River Waycock flowing north parallel to Five Mile Lane because the area discharging to the watercourse is too small to be confident of the results (in these instances the HAWRAT tool recommends that the site be considered as a soakaway rather than a watercourse due to the minimal discharge into the watercourse).

15.5.62 The existing road is proposed to be widened in the area adjacent to the tributary of River Waycock that flow north parallel to Five Mile Lane. The widening of the road is predicted to cause a 42% increase of traffic flow. This may increase the risk of pollution via surface water runoff and therefore increase the risk of pollutants entering this watercourse.

15.5.63 However, surface water from the existing road currently discharges untreated into this tributary via over-the-edge drainage. The widening works associated with the Scheme will include installation of a filter drain with cut-off points at outlets to the tributary in case of accidental spillage. This drainage system will not only serve the widened area of the road but also the existing width of the road that currently discharges untreated

into the tributary. DMRB Volume 4, Section 2, Part 1 indicates that filter drains can remove approximately 38% of total suspended solids, 52% of hydrocarbons and 7% of metals from surface water runoff prior to discharge. Whilst these values are indicative only, this suggests that a filter drain would be able to reduce pollution in runoff to such an extent that any increase in pollutants that results from increased traffic flows will be offset by the provision of the filter drain. Overall, the provision of a filter drain is considered adequate to mitigate any increase in pollutants in surface water runoff as a result of the road widening.

15.5.64 Consideration was given to the introduction of additional treatment stages for surface water runoff prior to discharge but none can be provided without additional land take in the area of SSSI woodland. Consideration was also given to the redirection of surface water runoff out of the SSSI area but the streams in the SSSI add to the ecological diversity of the woodland and so discharge to the tributary should be maintained for ecology benefits.

15.5.65 The overall magnitude of the impacts of the Scheme, both from increased traffic flows and provision of better treatment, are considered negligible. These operational impacts are summarised in Table 15.19.

Table 15.19: Impacts of Pollutants in Surface Water Runoff during Operation from Five Mile Lane

Receptor	Description of Impact	Magnitude	Significance
Nant Talwg	No direct or indirect runoff from the Scheme is likely to impact the receptor due to the distance between the road and the watercourse.	Negligible	Neutral
Tributary of River Waycock flowing north parallel to Five Mile Lane	Direct runoff from widened road via filter drain likely to result in negligible change in water quality.	Negligible	Neutral
River Waycock	HAWRAT assessed pollution impacts and spillage risks are low. Indirect surface water runoff from the road will pass through a minimum of three treatment stages (with the exception of discharge from the area of the road proposed to be widened) and within ditches/tributaries prior to discharge into the river. Very low likelihood of pollution impacting the River Waycock.	Negligible	Neutral
Tributary of River Waycock flowing south and crossing beneath Five Mile Lane	Surface water flows will be treated in filter drains, wetlands and balancing ponds prior to discharge into the tributary to the River Waycock. This will reduce the risk of direct pollution from silts and hydrocarbons to the watercourse.	Negligible	Neutral
Moulton Brook	HAWRAT assessed pollution impacts and spillage risks are low. Surface water flows will be treated in wetlands and balancing ponds prior to discharge into Moulton Brook. This will reduce the risk of direct pollution from silts and hydrocarbons to the watercourse.	Negligible	Neutral

Table 15.19: Impacts of Pollutants in Surface Water Runoff during Operation from Five Mile Lane

Receptor	Description of Impact	Magnitude	Significance
Ffynnon Whitton-mawr	Surface water flows from the road surface will be discharged downstream of Ffynnon Whitton-mawr.	Negligible	Neutral
Ford Brook	HAWRAT assessed pollution impacts and spillage risks are low. HAWRAT identified settlement required prior to discharge of runoff. Surface water flows will be treated in filter drains, wetlands and balancing ponds prior to discharge into Ford Brook. This will reduce the risk of direct pollution from silts and hydrocarbons to the watercourse.	Negligible	Neutral
Nant Whitton	No direct or indirect runoff from the Scheme is likely to impact the receptor due to the distance from the Scheme.	Negligible	Neutral
Nant Llancarfan	HAWRAT assessed pollution impacts and spillage risks are low. Surface water flows will be treated in filter drains, wetlands and balancing ponds prior to discharge into Moulton Brook and Ford Brook. This will reduce the risk of indirect pollution from silts and hydrocarbons to Nant Llancarfan downstream.	Negligible	Neutral
Tributary of River Waycock flowing around the south side of Blackland Farm	Surface water flows will be treated in filter drains, wetlands and balancing ponds prior to discharge into this watercourse. This will reduce the risk of direct pollution from silts and hydrocarbons to the watercourse.	Negligible	Neutral
Tributary of River Waycock flowing from the east side of Blackland Farm	There is no discharge into this watercourse from the Scheme and no predicted risk of surface water migrating to this watercourse.	Negligible	Neutral
Tributary of River Waycock to the north-east of Blackland Farm	No direct or indirect runoff from development likely to impact receptor due to the distance from road.	Negligible	Neutral
Groundwater resources	HAWRAT identified moderate risk to groundwater resources. However, provision of filter drains, wetland areas and detention basins to treat runoff prior to infiltration considered sufficient to reduce risks. Infiltration will not be promoted if groundwater levels found to be high.	Negligible	Neutral

Sycamore Cross Junction

15.5.66 No quantitative assessment has been undertaken of the proposed works at Sycamore Cross junction that uses the HAWRAT tool. Instead a qualitative assessment has been adopted that considers potential impacts to water bodies in accordance with DMRB methodology as set out in Tables 15.3 and 15.4. This is principally because the area of works around Sycamore Cross junction is relatively small, with an increase in impermeable area of approximately 650m^2, and there will be no change to the surface water drainage system that is proposed to remain the same as the current system. There is also some uncertainty regarding the existing surface water drainage regime that renders a quantitative assessment unviable at this stage.

15.5.67 The features included within the qualitative assessment of the proposed works at Sycamore Cross junction include the tributaries of Nant Llancarfan from Redland Wood, the offline watercourse north of Sycamore Cross junction, the unnamed pond at the outfall of the watercourse north of Sycamore Cross junction, the golf course ponds and the unnamed ponds in woodland adjacent to the A48. Further assessment of the potential risks to the River Waycock and Nant Llancarfan has also been undertaken specifically related to the works at Sycamore Cross junction.

15.5.68 The primary change at Sycamore Cross junction will be the increase in traffic flow as a result of the works undertaken at the junction and along Waycock Road. The predicted increase in traffic flows through Sycamore Cross junction as a result of the works is 21% when comparing the 2032 do-minimum and 2032 do-something scenarios. This increase in traffic flow at the junction may increase the volume of contaminants within surface water runoff and the risk of spillage, and therefore may increase the risk of pollution via surface water runoff to downstream receptors.

15.5.69 It is proposed to maintain the existing drainage system serving the Sycamore Cross junction. However, the location of the outfall from the existing drainage system at Sycamore Cross junction is currently unknown, as is the level of treatment currently provided prior to discharge and/or infiltration to ground.

15.5.70 In the absence of detailed knowledge of discharge points from existing highway drainage system around Sycamore Cross junction it is assumed that surface water flows at Sycamore Cross junction follow existing topography. It is assumed therefore that surface water runoff from Sycamore Cross junction will eventually discharge to either the River Waycock and/or Nant Llancarfan and/or infiltrate to ground. The impacts on these receptors are assessed qualitatively in Table 15.20.

Table 15.20: Impacts of Pollutants in Surface Water Runoff during Operation from Sycamore Cross Junction

Receptor	Description of Impact	Magnitude	Significance
Tributaries of Nant Llancarfan from Redland Wood	No direct or indirect runoff from the development is expected into this watercourse.	Negligible	Neutral
Offline watercourse north of Sycamore Cross junction	This watercourse may form part of the highway drainage system and may therefore receive runoff from the junction. However, this will be similar to the existing situation and therefore unlikely to cause loss in quality or biodiversity.	Minor Adverse	Neutral

Table 15.20: Impacts of Pollutants in Surface Water Runoff during Operation from Sycamore Cross Junction

Receptor	Description of Impact	Magnitude	Significance
Unnamed pond at outfall of watercourse north of Sycamore Cross junction	This pond may receive runoff from the offline watercourse north of Sycamore Cross junction that may in turn receive runoff from the junction. However, this will be similar to the existing situation and therefore unlikely to cause loss in quality or biodiversity.	Minor Adverse	Neutral
Golf course ponds	No direct or indirect runoff from the development is expected into this pond.	Negligible	Neutral
Unnamed ponds in woodland adjacent to A48	These ponds may form part of the highway drainage system and may therefore receive runoff from the junction. However, this will be similar to the existing situation and therefore unlikely to cause loss in quality or biodiversity.	Minor Adverse	Neutral
River Waycock	It is assumed that indirect discharge into this watercourse may occur from the surface water drainage network at Sycamore Cross junction. The upstream end of the River Waycock is located approximately 1km downstream of the junction and some treatment of pollutants prior to discharge is considered likely to be present. Despite this, without further knowledge of specific surface water treatment provided for discharge from the junction, it is assumed that there may be an adverse impact on the receptor although unlikely to cause loss in quality or biodiversity.	Minor Adverse	Moderate to Large Adverse
Nant Llancarfan	It is assumed that indirect discharge into this watercourse may occur from the surface water drainage network at Sycamore Cross junction. The upstream end of the Nant Llancarfan is located approximately 2km downstream of the junction and some treatment of pollutants prior to discharge is considered likely to be present. Despite this, without further knowledge of specific surface water treatment provided for discharge from the junction, it is assumed that there may be an adverse impact on the receptor although unlikely to cause loss in quality or biodiversity.	Minor Adverse	Slight to Moderate Adverse
Groundwater resources	If surface water runoff from the junction is discharge to the identified ponds, some infiltration of surface water runoff may occur. Slight increased risk of pollution depending on presence of existing treatment systems, although groundwater believed to flow south away from domestic water supply.	Minor Adverse	Moderate to Large Adverse

Increased Flood Risk Caused by the Location of the Scheme

15.5.71 Both the existing and new road alignments are classified as 'less vulnerable development' in accordance with the categories outlined in TAN 15. Sycamore Cross junction and the majority of the Scheme is proposed in areas classified as low risk Zone A. However, the Scheme passes through areas classified as Zone C2 and Zone B near the River Waycock and the unnamed tributary to the north of River Waycock. The development of less vulnerable development is acceptable in Zone C2 and Zone B subject to an assessment of the consequences of flooding as acceptable under the TAN 15 criteria.

15.5.72 Approximately 150m of the Scheme is located in Zone C2 associated with fluvial flooding in the 1 in 1000 year return period event from the River Waycock. The Scheme ties into the existing road immediately north of the existing bridge over the River Waycock and therefore the alignment and level of the Scheme cannot be altered to avoid this area of flood risk.

15.5.73 A comparison of the boundary of Zone C2 with the topographic survey of the area indicates that the maximum level that floodwater from the River Waycock reaches at this location is approximately 23m AOD. This suggests that the maximum depth of flooding that might impact the Scheme in a 1 in 1000 year rainfall event from this source is 9mm, which is considered to pose a negligible increase in risk to users of the road.

15.5.74 Approximately 200m of the Scheme is located in Zone B (areas indicated to have been flooded in the past by superficial deposits). In this area, the Scheme is raised above existing ground levels by an average of approximately 0.5m. The risk of flooding to users of the Scheme is therefore considered to be negligible.

15.5.75 The increase in elevation of the Scheme above existing ground levels will displace approximately 15m^3 of water within Zone C2 and 100m^3 of water within Zone B. Considering the 47ha size of the catchment of the River Waycock, this loss of floodplain storage is considered negligible is not predicted to significantly increase flood risk elsewhere.

15.5.76 The impacts of the location of the Scheme in an area deemed to be at flood risk on users of the road and people and property elsewhere are direct and permanent. However, the magnitude of the impact is considered negligible and therefore neutral in significance.

Impacts to Hydromorphology and Channel Hydraulics

15.5.77 It is proposed to realign approximately 230m of the unnamed watercourse crossing the existing Five Mile Lane from the north. The watercourse will be realigned so it flows adjacent to the Scheme before being culverted beneath both the proposed and existing roads to re-join its current alignment. The culvert will be of an equivalent or greater size to the existing culvert to ensure that flood risk to the road is not increased by throttling of flows through the new culvert. Where the Scheme will run adjacent to the watercourse the road will be elevated between 300mm and 900mm above existing ground. If flooding from the watercourse occurs floodwater will follow topography and flow adjacent to the road and into the River Waycock without spilling onto the new road or increasing the risk of flooding to the existing road.

15.5.78 The proposed realignment works will have an effect on the hydromorphology of this watercourse, although the watercourse has been realigned, straightened and

culverted beneath the exiting Five Mile Lane in the past. The realignment of the upper reaches on this watercourse is not considered to pose a long term impact to its quality or integrity.

15.5.79 It is proposed to re-align and widen the tributary of the River Waycock that flows north adjacent to the existing road that is proposed to be widened. Only where it is necessary to alter the watercourse will works be undertaken. Otherwise the watercourse will remain in its present location and form. The dimensions of the watercourse will not be reduced as a result of the works to ensure that flood risk to the road is not increased. Should flooding from the watercourse occur during extreme events, topography is such that floodwater will spill into Barry Woodland and flow toward the River Waycock and will not flow onto the widened road.

15.5.80 The works will have an effect on the hydromorphology of this watercourse in sections where the widening of the watercourse is necessary, although the watercourse has been realigned and straightened in the past to flow adjacent to the existing Five Mile Lane. The realignment of this therefore watercourse is not considered to pose a long term impact to its quality or integrity.

15.5.81 The re-alignment and culverting of these tributaries in terms of flood risk to users of the road and people and property elsewhere is considered to be negligible in magnitude and neutral in significance. The re-alignment and culverting of these tributaries in terms of hydromorphology and aquatic value is also considered to be negligible in magnitude and neutral in significance.

Increased Flood Risk Caused by an Increase in Surface Water Runoff and Exceedence of Drainage Systems

15.5.82 The Scheme will increase the impermeable area of the site by approximately 4.3ha.

15.5.83 To manage the increased surface water generated by this area the following measures will be put in place:

- The unnamed tributary of the River Waycock that flows parallel to the road from the south (between Ch4000m and Ch4852m) will be widened to provide attenuation storage for the increased surface water runoff generated by the proposed widening of the carriageway to the south of the River Waycock crossing.
- Wetlands and balancing ponds will be used to attenuate discharges from the proposed road. The peak discharge rate into all watercourses will be limited to greenfield discharge rates. Storage will be provided for all rainfall events up to the 1 in 100 year return period event. This will prevent an increase in flood risk downstream.
- Climate change will be incorporated into calculations for detention structures to mitigate against any potential increase in peak rainfall intensities.

15.5.84 In the event of system failure or extreme rainfall events beyond the 1 in 100 year return period event, any overflow from the drainage system and detention ponds will be directed toward the watercourses into which discharge is proposed and away from the proposed and existing roads and vulnerable property.

15.5.85 The impermeable area of road at Sycamore Cross junction is proposed to be increased by approximately 650m^2 as a result of the road widening and new cycle lane provision. Whilst details of the surface water drainage network for this area are unknown, the existing drainage system will be maintained and it is assumed that this

marginal increase in impermeable area draining to the surface water network and downstream receptors will have negligible impact on flood risk.

15.5.86 Flood risk caused by an increase in surface water runoff and exceedence of the surface water drainage system is considered to be an indirect and temporary impact - although the absence of mitigation measures would result in a permanent risk of flooding, flood risk is dependent on the occurrence of extreme weather conditions and is therefore considered to be temporary.

15.5.87 In light of the proposals outlined above, the magnitude of the impact of flood risk caused by an increase in surface water runoff or exceedence of drainage systems on users of the road and third party people and property is negligible with an overall neutral significance.

Flood risk caused by poorly maintained surface water management features

15.5.88 If surface water management features are not maintained, their capacity could be reduced or systems could become blocked. In these events, the surface water drainage system has been designed not to pose an unacceptable risk of flooding to users of the road or to people and property elsewhere.

15.5.89 However, in the event that flooding occurred from the system, any overflow from the drainage system and detention ponds will be directed toward the watercourses into which discharge is proposed and away from the proposed and existing roads.

15.5.90 The impact associated with a lack of maintenance to the users of the road is therefore considered negligible. The overall significance of this impact to road users is considered to be neutral. There is however an increased risk to people and property downstream of the Scheme as improperly functioning surface water attenuation systems would result in an increase in the rate and volume of water being discharged into downstream watercourses, principally the River Waycock. This could result in a minor adverse impact to people and property elsewhere with an overall significance of moderate to large adverse.

15.5.91 Flood risk caused by poorly maintained surface water management features is considered to be an indirect and permanent impact. Although the magnitude of the storm required to exceed surface water management features would be a temporary occurrence, the absence of mitigation measures could result in an uncontrolled blockage or reduced capacity in the drainage system that would then pose a permanent risk.

Summary of Impacts during Operation

15.5.92 Table 15.21 provides a summary of key risks to the water environment during operation and the associated magnitude and significance of these risks to identified receptors.

Table 15.21: Summary of Impacts during Operation

Receptor	Importance	Impact	Magnitude	Significance
Nant Talwg	Very High	Pollutants contained in surface water runoff	Negligible	Neutral
Tributary of River Waycock flowing north parallel to Five Mile Lane	Very High	Pollutants contained in surface water runoff	Negligible	Neutral
		Impacts to hydromorphology and channel hydraulics	Negligible	Neutral
River Waycock	Very High	Pollutants contained in surface water runoff	Negligible (from Five Mile Lane)	Neutral (from Five Mile Lane)
			Minor Adverse (from Sycamore Cross)	Moderate to Large Adverse (from Sycamore Cross)
Tributary of River Waycock flowing south and crossing beneath Five Mile Lane	Medium	Pollutants contained in surface water runoff	Negligible	Neutral
		Impacts to hydromorphology and channel hydraulics	Negligible	Neutral
Moulton Brook	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Ffynnon Whitton-mawr	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Ford Brook	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Nant Whitton	High	Pollutants contained in surface water runoff	Negligible	Neutral
Nant Llancarfan	High	Pollutants contained in surface water runoff	Negligible (from Five Mile Lane)	Neutral (from Five Mile Lane)
			Minor Adverse (from Sycamore Cross)	Slight to Moderate Adverse (from Sycamore Cross)
Tributary of River Waycock flowing around the south side of Blackland Farm	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Tributary of River Waycock flowing from the east side of Blackland Farm	Low	Pollutants contained in surface water runoff	Negligible	Neutral

Table 15.21: Summary of Impacts during Operation

Receptor	Importance	Impact	Magnitude	Significance
Tributary of River Waycock to the north-east of Blackland Farm	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Tributaries of Nant Llancarfan from Redland Wood	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Offline watercourse north of Sycamore Cross junction	Low	Pollutants contained in surface water runoff	Minor Adverse	Neutral
Unnamed pond at outfall of watercourse north of Sycamore Cross junction	Low	Pollutants contained in surface water runoff	Minor Adverse	Neutral
Golf course ponds	High	Pollutants contained in surface water runoff	Negligible	Neutral
Unnamed ponds in woodland adjacent to A48	Low	Pollutants contained in surface water runoff	Minor Adverse	Neutral
Groundwater resources	Very High	Pollutants contained in surface water runoff	Negligible (from Five Mile Lane)	Neutral (from Five Mile Lane)
			Minor Adverse (from Sycamore Cross)	Moderate to Large Adverse (from Sycamore Cross)
Users of the road	Very High	Increased flood risk caused by the location of the proposed development	Negligible	Neutral
		Increased flood risk caused by an increase in surface water runoff and exceedence of drainage systems	Negligible	Neutral
		Flood risk caused by poorly maintained surface water management features	Negligible	Neutral
People and property on third party land and downstream	High	Increased flood risk caused by the location of the proposed development	Negligible	Neutral

Table 15.21: Summary of Impacts during Operation

Receptor	Import ance	Impact	Magnitude	Significance
		Increased flood risk caused by an increase in surface water runoff and exceedence of drainage systems	Negligible	Neutral
		Flood risk caused by poorly maintained surface water management features	Minor Adverse	Slight to Moderate Adverse

15.6 Mitigation

15.6.1 This section provides a summary of recommended mitigation measures to control or reduce the potential impacts identified in Section 15.5. The measures recommended in this section are in addition to those discussed prior to assessment of impacts – i.e. measures that are not embedded in the design of the surface water and foul water drainage systems and layout of the proposed development.

Construction

15.6.2 It is recommended that the contractor be required to prepare a CEMP that will include mitigation measures to protect the water environment. This will set out how construction activities will be undertaken in accordance with the Pollution Prevention Guidelines (PPG) published by the EA. Particular attention should be given to PPG1 - General guide to the prevention of water pollution; PPG2 - Above ground oil storage tanks; PPG 5 - Works in, near or liable to affect watercourses; and PPG 6 - Working at construction and demolition sites, and other good construction guidance such as guidance on silt pollution and how to prevent it.

15.6.3 The CEMP should contain construction method statements and work instructions for on-site staff that will inform them of the way that they should work on site to reduce the risk off polluting the surrounding environment. It will include instructions on dealing with certain situations such as general good site practice, adverse weather conditions, environmental incidents and complaints.

15.6.4 There should be inspections and audits along with general monitoring and reporting of effectiveness of control measures. It is recommended that the contractor undertakes monitoring of water quality against the baseline results in Table 15.9.

15.6.5 At minimum, measures that should be included in the construction method statements and work instructions for managing risks to the water environment should include:

- Management of water that collects on site or within excavations.
- Management of polluting substances that are being brought on site and used as part of the construction process.
- Working methods for working in close proximity, or within, watercourses and drainage ditches.

15.6.6 The mitigation strategies implemented should be reviewed regularly to best suit the practices currently being undertaken on site.

15.6.7 Recommended measures that should be included in the CEMP are summarised below.

Increased Sediment Loads

15.6.8 Minimise areas of exposed surface by only removing vegetation when necessary and keep gradients as shallow as possible to prevent large amounts of earth being washed away during periods of heavy rainfall. Areas that are exposed should be reseeded or surfaced as soon as practicable.

15.6.9 Undertake works during periods of low flow to prevent transportation of sediment downstream.

15.6.10 Enforce tight control of site boundaries including minimal land clearance and restrictions on the use of machinery adjacent to water bodies. Where possible, do not locate stockpiles within 10m of water bodies or drainage lines.

15.6.11 Provide wheel wash facilities at all entry and exits points. Water from wheel wash facilities must not be discharged into water bodies or the on-site surface water sewerage network.

15.6.12 Capture site runoff in perimeter cut off ditches, settlement lagoons and/or settlement tanks where possible. Any dewatering required from site excavations should be pumped into a settlement tank or lagoon and not discharged directly to a water body or the on-site surface water sewerage network.

Release of Hydrocarbons and Oils

15.6.13 Incorporate interceptors into the site drainage system in high risk areas, such as parking, unloading and refuelling areas, to remove hydrocarbons and oils from surface water prior to discharge.

15.6.14 Other measures including drip trays under equipment such as generators, and wheel washing facilities should also be implemented to minimise the risk of pollutants infiltrating groundwater or the surface water drainage network. Drip trays used for diesel pumps and standing plant should be regularly maintained to prevent leaks.

Use of Hazardous Materials

15.6.15 Provide storage facilities and tanks and conduct refuelling of machinery within bunded areas, which should not be located within 10m of water bodies or drainage lines. Storage and bunded areas should be constructed of impervious floors and walls with the capacity for the contents of the storage tank and an additional 10% safety margin.

15.6.16 Construction materials, such as cement, should be mixed in designated areas located away from water bodies and drainage lines.

15.6.17 Precast culvert sections should be used to minimise the need for in-situ concrete pours in close proximity to watercourses.

15.6.18 As a remedial measure, spill containment equipment such as absorbent materials should be stored on site.

Dust and Debris

15.6.19 Dust management procedures should be applied which are typically implemented for air quality management issues, such as damping down to suppress the formation of dust. Contractors should also implement good site practice, perimeter fences and tight control of materials and waste to minimise the risk of debris entering water bodies.

Flood Risk

15.6.20 For works located within Zone C, it is recommended that the contractor prepares and implements a Flood Emergency Response Plan during the construction phase. The Plan should include arrangements to evacuate the area at flood risk, make safe any static plant, and move any mobile plant.

15.6.21 Construction workers should also be made aware of risks associated with excess surface water caused by overland flows and standing water - for example risks to deep excavations and damage to plant.

Operation

15.6.22 Mitigation controls must be considered from the beginning of the detailed design phase in order to avoid, reduce and minimise any significant adverse effects on surface water, groundwater and increased flood risk. This will enable mitigation to be embedded in the design and therefore minimise the need for active controls during occupation.

15.6.23 Many of the potential impacts during operation have already been mitigated through the design process, for example, flood risk has been mitigated through the provision of a robust surface water drainage system, adherence to NRW requirements and the use of SUDS techniques.

15.6.24 It is recommended that new and existing surface water management features be maintained to remove any debris, blockages or overgrown vegetation. Maintenance of onsite drainage systems will be the responsibility of Vale of Glamorgan Council as part of their asset management duties. .

15.6.25 Maintenance of highway drainage including any silt traps, gully pots and filter drains will ensure efficient removal of sediment, hydrocarbons and other pollutants, which will reduce the risk of pollution posed to surface water and groundwater. Effective maintenance of the wetland areas and detention basins will also maximise the removal of pollutants by vegetation and bacteria and this will protect both surface water and groundwater resources.

15.6.26 It is recommended that further investigation of on-site groundwater levels and soil infiltration rates be undertaken prior to design completion. Where infiltration rates are found to be high and there is a risk that groundwater levels are high such that a direct path might exist for pollutants to migrate to groundwater, wetland and detention pond areas should be lined with an impermeable layer to prevent pollution of groundwater.

15.6.27 It is also recommended that further analysis of the existing drainage system serving Sycamore Cross junction is undertaken to identify any issues associated with capacity and treatment, and confirm downstream receptors.

15.6.28 A clear 4m access corridor should be provided adjacent to all surface water management features to enable maintenance. No trees, vegetation or fencing should be placed within the designated maintenance access corridor.

15.7 Residual Effects (with Mitigation)

15.7.1 Significant impacts identified in Table 15.16 and Table 15.21 have been addressed and mitigation measures proposed to minimise the scale of the impact on the water environment.

Construction

15.7.2 The provision of, and adherence to, the measures outlined in the CEMP is considered adequate to reduce the likelihood of increased sediment loading, the release of hydrocarbons, hazardous substances and dust and debris. Where indirect impacts are expected, the magnitude of the impact with implementation of the CEMP can be reduced to negligible. However, where direct impacts are expected due to construction works taking place directly above watercourses there may still be some residual risk.

15.7.3 The greatest residual risks are identified to be within the tributary of the River Waycock that flows north adjacent to the road and the tributary of the River Waycock that flows south and crosses beneath the road. Due to the works within the channel of these watercourses, a residual risk associated with increased sedimentation remains likely. The magnitude of this impact is considered to be Minor Adverse with an overall impact significance of Moderate Adverse to Slight Adverse. A residual impact of Moderate Adverse significance also remains to the River Waycock as the river is located immediately downstream of these two tributaries.

15.7.4 These residual risks are temporary, however, and do not pose a risk to the long-term quality of the watercourses, local habitats or the watercourses' ability to achieve 'good' status under the WFD objectives.

15.7.5 Flood warning and flood risk management procedures outlined in the CEMP are considered adequate to render the impact of flood risk to construction operatives negligible with an overall significance of neutral.

Operation

15.7.6 Adverse impacts post construction will be mitigated through the detailed design of the development and, for the most part, are considered negligible.

15.7.7 It is proposed to maintain and reuse the existing drainage system serving Sycamore Cross junction. However, the details of this system have not yet been confirmed. Assumptions have therefore been made regarding the likely outfall of this system and the likely downstream receptors, as well as likely treatment systems that may be in place. It is considered highly likely that the existing drainage system has capacity to cater for the increase in impermeable area of 650m^2, but it is not clear if the existing drainage system has capacity to provide adequate treatment of runoff associated with the predicted 21% increase in traffic flow as a result of the proposed works. Some residual risk is therefore considered likely. At this stage, the residual risks associated with works at Sycamore Cross remain the same as those assessed during the unmitigated scenario.

15.7.8 If storm conditions exceed those predicted for the 1 in 100 year event or are significantly influenced by climate change (beyond that which has been accepted by NRW and as assessed within this ES), flood risk caused by exceedence of drainage systems could still occur.

15.8 Cumulative Effects

15.8.1 Within 500m of the Scheme there are five developments that are, at the time of writing, seeking planning permission.

15.8.2 Each of the developments seeking planning permission is outlined briefly below. A plan illustrating the location of these developments is provided in Chapter 16 Cumulative Effects.

- 2014/01205/SC1 – (160m from the Scheme) proposed residential development. 60 dwellings to be constructed in 2016. 60 dwellings to be constructed after 2021. A review of topography indicates that this site sits within the catchment of Nant Whitewell, which in turn discharges into Nant Llancarfan;
- 2014/00798/FUL - (120m from the Scheme) 6MW Solar PV array. This development is shown to lie in the catchment of the River Waycock, near the upstream tributaries of the river;
- 2014/01103/NMA - (300m from site) 8MW Solar farm covering 19ha. This development lies in the catchment of a minor tributary of the River Waycock;
- 2014/00081/FUL - (50m from the Scheme) 7MV PV solar farm including one electrical substation, seven power inverter stations and other supplementary works. This development lies in the catchment of the River Waycock and discharges into the River Waycock;
- 2015/00365/SC1 – (400m south-west of the Scheme) solar photovoltaic array covering a 14ha area.

15.8.3 Should these developments be granted planning permission, the following cumulative impacts to the water environment may occur from these developments and the Scheme during construction and operation.

Construction

15.8.4 To inform the assessment of cumulative impacts during construction, it is assumed that construction of the Scheme and the development in question occurs simultaneously. The cumulative impacts occurring during construction as a result of each of the developments listed above have been considered individually.

2014/01205/SC1

15.8.5 The cumulative impact of runoff from this development and the Scheme would most likely occur within Nant Llancarfan at a location approximately 6km downstream of the proposed residential development and 3.5km downstream of the Scheme. Whilst the construction of the Scheme has the potential to impact water quality within the Nant Llancarfan, these risks are considered negligible post-mitigation. The distance from the two sites to the point of potential cumulative impact will further reduce the concentration of pollutants from the developments via dilution, filtration, settlement and bacteriological treatment such that the cumulative impact is considered to be negligible.

15.8.6 The development is 6.8km upstream of where Nant Llancarfan discharges into the River Waycock. It is anticipated therefore that dilution, filtration, settlement and bacteriological treatment would further remove pollutants and sediment prior to the confluence of Nant Llancarfan with the River Waycock. Therefore, the cumulative impacts in the River Waycock that result from this development and the Scheme are also considered negligible.

2014/00798/FUL

15.8.7 The cumulative impact of runoff from this development and the Scheme would most likely occur within the River Waycock approximately 2.5km downstream of the Scheme. Whilst the construction of the Scheme has the potential to impact water quality within the River Waycock, these risks are considered negligible post-mitigation. The distance from the Scheme to the point at which potential cumulative impact could occur is considered large enough that dilution, settlement, filtration and bacteriological treatment in the River Waycock would adequately reduce the concentration of pollutants such that cumulative impacts would be negligible.

2014/01103/NMA

15.8.8 Runoff from this site during construction will discharge into the River Waycock approximately 2km downstream of the Scheme. Whilst the construction of the Scheme has the potential to impact water quality within the River Waycock, these risks are considered negligible post-mitigation. The distance from the Scheme to the point at which potential cumulative impact could occur is considered large enough that dilution, settlement, filtration and bacteriological treatment in the River Waycock would adequately reduce the concentration of pollutants such that cumulative impacts would be negligible.

2014/00081/FUL

15.8.9 Runoff from this site during construction will discharge into the River Waycock. Due to the proximity of this development to the Scheme, cumulative impact may occur within the River Waycock in close proximity to the crossing of the river beneath Five Mile Lane. Assuming that appropriate mitigation is implemented during construction of both developments, the risk of pollution is likely to be low although there is likely to be a residual risk associated with increased sedimentation. This impact is considered unlikely to cause a loss of part of the watercourse or significantly affect its integrity, but should construction of the two developments occur at the same time the cumulative impact to the River Waycock is considered to be Minor Adverse with an impact significance of Moderate Adverse.

2015/00365/SC1

15.8.10 Runoff from this site during construction will discharge into the River Waycock. Due to the proximity of this development to the Scheme, cumulative impact may occur within the River Waycock approximately 500m downstream of the crossing of the river beneath Waycock Road. Assuming that appropriate mitigation is implemented during construction of both developments, the risk of pollution is likely to be low although there is likely to be a residual risk associated with increased sedimentation. This impact is considered unlikely to cause a loss of part of the watercourse or significantly affect its integrity, but should construction of the two developments occur at the same time the cumulative impact to the River Waycock is considered to be Minor Adverse with an impact significance of Moderate Adverse.

Summary

15.8.11 Table 15.22 summarises the potential cumulative impacts posed to the water environment during construction of the developments listed above.

Table 15.22: Summary of Cumulative Effects During Construction

Development ref	Receptor	Magnitude of Cumulative Impact	Significance of Cumulative Effect
2014/01205/SC1	Nant Llancarfan	Negligible	Neutral
	River Waycock	Negligible	Neutral
2014/00798/FUL	River Waycock	Negligible	Neutral
2014/01103/NMA	River Waycock	Negligible	Neutral
2014/00081/FUL	River Waycock	Minor Adverse	Moderate Adverse
2015/00365/SC1	River Waycock	Minor Adverse	Moderate Adverse

Operation

15.8.12 In assessing the cumulative impacts during operation, it has been assumed that discharge of runoff from the sites will occur to watercourses within the catchments of the sites. This may not necessarily be accurate as surface water could be discharged via infiltration or to the public sewerage network. It has also been assumed that best practice measures will be implemented at the sites to control pollution risks from high risk development areas such as roads and car parking areas.

2014/01205/SC1

15.8.13 The cumulative impact of runoff from this development and the Scheme would occur within Nant Llancarfan at a location approximately 6km downstream of the proposed residential development and 2.5km downstream of the Scheme. Significant mitigation has been provided to reduce the concentration of pollutants discharged in runoff from the road with the exception of the possible minor adverse magnitude impact arising from increased traffic flows at Sycamore Cross junction. However, the distance from the two sites to the point of cumulative impact will further reduce the concentration of pollutants from the developments via dilution, filtration, settlement and bacteriological treatment such that the cumulative impact is considered to be negligible.

15.8.14 The development is 6.8km upstream of where Nant Llancarfan discharges into the River Waycock. It is anticipated therefore that dilution, filtration, settlement and bacteriological treatment would further remove pollutants and sediment prior to the confluence of Nant Llancarfan with the River Waycock. Therefore, the cumulative impacts in the River Waycock that result from this development and the Scheme are also considered negligible.

2014/00798/FUL

15.8.15 The cumulative impact of runoff from this development and the Scheme would occur within the River Waycock. There is expected to be little or no polluted runoff from the solar array during operation. Discharge from the road occurs at a location approximately 2.5km upstream of the location where cumulative impacts could occur. As a result of the anticipated low levels of pollutants from the development site, the mitigation provided to treat discharge from the Scheme and the 2.5km for dilution,

filtration, settlement of pollutants from the road site, the anticipated cumulative impact is considered to be negligible.

2014/01103/NMA

15.8.16 The cumulative impact of runoff from this development and the Scheme would occur within the River Waycock. There is expected to be little or no polluted runoff from the solar array during operation. Discharge from the Scheme occurs at a location approximately 2km upstream of the location where cumulative impacts could occur. As a result of the anticipated low levels of pollutants from the development site, the mitigation provided to treat discharge from the Scheme and the 2km for dilution, filtration, settlement of pollutants from the road site, the anticipated cumulative impact is considered to be negligible.

2014/00081/FUL

15.8.17 It is assumed that runoff from this development will be discharged to the River Waycock approximately 250m upstream of the crossing of the River Waycock beneath the Scheme. However, significant mitigation will be provided to treat discharge from the Scheme, with the exception of the possible minor adverse magnitude impact arising from increased traffic flows at Sycamore Cross junction, road and runoff from the PV farm is anticipated to be relatively unpolluted. The treatment provided for runoff from the Scheme, the distance between the PV site and the potential discharge from Sycamore Cross junction and the relatively clean nature of runoff from the PV farm mean that Therefore, the cumulative impact posed to the River Waycock is considered negligible.

2013/00701/OUT

15.8.18 Review of local topography indicates that this site lies in the catchment of Nant Talwg. The operation of the Scheme is not predicted to pose any risk to the Nant Talwg and therefore no cumulative impacts are predicted.

2015/00365/SC1

15.8.19 The Scheme is located adjacent to the River Waycock. However, due to the low risk nature of the Scheme, no cumulative operational effects are anticipated.

Summary

15.8.20 Table 15.23 summarises the potential cumulative impacts posed to the water environment during operation of the developments listed above.

Table 15.23: Summary of Cumulative Effects during Operation

Development ref	Receptor	Magnitude of Cumulative Impact	Significance of Cumulative Effect
2014/01205/SC1	Nant Llancarfan	Negligible	Neutral
	River Waycock	Negligible	Neutral
2014/00798/FUL	River Waycock	Negligible	Neutral
2014/01103/NMA	River Waycock	Negligible	Neutral
2014/00081/FUL	River Waycock	Negligible	Neutral
2013/00701/OUT	Nant Talwg	Negligible	Neutral

Development ref	Receptor	Magnitude of Cumulative Impact	Significance of Cumulative Effect
2015/00365/SC1	River Waycock	Negligible	Neutral

15.9 Summary & Conclusions

15.9.1 An assessment of the potential impacts associated with construction and operation of the Scheme has been undertaken in relation to the water environment. The assessment identified the potential hydrological effects that the Scheme may have on the surrounding area and assessed the potential implications of any such hydrological effects for the development. Mitigation measures have been proposed, where necessary, to minimise the scale of the impacts identified.

15.9.2 The assessment has been undertaken whilst taking the consultation responses received from the Vale of Glamorgan Council and NRW into account. In summary:

- The FCA satisfies the Vale of Glamorgan Council's requirements for an assessment of flood risk and the consequences of development;
- This assessment demonstrates that there will be no significant increase in flood risk as a result of the Scheme. The road alignment displaces a negligible volume of fluvial floodwater from Zone C2 and the surface water strategy outlines how runoff from the increased impermeable area will be attenuated to prevent an increase in flood risk downstream.
- This assessment includes the design of a surface water drainage system and identifies how SUDS will be implemented, setting aside land for wetlands and detention basins and attenuating discharge to greenfield rates in events up to the 1 in 100 year return period event, including an allowance for climate change, in accordance with TAN 15 guidance.
- Mitigation measures have been outlined to minimise the discharge of pollutants, including sediment, hydrocarbons and other hazardous substances, to watercourses near the site during construction of the Scheme.

15.9.3 The assessment has also been undertaken whilst taking national and local policies and legislation into account.

15.9.4 PPW requirements have been satisfied through:

- The provision of protection of water resources by controlling discharge rates and the quality of surface water runoff from the Scheme;
- The consideration of the DAM in accordance with TAN15 to confirm that the location of the Scheme is in areas defined as being of the lowest flood risk where possible. Only where the Scheme crosses the River Waycock at the existing crossing does a short stretch of road pass through Zones C2 and B and the consequences of flooding of the Scheme in this area have been assessed and deemed acceptable.

15.9.5 Local Development Plan (LDP) policies have been satisfied in the following ways:

- Policy MD1 is satisfied by the location of the Scheme out of the floodplain where possible and by providing adequate treatment of surface water prior to discharge in order that water resources are safeguarded.

- Policy MD8 is also satisfied by the provision water quality treatment prior to discharge and by provision of attenuation to limit the rate of discharge from the road drainage network so as not to increase flood risk to people or property downstream of the Scheme.

15.9.6 Within 500m of the Scheme there are five developments that are, at the time of writing, seeking planning permission. Should these developments be granted planning permission a potential moderate adverse cumulative effect is predicted for 2014/00081/FUL (a 7MV PV solar farm located approximately 50m from the Scheme) and 2015/00365/SC1 (14ha solar photovoltaic array located approximately 400m southeast of the Scheme) during construction. A neutral cumulative effect is predicted for the other developments. Neutral cumulative effects are predicted for all five developments during operation.

15.9.7 Overall, under the EIA regulations, these residual effects to the water environment are considered not significant.

15.9.8 A summary of key impacts and proposed mitigation is provided in Table 15.24 and Table 15.25.

Table 15.24: Summary of Residual Impacts during Construction

Receptor	Importance	Impact	Magnitude	Significance
Nant Talwg	Very High	Increased sediment loading	Negligible	Neutral
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Tributary of River Waycock flowing north parallel to Five Mile Lane	Very High	Increased sediment loading	Minor Adverse	Moderate Adverse
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
River Waycock	Very High	Increased sediment loading	Minor Adverse	Moderate Adverse
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral

Table 15.24: Summary of Residual Impacts during Construction

Receptor	Importance	Impact	Magnitude	Significance
Tributary of River Waycock flowing south and crossing beneath Five Mile Lane	Medium	Increased sediment loading	Minor Adverse	Slight Adverse
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Moulton Brook	Low	Increased sediment loading	Negligible	Neutral
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Ffynnon Whitton-mawr	Low	Increased sediment loading	Negligible	Neutral
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Ford Brook	Low	Increased sediment loading	Negligible	Neutral
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Nant Whitton	High	Increased sediment loading	Negligible	Neutral
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral

Table 15.24: Summary of Residual Impacts during Construction

Receptor	Importance	Impact	Magnitude	Significance
Nant Llancarfan	High	Increased sediment loading	Negligible	Neutral
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Tributary of River Waycock flowing around the south side of Blackland Farm	Medium	Increased sediment loading	Minor Adverse	Neutral
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Tributary of River Waycock flowing from the east side of Blackland Farm	Low	Increased sediment loading	Negligible	Neutral
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Tributary of River Waycock to the north-east of Blackland Farm	Low	Increased sediment loading	Negligible	Neutral
		Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Tributaries of Nant Llancarfan from Redland Wood	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Offline watercourse north of Sycamore Cross junction	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Minor Adverse	Neutral

Table 15.24: Summary of Residual Impacts during Construction

Receptor	Importance	Impact	Magnitude	Significance
		Dust and debris	Minor Adverse	Neutral
Unnamed pond at outfall of watercourse north of Sycamore Cross junction	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Golf course ponds	High	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Unnamed ponds in woodland adjacent to A48	Low	Increased pollution from sediment, hydrocarbons and hazardous materials	Negligible	Neutral
		Dust and debris	Negligible	Neutral
Groundwater resources	Very High	Release of hydrocarbons and oils	Negligible	Neutral
		Release of hazardous materials	Negligible	Neutral
Site operatives and plant	Very High	Flood risk	Negligible	Neutral
People and property on third party land and downstream	Very High	Flood risk	Negligible	Neutral

Table 15.25: Summary of Residual Impacts during Operation

Receptor	Importance	Impact	Magnitude	Significance
Nant Talwg	Very High	Pollutants contained in surface water runoff	Negligible	Neutral

Table 15.25: Summary of Residual Impacts during Operation

Receptor	Importance	Impact	Magnitude	Significance
Tributary of River Waycock flowing north parallel to Five Mile Lane	Very High	Pollutants contained in surface water runoff	Negligible	Neutral
River Waycock	Very High	Pollutants contained in surface water runoff	Negligible (Five Mile Lane)	Neutral (Five Mile Lane)
			Minor Adverse (Sycamore Cross)	Moderate to Large Adverse (Sycamore Cross)
Tributary of River Waycock flowing south and crossing beneath Five Mile Lane	Medium	Pollutants contained in surface water runoff	Negligible	Neutral
Moulton Brook	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Ffynnon Whitton-mawr	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Ford Brook	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Nant Whitton	High	Pollutants contained in surface water runoff	Negligible	Neutral
Nant Llancarfan	High	Pollutants contained in surface water runoff	Negligible (Five Mile Lane)	Neutral (Five Mile Lane)
			Minor Adverse (Sycamore Cross)	Slight to Moderate Adverse (Sycamore Cross)
Tributary of River Waycock east of Blackland Farm	Medium	Pollutants contained in surface water runoff	Negligible	Neutral
Tributary of River Waycock from Blackland Farm	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Tributary of River Waycock between Oaklands Farm and Redland	Low	Pollutants contained in surface water runoff	Negligible	Neutral
Tributaries of Nant Llancarfan from Redland Wood	Low	Pollutants contained in surface water runoff	Negligible	Neutral

Table 15.25: Summary of Residual Impacts during Operation

Receptor	Importance	Impact	Magnitude	Significance
Offline watercourse north of Sycamore Cross junction	Low	Pollutants contained in surface water runoff	Minor Adverse	Neutral
Unnamed pond at outfall of watercourse north of Sycamore Cross junction	Low	Pollutants contained in surface water runoff	Minor Adverse	Neutral
Golf course ponds	High	Pollutants contained in surface water runoff	Negligible	Neutral
Unnamed ponds in woodland adjacent to A48	Low	Pollutants contained in surface water runoff	Minor Adverse	Neutral
Groundwater resources	Very High	Pollutants contained in surface water runoff	Negligible (Five Mile Lane)	Neutral (Five Mile Lane)
			Minor Adverse (Sycamore Cross)	Moderate to Large Adverse (Sycamore Cross)
Users of the road	Very High	Increased flood risk caused by the location of the proposed development	Negligible	Neutral
		Increased flood risk caused by an increase in surface water runoff and exceedence of drainage systems	Negligible	Neutral
		Flood risk caused by poorly maintained surface water management features	Negligible	Neutral
People and property on third party land and downstream	Very High	Increased flood risk caused by the location of the proposed development	Negligible	Neutral
		Increased flood risk caused by an increase in surface water runoff and exceedence of drainage systems	Negligible	Neutral
		Flood risk caused by poorly maintained surface water management features	Negligible	Neutral

16 CUMULATIVE IMPACTS

16.1 Introduction

16.1.1 This chapter of the ES assesses the cumulative impacts from a single project (e.g. combined effects of differing environmental impacts on a single receptor or resource) and the cumulative impacts from different projects (in combination with the project being assessed).

16.1.2 All known projects and plans are assessed cumulatively with the Scheme. Cumulative impacts can result from multiple actions on receptors and resources and 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 Scheme.

16.2 Assessment Methodology

16.2.1 The approach to assessing cumulative impacts is addressed under DMRB Volume 11, Section 2, Part 5 (HA 205/08). This draws on guidelines for assessing indirect, cumulative and impact interactions, published by the European Commission[11]. HA 205/08 recognises two principle types of cumulative impacts to be addressed in EIAs as follows:

- Cumulative impacts from a single project (e.g. combined effects of differing environmental impacts on a single receptor or resource); and
- Cumulative impacts from different projects (in combination with the project being assessed).

16.2.2 The guidance states that in the first type (impacts from a single project), the impacts arise from the *'combined action of a number of different environmental topic specific impacts upon a single receptor/resource'.*

16.2.3 For the second cumulative impact assessment type (cumulative impacts from other projects), the guidance states:

'For the purposes of this guidance, 'reasonably foreseeable' is interpreted to include other projects that are 'committed'. These should include (but not necessarily be limited to):

- *Trunk road and motorway projects which have been confirmed (i.e., gone through the statutory processes); 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 non-statutory environmental impact assessment has been undertaken'.*

16.2.4 In terms of *'trunk road and motorway projects which have been confirmed*', there are no projects confirmed that will affect the same receptors or resources that are affected by the Scheme. Planned trunk road projects in Wales are included in the Wales Transport Strategy (2008) and National Transport Plan (2011). Both of these

[11] Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interaction, European Commission, May 1999

have been subject to SEA and an HRA has been undertaken for the NTP. Consideration has therefore been given to the potential environmental effects of planned transport schemes in Wales, including trunk road schemes, at a strategic level.

Assessment of Cumulative Impacts Arising from a Single Project

16.2.5 This assessment identifies the specific receptors that would experience a number of different impacts from the construction and operational stages of the Scheme. The significance of potential impact for each environmental topic on the receptor was first determined using the final impact assessment scores from each discipline (Chapters 6 to 15). Then, based on the number and magnitude of impacts, the significance of potential cumulative impacts was identified using DMRB definitions (Table 16.1). Whether the potential cumulative impact was adverse or beneficial was also noted.

Table 16.1: Determining Significance of Cumulative Effects

Significance	Effect
Severe	Effects that the decision maker must take into account as the receptor / resource is irretrievably compromised.
Major	Effects that may become key decision-making issues.
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance.
Minor	Effects that are locally significant.
Not Significant	Effects are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

(Source: DMRB, HA205/08)

Assessment of Cumulative Impacts Arising from Different Projects

16.2.6 The assessment considers other developments that may add cumulative impacts to those caused by the Scheme alone. Relevant developments are those that:

- Are located in the same locality or region of the Scheme; and / or
- Are considered likely to result in environmental effects that could act in synergy with effects arising from the Scheme.

16.2.7 Three categories of development were considered:

- Major planning applications (i.e. key commercial, residential or infrastructure development projects with planning permission granted by the Vale of Glamorgan Council);
- Areas allocated for development in the Vale of Glamorgan Adopted Unitary Development Plan 1996-2011 (UDP) (2005); and
- Areas proposed as allocations in the Draft Vale of Glamorgan Local Development Plan (LDP) (2013).

16.2.8 The list of developments to be considered for the assessment of cumulative effects was agreed in consultation with Vale of Glamorgan Council. The developments are shown in Table 16.2 and are collectively referred as the 'proposed developments'.

16.2.9 The assessment of specific cumulative impacts arising from different projects is best presented within each specialist chapter (i.e. Chapters 6 to 15). However, the methodology and baseline for the cumulative impact assessment of impacts arising from different projects has been set out in this chapter.

Assumptions & Limitations

16.2.10 The prediction and evaluation of cumulative effects is potentially complex and subject to change if developments are delayed or postponed. For this reason, the assessment is based on the identified developments as of March 2015. Those developments which had already been built have been discounted, as they are considered to be part of the existing baseline situation which would already be considered in the assessment.

16.2.11 The assessment is also often complicated by lack of detailed information on identified developments. The approach taken to identify the likely cumulative effects of the Scheme in conjunction with the identified developments has therefore been based on professional judgement that has been applied to make broad qualitative assumptions based on the available information.

16.2.12 The assessment of cumulative effects arising from the Scheme on a single receptor is based on the topic assessments provided in each chapter.

Study Area

16.2.13 DMRB guidance on the assessment of cumulative effects requires that the spatial boundary of the receptor/resource with potential to be affected directly or indirectly is considered. The study area has been set for each individual topic in line with DMRB guidance and therefore this is used to define which receptors have the potential to experience cumulative effects.

16.2.14 In setting the study area, consideration has been given to schemes that:

- Will be occurring at times prior to or during construction of the Scheme;
- Are 'in proximity' to the Scheme as defined by the Vale of Glamorgan as being close enough to the Scheme as to have an impact upon it; or
- Are considered likely to result in environmental effects which could act in synergy with effects arising from the Scheme.

16.2.15 It should be noted that the Transport Assessment (TA) submitted as part of the planning application (Appendix 13.1) uses proposed residential and commercial development within the Vale of Glamorgan to model traffic growth in the area for future years. Therefore, these effects are already taken into account in the assessment of traffic related impacts such as air and noise within the relevant section of this ES.

16.3 Baseline Conditions

16.3.1 Following responses to the Scoping Report, consultation with the Vale of Glamorgan Council and searches of the Vale of Glamorgan Council Planning Register a number

of projects and plans have been identified which may have a cumulative effect with the Scheme. Table 16.2 presents a schedule of the committed development around the Scheme that has been considered for the assessment of cumulative effects arising from different projects. The locations of these developments are shown in Figure 16.1.

Table 16.2: Other Plans and Projects Considered in the Assessment of Cumulative Effects

Project/Plan	Application Ref.	Planning Decision	Location in Relation to the Scheme
Proposed residential development. 60 Dwellings to be constructed in 2016. 60 dwellings to be constructed after 2021	2014/01205/SC1	EIA required (Nov 2014)	160m west of Sycamore Cross (Scheme's northern extent)
8MW Solar farm covering 19ha	2014/01103/NMA	Approved (Oct 2014)	300m west of Scheme (adjacent to existing road)
6MW solar PV array	2014/00798/FUL	Approved (Nov 2014)	120m east of Scheme at closest point
Solar farm comprising of installation of photo/voltaic panels with a total capacity of up to 7MW, one electrical substation, seven power inverter stations, four pole mounted CCTV cameras, paladin fencing and ancillary work.	2014/00081/FUL	Approved (Aug 2014)	50m to the east
14ha solar PV array	2015/00365/SC1	Approved. Planned opening in March 2016. EIA not required.	400m south-west of the Scheme's southern extent of offline works.

16.4 Cumulative Impacts Arising from a Single Project

16.4.1 To consider the potential for a combined impact of different environmental topic-specific impacts on a single receptor / resource, a review was undertaken of the topic-area environmental assessments undertaken as part of the EIA process. The cumulative impact assessment focussed on identifying residual impacts from each topic. It is considered that these residual impacts have the greatest potential to contribute to a significant cumulative impact.

16.4.2 It is also acknowledged that there is potential that multiple non-significant impacts in combination could result in a significant cumulative impact, and therefore all residual impacts were reviewed including non-significant residual impacts reported in the individual assessments of this ES.

16.4.3 Residual impacts were considered on a locational and/or receptor basis, for example the potential for a cumulative impact on a residential receptor to occur due to both

traffic noise and dust generated during construction thereby affecting air quality. The review of each topic area identified potential for significant cumulative impacts focussed on areas of high sensitivity in the vicinity of the Scheme, such as residential properties, designated sites etc.

16.4.4 It should be noted that within each topic area, any potential for a number of different impacts on a particular receptor was considered as part of the scoping and subsequent assessment process, and is therefore incorporated into the impact assessments reported in Chapters 6 to 15 of this ES. This required consideration of the overall project effects, e.g. habitat loss and effect on protected species. The approach to assessment also required specialists to review and take account of other subject areas (e.g. air quality specialists working with ecologists to determine the ecological impacts of changes in air quality on woodland receptors).

16.4.5 The receptors that have been considered for assessing cumulative effects arising from a single project (i.e. the Scheme) are as follows:

- *Residents of Affected Properties*: this includes residents of dwellings in potentially affected by the Scheme;
- *Residents of the Communities Neighbouring the Scheme*: this includes residents of the wider communities neighbouring the Scheme including the suburbs of Barry and Colcott, Culverhouse Cross and the villages of Bonvilston and St Nicholas and users of the St Athan and Cardiff Airport Enterprise Zones;
- *The Experience of Travellers*: this includes Motorised Travellers and Non-Motorised Users using the existing Five Mile Lane and connecting roads such as the A48 from Bonvilston to Culverhouse Cross, the A4050 and the A4226 between the St Athan and Cardiff Airport Enterprise Zones and Barry;
- *The Riverine Environments*: this includes the riverine environments potentially affected by the Scheme;
- *Woodland Habitats*: this includes the woodland habitats potentially affected by the Scheme.

16.4.6 The residual impacts for each topic area relevant to these receptors has been summarised in Table 16.3.

Table 16.3: Summary of Cumulative Effects arising from the Scheme (single project)

Topic	Receptor/Study Area	Value (Sensitivity)	Impact Description	Topic Significance
Residents of Affected Properties				
Noise & Vibration	All residential properties and other sensitive receptors within 600m of the Scheme	High	Temporary noise and vibration impacts during construction of the Scheme	Negligible
			Long-term noise and vibration impacts during operation of the Scheme	Minor – Moderate Adverse
Air Quality	Receptors in the vicinity of Five Mile Lane and associated lanes, A48 Culverhouse Cross to Sycamore Cross, A4050	Low	Temporary dust and vehicle exhaust emissions from earthworks during construction activities.	Negligible
			Vehicle exhaust (NOx) emissions during operation of the Scheme	Negligible / Slight Adverse
Landscape	The Zone of Visual Influence of Redland Farm, Blackland Farm, Whitton Lodge, Northcliffe Cottage, Grovelands, Sutton Fach Farm and New Zoo Bungalows	Poor - Attractive	Temporary visual amenity impacts on residents of affected properties during construction of the Scheme	Minor – Substantial Adverse
			Visual amenity impacts on residents of affected properties during operation of the Scheme	Minor Adverse
Cultural Heritage	The Historic Landscape HLCA 010, the Moulton Roman Site (GM613) and Scheduled Monuments Coed y Cwm Long Barrow (GM116) and Coed y Cwm Ringwork (GM117)	High	Temporary impacts on the setting of designated heritage assets during construction of the Scheme.	Moderate/Large Adverse
			Permanent impacts on the setting of designated heritage assets during construction of the Scheme.	Moderate/Large Adverse
Residents of the Communities Neighbouring the Scheme				
Air Quality	Urban areas within Barry, Culverhouse Cross and commercial areas within the St Athan and Cardiff Airport Enterprise Zones	High	Dust emissions from earthworks during construction activities.	Negligible
			Vehicle exhaust (NOx) emissions during construction activities	No change
			Vehicle exhaust (NOx) emissions during operation of the Scheme	Beneficial

Table 16.3: Summary of Cumulative Effects arising from the Scheme (single project)

Topic	Receptor/Study Area	Value (Sensitivity)	Impact Description	Topic Significance
Noise	Urban areas within Barry, Culverhouse Cross and commercial areas within the St Athan and Cardiff Airport Enterprise Zones	High	The Scheme would reduce congestion along the A48 at Sycamore Cross, the A4050 and A4226 at Waycock Cross by encouraging motorists to use the improved Five Mile Lane route. This would reduce noise levels in neighbouring communities during operation of the Scheme.	Beneficial
The Experience of Travellers				
Effects on All Travellers	NMUs using existing roads, footpaths and PRoW in the vicinity of the existing Five Mile Lane	Medium	No impediments to PRoWs during construction and operation of the Scheme are anticipated as the two PRoWs adjoining the Scheme are located on the western side of Five Mile Lane only. However, there will be impediments to equestrian users crossing the existing Five Mile Lane during construction of the Scheme until completion of the accommodation bridge at Sutton Fach Farm, which once constructed, will provide an alternative safe crossing of the Scheme.	Minor Adverse
		Medium	The Scheme will incorporate new pedestrian and cycle routes that open access to NMUs. The new NMU (pedestrian and cycle) routes will improve safety and provide new links between villages such as Walterstone, Moulton and Dyffryn and Barry.	Major Beneficial
	MTs travelling along the existing Five Mile Lane, A48, A4050, and A4226 at	High	Driver Stress experienced as a result of delays caused by Scheme construction activities	Minor Adverse

Table 16.3: Summary of Cumulative Effects arising from the Scheme (single project)

Topic	Receptor/Study Area	Value (Sensitivity)	Impact Description	Topic Significance
	Waycock Cross	High	The lengths of delays currently experienced by MTs are expected to reduce significantly once the proposed Scheme is operational. In addition, the route for MTs moving through to the St Athan and Cardiff Airport Enterprise Zones from the north will be clearer, reducing the route uncertainty currently experienced.	Major Beneficial
		Medium	Views from the Road experienced by MTs travelling along the new alignment during operation of the Scheme will change from intermittent to open.	Minor Beneficial
Riverine Environment				
Nature Conservation	Riverine habitats of Nant Talwg, the River Waycock and its tributaries, Moulton Book, Ffynnon Whitton-mawr, Ford Brook, Nant Whitton, and Nant Llancarfan.	District – Local Importance	Potential run-off of contaminants and sediment affecting water quality and subsequent habitat for protected species during construction of the Scheme. Control measures will be used to minimise silt runoff and contaminants into water.	Neutral
			Treatment of road drainage water in reed beds and oil inceptors may lead to increase in water quality.	Slight Beneficial
Road Drainage & the Water Environment	The tributary of the River Waycock that flows north adjacent to the road and the tributary of the River Waycock that flows south and crosses beneath the road	High	Increased pollution from sediment associated with works within the channel of these watercourses during construction of the Scheme.	Slight to Moderate Adverse
	All watercourses in the study area (as per Chapter 15: Road Drainage & the Water Environment)	Very High	Increased pollution in surface water runoff during operation of the Scheme	Neutral

Table 16.3: Summary of Cumulative Effects arising from the Scheme (single project)

Topic	Receptor/Study Area	Value (Sensitivity)	Impact Description	Topic Significance
		Woodland Habitat		
Nature Conservation	Barry Woodland SSSI and the Cwm Talwg Local Nature Reserve	Very High	Permanent loss of 0.431 ha of ancient semi-natural broad-leaved woodland and another 0.469 ha taken under temporary licence and returned after construction.	Very Large Adverse
Air Quality	Barry Woodlands SSSI	Very High	Air quality effects during the construction stage are not significant.	Neutral
	Barry Woodlands SSSI (Middleton Plantation, East and West of A4226)	Very High	Nitrogen deposition impacts on nearby ecological receptors during operation of the Scheme	Substantial Adverse
	Barry Woodlands SSSI (Lidmore Wood)	Very High	Nitrogen deposition impacts on nearby ecological receptors during operation of the Scheme	Slight Adverse
	Barry Woodlands SSSI (Pencoetre Wood, South of A4050 and East of A4231) and Cwm Talwg Local Nature Reserve (South of A4050)	Very High	Nitrogen deposition impacts on nearby ecological receptors during operation of the Scheme	Slight-Substantial Beneficial
Noise	Barry Woodland SSSI and the Cwm Talwg Local Nature Reserve	Very High	Noise impacts on nearby ecological receptors during construction and operation of the Scheme	Negligible

16.4.10 The anticipated cumulative impacts on these receptors during construction and operation of the Scheme are summarised in the following subsections.

Construction

Residents of Affected Properties

16.4.11 Residences in proximity to Five Mile Lane have the potential to experience cumulative impacts during construction of the Scheme from noise and vibration, dust and vehicle exhaust emissions, visual amenity disturbances and effects on the setting of cultural heritage assets. It is anticipated that noise and vibration and air quality impacts will be able to be largely mitigated through the implementation of control measures in accordance with the CEMP and will subsequently have negligible significance during construction. Impacts to visual amenity and the setting of designated heritage assets are expected to cause Large Adverse, but temporary cumulative effects.

Residents of the Communities Neighbouring the Scheme

16.4.12 Impacts to neighbouring residents of Barry, Colcott, Bonvilston, St Nicholas, and Culverhouse Cross are anticipated to be limited to only negligible dust emissions during construction. Subsequently, cumulative effects are assessed as Negligible.

The Experience of Travellers

16.4.13 There will be impediments to equestrian users crossing the existing Five Mile Lane during construction of the Scheme until completion of the accommodation bridge at Sutton Fach Farm, which once constructed, will provide an alternative safe crossing of the Scheme for equestrian users. No other impacts to NMUs are anticipated during construction of the Scheme.

16.4.14 Minor adverse driver stress is expected to be experienced for MTs using Five Mile Lane as a result of delays caused by the Scheme construction. The majority of the Scheme will be constructed offline, which will allow the existing alignment to remain operational during most of the construction period. Appropriate site access, public information requirements and traffic management will be developed with the appointed Contractor and the Highway Authority to ensure that driver stress is minimised during construction. As such, driver stress will result in a minor adverse impact during construction. The cumulative effects on the experience of travellers are subsequently assessed as Minor Adverse and temporary.

The Riverine Environment

16.4.15 The vicinity of the Scheme features several sensitive habitats, the impacts upon which are considered in Chapter 9: Nature Conservation and Chapter 15: Road Drainage and the Water Environment. Sensitive riverine environments include Nant Talwg, the River Waycock and its tributaries, Moulton Book, Ffynnon Whitton-mawr, Ford Brook, Nant Whitton, and Nant Llancarfan. During construction, some of these watercourses may be affected by sedimentation or release of various pollutants. However, it is considered likely that the significance of these impacts can be reduced through pollution control measures, which will be set out in the Contractor's CEMP. Despite these measures, there is potential that construction would have a Slight to Moderate Adverse effect on these watercourses. Chapter 9: Nature Conservation suggests there is potential for Slight Adverse ecological impacts on species within the above watercourses. When considered in combination with potential pollution

impacts, the cumulative impacts to the riverine environment during construction are assessed as Moderate Adverse.

Woodland Habitats

16.4.16 The Scheme may have an adverse effect on nearby woodland habitats, which include the Barry Woodland SSSI and a number of SINCs (SINC 222, 220, & 283). During construction, the woodland habitats in closest proximity to the Scheme are expected to experience disturbance or damage from construction activities. With the exception of the Very Large Adverse impacts on these woodlands through direct loss of woodland areas, it is considered likely that the significance of noise and air quality impacts can be reduced through measures that will be set out in the CEMP. Despite these measures, it is likely that construction would have a Very Large Adverse cumulative effect on woodland habitat.

Operation

Residents of Affected Properties

16.4.17 As described in Chapter 12: Noise & Vibration, operational noise impacts on residents of affected properties are anticipated to be Minor Adverse. This is based on an expectation that all properties would experience an increase in nuisance level of less than 40%, with the majority experiencing less than a 20% increase.

Screening and integration from landscape planting will reduce the overall impact of the Scheme during operation such that impacts from the Scheme on affected properties are anticipated to be Minor Adverse. When coupled with the Minor Adverse operational noise and vibration impacts, the cumulative effects on residents of nearby dwellings and other local receptors is assessed as Minor to Moderate Adverse.

Residents of the Communities Neighbouring the Scheme

16.4.18 Once constructed, the Scheme will reduce traffic congestion along the A48 between Bonvilston and Culverhouse Cross and the A4050 between the St Athan and Cardiff Airport Enterprise Zones and Barry. This will result in a reduction in traffic noise and improvements to air quality through reduced vehicle exhaust emissions. These two beneficial impacts have been assessed to contribute to a minor beneficial cumulative impact to the residents of the communities neighbouring the Scheme.

The Experience of Travellers

16.4.19 The Scheme will incorporate new pedestrian and cycle routes that open access to NMUs. The new NMU (pedestrian and cycle) routes will improve safety and provide new links between villages such as Walterstone, Moulton and Dyffryn and Barry.

16.4.20 The lengths of delays currently experienced by MTs are expected to reduce significantly once the proposed Scheme is operational. In addition, the route for MTs moving through to the St Athan and Cardiff Airport Enterprise Zones from the north will be clearer, reducing the route uncertainty currently experienced.

16.4.21 These improvements in combination have been assessed as providing a major beneficial effect on the experience of all travellers (Motorised Travellers and Non-Motorised Users) during operation of the Scheme.

The Riverine Environment

16.4.22 Riverine environments have been identified as experiencing potential environmental effects associated with the operational Scheme. Potentially sensitive riverine habitats that have been identified as hydrological and ecological receptors include Nant Talwg, the River Waycock and its tributaries, Moulton Book, Ffynnon Whitton-mawr, Ford Brook, Nant Whitton, and Nant Llancarfan. The potential impacts on these watercourses include pollution from road salt, and from increase run off during storms. The potential impacts on the environment have been considered in the design for the Scheme, consequently a range of surface water management systems are proposed which will ensure that these potential effects are mitigated, and the significance of any cumulative effects are therefore considered to be Neutral after mitigation.

Woodland Habitats

16.4.23 The Scheme would have an adverse operational effect on nearby woodland habitat, including Barry Woodlands SSSI, and a number of SINCs (174, 106, 220, 221, 222), semi-natural broad-leaved and mixed woodlands and a plantation broad-leaved woodland. During operation, the Barry Woodland SSSI is expected to experience Very Large Adverse impacts, with the other woodlands experiencing Slight Adverse impacts. These impacts are associated with nitrogen oxide(s) deposition, and the effect of noise on the habitat for sensitive species within the woodlands. These impacts will be mitigated through the planting of replacement woodland but will not change the significance of these impacts. The cumulative operational impact of the Scheme on woodland habitats is therefore assessed as Very Large Adverse.

17 REFERENCES

Arup. (2012). WelTAG Stage One Assessment.

Berthinussen, A. & Altringham, J. (2012). Do bat gantries and underpasses help bats cross roads safely? Plos one.

British Standards (BS 3882:2015). Specification for topsoil. BSI publication.

British Standards Institution (2011). 'BS 10175:2011: A1+2013. Investigation of potentially contaminated sites: Code of practice'.

CADW. (2011). Conservation Principles.

Carslaw, D.C., Beevers, S.D. Westmoreland, E. Williams, M.L. Tate, J.E., Murrells, T. Stedman, J. Li, Y., Grice, S., Kent, A. and I. Tsagatakis (2011). Trends in NOx and NO2 emissions and ambient measurements in the UK. Version: July 2011.

Chartered Institute for Archaeologists (CIfA) (2015). Standard and Guidance for Historic Environment Desk-based Assessment.

Chartered Institute for Archaeologists (CIfA) (2015). Code of Conduct.

CIRIA 692 Environmental Good Practice on Site, 2011.

Construction industry research and information association (CIRIA) 113 Control of Groundwater for Temporary Works, 1988.

Contaminated Land Report (CLR) 11: Model Procedures for the Management of Land Contamination. Environment Agency and Defra, 2004

Contaminated Land Risk Assessment, A guide to good practice, CIRIA C552, 2001.

Contaminated Land Statutory Guidance, Department for Environment, Food and Rural Affairs, April 2012.

Council Directive 2009/147/EC on the conservation of wild birds (EC Birds Directive).

Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive).

Depart for Environment, Food and Rural Affairs (Defra), Part IV of the Environment Act 1995, Local Air Quality Management (LAQM), Technical Guidance LAQM TG(09) (2009).

Department for Environment and Rural Affairs (DEFRA). (2011). Guidance on applying the Waste Hierarchy.

Department for Rural Affairs (Defra) (2014). Emissions Factors Toolkit User Guide.July 2014.

Directive 2004/35/EC of the European Parliament and of the Council of April (2004). on environmental liability with regard to the prevention and remedying of environmental damage (Environmental Liability Directive). Official Journal of the European Union.

Directive 2008/50/EC of the European Parliament and of the Council of May (2008). On ambient air and cleaner air for Europe. Official Journal of the European Union.

Environment Act 1995 (1997, revised in 2000 and 2007).

Environment Agency (2010a). 'GPLC1 – Guiding Principles of Land Contamination', 'GPLC2 – Frequently Asked Questions, Technical Information, Detailed Advice and References', and 'GPLC3 – Reporting Checklists', all March 2010.

Environment Agency (2013). Pollution Prevention Guidelines (PPGs).

Environmental Protection UK (EPUK, formerly NSCA) Development Control (2010 Update): Planning for Air Quality.

Environmental Protection, England and Wales. The Landfill (England and Wales) Regulations (Amendment) (2005). No.1640.

Environmental Protection, Wales. The Waste (Miscellaneous Provisions) (Wales) Regulations (2011). No 971 (W.141).

European Commission. May 1999. Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interaction.

Furness, R. W., Ensor, K. & Hudson, A. V. 1992. The use of fishery waste by gull populations around the British Isles. Ardea 80: 105–113.

Glamorgan Gwent Archaeological Trust Ltd (GGAT) (2007). Notes for archaeologists undertaking desk-based studies in South East Wales).

Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66. Environment Agency / National House-Building Council. Volume 1, 2008.

HA 205/08 (DMRB 11.2.5): Assessment and Management of Environmental Effects.

HA200/08 (DMBR 11.1.1): Aims and Objectives of Environmental Assessment.

HA201/08 (DMRB 11.2.1): General principles and Guidance of EIA.

HA202/08 (DMRB 11.2.2): Environmental Impact Assessment.

HA204/08 (DMRB 11.2.4): Scoping of EIA.

HD 45/09 (DMRB 11.3.10): Road Drainage and the Water Environment.

HD 47/08 (DMRB 11.2.3): Screening of Projects for EIA.

HD 48/08 (DMRB 11.2.6): Reporting of Environmental Impact Assessments.

Halcrow Group & Green, R. (2011). A review of bat mitigation in relation to highway severance. Highways Agency.

Highways Agency (2011). Interim Advice Note 153/11: Materials.

Historic England (2006). Management of Research Projects in the Historic Environment (MoRPHE).

Historic England (2015). The Setting of Heritage Assets, Historic Environment Good Practice in Planning: 3.

Institute for Air Quality Management (IAQM) (2014). Guidance on the assessment of dust from demolition and construction.

Interim Advice Note (IAN) 125/09 (W). Supplementary guidance for users of DMRB. Volume 11 'Environmental Assessment'.

Interim Advice Note (IAN) 135/10(W) which supercedes the Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment, Section 2 Part 5 Landscape Effects;

Interim Advice Note (IAN) 153/11: Guidance in the Environmental Impact Assessment of Materials and Technical Advice Note (TAN) 21 Waste (Welsh Government, 2014).

Limpens HJGA, Twisk P, Veenbaas G. 2005. Bats and road construction. Brochure about bats and the ways in which practical measures can be taken to observe the legal duty of care for bats in planning, constructing, reconstructing and managing roads. Dutch Ministry of Transport, Public Works and Water Management Directorate-General for Public Works and Water Management, Road and Hydraulic Engineering Institute, Delft, the Netherlands and the Association for the Study and Conservation of Mammals, Arnhem, the Netherlands.

Madden, B. & Newton, S. F. 2004. Herring Gull Larus argentatus. In: Mitchell, P. I., Newton, S. F., Ratcliffe, N. & Dunn, T. E. (eds.) Seabird Populations of Britain and Ireland: 242–261. Poyser, London.

National Transport Plan Strategic Environmental Assessment (SEA) Statement and Addendum to Environmental Report, March 2010.

Natural Resources Wales (NRW) formerly the Environment Agency Wales (EAW), Pollution Prevention Guidance (PPGs) documents (now revoked but not yet replaced).

Parsons Brinckerhoff. (2013). WelTAG Stage One Assessment.

Planning Policy Wales. (2007). Technical Advice Note (TAN) 18, Transport. Welsh Government.

Russell, A.L., Butchkoski, C.M., Saidak, L., McCracken., G.F. (2009). Road-killed bats, highway design, and the commuting ecology of bats. Endangered Species Research 8, 49-60.

Section I of the Planning (Listed Buildings and Conservation Areas) Act 1990.

TACP & Sturgess Ecology. (2014). River Waycock, Five Mile Lane, Barry: Crayfish Survey.

The Council of the European Union. EU Landfill Directive (1999/31/EC). Official Journal L18. 16/07/1999. 9. P 0001-0019.

The UK Biodiversity Steering Group Report (1995).

The Vale of Glamorgan. (2005). Adopted Unitary Development Plan (UDP) 1996-2011.

Vale of Glamorgan. (2013). Draft Local Development Plan (LDP).

Vale of Glamorgan. (2015). Draft Local Transport (LTP) Plan 2015 – 2030.

Welsh Assembly Government (2006).The Environment Strategy for Wales.

Welsh Assembly Government (2009). One Wales: One Planet. The Sustainable Development Scheme of the Welsh Assembly Government.

Welsh Assembly Government (2010). Towards Zero Waste – One Wales: One Planet.

Welsh Assembly Government. (2014). Technical Advice Note (TAN) 21 Waste.

Welsh Assembly Government. Minerals Planning Policy (Wales) (2004). Minerals Technical Advice Note (MTAN) 1 (Wales): Aggregates

Welsh Government (2010). National Transport Plan (NTP)

Welsh Government (2011). Prioritised National Transport Plan.

Welsh Government (2013). Active Travel (Wales) Act 2013.

Welsh Government. Technical Advice Note (TAN) 6: Planning for Sustainable Rural Communities (2010).

Welsh Government. Technical Advice Note (TAN) (1997) 11: Noise.

Welsh Government. Technical Advice Note (TAN) (2007) 18: Transport.

Welsh Government. Technical Advice Note (TAN) (2014) 12: Design.

Welsh Government. Technical Advice Note (TAN) 15 (2004): Development and Flood Risk.

Welsh Government. Technical Advice Note (TAN) 23 (2014): Economic Development.

Welsh Government. People, Places, Future (2008): The Wales Spatial Plan.

Welsh Government. (2014). Planning Policy Wales (PPW).

Welsh Government. (2015). Wales Infrastructure Investment Plan (WIIP) for Growth and Jobs.

Welsh Government. Planning Policy Wales (PPW). (Edition 8, January 2016).

Welsh Government. Technical Advice Note (TAN) 5 (2009): Nature Conservation and Planning.

Welsh Statutory Instrument (2002). Air Quality (Amendment) (Wales) Regulations 2002. Environment Protection, Wales. No. 3182 (W.298).

Welsh Transport Planning and Appraisal Guidance, 2008.

Winter, M. (2011). Interim Advice Note 153/11, Guidance on the Environmental Assessment of Material Resources.

VOLUME 2

FIGURES & APPENDICES

FIGURES

FIGURE 1.1 – 16.1

APPENDIX 1.1

SCREENING OPINION

APPENDIX 1.2

EIA SCOPING REPORT

APPENDIX 1.3

SCOPING OPINION REPORT WITH APPENDICES

APPENDIX 6.1

TRAFFIC DATA FOR AIR QUALITY ASSESSMENT

APPENDIX 6.2

DUST ASSESSMENT CRITERIA

APPENDIX 6.3

MODEL VERIFICATION

APPENDIX 6.4

MODEL RESULTS

APPENDIX 7.1

ARCHAEOLOGICAL DESK BASED ASSESSMENT

APPENDIX 7.2

GEOPHYSICAL SURVEY REPORT

APPENDIX 7.3

ARCHAEOLOGICAL WATCHING BRIEF REPORT

APPENDIX 7.4

WRITTEN SCHEME OF INVESTIGATION

APPENDIX 8.1

LANDMAP

APPENDIX 8.2

VISUAL EFFECTS SCHEDULE

APPENDIX 9.1

GREAT CRESTED NEWT SURVEY REPORT

APPENDIX 9.2

WATER VOLE SURVEY REPORT

APPENDIX 9.3

DORMOUSE REPORT

APPENDIX 9.4

BAT ACTIVITY SURVEY REPORT

APPENDIX 9.5

BAT TREE SURVEYS

APPENDIX 9.6

PHASE 1 HABITAT SURVEY

APPENDIX 9.7

CRAYFISH SURVEY REPORT

APPENDIX 9.8

FRESHWATER MACROINVERTEBRATE REPORT

APPENDIX 9.9

NATIONAL VEGETATION SURVEY

APPENDIX 10.1

PRELIMINARY RISK ASSESSMENT

APPENDIX 10.2

GROUND INVESTIGATION REPORT

APPENDIX 12.1

GLOSSARY OF ACOUSTICS TERMINOLOGY

APPENDIX 12.2

BASELINE NOISE REPORT

APPENDIX 12.3

WELTAG APPRAISAL

APPENDIX 13.1

TRANSPORT ASSESSMENT

APPENDIX 15.1

FLOOD CONSEQUENCES ASSESSMENT

APPENDIX 15.2

CONSULTATION FOR ROAD DRAINAGE & THE WATER ENVIRONMENT REPORT

APPENDIX 15.3

ENVIROCHECK EC DATASHEETS A, D G

APPENDIX 15.4

WFD RESULTS SUMMARY

APPENDIX 15.5

HAWRAT RESULTS

APPENDIX 15.6

DRAINAGE NETWORK PLANS

APPENDIX 15.7

PERMEABILITY TESTING